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IBM Tivoli Storage Productivity Center for Replication for System z

Effectively use Tivoli Storage Productivity Center for Replication

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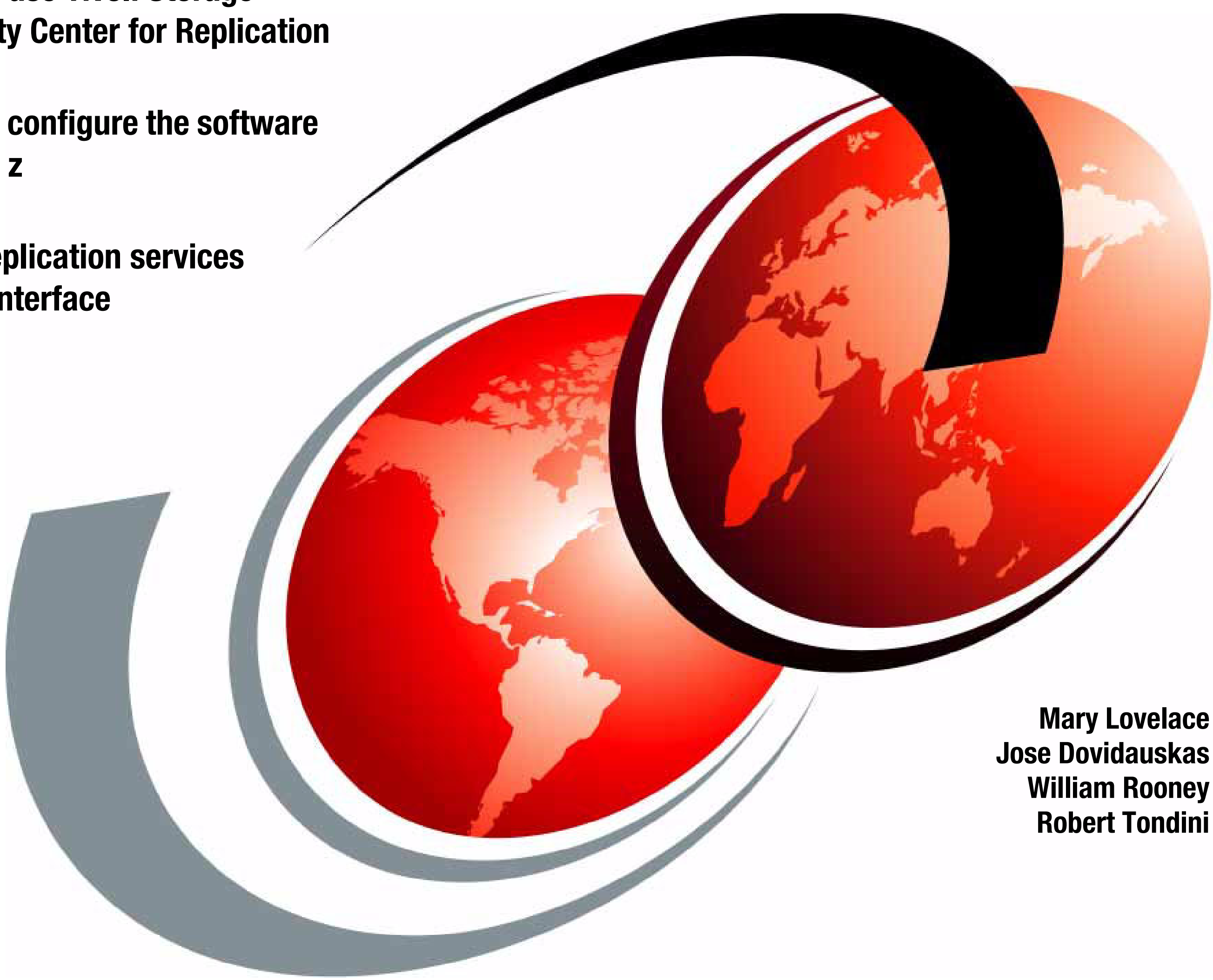
Manage replication services from one interface



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Tivoli Storage Productivity Center for Replication for System z

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Note: Before using this information and the product it supports, read the information in “Notices” on page xi.

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Contents

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Preface

IBM® Tivoli® Storage Productivity Center for Replication provides support for the advanced copy services capabilities on the IBM DS8000® and IBM DS6000™, in addition to the support for SAN Volume Controller. This support focuses on automating administration and configuration of these services, operational control (starting, suspending, resuming) copy services tasks, and monitoring and managing the copy services sessions.

In addition to the support for IBM FlashCopy® and Metro Mirror, Tivoli Storage Productivity Center for Replication supports Global Mirror on the DS8000, and SAN Volume hardware platforms. Advanced disaster recovery functions are also supported with failover/failback (planned and unplanned) from a primary site to a disaster recovery site. A new product, IBM Tivoli Storage Productivity Center for Replication Basic Edition for IBM System z® enables Basic IBM HyperSwap® on IBM z/OS®, which allows the management of disk replication services using an intuitive GUI on z/OS systems.

Tivoli Storage Productivity Center for Replication also can monitor the performance of the copy services that provide a measurement of the amount of replication and the amount of time that is required to complete the replication operations.

This IBM Redbooks® publication provides the information you need to install Tivoli Storage Productivity Center for Replication V5.1, and create and manage replication sessions on a z/OS platform. Scenarios are provided that document the work performed in our laboratory setting, using the GUI and CLI.

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Tivoli Storage Productivity Center for Replication introduction

This chapter provides an overview of Tivoli Storage Productivity Center for Replication for System z. It reviews copy services functions and then describes how they are implemented in Tivoli Storage Productivity Center for Replication. The architecture of Tivoli Storage Productivity Center for Replication and the communication paths it uses are documented. Terms that are used throughout the book are explained. This chapter also includes the enhancements made to Tivoli Storage Productivity Center for Replication and its new functions introduced in V5.1.

1.1 Tivoli Storage Productivity Center for Replication overview

The basic functions of Tivoli Storage Productivity Center for Replication provide management of FlashCopy, Metro Mirror, Global Mirror, and Metro Global Mirror capabilities for the IBM ESS Model 800, IBM DS6000, IBM DS8000, IBM System Storage® SAN Volume Controller (SVC), V7000, and IBM XIV®.

Tivoli Storage Productivity Center for Replication for System z offers all the functions that are provided by the Tivoli Storage Productivity Center for Replication open systems product version. It is packaged to run on System z, using a mixture of IBM FICON® and TCP/IP communications, to provide replication management of DS8000, DS6000, and ESS 800, regardless of type of data on them (IBM ECKD™ or FBA).

The Tivoli Storage Productivity Center for Replication for System z V5.1 consists of these solutions:

- Tivoli Storage Productivity Center for Replication Basic Edition for System z (single site solution with FlashCopy and Basic HyperSwap management)
- Tivoli Storage Productivity Center for Replication for System z (multisite solution for all advance copy services management on IBM storage systems)

Figure 1-1 shows the Tivoli Storage Productivity Center for Replication environment.

Tivoli Storage Productivity Center for Replication is designed to simplify management of advanced copy services in the following ways:

- By automating administration and configuration of these services with wizard-based session and copy set definitions
- By providing simple operational control of copy services tasks, including starting, suspending, and resuming
- By offering tools for monitoring and managing copy sessions

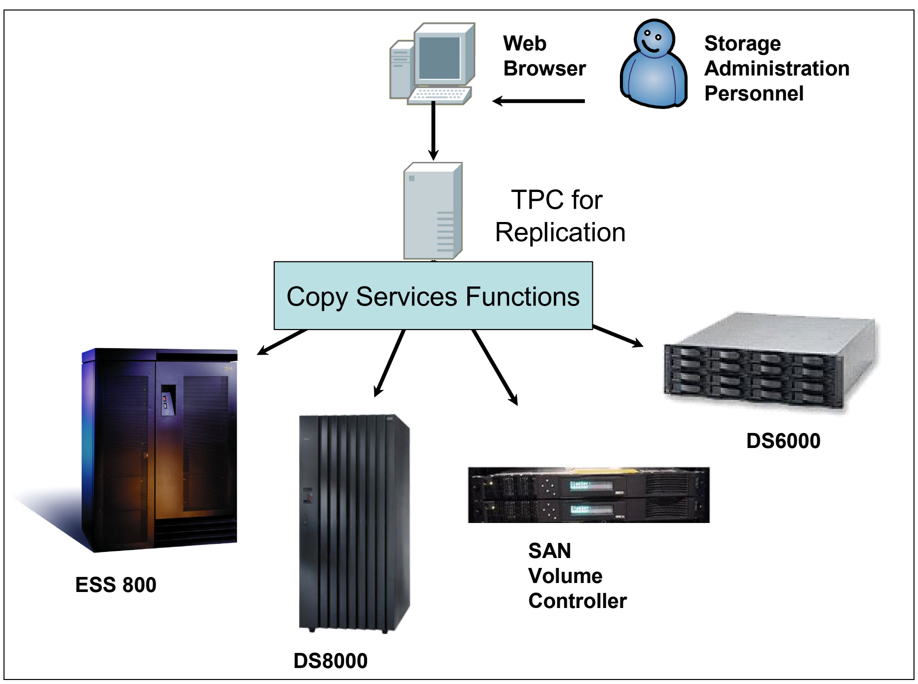

Figure 1-1 Tivoli Storage Productivity Center for Replication environment

1.1.1 Replication task management and automation

Tivoli Storage Productivity Center for Replication is designed to automate key replication management tasks to help you improve the efficiency of your storage replication. A simple graphical user interface is used to configure automation, manage ongoing activities and monitor progress of all key tasks. Your IT experts can use a single integrated tool for storage management, a feature designed to save administrators time and effort. Here we review the copy services advanced functions.

FlashCopy

The IBM FlashCopy feature is a point in time copy capability that can be used to help reduce application outages caused by backups and other data copy activities. FlashCopy is designed to enable data to be copied in the background while making both source and copied data available to users almost immediately. With its copy-on-write capability, the only data copied is that which is about to be changed or overlaid. Copies can be made quickly, after which data can be backed up and capacity reallocated.

This form of replication creates a replica (or T-zero copy) of the source within the same physical storage subsystem. Both the source and target volumes exist within the same storage subsystem. The DS8000 products provide multiple LSS (Logical Subsystems) within a single physical subsystem box. These products support local (same box) point in time copy where the source volume is in one LSS and the target volume is in another LSS. For a FlashCopy session in Tivoli Storage Productivity Center for Replication, Figure 1-2 shows the volume relationship established as part of the session creation.

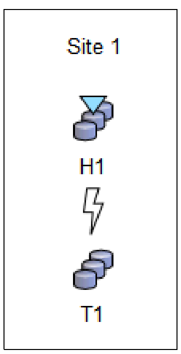

Figure 1-2 FlashCopy session

Metro Mirror

Metro Mirror is designed to constantly maintain an up-to-date copy of the primary location data at a remote site within the metropolitan area. Synchronous mirroring techniques are designed to maintain data currency between two sites. Because mirrored data is a time-consistent image of the original data, this can help you avoid a long and complicated data recovery process before restoring business operations.

A Metro Mirror session is a form of synchronous remote replication designed to operate over distances under 300 kilometers. With Metro Mirror, the source is located in one subsystem and the target is located in another subsystem. Metro Mirror replication maintains identical data in both the source and target. In synchronous replication, changes made to the source data are propagated to the target before the write is committed to the requesting host.

Figure 1-3 shows two available Metro Mirror session icons in Tivoli Storage Productivity Center for Replication.

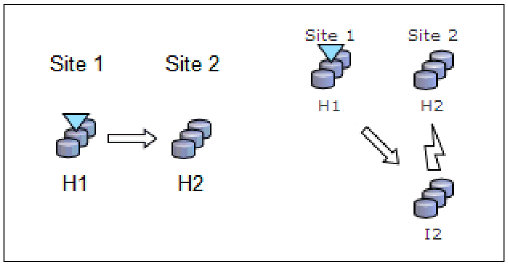

Figure 1-3 Metro Mirror and Metro Mirror with Practice sessions

Global Mirror

Global Mirror is designed to help maintain data currency at a remote site within a few seconds of the local site, regardless of distance. It includes exceptional capabilities such as self-managed cross-system data consistency groups, which help protect data integrity for large applications across a wide variety of flexible system configurations.

These copying and mirroring capabilities are designed to help give users constant access to critical information during both planned and unplanned local outages. And Tivoli Storage Productivity Center for Replication provides key configuration, administration, and monitoring tools to manage these capabilities. For businesses in on demand fields, these capabilities are essential for managing data availability and resiliency and sustaining business continuity.

Global Mirror is a method of continuous asynchronous replication. It is intended to enable data replication at distances over 300 kilometers. When a write is issued to the source copy, the change is propagated to the target copy, but subsequent changes are allowed to the source copy before the target copy verifies that it has received the change. However, because data changes are not applied synchronously, you can potentially lose some data. Figure 1-4 shows icons for all available Global Mirror session types in Tivoli Storage Productivity Center for Replication.

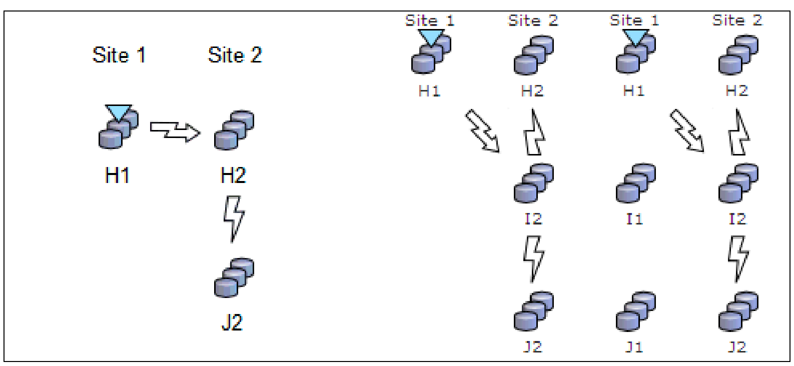

Figure 1-4 Global Mirror (with Failover/Failback), Global Mirror Failover/Failback with Practice, Global Mirror Either Direction with Two-Site Practice

Metro/Global Mirror

The Metro/Global Mirror function enables a three-site, high availability disaster recovery solution. It combines the capabilities of both Metro Mirror and Global Mirror functions for greater protection against planned and unplanned outages. Metro/Global Mirror is supported across zSeries and open-systems environments. Metro/Global Mirror is supported on the DS8000 only.

Metro/Global Mirror uses synchronous replication to mirror data between a local site and an intermediate site, and asynchronous replication to mirror data from an intermediate site to a remote site. In this configuration, a Metro Mirror pair is established between two nearby sites (local and intermediate) to protect from local site disasters. The Global Mirror volumes can be located thousands of miles away and continue to be updated if the original local site has suffered a disaster and I/O has to be failed over to the intermediate site. In the case of a local-site-only disaster, Metro/Global Mirror can provide a zero-data-loss recovery at the remote site as well as at the intermediate site.

The Metro/Global Mirror function provides the following combination of synchronous and asynchronous mirroring:

- A nearby two-site synchronous copy that can protect from local disasters.
- A longer distance asynchronous copy, at a third site, that can protect from larger scale regional disasters. The third site provides an extra layer of data protection. Metro/Global Mirror is an extension of Global Mirror, which is based on existing Global Copy (formerly known as PPRC XD) and FlashCopy functions. Global Mirror running at the intermediate site, using a master storage unit, internally manages data consistency, removing the need for external software to form consistency groups at the remote site.

Metro/Global Mirror should be used when two recovery sites are required. Its support for the DS8000 provides the following capabilities:

- Failover and failback support
- HyperSwap function in a Metro Mirror session between local and intermediate site
- Fast re-establishment of three-site mirroring
- Quick re-synchronization of mirrored sites using incremental changes only
- Data currency at the remote site

Incremental Resync for Metro/Global Mirror is used in a Metro/Global Mirror Peer-to-Peer Remote Copy configuration in order to maintain a backup site if one of the three sites is lost. The purpose of the Incremental Resync function is to avoid always having to do a full volume resynchronization between the local and remote sites if an outage occurs at your intermediate site. When the intermediate site is lost, the local and remote sites can be connected, copying a subset of the data on the volumes to maintain a backup site. The microcode records the bytes in flight at the local site. If the intermediate site is lost, then the local site volume may be established as the primary to the volume at the remote site.

Figure 1-5 shows a Metro/Global Mirror session icon in Tivoli Storage Productivity Center for Replication.

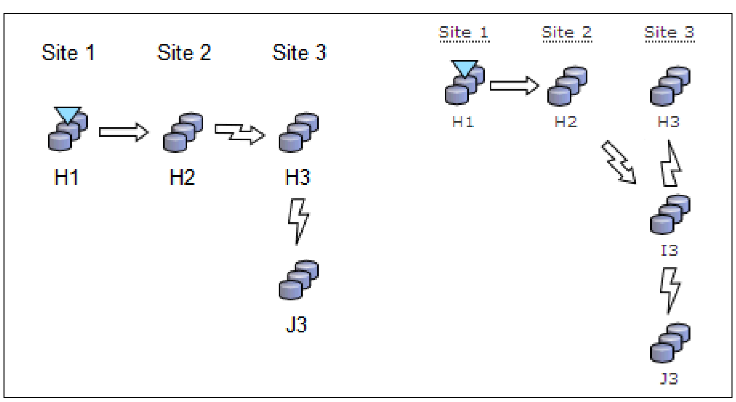

Figure 1-5 Metro/Global Mirror session

HyperSwap

IBM Tivoli Storage Productivity Center for Replication for System z (including the Basic Edition version) enables Basic HyperSwap on z/OS to provide a single-site or multi-site, high-availability disk solution, which allows the configuration of disk-replication services using a GUI from z/OS. The intention is that with Basic HyperSwap function enabled, seamless swapping between primary and secondary disk volumes in the event of planned and unplanned outages such as hardware maintenance, testing, or device failure, can be accomplished from z/OS.

When using Basic HyperSwap, Tivoli Storage Productivity Center for Replication helps eliminate single disk failures as a source of application outages by enabling you to specify a set of storage volumes to be synchronously mirrored. For example, in the event of a permanent I/O error, I/O requests can be automatically switched to the secondary copy, thereby masking the failure from the application and minimizing the need to restart the application (or system) after the failure. You can also initiate a planned failover to a secondary disk for the purpose of initiating hardware maintenance on primary storage controllers, or simply to periodically test the function. You can switch back to your preferred configuration via the GUI or operator commands.

Figure 1-6 shows a Basic HyperSwap session.

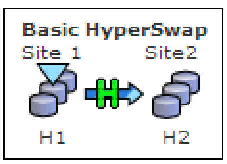

Figure 1-6 Basic HyperSwap session

1.2 IBM Tivoli Storage Productivity Center for Replication for System z

As we have seen, TotalStorage Productivity Center for Replication is a member of the IBM Tivoli Storage Productivity Center product family.

The Tivoli Storage Productivity Center for Replication family is designed to help simplify management of advanced copy services by automating administration and configuration of these services with wizard-based session and copy set definitions, providing simple operational control of copy services tasks, including starting, suspending and resuming, and finally, offering tools for monitoring and managing copy sessions.

The basic functions of Tivoli Storage Productivity Center for Replication provide management for the following advanced copy functions of IBM storage systems:

- Metro Mirror
- Global Mirror
- Metro Global Mirror for SVC
- FlashCopy

1.2.1 Tivoli Storage Productivity Center for Replication management overview

Tivoli Storage Productivity Center for Replication is designed to provide disaster recovery management through planned and unplanned failover and failback automation for the IBM ESS Model 800, IBM DS6000, and IBM DS8000.

It helps you manage replication to a remote backup site through Metro Mirror or Global Mirror or a combination of both, for a three-site Metro Global Mirror configuration. The software is designed to allow you to monitor the progress of the copy services so you can verify the amount of replication that has been done as well as the amount of time needed to complete the replication.

Automated failover is designed to keep your critical data online and available to your users even if your primary site fails. When the primary site comes back on, the software manages failback to the default configuration as well.

Tivoli Storage Productivity Center for Replication offers the following benefits:

- Support for redundant Tivoli Storage Productivity Center for Replication servers (active - standby)
- Support for the following additional session types for ESS model 800, DS6000, and / or DS8000:
  - Two-site Metro Mirror, ability to control the session in both directions with practice (from site 1 to site 2 or vice-versa).
  - Two-site Global Mirror, ability to control the session in both directions with practice (from site 1 to site 2 or vice-versa).
  - Three-site Metro Global Mirror configurations with practice.
  - Disaster recovery configurations that can be set up to indicate copy type (FlashCopy, Metro Mirror, Global Mirror, Metro Global Mirror) and the number of separate copies and sites to be involved.
- Replication Performance Monitoring showing the progress towards completion of hardware replication:
  - For Metro Mirror, the progress towards getting all data to full duplex.
  - For Global Mirror, the progress towards getting all data to fully joined in the session.
  - For FlashCopy without persistent specified, the progress of getting background copy complete

Tivoli Storage Productivity Center for Replication offers a high availability capability, so you can manage your replication even if the main Tivoli Storage Productivity Center for Replication server experiences a failure. With a second server operating as an active standby, services can switch quickly to the backup server to maintain copy services operations if the primary server goes off-line.

Tivoli Storage Productivity Center for Replication is designed to simplify disaster recovery management through planned and unplanned failover and failback automation for the IBM DS8000 using its Metro Global Mirror (MGM) feature. This allows for a synchronous copy between two sites combined with an asynchronous copy link to a distant site.

Tivoli Storage Productivity Center for Replication supports fast failover and failback, fast re-establishment of three-site mirroring, data currency at the remote site with minimal lag behind the local site, and quick resynchronization of mirrored sites using incremental changes only.

A three-site Metro Global Mirror configuration provides the following recovery options at the alternate sites if a failure occurs:

- If an outage occurs at the local site, recovery operations can begin at the intermediate site. Global Mirror continues to mirror updates between the intermediate and remote sites, maintaining the recovery capability at the remote site.
- If an outage occurs at the local site, recovery operations can begin at the remote site and preparations can be made to resynchronize the local site when it recovers from its disaster. When in recovery mode at the remote site, another Global Mirror session can be set up and put into operation using the former intermediate as its new remote site. This new Global Mirror session will provide additional disaster recovery solution while operating at the remote site.
- If an outage occurs at the intermediate site, data at the local storage unit is not affected. Applications continue to run normally.
- If an outage occurs at the remote site, data at the local and intermediate sites is not affected. Applications continue to run normally. The intermediate storage unit maintains a consistent up-to-date copy.
- If both the local and intermediate sites are lost, the scenario is similar to a two-site scenario when access to the local storage unit is lost. Recovery must be achieved using the last consistent point in time copy at the remote site.

1.2.2 Application design

Tivoli Storage Productivity Center for Replication is designed to scale to large numbers of volumes, supporting up to 100,000 copy sets, providing the capability to issue freeze and run commands for a metro mirror environment, and providing FlashCopy (FC) establish capabilities for FlashCopy operations with virtually no overhead.

The TotalStorage Productivity Center for Replication product utilizes Java, WebSphere®, and IBM DB2® or an embedded Apache Derby database to provide the required copy services management functions.

To ensure that environmental consistency is maintained during server restarts, persistent data from the TotalStorage Productivity Center for Replication environment is maintained within the database (DB2 or Apache Derby). This data is accessed using standard JDBC calls from within the WebSphere application. The WebSphere application name CSM stands for Copy Services Manager.

As we can see in Figure 1-7, the CSM module manages the aspects of the environment except for the relevant communications interfaces.

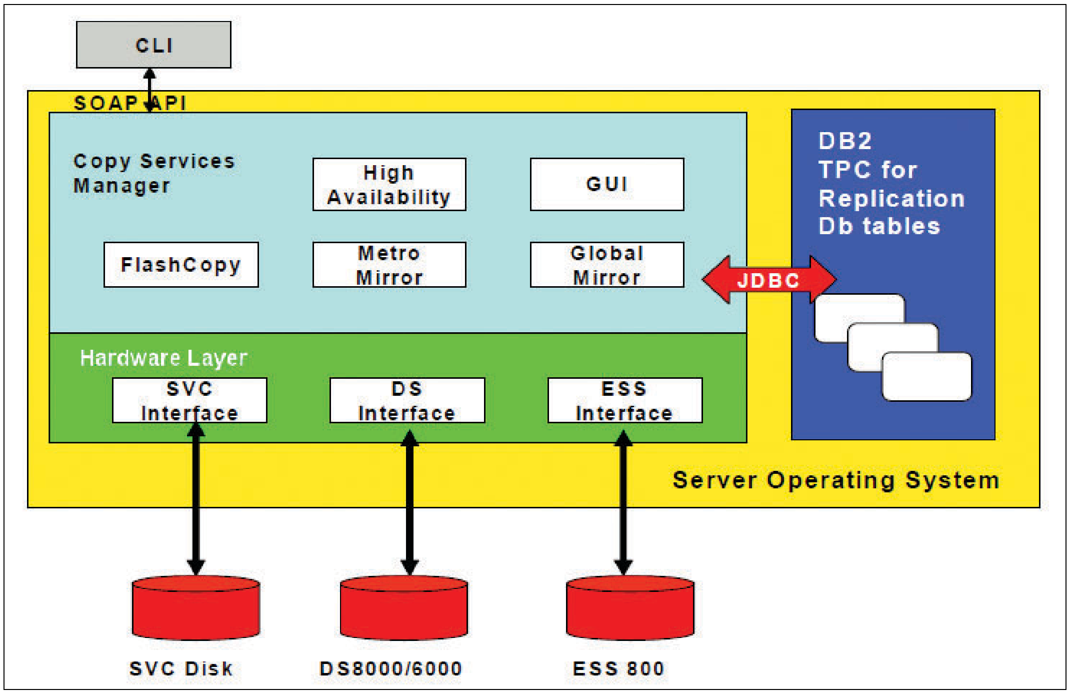

Figure 1-7 Application design

Commands from the Tivoli Storage Productivity Center for Replication server are passed from the CSM to the hardware layer and then packaged via the relevant subsystem interface. These packets are then passed to the destination storage subsystem via the IP or FICON communications path established as part of the storage subsystem add process. In Figure 1-8, we can see the communications from the CSM to an ESS or DS storage subsystem. In this instance, a command from CSM is received by the ESS or DS interface and packaged as a CCW packet. This CCW packet is then sent to the CCW server, which then passes the CCW commands to the functional code residing in the storage subsystem. The return journey is achieved in the same way.

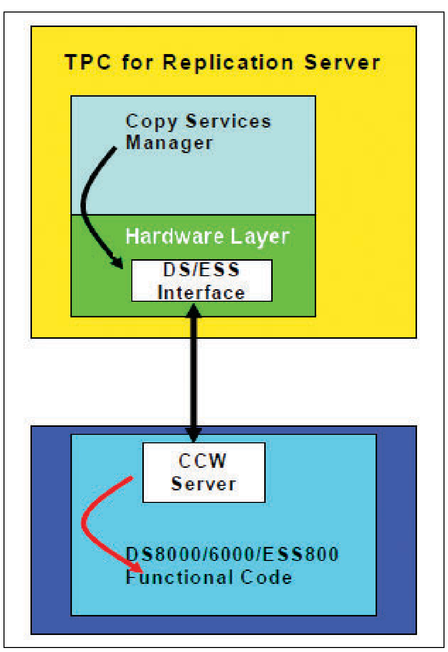

Figure 1-8 CSM to storage communications

1.3 Terminology

It is essential that you understand the following concepts and how they are used to enable the functionality of the replication environment. As such, the terminology is captured here along with a brief explanation of the term itself:

- *Role:* A volume's role is the function it assumes in the copy set, and is composed of the intended use and, for Global Mirror and Metro Mirror, the volume's site location. Every volume in a copy set is assigned a role. A role can assume the functions of a host volume, journal volume, or target volume. For example, a host volume at the primary site has the role of Host1, while a journal volume at the secondary site has the ole of Jornal2.
- *Role Pair:* A role pair is the association of two roles in a session that take part in a copy relationship. For example, in a Metro Mirror session, the role pair can be the association between the volume roles of Host1 and Host2.
- *Volume Roles:* A volume's role is the function it assumes in the copy set, and is composed of the intended use and, for Global Mirror and Metro Mirror, the volume's site location. Every volume in a copy set is assigned a role.
- *Copy Set:* A set of volumes that represent copies of the same data. All volumes in a Copy set must be of the same type and size. The number of volumes in a Copy set and the roles that each volume in a Copy set plays in the replication session are determined by the session policy.
- *Session:* The replication session is the fundamental concept that TotalStorage Productivity Center for Replication is built upon. The Copy sets within a session form a consistency group. Actions taken against the session are taken against all of the Copy sets within the session. The session policy determines what type of replication is to be controlled via the session and determines what actions and states are allowable in the session.
- *Source:* This is a Copy Set role, used in hardware support type sessions. The volume that plays this role in the Copy Set is the source volume of the Copy Set.
- *Target:* This is a Copy Set role, used in hardware support type sessions. The volume that plays this role in the Copy Set is the target volume of the Copy Set (T1 in a FlashCopy session only).
- *HostSite1 (H1):* This is a Copy Set role. The volume that plays this role in the Copy Set is the volume that is to be mounted and online to the application when the session has site 1 as the production site.
- *HostSite2 (H2):* This is a Copy Set role. The volume that plays this role in the Copy Set is the volume that is to be mounted and online to the application when the session has site 2 as the production site.
- *JournalSite2 (J2):* This is a Copy Set role. The volume that plays this role in the Copy Set is the volume used to maintain Global Mirror consistency when production is on site 1.
- *IntermediateSite2 (I2):* This is a Copy Set role. It is the volume at Site 2 that receives data from the primary host volume during a Metro Mirror or Global Mirror replication with a practice session. During a practice, data on the intermediate volumes is flash copied to the practice host volumes.
- *HostSite3 (H3):* This is a Copy Set role. The volume that plays this role in the Copy Set is the volume that is to be mounted and online to the application when the session has site 3 as the production site.
- *JournalSite3 (J3):* This is a Copy Set role. The volume that plays this role in the Copy Set is the volume that is used to maintain Global Mirror consistency at site 3.

- *IntermediateSite3 (I3):* This is a Copy Set role. It is the volume at Site 3 that receives data from the primary host volume at Site 2 during a Metro Global Mirror replication with a practice session. During a practice, data on the intermediate volumes is flash copied to the practice host volumes.

Figure 1-9 shows the terms and how they relate to each other.

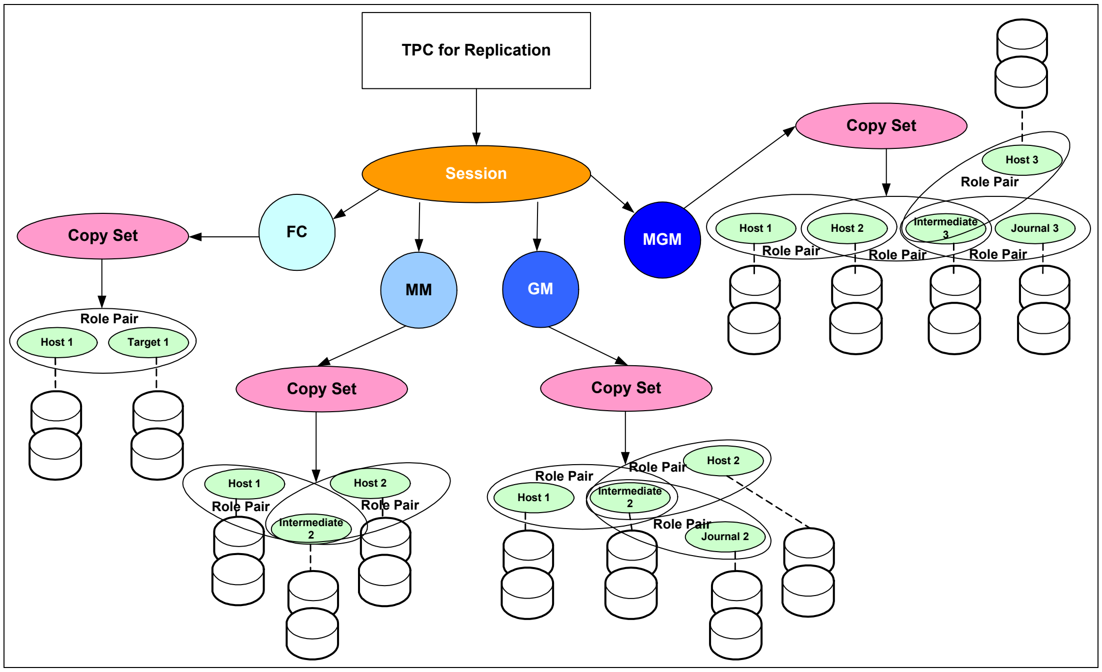

Figure 1-9 TotalStorage Productivity Center for Replication terminology

In addition, sessions themselves can exist in different states depending on the situation.

- *Defined:* Session created with or without Copy Sets but not started.
- *Preparing:* Started and in the process of initialization or re-initialization. Will automatically transition to Prepared when all pairs are initialized (prepared).
- *Prepared:* All volumes are initialized (prepared).
- *Suspending:* Transitory state caused by Suspend command or suspending event. In the process of suspending copy operations.
- *Suspended:* Copying has stopped. For Metro Mirror, the application can continue writes. An additional recoverable flag indicates if data is consistent and recoverable.
- *TargetAvailable:* Recover command processing has completed. The target volume are write enabled. An additional recoverable flag indicates if data is consistent and recoverable.

Figure 1-10 shows the transitional relationship of these session states for a continuous replication session.

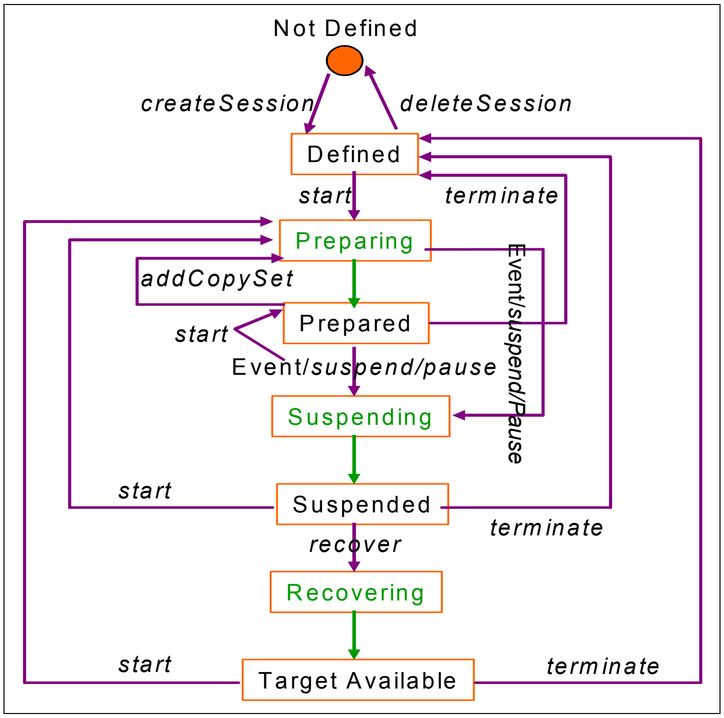

Figure 1-10 Session state transition - continuous replication

Figure 1-11 shows the transitional relationship of these session states for a FlashCopy session.

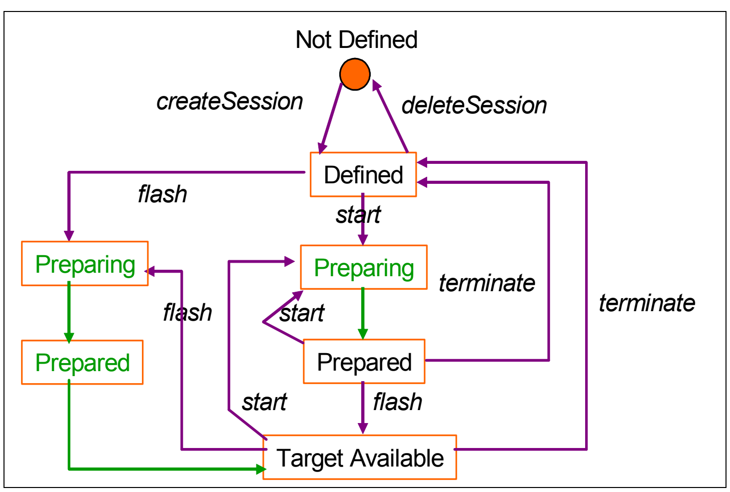

Figure 1-11 Session state transition - point in time

It is important to understand these transitions, since they can and will at times determine which TotalStorage Productivity Center for Replication commands are required to move to the next state.

1.3.1 Tivoli Storage Productivity Center for Replication session types and commands

Tivoli Storage Productivity Center for Replication enables you to configure a number of different sessions with different copy types, as follows:

- FlashCopy (Point in Time)
- Basic HyperSwap
- Metro Mirror Single Direction
- Metro Mirror Failover / Failback (Bidirectional)
- Metro Mirror Failover / Failback w/Practice (Bidirectional)
- Global Mirror Single Direction
- Global Mirror Failover / Failback (Bidirectional)
- Global Mirror Failover / Failback w/Practice (Bidirectional)
- Global Mirror Either Direction with Two-Site Practice (Bidirectional)
- Metro Global Mirror (Three-Site)
- Metro Global Mirror with Practice (Three-Site)

Metro Mirror Failover/Failback with Practice and Global Mirror Failover/Failback with Practice provide all the functions available in Metro Mirror and Global Mirror sessions, with the added support for a third volume to allow users to practice recovery procedures. The third additional volume is both the Metro Mirror or Global Mirror target and a FlashCopy source to the H2 target volume.

Session commands

The following tables show the commands that can be issued against any defined session. These commands represent the GUI interface and not the CLI command, which may require specific syntax to be valid.

Table 1-1 contains the FlashCopy commands.

Table 1-1 FlashCopy commands

Command	Meaning
Flash	Perform the FlashCopy operation using the specified options.
Initiate Background Copy	Copy all tracks from the source to the target immediately, instead of waiting until the source track is written to. This command is valid only when the background copy is not already running.
Terminate	Removes all physical copies from the hardware. This command can be issued at any point during an active session. If you want the targets to be data consistent before removing their relationship, you must issue the Initiate Background Copy command if NOCOPY was specified, and then wait for the background copy to complete by checking the copying status of the pairs.

Table 1-2 contains the Metro Mirror commands.

Table 1-2 Metro Mirror commands

Command	Meaning
Recover	Issue the Recover command to suspended sessions. This command performs the steps necessary to make the target available as the new primary site. Upon completion of this command, the session becomes Target Available. This command does not apply for SVC.

Command	Meaning
Start	Establishes a single-direction session with the hardware and begins the synchronization process between the source and target volumes.
Start H1 → H2	Applies only to failover/failback BC sessions. Indicates the direction between two hosts in a Metro Mirror failover/fallback session.
Start H2 → H1	Indicates direction of a failover/failback between two hosts in a Metro Mirror session. If the session has been recovered with the failover/failback function such that the production site is now H2, you can issue the Start H2-H1 command to start production on H2 and provide protection. This command is not supported for SVC.
Stop	Suspends updates to all the targets of pairs in a session. This command can be issued at any point during an active session. Note, however, that updates are not considered to be consistent.
Suspend	Causes all target volumes to remain at a data-consistent point and stops all data that is moving to the target volumes. This command can be issued at any point during a session when the data is actively being copied.
Terminate	Removes all physical copies from the hardware during an active session. If you want the targets to be data consistent before removing their relationship, you must issue the Suspend command, the Recover command, and then the Terminate command.

Table 1-3 contains the Global Mirror commands.

Table 1-3 Global Mirror

Command	Meaning
Recover	Issue the Recover command to suspended sessions. This command performs the steps necessary to make the target available as the new primary site. Upon completion of this command, the session becomes Target Available. This command does not apply for SVC.
Start	Sets up all relationships in a single-direction session and begins the process necessary to start forming consistency groups on the hardware.
Start H1 → H2	Indicates direction between two hosts in a Global Mirror failover/fallback session. Suspend Stops all consistency group formation when the data is actively being copied. This command can be issued at any point during a session when the data is actively being copied.
Start H2 → H1	Indicates direction of a failover/failback session. If a recover has been performed on a session such that the production site is now H2, you can issue Start H2-H1 to start moving data back to Site 1. However, this start does not provide consistent protection as it copies only asynchronously back because of the long distance. An extended distance (XD) relationship is used. When you are ready to move production back to Site 1, issue a suspend to the session; this puts the relationships into a synchronized state and suspends them consistently. This command is not supported for SVC.
Suspend	Stops all consistency group information when the data is actively being copied. This command can be issued at any point during a session when the data is actively being copied.

Command	Meaning
Terminate	Removes all physical copies from the hardware. This command can be issued at any point in an active session. If you want the targets to be data consistent before removing their relationship, you must issue the Suspend command, the Recover command, and then the Terminate command.

Table 1-4 contains the Metro/Global Mirror commands.

Table 1-4 Metro/Global Mirror commands

Command	Meaning
Start H1 → H2 → H3	Metro/Global Mirror initial start command. This command creates Metro Mirror relationships between H1 and H2, and Global Mirror relationships between H2 and H3. For Metro/Global Mirror, this includes the J3 volume to complete the Global Mirror configuration. (The J3 volume role is the journal volume at site 3). Start H1 → H2 → H3 can be used from some Metro/Global Mirror configurations to transition back to the starting H1 → H2 → H3 configuration.
Start H1 → H3	From the H1 → ¨H2 → ¨H3 configuration, this command changes the session configuration to a Global Mirror-only session between H1 and H3, with H1 as the source. Use this command in case of an H2 failure with transition bitmap support provided by incremental resynchronization. It can be used when a session is in preparing, prepared, and suspended states because there is not a source host change involved. This command allows you to bypass the H2 volume in case of an H2 failure and copy only the changed tracks and tracks in flight from H1 to H3. After the incremental resynchronization is performed, the session is running Global Mirror from H1 to H3 and thus loses the near-zero data loss protection achieved with Metro Mirror when running H1 → ¨H2 → ¨H3. However, data consistency is still maintained at the remote site with the Global Mirror solution. From H2 → ¨H1 → ¨H3 configuration, this command changes the session configuration to a Global Mirror-only session configuration between H1 and H3, with H1 as the source. Use this command when the source site has a failure and production is moved to the H1 site. This can be done for unplanned HyperSwap. The Global Mirror session is continued. This is a host-volume change so this command is valid only when restarting the H1 → ¨H3 configuration or from the TargetAvailable H2 → ¨H1 → ¨H3 state.
Start H3 → H2	Metro Global Mirror command to start Global Copy from the disaster recovery site back to the H2 volumes. This is a host-volume change so this command is valid only when restarting the H3->H2 configuration or from the TargetAvailable H1 → ¨H2 → ¨H3 state.

Command	Meaning
Start H2 → H3	From the H1 → ¨H2 → ¨H3 configuration, this command moves the session configuration to a Global Mirror only session configuration between H2 and H3, with H2 as the source. Use this command when the source site has a failure and production is moved to the H1 site. This can be done for unplanned HyperSwap. The Global Mirror session is continued. This is a host-volume change so this command is valid only when restarting the H1 → ¨H3 configuration or from the TargetAvailable H2 → ¨H1 → ¨H3 state. From the H2 → ¨H1 → ¨H3 configuration, this command transitions the session configuration to a Global Mirror only session configuration between H2 and H3 with H2 as the source. Use this command in case of an H1 failure with transition bitmap support provided by incremental resynchronization. It can be used when the session is in preparing, prepared, and suspended states because there is not a source-host change involved. Start H2 → H1 → H3 can be used from some Metro Global Mirror configurations to transition back to the starting H2 → ¨H1 → ¨H3 configuration.
Start H2 → H1 → H3	Metro/Global Mirror start command. This is the configuration that completes the HyperSwap processing. This command creates Metro Mirror relationships between H2 and H1 and Global Mirror relationships between H1 and H3. For Metro/Global Mirror, this includes the J3 volume to complete the Global Mirror configuration.
Start H3 → H1 → H2	After recovering to H3, this command sets up the hardware to allow the application to begin writing to H3, and the data is copied back to H1 and H2. However, issuing this command does not guarantee consistency in the case of a disaster because only Global Copy relationships are established to cover the long distance copy back to site 1. To move the application back to H1, you can issue a suspend while in this state to drive all the relationships to a consistent state and then issue a freeze to make the session consistent. You can then issue a recover followed by a start H1 → H2 → H3 to go back to the original configuration.
Suspend H2 → H3	When running H1 → ¨H2 → ¨H3, this command issues a pause to the Global Mirror master and causes the Global Mirror master to stop forming consistency groups. This command is valid only when the session is in a prepared state.
Suspend H1 → H3	When running H2 → ¨H1 → ¨H3, this command issues a pause to the Global Mirror master and causes the Global Mirror master to stop forming consistency groups. This command is valid only when the session is in a prepared state.
Recover H1	Specifying H1 makes the H1 volume TargetAvailable. Metro/Global Mirror (when running H2 → ¨H1 → ¨H3) can move production to either the H1 or H3 set of volumes. Tivoli Storage Productivity Center for Replication processing is different depending on the recovery site. Therefore, the site designation is added to the recover command so Tivoli Storage Productivity Center for Replication can set up for the failback.

Command	Meaning
Recover H2	Specifying H2 makes the H2 volume TargetAvailable. Metro/Global Mirror (when running H1 → H2 → H3) can move production to either the H2 or H3 set of volumes. Tivoli Storage Productivity Center for Replication processing is different depending on the recovery site. Therefore the site designation is added to the recover command so Tivoli Storage Productivity Center for Replication can set up for the failback.
Recover H3	Specifying H3 makes the H3 volume TargetAvailable. Metro/Global Mirror (when running H1 → H2 → H3) can then move production to the H3 set of volumes. Because Tivoli Storage Productivity Center for Replication processing is different depending on the recovery site, the site designation is added to the recover command so that Tivoli Storage Productivity Center for Replication can set up for the failback. This command sets up H3 so that you can start the application on H3. H3 becomes the active host, and you then have the option to start up H3 → ¨H1 → ¨H2 to perform a Global Copy copy back.

Table 1-5 on page 17 shows the HyperSwap commands.

Table 1-5 HyperSwap command

Command	Meaning
HyperSwap	Causes a site switch, equivalent to a suspend and recover for a Metro Mirror with Failover/Failback. Because of this, individual suspend and recover commands are not available.

1.4 New functions in Tivoli Storage Productivity Center for Replication V5.1

This section describes new features and enhancements in Tivoli Storage Productivity Center for Replication for System z version 5.1. This information highlights the changes since the last release of Tivoli Storage Productivity Center for Replication for System z.

The list of the new/improved capabilities for this release includes the following features:

1. Failover operations that are managed by other applications
2. Additional support for space-efficient volumes in remote copy Tivoli Storage Productivity Center for Replication for System z sessions
3. Reflash After Recover option for Global Mirror Failover/Failback with Practice sessions
4. No Copy option for Global Mirror with Practice and Metro Global Mirror with Practice sessions
5. Recovery Point Objective Alerts option for Global Mirror sessions
6. Enable Hardened Freeze option for Metro Mirror sessions
7. StartGC H1->H2 command for Global Mirror sessions
8. Export Global Mirror Data command for Global Mirror role pairs

1.4.1 Failover operations that are managed by other applications

Applications such as the IBM i Toolkit, VMware Site Recovery Manager, and Veritas Cluster Server manage failover operations for certain session types and storage systems. If an application completes a failover operation for a session, Tivoli Storage Productivity Center for Replication recognizes when an external failover is issued to a Storage System that Tivoli Storage Productivity Center for Replication is managing, and as a consequence, it displays the *Severe* status for the session, and an error message is generated for the role pairs for which the failover occurred.

1.4.2 Additional support for space-efficient volumes in remote copy

You can use extent space-efficient (ESE) volumes as copy set volumes the session's various roles. It is supported on the following IBM System Storage DS8000 session types:

- FlashCopy (System Storage DS8000 6.2 or later)
- Metro Mirror (System Storage DS8000 6.3 or later)
- Global Mirror or Metro Global Mirror (System Storage DS8000 6.3 or later)

1.4.3 Reflash After Recover option for Global Mirror Failover/Failback with Practice sessions

You can use the Reflash After Recover option with System Storage DS8000 version 4.2 or later. Use this option to create a FlashCopy replication between the Intermediate Site 2 (I2) and Journal Site 2 (J2) volumes after the recovery of a Global Mirror Failover/Failback with Practice session. If you do not use this option, a FlashCopy replication is created only between the I2 and H2 volumes.

1.4.4 No Copy option for Global Mirror with Practice and Metro Global Mirror with Practice sessions

You can use the **No Copy** option with System Storage DS8000 version 4.2 or later. Use this option if you do not want the hardware to write the background copy until the source track is written to. Data is not copied to the Intermediate Site 2 (I2) volume until the blocks or tracks of the H2 volume are modified.

The point in time volume image is composed of the unmodified data on the H1 volume and the data that was copied to the T1 volume. If you want a complete point in time copy of the H1 volume to be created on the T1 volume, do not use the **No Copy** option. This option causes the data to be asynchronously copied from the H1 volume to the T1 volume.

Although you can select any space-efficient volume as the target, you cannot change the **Permit Space Efficient Target** flag. This flag is always set. When selecting space-efficient volumes as targets, you might receive an x0FBD error message when you start a full background copy. To avoid this message, select the **No Copy** option.

1.4.5 Recovery Point Objective Alerts option for Global Mirror sessions

You can use the Recovery Point Objective Alerts option with IBM TotalStorage IBM Enterprise Storage Server® Model 800, System Storage DS8000, and System Storage DS6000. Use this option to specify the length of time that you want to set for the recovery point objective (RPO) thresholds. The values determine whether a **Warning** or **Severe** alert is generated when the RPO threshold is exceeded for a role pair. The RPO represents the length of time in seconds of data exposure that is acceptable in the event of a disaster.

1.4.6 Enable Hardened Freeze option for Metro Mirror sessions

You can use the **Enable Hardened Freeze** option with Enterprise Storage Server Model 800, System Storage DS8000, and System Storage DS6000. Use this option to enable the z/OS Input/Output Supervisor (IOS) to manage freeze operations. This option is enabled by default. If you select the **Manage H1-H2 with HyperSwap** option for the session, the **Enable Hardened Freeze** option is ignored. IOS support for managing freeze operations is included with HyperSwap. The **Enable Hardened Freeze** option ensures data integrity if Tivoli Storage Productivity Center for Replication freezes and HyperSwap is not enabled for a session.

If you select the **Enable Hardened Freeze** option, the following actions can occur:

- IOS can freeze volumes regardless of whether the Tivoli Storage Productivity Center for Replication server is started or stopped.
- You can include z/OS system volumes such as paging, database, and IBM WebSphere Application Server hierarchical file system (HFS) as Metro Mirror volumes in the session. When you select the **Enable Hardened Freeze** option, IOS manages the freeze operations for all Metro Mirror volumes in the session, which prevents Tivoli Storage Productivity Center for Replication from freezing the volumes and possibly freezing itself. The **Enable Hardened Freeze** option does not enable IOS to manage freeze operations for Global Mirror volumes.

Note: The **Enable Hardened Freeze** option requires the z/OS address spaces Basic HyperSwap Management and Basic HyperSwap API.

1.4.7 StartGC H1->H2 command for Global Mirror sessions

You can use the StartGC H1->H2 command with TotalStorage Enterprise Storage Server Model 800, System Storage DS8000, and System Storage DS6000. This command establishes Global Copy relationships between site 1 and site 2, and begins asynchronous data replication from H1 to H2 but without forming consistency groups. There is no disaster recovery protection for Global Copy relationships. If a disaster such as the loss of a primary storage system or a link failure between the sites occurs, the session might be inconsistent when you issue the **Recover** command.

1.4.8 Export Global Mirror Data command for Global Mirror role pairs

You can use this option to export data for a Global Mirror role pair that is in a session to a comma-separated value (CSV) file. You can then use the data in the CSV file to analyze trends in your storage environment that affect your recovery point objective (RPO).

For example, the file that contains data for the RPO might show that the RPO threshold is often exceeded on a particular day and time. You can then view the file that contains data for logical subsystem (LSS) out-of-sync tracks to see whether a particular LSS or set of LSSs have high out-of-sync track values for that day and time.

2

WebSphere Application Server OEM Edition for z/OS installation

Tivoli Storage Productivity Center for Replication for System z, V5.1 requires WebSphere Application Server as a prerequisite. It can be WebSphere Application Server OEM Edition for z/OS V7.0, WebSphere Application Server for z/OS V7.0, or WebSphere Application Server for z/OS V8.0.

Although Tivoli Storage Productivity Center for Replication supports both full WebSphere Application Server edition as well as WebSphere Application Server OEM, for the users not familiar with WebSphere Application Server, just deploy WebSphere Application Server OEM edition. This chapter includes the installation procedure of WebSphere Application Server OEM Edition with a detailed description of the scripts and jobs used to complete and customize WebSphere Application Server OEM.

For detailed instructions how to prepare your environment for IBM WebSphere Application Server OEM customization, see the following documentation:

- *IBM WebSphere Application Server OEM Edition for z/OS Configuration Guide (V7.0.x)*, GA32-0631-07.

> **Note:** WebSphere Application Server OEM SMP/E RECEIVE, APPLY, and ACCEPT are not documented in this book. See *Program Directory for IBM WebSphere Application Server OEM Edition for z/OS V7.0,* GI11-4326.

2.1 Configuration overview

Installation concept of deploying a new IBM WebSphere Application Server OEM Edition for z/OS is based on a configuration script, WASOEM.sh, which allows you to configure a WebSphere Application Server instance in a seamless manner, requiring minimal knowledge of the underlying WebSphere Application Server configuration process.

The WASOEM.sh script uses a configuration file, known as a response file, along with the underlying WebSphere Application Server configuration technology, to configure an instance of the IBM WebSphere Application Server OEM Edition for z/OS server. A default response file, which contains default configuration key and value pairs that can be used to create an out of the box base IBM WebSphere Application Server OEM Edition for z/OS server instance, is provided with the product. The main task of the WASOEM.sh configuration script is to provide a prompt environment that makes it easy to modify the required subset of default response file settings needed for a basic configuration of an IBM WebSphere Application Server OEM Edition for z/OS server instance.

During WASOEM.sh processing, a series of prompts display on your console. All of these prompts require a response; either an acceptance of a default value, or a value that you enter in response to the prompt. All prompts include the setting that will be used if you accept the default, which is presented along with the prompt itself. The default values that are presented are based on a subset of configuration values contained in the default response file. If any default value is not appropriate for your system environment, you can change the value when you respond to the prompt. After you respond to all of the prompts that display, the WASOEM.sh scripting process creates a final tailored response file based on the prompt updates you provide, and the values contained in the default response file.

Some of the important values, which are used in the Tivoli Storage Productivity Center for Replication implementation jobs, are WebSphere Application Server OEM Cell, Node, and Server name. IBM WebSphere Application Server OEM Edition structure with its default Cell, Node, and Server names is shown in Figure 2-1.

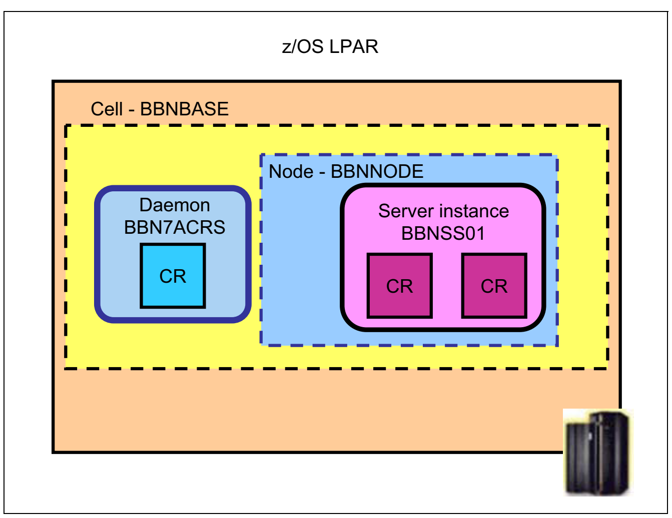

Figure 2-1 IBM WebSphere Application Server OEM Edition basic design structure

In Figure 2-1, you can see the high level WebSphere Application Server OEM design structure, where SR stands for Servant Region and CR is Controller region. Servant Region basically represents application infrastructure. Controller region does not contain any application code, but it contains TCP listeners and accepts commands issued from z/OS.

The Node is simply the logical collection of applications server on an z/OS LPAR. The Cell is a logical construct and it controls the node. Daemon provides access to modules held in storage and the “Location Name Service” for remote client requests.

2.2 WebSphere Application Server OEM configuration procedure

This section describes the WebSphere Application Server OEM configuration procedure, with an assumption that you have already used SMP/E to install IBM WebSphere Application Server OEM edition for z/OS, according to the instructions provided in the IBM WebSphere Application Server OEM Edition for z/OS Program Directory.

> **Important:** Read the **Typical configuration procedure - Before you begin** section in the *IBM WebSphere Application Server OEM Edition for z/OS Configuration Guide (V7.0.x)*, GA32-0631-07, before you start the WASOEM.sh script. Although most of the default values provided in the default response file are appropriate for your system environment, this configuration guide includes checklists, prompt responses worksheet, and other useful information to get you more familiar with the WebSphere Application Server OEM configuration process.

The IBM WebSphere Application Server OEM configuration process occurs in three stages, and in the following order:

1. Stage 1: Configuration
2. Stage 2: Security setup
3. Stage 3: Server instance creation

A more detailed description of each configuration stage is provided further in this chapter.

2.2.1 Stage 1: Configuration

During this stage, you interact with a series of prompts. Your responses to these prompts are used to generate a response file that is specific to the IBM WebSphere Application Server OEM Edition for z/OS server instance that you are configuring. You should use these prompts to change any of the default values that are not appropriate for your system environment. Any name and value pairs that you provide in the override response file before invoking the WASOEM.sh script are incorporated into the resulting response file.

The configuration stage can be run in either the typical mode or advanced mode:

- The *typical mode* only prompts you for very system specific configuration details. and utilizes many of the best practices defaults values that are used for a basic WebSphere Application Server for z/OS configuration. Use this mode if you desire a basic functional configuration with minimal prompt interaction.
- The *advanced mode* includes additional prompts that enable you to specify most configuration settings for your installation, and should only be used if the IBM WebSphere Application Server OEM Edition for z/OS server instance that you are creating requires a fine level of configuration specification. During processing in the advanced mode, you can still select any of the default values that meet the needs of your installation. However, the additional prompts that display give you the opportunity to override any of these default values that are not appropriate for your environment.

If you do not include the **-mode** parameter when you issue the **WASOEM.sh –config** command, the typical mode processing occurs because **typical** is the default value for the **-mode** parameter.

If you are not an advanced WebSphere Application Server user, then the typical mode is the preferable one. It is the appropriate configuration process to follow for most z/OS systems. All default settings match the system requirements for most z/OS systems.

> **Note:** In this chapter we discuss the typical mode configuration only. See the *IBM WebSphere Application Server OEM Edition for z/OS Configuration Guide (V7.0.x), GA32-0631-07* publication for the advanced mode configuration procedure.

The WASOEM.sh script can be invoked from an OMVS or telnet/rlogin session. You cannot run this script from under ISHELL. Log on to your z/OS system where you received and applied IBM WebSphere Application Server OEM edition and invoke OMVS session to start with the configuration procedure described next.

Before you invoke the WASOEM.sh script, you need to set the $PATH value from OMVS as shown in Example 2-1.

Example 2-1 Set $PATH value

```
export PATH=.:/usr/lpp/zWebSphereOEM/V7R0/bin:$PATH
```

Here, `/usr/lpp/zWebSphereOEM/V7R0` is the default WebSphere mount point path.

Setting this value provides all of the WebSphere Application Server OEM Edition for z/OS scripts system wide access to required items.

In addition, you need to update the WASOEM_CONFIG_WORKDIR environmental variable with the name of the directory under which you want the IBM WebSphere Application Server OEM Edition for z/OS configuration files, and instance configuration working directories to be located. WASOEM.sh uses the value specified for this variable to locate these files and working directories during the IBM WebSphere Application Server OEM Edition for z/OS configuration process. Use the command shown in Example 2-2 to perform this update.

Example 2-2 Define WebSphere Application Server OEM working directory

```
export WASOEM_CONFIG_WORKDIR=/etc
```

Here, `/etc` is the top level directory under which WASOEM.sh creates the following IBM WebSphere Application Server OEM Edition for z/OS product configuration files:

- zWebSphereOEM/V7R0/conf
- zWebSphereOEM/V7R0/conf/wasOverride.responseFile
- zWebSphereOEM/V7R0/conf/wasOEM_env.sh

The working directories for each configuration of IBM WebSphere Application Server OEM Edition for z/OS will also be located in this directory.

This WASOOEM_CONFIG_WORKDIR path will be required when you start configuration by invoking WASOEM.sh script.

> **Note:** The default setting for this variable is the `/etc/` directory. The value you specify on this export statement for the WASOEM_CONFIG_WORKDIR variable only remains in effect for the current WASOEM.sh session.

If this is the first time the IBM WebSphere Application Server OEM is being configured since it was installed, issue the **WASOEM.sh** command (as shown in Example 2-3) from OMVS session in order to copy the two required configuration files from the IBM WebSphere Application Server OEM installation location to a predetermined location in the file system. This action is required once per product installation. Example 2-3 includes the output of the **WASOEM.sh** command.

Example 2-3 WASOEM.sh first run output

```
>WASOEM.sh
BBN0400I:The current top-level WebSphere Application Server OEM configuration
working directory is set to: /etc

BBN0400I:The WebSphere Application Server OEM configuration working directories
will be located under: /etc/zWebSphereOEM/V7R0/conf

BBN0400I:This location setting will be valid for this session only.

BBN0235I:Creating configuration directory /etc/zWebSphereOEM/V7R0/conf

BBN0233I:/usr/lpp/zWebSphereOEM/V7R0/zOS-config/zpmt/samples/wasOEM_env.sh was
copied to /etc/zWebSphereOEM/V7R0/conf/wasOEM_env.sh.
Review the contents of /etc/zWebSphereOEM/V7R0/conf/wasOEM_env.sh before
continuing.

BBN0234I:/usr/lpp/zWebSphereOEM/V7R0/zOS-config/zpmt/samples/wasOEMOverride.respon
seFile was copied to
/etc/zWebSphereOEM/V7R0/conf/wasOEMOverride.responseFile.
Review the contents of /etc/zWebSphereOEM/V7R0/conf/wasOEMOverride.responseFile
before continuing.
```

If you issue this command, and the files have already been copied to the predetermined location in the file system, the help message for the WASOEM.sh command displays.

Note: If you cannot use the `/etc/` directory to store the configuration file and the default environment files, you can specify a different working directory for these files when you receive the following prompts. These prompts only appear the first time you issue the **WASOEM.sh** command:

```
BBN0400I:The current WebSphere Application Server OEM configuration working directory is
not set
BBN0094I:Enter a file system location under which the WebSphere Application Server OEM
working directories will be located, or press Return to accept (/etc):
```

WASOEM.sh shell script prompt responses

Start OMVS session and change directory to WebSphere Application Server OEM home directory and locate the WASOEM.sh script by using the **ls** command as in Example 2-4.

Example 2-4 Locate WASOEM.sh script

```
>cd /usr/lpp/zWebSphereOEM/V7R0/bin
>ls WASOEM.sh
WASOEM.sh
```

When you find the WASOEM.sh script, issue the **WASOEM.sh** command using the parameters shown in Example 2-5.

Example 2-5 WASOEM.sh shell script output and responses

```
>WASOEM.sh -config -mode typical
```

The first prompt asks you to provide working directory path. The default is **/etc** and you can see in our Example 2-6 that we accept the default working directory.

Example 2-6 Specify WebSphere Application Server OEM working directory

```
BBN0094I:Enter a filesystem location under which the WebSphere Application Server
OEM working directories will be located, or press return to accept (/etc):
 ===> /etc
BBN0400I:This location setting will be valid for this session only.

BBN0014I:Located /etc/zWebSphereOEM/V7R0/conf/wasOEM_env.sh - Setting global
defaults.
```

The BBN0014I message gives you information where the wasOEM_env.sh script is located. This script is used to configure the IBM WebSphere Application Server OEM Edition for the z/OS configuration environment. As part of its processing, the WASOEM.sh shell script performs various file creations, and writes logs of its activity to the file system. The locations of these various files are set by wasOEM_env.sh shell script and can be changed by an administrator.

Note: Mark the directory above, where wasOEM_env.sh script is located. After the WASOEM.sh script completes, open the wasOEM_env.sh file to find out location of the relevant WebSphere Application Server OEM environmental files generated by the WASOEM.sh script.

Log directory information

If this is the first time you run **WASOEM.sh - config**, you are prompted to create log files as indicated in Example 2-7. You need to respond **Y** to this prompt. In case you will need to cancel the script and restart it again, you will not be prompted again for log creation even if you responded **N** the first time. After the log directory is created, the WASOEM.sh script starts.

Example 2-7 Create log files

```
BBN0002W:Log directory /var/zWebSphereOEM/V7R0/logs does not exist. Would you like
to create it? (Y/N) Y
BBN0229I:   * Your response was Y

Log directory has been set to /var/zWebSphereOEM/V7R0/logs.
WASOEM.sh log will be written to
/var/zWebSphereOEM/V7R0/logs/WASOEM_070212_135839.log.
IBM WebSphere Application Server OEM Edition for z/OS Version 7, Release 0,
configuration request is being processed.

WASOEM.sh  started.
```

Note: Mark the log file name and its location. In case the WASOEM.sh script fails, you can find the error message and the reason why it failed. The new log file is allocated every time you start the WASOEM.sh script.

As part of its initial processing, the WASOEM.sh script creates a series of subdirectories for its use and one of them is the `/tmp` directory. It is a temporary directory that requires a minimum of 25 megabytes of free space that is used during WASOEM.sh processing. The default mount point for the configuration file system requires approximately 1 GB of storage. Therefore, WASOEM.sh creates and allocates the space for this mount point as a separate file system. After WASOEM.sh processing completes, the objects created in this directory are no longer needed, and can be deleted.

The WASOEM.sh script invokes the zpmt.sh script. The zpmt.sh script generates the components, or system jobs, that are used to create and configure the WebSphere Application Server OEM Edition for z/OS instance based on the content of the response file. The zpmt.sh script uses the `/tmp` subdirectory as its work area during installation process. As shown in Example 2-8, the warning message indicates that this subdirectory does not exist. You need to accept creation of this directory, otherwise you will receive an error message indicating that processing cannot continue. After you accept it, the `BBN0022I` message confirms creation of the directory followed by the WASOEM.sh startup information.

Example 2-8 Create /tmp/zWebSphereOEM/V7R0/zpmt/work directory

```
BBN0004W:ZPMT_WORK_ROOT directory (/tmp/zWebSphereOEM/V7R0/zpmt/work) does not
exist. Would you like to create it? (Y/N)

   * Your response was Y

BBN0022I:ZPMT_WORK_ROOT directory has been set to
/tmp/zWebSphereOEM/V7R0/zpmt/work.
*******************************************************************************
* IBM WebSphere Application Server OEM Edition for z/OS Version 7, Release 0
* Version 1.13
* Date updated 10/06/2010
* Options selected:
*              -v              0
*              -noclear        1
*              -nooverride     0
*              -fastpath       0
*              -showmsgprefix  0
*              -nocustom       1
*              -create         0
*              -config         1
*******************************************************************************
```

Configuration naming prompts

The next required input is the name of your configuration. The default name is CONFIG1. If you accept it as the name for your configuration file system (Example 2-9), and /etc/zWebSphereOEM/ V7R0/conf/ is the directory that you are using for the WebSphere Application Server OEM Edition for z/OS configuration files, the fully-qualified name of your configuration is: /etc/zWebSphereOEM/V7R0/conf/CONFIG1.

Example 2-9 Set up WebSphere Application Server OEM configuration name

```
BBN0025I:Enter a 1-12 character name to call this configuration, or press Return
to accept (CONFIG1):
```

The following prompts, shown in Example 2-10, define the high level qualifier (HLQ) for the location of the partitioned data sets where the generated customization jobs and files will be stored. When WebSphere Application Server OEM Edition for z/OS uploads a z/OS customization definition to the target z/OS system, the customization jobs and files are written to these data sets. Press Return to accept the default value or specify your own HLQ if preferred.

Example 2-10 Define HLQ for location of customization jobs

```
BBN0114I:When a z/OS customization definition is uploaded to the target z/OS
system, the customization jobs and files are written to a pair of partitioned data
sets.

BBN0115I:Enter a high-level qualifier for the target z/OS data sets that will
contain the generated jobs and instructions (BBN.V7R0.CONFIG1.ZPMTJOBS):

===> WASOEM.V7R0.CONFIG1.ZPMTJOBS

   * Your response was WASOEM.V7R0.CONFIG.ZPMTJOBS issued tso listcat
entry('WASOEM.V7R0.CONFIG1.ZPMTJOBS.CNTL') all listcat
entry('WASOEM.V7R0.TPCRSC70.ZPMTJOBS.CNTL') all RC(4)
issued tso listcat entry('WASOEM.V7R0.TPCRSC70.ZPMTJOBS.DATA') all listcat
entry('WASOEM.V7R0.TPCRSC70.ZPMTJOBS.DATA') all RC(4) no HLQ datasets found...will
allocate
```

The input required for the WebSphere Application Server OEM customization shown in Example 2-11 is the volume serial number of the DASD that contains the file system data set. If SMS automatic class selection (ACS) routines are set up to handle data set allocation automatically you can specify * to let SMS select a volume for you. If SMS is not set up to handle data set allocation automatically, and you do not want to use the default volume, you must specify a specific volume. In our Example 2-11, we let SMS to handle volume selection.

Example 2-11 Specify the volume serial for DASD

```
BBN0133I:Enter the volume name to allocate the DATA and CNTL datasets on, or enter
* to s
elect SMS managed :
 ===>  *
elect SMS managed :*
   * Your response was *
issued tso alloc dsn('WASOEM.V7R0.CONFIG1.ZPMTJOBS.DATA') TRACKS DIR(30)
BLKSIZE(0) space(5,5) LRECL(255) new cyl recfm(V,B) unit(SYSALLDA)
alloc dsn('WASOEM.V7R0.CONFIG1.ZPMTJOBS.DATA') TRACKS DIR(30) BLKSIZE(0)
space(5,5) LRECL(255) new cyl recfm(V,B) unit(SYSALLDA)
5,5) LRECL(255) new cyl recfm(V,B) unit(SYSALLDA) issued tso alloc
dsn('WASOEM.V7R0.CONFIG1.ZPMTJOBS.CNTL') TRACKS DIR(30) BLKSIZE(0) space(15,15)
LRECL(80) new cyl recfm(F,B) unit(SYSALLDA) alloc
dsn('WASOEM.V7R0.CONFIG1.ZPMTJOBS.CNTL') TRACKS DIR(30) BLKSIZE(0) space(15,15)
LRECL(80) new cyl recfm(F,B) unit(SYSALLDA) issued tso free
dsn('WASOEM.V7R0.CONFIG1.ZPMTJOBS.CNTL') free
dsn('WASOEM.V7R0.CONFIG1.ZPMTJOBS.CNTL') RC(12)
issued tso free dsn('WASOEM.V7R0.CONFIG1.ZPMTJOBS.DATA') free
dsn('WASOEM.V7R0.CONFIG1.ZPMTJOBS.DATA') RC(12)

WASOEM.V7R0.CONFIG1.ZPMTJOBS.DATA and WASOEM.V7R0.CONFIG1.ZPMTJOBS.CNTL data sets
have been allocated.
```

The next required input is to define the WebSphere Application Server OEM file system directory. It is the read-only file system mount point. If you want to use a symbolic link mount point, enter that mount point instead of the absolute mount point in response to this prompt. If you specify a symbolic link mount point, during **WASOEM.sh -create** processing symbolic inks are created in the configuration file system that point to the product files mounted at the location that you specified. In Example 2-12 we accepted the default directory.

Example 2-12 Define WebSphere Application Server OEM file system directory

```
BBN0238I:Enter the WebSphere Application Server Product File System directory, or
press return to accept (/usr/lpp/zWebSphereOEM/V7R0):
 ===>
accept default
```

Configuration file system prompts

The following prompts are related to the WebSphere Application Server OEM file system properties (for example, name, type, and location). In Example 2-13 we provide name of the file system data set that will be created and mounted at the mount point specified for the zConfigMountPoint variable in the response file. The data set name can include up to 44 characters. In our example we do not accept the default since we use a different HLQ.

Example 2-13 Define name of the file system data set

```
BBN0112I:Enter the name of the configuration file system dataset to create, or
press Return to accept (BBN.V7R0.CONFIG1.ZFS):
===> WASOEM.V7R0.CONFIG1.ZFS

   * Your response was WASOEM.V7R0.CONFIG.ZFS
```

The next required input is the type of configuration file system you will use to run WebSphere Application Server OEM Edition for z/OS. You must use either a ZFS file system or an HFS file system. We use ZFS as shown in Example 2-14.

Example 2-14 Define configuration file system type

```
BBN0109I:Enter the type of the configuration file system (ZFS/HFS), or press
Return to accept (ZFS):

===> ZFS

   * Your response was ÝWASOEM.V7R0.TPCRSC70.ZFS¨
```

At this point, you need to provide the volume serial where you want to allocate the configuration file system. Alternatively, specify * if you want SMS handle allocation as we used in our Example 2-15.

Example 2-15 Specify the volume serial number for file system allocation

```
BBN0110I:To allocate the configuration file system on a particular volume, enter
the volser here (enter * for SMS managed), or press return to accept (BBNVOL):
 ===>     *
* Your response was *
```

The next required input is for the read/write file system directory mount point where application data and environment files will be written The customization process creates this mount point if it does not already exist. In Example 2-16, we accept the default path.

Example 2-16 Define file system directory mount point

```
BBN0108I:Enter the path of the configuration file system mount point, or return to
accept (/zWebSphereOEM/V7R0/config1):
 ===> /zWebSphereOEM/V7R0/config1
```

Server, cell and node configuration prompts

The next group of inputs define the WebSphere Application Server OEM properties. Since this WebSphere Application Server OEM is a stand-alone edition and it is exclusively used for Tivoli Storage Productivity Center for Replication, we suggest to keep it simple and accept default names for WebSphere Application Server server, cell, and node. Default server, cell, and node names will be required later for Tivoli Storage Productivity Center for Replication installation.

If you enter **Y**, to the following prompt (see Example 2-17), you do not receive any more server, cell, and node messages.

Example 2-17 Accept default names for WebSphere Application Server server, cell, and node name

```
BBN0999I:Would you like to use the WebSphere Application Server OEM default values
for the cell, cluster and system identifiers? (Y/N)
===> Y

   * Your response was Y
Assigning default values
```

UID and GID prompts

The next prompt is related to user ID names, group names, and UID/GID values. Instead of manually providing UID/GID values, you can allow IBM RACF® to automatically generate a unique ID values for you. This option parameter is called AUTOGID. It assigns unique UIDs to WebSphere Application Server OEM Edition for z/OS, and you do not receive any additional prompts if you accept it. If you enter **N**, you receive additional UID prompts.You must reply with **Y** or **N.** In our Example 2-18, we accept AUTOGID option.

Example 2-18 UID and GID prompt for AUTOGID option

```
BBN0511I:Using AUTOUID will help avoid UID collisions with existing installations
of WAS, but SHARED.IDS and BPX.NEXT.USER must be defined. Would you like to allow
OS security to automatically assign unique UIDs for you with AUTOUID? (Y/N)
 ===> Y

   * Your response was Y
```

Hostname prompt

The following prompt asks for TCP/IP network name for the TCP/IP stack within the z/OS Operating System on which WebSphere Application Server OEM Edition for z/OS is configured. The override response file sets this variable to @HOSTNAME. Therefore, the scripts do a hostname lookup on the system during the configuration process and it provides your hostname to accept it. As shown in Example 2-19, our specific DNS hostname is WTSC70.ITSO.IBM.COM.

Example 2-19 Specify DNS hostname

```
BBN0096I:Enter the DNS hostname for TCP/IP, or press return to accept
(WTSC70.ITSO.IBM.COM):

===> WTSC70.ITSO.IBM.COM
```

Port information and selection messages

The following block of messages list all ports required to complete WebSphere Application Server OEM customization. If you plan to accept the default port values as in Example 2-20, make sure that the default ports (starting 32200) are not used. If the default range of ports is already in use, then specify the new port and additional 15 consecutive ports will be assigned accordingly.

Example 2-20 TCP/IP port assignment

```
Port Selections.
A total of 15 free ports are needed for your configuration.

Review the following options before making your selection.

 * Use the values from your response file.
 * Automatically generate 15 ports using a base number. This process will select
the next 15 free ports from the provided base

Here are the port values currently defined for your configuration

 Location Service Daemon port ............ (32200)
 Location Service Daemon SSL port ........ (32201)
 JMX SOAP connector port ................. (32202)
 JMX SOAP connector port ................. (32202)
 ORB port ................................ (32203)
 ORB SSL port ............................ (32204)
 HTTP transport port ..................... (32207)
 HTTPS transport port .................... (32208)
 Administrative interprocess communication port ....... (32209)
 High Availability Manager Communications port ........ (32210)
 Service Integration port ............................. (32211)
 Service Integration Secure port ...................... (32212)
 Service Integration MQ Interoperability port ......... (32213)
 Service Integration MQ Interoperability Secure port .. (32214)
 Session Initiation Protocol (SIP) port ............... (32215)
 Session Initiation Protocol (SIP) secure port ........ (32216)

Simply press return to accept the values from your response file.
Or, enter a base port to automatically assign the 15 ports. For example, if you
enter 32200, 32200 and the next 14 free ports will be assigned. If 32200 is in use
then it will start at the next free port.

Make a selection:
 ===> 32600


   * Your response was 32600
Automatically assigning ports using 32600 as a base value.
```

System and data set names prompts

The next series of prompts give you the opportunity to specify system and data set names that are more appropriate for your environment.

The name for the target z/OS system on which you will be configuring WebSphere Application Server OEM Edition for z/OS is one of the input you need to provide. If you are not sure of the system name, issue the **D SYMBOLS** command from the OMVS shell on the target z/OS system. This command will display the system and sysplex name for that target z/OS system. However, if you do not provide a system name, the scripts do a sysname lookup on the system during the configuration process. In Example 2-21, the name of our z/OS system is SC70.

Example 2-21 Define System Name

```
BBN0099I:Select System and Data Set Names.
BBN0097I:Enter the system name, or press return to accept ........... (SC70):
 ===> SC70
accept default
```

The next required input is the sysplex name for the target z/OS system on which you will be configuring WebSphere Application Server OEM Edition for z/OS. If you are not sure of the sysplex name, issue the D SYMBOLS command from the OMVS shell on the target z/OS system. This command will display the system and sysplex name for that target z/OS system. Same as in the previous example for system name, if you do not provide a system name, the scripts do a sysplex name lookup on the system during the configuration process. In Example 2-22, the name of our z/OS system is SC70.

Example 2-22 Define Sysplex Name

```
BBN0098I:Enter the sysplex name, or press return to accept .......... (SNDBOX):

===> SNDBOX

accept default
```

The following message prompts you to provide the PROCLIB PDS name of an existing procedure library to which the WebSphere Application Server OEM Edition for z/OS cataloged procedures will be added. The user ID that runs the **WASOEM.sh - create** script must have permission to update this PROCLIB PDS. In our Example 2-23, we change the HLQ to WASOEM.

Note: Allocate manually WASOEM.V7R0.TPCRSC70.PROCLIB and then continue by pressing Enter.

Example 2-23 Define PROCLIB PDS name

```
BBN0113I:Enter the name of a cataloged PROCLIB PDS into which to copy the started
task procs, or press return to accept (BBN.V7R0.CONFIG1.PROCLIB):
WASOEM.V7R0.CONFIG1.PROCLIB
   * Your response was WASOEM.V7R0.CONFIG1.PROCLIB

Press enter if done with this section, or enter an N if not.
 ===>
```

WASOEM.sh -config completion information messages

The following series of messages in Example 2-24 indicate that the **WASOEM.sh -config** process has completed. This processing created three security customization jobs, which are part of Stage 2 customization.

These messages include important information about the authority level requirements for running the security jobs. They also indicate the RACF profiles that are required if you are having UID and GID values automatically assigned and did not specify a base value.

Example 2-24   Completion information messages

```
BBN0122I:Invoking /usr/lpp/zWebSphereOEM/V7R0/bin/zpmt.sh -workspace
/tmp/zWebSphereOEM/V7R0/zpmt/work -transfer -responseFile
/etc/zWebSphereOEM/V7R0/conf/zWebSphereOEM/V7R0/conf/CONFIG1/CONFIG1.responseFile
BBN0007I:Wait ...
 ===>
> Customization definition successfully written to
/etc/zWebSphereOEM/V7R0/conf/CONFIG1/zpmt
Copying CNTL files to WASOEM.V7R0.TPCRSC70.ZPMTJOBS.CNTL...
Copy successful.
Copying DATA files to WASOEM.V7R0.TPCRSC70.ZPMTJOBS.DATA...
Copy successful.

BBN0143I:Success: customization jobs have been created successfully.
 ===>

BBN0144I:Submit the following jobs before running WASOEM.sh -create
BBN0225I:First, submit WASOEM.V7R0.TPCRSC70.ZPMTJOBS.CNTL(BBOSBRAK) - Make sure
that you select BBOSBRAK.

BBN0236I:After WASOEM.V7R0.TPCRSC70.ZPMTJOBS.CNTL(BBOSBRAK) completes, submit the
following.
BBN0226I: WASOEM.V7R0.TPCRSC70.ZPMTJOBS.CNTL(BBOSBRAM)
BBN0227I: WASOEM.V7R0.TPCRSC70.ZPMTJOBS.CNTL(BBOCBRAK)

BBN0500I:NOTE:
BBN0501I:RACF SPECIAL authority is required for the user that submits the BBOSBRAK
and BBOCBRAK jobs.

BBN0502I:Additionally, the user that submits the BBOSBRAM job must EITHER be uid=0
or have the following authority:

BBN0503I:CONTROL access to SUPERUSER.FILESYS
BBN0504I:READ    access to SUPERUSER.FILESYS.CHOWN
BBN0505I:READ    access to SUPERUSER.FILESYS.CHANGEPERMS


BBN0506I:Finally, if you opted to have UID or GID values automatically assigned
and did not specify a base value:
BBN0507I: - The RACF profile SHARED.IDS must be defined.
BBN0508I: - The RACF profile BPX.NEXT.USER must be defined and used to indicate
the ranges from which UID and GID values are to be selected.

Run /usr/lpp/zWebSphereOEM/V7R0/bin/WASOEM.sh -create /etc/zWebSphereOEM/
V7R0/conf/CONFIG1

WASOEM.sh has completed

Check log file /var/zWebSphereOEM/V7R0/logs/WASOEM_070212_142053.log for more in
formation
```

In addition to the information that displays on the console, every time that you run the WASOEM.sh script, two log files are written to one of the directory you choose after the WASOEM.sh script is started for the first time (see Example 2-7 on page 26). The name of this log file displays on the console when you run the script file as shown in Example 2-24.

Open the log file and scroll down to the end of the log. As shown in our Example 2-25, there is information about ports you specified during the installation, but more importantly, you can find the MVS commands used to start and stop WebSphere Application Server.

Example 2-25 Installation log file

```
The following ports have been set, ensure that they are added to the reserved port
list:
zDaemonPort                          32600
 zDaemonSslPort                       32601
 zSoapPort                            32602
 zOrbListenerPort                     32603
 zOrbListenerSslPort                  32604
 zHttpTransportPort                   32605
 zHttpTransportSslPort                32606
 zAdminLocalPort                      32607
 zHighAvailManagerPort                32608
 zServiceIntegrationPort              32609
 zServiceIntegrationSecurePort        32610
 zServiceIntegrationMqPort            32611
 zServiceIntegrationSecureMqPort      32612
 zSessionInitiationPort               32613
 zSessionInitiationSecurePort         32614
BBN0152I:To start the application server, issue the MVS command:
BBN0153I:START BBN7ACR,JOBNAME=BBNS001,ENV=BBNBASE.BBNNODE.BBNS001
BBN0154I:To stop the application server, enter the MVS command:
BBN0155I:STOP BBN7ACRS
BBN0148I:WASOEM.sh has completed
```

2.2.2 Stage 2: Security setup

During **WASOEM.sh -config** processing, three security customization jobs, which contain UID, GID, and RACF definitions and setup, are created and written to a partitioned data set. These jobs are specific to the instance being configured, and contain information gathered during the configuration stage. These jobs are placed in a data set whose high level qualifier (HLQ) is gathered as part of the prompt interaction and ends with the qualifier CNTL.

You must run these customization jobs in the indicated order, using a user ID that has RACF special authority to run these jobs, and file system update authority, which is required by the BBOSBRAM job. Whenever file system update authority is indicated for one of these jobs, the user ID that you use to run that job must have either uid = 0, or the following UNIXPRIV class profile privileges:

- CONTROL access to SUPERUSER.FILESYS
- UPDATE access to SUPERUSER.FILESYS.MOUNT
- READ access to SUPERUSER.FILESYS.CHOWN
- READ access to SUPERUSER.FILESYS.CHANGEPERMS
- READ access to SUPERUSER.FILESYS.PFSCTL

You should have your RACF administrator review these jobs before you submit them.

As indicated in Example 2-24 on page 33, the security jobs were copied in WASOEM.V7R0.TPCRSC70.ZPMTJOBS.CNTL and should be run in the following order:

1. BBOSBRAK
2. BBOSBRAM
3. BBOCBRAK

Note: After each job completes, carefully check the output. Errors might exist even if all of the Return codes are zero.

The BBOSBRAK security job

This job creates the following common IBM WebSphere Application Server OEM groups, and user IDs (see Table 2-1).

Table 2-1 IBM WebSphere Application Server OEM groups and user IDs

Type	Group/User ID	GID/UID
Administrator user ID	WOEMADM	uid 2403
Control user ID	WSCRU1	uid 2431
Servant user ID	WSSRU1	uid 2432
Configuration group	WSCFG1	gid 2500
Servant group	WSSR1	gid 2501
Local user group	WSCLGP	gid 2502

If these group and user IDs have already been created during a previous IBM WebSphere Application Server OEM configuration, and are in all target system RACF databases, you do not have to run this job.

Note: This job creates the administrator ID (zAdminUserid) without a password, or password phrase. You must assign this user ID a password, or password phrase that complies with your standards.

If you are using a different security system, make sure that the administrator ID has a password, or password phrase.

Enter the following RACF command to assign a password:

```
ALTUSER WOEMADM PASSWORD(password) NOEXPIRED
```

To use RACF password phrase support, your target system must be running z/OS Version 1.9 or higher. Enter the following RACF command to assign a password phrase:

```
ALTUSER WOEMADM PHRASE('password phrase') NOEXPIRED
```

If you receive error messages from this job, such as messages that indicate that the user is invalid because a user ID, group, or profile is already defined, make sure that the existing user ID, group, or profile has the same characteristics as the user ID, group, or profile that the BBOSBRAK job is creating. If these characteristics are not the same, use the Profile Management Tool to change the values that are causing the conflict, and then upload the updated customization jobs, and restart the process.

When this job completes, all groups and user IDs listed in the previous table for job BBOSBRAK are defined in the RACF database on each target system for the cell.

Before proceeding with submitting the next security job, verify that the IBM WebSphere Application Server OEM administrator user ID has the configuration group WSCFG1 as its default OMVS group.

The BBOSBRAM security job

Running this job creates the following home directories for IBM WebSphere Application Server OEM Edition for z/OS. All of these home directories are subdirectories of /var/WebSphereOEM/home, which has permission bits 755. If the following directories already exist with the specified ownership, and permission on a target system, you do not have to run this job on that system:

- /var/WebSphereOEM/home/WSCFG1 with ownership WSCRU1:WSCFG1, and permission bits 770
- /var/WebSphereOEM/home/WSSR1 with ownership WSCRU1:WSSR1, and permission bits 770
- /var/WebSphereOEM/home/WSCFGP with ownership WSCRU1:WSCLGP, and permission bits 770

In our Example 2-26, we show the messages in the BBOSBRAM security job output when the foregoing specified directories already exist.

Example 2-26 BBOSBRAM security job output

```
This EXEC completed with Return Code 0

Created the following directories:
==================================
None. No directories were created.

Following directories already exist:
====================================
/var/
/var/zWebSphereOEM/
/var/zWebSphereOEM/V7R0/
/var/zWebSphereOEM/V7R0/home/
/var/zWebSphereOEM/V7R0/home/WSCFG1/
/var/zWebSphereOEM/V7R0/home/WSSR1/
/var/zWebSphereOEM/V7R0/home/WSCLGP/

Problems creating the following directories:
============================================
No problems while creating the directories.

End of EXEC.
```

After this job finishes, verify that the directories exist on each system and have the correct permissions.

The BBOCBRAK security job

Running this job creates the RACF users and profiles listed in Table 2-2. They are required by the IBM WebSphere Application Server OEM Edition for z/OS node. Carefully review these definitions with your RACF security administrator.

Table 2-2 RACF users and profiles required by the IBM WebSphere Application Server OEM node

Type	User ID	UID
Asynch admin user ID	WSADMSH	uid 2504
Unauthenticated user ID	WSGUEST	uid 2402

If you receive error messages from this job, such as messages that indicate that the user is invalid because a user ID, group, or profile is already defined, make sure that the existing user ID, group, or profile has the same characteristics as the user ID, group, or profile that the BBOCBRAK job is creating.

When this job completes, all user IDs listed in the previous table for job BBOCBRAK should be defined in the RACF database on each target system for the cell.

2.2.3 Stage 3: Server instance creation

In this stage, you create an IBM WebSphere Application Server instance by using the **WASOEM.sh** script with the **-create** parameter. The WASOEM.sh script uses the response file, which was created in the configuration stage, to create your new IBM WebSphere Application Server OEM Edition for z/OS server instance, which is going to be used for Tivoli Storage Productivity Center for Replication.

Invoke OMVS and go to the following directory:

/usr/lpp/zWebSphereOEM/V7R0/bin

In order to create the IBM WebSphere Application Server OEM server instance, issue the command as shown in Example 2-27. In our example, we use the default configuration name, CONFIG1. Specify your WebSphere Application Server OEM working directory and wait for further messages.

Example 2-27 Create IBM WebSphere Application Server OEM server instance

```
WASOEM.sh -create CONFIG1

BBN0094I:Enter a filesystem location under which
the WebSphere Application Server OEM working directories will be located, or press
return to accept (/etc):
 ===> /etc/zWebSphereOEM/V7R0/conf/CONFIG1
```

When this step completes, a series of messages, similar to the messages displayed in our Example 2-28 will appear.

Example 2-28 IBM WebSphere Application Server OEM server instance created

```
BBN2006I:Exiting updateConfigWASOEM.py ownership of files...updating
BBN0016I:Success: Update of configuration completed.

The following ports have been set, ensure that they are added to the reserved port
list:

 zDaemonPort                           32600
 zDaemonSslPort                        32601
 zSoapPort                             32602
 zOrbListenerPort                      32603
 zOrbListenerSslPort                   32604
 zOrbListenerSslPort                   32604
 zHttpTransportPort                    32605
 zHttpTransportSslPort                 32606
 zAdminLocalPort                       32607
 zHighAvailManagerPort                 32608
 zServiceIntegrationPort               32609
 zServiceIntegrationSecurePort         32610
 zServiceIntegrationMqPort             32611
 zServiceIntegrationSecureMqPort       32612
 zSessionInitiationPort                32613
 zSessionInitiationSecurePort          32614

To start the application server, issue the MVS command:
START BBN7ACR,JOBNAME=BBNS001,ENV=BBNBASE.BBNNODE.BBNS001

To stop the application server, enter the MVS command:
STOP BBN7ACRS

WASOEM.sh has completed
Check log file /var/zWebSphereOEM/V7R0/logs/WASOEM_070212_192359.log for more
information
```

Keep a record of the start command that is specified in this group of messages at the end. You are now ready to issue this command to start the IBM WebSphere Application Server OEM server instance you installed.

3

Tivoli Storage Productivity Center for Replication installation on z/OS

In this chapter, we explain the necessary activities to successfully deploy Tivoli Storage Productivity Center for Replication within your environment.

This chapter covers the requirements for installing Tivoli Storage for Replication on System z, including these areas:

- Hardware and software requirements
- How to connect Tivoli Storage Productivity Center for Replication servers to storage subsystems
- Tivoli Storage Productivity Center for Replication licensing

Additional planning information and documents that provide information about how to plan for Tivoli Storage Productivity Center for Replication are listed in the bibliography under “Other publications” on page 555.

3.1 Hardware and software requirements

This section contains the hardware and software requirements for the Tivoli Storage Productivity Center for Replication V5.1 servers and subsystems. Note that the hardware and software requirements for the Tivoli Storage Productivity Center for Replication servers are the same for the back-up servers for a High Availability environment. Thus both the active and the standby servers need to meet all minimum requirements specified next.

3.1.1 Software requirements

On z/OS, two versions of Tivoli Storage Productivity Center for Replication are available.

Tivoli Storage Productivity Center for Replication for System z

- Operating system:
  - IBM z/OS V1.11 with APAR OA39124, APAR OA37632
  - IBM z/OS V1.12 with APAR OA39124, APAR OA37632
  - IBM z/OS V1.13 with APAR OA39124, APAR OA37632

> **Note:** APAR OA37632 is required for the new Basic HyperSwap and Metro Mirror functions.

- IBM SMP/E for z/OS V3.03.0, or later
- Any one of the following databases (if not using the EMBEDDED database):
  - IBM DB2 V9 for z/OS, or later
  - IBM DB2 V9 for z/OS Value Unit Edition, or later
- Any one of the following WebSphere Application Server editions:
  - IBM WebSphere Application Server for z/OS V7 or V8
  - IBM WebSphere Application Server OEM Edition for z/OS V7

> **Note:** IBM WebSphere Application Server is a prerequisite for Tivoli Storage Productivity for Replication Basic Edition for z/OS. If you currently have the supported version of IBM WebSphere Application Server, you may use it. If you do not, IBM WebSphere Application Server OEM Edition for z/OS V7.0 is shipped with Tivoli Storage Productivity for Replication for z/OS (including Tivoli Storage Productivity Center for Replication, Basic Edition), V5.1.

- z/OS Unix System Services (USS)
- TCP/IP connection to manage storage systems

Tivoli Storage Productivity Center for Replication Basic Edition for System z

- Operating system:
  - IBM z/OS V1.11 with APAR OA39124, APAR OA37632
  - IBM z/OS V1.12 with APAR OA39124, APAR OA37632
  - IBM z/OS V1.13 with APAR OA39124, APAR OA37632

> **Note:** APAR OA37632 is required for the new Basic HyperSwap and Metro Mirror functions.

- IBM SMP/E for z/OS V3.03.0, or later
- Any one of the following databases (if not using the EMBEDDED database):
  - IBM DB2 V9 for z/OS, or later
  - IBM DB2 V9 for z/OS Value Unit Edition, or later
- Any one of the following WebSphere Application Server editions:
  - IBM WebSphere Application Server for z/OS V7 or V8
  - IBM WebSphere Application Server OEM Edition for z/OS V7

Note: IBM WebSphere Application Server is a prerequisite for Tivoli Storage Productivity for Replication Basic Edition for z/OS. If you currently have the supported version of IBM WebSphere Application Server, you may use it. If you do not, IBM WebSphere Application Server OEM Edition for z/OS V7.0 is shipped with Tivoli Storage Productivity for Replication for z/OS (including Tivoli Storage Productivity Center for Replication Basic Edition), V5.1.

- z/OS Unix System Services (USS)
- TCP/IP connection to manage storage systems and Fixed Block volumes

3.1.2 Minimum hardware requirements

This section lists the minimum hardware requirements for Tivoli Storage Productivity Center for Replication for System z V5.1.

z/OS

- System z architecture CPU
- Minimum disk space requirement to run is documented in the *Program Directory for Tivoli Storage Productivity Center for Replication for System z, V5.1.0*, GI13-2228-00.

Systems storage hardware requirements

- IBM storage controller (ESS Model 800, DS6000, DS8000 family) with one of the following Advanced Copy features:
  - Metro Mirror: Synchronous data replication (required for Basic HyperSwap)
  - Global Mirror: Asynchronous data replication
  - Metro Global Mirror: Three-site replication
  - FlashCopy: Point in time copy
- System Storage DS8000 Hardware Management Console (HMC) V4.3 microcode or later

3.1.3 GUI Client software requirements

Tivoli Storage Productivity Center for Replication is accessed via web browsers. This section lists supported web browser and instructions for setting up Internet security.

Web browser requirements

The following Web browsers are supported by Tivoli Storage Productivity Center for Replication V5.1:

- Windows Internet Explorer Version 8, 9 or 10
- Mozilla Firefox Version ESR 10 or ESR 17

Internet security settings

Note that all connections between the server, clients, and hardware components are secured via Secure Sockets Layer (SSL) protocol. The default Internet Explorer security settings on Windows 2003 Server inhibit some GUI features from working properly. Therefore, if you run the Tivoli Storage Productivity Center for Replication GUI with Internet Explorer on Windows 2003 server, you need to lower your security settings.

To lower your Internet Explorer browser security settings, open your Internet Explorer browser and click **Tools** → **Internet Options**. Click the **Security** tab. On the security panel, click the **Custom Level** button and this will open the Security Settings panel. Then select **Low** in the reset custom settings drop-down menu and then click the **Reset** button (see Figure 3-1).

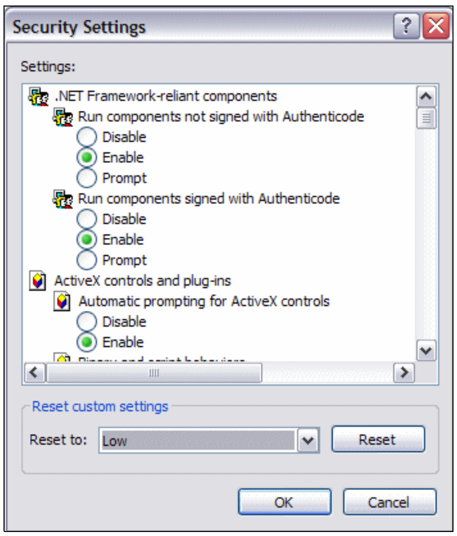

Figure 3-1 Resetting custom settings to Low

3.2 Connecting servers to storage subsystems

To manage data replication among storage systems using Tivoli Storage Productivity Center for Replication, you must manually add a connection to each storage system in the Tivoli Storage Productivity Center for Replication configuration. This allows you to omit storage systems for which Tivoli Storage Productivity Center for Replication is not to manage replication and omit storage systems that are being managed by another Tivoli Storage Productivity Center for Replication management server.

For redundancy, you can connect a single DS8000 storage system using a combination of direct (via TCP/IP), Hardware Management Console - HMC (via TCP/IP), and z/OS connections (via FICON). The following sections discuss this in more detail.

3.2.1 Physical planning and firewall considerations

Since Tivoli Storage Productivity Center for Replication communicates down an IP path, you must ensure that your Tivoli Storage Productivity Center for Replication Server has the necessary access to all required infrastructure.

If you will be running in a High Availability environment where you have Tivoli Storage Productivity Center for Replication installed on two servers with one server running in active mode and the second one in standby mode, make sure that both servers can communicate with each other and that they are authenticated through all firewalls. Remember that if the firewall times out on either server, it will require re-authentication to allow communication between servers.

Also ensure that your ICAT server is authenticated to enable communication with the Tivoli Storage Productivity Center for Replication server. The firewall may timeout and block communication, thus re-authentication is necessary to allow communication between servers.

3.2.2 TCP/IP ports used by Tivoli Storage Productivity Center for Replication

Tivoli Storage Productivity Center for Replication utilizes a range of ports to communicate with various aspects of the environment. You can find the port number in the WAS_HOME/profiles/ default/properties/portdef.props file on the Tivoli Storage Productivity Center for Replication for System z server.

3.2.3 Tivoli Storage Productivity Center for Replication Server layout for ESS 800 connectivity

With the Enterprise Storage Server, ESS 800, the communications between the ESS and the Tivoli Storage Productivity Center for Replication server installed on z/OS can be established via FICON channels (also called z/OS Connection in Tivoli Storage Productivity Center for Replication) or over TCP/IP as shown in Figure 3-2.

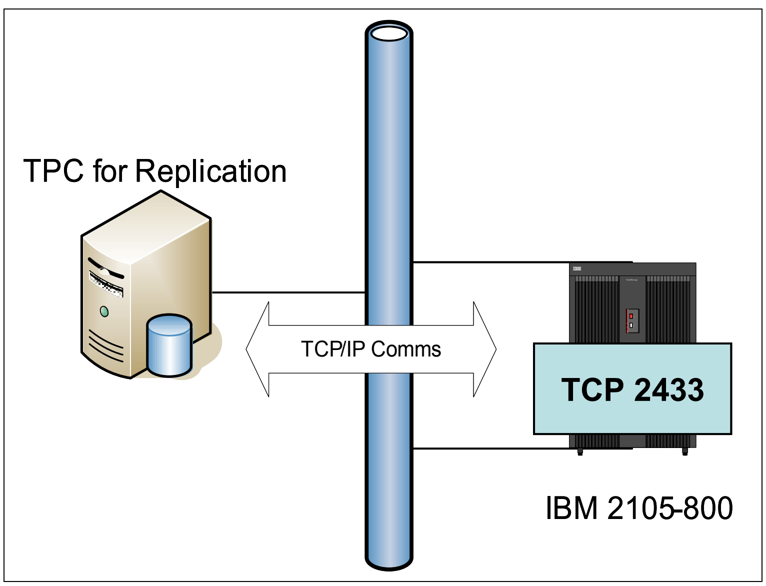

Figure 3-2 ESS communications

The ESS subsystem will have established IP connectivity as part of its deployment. Tivoli Storage Productivity Center for Replication needs access to the IP network to enable the two environments to communicate.

In Figure 3-3, we can again see the attachment schema.

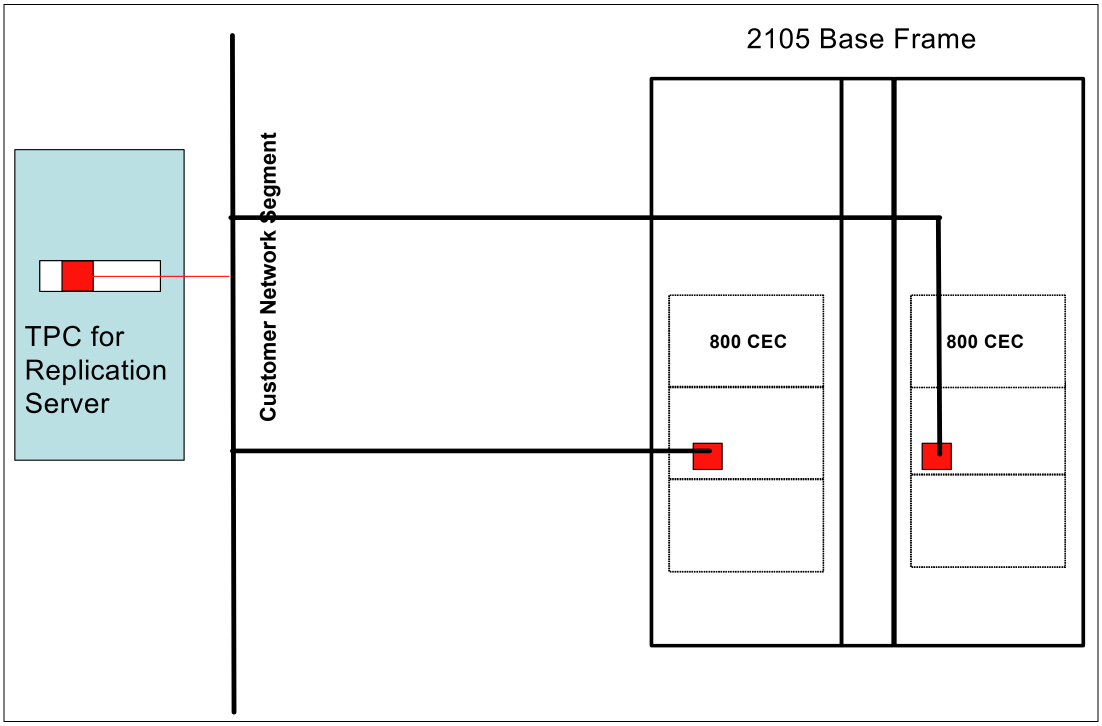

Figure 3-3 ESS connectivity

3.2.4 Tivoli Storage Productivity Center for Replication server layout for DS6000 connectivity

As with the ESS 800, the DS6000 subsystem needs IP connectivity as part of its deployment. As such, Tivoli Storage Productivity Center for Replication requires access to the IP network to enable the two environments to communicate with each other. Figure 3-4 displays the basic connectivity layout for Tivoli Storage Productivity Center for Replication server and shows how it connects to the DS6000.

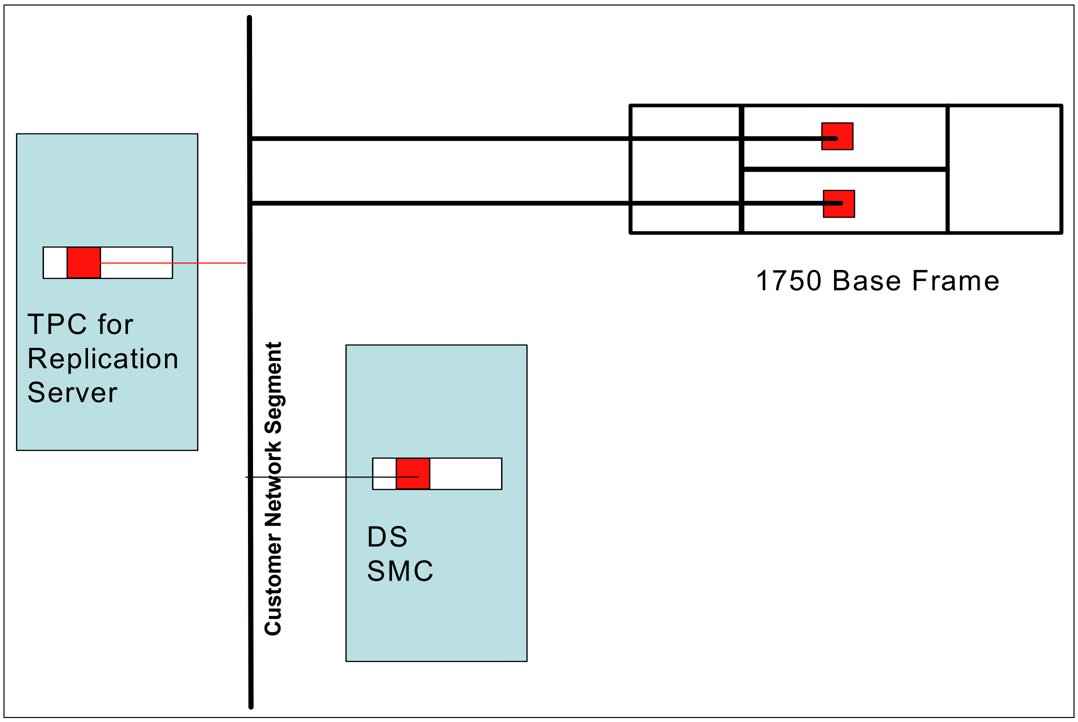

Figure 3-4 DS6000 connectivity

Note that Tivoli Storage Productivity Center for Replication does not connect to the SMC. The SMC, as an external server, does provide the interface to the DS6000, and through its software stack, it offers access to the DS6000 controllers through the GUI or the DSCLI. Both applications execute against the SMC.

As Figure 3-5 shows, this is different with Tivoli Storage Productivity Center for Replication and how the server connects to the DS6000. Tivoli Storage Productivity Center for Replication shares the same internal DS6000 network that the SMC already utilizes. But Tivoli Storage Productivity Center for Replication communicates directly to the DS6000 servers, which are server0 and server1, as shown in Figure 3-5.

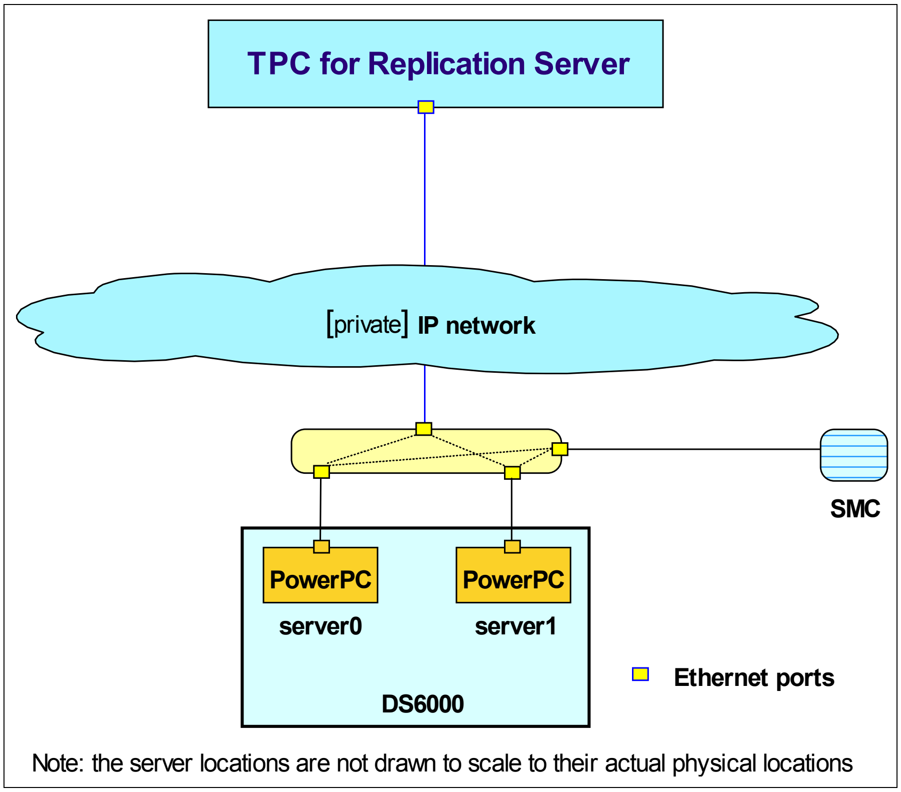

Figure 3-5 Tivoli Storage Productivity Center for Replication server connection to DS6000

After Tivoli Storage Productivity Center for Replication server connects to the DS6000 network, you need to define the storage server (here the DS6000) to the Tivoli Storage Productivity Center for Replication server.

3.2.5 Tivoli Storage Productivity Center for Replication server layout for DS8000 connectivity

There are three types of connectivity from a Tivoli Storage Productivity Center for Replication server installed on z/OS to a DS8000 storage system:

- Direct connection (using a dedicated Ethernet port on DS8000)
- Hardware Management Console (HMC) connection
- IBM z/OS connection

Direct connection

Direct connection between the Tivoli Storage Productivity Center for Replication server and the storage servers is based on particular Ethernet ports in the DS8000 internal controllers. This particular Ethernet card is available only on selected DS8000 models (921, 922, 931, and 932 with feature code 1801) and it slides into the first slot out of these four or five slots in the IBM System p® controllers in the rear of the DS8000 base frame, as Figure 3-6 shows.

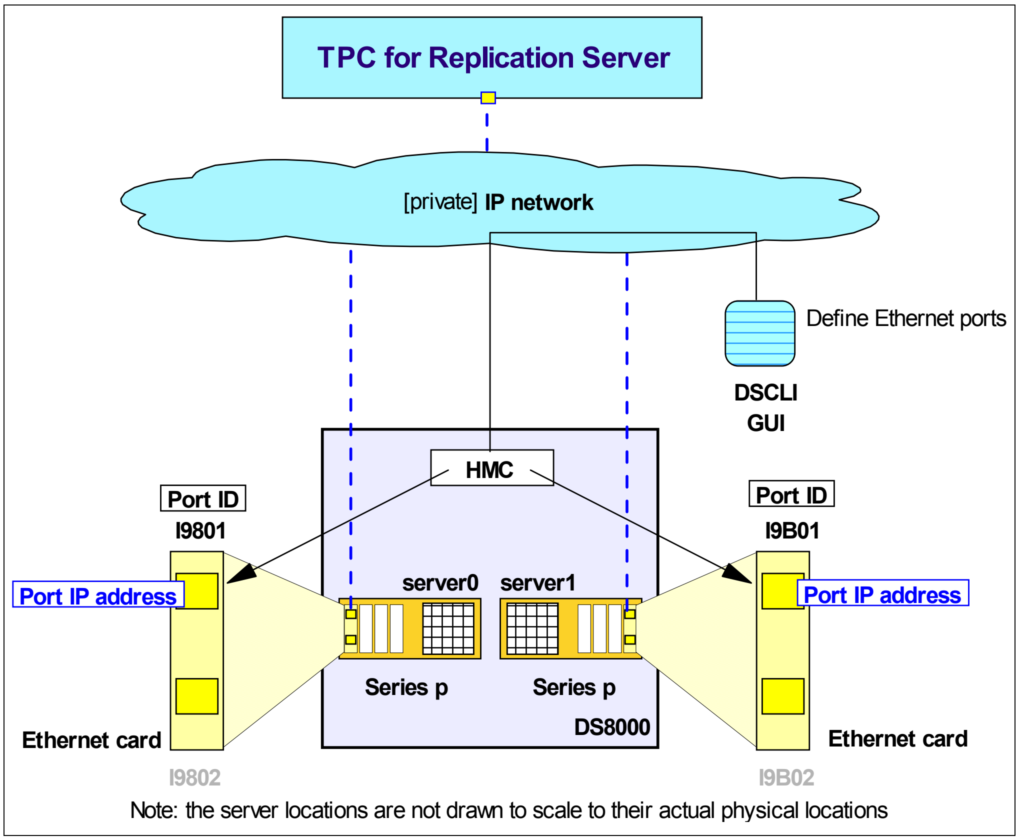

Figure 3-6   Direct connection via dedicated Ethernet ports on DS8000

The HMC is used to configure these new Ethernet ports. This is done either through the DSCLI or via the GUI. Note that this only assigns an IP address to the ports and also defines the internal DS8000 network of the DS8000 but does not actually connect the Tivoli Storage Productivity Center for Replication server to the ports.

Figure 3-6 shows that only the upper port in each Ethernet card is used and defined to which the Tivoli Storage Productivity Center for Replication server later connects and communicates directly to the DS8000 servers, server0 and server1.

Hardware Management Console (HMC) connection

HMC connection between Tivoli Storage Productivity Center for Replication server and DS8000 is available for newer DS8000 models (941 and 951 also known as DS8700 and DS8800). Each DS8000 HMC is connected to the client network. Therefore, Tivoli Storage Productivity Center for Replication has to be connected to the same client network as DS8000 HMC as shown in the diagram in Figure 3-7.

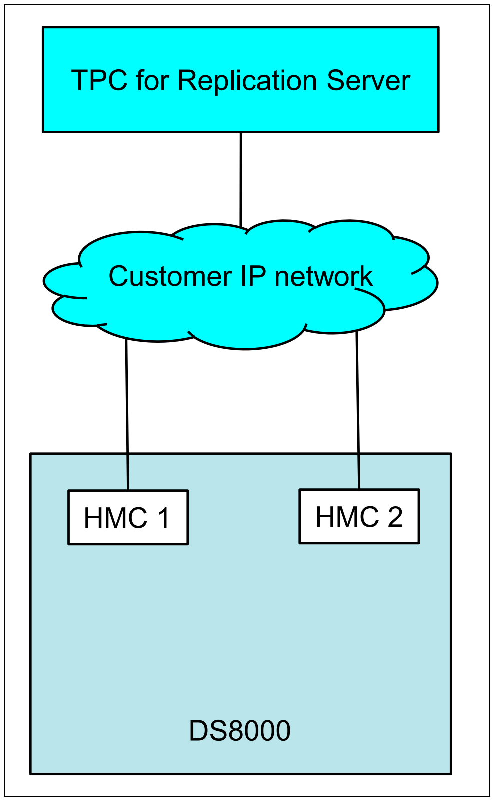

Figure 3-7 HMC connection

DS8000 HMC can have multiple DS8000 storage systems connected to it. When you add an HMC to the Tivoli Storage Productivity Center for Replication configuration, all DS8000 storage systems that are behind the HMC are also added. You cannot add or remove individual storage systems that are behind an HMC.

You can also add a dual-HMC configuration, in which you have two HMCs for redundancy (see Figure 3-7). You must configure both HMCs identically, including the user ID and password.

IBM z/OS connection

A Tivoli Storage Productivity Center for Replication management server that runs on z/OS can connect to DS8000 through a z/OS connection. The z/OS connection is used to issue replication commands and queries for attached ECKD volumes over an existing FICON network and to receive asynchronous events. When a storage system is added to Tivoli Storage Productivity Center for Replication through the z/OS connection, all ECKD volumes that are attached to the Tivoli Storage Productivity Center for Replication management system are added to the Tivoli Storage Productivity Center for Replication configuration. ECKD volumes that are not attached to the Tivoli Storage Productivity Center for Replication z/OS management server are not added to the Tivoli Storage Productivity Center for Replication configuration through the z/OS connection.

For more information on how to define DS8000 connection to the Tivoli Storage Productivity Center for Replication server, see 4.1.3, “Preparing the IBM DS8000” on page 129.

3.3 Pre-installation steps

Before you begin the installation of Tivoli Storage Productivity Center for Replication, ensure that the system environment is set correctly and install the prerequisite applications. Complete the following steps to ensure that your system environment is ready:

- Ensure that your Tivoli Storage Productivity Center for Replication servers meet all minimum hardware and software requirements as described in “Hardware and software requirements” on page 40.
- When you enable IBM WebSphere Application Server security, ensure that a WebSphere administrator user ID or group is defined in the IBM Resource Access Control Facility (RACF) security program on the target system.
- Ensure that your storage devices have the advanced copy feature codes and licenses installed.

You are now ready to install DB2 and Tivoli Storage Productivity Center for Replication.

3.4 Tivoli Storage Productivity Center for Replication database repositories

Tivoli Storage Productivity Center for Replication uses a database as a repository where all information about storage and copy services configuration is stored. There are two methods available to install Tivoli Storage Productivity Center for Replication:

- Tivoli Storage Productivity Center for Replication using DB2 subsystem
- Tivoli Storage Productivity Center for Replication using Apache Derby database

DB2 subsystem as a Tivoli Storage Productivity Center for Replication database repository can be optionally used if it is already installed on your z/OS system. Otherwise Apache Derby database, which is embedded in the WebSphere Application Server, might be an option. However, with DB2 installed on your system, you can still use an embedded Apache Derby database since the installation is much simpler and there is no need for any maintenance (that is, backup, reorg).

In the following section, we guide you through step-by-step procedures for both DB2 and Apache Derby installations.

Tivoli Storage Productivity Center for Replication using DB2 as a database repository requires additional batch jobs to be run in order to create all database objects. In addition, it requires DB2 and WebSphere customization through the WebSphere Administration Console.

The Apache Derby database will be created automatically after the Tivoli Storage Productivity Center for Replication installation is initiated through WebSphere.

3.5 Installing Tivoli Storage Productivity Center for Replication using embedded Derby database

In this topic, we explain how to configure Tivoli Storage Productivity Center for Replication for System z V5.1 with the IBM WebSphere Application Server OEM and Apache Derby support.

WebSphere Application Server OEM is an alternative to WebSphere full edition. It provides a native Web services runtime environment for select system-level applications that run on z/OS and are provided at no charge.

You have to perform the SMP/E installation of Tivoli Storage Productivity Center for Replication by following the directions in the Program Directory that comes with the product. After you complete the SMP/E installation, you can follow the steps that we describe in this topic to do the post installation tasks.

3.5.1 Configuring Derby (zero-administration database)

If you do not already have DB2 for z/OS in your environment, an embedded Derby database is used for Tivoli Storage Productivity Center for Replication.

Derby, also referred to as an embedded database or zero-administration database, creates internal tables and requires less post-installation and configuration maintenance. If you are using the Derby configuration, complete the steps described in "Starting Tivoli Storage Productivity Center for Replication installation with IWNINSTL job".

You might want to set appropriate permissions for the embedded database. WebSphere Application Server OEM allocates a message file on the directory where the embedded database resides. To set this permission bits issue the z/OS Unix System Services **`chmod`** command to set the appropriate permissions for the Derby directory.

For example, if you used the default directories to perform the installation and customization of WebSphere Application Server OEM and Tivoli Storage Productivity Center for Replication, you can use the following command to change the permission bits for the directory:

```
chmod -R 775 /zWebShereOEM/V7R0/config1/AppServer/profiles/default/database/
```

3.5.2 Starting Tivoli Storage Productivity Center for Replication installation with IWNINSTL job

The IWNINSTL job sets up the data source, applications, security, Java Virtual Machine, and libraries in the WebSphere Application Server OEM. It also points the properties files to the correct locations on your machine.

Copy IWNINSTL from the hlq.SAMPLIB where it was installed to your JCL library. Edit it following the notes contained in the member and submit the job.

Note: Remember that the WebSphere Application Server values are CASE SENSITIVE!

Following are some tips with regard to the variables used in the IWNINSTL JCL stream:

1. Substitute the JOB card for a JOB card that is valid for your z/OS. Ensure that it specifies REGION=0M.
2. Ensure that WebSphere Application Server OEM is running. We are going to use Derby, so we do not need DB2.
3. Change the -PathPrefix- string to the appropriate high level directory name. The -PathPrefix- string must match the specification for -PathPrefix- string in the BBAISMKD job that was run during the SMP/E install of WebSphere Application Server OEM. If you did not specify -PathPrefix- during the SMP/E install, simply remove all references to it in this JCL.
4. Match the USS path for your installation of WebSphere Application Server OEM:
   a. WAS_HOME should be the install root of WebSphere Application Server OEM. The following is a default WebSphere Application Server OEM home directory:

      `/zWebSphereOEM/V7R0/config1/AppServer`

   b. JAVA_HOME Java home directory, often uses the same path as WAS_HOME, with directory `java` appended at the end:

      `/zWebSphereOEM/V7R0/config1/AppServer/java`

5. Replace the following values:
   a. WAS_USER should be the WebSphere Application Server OEM administrator userid.
   b. WAS_PASSWD is the password for that userid.
   c. WAS_GROUP can be found in WebSphere Application Server OEM response file. Look for `zServantGroup` value.
      Default is `WSSR1`.
   d. WAS_SERVER can be found in WebSphere Application Server OEM response file. Look for `serverName` value.
      Default is `server1`.
   e. WAS_NODE can be found in WebSphere Application Server OEM response file. Look for `nodeName` value.
      Default is `bbnnode`.
   f. WAS_CELL can be found in WebSphere Application Server OEM response file. Look for `cellName` value.
      Default is `bbnbase`.
6. DB_TYPE specification is *EMBEDDED*, as we are going to use the embedded Apache Derby database.
7. The #was_servant_user in the RACF **`PERMIT ANT.REPLICATIONMANAGER`** can be found in WebSphere Application Server OEM response file. Look for `zServantUserid` value. Default is `WSSRU1`.
8. You can browse files install_RM.log and install_RM_err.log to monitor the install progress and look for any errors that may occur. These files are pointed by DDNAMEs STDOUT and STDERR in the IWNINSTL job stream.

Example 3-1 is an example of IWNINSTL JCL, as we run in our system. The text in bold are variables we used as appropriate for our system.

Example 3-1 IWNINSTL job

```
//IWNINSTL  JOB (999,POK),'TPC-R 5.1.0',CLASS=A,REGION=0M,
//         MSGCLASS=T,NOTIFY=&SYSUID,MSGLEVEL=(1,1)
/*JOBPARM L=999,SYSAFF=SC70
//IWNINSTL EXEC PGM=BPXBATCH
//STDOUT DD PATH='/etc/install_RM510.log',
//       PATHOPTS=(OCREAT,OTRUNC,OWRONLY),
//       PATHMODE=(SIRWXU),
//       PATHDISP=KEEP
//STDERR DD PATH='/etc/install_RM510_err.log',
//       PATHOPTS=(OCREAT,OTRUNC,OWRONLY),
//       PATHMODE=(SIRWXU),
//       PATHDISP=KEEP
//STDPARM DD *
SH
/usr/lpp/Tivoli/RM/scripts/installRM.sh
//STDENV DD *
CLASSPATH=/usr/lpp/Tivoli/RM/scripts
WAS_HOME=/zWebSphereOEM/V7R0/tpcr510/AppServer
WAS_USER=WOEMADM
WAS_PASSWD=woemadm
WAS_GROUP=WSSR1
WAS_SERVER=server1
WAS_NODE=TPCNODE
WAS_CELL=TPCBASE
JAVA_HOME=/zWebSphereOEM/V7R0/tpcr510/AppServer/java
TPCR_InstallRoot=/usr/lpp/Tivoli/RM
TPCR_ProductionRoot=/var/Tivoli/RM
DB_TYPE=EMBEDDED
/*
//ANTRAC  EXEC PGM=IKJEFT01
//SYSLBC   DD DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSPRT DD SYSOUT=*
//SYSTSIN  DD *
RDEFINE FACILITY ANT.REPLICATIONMANAGER UACC(NONE)
PERMIT ANT.REPLICATIONMANAGER CLASS(FACILITY)+
    ID(WSSRU1) ACCESS(CONTROL)
SETROPTS RACLIST(FACILITY) REFRESH
/*
```

This job needs to complete with a return code 0. You must check allocation messages to verify that the data sets are allocated and cataloged as expected.

Error logs

After you submit the job, it should take several minutes to complete. Installation progress can be monitored from USS by browsing the installation logs located at the path defined in STDOUT and STDERR. In our Example 3-1 on page 52, the following installation logs were created:

- /etc/install_RM510.log
- /etc/install_RM510_err.log

Check these logs in order to ensure successful completion of the installation. There is a message at the end of the *install_RM.log* in our Example 3-2, indicating that installation completed successfully and without errors.

Example 3-2 The end of the install_RM.log

```
DONE CONFIGURING NATIVE LIBRARIES

The following Library objects are configured:
-------------------------------------------------------------------
JWLLib(cells/cl6641/nodes/nd6641/servers/ws6641|libraries.xml#Library_1189600722
RMSharedLibraries(cells/cl6641/nodes/nd6641/servers/ws6641|libraries.xml#Library

Done installing applications



Done.
******************************** Bottom of Data ********************************
```

Note: After *IWNINSTL job* successful ran you need to take the following steps:

1. Edit the csmConnections.properties file located in the `/zWebSphereOEM/V7R0/config1/AppServer/profiles/default/properties/` directory.
2. Change localhost to the IP address or hostname of the machine and port number; in our case, we used:
   - server=**WTSC64.ITSO.IBM.COM**
   - port=**5110**
3. Restart the GUI so that it can connect to the local machine.
4. Configure the CLI configuration file `/var/Tivoli/RM/CLI/repcli.properties` to point to the IP address or hostname instead of the local-host that it defaults to.

3.5.3 Logging on to Tivoli Storage Productivity Center for Replication server

After you get confirmation about a successful Tivoli Storage Productivity Center for Replication installation, you can now log on to Tivoli Storage Productivity Center for Replication by pointing your browser to this URL:

```
https://<HostName>:port/CSM/
```

Host name and port number were specified during the WebSphere Application Server OEM installation and these values can be found in WebSphere Application Server OEM response file. Just look for these names:

- hostName
- zHttpTransportSslPort

Following is the Tivoli Storage Productivity Center for Replication URL for our system:

```
https://wtsc64.itso.ibm.com:32408/CSM/
```

The Tivoli Storage Productivity Center for Replication logon panel appears as shown in Figure 3-8.

Figure 3-8 Tivoli Storage Productivity Center for Replication logon panel

If you get an `Unable to connect to the server` message when trying to log on to Tivoli Storage Productivity Center for Replication, check for the following possibilities:

- Check if the port number you typed matches the zHttpTransportSslPort during WebSphere Application Server OEM installation.
- Check for `ICH408I` RACF messages on the WebSphere Application Server OEM servant address space job log.

3.6 Installing Tivoli Storage Productivity Center for Replication using DB2

After you have successfully allocated HFS or zFS Paths and you have run the SMP/E RECEIVE, APPLY, and ACCEPT jobs, you can start the post-installation procedures in the following sequence:

1. Preparing and configuring DB2 on z/OS
2. Running DB2 installation jobs
3. Tivoli Storage Productivity Center for Replication installation and setup under WebSphere
4. Customizing DB2 and WebSphere on z/OS

Ensure that DB2 and WebSphere subsystems are up and running before you start Tivoli Storage Productivity Center for Replication installation. Also you need to have Distributed Data Facility (DDF) installed and configured.

3.6.1 Preparing and configuring DB2

This topic presents the steps to configure DB2 for your installation of Tivoli Storage Productivity Center for Replication for z/OS.

Before you start the preparation and configuration described in this section, review with your DB2 data base administrator (DBA) all libraries, programs, paths, commands, IDs, and passwords required and listed in this section.

Configuring DB2 in your z/OS environment requires that you run post-configuration sample jobs. These jobs reside in HLQ.ASAMPLIB (where HLQ is the high level qualifier that you have specified), and are described in Table 3-1 on page 59. These jobs execute SQL statements to create and configure the necessary data schema for Tivoli Storage Productivity Center for Replication.

Pre-installation tasks

Before you start the installation, complete the following tasks:

1. Create the image copies of the DB2 directory and catalog using the DSNTIJIC sample job provided with DB2.
2. Ensure that you have created a database plan and that a storage group exists. By default, the storage group is *SYSDEFLT*.

   You can use SYSDEFLT or create your own storage group. Be sure that this storage group has sufficient space and, if possible, mount it on a separate volume.

   In order to find out what is the name of the existing DB2 storage group, issue the following SQL command via SPUFI:

   SELECT * FROM SYSIBM.SYSSTOGROUP;

   Or you can do this by using JCL as shown in Example 3-3.

   Example 3-3 Executing SQL commands using DSNTEP2

```
//MLTPCR21 JOB (999,POK),'TPC-R 340',CLASS=A,MSGLEVEL=(1,1),
// MSGCLASS=T,NOTIFY=&SYSUID,REGION=0M,TIME=NOLIMIT
/*JOBPARM L=999,SYSAFF=SC74
//DSNTIST EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB DD DSN=DB9D9.SDSNLOAD,DISP=SHR
//SYSTSPRT DD SYSOUT=*
//SYSPRINT DD SYSOUT=*
//SYSUDUMP DD SYSOUT=*
//SYSTSIN DD *
 DSN SYSTEM(DB8Y)
 RUN PROGRAM(DSNTEP2) -
     PLAN(DSNTEP81) -
     LIB('DB8YU.RUNLIB.LOAD')
//SYSIN DD *
SELECT * FROM SYSIBM.SYSSTOGROUP;
```

   Note: The job must return a JCL return code of 0.

3. Ensure that the Tivoli Storage Productivity Center for Replication administrative ID that you are going to use has DB2 SYSADM authority. This ID should also have authority to access the WebSphere Administration Server Console to set up a JDBC data source. In our installation, we use the following SQL command:

   GRANT SYSADM TO *your_DB2_ID*;

Note: ***your_DB2_ID*** is the WebSpere administrator user ID used to connect to the target DB2 subsystem

The SQL command can be issued from SPUFI or using JCL similar to Example 3-3.

Note: The job must return a JCL return code of 0. All SQL Codes returned have to be 000.

4. Bind your DB2 instance to the TCP/IP server with the JDBC bind utility provided with DB2.

   There are two ways to bind the JCC drivers. Run the supplied batch job using the AOPBATCH utility (see Example 3-4), or complete the following steps which require Unix System Services (USS) access:

   – Update your CLASSPATH and PATH (you will need to make sure that you have the correct CLASSPATH and PATH settings to run the JCC Binder).

```
PATH=/usr/lpp/Printsrv/bin:/bin
PATH=/usr/lpp/java/J6.0/bin:$PATH
PATH=/pp/db2v9/D100722/db2910_jdbc/bin:$PATH
EXPORT PATH

CLASSPATH=/pp/db2v9/D100722/db2910_jdbc/classes/db2jcc_license_cisuz.jar
CLASSPATH=/pp/db2v9/D100722/db2910_jdbc/classes/db2jcc.jar:$CLASSPATH
CLASSPATH=/usr/lpp/Printsrv/classes:$CLASSPATH
EXPORT CLASSPATH
```

   – Invoke the JDBC bind from the command line

```
java com.ibm.db2.jcc.DB2Binder \
-url jdbc:db2://wtsc70.itso.ibm.com:38320/DB9C \
-user WOEMADM \
-password woemadm \
-collection NULLID
```

   In our environment, we use the following settings:

   – `wtsc70.itso.ibm.com` as WebSphere server path

   – `38320` as the DB2 port number

   – `DB9C` as the DB2 subsystem

   – `WOEMADM` as the WebSphere user ID used to connect to the target DB2 subsystem. It must have bind authority. Use the following command to list and ensure that your user ID has the necessary SYSADM authority:

```
SELECT * FROM SYSIBM.SYSUSERAUTH;
```

   Example 3-4 shows the job used to bind the DB2 instance.

Example 3-4 Binding the JDBC driver packages with AOPBATCH utility

```
//MGDSAOP JOB (999,POK),'TPC-R 340',CLASS=A,MSGCLASS=T,
// NOTIFY=&SYSUID,TIME=1440,REGION=0M,MSGLEVEL=(1,1)
//JOBLIB DD DSN=CEE.SCEERUN,DISP=SHR
//JBINDER EXEC PGM=AOPBATCH,PARM='sh -L'
//SYSTSPRT DD SYSOUT=*
//SYSPRINT DD SYSOUT=*
```

```
//SYSUDUMP DD SYSOUT=*
//STDERR DD SYSOUT=*
//STDOUT DD SYSOUT=*
//STDIN DD *
PATH=/usr/lpp/Printsrv/bin:/bin
PATH=/usr/lpp/java/J6.0/bin:$PATH
PATH=/pp/db2v9/D100722/db2910_jdbc/bin:$PATH
EXPORT PATH

CLASSPATH=/pp/db2v9/D100722/db2910_jdbc/classes/db2jcc_license_cisuz.jar
CLASSPATH=/pp/db2v9/D100722/db2910_jdbc/classes/db2jcc.jar:$CLASSPATH
CLASSPATH=/usr/lpp/Printsrv/classes:$CLASSPATH

EXPORT CLASSPATH

echo $PATH
    echo $CLASSPATH
    echo $LIBPATH

java com.ibm.db2.jcc.DB2Binder \
     -url jdbc:db2://wtsc70.itso.ibm.com:38320/DB9C \
     -user MHLRES1 \
     -password kan3da \
     -collection NULLID
/*
```

Note: The job must return a JCL return code of 0. Review the entire job log to verify that the message **`Package "xxxxxxxx": Bind succeeded`** (where **`xxxxxxxx`** is the package name) that appears for all packages. Verify also that there are no SQL error codes returned and that **`DB2Binder finished`** is the final message.

For usage and help binding your JDBC driver packages on your z/OS systems, see the following Web site for information:

http://publib.boulder.ibm.com/infocenter/mptoolic/v1r0/index.jsp?topic=/com.ibm.db2tools.aeu.doc.ug/ahxutcfg500.htm

5. Check which DB2 buffer pool you have on your system by using the following SQL command issued directly to the DB2 subsystem from z/OS SDSF:

   -DB9C **dis bpool(BP32K)**

   Here, ***-DB9C*** is our DB2 subsystem recognition character.

   If the *BP32K* buffer pool listed has a virtual pool size less than 22000, then you need to increase the size as follows:

   -DB2M **ALTER BPOOL(*BP32K*) VPSIZE(*22000*)**

   Here, *BP32K* is the buffer pool name and *vpsize* is the size of the virtual pool.

   The following confirmation is displayed:

   ```
   DSNB522I -DB9C VPSIZE FOR BP32K HAS BEEN SET TO 22000
   DSN9022I -DB9C DSNB1CMD '-ALTER BPOOL' NORMAL COMPLETION
   ```

6. Ask your DB2 Administrator to ensure that the DB2 sample DSNTIJUZ has specified a large number for the parameter `'idthtoin'`, or have set it to zero to dedicate function to it.

3.6.2 Creating a Tivoli Storage Productivity Center for Replication database

This topic presents information on editing and running the DB2 jobs required to create the Tivoli Storage Productivity Center for Replication information repository database, tables, and indexes. There are a set of IWNDBxxx jobs to customize and execute to build the DB2 database structures.

These jobs reside in HLQ.ASAMPLIB, and are described in Table 3-1. These jobs execute SQL statements to create and configure the necessary data schema for Tivoli Storage Productivity Center for Replication.

> **Caution:** Running these jobs after you have already successfully installed Tivoli Storage Productivity Center for Replication results in a loss of session management, functionality, and device knowledge, after which Tivoli Storage Productivity Center for Replication will not run. Execute these jobs only during the initial installation or if you want to purposely clean up the Tivoli Storage Productivity Center for Replication tables of all data.

All the jobs described in Table 3-1 must return a JCL return code of 0. Check the joblog to verify successful database creation and execution messages and to look for SQL errors. It is not a problem to see SQL error code 201 statements during delete-statement execution. This simply ensures that the latest database tables are installed. Other error codes that do not cause problems in this context include these codes:

- 100 - One of the following exceptions occurred:
  - The result of the SELECT INTO statement or the subselect of the INSERT statement was an empty table. (This is the most likely reason for an error code in the IWNDB jobs.)
  - The number of rows identified in the searched UPDATE or DELETE statement was zero.
  - The position of the cursor referenced in the FETCH statement was after the last row of the result table.
  - The fetch orientation is invalid.
- 200 - An undefined object or constraint name was detected.
- 601 - A duplicate object or constraint name was detected.
- 612 - A duplicate column name was detected in the object definition or ALTER TABLE statement.

All other SQL error codes must be examined and analyzed.

Note: The jobs are not ready to run as-is. They need appropriate job cards for the system on which they run and possibly other modification. Do not edit the original copies of the jobs in HLQ.SAMPLIB, because HLQ.SAMPLIB is one of the data sets managed by SMP/E when installing and maintaining products and should not be modified by anything other than SMP/E. Either edit the jobs in HLQ.ASAMPLIB or copy them to a data set of your choosing.

Before executing any of the jobs, ensure that WebSphere Application Server and DB2 are started.

Always run the installation jobs from the system where your WebSphere and DB2 are started. Use the affinity PARM `/*JOBPARM SYSAFF=xxx,` where `xxx` is the *system name*, to ensure that the jobs run on the system where WebSphere and DB2 are installed.

Run the jobs in the same order as they are listed in Table 3-1.

DB2 post-installation jobs

Table 3-1 describes the DB2 post-installation jobs you have to run. Run the jobs in the order they are listed in the table, and check the status job queue to verify successful creation and execution messages.

Table 3-1 Jobs that you need to edit before running

JCL Name	Purpose of the job
IWNDBALO	Submit this DB2 job first as it creates the underlying database for the rest of the jobs.
IWNDBSHL	This sample creates the SVC Hardware layer database, used for cataloging information about SAN Volume Controller clusters and storage representations.
IWNDBELM	This sample creates the element catalog table, which stores information about size, type, and availability of volumes.
IWNDBHWL	This sample creates the hardware layer table that stores information pertaining to ESS 800 (2105 models), DS 8000 (2107 models), and DS 6000 (1750 models).
IWNDBREP	This sample creates the Tivoli Storage Productivity Center for Replication table which stores session, relational, high availability, and state information.
IWNDBHAE	This sample provides high availability backup for the element catalog.
IWNDBHAH	This sample provides high availability backup for the hardware layer.
IWNDBHAR	This sample provides high availability backup for the Tivoli Storage Productivity Center for Replication table.
IWNDBHAS	This sample provides high availability backup for the SVC hardware layer.
IWNDBMIG	This sample updates any table changes that have occurred from release to release of Tivoli Storage Productivity Center for Replication.
IWNDB2ZZ	This sample sets the initial user that will have access to Tivoli Storage Productivity Center for Replication. It also sets the communication default for the server to the Tivoli Storage Productivity Center for Replication CLI and GUI.

We use the following parameters for all jobs. You will need to customize them based on your system naming conventions and configuration:

- **`DB9D9.SDSNLOAD`** is the data set name of the DB2 system load library.

- **D9D4** is the DB2 Subsystem identifier.
- **DSNTIA91** is the defined PLAN parameter for DB2.
- **DB9CU.RUNLIB.LOAD** is the DB2 runtime library.
- **SYSDEFLT** is the DB2 storage group default; you can replace it to match your DB2 storage group configured in the *IWNDBALO* job.
- **TPCR510** is the name of the ITSO RM database. Ensure that this name is unique in your environment.

The examples in the following sections describe each job. The parameters you need to change based on your system configuration are highlighted. Here we list the jobs in order:

1. 1. IWNDBALO job
2. 2. IWNDBSHL job
3. 3. IWNDBELM job
4. 4. IWNDBHWL job
5. 5. IWNDBREP job
6. 6. IWNDBHAE job
7. 7. IWNDBHAH job
8. 8. IWNDBHAR job
9. 9. IWNDBHAS job
10. 10. IWNDBMIG job
11. 1. IWNDBALO job

1. IWNDBALO job

The IWNDBALO job (see Example 3-5) creates the underlying database for the rest of the jobs.

Example 3-5 IWNDBALO job

```
//IWNDBALO  JOB (999,POK),'TPC-R 5.1.0',CLASS=A,REGION=0M,
//         MSGCLASS=T,NOTIFY=&SYSUID,MSGLEVEL=(1,1)
/*JOBPARM L=999,SYSAFF=SC70 //DSNTIST EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB  DD DSN=DB9D9.SDSNLOAD,DISP=SHR
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
DSN SYSTEM(D9D4)
RUN PROGRAM(DSNTIAD) -
    PLAN(DSNTIA91) -
    PARMS('RC0') -
    LIB('DB9DU.RUNLIB.LOAD')
//*****************************************************************
//*** CREATE CSM DATABASE AND CSMTS TABLESPACE ********************/
//*****************************************************************
//SYSIN    DD  *
     CREATE DATABASE TPCR510
            STOGROUP SYSDEFLT
            BUFFERPOOL BP0
            CCSID UNICODE;
     CREATE TABLESPACE CSMTS
         IN TPCR510
      USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
```

```
    SEGSIZE 32
   LOCKSIZE PAGE
    LOCKMAX SYSTEM
 BUFFERPOOL BP0
      CLOSE NO
      CCSID UNICODE;
  COMMIT;
/*
```

Note: The job must return a JCL return code of 0. Verify the whole log to certify that SQL Codes returned are 000 or acceptable.

2. IWNDBSHL job

The IWNDBSHL job (see Example 3-6) creates the SVC Hardware layer database.

Example 3-6 IWNDBSHL job

```
//IWNDBSHL  JOB (999,POK),'TPC-R 5.1.0',CLASS=A,REGION=0M,
//         MSGCLASS=T,NOTIFY=&SYSUID,MSGLEVEL=(1,1)
/*JOBPARM L=999,SYSAFF=SC70
//DSNTIST EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB  DD DSN=DB9D9.SDSNLOAD,DISP=SHR
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
DSN SYSTEM(D9D4)
RUN PROGRAM(DSNTIAD) -
    PLAN(DSNTIA91) -
     PARMS('RC0') -
    LIB('DB9DU.RUNLIB.LOAD')
//*****************************************************************
//****CREATE CSM DATABASE AND CSMTS TABLESPACE ******************
//*****************************************************************
//SYSIN    DD  *
DROP TABLE SVCHWL.LSSERVERLOCATIONMAPPING;
COMMIT;
CREATE TABLE SVCHWL.LSSERVERLOCATIONMAPPING
  (SERVERLOCATION VARCHAR(250) NOT NULL,
   USERNAME VARCHAR(250),
   PASSWORD VARCHAR(250),
   UNIQUENAME VARCHAR(250),
   NOTIFICATIONPORT INTEGER,
   SITELOCATIONID SMALLINT NOT NULL DEFAULT 0)
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX SVCHWL.LSSERVERLOCATIONMAPPING1
                 ON SVCHWL.LSSERVERLOCATIONMAPPING
                 (SERVERLOCATION ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE SVCHWL.LSSERVERLOCATIONMAPPING
```

```
  ADD CONSTRAINT PK_LSSERVERLOCATI1 PRIMARY KEY (SERVERLOCATION);
DROP TABLE SVCHWL.CLUSTERSERVERMAPPING;
COMMIT;
CREATE TABLE SVCHWL.CLUSTERSERVERMAPPING
  (CLUSTERNAME VARCHAR(250) NOT NULL,
   SERVERLOCATION VARCHAR(250) NOT NULL)
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX SVCHWL.CLUSTERSERVERMAPPING1
                 ON SVCHWL.CLUSTERSERVERMAPPING
                 (CLUSTERNAME ASC, SERVERLOCATION ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE SVCHWL.CLUSTERSERVERMAPPING
  ADD CONSTRAINT PK_CLUSTERSERVERM2 PRIMARY KEY
  (CLUSTERNAME, SERVERLOCATION);
COMMIT;
/*
```

Note: The job must return a JCL return code of 0. Verify the whole log to certify that SQL Codes returned are 000 or acceptable. It is acceptable to get an *SQLCODE = -204* error when trying to drop an undefined table.

3. IWNDBELM job

The IWNDBELM job (see Example 3-7) creates the element catalog table.

Example 3-7 IWNDBELM job

```
//IWNDBELM  JOB (999,POK),'TPC-R 5.1.0',CLASS=A,REGION=0M,
//         MSGCLASS=T,NOTIFY=&SYSUID,MSGLEVEL=(1,1)
/*JOBPARM L=999,SYSAFF=SC70
//DSNTIST EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB  DD DSN=DB9D9.SDSNLOAD,DISP=SHR
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
DSN SYSTEM(D9D4)
RUN PROGRAM(DSNTIAD) -
    PLAN(DSNTIA91) -
    PARMS('RC0') -
    LIB('DB9DU.RUNLIB.LOAD')
//****************************************************************
//****CREATE CSM DATABASE AND CSMTS TABLESPACE *******************
//****************************************************************
//SYSIN    DD  *
DROP TABLE EC.ELEMENTS;
COMMIT;
CREATE TABLE EC.ELEMENTS
  (INTERNALNAME VARCHAR(250) NOT NULL,
   ELEMENTID VARCHAR(250) NOT NULL,
   PARENTID VARCHAR(250),
```

```
   NICKNAME VARCHAR(250),
   BASETYPE VARCHAR(250),
   SPECIFICTYPE1 VARCHAR(250),
   CAPACITY VARCHAR(250),
   CAPACITYTYPE VARCHAR(250),
   ISALIVE SMALLINT NOT NULL,
   ISPROTECTED SMALLINT NOT NULL DEFAULT 0,
   PROTECTIONBY VARCHAR(32) NOT NULL DEFAULT 'nobody',
   SITELOCATIONID SMALLINT NOT NULL DEFAULT 0,
   ISSPACEEFFICIENT SMALLINT NOT NULL DEFAULT 0,
   SUPERPARENTID VARCHAR(250),
   ELEMENTTYPE VARCHAR(250))
   IN TPCR510.CSMTS;
CREATE UNIQUE INDEX EC.ELEMENTS1
                 ON EC.ELEMENTS
                 (ELEMENTID   ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
             SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE EC.ELEMENTS
  ADD CONSTRAINT PK_ELEMENTS PRIMARY KEY (ELEMENTID);
DROP TABLE EC.SITELOCATION;
COMMIT;
CREATE TABLE EC.SITELOCATION
   (SITELOCATIONID SMALLINT NOT NULL,
    SITENAME VARCHAR (250) NOT NULL)
    IN TPCR510.CSMTS;

CREATE UNIQUE INDEX EC.SITELOCATION1
                 ON EC.SITELOCATION
                 (SITELOCATIONID ASC)
                 USING STOGROUP SYSDEFLT
                 PRIQTY 3200
                 SECQTY 3200
                 ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
CREATE UNIQUE INDEX EC.SITELOCATION2
                 ON EC.SITELOCATION
                 (SITENAME ASC)
                 USING STOGROUP SYSDEFLT
                 PRIQTY 3200
                 SECQTY 3200
                 ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
COMMIT;
ALTER TABLE EC.SITELOCATION
  ADD CONSTRAINT PK_SITELOCATION PRIMARY KEY
     (SITELOCATIONID);
ALTER TABLE EC.SITELOCATION
  ADD CONSTRAINT UN_SITELOCATION UNIQUE (SITENAME);
```

```
COMMIT;
/*
```

Note: The job must return a JCL return code of 0. Verify the whole log to certify that SQL Codes returned are 000 or acceptable. It is acceptable to get an *SQLCODE = -204* error when trying to drop an undefined table.

4. IWNDBHWL job

The IWNDBHWL job (see Example 3-8) creates the hardware layer table.

Example 3-8 IWNDBHWL job

```
//IWNDBHWL  JOB (999,POK),'TPC-R 5.1.0',CLASS=A,REGION=0M,
//         MSGCLASS=T,NOTIFY=&SYSUID,MSGLEVEL=(1,1)
/*JOBPARM L=999,SYSAFF=SC70
//DSNTIST EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB  DD DSN=DB9D9.SDSNLOAD,DISP=SHR
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
DSN SYSTEM(D9D4)
RUN PROGRAM(DSNTIAD) -
    PLAN(DSNTIA91) -
    PARMS('RC0') -
    LIB('DB9DU.RUNLIB.LOAD')
//*****************************************************************
//****CREATE CSM DATABASE AND CSMTS TABLESPACE ******************
//*****************************************************************
//SYSIN    DD  *
DROP TABLE ESSHWL.ESSSERVERMAPPING;
COMMIT;
CREATE TABLE ESSHWL.ESSSERVERMAPPING
  (ESSNAME VARCHAR(250) NOT NULL,
   SERVERLOCATION VARCHAR(250) NOT NULL,
   ESSINFORMATION BLOB(1K) NOT NULL)
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX ESSHWL.ESSSERVERMAPPING1
                 ON ESSHWL.ESSSERVERMAPPING
                 (SERVERLOCATION   ASC, ESSNAME ASC)
                 USING STOGROUP SYSDEFLT
                 PRIQTY 3200
                 SECQTY 3200
                 ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE ESSHWL.ESSSERVERMAPPING
  ADD CONSTRAINT PK_ESSSERVERMAPPIN PRIMARY KEY
     (SERVERLOCATION, ESSNAME);
CREATE LOB TABLESPACE ESSINFTS
  IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
```

```
  LOG NO;
CREATE AUXILIARY TABLE ESSHWL.ESSSERVERMAPPING_ESSINFORMATION_TAB
  IN TPCR510.ESSINFTS
  STORES ESSHWL.ESSSERVERMAPPING
  COLUMN ESSINFORMATION;
CREATE UNIQUE INDEX ESSHWL.ESSSERVERMAPPING_ESSINFORMATION_TAB1
  ON ESSHWL.ESSSERVERMAPPING_ESSINFORMATION_TAB
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;
DROP TABLE ESSHWL.SERVERLOCATIONMAPPING;
COMMIT;
DROP TABLE ESSHWL.SERVERLOCATIONMAPPING;
COMMIT;
CREATE TABLE ESSHWL.SERVERLOCATIONMAPPING
  (SERVERLOCATION VARCHAR(250) NOT NULL,
   USERNAME VARCHAR(250),
   PASSWORD VARCHAR(250),
   UNIQUENAME VARCHAR(250),
   NOTIFICATIONPORT INTEGER NOT NULL,
   SERVERTYPE SMALLINT NOT NULL,
   HOSTNAMECLUSTER0 VARCHAR(250),
   PORTNUMBERCLUSTER0 INTEGER NOT NULL,
   USERNAMECLUSTER0 VARCHAR(250),
   PASSWORDCLUSTER0 VARCHAR(250),
   HOSTNAMECLUSTER1 VARCHAR(250),
   PORTNUMBERCLUSTER1 INTEGER NOT NULL,
   USERNAMECLUSTER1 VARCHAR(250),
   PASSWORDCLUSTER1 VARCHAR(250),
   SITELOCATIONID SMALLINT NOT NULL DEFAULT 0)
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX ESSHWL.SERVERLOCATIONMAPPING1
                 ON ESSHWL.SERVERLOCATIONMAPPING
                 (SERVERLOCATION   ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
             SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE ESSHWL.SERVERLOCATIONMAPPING
  ADD CONSTRAINT PK_SERVERLOCATION PRIMARY KEY (SERVERLOCATION);
DROP TABLE ESSHWL.ESSPATH;
COMMIT;
CREATE TABLE ESSHWL.ESSPATH
  (PATHID VARCHAR(250) NOT NULL,
   PATHTYPE SMALLINT NOT NULL,
   SERVERLOCATION VARCHAR(250) NOT NULL,
   PATHSTATE SMALLINT NOT NULL,
   SOURCEPORTS BLOB(1K) NOT NULL,
   TARGETPORTS BLOB(1K) NOT NULL,
   AUTOGENERATED BLOB(1K) NOT NULL,
```

```
   SOURCEWWNN VARCHAR(250) NOT NULL,
   TARGETWWNN VARCHAR(250) NOT NULL)
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX ESSHWL.ESSPATH1
                 ON ESSHWL.ESSPATH
                 (PATHTYPE   ASC, PATHID ASC, SERVERLOCATION ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
             SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE ESSHWL.ESSPATH
  ADD CONSTRAINT PK_ESSPATH PRIMARY KEY
  (PATHTYPE, PATHID, SERVERLOCATION);
DROP TABLESPACE TPCR510.SRCPORTS;
COMMIT;
CREATE LOB TABLESPACE SRCPORTS
  IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;
CREATE AUXILIARY TABLE ESSHWL.ESSPATH_SOURCEPORTS_TAB
  IN TPCR510.SRCPORTS
  STORES ESSHWL.ESSPATH
  COLUMN SOURCEPORTS;
CREATE UNIQUE INDEX ESSHWL.ESSPATH_SOURCEPORTS_TAB1
  ON ESSHWL.ESSPATH_SOURCEPORTS_TAB
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;
DROP TABLESPACE TPCR510.TGTPORTS;
COMMIT;
CREATE LOB TABLESPACE TGTPORTS
  IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;
CREATE AUXILIARY TABLE ESSHWL.ESSPATH_TARGETPORTS_TAB
  IN TPCR510.TGTPORTS
  STORES ESSHWL.ESSPATH
  COLUMN TARGETPORTS;
CREATE UNIQUE INDEX ESSHWL.ESSPATH_TARGETPORTS_TAB1
  ON ESSHWL.ESSPATH_TARGETPORTS_TAB
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;
```

```
DROP TABLESPACE TPCR510.AUTOGENE;
COMMIT;
CREATE LOB TABLESPACE AUTOGENE
  IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;
CREATE AUXILIARY TABLE ESSHWL.ESSPATH_AUTOGENERATED_TAB
  IN TPCR510.AUTOGENE
  STORES ESSHWL.ESSPATH
  COLUMN AUTOGENERATED;
CREATE UNIQUE INDEX ESSHWL.ESSPATH_AUTOGENERATED_TAB1
  ON ESSHWL.ESSPATH_AUTOGENERATED_TAB
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;
DROP TABLE ESSHWL.ASYNCMASTERQUERYMONITOR;
COMMIT;
CREATE TABLE ESSHWL.ASYNCMASTERQUERYMONITOR
  (ESSNAME VARCHAR(250) NOT NULL,
   SESSIONNUMBER INTEGER NOT NULL,
   LSSNUMBER INTEGER NOT NULL,
   SSID INTEGER NOT NULL,
   QUERYISRUNNING SMALLINT NOT NULL)
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX ESSHWL.ASYNCMASTERQUERYMONITOR1
                 ON ESSHWL.ASYNCMASTERQUERYMONITOR
                 (ESSNAME   ASC, SESSIONNUMBER ASC, LSSNUMBER ASC)
                 USING STOGROUP SYSDEFLT
                 PRIQTY 3200
                 SECQTY 3200
                 ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE ESSHWL.ASYNCMASTERQUERYMONITOR
  ADD CONSTRAINT PK_ASYNCMASTERQUER PRIMARY KEY
  (ESSNAME, SESSIONNUMBER, LSSNUMBER);
COMMIT;
/*
```

Note: The job must return a JCL return code of 0. Review the job log to certify that SQL Codes returned are 000 or acceptable. It is acceptable to get an *SQLCODE = -204* error when trying to drop an undefined table.

5. IWNDBREP job

The IWNDBREP job (see Example 3-9) creates the Tivoli Storage Productivity Center for Replication table.

Example 3-9 IWNDBREP job

```
//IWNDBREP  JOB (999,POK),'TPC-R 5.1.0',CLASS=A,REGION=0M,
//         MSGCLASS=T,NOTIFY=&SYSUID,MSGLEVEL=(1,1)
/*JOBPARM L=999,SYSAFF=SC70
//DSNTIST EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB  DD DSN=DB9D9.SDSNLOAD,DISP=SHR
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
DSN SYSTEM(D9D4)
RUN PROGRAM(DSNTIAD) -
    PLAN(DSNTIA91) -
    PARMS('RC0') -
    LIB('DB9DU.RUNLIB.LOAD')
//*****************************************************************
//****CREATE CSM DATABASE AND CSMTS TABLESPACE ******************
//*****************************************************************
//SYSIN    DD  *
DROP TABLE REPMGR.CSMUSER;
COMMIT;
CREATE TABLE REPMGR.CSMUSER
   ("NAME" VARCHAR(255) NOT NULL ,
 "TYPE" INTEGER NOT NULL ,
 "PERMISSION" VARCHAR(255) NOT NULL ,
 "RESOURCE" VARCHAR(255) NOT NULL ,
 "ACTIONS" VARCHAR(255) NOT NULL )
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX REPMGR.CSMUSER1
                 ON REPMGR.CSMUSER
                 (NAME   ASC, TYPE ASC,
                 PERMISSION ASC, RESOURCE ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
             SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE REPMGR.CSMUSER
  ADD CONSTRAINT PK_CSMUSER PRIMARY KEY
  (NAME, TYPE, PERMISSION, RESOURCE);
DROP TABLE REPMGR.CSMPROPERTIES;
COMMIT;
CREATE TABLE REPMGR.CSMPROPERTIES
  (PROP_NAME VARCHAR(250) NOT NULL,
   PROP_VALUE VARCHAR(250) NOT NULL)
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX REPMGR.CSMPROPERTIES1
                 ON REPMGR.CSMPROPERTIES
                 (PROP_NAME   ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
             SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
```

```
                 CLOSE NO;
ALTER TABLE REPMGR.CSMPROPERTIES
  ADD CONSTRAINT PK_CSMPROPERTIES PRIMARY KEY (PROP_NAME);
DROP TABLE REPMGR.DRIVER;
COMMIT;
CREATE TABLE REPMGR.DRIVER
  (DRIVERID VARCHAR(250) NOT NULL,
   TYPE1 VARCHAR(250),
   ISSHADOWING SMALLINT NOT NULL,
   CONTROLCLASS VARCHAR(250),
   NUMBEROFPAIRS INTEGER NOT NULL,
   CGINFO BLOB(13000),
   SEQUENCENAME VARCHAR(250),
   SESSIONNAME VARCHAR(250) NOT NULL,
   ISDEFINED SMALLINT NOT NULL,
   TIMESTAMP1 VARCHAR(250),
   INUSE SMALLINT NOT NULL,
   HWCONSISTENCYGROUPNAME VARCHAR(250),
   ISNEW SMALLINT NOT NULL)
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX REPMGR.DRIVER1
                 ON REPMGR.DRIVER
                 (DRIVERID   ASC, SESSIONNAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
             SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE REPMGR.DRIVER
  ADD CONSTRAINT PK_DRIVER PRIMARY KEY (DRIVERID, SESSIONNAME);
DROP TABLESPACE TPCR510.CGINFOTS;
COMMIT;
CREATE LOB TABLESPACE CGINFOTS
  IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;
CREATE AUXILIARY TABLE REPMGR.DRIVER_CGINFO_TAB
  IN TPCR510.CGINFOTS
  STORES REPMGR.DRIVER
  COLUMN CGINFO;
CREATE UNIQUE INDEX REPMGR.DRIVER_CGINFO_TAB1
  ON REPMGR.DRIVER_CGINFO_TAB
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;
DROP TABLE REPMGR.PAIR;
COMMIT;
CREATE TABLE REPMGR.PAIR
  (SOURCEID VARCHAR(250) NOT NULL,
```

```
   TARGETID VARCHAR(250) NOT NULL,
   STATE1 VARCHAR(250),
   DRIVERID VARCHAR(250),
   PENDINGSTATE VARCHAR(250),
   SESSIONNAME VARCHAR(250) NOT NULL,
   SEQUENCENAME VARCHAR(250) NOT NULL,
   ISNEW SMALLINT NOT NULL,
   TIMESTAMP1 VARCHAR(250),
   ISSHADOWING SMALLINT NOT NULL,
   ISCONSISTENT SMALLINT NOT NULL,
   LASTRESULTTYPE INTEGER NOT NULL,
   LASTRESULTMSGKEY VARCHAR(10),
   LASTRESULTINSERTS BLOB(11000),
   LASTRESULTTIME TIMESTAMP NOT NULL,
   PENDINGREASONCODE INTEGER NOT NULL,
   ISINHWCONSISTENCYGROUP SMALLINT NOT NULL,
   DIRECTION SMALLINT NOT NULL,
   COPYSETID VARCHAR(250))
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX REPMGR.PAIR1
                 ON REPMGR.PAIR
                 (SOURCEID   ASC, TARGETID ASC, SESSIONNAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
             SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE REPMGR.PAIR
  ADD CONSTRAINT PK_PAIR PRIMARY KEY
  (SOURCEID, TARGETID, SESSIONNAME);
DROP  TABLESPACE TPCR510.LRESINTS;
COMMIT;
CREATE LOB TABLESPACE LRESINTS
 IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;
CREATE AUXILIARY TABLE REPMGR.PAIR_LASTRESULTINSERTS_TAB
  IN TPCR510.LRESINTS
  STORES REPMGR.PAIR
  COLUMN LASTRESULTINSERTS;
CREATE UNIQUE INDEX REPMGR.PAIR_LASTRESULTINSERTS_TAB1
  ON REPMGR.PAIR_LASTRESULTINSERTS_TAB
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;
DROP TABLE REPMGR.SESSION1;
COMMIT;
CREATE TABLE REPMGR.SESSION1
  (SESSIONNAME VARCHAR(250) NOT NULL,
```

```
   COPYRULES BLOB(65000),
   CMDBEINGPROCESSED VARCHAR(250),
   STATE VARCHAR(250),
   DESCRIPTION VARCHAR(250),
   PRODUCTIONROLE VARCHAR(250),
   NUMACTIVEDRIVERS INTEGER NOT NULL,
   INUSE SMALLINT NOT NULL,
   INGENERATE VARCHAR(250))
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX REPMGR.SESSION11
                 ON REPMGR.SESSION1
                 (SESSIONNAME   ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
             SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE REPMGR.SESSION1
  ADD CONSTRAINT PK_SESSION1 PRIMARY KEY (SESSIONNAME);
DROP TABLESPACE TPCR510.CPYRULTS;
COMMIT;
CREATE LOB TABLESPACE CPYRULTS
 IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;
CREATE AUXILIARY TABLE REPMGR.SESSION1_COPYRULES_TAB
  IN TPCR510.CPYRULTS
  STORES REPMGR.SESSION1
  COLUMN COPYRULES;
CREATE UNIQUE INDEX REPMGR.SESSION1_COPYRULES_TAB1
  ON REPMGR.SESSION1_COPYRULES_TAB
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;
DROP TABLE REPMGR.COPYSET;
COMMIT;
CREATE TABLE REPMGR.COPYSET
  (COPYSETID VARCHAR(250) NOT NULL,
   CONSISTENCYLEVEL VARCHAR(250),
   SESSIONNAME VARCHAR(250) NOT NULL,
   INGAME SMALLINT NOT NULL,
   ISVALID SMALLINT NOT NULL,
   ISVERIFIED SMALLINT NOT NULL)
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX REPMGR.COPYSET1
                 ON REPMGR.COPYSET
                 (COPYSETID   ASC, SESSIONNAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
```

```
             SECQTY 3200
                       ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE REPMGR.COPYSET
  ADD CONSTRAINT PK_COPYSET PRIMARY KEY (COPYSETID, SESSIONNAME);
DROP TABLE REPMGR.POINT;
COMMIT;
CREATE TABLE REPMGR.POINT
  (POINTID VARCHAR(250) NOT NULL,
   POINTNUMBER INTEGER NOT NULL,
   SESSIONID VARCHAR(250) NOT NULL,
   COPYSETID VARCHAR(250))
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX REPMGR.POINT1
                 ON REPMGR.POINT
                 (POINTID   ASC, SESSIONID ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
             SECQTY 3200
                       ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE REPMGR.POINT
  ADD CONSTRAINT PK_POINT PRIMARY KEY (POINTID, SESSIONID);
DROP TABLE REPMGR.SEQUENCE;
COMMIT;
CREATE TABLE REPMGR.SEQUENCE
  (SEQUENCENAME VARCHAR(250) NOT NULL,
   SESSIONNAME VARCHAR(250) NOT NULL,
   DIRECTION SMALLINT NOT NULL)
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX REPMGR.SEQUENCE1
                 ON REPMGR.SEQUENCE
                 (SEQUENCENAME   ASC, SESSIONNAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
             SECQTY 3200
                       ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

ALTER TABLE REPMGR.SEQUENCE
  ADD CONSTRAINT PK_SEQUENCE PRIMARY KEY (SEQUENCENAME, SESSIONNAME);
DROP TABLE REPMGR.HA_STATUS;
COMMIT;
CREATE TABLE REPMGR.HA_STATUS
 (HOSTNAME VARCHAR(250) NOT NULL,
  IPADDRESS VARCHAR(36) NOT NULL,
  ROLE SMALLINT NOT NULL DEFAULT 0,
  STATE SMALLINT NOT NULL DEFAULT 0,
  TIME_STAMP TIMESTAMP NOT NULL)
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX REPMGR.HA_STATUS1
                 ON REPMGR.HA_STATUS
```

```
                 (HOSTNAME   ASC, IPADDRESS ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
             SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE REPMGR.HA_STATUS
  ADD CONSTRAINT PK_HA_STATUS PRIMARY KEY (HOSTNAME, IPADDRESS);
DROP TABLE REPMGR.SNMP_MGRS;
COMMIT;
CREATE TABLE REPMGR.SNMP_MGRS
 (MGRNAME VARCHAR (250) NOT NULL,
  PORT INTEGER NOT NULL WITH DEFAULT 162)
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX REPMGR.SNMP_MGRS1
                 ON REPMGR.SNMP_MGRS
                 (MGRNAME   ASC, PORT ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
             SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE REPMGR.SNMP_MGRS
  ADD CONSTRAINT PK_SNMP_MGRS PRIMARY KEY ( MGRNAME, PORT);
CREATE TABLE REPMGR.SITELOCATIONS
   (SITELOCATIONID SMALLINT NOT NULL,
    SESSIONNAME VARCHAR (250) NOT NULL,
    SITENAME VARCHAR(20) NOT NULL)
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX REPMGR.SITELOCATIONS1
                 ON REPMGR.SITELOCATIONS
                 (SESSIONNAME ASC, SITENAME   ASC,
                  SITELOCATIONID ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
             SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE REPMGR.SITELOCATIONS
  ADD CONSTRAINT PK_SITELOCATIONS PRIMARY KEY
  (SESSIONNAME, SITENAME, SITELOCATIONID);
COMMIT;
/*
```

Note: The job must return a JCL return code of 0. Verify the whole log to certify that SQL Codes returned are 000 or acceptable. It is acceptable to get an *SQLCODE = -204* error when trying to drop an undefined table.

6. IWNDBHAE job

The IWNDBHAE job (see Example 3-10) creates the Tivoli Storage Productivity Center for Replication table.

Example 3-10 IWNDBHAE job

```
//IWNDBHAE  JOB (999,POK),'TPC-R 5.1.0',CLASS=A,REGION=0M,
//          MSGCLASS=T,NOTIFY=&SYSUID,MSGLEVEL=(1,1)
/*JOBPARM L=999,SYSAFF=SC70
//DSNTIST EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB  DD DSN=DB9D9.SDSNLOAD,DISP=SHR
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
DSN SYSTEM(D9D4)
RUN PROGRAM(DSNTIAD) -
    PLAN(DSNTIA91) -
    PARMS('RC0') -
    LIB('DB9DU.RUNLIB.LOAD')
//*******************************************************************
//*** CREATE CSM DATABASE AND CSMTS TABLESPACE ********************/
//*******************************************************************
//SYSIN    DD  *
CREATE TABLE EC.ELEMENTS_bak
  (INTERNALNAME VARCHAR(250) NOT NULL,
   ELEMENTID VARCHAR(250) NOT NULL,
   PARENTID VARCHAR(250),
   NICKNAME VARCHAR(250),
   BASETYPE VARCHAR(250),
   SPECIFICTYPE1 VARCHAR(250),
   CAPACITY VARCHAR(250),
   CAPACITYTYPE VARCHAR(250),
   ISALIVE SMALLINT NOT NULL,
   ISPROTECTED SMALLINT NOT NULL DEFAULT 0,
   PROTECTIONBY VARCHAR(32) NOT NULL DEFAULT 'nobody',
   SITELOCATIONID SMALLINT NOT NULL DEFAULT 0,
   ISSPACEEFFICIENT SMALLINT NOT NULL DEFAULT 0,
   SUPERPARENTID VARCHAR(250),
   ELEMENTTYPE VARCHAR(250))
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX EC.ELEMENTS_bak1
                 ON EC.ELEMENTS_bak
                 (ELEMENTID   ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

ALTER TABLE EC.ELEMENTS_bak
  ADD CONSTRAINT PK_ELEMENTS_bak PRIMARY KEY (ELEMENTID);

CREATE TABLE EC.SITELOCATION_bak
```

```
   (SITELOCATIONID SMALLINT NOT NULL,
    SITENAME VARCHAR (250) NOT NULL)
IN TPCR510.CSMTS;

 CREATE UNIQUE INDEX EC.SITELOCATION_bak1
                  ON EC.SITELOCATION_bak
                  (SITELOCATIONID   ASC)
                  USING STOGROUP SYSDEFLT
                            PRIQTY 3200
                            SECQTY 3200
                            ERASE NO
                  BUFFERPOOL BP0
                  CLOSE NO;

 CREATE UNIQUE INDEX EC.SITELOCATION_bak2
                  ON EC.SITELOCATION_bak
                  (SITENAME   ASC)
                  USING STOGROUP SYSDEFLT
                            PRIQTY 3200
                           SECQTY 3200
                            ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

ALTER TABLE EC.SITELOCATION_bak
  ADD CONSTRAINT PK_SITELOCA_bak PRIMARY KEY (SITELOCATIONID)
  ADD CONSTRAINT UN_SITELOCA_bak UNIQUE (SITENAME);
COMMIT;
/*
```

Note: The job must return a JCL return code of 0. Review the job log to certify that SQL Codes returned are 000 or acceptable.

7. IWNDBHAH job

The IWNDBHAH job (see Example 3-11) provides high availability backup for the hardware layer.

Example 3-11 IWNDBHAH job

```
//IWNDBHAH  JOB (999,POK),'TPC-R 5.1.0',CLASS=A,REGION=0M,
//         MSGCLASS=T,NOTIFY=&SYSUID,MSGLEVEL=(1,1)
/*JOBPARM L=999,SYSAFF=SC70
//DSNTIST EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB  DD DSN=DB9D9.SDSNLOAD,DISP=SHR
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
DSN SYSTEM(D9D4)
RUN PROGRAM(DSNTIAD) -
    PLAN(DSNTIA91) -
    PARMS('RC0') -
    LIB('DB9DU.RUNLIB.LOAD')
//*****************************************************************
```

```
//*** CREATE CSM DATABASE AND CSMTS TABLESPACE ********************/
//***************************************************************
//SYSIN    DD  *
CREATE TABLE ESSHWL.ESSSERVERMAPPING_bak
  (ESSNAME VARCHAR(250) NOT NULL,
   SERVERLOCATION VARCHAR(250) NOT NULL,
   ESSINFORMATION BLOB(1K) NOT NULL)
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX ESSHWL.ESSSERVERMAPPING_bak1
                 ON ESSHWL.ESSSERVERMAPPING_bak
                 (SERVERLOCATION   ASC, ESSNAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

ALTER TABLE ESSHWL.ESSSERVERMAPPING_bak
  ADD CONSTRAINT PK_ESSSERVERMA_bak PRIMARY KEY
  (SERVERLOCATION, ESSNAME);

CREATE LOB TABLESPACE ESSINFTB
  IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;

CREATE AUXILIARY TABLE ESSHWL.ESSSERVERMAPPING_ESSINFORMATION_TAB_bak
  IN TPCR510.ESSINFTB
  STORES ESSHWL.ESSSERVERMAPPING_bak
  COLUMN ESSINFORMATION;

CREATE UNIQUE INDEX ESSHWL.ESSSERVERMAPPING_ESSINFORMATION_TAB_bak1
  ON ESSHWL.ESSSERVERMAPPING_ESSINFORMATION_TAB_bak
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;

CREATE TABLE ESSHWL.SERVERLOCATIONMAPPING_bak
  (SERVERLOCATION VARCHAR(250) NOT NULL,
   USERNAME VARCHAR(250),
   PASSWORD VARCHAR(250),
   UNIQUENAME VARCHAR(250),
   NOTIFICATIONPORT INTEGER NOT NULL,
   SERVERTYPE SMALLINT NOT NULL,
   HOSTNAMECLUSTER0 VARCHAR(250),
   PORTNUMBERCLUSTER0 INTEGER NOT NULL,
   USERNAMECLUSTER0 VARCHAR(250),
   PASSWORDCLUSTER0 VARCHAR(250),
```

```
   HOSTNAMECLUSTER1 VARCHAR(250),
   PORTNUMBERCLUSTER1 INTEGER NOT NULL,
   USERNAMECLUSTER1 VARCHAR(250),
   PASSWORDCLUSTER1 VARCHAR(250),
   SITELOCATIONID SMALLINT NOT NULL DEFAULT 0)
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX ESSHWL.SERVERLOCATIONMAPPING_bak1
                 ON ESSHWL.SERVERLOCATIONMAPPING_bak
                 (SERVERLOCATION   ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

ALTER TABLE ESSHWL.SERVERLOCATIONMAPPING_bak
  ADD CONSTRAINT PK_SERVERLOCAT_bak PRIMARY KEY (SERVERLOCATION);

CREATE TABLE ESSHWL.ESSPATH_bak
  (PATHID VARCHAR(250) NOT NULL,
   PATHTYPE SMALLINT NOT NULL,
   SERVERLOCATION VARCHAR(250) NOT NULL,
   PATHSTATE SMALLINT NOT NULL,
   SOURCEPORTS BLOB(1K) NOT NULL,
   TARGETPORTS BLOB(1K) NOT NULL,
   AUTOGENERATED BLOB(1K) NOT NULL,
   SOURCEWWNN VARCHAR(250) NOT NULL,
   TARGETWWNN VARCHAR(250) NOT NULL)
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX ESSHWL.ESSPATH_bak1
                 ON ESSHWL.ESSPATH_bak
                 (PATHTYPE   ASC, PATHID ASC, SERVERLOCATION ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

ALTER TABLE ESSHWL.ESSPATH_bak
  ADD CONSTRAINT PK_ESSPATH_bak PRIMARY KEY
                 (PATHTYPE, PATHID, SERVERLOCATION);


CREATE LOB TABLESPACE SRCPORTB
  IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;

CREATE AUXILIARY TABLE ESSHWL.ESSPATH_SOURCEPORTS_TAB_bak
```

```
  IN TPCR510.SRCPORTB
  STORES ESSHWL.ESSPATH_bak
  COLUMN SOURCEPORTS;

CREATE UNIQUE INDEX ESSHWL.ESSPATH_SOURCEPORTS_TAB_bak1
  ON ESSHWL.ESSPATH_SOURCEPORTS_TAB_bak
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;

CREATE LOB TABLESPACE TGTPORTB
  IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;

CREATE AUXILIARY TABLE ESSHWL.ESSPATH_TARGETPORTS_TAB_bak
  IN TPCR510.TGTPORTB
  STORES ESSHWL.ESSPATH_bak
  COLUMN TARGETPORTS;

CREATE UNIQUE INDEX ESSHWL.ESSPATH_TARGETPORTS_TAB_bak1
  ON ESSHWL.ESSPATH_TARGETPORTS_TAB_bak
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;


CREATE LOB TABLESPACE AUTOGENB
  IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;

CREATE AUXILIARY TABLE ESSHWL.ESSPATH_AUTOGENERATED_TAB_bak
  IN TPCR510.AUTOGENB
  STORES ESSHWL.ESSPATH_bak
  COLUMN AUTOGENERATED;

CREATE UNIQUE INDEX ESSHWL.ESSPATH_AUTOGENERATED_TAB_bak1
  ON ESSHWL.ESSPATH_AUTOGENERATED_TAB_bak
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;
```

```
CREATE TABLE ESSHWL.ASYNCMASTERQUERYMONITOR_bak
  (ESSNAME VARCHAR(250) NOT NULL,
   SESSIONNUMBER INTEGER NOT NULL,
   LSSNUMBER INTEGER NOT NULL,
   SSID INTEGER NOT NULL,
   QUERYISRUNNING SMALLINT NOT NULL)
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX ESSHWL.ASYNCMASTERQUERYMONITOR_bak1
                 ON ESSHWL.ASYNCMASTERQUERYMONITOR_bak
                 (ESSNAME   ASC, SESSIONNUMBER ASC, LSSNUMBER ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

ALTER TABLE ESSHWL.ASYNCMASTERQUERYMONITOR_bak
  ADD CONSTRAINT PK_ASYNCMASTER_bak PRIMARY KEY
                 (ESSNAME, SESSIONNUMBER, LSSNUMBER);

COMMIT;
/*
```

Note: The job must return a JCL return code of 0. Review the job log to verify that SQL Codes returned are 000 or acceptable.

8. IWNDBHAR job

The IWNDBHAR job (see Example 3-12) provides high availability backup for the Tivoli Storage Productivity Center for Replication table.

Example 3-12 IWNDBHAR job

```
/IWNDBHAR  JOB (999,POK),'TPC-R 5.1.0',CLASS=A,REGION=0M,
/          MSGCLASS=T,NOTIFY=&SYSUID,MSGLEVEL=(1,1)
*JOBPARM L=999,SYSAFF=SC70
//DSNTIST EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB  DD DSN=DB9D9.SDSNLOAD,DISP=SHR
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
DSN SYSTEM(D9D4)
RUN PROGRAM(DSNTIAD) -
    PLAN(DSNTIA91) -
    PARMS('RC0') -
    LIB('DB9DU.RUNLIB.LOAD')
//*****************************************************************
//*** CREATE CSM DATABASE AND CSMTS TABLESPACE ********************/
//*****************************************************************
//SYSIN    DD  *
CREATE TABLE REPMGR.CSMUSER_bak
```

```
  ("NAME" VARCHAR(255) NOT NULL ,
 "TYPE" INTEGER NOT NULL ,
 "PERMISSION" VARCHAR(255) NOT NULL ,
 "RESOURCE" VARCHAR(255) NOT NULL ,
 "ACTIONS" VARCHAR(255) NOT NULL )
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX REPMGR.CSMUSER_bak1
                 ON REPMGR.CSMUSER_bak
                 (NAME   ASC, TYPE ASC,
                 PERMISSION ASC, RESOURCE ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

ALTER TABLE REPMGR.CSMUSER_bak
  ADD CONSTRAINT PK_CSMUSER_bak PRIMARY KEY
           (NAME, TYPE, PERMISSION, RESOURCE);


CREATE TABLE REPMGR.CSMPROPERTIES_bak
  (PROP_NAME VARCHAR(250) NOT NULL,
   PROP_VALUE VARCHAR(250) NOT NULL)
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX REPMGR.CSMPROPERTIES_bak1
                 ON REPMGR.CSMPROPERTIES_bak
                 (PROP_NAME   ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

ALTER TABLE REPMGR.CSMPROPERTIES_bak
  ADD CONSTRAINT PK_CSMPROPER_bak PRIMARY KEY (PROP_NAME);


CREATE TABLE REPMGR.DRIVER_bak
  (DRIVERID VARCHAR(250) NOT NULL,
   TYPE1 VARCHAR(250),
   ISSHADOWING SMALLINT NOT NULL,
   CONTROLCLASS VARCHAR(250),
   NUMBEROFPAIRS INTEGER NOT NULL,
   CGINFO BLOB(13000),
   SEQUENCENAME VARCHAR(250),
   SESSIONNAME VARCHAR(250) NOT NULL,
   ISDEFINED SMALLINT NOT NULL,
   TIMESTAMP1 VARCHAR(250),
   INUSE SMALLINT NOT NULL,
   HWCONSISTENCYGROUPNAME VARCHAR(250),
```

```
   ISNEW SMALLINT NOT NULL)
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX REPMGR.DRIVER1_bak
                 ON REPMGR.DRIVER_bak
                 (DRIVERID   ASC, SESSIONNAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

ALTER TABLE REPMGR.DRIVER_bak
  ADD CONSTRAINT PK_DRIVER_bak PRIMARY KEY (DRIVERID, SESSIONNAME);

CREATE LOB TABLESPACE CGINFOTB
  IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;

CREATE AUXILIARY TABLE REPMGR.DRIVER_CGINFO_TAB_bak
  IN TPCR510.CGINFOTB
  STORES REPMGR.DRIVER_bak
  COLUMN CGINFO;

CREATE UNIQUE INDEX REPMGR.DRIVER_CGINFO_TAB_bak1
  ON REPMGR.DRIVER_CGINFO_TAB_bak
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;


CREATE TABLE REPMGR.PAIR_bak
  (SOURCEID VARCHAR(250) NOT NULL,
   TARGETID VARCHAR(250) NOT NULL,
   STATE1 VARCHAR(250),
   DRIVERID VARCHAR(250),
   PENDINGSTATE VARCHAR(250),
   SESSIONNAME VARCHAR(250) NOT NULL,
   SEQUENCENAME VARCHAR(250) NOT NULL,
   ISNEW SMALLINT NOT NULL,
   TIMESTAMP1 VARCHAR(250),
   ISSHADOWING SMALLINT NOT NULL,
   ISCONSISTENT SMALLINT NOT NULL,
   LASTRESULTTYPE INTEGER NOT NULL,
   LASTRESULTMSGKEY VARCHAR(10),
   LASTRESULTINSERTS BLOB(11000),
   LASTRESULTTIME TIMESTAMP NOT NULL,
   PENDINGREASONCODE INTEGER NOT NULL,
```

```
   ISINHWCONSISTENCYGROUP SMALLINT NOT NULL,
   DIRECTION SMALLINT NOT NULL,
   COPYSETID VARCHAR(250))
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX REPMGR.PAIR_bak1
                 ON REPMGR.PAIR_bak
                 (SOURCEID   ASC, TARGETID ASC, SESSIONNAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

ALTER TABLE REPMGR.PAIR_bak
  ADD CONSTRAINT PK_PAIR_bak PRIMARY KEY
                 (SOURCEID, TARGETID, SESSIONNAME);

CREATE LOB TABLESPACE LRESINTB
 IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;

CREATE AUXILIARY TABLE REPMGR.PAIR_LASTRESULTINSERTS_TAB_bak
  IN TPCR510.LRESINTB
  STORES REPMGR.PAIR_bak
  COLUMN LASTRESULTINSERTS;

CREATE UNIQUE INDEX REPMGR.PAIR_LASTRESULTINSERTS_TAB_bak1
  ON REPMGR.PAIR_LASTRESULTINSERTS_TAB_bak
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;


CREATE TABLE REPMGR.SESSION1_bak
  (SESSIONNAME VARCHAR(250) NOT NULL,
   COPYRULES BLOB(65000),
   CMDBEINGPROCESSED VARCHAR(250),
   STATE VARCHAR(250),
   DESCRIPTION VARCHAR(250),
   PRODUCTIONROLE VARCHAR(250),
   NUMACTIVEDRIVERS INTEGER NOT NULL,
   INUSE SMALLINT NOT NULL,
   INGENERATE VARCHAR(250))
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX REPMGR.SESSION1_bak1
                 ON REPMGR.SESSION1_bak
```

```
                 (SESSIONNAME   ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

ALTER TABLE REPMGR.SESSION1_bak
  ADD CONSTRAINT PK_SESSION1_bak PRIMARY KEY (SESSIONNAME);

CREATE LOB TABLESPACE CPYRULTB
 IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;

CREATE AUXILIARY TABLE REPMGR.SESSION1_COPYRULES_TAB_bak
  IN TPCR510.CPYRULTB
  STORES REPMGR.SESSION1_bak
  COLUMN COPYRULES;

CREATE UNIQUE INDEX REPMGR.SESSION1_COPYRULES_TAB_bak1
  ON REPMGR.SESSION1_COPYRULES_TAB_bak
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;


CREATE TABLE REPMGR.COPYSET_bak
  (COPYSETID VARCHAR(250) NOT NULL,
   CONSISTENCYLEVEL VARCHAR(250),
   SESSIONNAME VARCHAR(250) NOT NULL,
   INGAME SMALLINT NOT NULL,
   ISVALID SMALLINT NOT NULL,
   ISVERIFIED SMALLINT NOT NULL)
p      F2=Split     F3=Exit      F5=Rfind     F6=Rchange   F7=Up
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX REPMGR.COPYSET_bak1
                 ON REPMGR.COPYSET_bak
                 (COPYSETID   ASC, SESSIONNAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

ALTER TABLE REPMGR.COPYSET_bak
  ADD CONSTRAINT PK_COPYSET_bak PRIMARY KEY (COPYSETID, SESSIONNAME);
```

```
CREATE TABLE REPMGR.POINT_bak
  (POINTID VARCHAR(250) NOT NULL,
   POINTNUMBER INTEGER NOT NULL,
   SESSIONID VARCHAR(250) NOT NULL,
   COPYSETID VARCHAR(250))
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX REPMGR.POINT1_bak
                 ON REPMGR.POINT_bak
                 (POINTID   ASC, SESSIONID ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

ALTER TABLE REPMGR.POINT_bak
  ADD CONSTRAINT PK_POINT_bak PRIMARY KEY (POINTID, SESSIONID);

CREATE TABLE REPMGR.SEQUENCE_bak
  (SEQUENCENAME VARCHAR(250) NOT NULL,
   SESSIONNAME VARCHAR(250) NOT NULL,
   DIRECTION SMALLINT NOT NULL)
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX REPMGR.SEQUENCE1_bak
                 ON REPMGR.SEQUENCE_bak
                 (SEQUENCENAME   ASC, SESSIONNAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

ALTER TABLE REPMGR.SEQUENCE_bak
  ADD CONSTRAINT PK_SEQUENC_bak PRIMARY KEY
                          (SEQUENCENAME, SESSIONNAME);

CREATE TABLE REPMGR.HA_STATUS_bak
 (HOSTNAME VARCHAR(250) NOT NULL,
  IPADDRESS VARCHAR(36) NOT NULL,
  ROLE SMALLINT NOT NULL DEFAULT 0,
  STATE SMALLINT NOT NULL DEFAULT 0,
  TIME_STAMP TIMESTAMP NOT NULL)
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX REPMGR.HA_STATUS1_bak
                 ON REPMGR.HA_STATUS_bak
                 (HOSTNAME   ASC, IPADDRESS ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
```

```
                            SECQTY 3200
                            ERASE NO
                  BUFFERPOOL BP0
                  CLOSE NO;

ALTER TABLE REPMGR.HA_STATUS_bak
  ADD CONSTRAINT PK_HA_STATU_bak PRIMARY KEY (HOSTNAME, IPADDRESS);


CREATE TABLE REPMGR.SNMP_MGRS_bak
 (MGRNAME VARCHAR (250) NOT NULL,
  PORT INTEGER NOT NULL WITH DEFAULT 162)
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX REPMGR.SNMP_MGRS1_bak
                  ON REPMGR.SNMP_MGRS_bak
                  (MGRNAME   ASC, PORT ASC)
                  USING STOGROUP SYSDEFLT
                            PRIQTY 3200
                            SECQTY 3200
                            ERASE NO
                  BUFFERPOOL BP0
                  CLOSE NO;

ALTER TABLE REPMGR.SNMP_MGRS_bak
  ADD CONSTRAINT PK_SNMP_MGR_bak PRIMARY KEY ( MGRNAME, PORT);


CREATE TABLE REPMGR.SITELOCATIONS_bak
   (SITELOCATIONID SMALLINT NOT NULL,
    SESSIONNAME VARCHAR (250) NOT NULL,
    SITENAME VARCHAR(20) NOT NULL)
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX REPMGR.SITELOCATIONS1_bak
                  ON REPMGR.SITELOCATIONS_bak
                  (SESSIONNAME ASC, SITENAME   ASC,
                   SITELOCATIONID ASC)
                  USING STOGROUP SYSDEFLT
                            PRIQTY 3200
                            SECQTY 3200
                            ERASE NO
                  BUFFERPOOL BP0
                  CLOSE NO;

ALTER TABLE REPMGR.SITELOCATIONS_bak
  ADD CONSTRAINT PK_SITELOCATIONS PRIMARY KEY
                      (SESSIONNAME, SITENAME, SITELOCATIONID);

COMMIT;
 /*
```

Note: The job must return a JCL return code of 0. Review the job log to verify that SQL Codes returned are 000 or acceptable.

9. IWNDBHAS job

The IWNDBHAS job (see Example 3-13) provides high availability backup for the SVC hardware layer.

Example 3-13 IWNDBHAS job

```
//IWNDBHAS  JOB (999,POK),'TPC-R 5.1.0',CLASS=A,REGION=0M,
//          MSGCLASS=T,NOTIFY=&SYSUID,MSGLEVEL=(1,1)
/*JOBPARM L=999,SYSAFF=SC70
//DSNTIST EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB  DD DSN=DB9D9.SDSNLOAD,DISP=SHR
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
DSN SYSTEM(D9D4)
RUN PROGRAM(DSNTIAD) -
    PLAN(DSNTIA91) -
    PARMS('RC0') -
    LIB('DB9DU.RUNLIB.LOAD')
//*******************************************************************
//*** CREATE CSM DATABASE AND CSMTS TABLESPACE ********************/
//*******************************************************************
//SYSIN    DD  *
DROP TABLE SVCHWL.LSSERVERLOCATIONMAPPING_bak;
COMMIT;
CREATE TABLE SVCHWL.LSSERVERLOCATIONMAPPING_bak
  (SERVERLOCATION VARCHAR(250) NOT NULL,
   USERNAME VARCHAR(250),
   PASSWORD VARCHAR(250),
   UNIQUENAME VARCHAR(250),
   NOTIFICATIONPORT INTEGER,
   SITELOCATIONID SMALLINT NOT NULL DEFAULT 0)
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX SVCHWL.LSSERVERLOCATIONMAPPING_bak1
                 ON SVCHWL.LSSERVERLOCATIONMAPPING_bak
                 (SERVERLOCATION ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE SVCHWL.LSSERVERLOCATIONMAPPING_bak
  ADD CONSTRAINT PK_LSSRVRLOCBAK1 PRIMARY KEY (SERVERLOCATION);
DROP TABLE SVCHWL.CLUSTERSERVERMAPPING_bak;
COMMIT;
CREATE TABLE SVCHWL.CLUSTERSERVERMAPPING_bak
  (CLUSTERNAME VARCHAR(250) NOT NULL,
   SERVERLOCATION VARCHAR(250) NOT NULL)
IN TPCR510.CSMTS;
CREATE UNIQUE INDEX SVCHWL.CLUSTERSERVERMAPPING_bak1
                 ON SVCHWL.CLUSTERSERVERMAPPING_bak
                 (CLUSTERNAME ASC, SERVERLOCATION ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
```

```
                              SECQTY 3200
                              ERASE NO
                    BUFFERPOOL BP0
                    CLOSE NO;
ALTER TABLE SVCHWL.CLUSTERSERVERMAPPING_bak
  ADD CONSTRAINT PK_CLSTSRVBAK1 PRIMARY KEY
  (CLUSTERNAME, SERVERLOCATION);
COMMIT;
/*
```

Note: The job must return a JCL return code of 0. Verify the whole log to certify that SQL Codes returned are 000 or acceptable. It is acceptable to get an *SQLCODE = -204* error when trying to drop an undefined table.

10. IWNDBMIG job

The IIWNDBMIG job (see Example 3-14) updates any table changes that have occurred from release to release of Tivoli Storage Productivity Center for Replication.

Example 3-14 IWNDBMIG job

```
//IWNDBMIG  JOB (999,POK),'TPC-R 5.1.0',CLASS=A,REGION=0M,
//         MSGCLASS=T,NOTIFY=&SYSUID,MSGLEVEL=(1,1)
/*JOBPARM L=999,SYSAFF=SC70
//*************************************************************
//DSNTIST EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB  DD DSN=DB9D9.SDSNLOAD,DISP=SHR
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
DSN SYSTEM(D9D4)
RUN PROGRAM(DSNTIAD) -
      PLAN(DSNTIA91) -
      PARM('RC0') -
      LIB('DB9DU.RUNLIB.LOAD')
//**** MIGRATION CONFIGURATION ASSISTANCE ***********************
//**** FOR CSM DATABASE V.R.M.L to V.R.M.L **********************
//*************************************************************
//SYSIN    DD  *

ALTER TABLE REPMGR.CSMUSER
  ADD COLUMN "NAME" VARCHAR (255) NOT NULL WITH DEFAULT 'nobody';
ALTER TABLE REPMGR.CSMUSER
  ADD COLUMN "TYPE" INTEGER NOT NULL WITH DEFAULT 0;
ALTER TABLE REPMGR.CSMUSER
  ADD COLUMN "PERMISSION" VARCHAR(255) NOT NULL WITH DEFAULT
           'com.ibm.csm.common.permission.LogonPermission';
ALTER TABLE REPMGR.CSMUSER
  ADD COLUMN "RESOURCE" VARCHAR(255) NOT NULL WITH DEFAULT '  LOGON  ';
ALTER TABLE REPMGR.CSMUSER
  ADD COLUMN "ACTIONS" VARCHAR(255) NOT NULL WITH DEFAULT 'none';
ALTER TABLE REPMGR.CSMUSER DROP PRIMARY KEY;
DROP INDEX REPMGR.CSMUSER1;
COMMIT;
```

```
CREATE UNIQUE INDEX REPMGR.CSMUSER1
                 ON REPMGR.CSMUSER
                 (NAME ASC, TYPE ASC,
                 PERMISSION ASC, RESOURCE ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE REPMGR.CSMUSER
  ADD CONSTRAINT PK_CSMUSER PRIMARY KEY
           (NAME, TYPE, PERMISSION, RESOURCE);
CREATE TABLE REPMGR.TMP_SESSION1
  (SESSIONNAME VARCHAR(250) NOT NULL,
   COPYRULES BLOB(100000),
   CMDBEINGPROCESSED VARCHAR(250),
   STATE VARCHAR(250),
   DESCRIPTION VARCHAR(250),
   PRODUCTIONROLE VARCHAR(250),
   NUMACTIVEDRIVERS INTEGER NOT NULL,
   INUSE SMALLINT NOT NULL,
   INGENERATE VARCHAR(250))
 IN TPCR510.CSMTS;
CREATE UNIQUE INDEX REPMGR.TMP_SESSION11
                 ON REPMGR.TMP_SESSION1
                 (SESSIONNAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

DROP TABLESPACE TPCR510.TMPCPRL;
COMMIT;
CREATE LOB TABLESPACE TMPCPRL
 IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;
CREATE AUXILIARY TABLE REPMGR.TMP_SESSION1_COPYRULES_TAB
  IN TPCR510.TMPCPRL
  STORES REPMGR.TMP_SESSION1
  COLUMN COPYRULES;
CREATE UNIQUE INDEX REPMGR.TMP_SESSION1_COPYRULES_TAB1
  ON REPMGR.TMP_SESSION1_COPYRULES_TAB
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;
COMMIT;
```

```
INSERT INTO REPMGR.TMP_SESSION1 SELECT * FROM REPMGR.SESSION1;
DROP TABLE REPMGR.SESSION1;
COMMIT;
CREATE TABLE REPMGR.SESSION1
  (SESSIONNAME VARCHAR(250) NOT NULL,
   COPYRULES BLOB(100000),
   CMDBEINGPROCESSED VARCHAR(250),
   STATE VARCHAR(250),
   DESCRIPTION VARCHAR(250),
   PRODUCTIONROLE VARCHAR(250),
   NUMACTIVEDRIVERS INTEGER NOT NULL,
   INUSE SMALLINT NOT NULL,
   INGENERATE VARCHAR(250))
 IN TPCR510.CSMTS;
CREATE UNIQUE INDEX REPMGR.SESSION11
                 ON REPMGR.SESSION1
                 (SESSIONNAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
ALTER TABLE REPMGR.SESSION1
  ADD CONSTRAINT PK_SESSION1 PRIMARY KEY (SESSIONNAME);
DROP TABLESPACE TPCR510.CPYRULTS;
COMMIT;
CREATE LOB TABLESPACE CPYRULTS
 IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;
CREATE AUXILIARY TABLE REPMGR.SESSION1_COPYRULES_TAB
  IN TPCR510.CPYRULTS
  STORES REPMGR.SESSION1
  COLUMN COPYRULES;
CREATE UNIQUE INDEX REPMGR.SESSION1_COPYRULES_TAB1
  ON REPMGR.SESSION1_COPYRULES_TAB
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;
COMMIT;
INSERT INTO REPMGR.SESSION1 SELECT * FROM REPMGR.TMP_SESSION1;
DROP TABLE REPMGR.TMP_SESSION1;
COMMIT;
CREATE TABLE REPMGR.TMP_SESSION1_bak
  (SESSIONNAME VARCHAR(250) NOT NULL,
   COPYRULES BLOB(100000),
   CMDBEINGPROCESSED VARCHAR(250),
   STATE VARCHAR(250),
   DESCRIPTION VARCHAR(250),
```

```
   PRODUCTIONROLE VARCHAR(250),
   NUMACTIVEDRIVERS INTEGER NOT NULL,
   INUSE SMALLINT NOT NULL,
   INGENERATE VARCHAR(250))
 in TPCR510.CSMTS;
CREATE UNIQUE INDEX REPMGR.TMP_SESSION1_bak1
                 ON REPMGR.TMP_SESSION1_bak
                 (SESSIONNAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

DROP TABLESPACE TPCR510.TMPCPRLB;
COMMIT;
CREATE LOB TABLESPACE TMPCPRLB
 IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;
CREATE AUXILIARY TABLE REPMGR.TMP_SESSION1_COPYRULES_TAB_bak
  IN TPCR510.TMPCPRLB
  STORES REPMGR.TMP_SESSION1_bak
  COLUMN COPYRULES;
CREATE UNIQUE INDEX REPMGR.TMP_SESSION1_COPYRULES_TAB1_bak
  ON REPMGR.TMP_SESSION1_COPYRULES_TAB_bak
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;
COMMIT;
INSERT INTO REPMGR.TMP_SESSION1_bak SELECT * FROM REPMGR.SESSION1_bak;
DROP TABLE REPMGR.SESSION1_bak;
COMMIT;
CREATE TABLE REPMGR.SESSION1_bak
  (SESSIONNAME VARCHAR(250) NOT NULL,
   COPYRULES BLOB(100000),
   CMDBEINGPROCESSED VARCHAR(250),
   STATE VARCHAR(250),
   DESCRIPTION VARCHAR(250),
   PRODUCTIONROLE VARCHAR(250),
   NUMACTIVEDRIVERS INTEGER NOT NULL,
   INUSE SMALLINT NOT NULL,
   INGENERATE VARCHAR(250))
 in TPCR510.CSMTS;
CREATE UNIQUE INDEX REPMGR.SESSION1_bak1
                 ON REPMGR.SESSION1_bak
                 (SESSIONNAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
```

```
                          SECQTY 3200
                          ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

DROP TABLESPACE TPCR510.CPYRULTB;
COMMIT;
CREATE LOB TABLESPACE CPYRULTB
 IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;
CREATE AUXILIARY TABLE REPMGR.SESSION1_COPYRULES_TAB_bak
  IN TPCR510.CPYRULTB
  STORES REPMGR.SESSION1_bak
  COLUMN COPYRULES;
CREATE UNIQUE INDEX REPMGR.SESSION1_COPYRULES_TAB_bak1
  ON REPMGR.SESSION1_COPYRULES_TAB_bak
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;
ALTER TABLE REPMGR.SESSION1_bak
  ADD CONSTRAINT PK_SESSION1_bak PRIMARY KEY (SESSIONNAME);
INSERT INTO REPMGR.SESSION1_bak SELECT * FROM REPMGR.TMP_SESSION1_bak;
DROP TABLE REPMGR.TMP_SESSION1_bak;
COMMIT;
ALTER TABLE EC.ELEMENTS
  ADD COLUMN ISPROTECTED SMALLINT NOT NULL WITH DEFAULT 0;
ALTER TABLE EC.ELEMENTS
  ADD COLUMN PROTECTIONBY VARCHAR (32) NOT NULL WITH DEFAULT 'nobody';
ALTER TABLE EC.ELEMENTS
  ADD COLUMN SITELOCATIONID SMALLINT NOT NULL WITH DEFAULT 0;
ALTER TABLE EC.ELEMENTS
  DROP CONSTRAINT PK_ELEMENTS;
COMMIT;
DROP INDEX EC.ELEMENTS1;
COMMIT;
CREATE UNIQUE INDEX EC.ELEMENTS1
                 ON EC.ELEMENTS
                 (ELEMENTID   ASC)
                 USING STOGROUP SYSDEFLT
                          PRIQTY 3200
                          SECQTY 3200
                          ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
COMMIT;
CREATE UNIQUE INDEX EC.ELEMENTS2
                 ON EC.ELEMENTS
                 (INTERNALNAME ASC, PARENTID ASC,
                  BASETYPE ASC, SPECIFICTYPE1 ASC)
```

```
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
COMMIT;
ALTER TABLE EC.ELEMENTS
  ADD CONSTRAINT PK_ELEMENTS PRIMARY KEY(ELEMENTID);
COMMIT;
ALTER TABLE EC.ELEMENTS_bak
  ADD COLUMN ISPROTECTED SMALLINT NOT NULL WITH DEFAULT 0;
ALTER TABLE EC.ELEMENTS_bak
  ADD COLUMN PROTECTIONBY VARCHAR (32) NOT NULL WITH DEFAULT 'nobody';
ALTER TABLE EC.ELEMENTS_bak
  ADD COLUMN SITELOCATIONID SMALLINT NOT NULL WITH DEFAULT 0;
ALTER TABLE EC.ELEMENTS_bak
  DROP CONSTRAINT PK_ELEMENTS_bak;
COMMIT;
DROP INDEX EC.ELEMENTS_bak1;
COMMIT;
CREATE UNIQUE INDEX EC.ELEMENTS_bak1
                 ON EC.ELEMENTS_bak
                 (ELEMENTID   ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
COMMIT;
CREATE UNIQUE INDEX EC.ELEMENTS_bak2
                 ON EC.ELEMENTS_bak
                 (INTERNALNAME ASC, PARENTID ASC,
                  BASETYPE ASC, SPECIFICTYPE1 ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;
COMMIT;
ALTER TABLE EC.ELEMENTS_bak
  ADD CONSTRAINT PK_ELEMENTS_bak PRIMARY KEY(ELEMENTID);
COMMIT;
DROP INDEX ESSHWL.ESSSMIDX;
COMMIT;
CREATE INDEX ESSHWL.ESSSMIDX
                 ON ESSHWL.ESSSERVERMAPPING
                 (ESSNAME ASC, SERVERLOCATION ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                   SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
```

```
                 CLOSE NO;

ALTER TABLE ESSHWL.SERVERLOCATIONMAPPING
        ADD COLUMN SITELOCATIONID SMALLINT NOT NULL WITH DEFAULT 0;
DROP INDEX ESSHWL.SERVLIDX;
COMMIT;
CREATE INDEX ESSHWL.SERVLIDX
                 ON ESSHWL.SERVERLOCATIONMAPPING
                 (SERVERLOCATION ASC, HOSTNAMECLUSTER0 ASC,
                  HOSTNAMECLUSTER1 ASC, SERVERTYPE ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                   SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

DROP INDEX ESSHWL.ASCMQIDX;
COMMIT;
CREATE INDEX ESSHWL.ASCMQIDX
                 ON ESSHWL.ASYNCMASTERQUERYMONITOR
                 (ESSNAME ASC, SESSIONNUMBER ASC,
                  QUERYISRUNNING ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                   SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

COMMIT;
ALTER TABLE ESSHWL.SERVERLOCATIONMAPPING_bak
        ADD COLUMN SITELOCATIONID SMALLINT NOT NULL WITH DEFAULT 0;
ALTER TABLE SVCHWL.LSSERVERLOCATIONMAPPING
        ADD COLUMN SITELOCATIONID SMALLINT NOT NULL WITH DEFAULT 0;
ALTER TABLE SVCHWL.LSSERVERLOCATIONMAPPING_bak
        ADD COLUMN SITELOCATIONID SMALLINT NOT NULL WITH DEFAULT 0;
COMMIT;

ALTER TABLE EC.ELEMENTS
        ADD COLUMN ISSPACEEFFICIENT SMALLINT NOT NULL WITH DEFAULT 0;
ALTER TABLE EC.ELEMENTS_bak
  ADD COLUMN ISSPACEEFFICIENT SMALLINT NOT NULL WITH DEFAULT 0;
COMMIT;

DROP TABLE REPMGR.DRIVER_tmp;
COMMIT;

CREATE TABLE REPMGR.DRIVER_tmp
  (DRIVERID VARCHAR(250) NOT NULL,
   TYPE1 VARCHAR(250),
   ISSHADOWING SMALLINT NOT NULL,
   CONTROLCLASS VARCHAR(250),
   NUMBEROFPAIRS INTEGER NOT NULL,
   CGINFO BLOB(50000),
```

```
   SEQUENCENAME VARCHAR(250) NOT NULL,
   SESSIONNAME VARCHAR(250) NOT NULL,
   ISDEFINED SMALLINT NOT NULL,
   TIMESTAMP1 VARCHAR(250),
   INUSE SMALLINT NOT NULL,
   HWCONSISTENCYGROUPNAME VARCHAR(250),
   ISNEW SMALLINT NOT NULL,
   PRIMARY KEY (DRIVERID, SESSIONNAME))
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX REPMGR.DRIVER1_tmp
                 ON REPMGR.DRIVER_tmp
                 (DRIVERID ASC, SESSIONNAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

CREATE LOB TABLESPACE CGINFTMP
  IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;

CREATE AUXILIARY TABLE REPMGR.DRIVER_CGINFO_TAB_tmp
  IN TPCR510.CGINFTMP
  STORES REPMGR.DRIVER_tmp
  COLUMN CGINFO;

CREATE UNIQUE INDEX REPMGR.DRIVER_CGINFO_TAB1_tmp
  ON REPMGR.DRIVER_CGINFO_TAB_tmp
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;

COMMIT;

INSERT INTO REPMGR.DRIVER_tmp SELECT * FROM REPMGR.DRIVER;
COMMIT;

DROP TABLE REPMGR.DRIVER;
DROP TABLESPACE TPCR510.CGINFOTS;
COMMIT;

CREATE TABLE REPMGR.DRIVER
  (DRIVERID VARCHAR(250) NOT NULL,
   TYPE1 VARCHAR(250),
   ISSHADOWING SMALLINT NOT NULL,
   CONTROLCLASS VARCHAR(250),
```

```
   NUMBEROFPAIRS INTEGER NOT NULL,
   CGINFO BLOB(50000),
   SEQUENCENAME VARCHAR(250) NOT NULL,
   SESSIONNAME VARCHAR(250) NOT NULL,
   ISDEFINED SMALLINT NOT NULL,
   TIMESTAMP1 VARCHAR(250),
   INUSE SMALLINT NOT NULL,
   HWCONSISTENCYGROUPNAME VARCHAR(250),
   ISNEW SMALLINT NOT NULL,
   PRIMARY KEY (DRIVERID, SESSIONNAME, SEQUENCENAME))
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX REPMGR.DRIVER1
                 ON REPMGR.DRIVER
                 (DRIVERID ASC, SESSIONNAME ASC, SEQUENCENAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

CREATE LOB TABLESPACE CGINFOTS
  IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;

CREATE AUXILIARY TABLE REPMGR.DRIVER_CGINFO_TAB
  IN TPCR510.CGINFOTS
  STORES REPMGR.DRIVER
  COLUMN CGINFO;

CREATE UNIQUE INDEX REPMGR.DRIVER_CGINFO_TAB1
  ON REPMGR.DRIVER_CGINFO_TAB
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;

COMMIT;

INSERT INTO REPMGR.DRIVER SELECT * FROM REPMGR.DRIVER_tmp;
COMMIT;

DROP TABLE REPMGR.DRIVER_tmp;
DROP TABLESPACE TPCR510.CGINFTMP;

COMMIT;

DROP TABLE REPMGR.DRIVER_bak_tmp;
COMMIT;
```

```
CREATE TABLE REPMGR.DRIVER_bak_tmp
  (DRIVERID VARCHAR(250) NOT NULL,
   TYPE1 VARCHAR(250),
   ISSHADOWING SMALLINT NOT NULL,
   CONTROLCLASS VARCHAR(250),
   NUMBEROFPAIRS INTEGER NOT NULL,
   CGINFO BLOB(50000),
   SEQUENCENAME VARCHAR(250) NOT NULL,
   SESSIONNAME VARCHAR(250) NOT NULL,
   ISDEFINED SMALLINT NOT NULL,
   TIMESTAMP1 VARCHAR(250),
   INUSE SMALLINT NOT NULL,
   HWCONSISTENCYGROUPNAME VARCHAR(250),
   ISNEW SMALLINT NOT NULL,
   PRIMARY KEY (DRIVERID, SESSIONNAME))
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX REPMGR.DRIVER1_bak_tmp
                 ON REPMGR.DRIVER_bak_tmp
                 (DRIVERID ASC, SESSIONNAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

CREATE LOB TABLESPACE CGIBTMP
  IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;

CREATE AUXILIARY TABLE REPMGR.DRIVER_CGINFO_TAB_bak_tmp
  IN TPCR510.CGIBTMP
  STORES REPMGR.DRIVER_bak_tmp
  COLUMN CGINFO;

CREATE UNIQUE INDEX REPMGR.DRIVER_CGINFO_TAB_bak1_tmp
  ON REPMGR.DRIVER_CGINFO_TAB_bak_tmp
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;

COMMIT;

INSERT INTO REPMGR.DRIVER_bak_tmp SELECT * FROM REPMGR.DRIVER_bak;
COMMIT;

DROP TABLE REPMGR.DRIVER_bak;
```

```
DROP TABLESPACE TPCR510.CGINFOTB;
COMMIT;

CREATE TABLE REPMGR.DRIVER_bak
  (DRIVERID VARCHAR(250) NOT NULL,
   TYPE1 VARCHAR(250),
   ISSHADOWING SMALLINT NOT NULL,
   CONTROLCLASS VARCHAR(250),
   NUMBEROFPAIRS INTEGER NOT NULL,
   CGINFO BLOB(50000),
   SEQUENCENAME VARCHAR(250) NOT NULL,
   SESSIONNAME VARCHAR(250) NOT NULL,
   ISDEFINED SMALLINT NOT NULL,
   TIMESTAMP1 VARCHAR(250),
   INUSE SMALLINT NOT NULL,
   HWCONSISTENCYGROUPNAME VARCHAR(250),
   ISNEW SMALLINT NOT NULL,
   PRIMARY KEY (DRIVERID, SESSIONNAME, SEQUENCENAME))
IN TPCR510.CSMTS;

CREATE UNIQUE INDEX REPMGR.DRIVER1_bak
                 ON REPMGR.DRIVER_bak
                 (DRIVERID ASC, SESSIONNAME ASC, SEQUENCENAME ASC)
                 USING STOGROUP SYSDEFLT
                           PRIQTY 3200
                           SECQTY 3200
                           ERASE NO
                 BUFFERPOOL BP0
                 CLOSE NO;

CREATE LOB TABLESPACE CGINFOTB
  IN TPCR510
  USING STOGROUP SYSDEFLT
     PRIQTY 3200
     SECQTY 3200
  LOG NO;

CREATE AUXILIARY TABLE REPMGR.DRIVER_CGINFO_TAB_bak
  IN TPCR510.CGINFOTB
  STORES REPMGR.DRIVER_bak
  COLUMN CGINFO;

CREATE UNIQUE INDEX REPMGR.DRIVER_CGINFO_TAB_bak1
  ON REPMGR.DRIVER_CGINFO_TAB_bak
  USING STOGROUP SYSDEFLT
  PRIQTY 3200
  SECQTY 3200
  ERASE NO
  BUFFERPOOL BP0
  CLOSE NO;

COMMIT;

INSERT INTO REPMGR.DRIVER_bak SELECT * FROM REPMGR.DRIVER_bak_tmp;
COMMIT;
```

```
DROP TABLE REPMGR.DRIVER_CGINFO_TAB_bak_tmp;
DROP TABLE REPMGR.DRIVER_bak_tmp;
DROP TABLESPACE TPCR510.CGIBTMP;

COMMIT;
/*
```

Note: The job must return a JCL return code of 0. Review the job log to verify that SQL Codes returned are 000 or acceptable. It is acceptable to get an *SQLCODE = -204* error when trying to drop an undefined table.

11. IWNDBH2ZZ job

The IWNDB2ZZ job (see Example 3-15) sets the initial user that will have access to Tivoli Storage Productivity Center for Replication and also sets the communication default for the server to the Tivoli Storage Productivity Center for Replication CLI and GUI. In Example 3-15, you need to specify the userid used for Tivoli Storage Productivity Center for Replication installation in the *INSERT INTO REPMGR.CSMUSER VALUES* SQL statement. In our example, **WOEMADM** is the administrator WebSphere user ID which is going to be used for the Tivoli Storage Productivity Center for Replication installation.

Example 3-15 IWNDB2ZZ job

```
//IWNDB2ZZ  JOB (999,POK),'TPC-R 5.1.0',CLASS=A,REGION=0M,
//         MSGCLASS=T,NOTIFY=&SYSUID,MSGLEVEL=(1,1)
/*JOBPARM L=999,SYSAFF=SC70
//DSNTIST EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB  DD DSN=DB9D9.SDSNLOAD,DISP=SHR
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
DSN SYSTEM(D9D4)
RUN PROGRAM(DSNTIAD) -
    PLAN(DSNTIA91) -
PARMS('RC0') -
    LIB('DB9DU.RUNLIB.LOAD')
//*****************************************************************
//****CREATE CSM DATABASE AND CSMTS TABLESPACE ******************
//*****************************************************************
//SYSIN    DD  *
DELETE FROM REPMGR.CSMUSER WHERE NAME='*';
COMMIT;
INSERT INTO REPMGR.CSMUSER VALUES
  ('csmgui',2,'com.ibm.csm.common.permission.AdministratorPermission',
  'SYSTEM','*');
INSERT INTO REPMGR.CSMUSER VALUES
  ('Administrators',1,'com.ibm.csm.common.permission.LogonPermission',
  'Logon','*');
INSERT INTO REPMGR.CSMUSER VALUES
  ('WOEMADM',0,
  'com.ibm.csm.common.permission.AdministratorPermission',
  'SYSTEM','*');
COMMIT;
```

Note: The job must return a JCL return code of 0. Review the joblog to verify that SQL Codes returned are 000 or acceptable. It is acceptable to get an *SQLCODE = -204* error when trying to drop an undefined table.

To avoid a return code 4, you can add the **PARMS('RC0')** parameter as highlighted in JCL Example 3-15 on page 98.

Verifying Tivoli Storage Productivity Center for Replication database creation

Check if all Tivoli Storage Productivity Center for Replication database tables were created successfully. The following SQL command lists all the tables created in Tivoli Storage Productivity Center for Replication repository database:

```
SELECT * FROM SYSIBM.SYSTABLES
WHERE DBNAME = 'TPCR510';
```

Or you can do this by using JCL as shown in Example 3-16.

Example 3-16 Executing SQL commands using DSNTE2

```
//MLTPCR22  JOB (999,POK),'TPC-R 340',CLASS=A,MSGLEVEL=(1,1),
// MSGCLASS=T,NOTIFY=&SYSUID,REGION=0M,TIME=NOLIMIT
/*JOBPARM L=999,SYSAFF=SC74
//DSNTIST EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB DD DSN=DB9D9.SDSNLOAD,DISP=SHR
//SYSTSPRT DD SYSOUT=*
//SYSPRINT DD SYSOUT=*
//SYSUDUMP DD SYSOUT=*
//SYSTSIN DD *
 DSN SYSTEM(D9D4)
 RUN PROGRAM(DSNTEP2) -
     PLAN(DSNTEP91) -
     LIB('DB9DU.RUNLIB.LOAD')
//SYSIN DD *
SELECT * FROM SYSIBM.SYSTABLES
WHERE DBNAME = 'TPCR510';
/*
```

Check if all tables were created by comparing the table names listed in the output result of the foregoing SQL commands with the table names used in each job previously submitted (search for the **CREATE TABLE** SQL statement in each job). If you have accidentally skipped some job, you need to run it now before you proceed with the installation.

Table 3-2 lists all tables in the Tivoli Storage Productivity Center for Replication database created previously.

Table 3-2 Tivoli Storage Productivity Center for Replication database tables

	Tivoli Storage Productivity Center for Replication table names
1	SVCHWL.LSSERVERLOCATIONMAPPING
2	SVCHWL.CLUSTERSERVERMAPPING
3	EC.ELEMENTS

	Tivoli Storage Productivity Center for Replication table names
4	EC.SITELOCATION
5	ESSHWL.ESSSERVERMAPPING
6	ESSHWL.ESSSERVERMAPPING_ESSINFORMATION_TAB
7	ESSHWL.SERVERLOCATIONMAPPING
8	ESSHWL.ESSPATH
9	ESSHWL.ESSPATH_SOURCEPORTS_TAB
10	ESSHWL.ESSPATH_TARGETPORTS_TAB
11	ESSHWL.ESSPATH_AUTOGENERATED_TAB
12	ESSHWL.ASYNCMASTERQUERYMONITOR
13	REPMGR.CSMUSER
14	REPMGR.CSMPROPERTIES
15	REPMGR.DRIVER
16	REPMGR.DRIVER_CGINFO_TAB
17	REPMGR.PAIR
18	REPMGR.PAIR_LASTRESULTINSERTS_TAB
19	REPMGR.SESSION1
20	REPMGR.SESSION1_COPYRULES_TAB
21	REPMGR.COPYSET
22	REPMGR.POINT
23	REPMGR.SEQUENCE
24	REPMGR.HA_STATUS
25	REPMGR.SNMP_MGRS
26	REPMGR.SITELOCATIONS
27	EC.ELEMENTS_BAK
28	EC.SITELOCATION_BAK
29	ESSHWL.ESSSERVERMAPPING_BAK
30	ESSHWL.ESSSERVERMAPPING_ESSINFORMATION_TAB_BAK
31	ESSHWL.SERVERLOCATIONMAPPING_BAK
32	ESSHWL.ESSPATH_BAK
33	ESSHWL.ESSPATH_SOURCEPORTS_TAB_BAK
34	ESSHWL.ESSPATH_TARGETPORTS_TAB_BAK
35	ESSHWL.ESSPATH_AUTOGENERATED_TAB_BAK

	Tivoli Storage Productivity Center for Replication table names
36	ESSHWL.ASYNCMASTERQUERYMONITOR_BAK
37	REPMGR.CSMUSER_BAK
38	REPMGR.CSMPROPERTIES_BAK
39	REPMGR.DRIVER_BAK
40	REPMGR.DRIVER_CGINFO_TAB_BAK
41	REPMGR.PAIR_BAK
42	REPMGR.PAIR_LASTRESULTINSERTS_TAB_BAK
43	REPMGR.SESSION1_BAK
44	REPMGR.SESSION1_COPYRULES_TAB_BAK
45	REPMGR.COPYSET_BAK
46	REPMGR.POINT_BAK
47	REPMGR.SEQUENCE_BAK
48	REPMGR.HA_STATUS_BAK
49	REPMGR.SNMP_MGRS_BAK
50	REPMGR.SITELOCATIONS_BAKAK
51	SVCHWL.LSSERVERLOCATIONMAPPING_BAK
52	SVCHWL.CLUSTERSERVERMAPPING_BAK

Note: The jobs contain table names with a TMP qualifier. These are temporary tables created and deleted during job execution and therefore are not included in the list of Tivoli Storage Productivity Center for Replication tables.

3.6.3 DB2 for z/OS customization

In this section, we describe the step-by-step procedure required to customize DB2 for z/OS using WebSphere Administration console. Ask your WebSphere administrator to provide the WebSphere Admin console URL. This is the default URL:

`https://server.domain.com:9443/ibm/console/`

In our installation, we used the following URL:

`http://wtsc74.itso.ibm.com:9106/ibm/console/`

Here, **`wtsc74.itso.ibm.com`** is our server name, where WebSphere Application Server is installed and **`9106`** is WebSphere HTTPS port.

Proceed as follows:

1. Log on to the WebSphere Administrator console using the user ID provided by the WebSphere administrator as shown in Figure 3-9. In our example we use the WebSphere Application Server Administrator user ID.

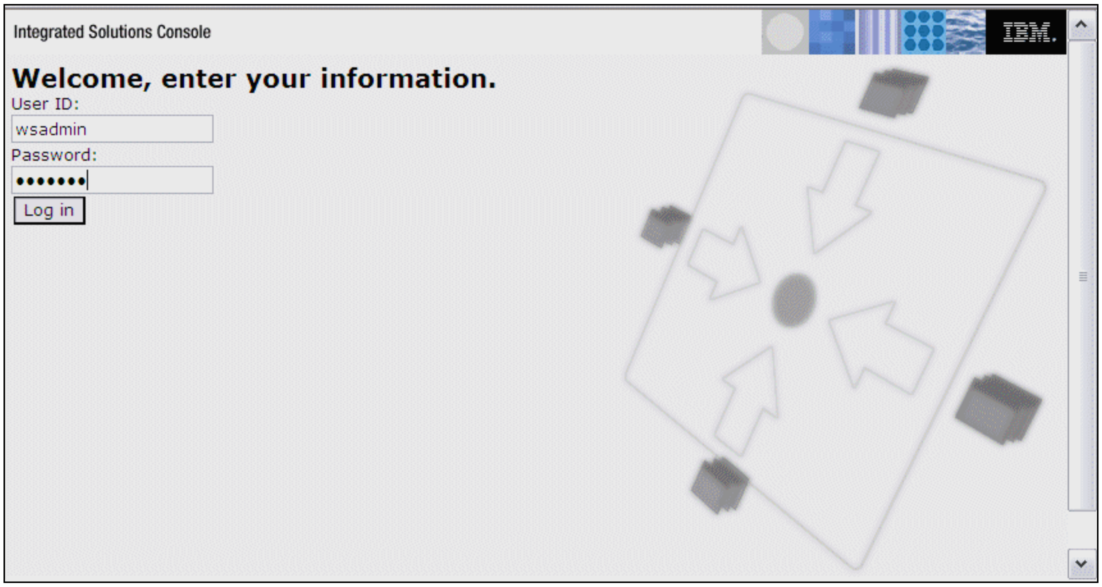

Figure 3-9 WebSphere Admin console logon panel

After your successful logon, you receive the WebSphere welcome panel as shown in Figure 3-10.

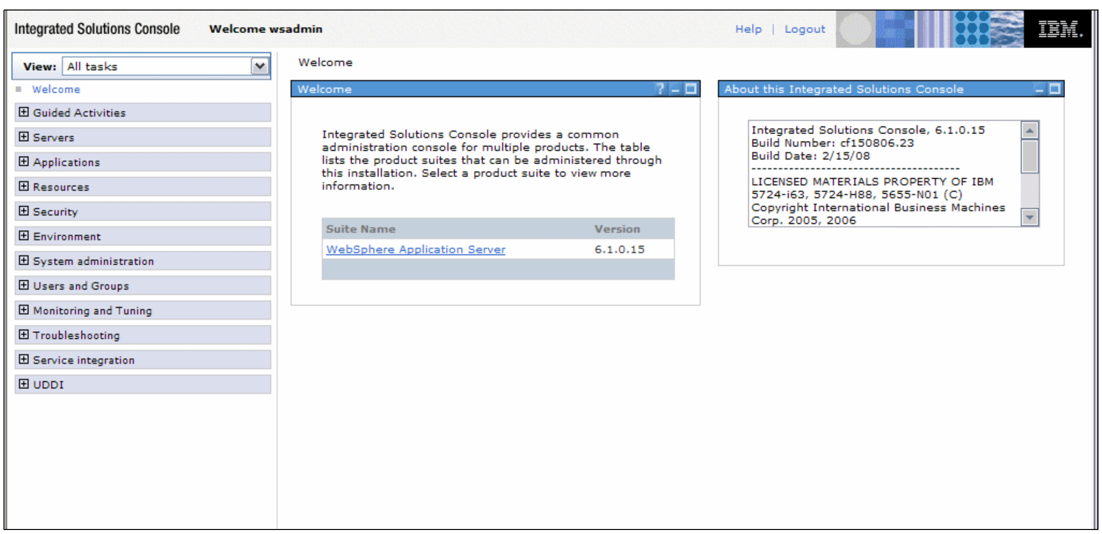

Figure 3-10 WebSphere welcome panel

2. After you have logged in to the WebSphere console, click the **Environment** twisty in the left pane. From the expanded list, click **WebSphere Variables** as shown in Figure 3-11. The right side pane will display a list of the WebSphere Variables and their values.

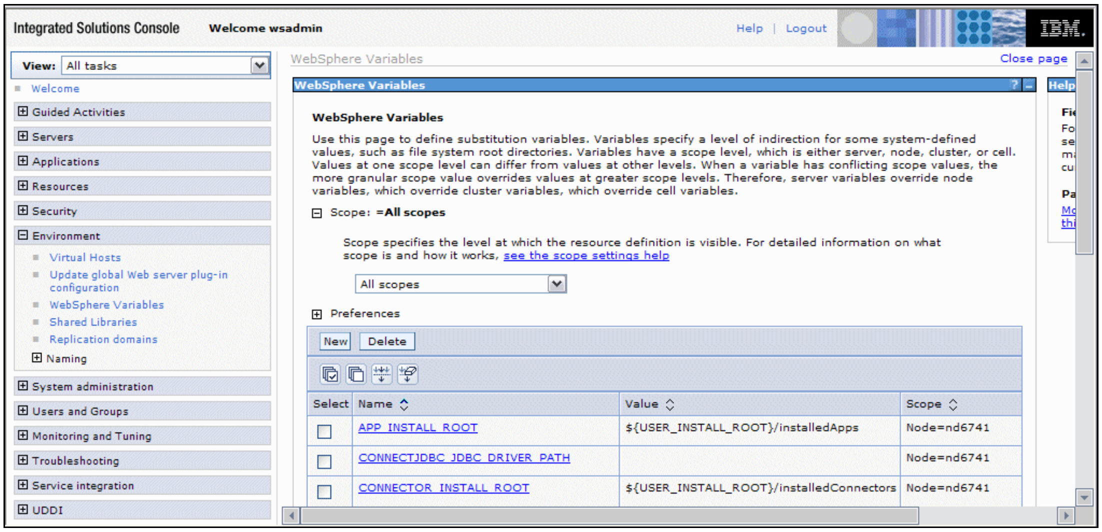

Figure 3-11 WebSphere Variables

3. Scroll down the WebSphere Variables list to find the following environment variables that are required to define paths to jar files that connect WebSphere to DB2 using IBM Java:
   - DB2UNIVERSAL_JDBC_DRIVER_NATIVEPATH
   - DB2UNIVERSAL_JDBC_DRIVER_PATH
   - DB2_JDBC_DRIVER_PATH
4. Click **DB2UNIVERSAL_JDBC_DRIVER_NATIVEPATH** and the window in Figure 3-12 displays.

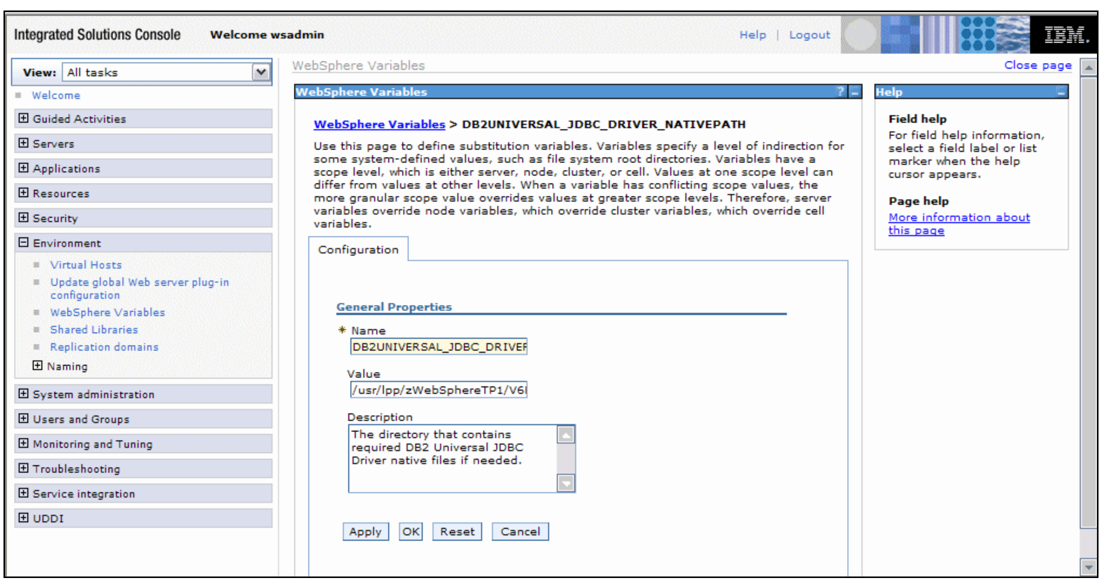

Figure 3-12 DB2UNIVERSAL_JDBC_DRIVER_NATIVEPATH variable

5. In the **Value** field, enter the path to the DB2UNIVERSAL_JDBC_DRIVER_NATIVEPATH and select **OK**. The path is similar to this example:

   -DB2_install_path`/lib`

6. Ensure in USS that the following files are there:
   - libdb2jcct2zos.so
   - libdb2jcct2zos_64.so
   - libdb2jcct2zos4.so
   - libdb2jcct2zos4_64.so
7. Repeat the same procedure for these files:
   - DB2UNIVERSAL_JDBC_DRIVER_PATH
   - DB2_JDBC_DRIVER_PATH.
8. The path to DB2UNIVERSAL_JDBC_DRIVER_PATH and DB2_JDBC_DRIVER_PATH is similar to this example:

   -DB2_install_path`/jcc/classes`
9. Make sure that the following files are there from USS:
   - db2jcc.jar
   - db2jcc_javax.jar
   - db2jcc_license_cisuz.jar

After all three variables are set, click the **Save directly to the master configuration** link as shown in Figure 3-13.

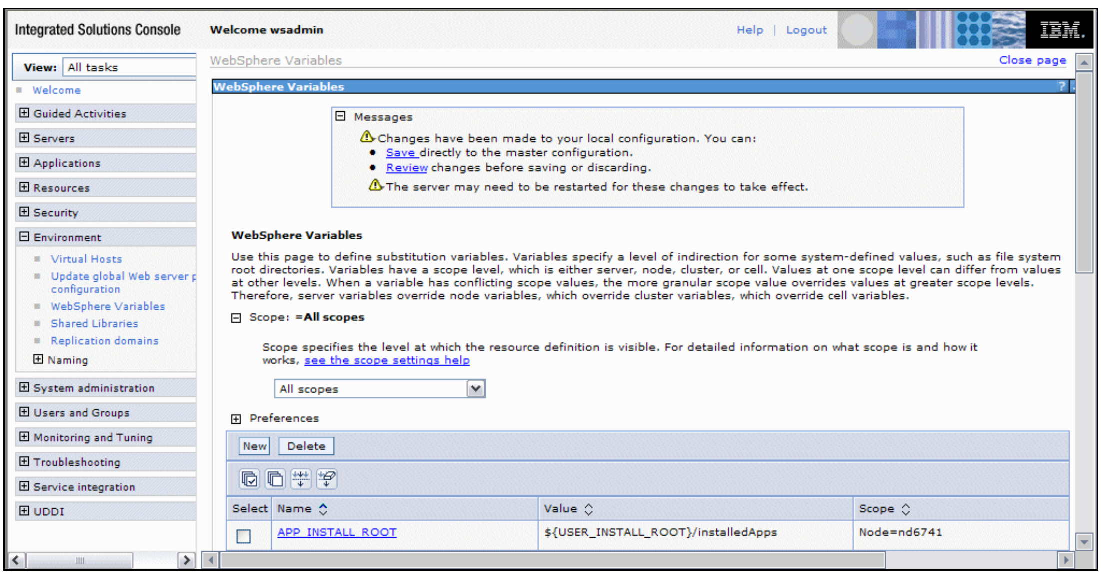

Figure 3-13 Save WebSphere Variables changes to the master configuration

10. The next step is to define a data source provider through the WebSphere Admin console by expanding **Resources** in the *left side pane*. From the expanded **Resources** menu, expand **JDBC** and select **JDBC Providers**. The panel in Figure 3-14 will be displayed. In the **Create new JDBC provider** pane, select your WebSphere node and server as the scope in the pull-down menu and select **New** under the Preferences section.

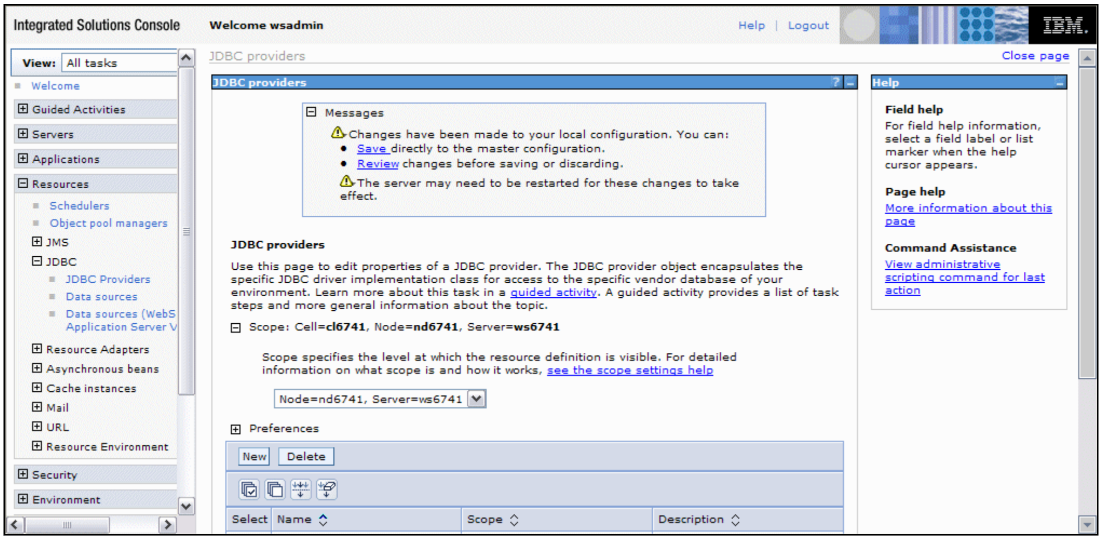

Figure 3-14 JDBC Providers

At this point, you are about to set up the new JDBC Provider as shown in Figure 3-15.

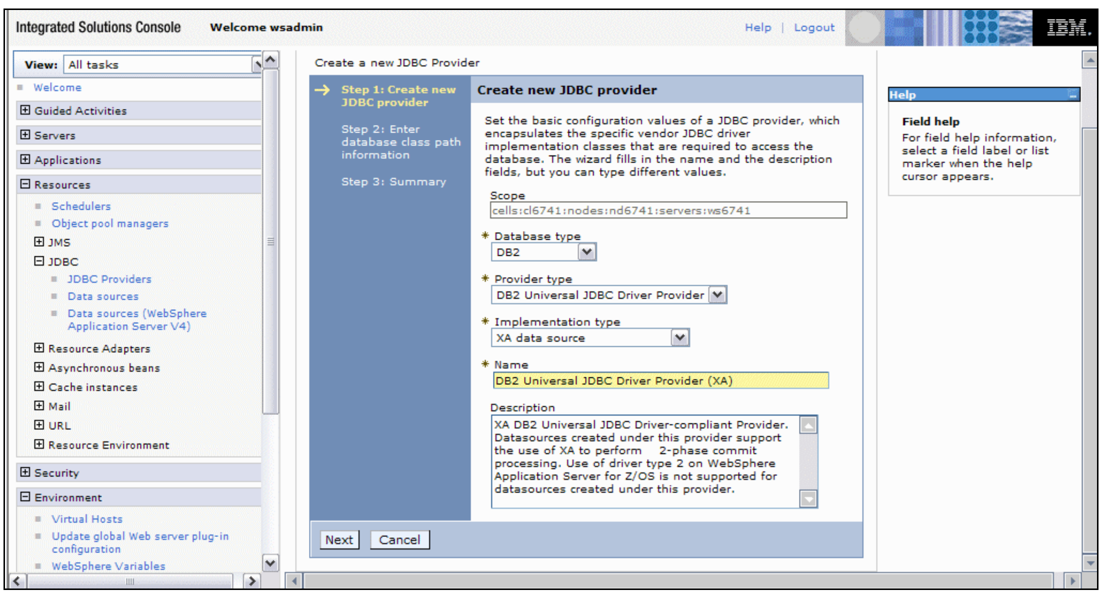

Figure 3-15 Create new JDBC Provider - Step 1

In this first step, make sure you have the correct WebSphere cell, node, and server name in the **Scope** field:

1. Select the following values for the next three fields:
   - Database type pull-down list: **DB2**
   - Provider type pull-down list: **DB2 Universal JDBC Driver Provider**
   - Implementation type pull-down list: **XA data source**

   In the Name text field, the default description is **DB2 Universal JDBC Driver Provider (XA)**. However, if you have already defined JDBC Providers for different applications, you can change it to **CSM Provider** (CSM represents Tivoli Storage Productivity Center for Replication and it stands for Copy Services Manager).

2. Click **Next** to continue. The step 2 panel is displayed (see Figure 3-16).

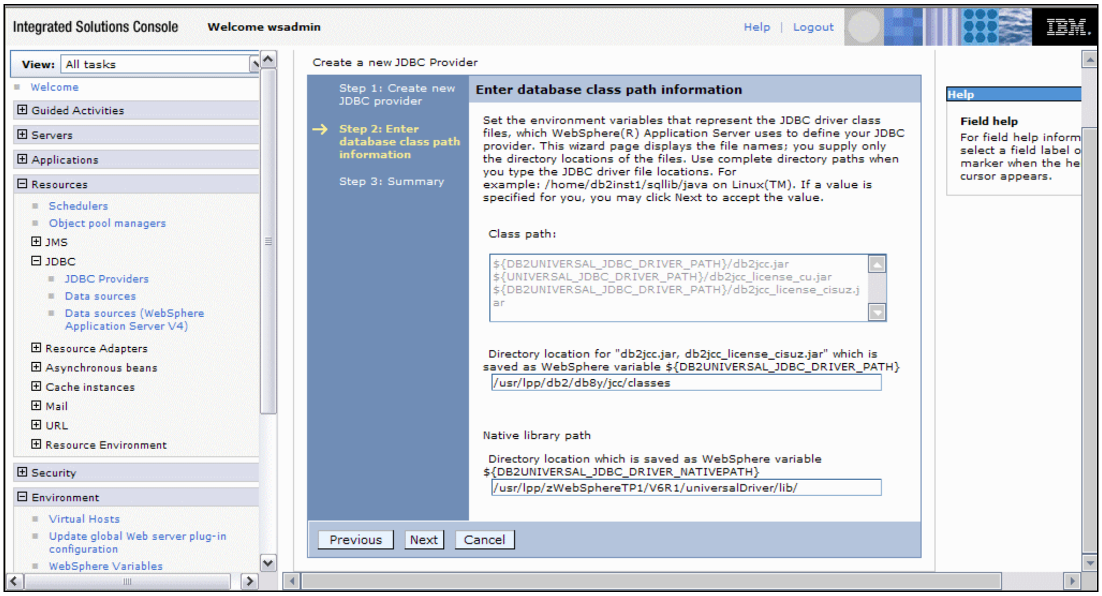

Figure 3-16 Create new JDBC Provider - Step 2

3. In this panel, you provide the database class path information. Provide the correct location for **db2jcc.jar** and **db2jcc_license_cisuz.jar** files as well as location for **DB2UNIVERSAL_JDBC_DRIVER_NATIVEPATH**. Use the same path which was saved in the WebSphere variable panel previously (see Figure 3-12 on page 103).
4. Click **Next** to proceed to the next panel as shown in Figure 3-17.

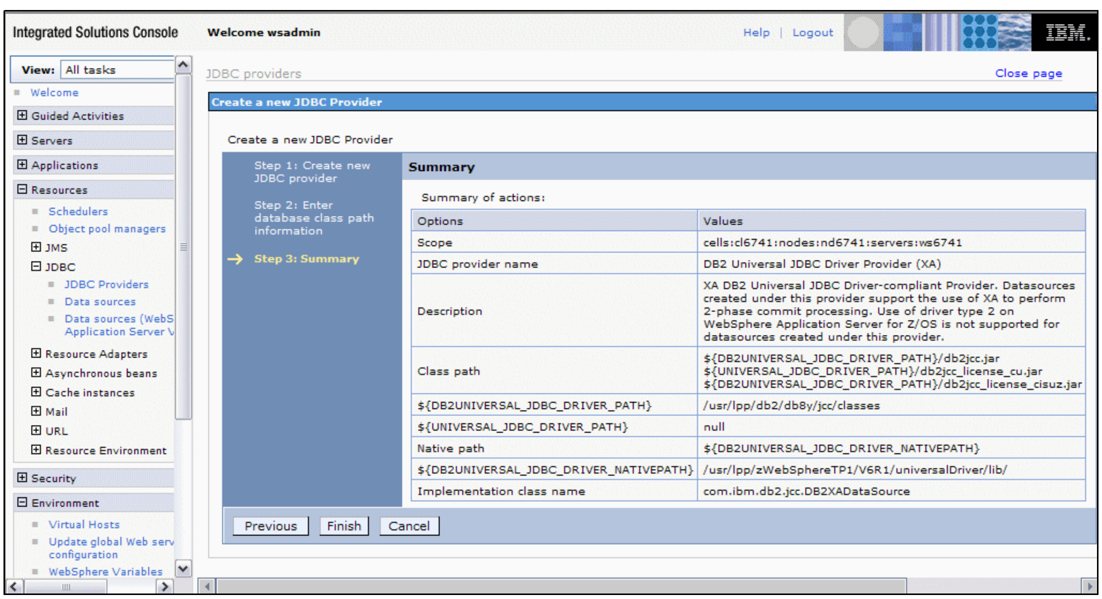

Figure 3-17 Create new JDBC Provider - Summary

5. Verify that all values are correct and click **Finish.** In the next panel, save the changes to the master configuration by clicking **Save directly to the master configuration** in the Messages box, as shown in Figure 3-18.

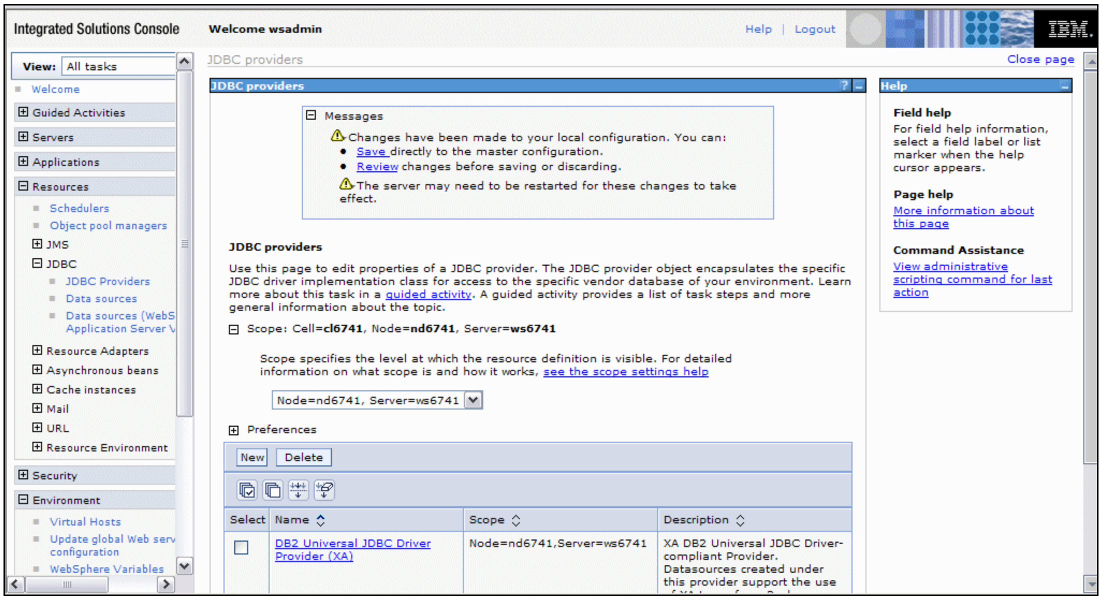

Figure 3-18 Save the new JDBC Provider to the master configuration

6. After you have set up a JDBC Provider, the next step is to define a data source by navigating in the left pane to **Resources**, then **JDBC**, and click the **Data Sources** link as shown in Figure 3-19. Make sure you have the correct WebSphere cell, node, and server name in the **Scope** field. Click **New** in the Data sources pane under the Preferences section to continue.

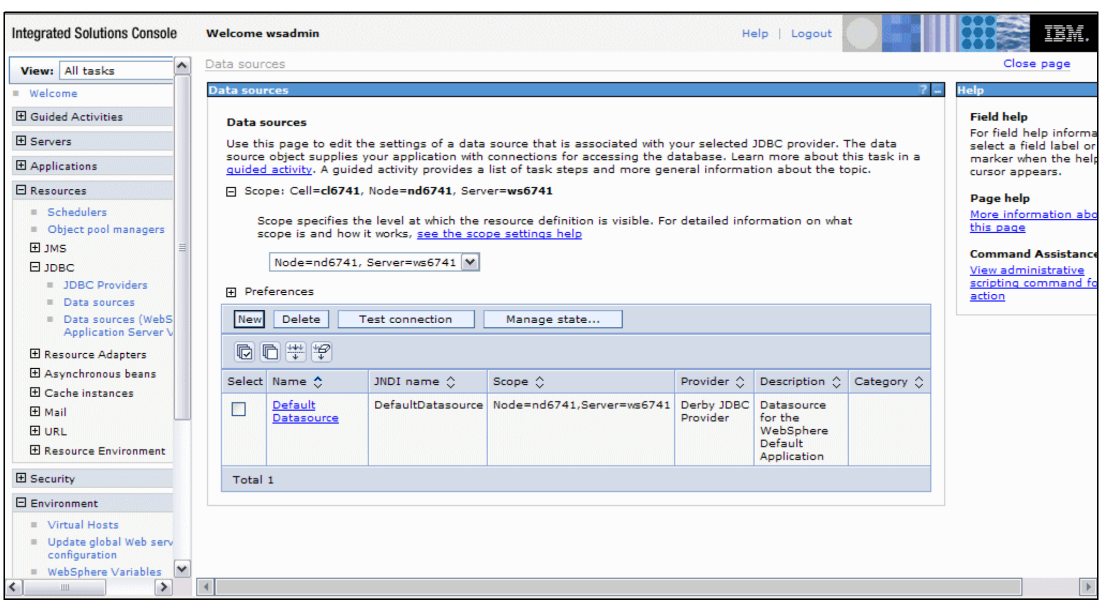

Figure 3-19 Data sources

Follow the wizard instructions to create the Data source:

1. The first step is shown in Figure 3-20. Verify that you have the correct WebSphere cell, node and server name in the **Scope** field. Enter the following values:

   – Data source name filed: **CSMDS**
   – JNDI name field: **jdbc/CSMDS**

   The component-managed authentication alias for DB2 will be created later. Select **Next** to proceed to the following step.

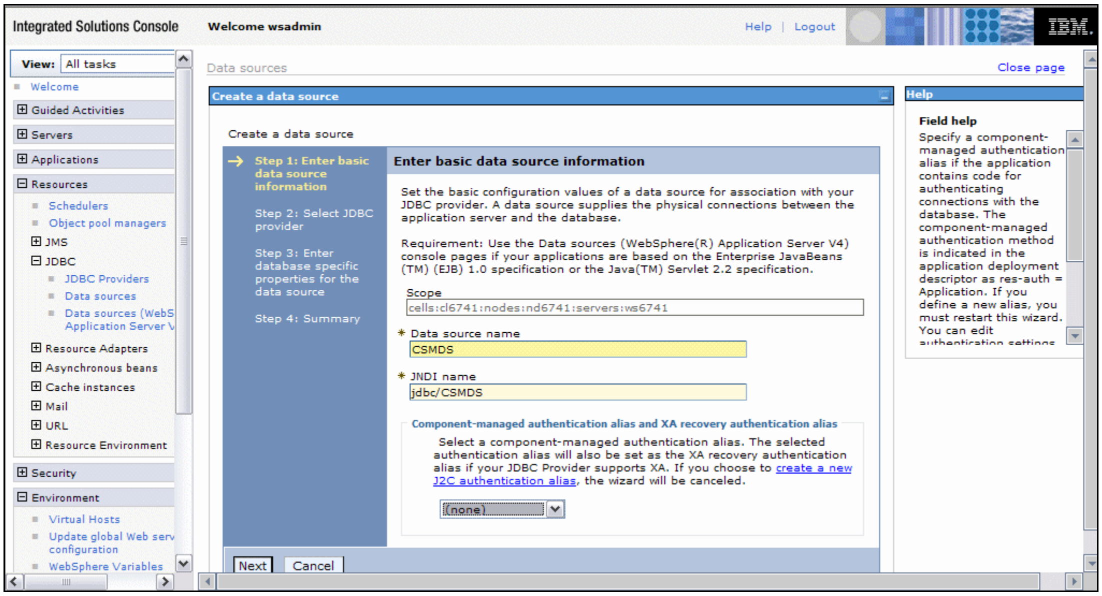

Figure 3-20 Create new Data Source - Step1

2. Click the **Select an existing JDBC Provider** radio button and select the JDBC provider you created earlier from the pull-down menu as shown in Figure 3-21. Click **Next** to continue.

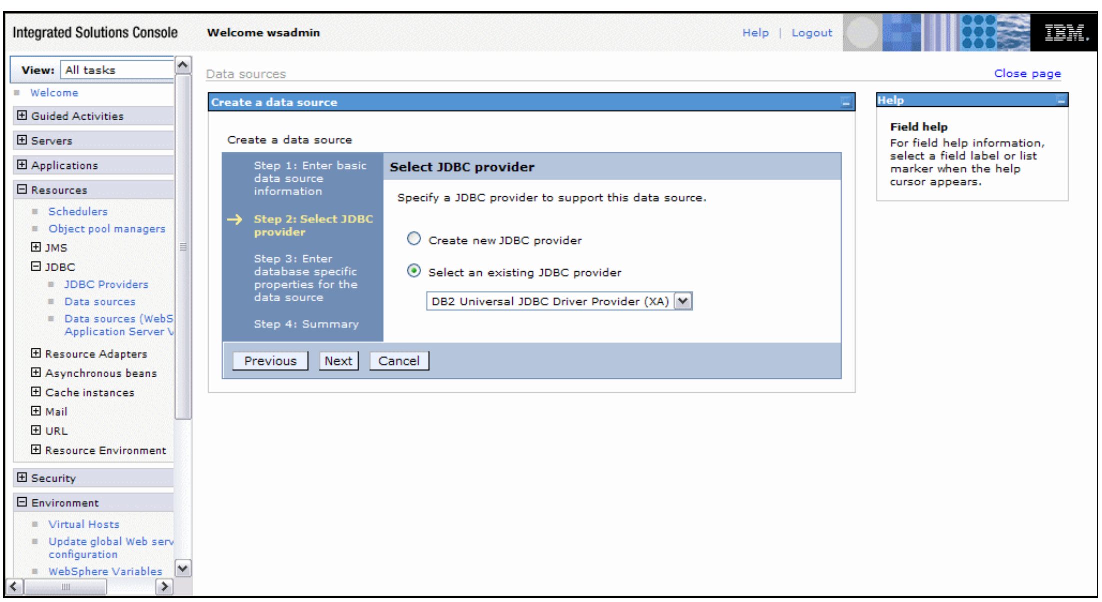

Figure 3-21 Create new Data Source - Step 2

3. You need to provide the following information in Step 3 (see Figure 3-22):
   – Database name: Name of the DB2 subsystem on z/OS where the Tivoli Storage Productivity Center for Replication database is created
   – Server name: TCP/IP address or host name of the z/OS system where the foregoing DB2 subsystem resides
   – Port number: TCP/IP port number where DB2 IBM Distributed Relational Database Architecture™ - IBM DRDA® server resides

   In order to find this information, go to z/OS SDSF and issue the following command:

   -DB8Y **display DDF**

   Here, ***-DB8Y*** is the DB2 recognition character of our DB2 subsystem. The output result of this command is shown in Example 3-17.

Example 3-17 DB2 **display DDF** *command*

```
DSNL080I  -DB8Y DSNLTDDF DISPLAY DDF REPORT FOLLOWS:
DSNL081I STATUS=STARTD
DSNL082I LOCATION           LUNAME            GENERICLU
DSNL083I DB8Y               USIBMSC.SCPDB8Y   -NONE
DSNL084I IPADDR          TCPPORT RESPORT
DSNL085I 9.12.4.70       38270   38271
DSNL086I SQL    DOMAIN=wtsc74.itso.ibm.com
DSNL086I RESYNC DOMAIN=wtsc74.itso.ibm.com
DSNL099I DSNLTDDF DISPLAY DDF REPORT COMPLETE
```

4. The alternative is to look at the DB2 master address space log (SDSF → DA). The DB2 master address space name is similar to ***XXXX*****MSTR.** Search for DDF keyword and you should see similar DDF information as shown in Example 3-18.

Example 3-18 DDF information from DB2 master address space log

```
-DB8Y DDF START COMPLETE  918
 LOCATION  DB8Y
 LU        USIBMSC.SCPDB8Y
 GENERICLU -NONE
 DOMAIN    wtsc74.itso.ibm.com
 TCPPORT   38270
 RESPORT   38271
```

Note: Distributed Data Facility - DDF has to be installed and running. Otherwise you will not be able to complete the installation and use Tivoli Storage Productivity Center for Replication.

Based on our DB2 subsystem installation setup and the information in Example 3-17 and Example 3-18, we used the following values (see Figure 3-22):

– Database name: **DB8Y**
– Server name: **wtsc74.itso.ibm.com**
– Port number: **38270**

In addition, select **4** from the **Driver type** pull-down list and check the **Use this data source in Container Managed Persistence (CMP)** check box.

Note: Driver Type specifies the JDBC connectivity type of the data source. On the z/OS platform, the Type 4 driver implementation that connects to the DB2 Subsystem uses Distributed Relational Database Architecture - DRDA over TCP/IP, whereas the Type 2 driver implementation connects to the DB2 Subsystem through Resource Recovery Services - RRS (it requires DLLs that are included with DB2 for z/OS V8 and APAR PQ80841 distribution for the driver).

Generally, use the DB2 Universal JDBC Driver Type 2 implementation for local DB2 connections and Type 4 implementation for remote DB2 connections. “Local” means that the DB2 Subsystem is located in the same LPAR as WebSphere Application Server for z/OS; whereas “remote” refers to the DB2 Subsystem located on a different LPAR from the WebSphere Application Server for z/OS.

In our environment, Type 4 was used.

Click **Next** to continue.

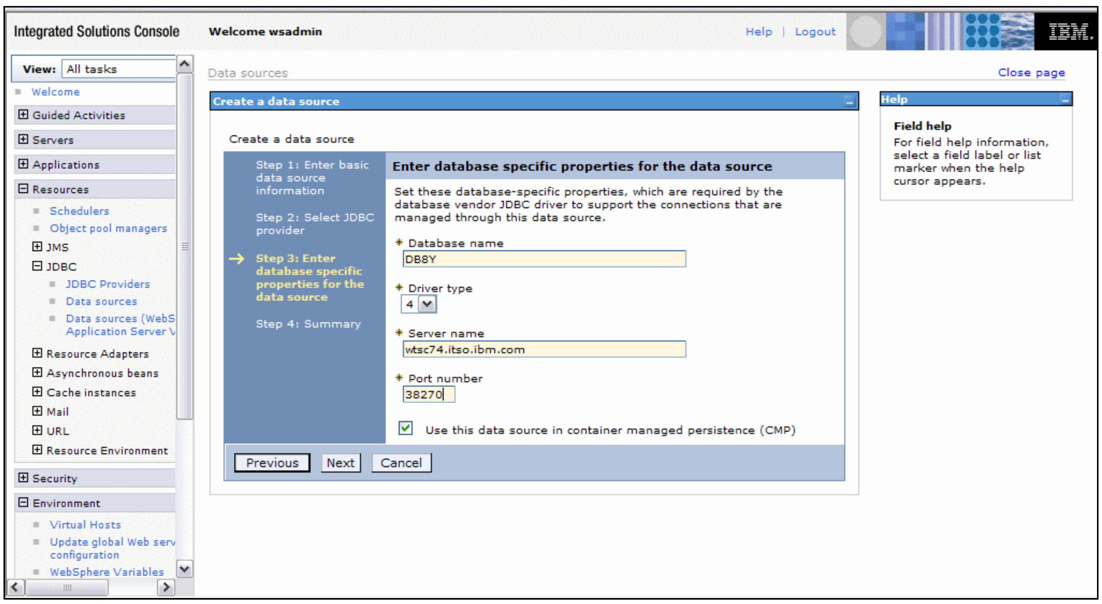

Figure 3-22 Create new Data Source - Step 3

5. The next panel you are presented (see Figure 3-23) provides a Data source summary. Verify that all values are correct and click **Finish** to continue.

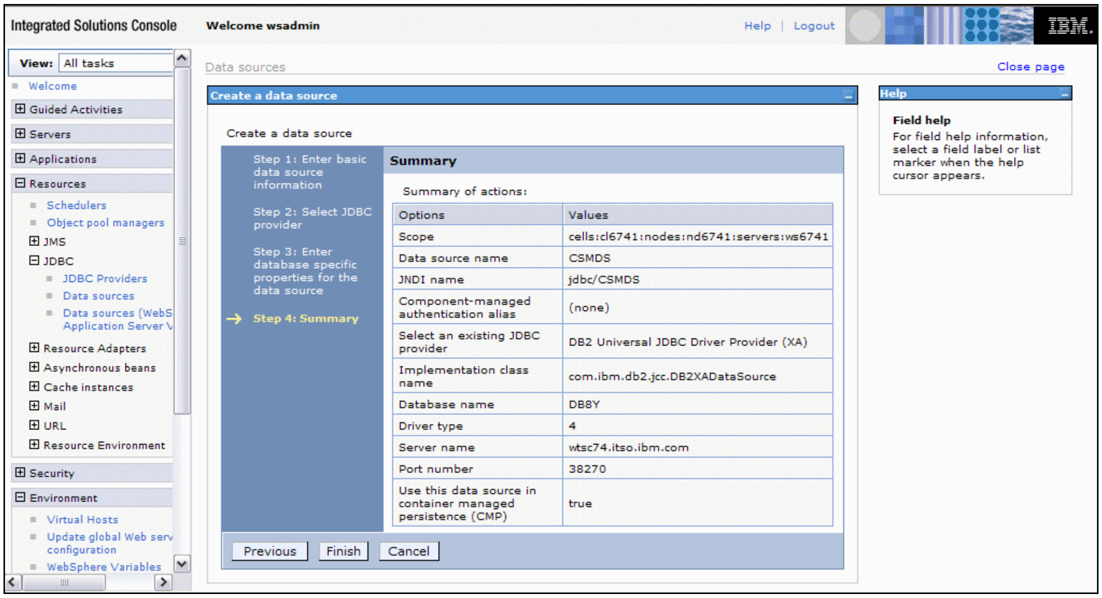

Figure 3-23 Create new Data Source - Summary

6. In the next panel, click the **Save directly to the master configuration** link (see Figure 3-24) to save the Data source changes to the master configuration.

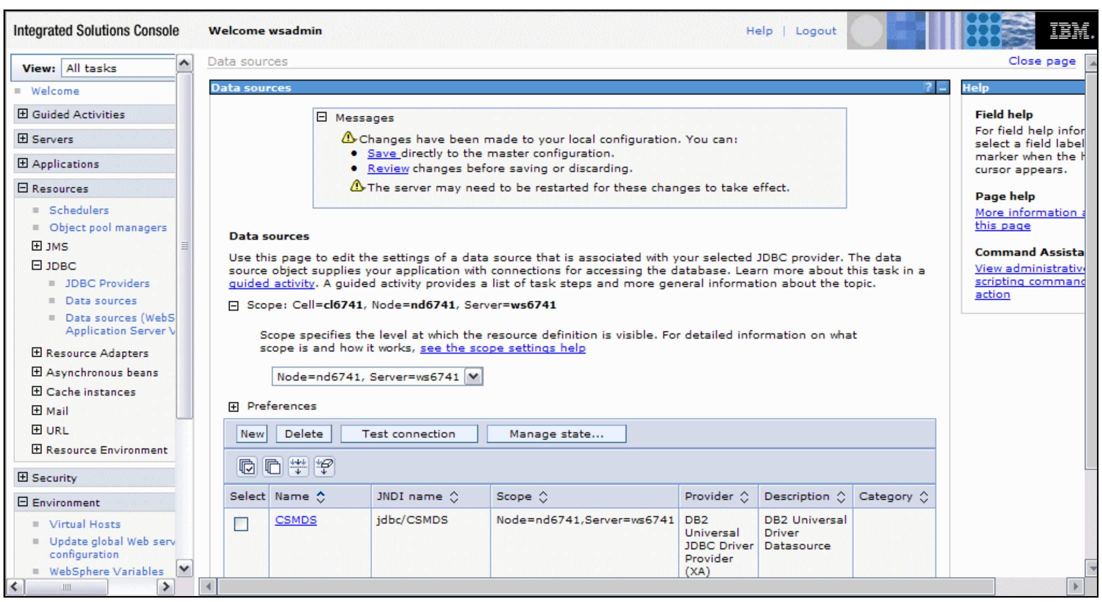

Figure 3-24 Save the new Data source to the master configuration

7. After the configuration has been saved, click the **CSMDS** link to the data source you have created (see Figure 3-25) in order to set up J2EE Connector Architecture (J2C) authentication.

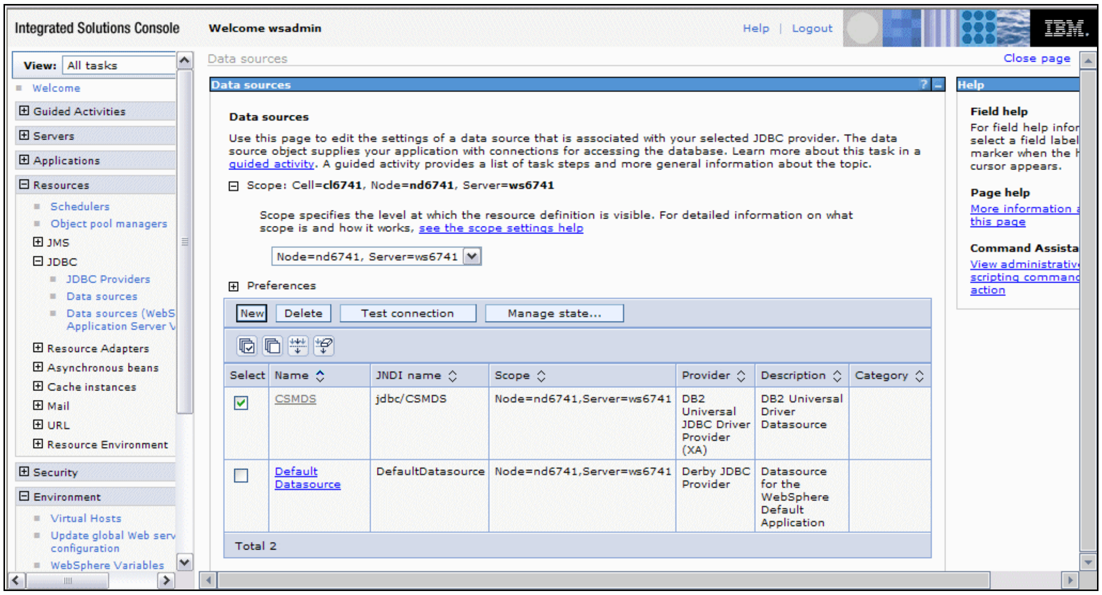

Figure 3-25   CSMDS Data Source

8. On the right side of the Data sources pane, under the heading **Related Items**, click **JAAS - J2C authentication data entries** as shown in Figure 3-26.

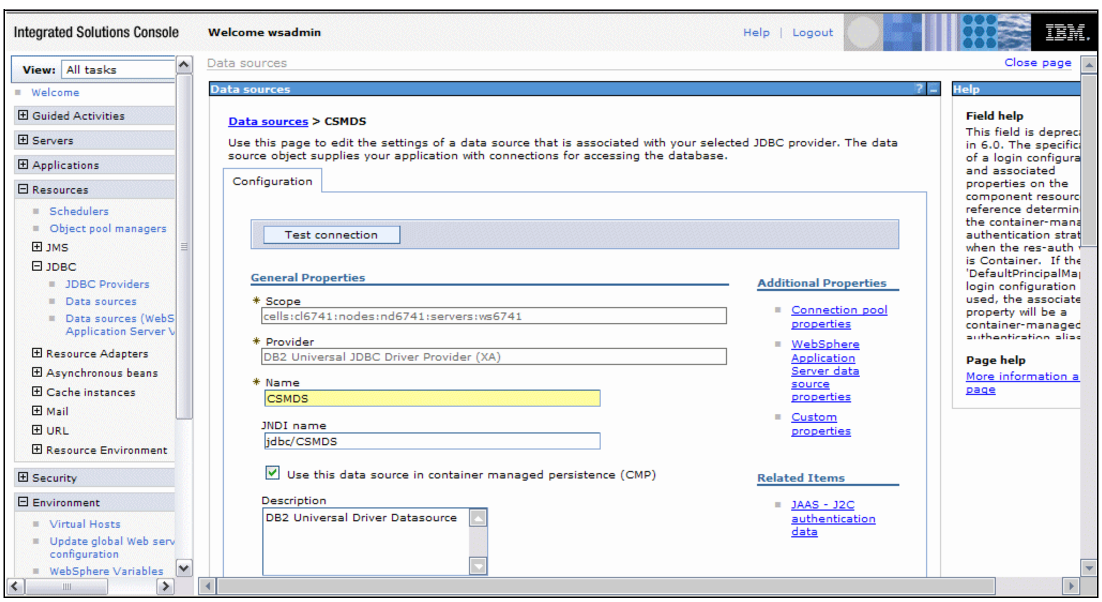

Figure 3-26   CSMDS Data Source - J2EE Connector (J2C) authentication data entries

9. In the next panel, click **New** to continue as shown in Figure 3-27.

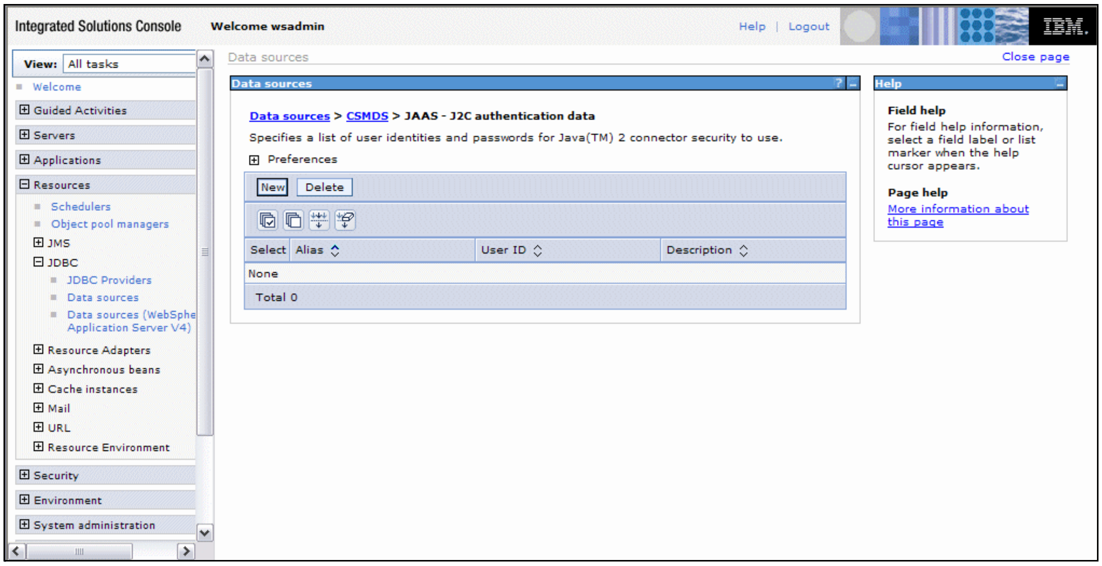

Figure 3-27 CSMDS Data Source - New JAAS - J2C authentication data entries

10. Enter any alias (in our environment, we use SYSADM) and your DB2 user ID and password. Use the same user ID and password you defined in Example 3-1 on page 52. We used **wsadmin** user ID in our installation. The wsadmin user is Tivoli Storage Productivity Center for Replication administrative user and it will be used for the first logon to Tivoli Storage Productivity Center for Replication.

Attention: Ensure that the Tivoli Storage Productivity Center for Replication user ID you specify has DB2 SYSADM authority. You can grant DB2 SYSADM authority by issuing the following DB2 SQL command via SPUFI:

```
GRANT SYSADM TO wsadmin;
```

Or by using the following JCL:

```
//DSNTIST EXEC PGM=IKJEFT01,DYNAMNBR=20
//STEPLIB  DD DSN=DB2Y8.SDSNLOAD,DISP=SHR
//SYSTSPRT DD  SYSOUT=*
//SYSPRINT DD  SYSOUT=*
//SYSUDUMP DD  SYSOUT=*
//SYSTSIN  DD  *
DSN SYSTEM(DB8Y)
RUN PROGRAM(DSNTIAD) -
    PLAN(DSNTIA81) -
    PARMS('RC0') -
    LIB('DB9D9U.RUNLIB.LOAD')
//SYSIN    DD  *
GRANT SYSADM TO wsadmin;
```

Use the following SQL command to list end ensure that **wsadmin** has the necessary SYSADM authority:

```
SELECT * FROM SYSIBM.SYSUSERAUTH;
```

11. Click **OK** to continue.

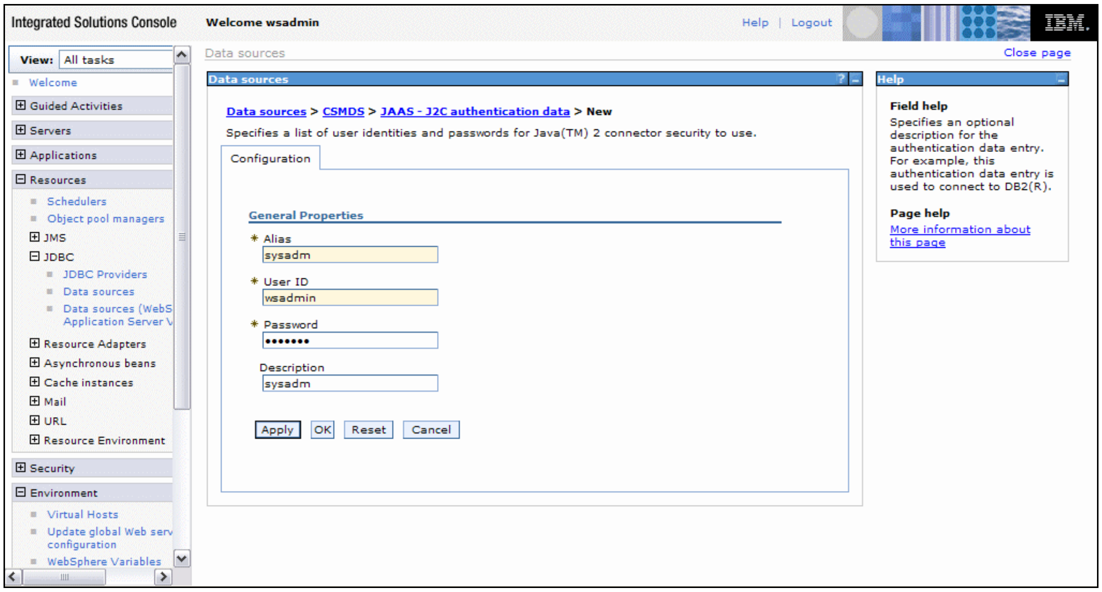

Figure 3-28 CSMDS Data Source - new JAAS - (J2C) authentication data entries definitions

12. In the next panel, click the **Save directly to the master configuration** link as shown in Figure 3-29 to save the JAAS - J2C authentication data changes to the master configuration.

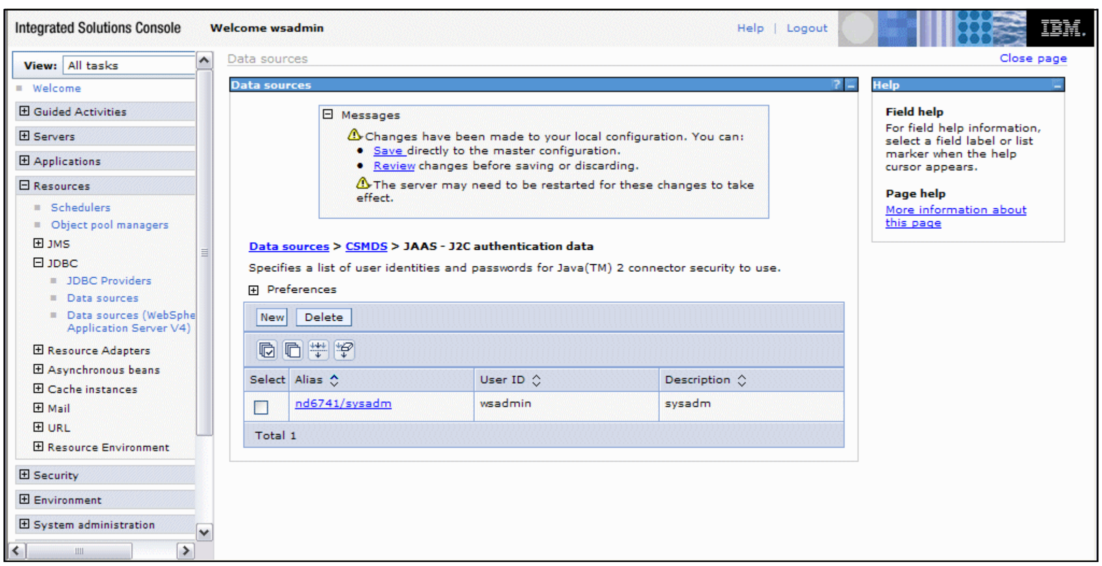

Figure 3-29 Save CSMDS Data Source - J2EE Connector (J2C) authentication data entries

13. Return back to the CSMDS data source defined previously by clicking the **CSMDS** link on the top of the Data sources pane as shown in Figure 3-30.

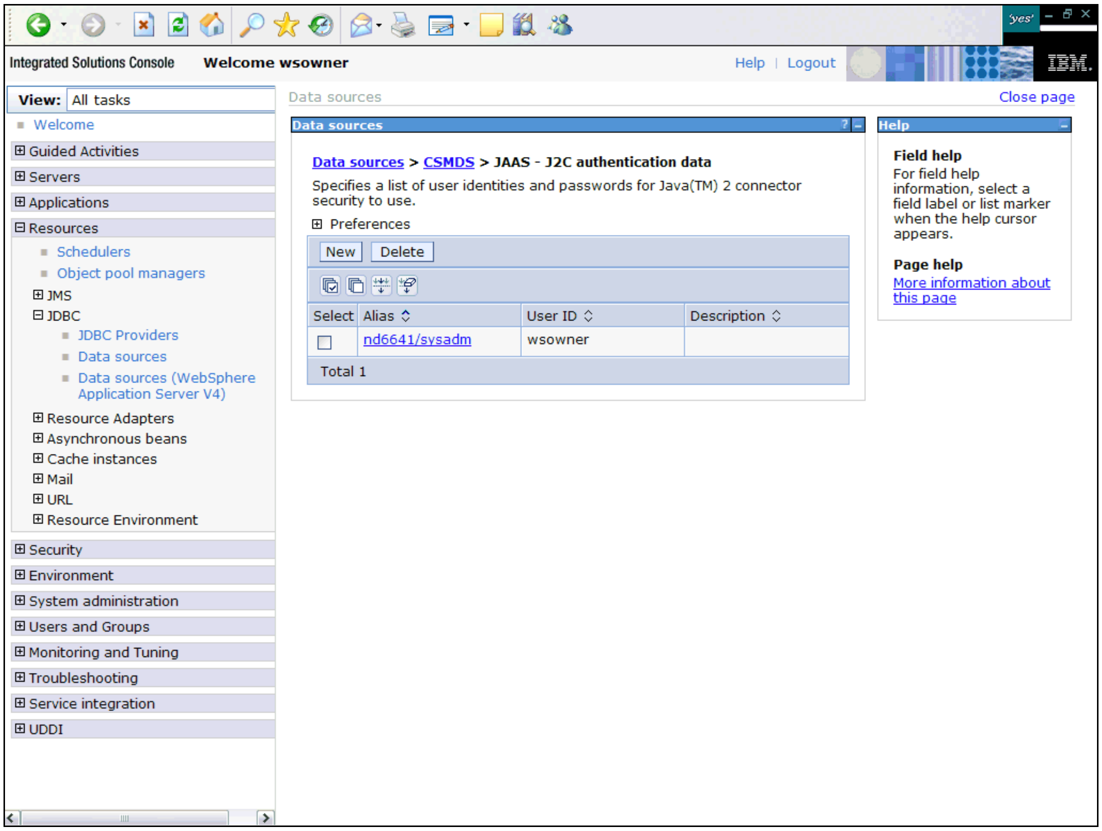

Figure 3-30 CSMDS Data Source - J2EE Connector (J2C) authentication data entries

14. Scroll down from Data sources → CSMDS pane to find the **Component-managed authentication alias** pull-down list and select **sysadm** (or the alias name that you chose). The same **sysadm** user ID has to be selected from the **Container-managed authentication** pull-down list as shown in Figure 3-31. Click **Apply** to continue.

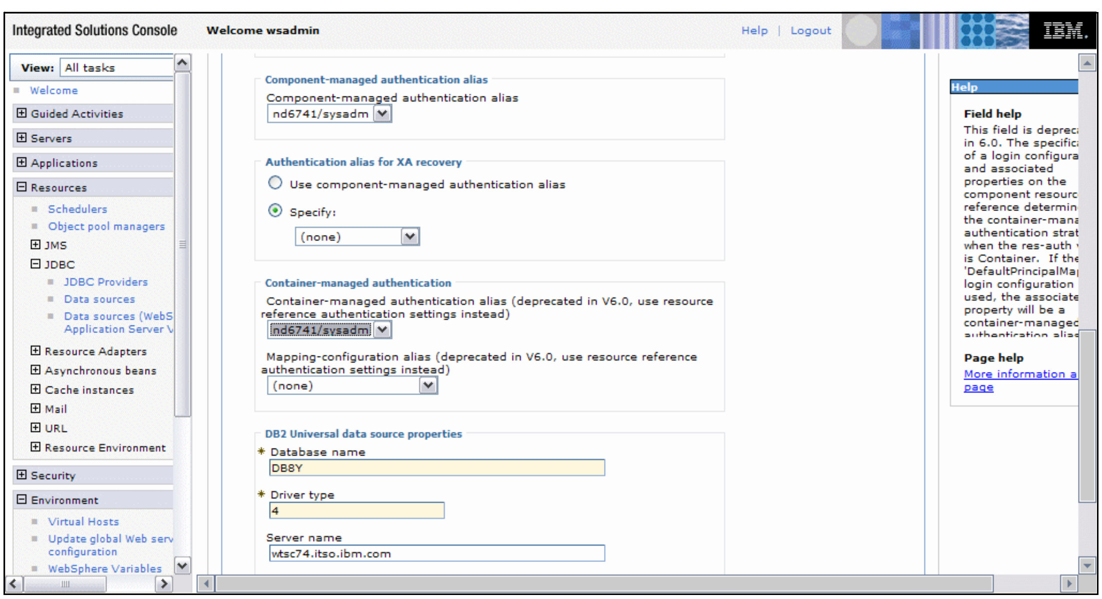

Figure 3-31 CSMDS Data Source - J2EE Connector (J2C) authentication data entries - SYSADM

15.In the next panel, select **Save directly to the master configuration** link as shown in Figure 3-32 to save the changes to the master configuration.

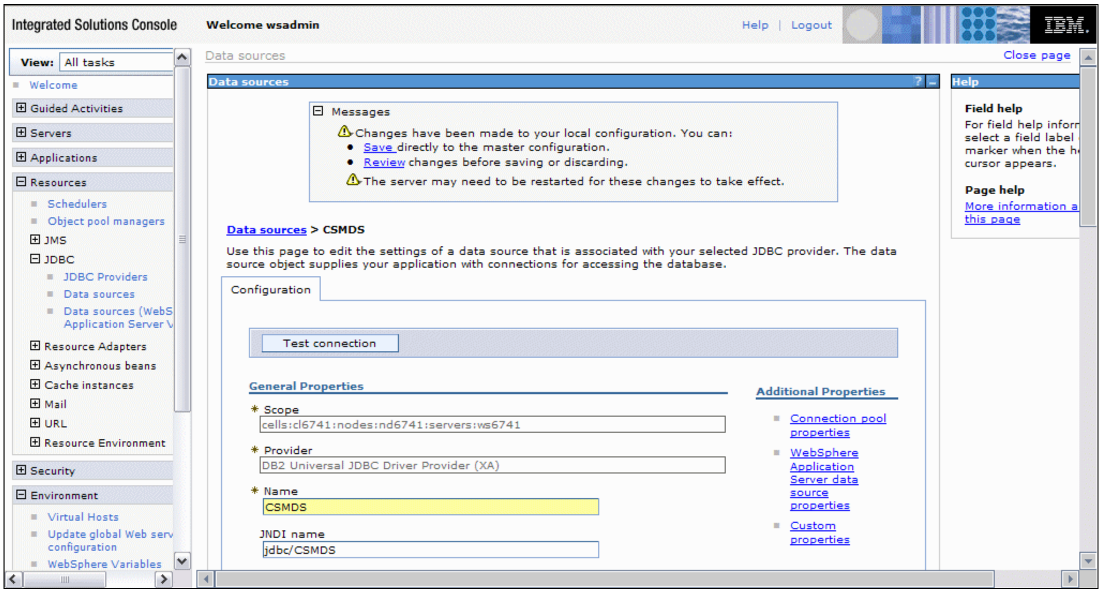

Figure 3-32 Save the CSMDS data source changes to the master configuration

16.The last step prior to data source test connection is to verify the WebSphere security setup on the WebSphere Admin console. Select **Security** and then the **Secure administration, applications, and infrastructure** link as shown in Figure 3-33. Check the **Enable Administrative security** and **Enable application security** check boxes. However, Tivoli Storage Productivity Center for Replication does not require you to use Java 2 security, so this check box should be left unchecked. Click **Apply** to continue.

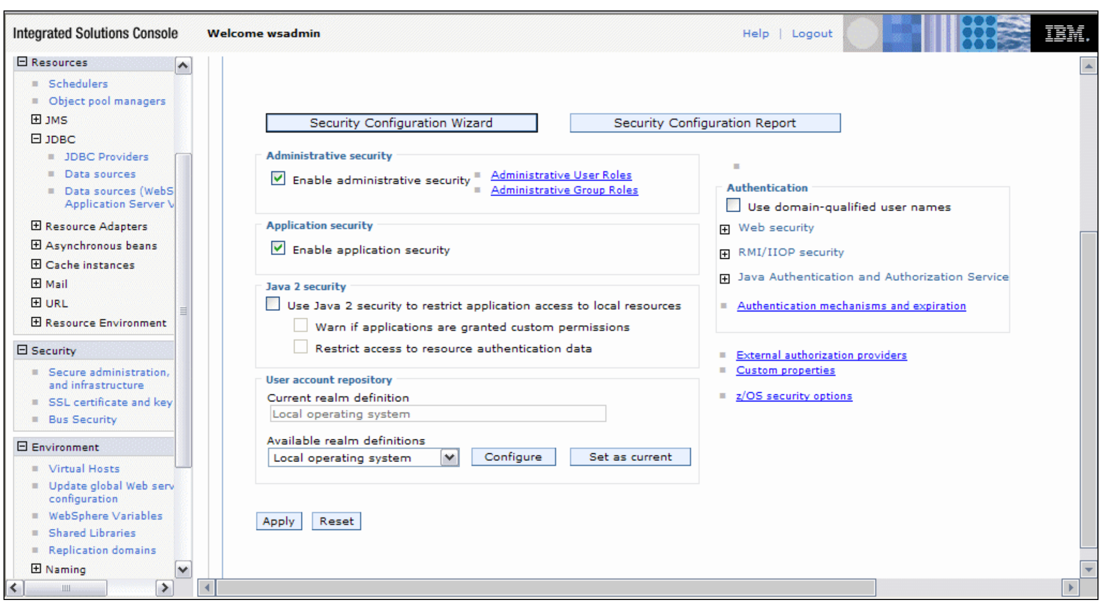

Figure 3-33 Security - Secure administration, applications, and infrastructure

17. In the next panel, click the **Save directly to the master configuration** link as shown in Figure 3-34 to save the security changes to the master configuration.

Note: You may receive error messages after applying the changes to the WebSphere security setup as shown in Figure 3-34. You should review these messages to determine if any action is required. In our environment, the second error message is due to the fact that the “Restrict access to resource authentication” check box under the Java 2 Security section was not checked.

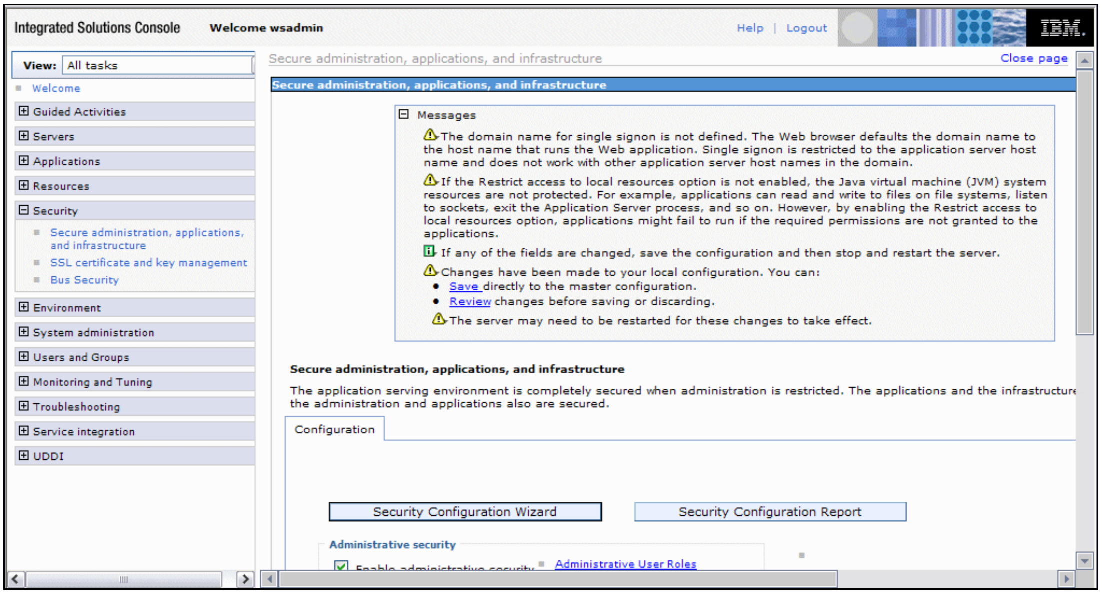

Figure 3-34 Save security changes

18. Go back to CSMDS data source by navigating to **Resources** → **JDBC** → **Data sources** in the right pane. Select the **CSMDS** data source by clicking the check box next to it under the Preferences section and click **Test Connection** as shown in Figure 3-35.

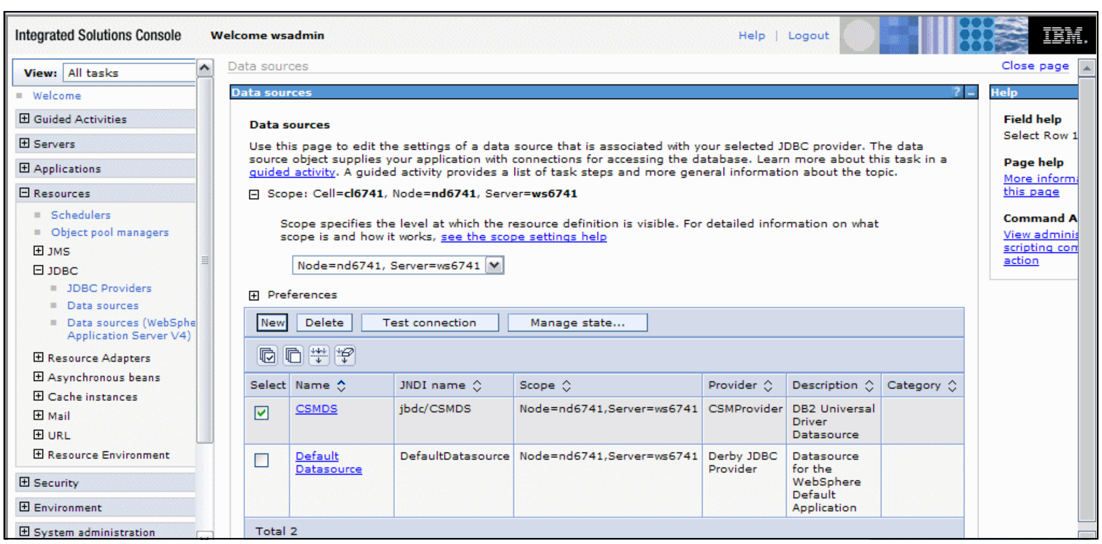

Figure 3-35 CSMDS data source - Test Connection

19. You should see a message that connection was successful as shown in Figure 3-36.

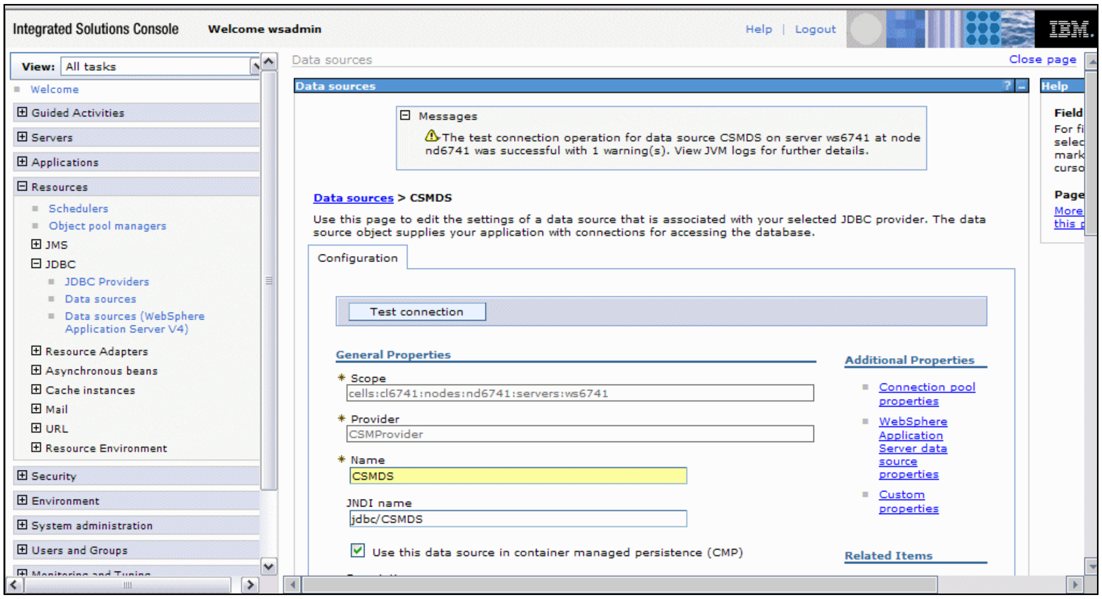

Figure 3-36 CSMDS data source - Successful Test Connection

20. If you get a failure message, click **Troubleshooting** and then **Logging and Tracing** from the WebSphere Admin console as shown in Figure 3-37. Select your WebSphere server to view the logs and determine the problem. Review the preceding steps to ensure they were done correctly.

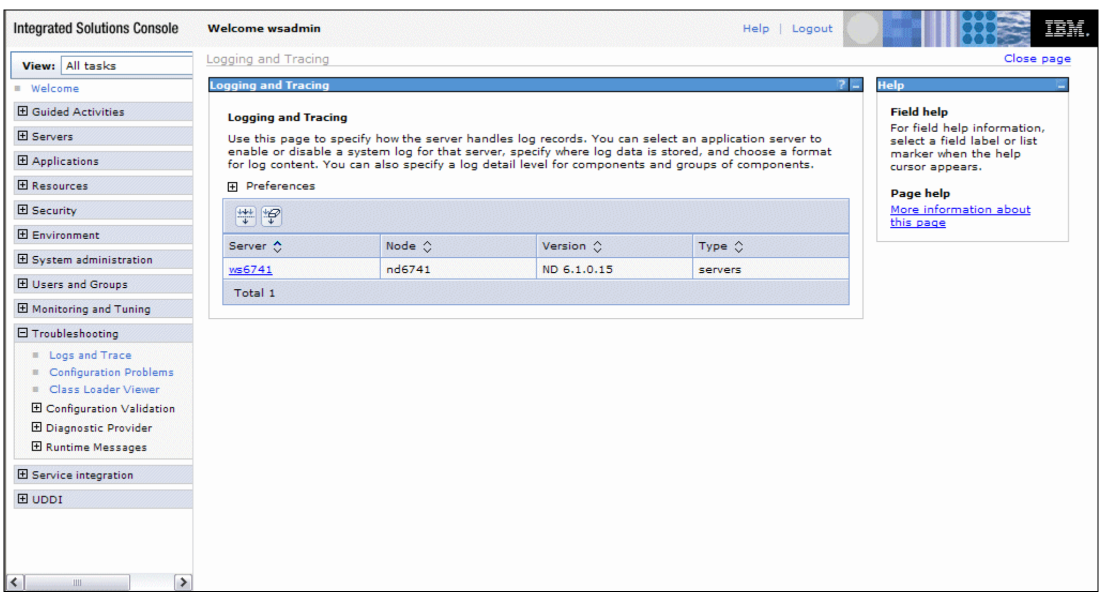

Figure 3-37 Troubleshooting, Logs and Trace

3.6.4 Starting Tivoli Storage Productivity Center for Replication installation with IWNINSTL job

The IWNINSTL job sets up the data source, applications, security, Java Virtual Machine, and libraries in the WebSphere Application Server OEM. It also points the properties files to the correct locations on your machine.

Copy IWNINSTL from the hlq.SAMPLIB where it was installed to your JCL library. Edit it following the notes contained in the member and submit the job.

> **Note:** Remember that the WebSphere Application Server values are *case sensitive*!

Following are some tips with regard to the variables used in the IWNINSTL JCL stream:

1. Substitute the JOB card for a JOB card that is valid for your z/OS. Ensure that it specifies REGION=0M.
2. Ensure that WebSphere Application Server OEM is running. We are going to use Derby, so we do not need DB2.
3. Change the -PathPrefix- string to the appropriate high level directory name. The -PathPrefix- string must match the specification for -PathPrefix- string in the BBAISMKD job that was run during the SMP/E install of WebSphere Application Server OEM. If you did not specify -PathPrefix- during the SMP/E install, simply remove all references to it in this JCL.
4. Match the USS path for your installation of WebSphere Application Server OEM:
   a. WAS_HOME should be the install root of WebSphere Application Server OEM. The following is a default WebSphere Application Server OEM home directory:

      `/zWebSphereOEM/V7R0/config1/AppServer`

   b. JAVA_HOME Java home directory, often uses the same path as WAS_HOME, with directory `java` appended at the end:

      `/zWebSphereOEM/V7R0/config1/AppServer/java`
5. Replace the following values:
   a. WAS_USER should be the WebSphere Application Server OEM administrator userid.
   b. WAS_PASSWD is the password for that userid.
   c. WAS_GROUP can be found in WebSphere Application Server OEM response file. Look for `zServantGroup` value.
   Default is `WSSR1.`
   d. WAS_SERVER can be found in WebSphere Application Server OEM response file. Look for `serverName` value. Default is `server1.`
   e. WAS_NODE can be found in WebSphere Application Server OEM response file. Look for `nodeName` value.
   Default is `bbnnode.`
   f. WAS_CELL can be found in WebSphere Application Server OEM response file. Look for `cellName` value.
   Default is `bbnbase.`
6. DB_TYPE specification is *DB2*, as we are going to use the DB2 database on z/OS, previously customized.

7. The #was_servant_user in the RACF **PERMIT ANT.REPLICATIONMANAGER** can be found in WebSphere Application Server OEM response file. Look for `zServantUserid` value. Default is `WSSRU1`.
8. You can browse files install_RM.log and install_RM_err.log to monitor the install progress and look for any errors that may occur. These files are pointed by DDNAMEs STDOUT and STDERR in the IWNINSTL job stream.

Example 3-1 is an example of IWNINSTL JCL, as we run in our system. The text items in bold are variables that we used as appropriate for our system.

Example 3-19 IWNINSTL job

```
//IWNINSTL  JOB (999,POK),'TPC-R 5.1.0',CLASS=A,REGION=0M,
//         MSGCLASS=T,NOTIFY=&SYSUID,MSGLEVEL=(1,1)
/*JOBPARM L=999,SYSAFF=SC70
//IWNINSTL EXEC PGM=BPXBATCH
//STDOUT DD PATH='/etc/install_RM510.log',
//       PATHOPTS=(OCREAT,OTRUNC,OWRONLY),
//       PATHMODE=(SIRWXU),
//       PATHDISP=KEEP
//STDERR DD PATH='/etc/install_RM510_err.log',
//       PATHOPTS=(OCREAT,OTRUNC,OWRONLY),
//       PATHMODE=(SIRWXU),
//       PATHDISP=KEEP
//STDPARM DD *
SH
/usr/lpp/Tivoli/RM/scripts/installRM.sh
//STDENV DD *
CLASSPATH=/usr/lpp/Tivoli/RM/scripts
WAS_HOME=/zWebSphereOEM/V7R0/tpcr510/AppServer
WAS_USER=WOEMADM
WAS_PASSWD=woemadm
WAS_GROUP=WSSR1
WAS_SERVER=server1
WAS_NODE=TPCNODE
WAS_CELL=TPCBASE
JAVA_HOME=/zWebSphereOEM/V7R0/tpcr510/AppServer/java
TPCR_InstallRoot=/usr/lpp/Tivoli/RM
TPCR_ProductionRoot=/var/Tivoli/RM
DB_TYPE=DB2
/*
//ANTRAC  EXEC PGM=IKJEFT01
//SYSLBC   DD DSN=SYS1.BRODCAST,DISP=SHR
//SYSTSPRT DD SYSOUT=*
//SYSTSIN  DD *
RDEFINE FACILITY ANT.REPLICATIONMANAGER UACC(NONE)
PERMIT ANT.REPLICATIONMANAGER CLASS(FACILITY)+
    ID(WSSRU1) ACCESS(CONTROL)
SETROPTS RACLIST(FACILITY) REFRESH
/*
```

This job needs to complete with a return code 0. You must check allocation messages to verify that the data sets are allocated and cataloged as expected.

Error logs

After you submit the job, it should take several minutes to complete. Installation progress can be monitored from USS by browsing the installation logs located at the path defined in STDOUT and STDERR. In our Example 3-19, the following installation logs were created:

- /etc/install_RM510.log
- /etc/install_RM510_err.log

Check the above logs in order to ensure successful completion of the installation. There is a message at the end of the *install_RM.log* in our Example 3-20, indicating that installation completed successfully and without errors.

Example 3-20 The end of the install_RM.log

```
DONE CONFIGURING NATIVE LIBRARIES

The following Library objects are configured:
-----------------------------------------------------------------
JWLLib(cells/cl6641/nodes/nd6641/servers/ws6641|libraries.xml#Library_1189600722
RMSharedLibraries(cells/cl6641/nodes/nd6641/servers/ws6641|libraries.xml#Library

Done installing applications



Done.
******************************** Bottom of Data ********************************
```

> **Note:** After the *IWNINSTL job* has run successfully, you need to do these tasks:
>
> 1. Edit the `csmConnections.properties` file located in the `/zWebSphereOEM/V7R0/config1/AppServer/profiles/default/properties/` directory.
> 2. Change localhost to the IP address or hostname of the machine and port number, in our case, we used:
>   - server=**`WTSC70.ITSO.IBM.COM`**
>   - port=**`5110`**
> 3. Restart the GUI so that it can connect to the local machine.
> 4. Configure the CLI configuration file `/var/Tivoli/RM/CLI/repcli.properties` to point to the IP address or hostname instead of the local-host that it defaults to.

3.6.5 Logging on to the Tivoli Storage Productivity Center for Replication console

After you get confirmation about successful Tivoli Storage Productivity Center for Replication installation, you can now log on to Tivoli Storage Productivity Center for Replication by pointing your browser to this URL:

```
https://<HostName>:port/CSM/
```

Host name and port number were specified during the WebSphere Application Server OEM installation and these values can be found in the WebSphere Application Server OEM response file. Just look for these items:

- hostName
- zHttpTransportSslPort

Following is the Tivoli Storage Productivity Center for Replication URL for our system:

```
https://wtsc70.itso.ibm.com:32608/CSM/
```

The Tivoli Storage Productivity Center for Replication logon panel appears as shown in Figure 3-8.

Figure 3-38 Tivoli Storage Productivity Center for Replication logon panel

3.7 Upgrading from Tivoli Storage Productivity Center for Replication Basic Edition for System z to Tivoli Storage Productivity Center for Replication for System z

The procedure to upgrade Tivoli Storage Productivity Center for Replication Basic Edition for System z to Tivoli Storage Productivity Center for Replication for System z is based on SMP/E APPLY of the code in the same location as your Tivoli Storage Productivity Center for Replication Basic Edition code. You do not need to re-run the IWNINSTL job; just restart your WebSphere.

4

Configuring the DS8000 storage system for use with Tivoli Storage Productivity Center for Replication

After you have successfully installed the Tivoli Storage Productivity Center for Replication server, you have to connect your storage subsystems to be able to manage the replication services via Tivoli Storage Productivity Center for Replication.

With Tivoli Storage Productivity Center for Replication V5.1, the following storage subsystems are supported:

- IBM DS8000 family of Storage Servers
- IBM DS6000
- IBM Enterprise Storage Server 800
- IBM SAN Volume Controller
- IBM V7000
- IBM XIV

In this chapter, we describe what steps are needed to prepare the ESS 800, DS6000, and DS8000 storage subsystem for use with Tivoli Storage Productivity Center for Replication for System z, and how to connect it to the Tivoli Storage Productivity Center for Replication.

We also cover the use of the Tivoli Storage Productivity Center for Replication Volume Protection feature and show how to remove a configured DS8000 storage subsystem from Tivoli Storage Productivity Center for Replication.

4.1 Configuring IBM ESS and DS Storage Servers

In Chapter 1, “Tivoli Storage Productivity Center for Replication introduction” on page 1, we described the methods that Tivoli Storage Productivity Center for Replication is using to communicate with the attached storage subsystems.

The methods of communication differ between the various storage servers supported by Tivoli Storage Productivity Center for Replication. Tivoli Storage Productivity Center for Replication uses the standard Ethernet based TCP/IP connectivity to the IBM ESS clusters and the IBM DS6000 and DS8000 Storage Servers. In Tivoli Storage Productivity Center for Replication terminology, it is called Direct Connection. When defining a direct connection on DS8000, a pair of dedicated, additional Ethernet cards are used for specific DS8000 models (921, 931) which connect directly to the IP network.

However, the newer DS8000 models (941, 951) do not have an option for dedicated Ethernet cards installed in the internal DS8000 servers, but the only way to connect them to the Tivoli Storage Productivity Center for Replication server is via DS8000 Hardware Management Console - HMC. This connection is called HMC Connection in the Tivoli Storage Productivity Center for Replication and it is available for DS8000 storage systems only.

Figure 4-1 depicts an overview of the different TCP/IP communication methods for ESS 800, DS6000, and DS8000 storage systems:

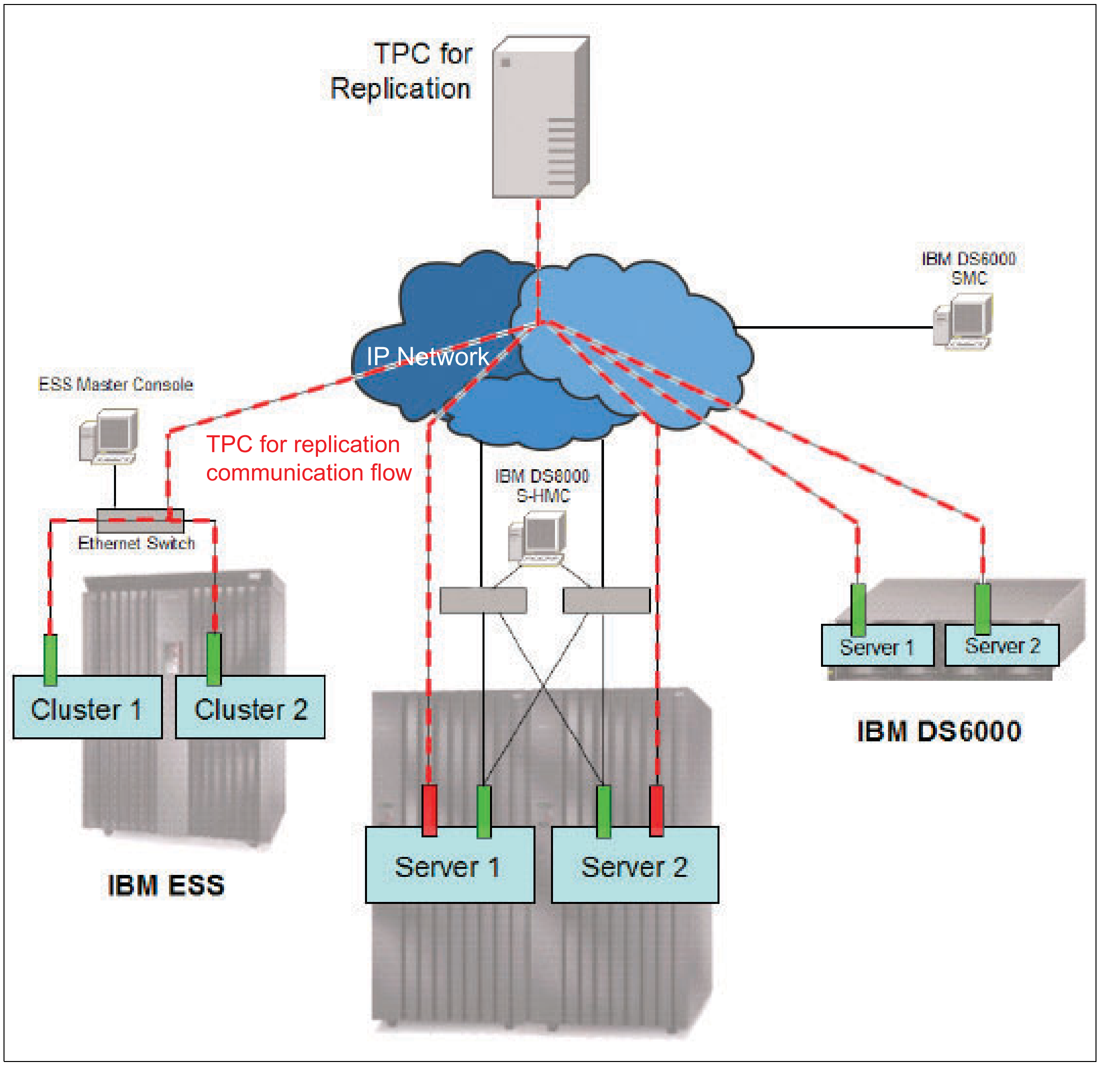

Figure 4-1 Connectivity for Tivoli Storage Productivity Center for Replication and IBM Storage Servers

4.1.1 Preparing the IBM ESS 800

Before adding an ESS 800 in the Tivoli Storage Productivity Center for Replication server, you need to define a Storwatch Specialist user:

1. Point your web browser to the IP address of your IBM ESS800 as shown in Figure 4-2.

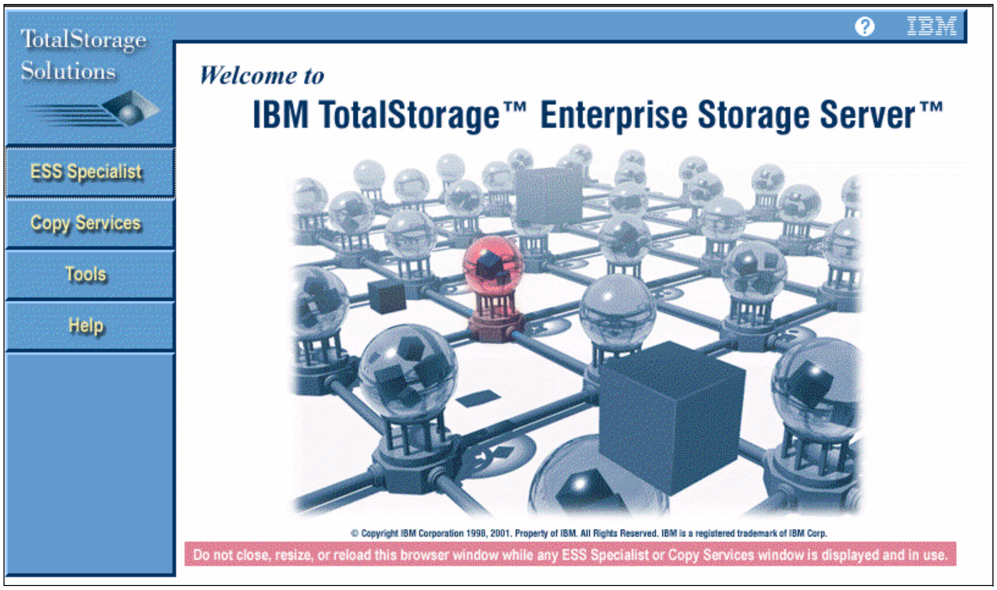

Figure 4-2 ESS 800 Storwatch Specialist

2. To start the Storwatch Specialist, click **ESS Specialist,**. You will be asked to enter a valid username and password to logon, as shown in Figure 4-3.

Figure 4-3 Storwatch Specialist logon

3. Enter the administrator user ID and password and click **OK** to continue. If you are presented with pop-up windows, accept all of them. The Storwatch Specialist panel will be displayed as shown in Figure 4-4.

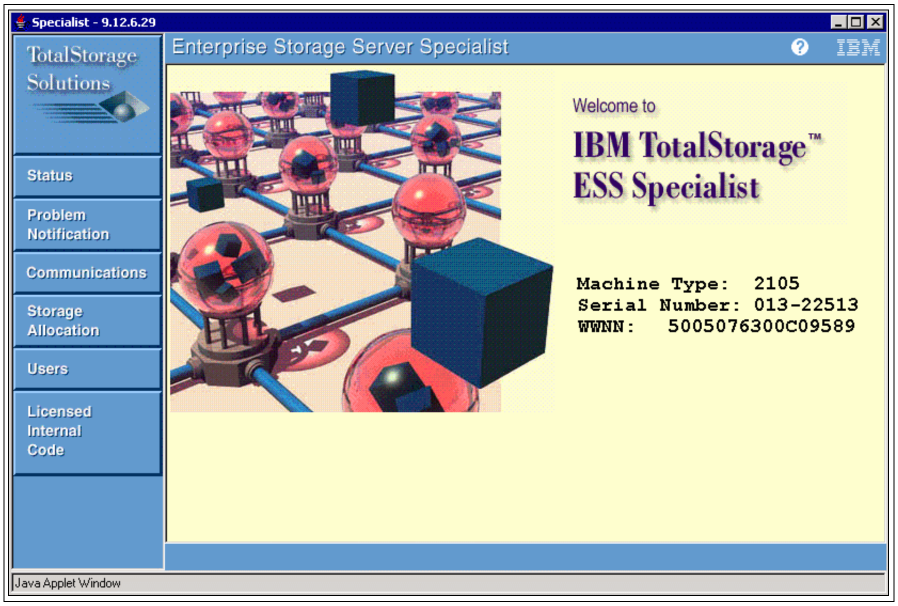

Figure 4-4 Storwatch Specialist

4. On the left side, select **Users** as shown in Figure 4-5.

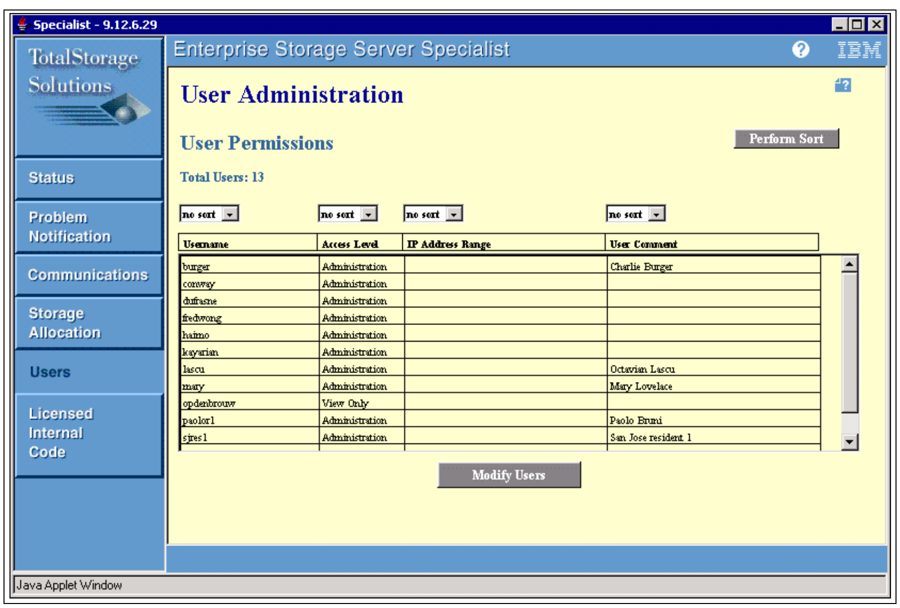

Figure 4-5 Storwatch Specialist Users

5. To add the Tivoli Storage Productivity Center for Replication user, click **Modify Users.** In Modify Users, define a new user as shown in Figure 4-6.

> **Note:** The Tivoli Storage Productivity Center for Replication user must have Administration rights.

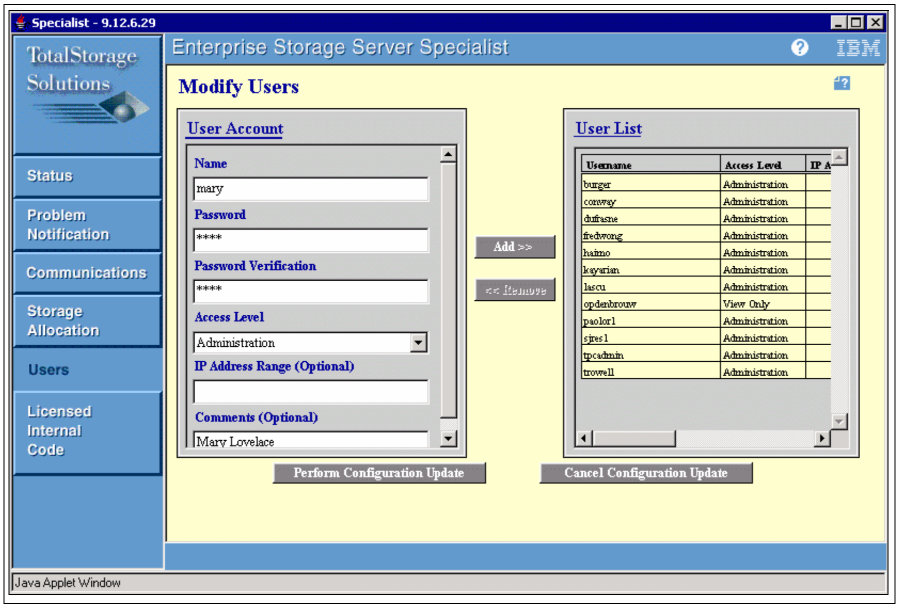

Figure 4-6 Storwatch Specialist Adding user

6. Type in the *Name* and *Password* you have chosen for the Tivoli Storage Productivity Center for Replication user and click **Add.** To save the user definition, click **Perform Configuration Update.** You will be asked to confirm the changes.

This user can be now used to define the Storage Subsystem in the Tivoli Storage Productivity Center for Replication server.

4.1.2 Preparing the IBM DS6800

Before adding the DS6800 in the Tivoli Storage Productivity Center for Replication server, the IBM CE has to define the Tivoli Storage Productivity Center for Replication user ID and password. This is performed through root level access to the Linux system on the DS6800. Information about Tivoli Storage Productivity Center for Replication user is in a file named `/persost/etc/fccwUsers`. The file has two lines with Tivoli Storage Productivity Center for Replication user definition:

- The first line must contain the digit 1 in position 1.
- The second line contains the *username* and *password* without any tabs or any other separator characters.

A certain permission activates this setting, which the IBM CE performs. Remember that this file has to go to both controllers.

Example 4-1 shows an example of the DS6800 based username and password file.

Example 4-1 DS6800 based file which contains username and password

```
1
tpc passw0rd
```

4.1.3 Preparing the IBM DS8000

In this section, we describe the various ways to connect the DS8000 to Tivoli Storage Productivity Center for Replication.

DS8000 storage systems using direct connection

The direct connection between the Tivoli Storage Productivity Center for Replication server and the DS88000 system is established via Ethernet cards installed in your DS8000 storage system internal controllers. Tivoli Storage Productivity Center for Replication cannot connect to the DS8000 using direct connection definitions if these ports are not properly configured.

This Ethernet card may come already installed from the plant site or they can be installed concurrently in the field.

To configure the Ethernet ports, Release 2 and above Licensed Internal Code is required for the DS8000. This is a code bundle which starts with 6.2.xxx.xx.

Port numbers on the first card are I9801 and I9802. This card installs in server0.
Port numbers on the second card are I9B01 and I9B02. This card installs in server1.
Note that only the first port on each card is currently being used.

Communication through these ports uses static IP addresses. DHCP is not supported.

You may configure these new ports through either the GUI or the DSCLI. Note that this is not done through the Tivoli Storage Productivity Center for Replication server, but through the management means provided through the DS8000 HMC.

Using the GUI to define Ethernet ports

The GUI provides a new panel to configure the required IP addresses. Proceed as follows:

1. Under **Manage hardware**, select **Storage images** as shown in Figure 4-7.

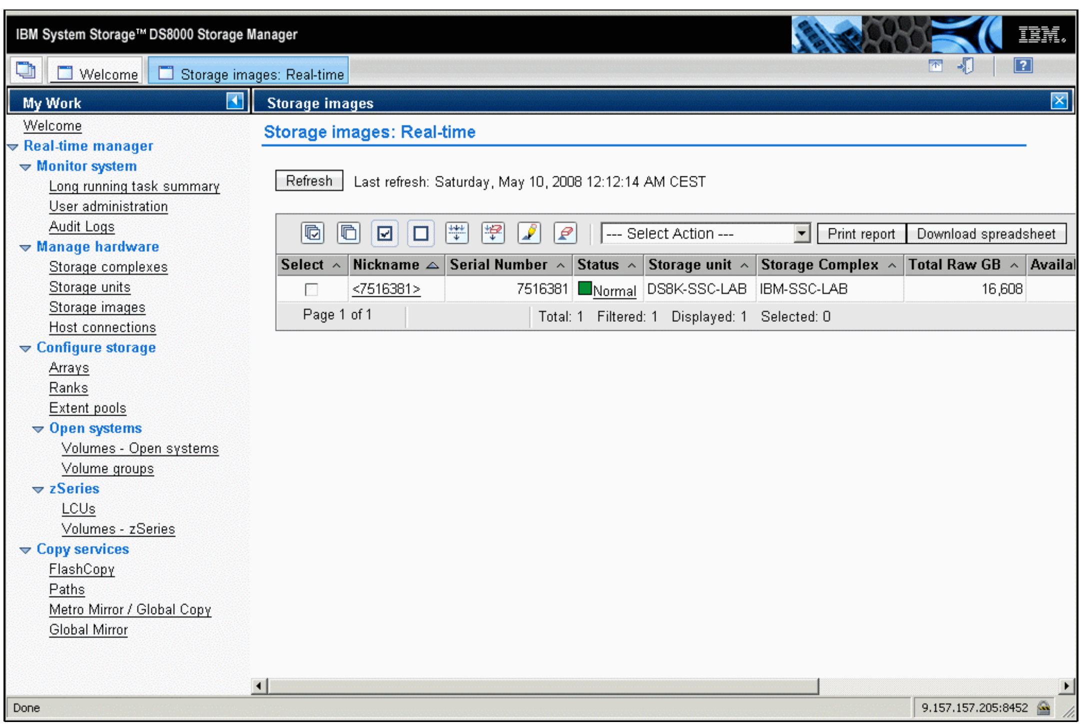

Figure 4-7 Storage images

2. Select your storage subsystem. In the pull-down menu, select **Configure network ports** as shown in Figure 4-8.

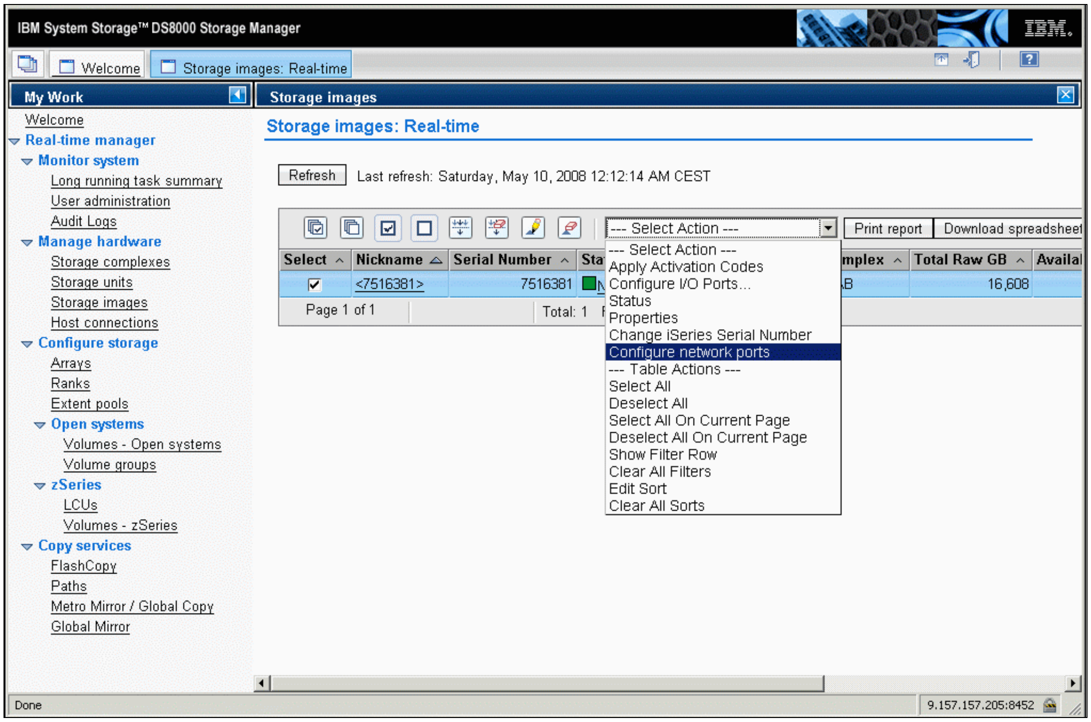

Figure 4-8 Configure network ports

3. Have the following information available to fill in the next panel as shown in Figure 4-9:
   – IP address that is assigned to the Ethernet card port for each server
   – Internal DS8000 gateway IP address and subnet mask
   – Optionally, the IP addresses of primary DNS and secondary DNS.

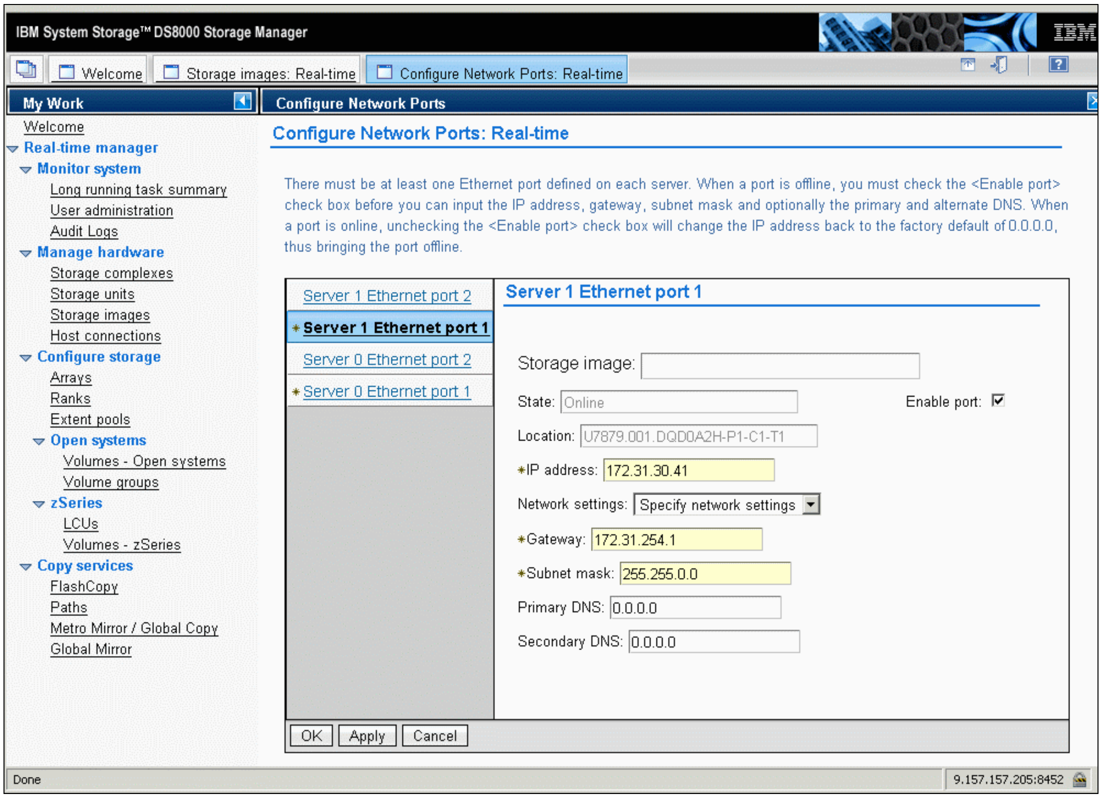

Figure 4-9 Ethernet port setup through the GUI

4. After you have entered the data for both ports, click **OK** and this will complete the GUI configuration of the Ethernet ports.

Using the DSCLI to define Ethernet ports

The DSCLI provides the following commands to manage these new network ports. Again, these commands are DS6000 and DS8000 DSCLI commands and are not available through the Tivoli Storage Productivity Center for Replication CLI, CSMCLI:

- **`lsnetworkport -l`**
  This command shows the server associations, physical port location, and all IP address settings for all ports on the queried Storage Image Facility. An example is shown in Example 4-3.
- **`shownetworkport`**
  This command shows the server association, physical location, and IP addresses for a particular port on the Ethernet card. An example is shown in Example 4-4.
- **`setnetworkport`**
  This command configures the network ports. Example 4-2 displays a command example and configures the first port on the Ethernet card in server0.

Figure 4-10 provides an overview of the setnetworkport command (see Example 4-2).

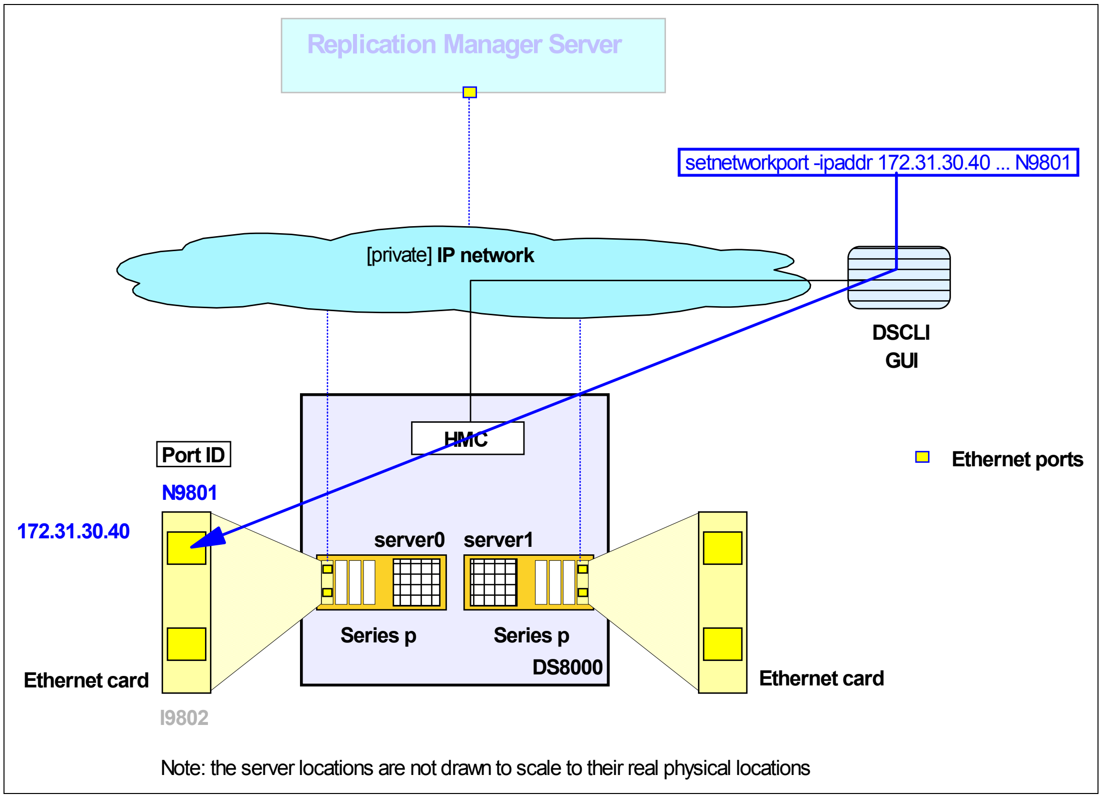

Figure 4-10 Define Ethernet port attached to server 0 in DS8000

Use the DSCLI command as shown in Example 4-2 to configure Ethernet ports.

Example 4-2 setnetworkport command example

```
dscli> setnetworkport -ipaddr 172.31.30.40 -subnet 255.255.0.0 -gateway 172.31.254.1 I9801
Date/Time: Sobota, 10 maj 2008 2:40:49 CEST IBM DSCLI Version: 5.3.0.1022 DS:
IBM.2107-7516381
CMUC00250I setnetworkport: You configured network port I9801 successfully.

dscli> setnetworkport -ipaddr 172.31.30.41 -subnet 255.255.0.0 -gateway 172.31.254.1 I9B01
Date/Time: Sobota, 10 maj 2008 2:41:19 CEST IBM DSCLI Version: 5.3.0.1022 DS:
IBM.2107-7516381
CMUC00250I setnetworkport: You configured network port I9B01
successfully.
```

Example 4-3 shows sample output of the **lsnetworkport** command, which provides an overview of all available Ethernet ports on the concerned storage image facility.

Example 4-3 Output of lsnetworkport command

```
dscli> lsnetworkport
Date/Time: Sobota, 10 maj 2008 2:43:53 CEST IBM DSCLI Version: 5.3.0.1022 DS:
IBM.2107-7516381
ID    IP Address   Subnet Mask Gateway      Primary DNS Secondary DNS State
=============================================================================
I9801 172.31.30.40 255.255.0.0 172.31.254.1 0.0.0.0     0.0.0.0       Online
I9802 0.0.0.0      0.0.0.0     0.0.0.0      0.0.0.0     0.0.0.0       Offline
I9B01 172.31.30.41 255.255.0.0 172.31.254.1 0.0.0.0     0.0.0.0       Online
I9B02 0.0.0.0      0.0.0.0     0.0.0.0      0.0.0.0     0.0.0.0
Offline
```

Example 4-4 shows sample output example of the **shownetworkport** command, which provides an overview of all settings for both Ethernet ports.

Example 4-4 Output of shownetworkport command for both Ethernet ports

```
dscli> shownetworkport I9801
Date/Time: Sobota, 10 maj 2008 2:46:46 CEST IBM DSCLI Version: 5.3.0.1022 DS:
IBM.2107-7516381
ID            I9801
IP Address    172.31.30.40
Subnet Mask   255.255.0.0
Gateway       172.31.254.1
Primary DNS   0.0.0.0
Secondary DNS 0.0.0.0
State         Online
Server        00
Speed         1 Gb/sec
Type          Ethernet-Copper
Location      U7879.001.DQD0NH0-P1-C1-T1

dscli> shownetworkport I9B01
Date/Time: Sobota, 10 maj 2008 2:47:11 CEST IBM DSCLI Version: 5.3.0.1022 DS:
IBM.2107-7516381
ID            I9B01
IP Address    172.31.30.41
Subnet Mask   255.255.0.0
Gateway       172.31.254.1
Primary DNS   0.0.0.0
Secondary DNS 0.0.0.0
State         Online
Server        01
Speed         1 Gb/sec
Type          Ethernet-Copper
Location
U7879.001.DQD0A2H-P1-C1-T1
```

This definition process is only required once for each DS8000 with Ethernet adapters and when trying to establish direct connection between Tivoli Storage Productivity Center for Replication and DS8000 systems.

DS8000 storage systems using HMC connection

DS8000 storage systems can be connected to Tivoli Storage Productivity Center for Replication server through DS8000 Hardware Management Console - HMC. DS8000 HMC is connected to the client network, the same network as the Tivoli Storage Productivity Center for Replication server. For redundancy, have two DS8000 HMC servers per site connected to one or more DS8000 systems. When you add an HMC to the Tivoli Storage Productivity Center for Replication configuration, all DS8000 storage systems that are behind the HMC are also added. You cannot add or remove individual storage systems that are behind an HMC.

Tivoli Storage Productivity Center for Replication server should be connected to both HMC servers for a given DS8000 storage system. In case one DS8000 HMC is not responsive, Tivoli Storage Productivity Center for Replication server will use the remaining DS8000 HMC.

When defining DS8000 storage systems connection to Tivoli Storage Productivity Center for Replication via DS8000 HMC network, all you need to provide is the IP address of each DS8000 HMC.

z/OS FICON connection

When Tivoli Storage Productivity Center for Replication management server runs on z/OS, it can connect to ESS 800, DS8000, and DS6000 storage systems through a z/OS FICON Connection, which is used to issue replication commands and queries for attached ECKD volumes over an existing FICON channels and to receive asynchronous events.

When a storage system is added to Tivoli Storage Productivity Center for Replication through the z/OS FICON Connection, all ECKD volumes that are attached to the Tivoli Storage Productivity Center for Replication management system are added to the Tivoli Storage Productivity Center for Replication configuration. ECKD volumes that are not attached to the Tivoli Storage Productivity Center for Replication z/OS management server are not added to the Tivoli Storage Productivity Center for Replication configuration through the z/OS FICON Connection.

Ensure that all volumes in the logical storage subsystem (LSS) that you want to manage through a z/OS FICON Connection are attached to z/OS. Either the entire LSS must be attached to z/OS or none of the volumes in the LSS should be attached to z/OS for Tivoli Storage Productivity Center for Replication to properly manage queries to the hardware.

Use the following guidelines to add storage systems through a z/OS FICON Connection:

- Use the z/OS connection to manage ECKD volumes that are attached to Tivoli Storage Productivity Center for Replication management server running on z/OS.
- To manage z/OS attached volumes through a z/OS connection (for example, for HyperSwap), you must explicitly add the z/OS connection for that storage system in addition to a TCP/IP connection (either the direct connection or the HMC connection)
- Create a z/OS connection before all TCP/IP connections if you want to continue to have Tivoli Storage Productivity Center for Replication manage only the attached ECKD volumes.

> **Tip:** Create both TCP/IP and z/OS connections for ECKD volumes to allow for greater storage accessibility.

Adding Tivoli Storage Productivity Center for Replication userid and password into DS8000

Some DS8000 systems (older models, that is, 921, 931) used to come with predefined *user* and *password* for Tivoli Storage Productivity Center for Replication servers. The default *user* is `tpcruser` and the *password* is the serial number of the storage facility image (SFI). Note that it is not the unit number. For example, the unit number is **27550**. Then the SFI is **27551**. The SFI number is preceded by the code of the manufacturing site, which is usually **75** for the European manufacturing site or **13** when the DS8000 has been built in San Jose. The corresponding password in this case is then **7527551**.

With Release 2.4 of the DS8000 microcode, you may alter the password without the help of an IBM CE. Release 2.4 provides a new DSCLI command to alter the *password*, as shown in Example 4-5.

Example 4-5 DSCLI command to alter the password

```
dscli> setrmpw -server both -rmpw XXXXXXX
Date/Time: Sobota, 10 maj 2008 3:13:10 CEST IBM DSCLI Version: 5.3.0.1022 DS:
IBM.2107-7516381
CMUC00265I setrmpw: You have updated the Replication Manager password
successfully.
```

It is useful to specify *both* to create the same password for both DS8000 servers.

Note that the *username* remains as *tpcruser*.

With newer DS8000 systems (that is, 941 and 951 models) with microcode Release 6.x, you need to create the userid for Tivoli Storage Productivity Center for Replication.

The following procedure describes the steps required to define a Tivoli Storage Productivity Center for Replication userid on the DS8000 with microcode Release 6.2 and above:

1. Log on to the DS8000 storage systems and from the navigation pane on the left, by hovering over the **Access** icon, select the **Users** submenu as shown in Figure 4-11.

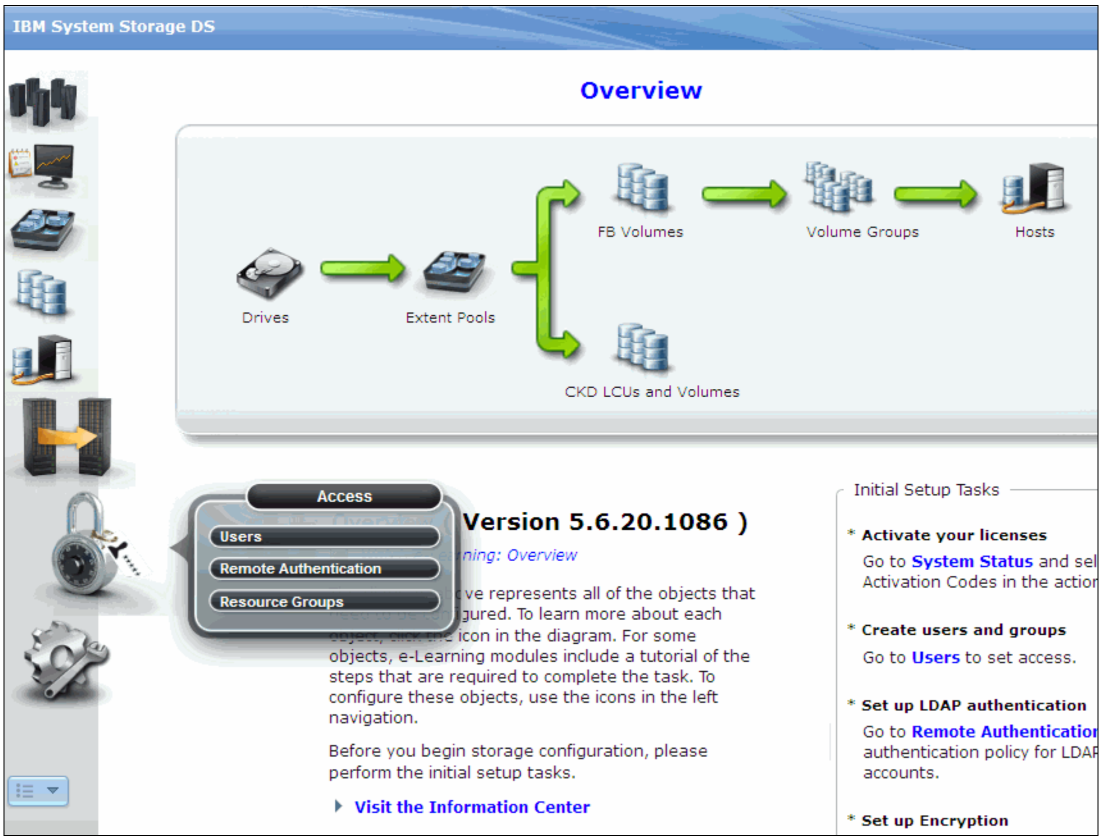

Figure 4-11 DS8000 Access menu

2. In the *Users* window, select **Add user** from the **Action** drop-down menu (see Figure 4-12).

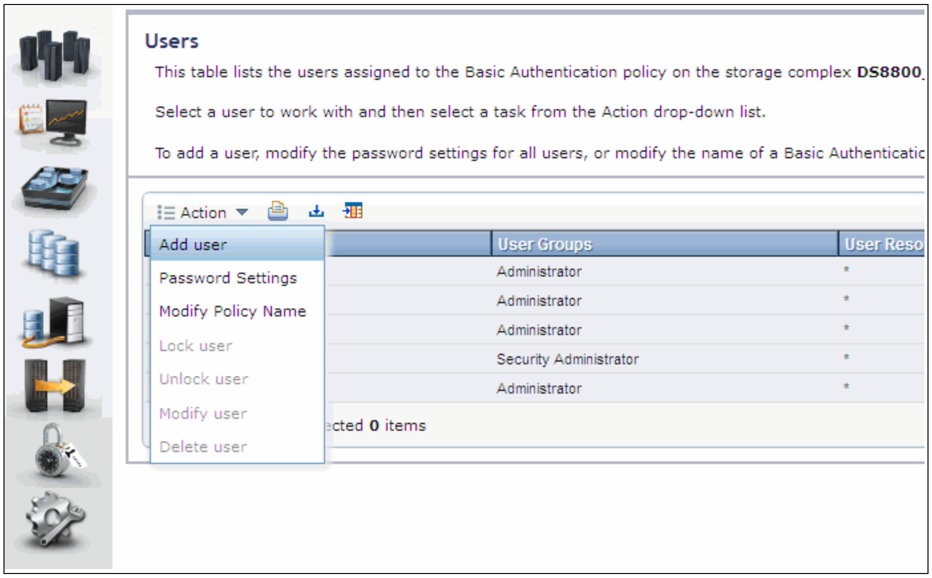

Figure 4-12 DS8000 Users window

3. The *Add User* window appears as shown in Figure 4-13. Create the new Tivoli Storage Productivity Center for Replication userid and assign a password accordingly. Under the *Group Assignment* section, select **Administrator** user permissions.

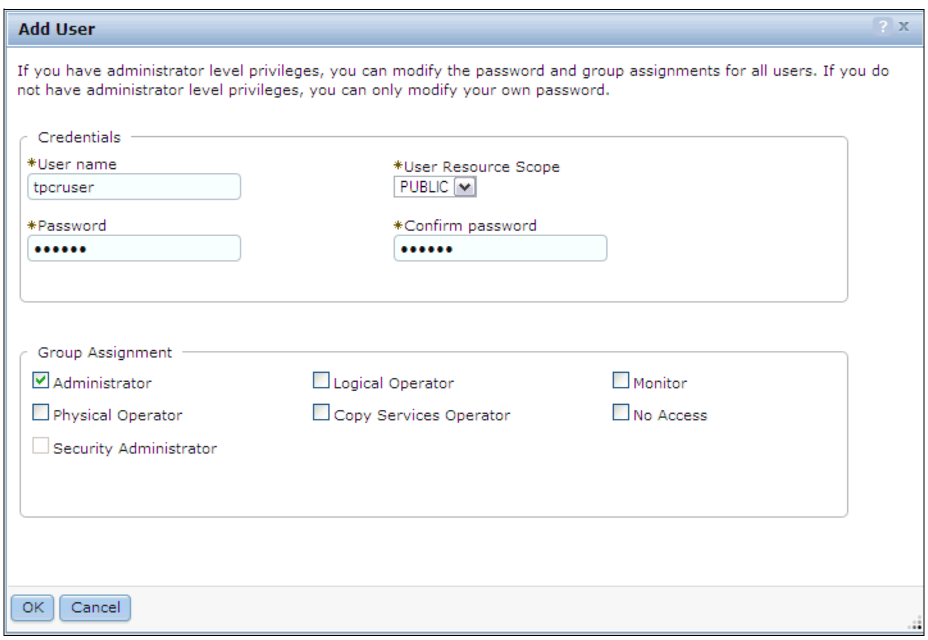

Figure 4-13 Add Tivoli Storage Productivity Center for Replication userid

4. Click **OK** to complete this task.

4.2 Adding IBM ESS or DS Storage Server to Tivoli Storage Productivity Center for Replication server

Before you can use Tivoli Storage Productivity Center for Replication with an IBM ESS or an IBM DS8000/DS6000 Storage System, you will have to add it to Tivoli Storage Productivity Center for Replication as a Storage Subsystem. You can do that by using the Tivoli Storage Productivity Center for Replication GUI or the Command Line Interface.

You can connect storage systems over TCP/IP either directly or through a Hardware Management Console (HMC) or using FICON IBM z/OS connection. A single storage system can be connected using multiple connections for redundancy. For example, you can connect an IBM System Storage DS8000 storage system using an HMC connection and a z/OS connection. Tivoli Storage Productivity Center for Replication monitors how a storage system has been added to the configuration.

4.2.1 Adding an IBM Storage Server using the Tivoli Storage Productivity Center for Replication GUI

Follow this procedure:

1. Start your Web browser and sign on to your Tivoli Storage Productivity Center for Replication server.
2. After you are signed on, select **Storage Systems** from the Navigation Menu on the left as shown in Figure 4-14.

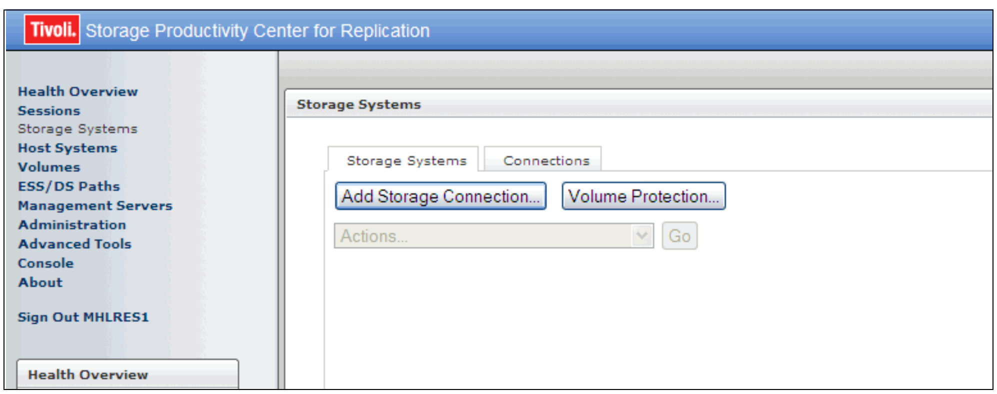

Figure 4-14 Storage Subsystems

3. Click the **Add Storage Connection** button in order to invoke *Add Storage System Wizard* as displayed in Figure 4-15.

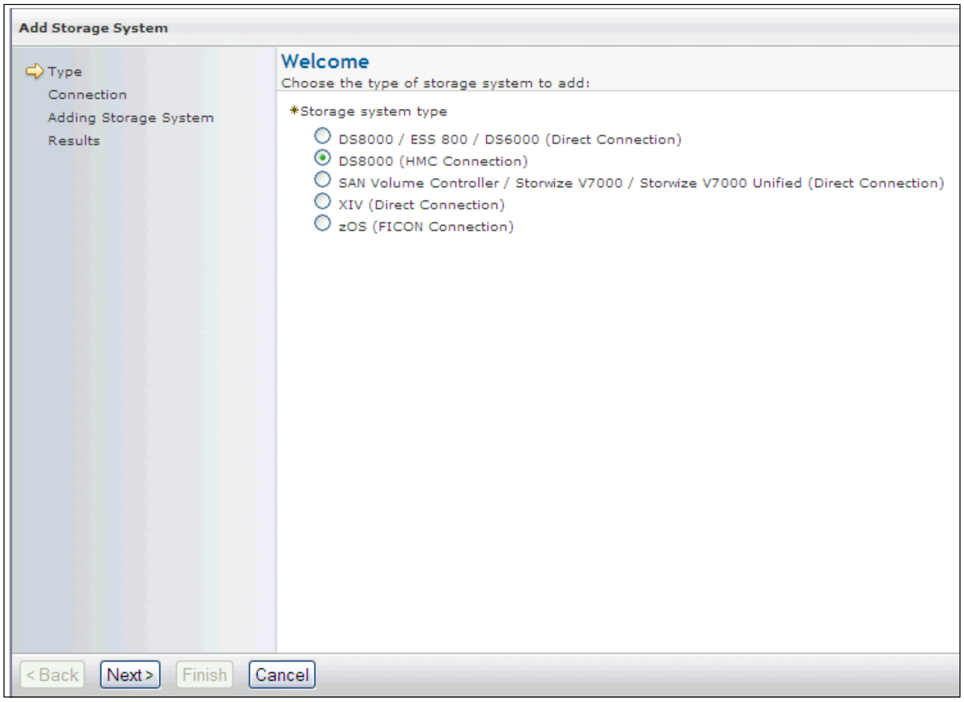

Figure 4-15 Add Storage System - Connection Type

4. Use the following settings:
   – Direct Connection should be selected for ESS 800, DS6000, and selected DS8000 models with dedicated Ethernet adapters.
   – DS8000 HMC Connection is used for all DS8000 models connected to Tivoli Storage Productivity Center for Replication server via DS8000 HMC network. For DS8000 model 941 and 951, this is the only available connection over TCP/IP.
   – The z/OS FICON Connection is limited to storage systems that are connected to a Tivoli Storage Productivity Center for Replication management server running on z/OS.

5. In our example, we define DS8000 HMC Connection connection. After you select the appropriate connection, click **Next** to continue. The Connection definition window is displayed as shown in Figure 4-16.

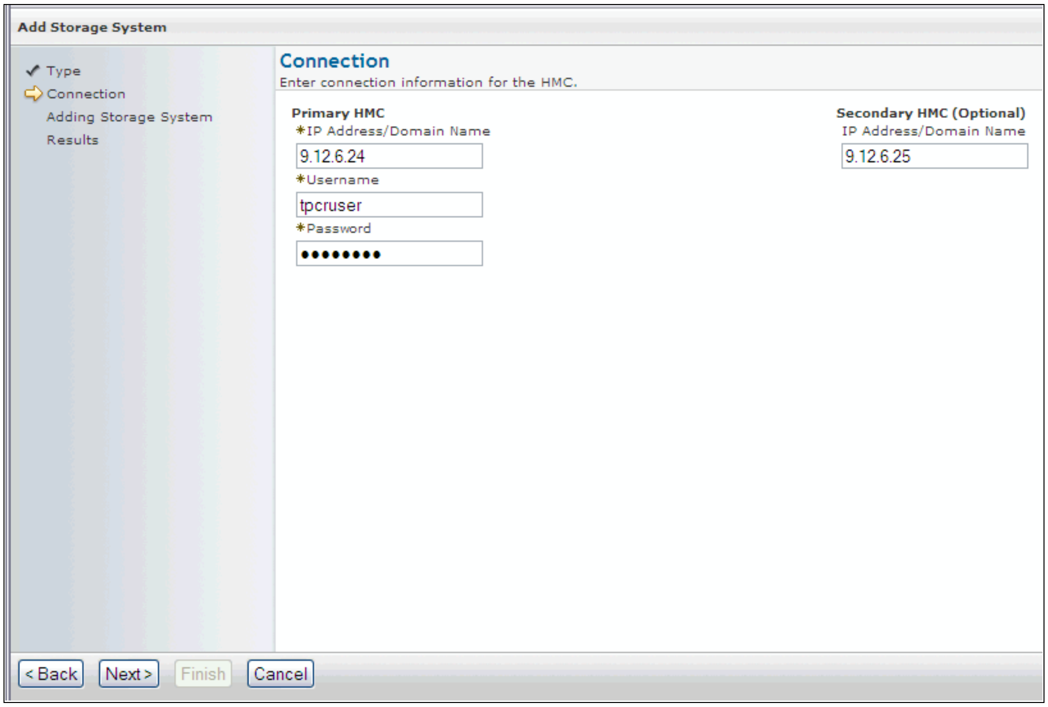

Figure 4-16 Add Storage System - Connection properties

6. Enter the primary DS8000 HMC IP address and the same for the secondary DS8000 HMC if it exists. Enter the username and password dedicated for Tivoli Storage Productivity Center for Replication server which you previously defined on DS8000 storage system as explained in "Adding Tivoli Storage Productivity Center for Replication userid and password into DS8000" on page 134. Click **Next** to continue. The next window displays the Adding Storage System phase and it takes a few seconds to complete (Figure 4-17).

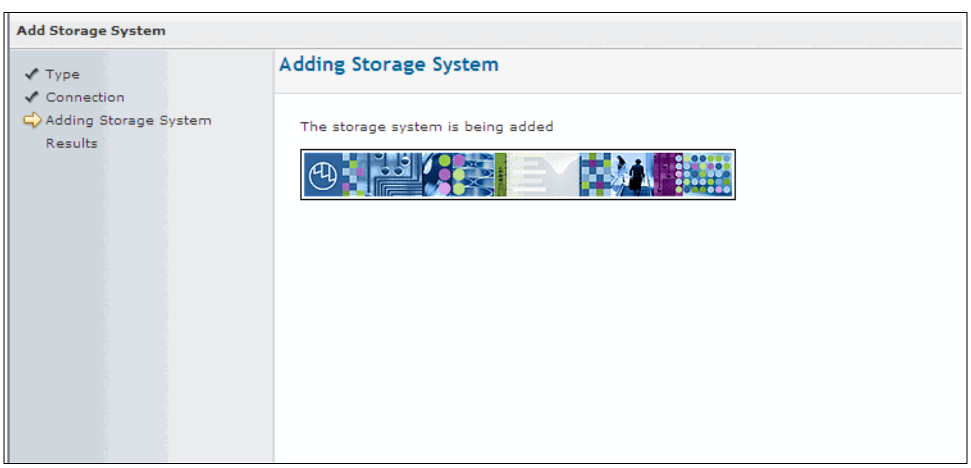

Figure 4-17 Adding Storage System

7. After the adding storage system phase is completed, Tivoli Storage Productivity Center for Replication displays the window as shown in Figure 4-18, indicating that the storage system has been successfully defined.

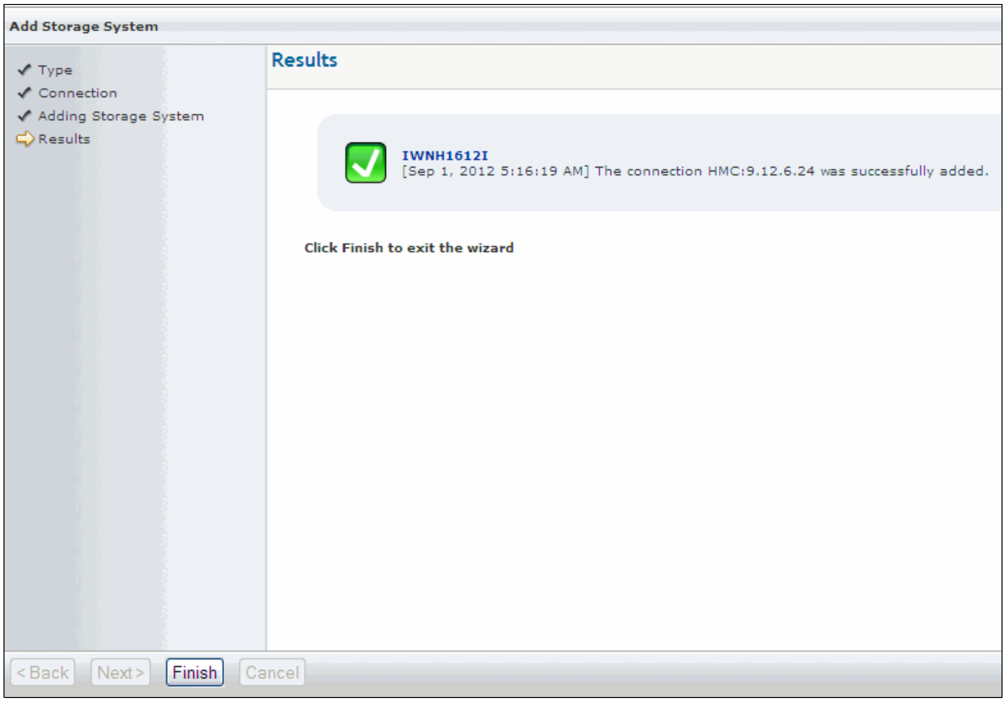

Figure 4-18 Successfully added storage subsystem

8. Click **Finish** to complete the task. The newly defined storage subsystem will appear in the Tivoli Storage Productivity Center for Replication Storage Subsystem Panel as shown in Figure 4-19.

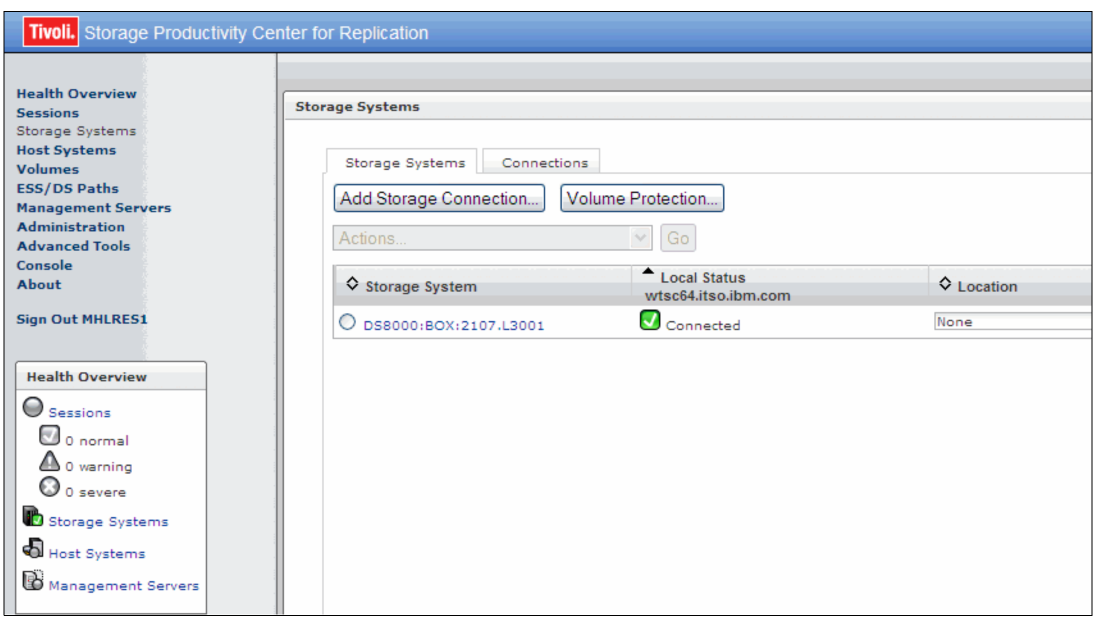

Figure 4-19 Storage System Overview panel with new DS8000 storage system added

As you can see in Figure 4-19, the location description is, by default, *None*.

In order to give more a meaningful name of the location for the defined storage system, click in the location box and select and overwrite *None* with your specific site description as shown in Figure 4-20. You must have Administrator privileges to modify the location of a storage system.

> **Note:** Changing the location of a storage system might have consequences. When a session has a volume role with a location that is linked to the location of the storage system, changing the location of the storage system could change the session's volume role location. For example, if there is one storage system with the location of Site 1 and a session with the location of Site 1 for its H1 role, then changing the location of the storage system to a different location, such as Site 2, also changes the session's H1 location to Site 2. However, if there is a second storage system that has the location of Site 1, the session's role location is not changed.

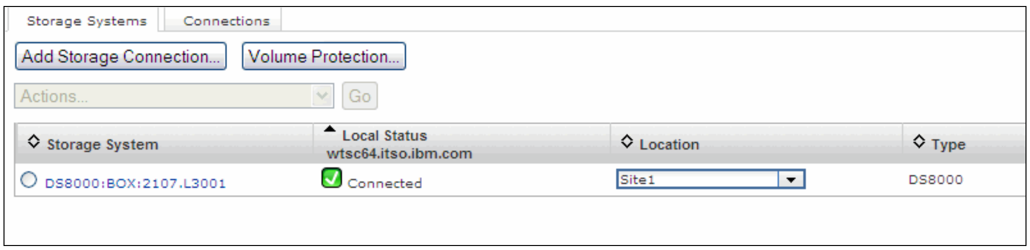

Figure 4-20 Specify the location name for the added storage system

4.3 Enabling/disabling heartbeat for DS8000 storage systems

The heartbeat is a Metro Mirror function and it is available only for ESS 800, DS6000, and DS8000 storage systems. It is a heartbeat between Tivoli Storage Productivity Center for Replication server and storage systems. When the Metro Mirror heartbeat is disabled, data consistency across multiple storage systems is not guaranteed if the Tivoli Storage Productivity Center for Replication management server cannot communicate with one or more storage systems.

The problem occurs as a result of the Hardware Freeze Timeout Timer function within the storage system. If the controlling software loses connection to a storage system, the Metro Mirror relationships that it is controlling stay established and there is no way to freeze those pairs to create data consistency across the multiple storage systems. When the freeze times out, dependent I/O is written to the target storage systems, which might corrupt data consistency. Freeze refers to a Metro Mirror freeze function.

Metro Mirror heartbeat is disabled by default.

> **Note:** Metro Mirror heartbeat is not available for Metro Mirror with HyperSwap or Metro Global Mirror with HyperSwap.

In order to find out if the Heartbeat between Tivoli Storage Productivity Center for Replication server is enabled or disabled, click **Advanced Tools** from the Navigation panel as shown in Figure 4-21.

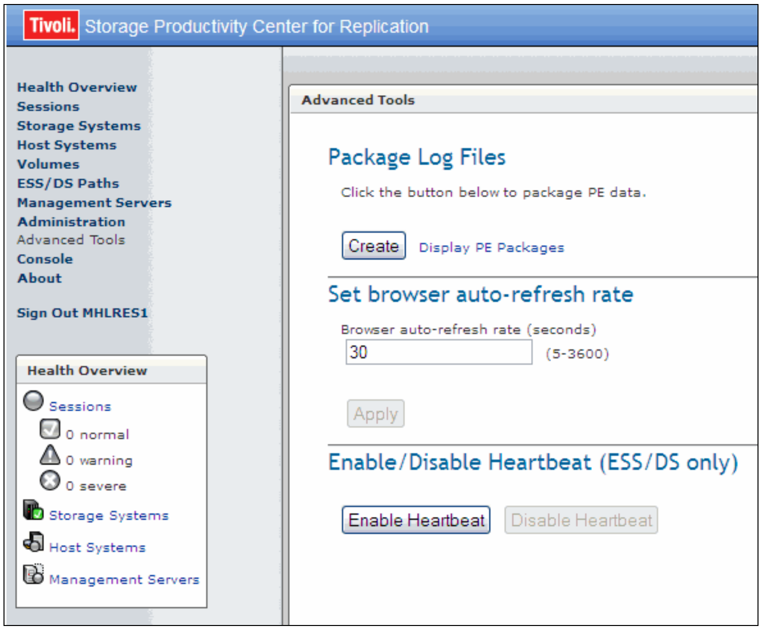

Figure 4-21 Enable/Disable Heartbeat

In our example, the heartbeat is disabled since the **Enable Heartbeat** button is active.

4.4 Tivoli Storage Productivity Center for Replication Volume Protection

In most cases, not all volumes configured in your storage infrastructure are meant to take part in copy services relationships. Those volumes should not be accessible by Tivoli Storage Productivity Center for Replication to securely avoid them being erroneously selected as copy services target disks impose the inevitable risk of damaging data.

With the Volume Protection feature, Tivoli Storage Productivity Center for Replication is offering a method to exclude volumes of attached storage subsystems from Tivoli Storage Productivity Center for Replication management by preventing those volumes to be selected as members of Copy Sets.

You can activate the Tivoli Storage Productivity Center for Replication Volume Protection either using the GUI or the Command Line Interface.

To access the Volume Protection feature using the GUI, proceed as follows:

1. Log on to Tivoli Storage Productivity Center for Replication and click **Storage Systems** in the Navigation Area. This takes you to the Storage Systems panel as shown in Figure 4-22. Click **Volume Protection**.

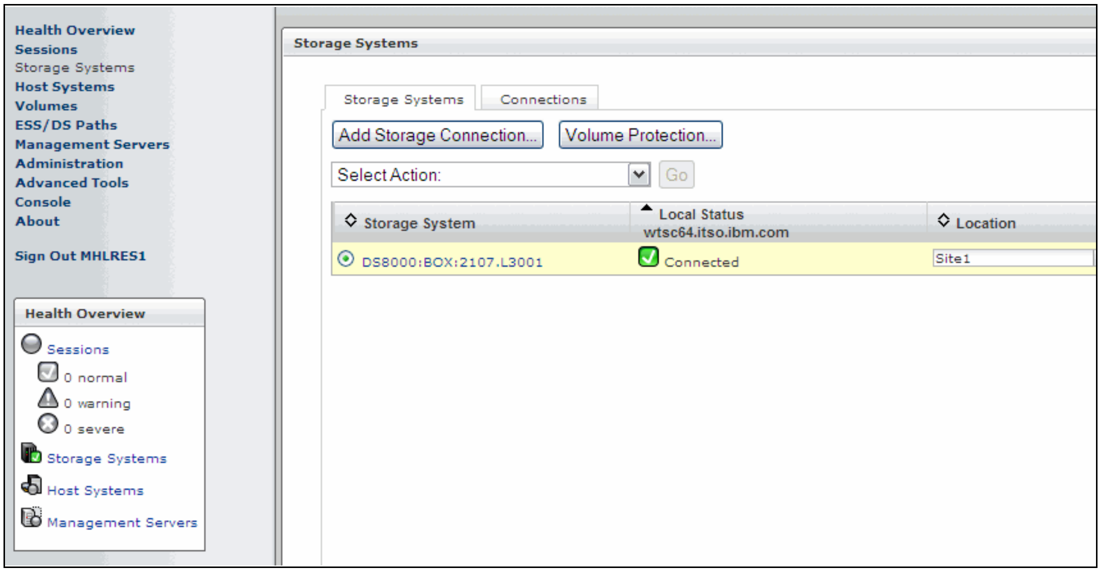

Figure 4-22 Storage Subsystems panel - access Volume Protection

2. This will start the Volume Protection Wizard. You can now specify the volumes which Tivoli Storage Productivity Center for Replication will protect. You could either select the volumes by specifying storage system, logical storage subsystem and a specific volume or you could specify the volume name (also including wildcards) or using a combination of both. In our example we protect all volumes in LSS 00. Click **Next** as shown in Figure 4-23.

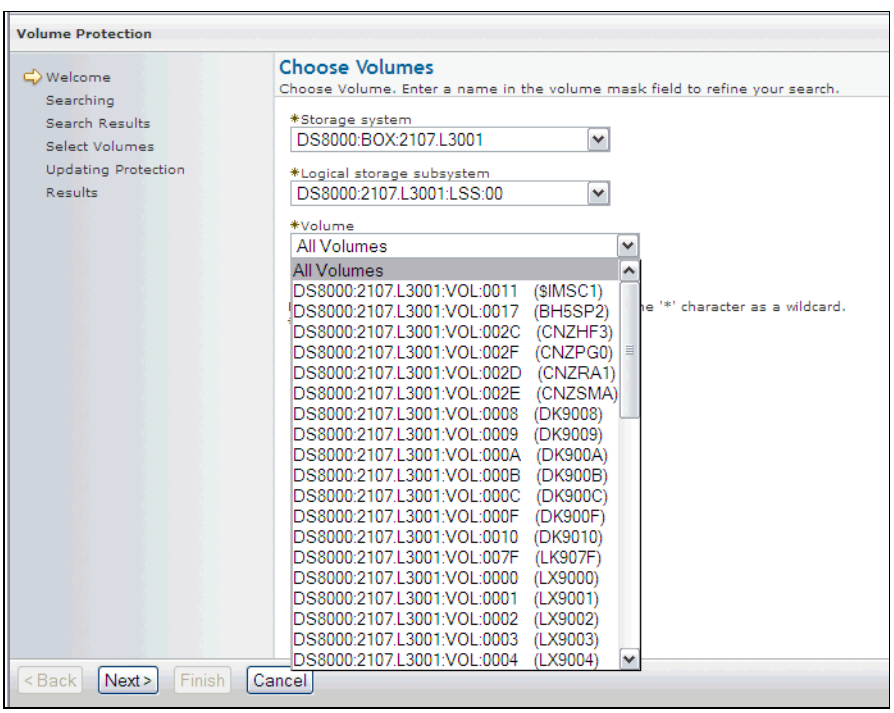

Figure 4-23 Volume Protection Wizard - select volumes to protect

3. Tivoli Storage Productivity Center for Replication will now create a list of volumes matching to the volume selection input you have made in the panel shown in Figure 4-24. In our example, this list will contain 51 volumes. Click **Next** to continue.

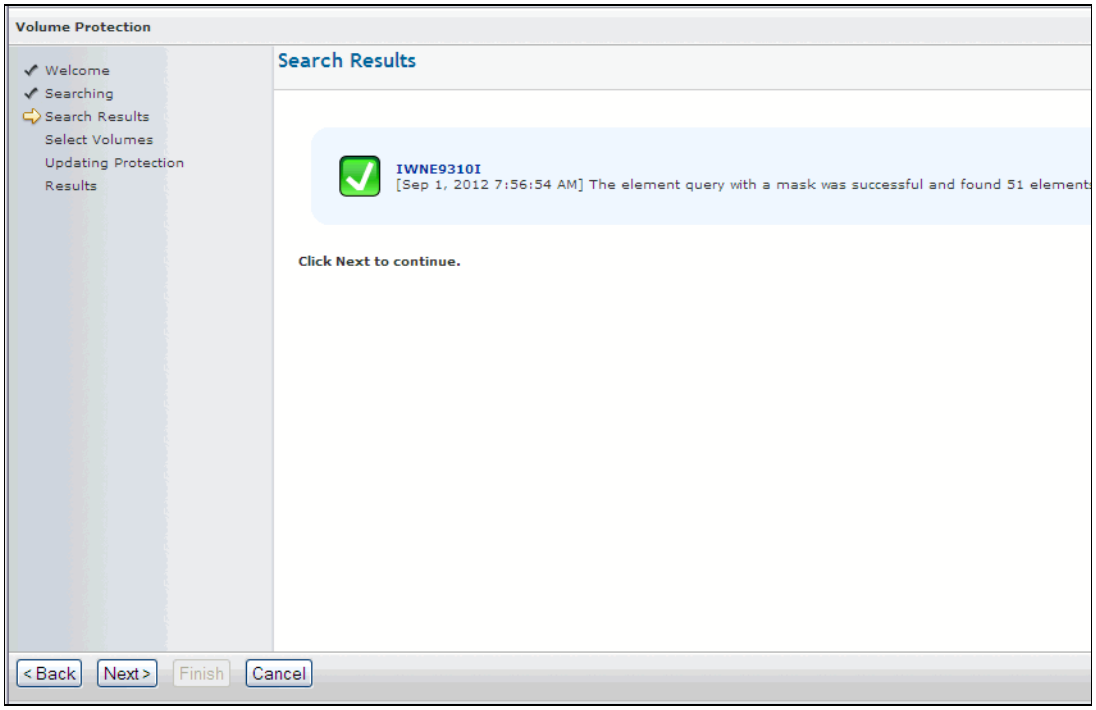

Figure 4-24 Volume Protection Wizard - search results

4. You will now be presented the list of volumes matching your volume masking inputs. You can select single volumes in this list or use the **Select All** button to confirm selection of all the volumes in the list as shown in Figure 4-25 and then click **Next** to continue.

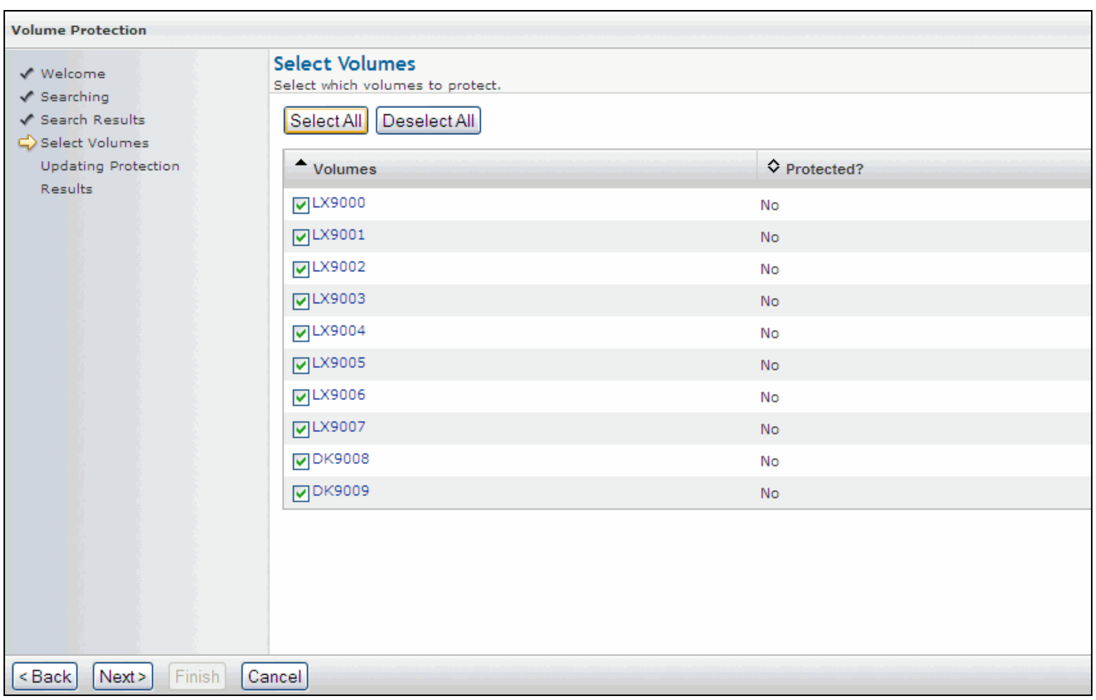

Figure 4-25 Volume Protection Wizard - select volumes to protect

5. Tivoli Storage Productivity Center for Replication will now mark the selected volumes as protected and report if this action has completed successfully (Figure 4-26).

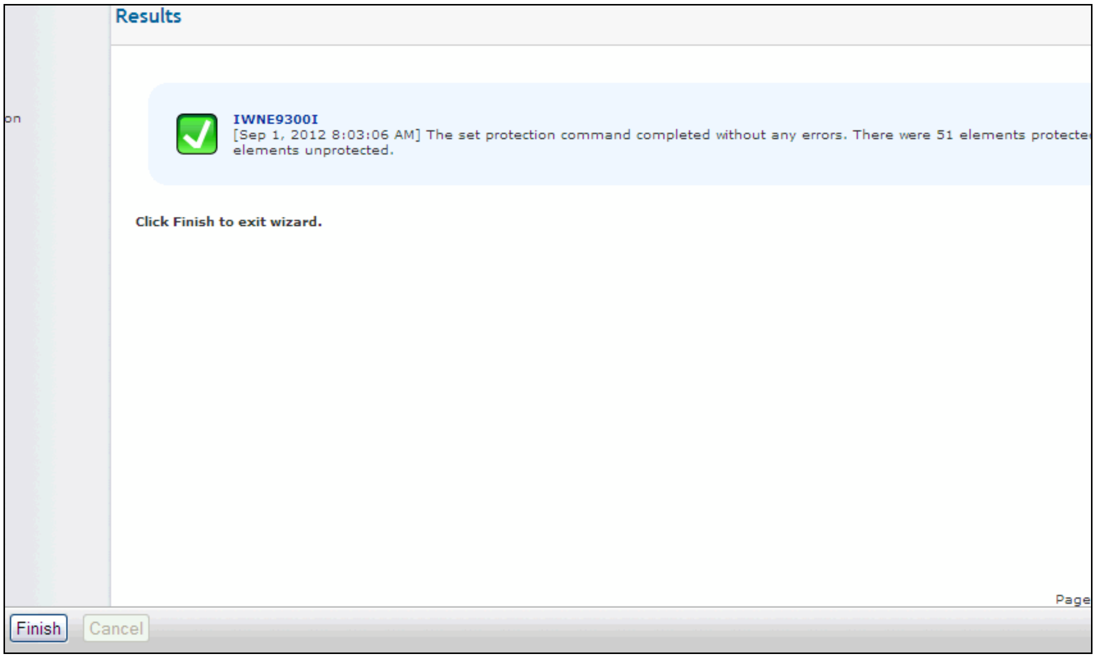

Figure 4-26 Volume Protection Wizard - select volumes to protect

> **Note:** If your volume selection input includes volumes that are already members of Tivoli Storage Productivity Center for Replication Copy Sets, these volumes would appear in the list of matched volumes and you could select them for protection. However, the actual protection process would fail for those volumes and an error message would be produced. An example of such a message is shown in Figure 4-27.

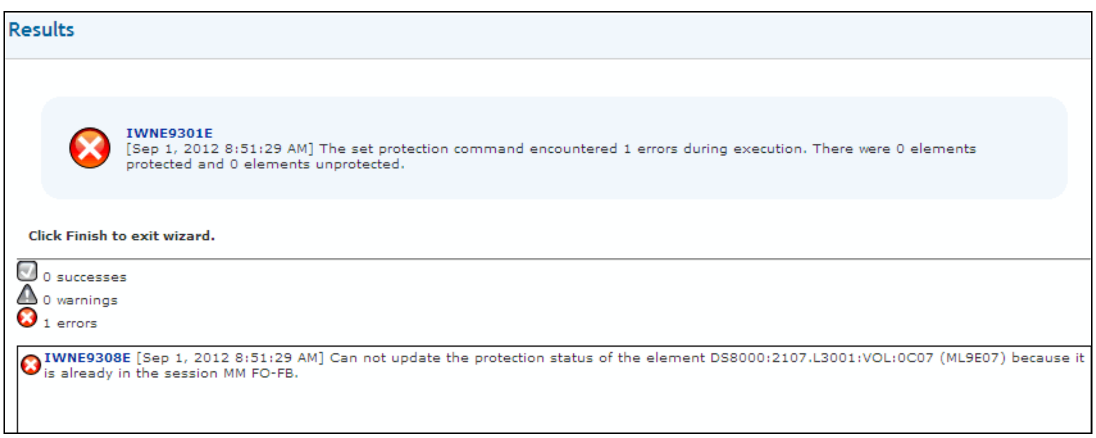

Figure 4-27 Volume Protection Wizard - some volumes already members of Copy Sets

6. If you want to unprotect volumes that are currently protected by Tivoli Storage Productivity Center for Replication, start the Volume Protection Wizard and enter the appropriate volume masking information as shown in Figure 4-23 on page 143 and Figure 4-25 on page 144. Tivoli Storage Productivity Center for Replication will again show a list with all volumes matching your masking criteria. Volumes that are currently protected by Tivoli Storage Productivity Center for Replication will appear with a tick in the associated checkbox. To unprotect a volume, just deselect it in the list and click **Next**.

4.5 Removing a storage subsystem from Tivoli Storage Productivity Center for Replication management

To remove a Storage Subsystems from Tivoli Storage Productivity Center for Replication management, proceed as follows:

1. Log on to Tivoli Storage Productivity Center for Replication and click the **Storage Systems** in the **Health Overview Panel's Work Area** or in the **Navigation Area**. This takes you to the Systems panel shown in Figure 4-28.

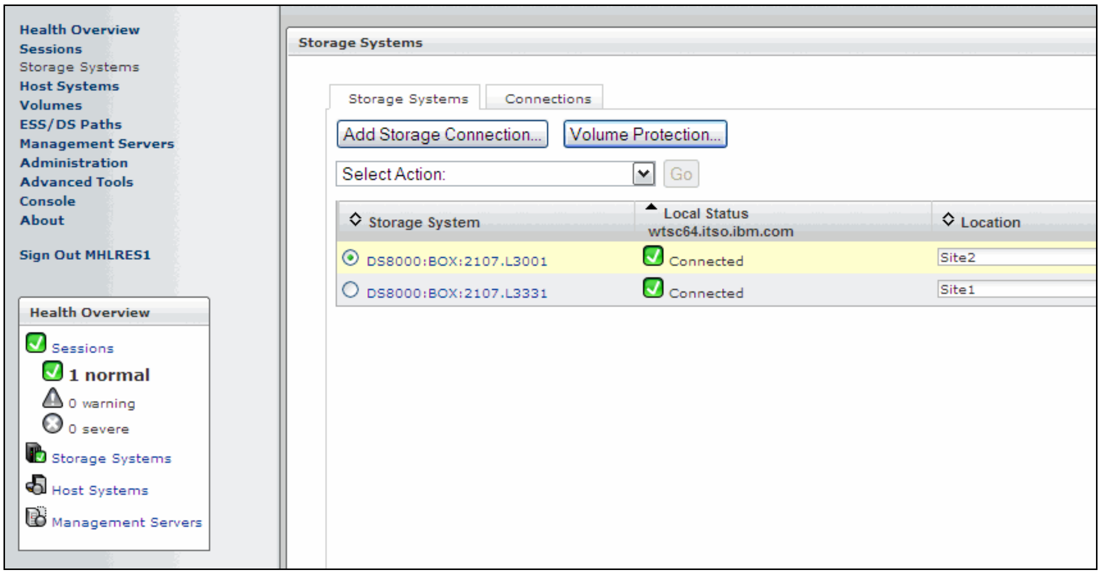

Figure 4-28 Storage Subsystems panel

2. Select the storage subsystem you want to remove from Tivoli Storage Productivity Center for Replication by marking the associated radio button, choose **Remove Storage System,** and click **Go** as shown in Figure 4-29.

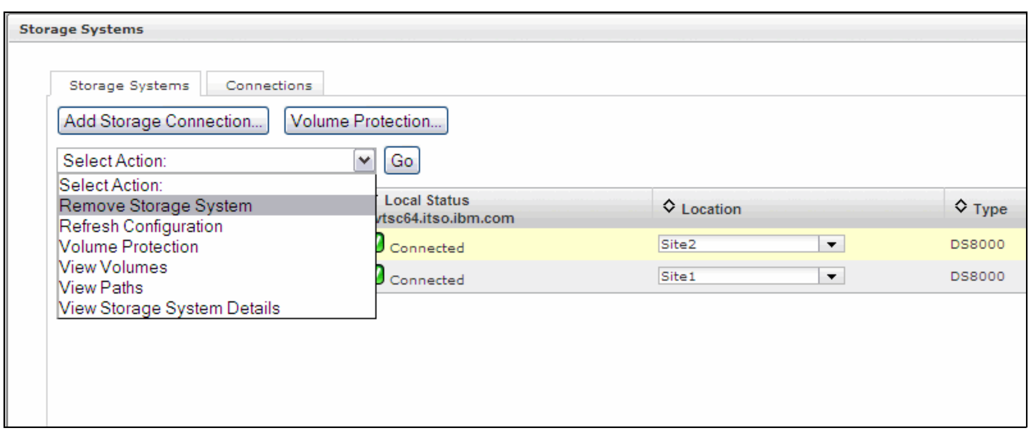

Figure 4-29 Storage Subsystems panel - remove storage subsystem

3. Next, you will see a confirmation message as shown in Figure 4-30 warning you that the removal of a storage subsystem from Tivoli Storage Productivity Center for Replication will result in the removal of all Copy Sets containing volumes from this storage subsystem from their Tivoli Storage Productivity Center for Replication Sessions. If you are sure that you want to remove the storage subsystem, click **Yes** to continue.

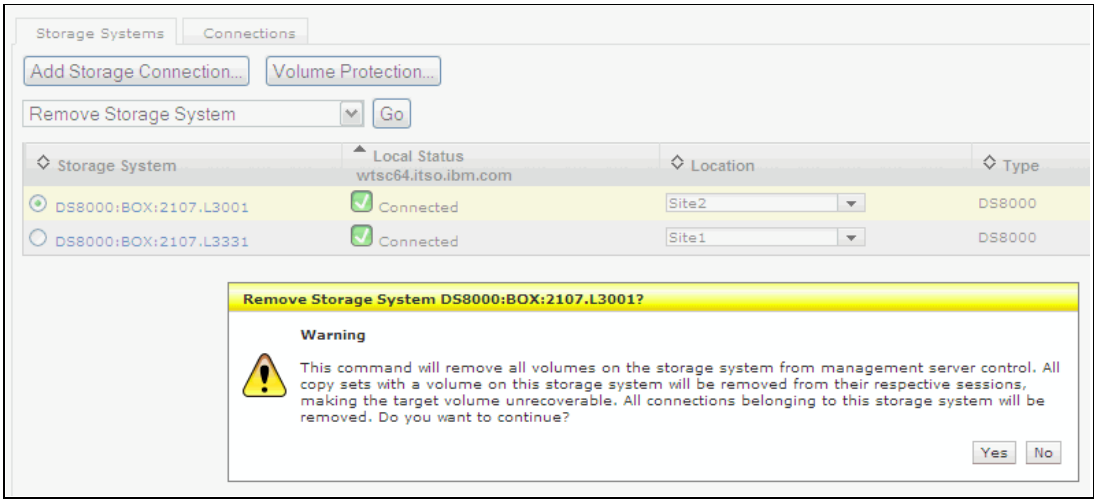

Figure 4-30 Storage Subsystems panel - remove storage subsystem

After having acknowledged the confirmation message shown in Figure 4-30, Tivoli Storage Productivity Center for Replication will remove the storage subsystem, all volumes on this subsystem, and all Copy Sets containing these volumes. You will be taken back to the Storage Subsystems panel and will see a message in the message line indicating that the storage subsystem has been successfully removed.

Important: When you remove a storage subsystem, all connections to the subsystems will be withdrawn and access to all volumes within that subsystem will be withdrawn. This will cause any Tivoli Storage Productivity Center for Replication Copy Sets containing volumes of this storage subsystem to be removed from their respective Tivoli Storage Productivity Center for Replication Sessions. If these sessions are active, this could also lead to relationships being left on the hardware that are no longer managed by Tivoli Storage Productivity Center for Replication.

4.6 Refreshing the storage system configuration

Every time you change the logical configuration on your DS8000 storage system, such as adding new volumes, you need to refresh the storage system configuration. By refreshing the storage system, Tivoli Storage Productivity Center for Replication is aware of new changes.

You must have Administrator privileges to modify storage connection settings. Proceed as follows:

1. In the Tivoli Storage Productivity Center for Replication Navigation Tree, select Storage Systems. The Storage Systems panel is displayed in the Storage Systems view as in Figure 4-31.

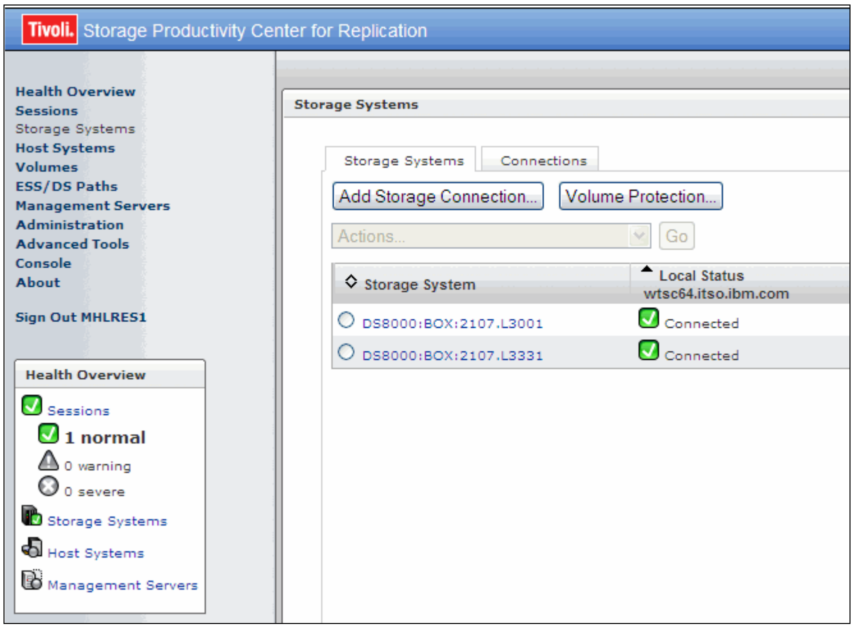

Figure 4-31   Refresh Storage System configuration

2. Select the storage system for which you want to refresh the configuration and select **Refresh Configuration** from the Actions list, and click **Go** as in Figure 4-32.

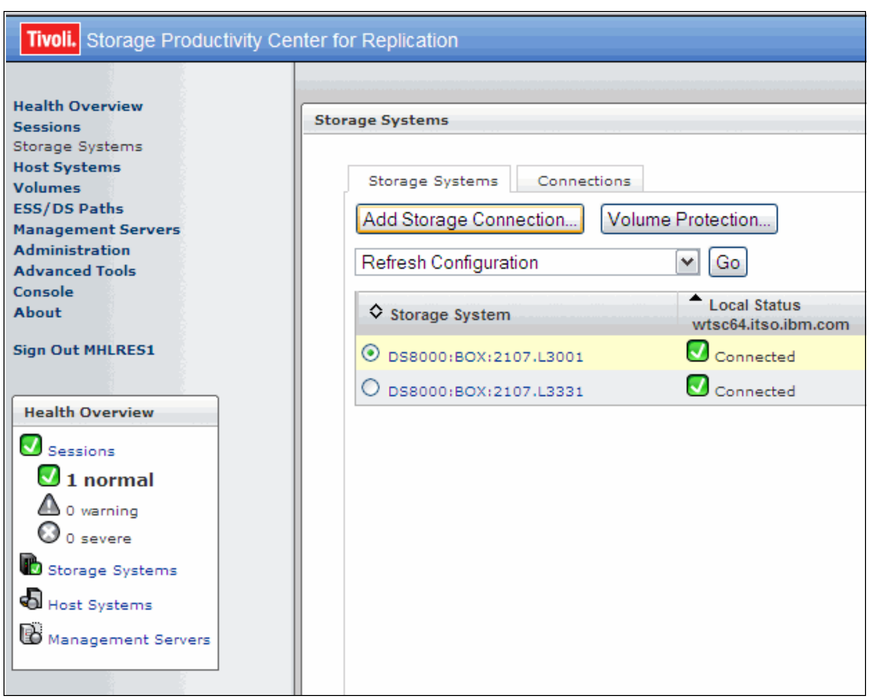

Figure 4-32   Refresh Storage Configuration

The panel in Figure 4-33 displays the confirmation message that refreshing the storage configuration has been completed.

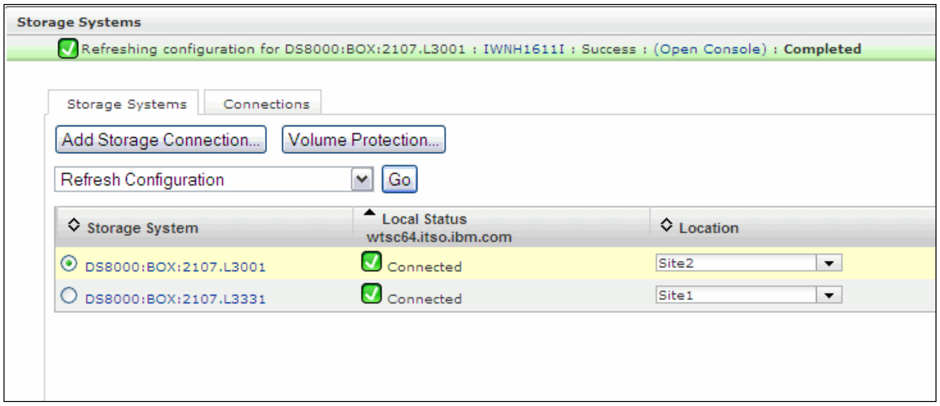

Figure 4-33   Refreshing configuration completed

Now you should be able to see, from Tivoli Storage Productivity Center for Replication, all newly added volumes in your DS8000 storage systems.

5

Tivoli Storage Productivity Center for Replication general administration and high availability

At this point, you have successfully installed the Tivoli Storage Productivity Center for Replication. In this chapter, we show you how to perform general administration tasks with your Tivoli Storage Productivity Center for Replication application.

We provide an overview of the graphical user interface (GUI) and the command line interface (CLI), explain the Tivoli Storage Productivity Center for Replication User Administration, and show how to configure some basic settings of Tivoli Storage Productivity Center for Replication.

We also show how to set up Tivoli Storage Productivity Center for Replication servers for high availability, as well as the process of performing a takeover from the active Tivoli Storage Productivity Center for Replication server to the standby server.

Administration and configuration tasks related to Tivoli Storage Productivity Center for Replication sessions for specific storage subsystems, Copy Sets, Paths, and Storage Subsystems are not covered in this chapter, but are described in detail in dedicated chapters.

5.1 GUI overview

The Tivoli Storage Productivity Center for Replication GUI is a Web based interface that presents the user a single point of control to configure, manage, and monitor the copy services of the attached storage subsystems. The GUI reports states and availability of the administration components as well as information for the established copy operations in real-time.

The GUI contains the following features, as shown in Figure 5-1:

Navigation tree Provides categories of tasks that you can complete in Tivoli Storage Productivity Center for Replication. Clicking a task opens a main page in the content pane.

Health overview Shows a status summary for all sessions, storage systems, host systems, and management servers that Tivoli Storage Productivity Center for Replication for System z is managing.

Content area Displays content based on the item that you selected in the navigation tree.

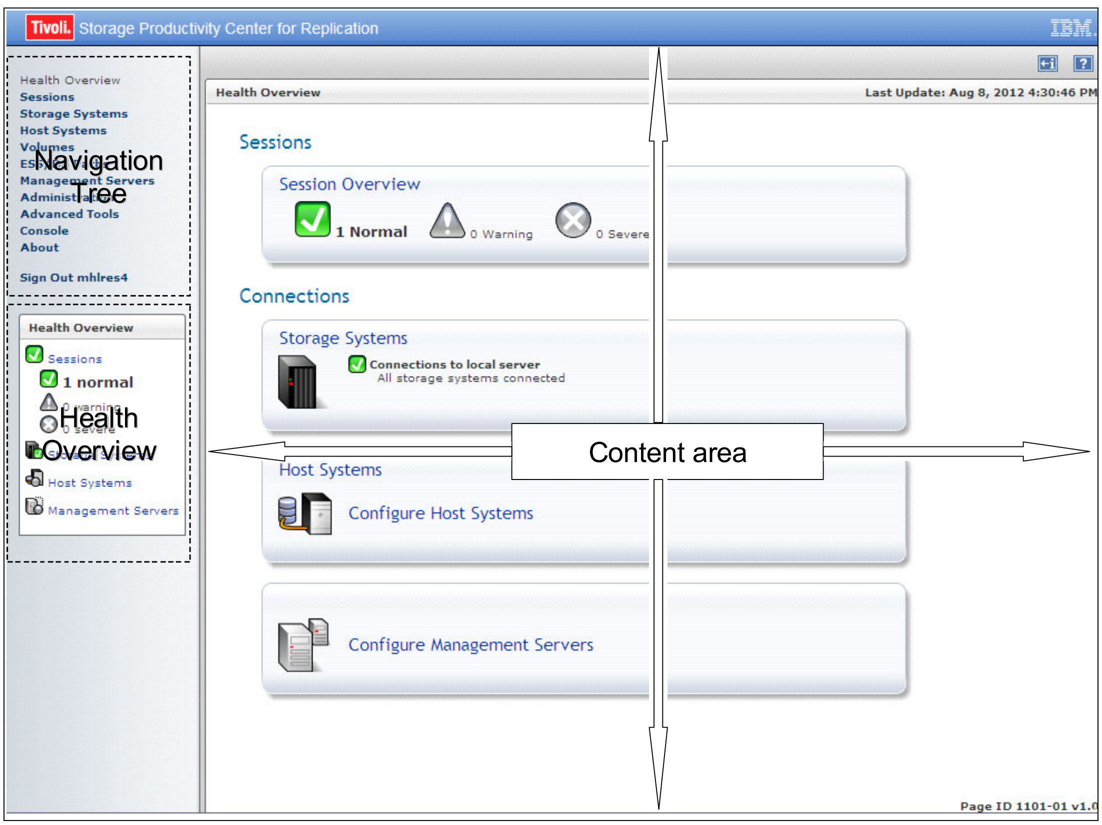

Figure 5-1 GUI layout

5.1.1 Health Overview panel

The Health Overview panel is the first panel you see after you log in. This panel provides the following information:

- Overall session status: Indicates the session statuses, which can be normal, warning, or severe.

- Overall storage subsystem status: Indicates the connection status of the storage subsystems.
- Overall host systems status: Indicates the connection status of host systems. This status does not apply for System z hosts.
- Management server status: Indicates the status of the standby server if you are logged on to the local server. If you are logged on to the standby server, this status indicates the status of the local server. Management server status is not available if you are using Tivoli Storage Productivity Center for Replication Basic Edition for System z.

Tivoli Storage Productivity Center for Replication uses color based status indicators to provide a quick overview of the overall state of specific Tivoli Storage Productivity Center for Replication components. In addition, various icons are used to represent a more detailed status of different objects. These icons are shown in Table 5-1:

- **Green**: Tivoli Storage Productivity Center Copy Services is in "normal" mode. The session is in *prepared* state for all defined volumes and maintaining a current consistent copy of the data. Or, the session has successful processed a Recover command and is in *Target Available* state with all volumes consistent and no exceptions.
- **Yellow**: Tivoli Storage Productivity Center Copy Services is not maintaining a current consistent copy at this time but is working toward that goal. In other words, sessions may have volumes that are actively being copied or pending to be copied, there are no suspended volumes and copy services is temporarily inconsistent but actions are in place to come into duplex state. No action is required to make this become Green as states will automatically change.
- **Red**: Tivoli Storage Productivity Center Copy Services has one or more exceptions that need to be dealt with immediately.

Table 5-1 TTivoli Storage Productivity Center symbols

Symbol	Meaning
	The sessions are in a normal state.
	The sessions are in the warning state.
	The sessions are in an error state.
	The storage subsystems is connected to the local server.
	At least one storage subsystem cannot communicate with the active servers.
	No storage subsystems are defined.
	The session is in an inactive state.
	The standby server is defined and synchronized.

Symbol	Meaning
	No standby server is defined.
	The standby server is synchronizing.
	The standby server cannot communicate with the local server.

5.2 Accessing Tivoli Storage Productivity Center for Replication through the CLI

When you install Tivoli Storage Productivity Center for Replication on your server, the Java based command line Interface also gets installed into the installation directory.

You can use the Tivoli Storage Productivity Center for Replication for System z CLI by using the *csmcli* utilities. You can use the CLI directly or group several CLI commands into scripts for automating functions.

For security reasons, the CLI runs only on the Tivoli Storage Productivity Center for Replication for System z management server.

5.2.1 Configuring the command-line interface

There are three properties files that are used to configure the command-line interface:

- repcli.properties

  Contains the server and port information used to communicate with the IBM Tivoli Storage Productivity Center for Replication server and the command-line interface. You can find it in the directory where CLI was installed; the default directory is `/var/Tivoli/RM/CLI`. The following example shows the contents of this file in our system:

  server Points to the z/OS server where Tivoli Storage Productivity Center for Replication is running.

  port Port to be used for communication between Tivoli Storage Productivity Center for Replication and the CLI. It must point to the same port as specified in *communications.port* in the rmserver.properties file. Otherwise you will not be able to login to CLI.

  Example 5-1 repcli.properties example

  ```
  server=WTSC64.itso.ibm.com
  port=9560
  ```

- rmserver.properties

  Contains configuration information about logging. It is located in the directory `/install_root/AppServer/profiles/default/properties`. In our system, this directory is `/zWebSphereOEM/V7R0/tpcr510/AppServer/profiles/default/properties`. The communication.port that you specify here in this file must be the same as in the repcli.properties file. Otherwise you get a *login failed* message when trying to use the CLI.

- tpcrcli-auth.properties

  Contains authorization information for signing on to the CLI automatically without entering your user name and password.

5.2.2 Setting up automatic login to the CLI

You can set up the command line interface to automatically log you in without specifying your user name or password each time you issue a csmcli command or enter the csmcli shell. Use the tpcrcli-auth.properties file to create a persistent copy of the user name and encrypted password to be used for automatic authentication and authorization.

Perform these steps to set up automatic login authentication:

1. Locate the tpcrcli-auth.properties template file in the `install_root\CLI` directory. The template is located in the /var/Tivoli/RM/CLI directory by default.
2. Create a tpcr-cli directory in your home directory and copy the template to that directory.
3. Edit the file, and change the password and user name values in it to your password and user id.
4. Issue a csmcli command or enter the csmcli shell to encrypt the password in the tpcrcli-auth.properties file.

5.2.3 Using the CLI in the z/OS environment

The default directory used to store shell script to run CLI is /var/Tivoli/RM/CLI. To be able to issue CLI commands, you have to start a TSO session, go to the ISPF command line option, and type OMVS and <enter> as shown in Figure 5-2.

```
Menu  List  Mode  Functions  Utilities  Help
sssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssssss
                              ISPF Command Shell
Enter TSO or Workstation commands below:

===> omvs



Place cursor on choice and press enter to Retrieve command

=> omvs
=> ishell
```

Figure 5-2 Using OMVS under ISPF

Now you have to type `cd` and the path `/var/Tivoli/RM/CLI` (assuming you take defaults) and <enter> as shown in Figure 5-3.

```
IBM
Licensed Material - Property of IBM
5694-A01 Copyright IBM Corp. 1993, 2011
(C) Copyright Mortice Kern Systems, Inc., 1985, 1996.
(C) Copyright Software Development Group, University of Waterloo, 1989.

All Rights Reserved.

U.S. Government Users Restricted Rights -
Use,duplication or disclosure restricted by
GSA ADP Schedule Contract with IBM Corp.

IBM is a registered trademark of the IBM Corp.

MHLRES4 @ SC64:/u/mhlres4>




 ===> cd /var/Tivoli/RM/CLI/
                                                                  INPUT
ESC=¢   1=Help      2=SubCmd    3=HlpRetrn  4=Top       5=Bottom    6=TSO
        7=BackScr   8=Scroll    9=NextSess 10=Refresh  11=FwdRetr  12=Retrieve
```

Figure 5-3 Selecting CLI script path

Type the shell script **csmcli.sh** and <enter> as shown in Figure 5-4. Use the <PF10> to refresh the panel after <enter> commands any time you need.

```
IBM
Licensed Material - Property of IBM
5694-A01 Copyright IBM Corp. 1993, 2011
(C) Copyright Mortice Kern Systems, Inc., 1985, 1996.
(C) Copyright Software Development Group, University of Waterloo, 1989.

All Rights Reserved.

U.S. Government Users Restricted Rights -
Use,duplication or disclosure restricted by
GSA ADP Schedule Contract with IBM Corp.

IBM is a registered trademark of the IBM Corp.

MHLRES4 @ SC64:/u/mhlres4>cd /var/Tivoli/RM/CLI/
MHLRES4 @ SC64:/SC64/var/Tivoli/RM/CLI>




 ===> csmcli.sh
                                                                          INPUT
ESC=¢   1=Help      2=SubCmd    3=HlpRetrn  4=Top       5=Bottom    6=TSO
        7=BackScr   8=Scroll    9=NextSess 10=Refresh  11=FwdRetr  12=Retrieve
```

Figure 5-4 Calling csmcli.sh shell script

CLI automatically authenticates your user id and password if you have done the customization to automatically login as described in 5.2.2, “Setting up automatic login to the CLI” on page 155. Otherwise, you have to enter them manually.

```
(C) Copyright Software Development Group, University of Waterloo, 1989.

All Rights Reserved.

U.S. Government Users Restricted Rights -
Use,duplication or disclosure restricted by
GSA ADP Schedule Contract with IBM Corp.

IBM is a registered trademark of the IBM Corp.

MHLRES4 @ SC64:/u/mhlres4>cd /var/Tivoli/RM/CLI/
MHLRES4 @ SC64:/SC64/var/Tivoli/RM/CLI>csmcli.sh
Tivoli Storage Productivity Center for Replication Command Line Interface (CLI)
 Copyright 2007, 2012 IBM Corporation
 Version: 5.1
 Build: l20120510-1010
 Server: wtsc64.itso.ibm.com Port: 9560
 Authentication file: /u/mhlres4/tpcr-cli/tpcrcli-auth.properties

csmcli>
 ===>
                                                                          INPUT
ESC=¢   1=Help      2=SubCmd    3=HlpRetrn  4=Top       5=Bottom    6=TSO
        7=BackScr   8=Scroll    9=NextSess 10=Refresh  11=FwdRetr  12=Retrieve
```

Figure 5-5 Authenticated to use the CLI.

To verify the available CLI commands, type `help` after a successful login into the CLI as shown in Figure 5-6.

```
addhost        lsauth         lssnapgrpactions   rmmc
addmc          lsavailports   lssnapshots        rmpath
addstorsys     lscpset        lssnmp             rmsess
chauth         lscptypes      lsstorcandidate    rmsnmp
chdevice       lsdevice       lsvol              rmstdby
chhost         lshaservers    mkauth             rmstorsys
chlocation     lshost         mkbackup           setasstdby
chmc           lslocation     mkcpset            setoutput
chsess         lslss          mklogpkg           setparameter
chvol          lsmc           mkpath             setstdby
cmdsess        lspair         mksess             showcpset
cmdsnapgrp     lsparameter    mksnmp             showdevice
csmcli         lspath         quit               showgmdetails
exit           lspool         refreshdevice      showha
exportcsv      lsrolepairs    rmactive           showmc
exportgmdata   lsrolescpset   rmassoc            showsess
hareconnect    lssess         rmauth             ver
hatakeover     lssessactions  rmcpset            whoami
help           lssessdetails  rmdevice
csmcli>
 ===>
                                                                        RUNNING
ESC=¢   1=Help      2=SubCmd    3=HlpRetrn  4=Top       5=Bottom    6=TSO
        7=BackScr   8=Scroll    9=NextSess 10=Refresh  11=FwdRetr  12=Retrieve
```

Figure 5-6 Available CLI commands

5.2.4 Tivoli Storage Productivity Center for Replication CLI overview

A Tivoli Storage Productivity Center for Replication command-line interface command consists of one to four types of components, arranged in the following order:

- The *command name*
- One or more *flags*
- Each followed by any *flag parameters* it might require
- The *command parameter*

Example 5-2 shows the CLI structure.

Example 5-2 CLI structure

```
csmcli command name -flag parameter -command parameter
```

The *command name* specifies the task that the command-line interface will have to perform. For example, **lssess** tells the command-line interface to list sessions, and **mksess** tells the command-line interface to create a session.

Flags modify the command. They provide additional information that directs the command-line interface to perform the command task in a specific way. For example, the **-v** flag tells the command-line interface to display the command results in verbose mode. Some flags may be used with every command-line interface command, others are specific to a command and are invalid when used with other commands. Flags are preceded by a hyphen (-), and may be followed immediately by space and a flag parameter.

Flag parameters provide information that is required to implement the command modification that is specified by a flag. If you do not provide a parameter, then a default value is assumed. For example, you can specify `-v on`, or `-v off` to turn verbose mode on or off; but if you specify `-v` only, then the flag parameter is assumed to be on.

The *command parameter* provides basic information that is necessary to perform the command task. When a command parameter is required, it is always the last component of the command; and it is not preceded by a flag. Some commands permit multiple command parameters with each parameter separated by a blank space and not a comma (unlike flag parameters that allow multiple values).

Full details of the CLI can be found in the manual *IBM Tivoli Storage Productivity Center for Replication Command-Line Interface User's Guide,* SC27-2323.

5.3 Tivoli Storage Productivity Center for Replication user administration

This section explains the role based security model of Tivoli Storage Productivity Center for Replication and shows how to add, manage, and remove access to the application.

Tivoli Storage Productivity Center for Replication itself does not maintain a directory of user names and passwords. Instead, Tivoli Storage Productivity Center for Replication uses either the local operating system or an LDAP Directory for user authentication. You have to specify during installation which method you want to utilize.

5.3.1 Tivoli Storage Productivity Center for Replication role based access control

Tivoli Storage Productivity Center for Replication controls access to its resources by mapping roles to either specific users or groups (both of which have to exist either locally or in your LDAP directory, depending on the authentication method used).

No user can log into Tivoli Storage Productivity Center for Replication unless access has explicitly been granted (that is, a role has been mapped) to his user ID or to a group of which he is a member.

There are currently three static roles defined in Tivoli Storage Productivity Center for Replication:

- Administrator
- Monitor
- Session Operator

Administrator

Administrators can perform all actions within Tivoli Storage Productivity Center for Replications without any restriction. They can manage all replication related activities, manage storage subsystems, and also manage access control. Note that Administrators could revoke their own administrative access rights.

Monitor

Monitors can display information within Tivoli Storage Productivity Center for Replication but are not allowed to modify anything. Monitors can view the following information:

- All storage subsystems
- All path information
- All sessions and session details
- High availability status and standby servers

Session Operator

Session Operators can manage specific sessions. An Administrator has to specify for which session a Session Operator is authorized when granting access. A Session Operator is allowed to perform the following tasks:

- Create sessions
- For specified sessions and for sessions created by the Session Operator, do the following tasks:
  - Add and remove Copy Sets
  - Modify the Session Description
  - Set the Session Options
  - Remove the Session
  - Execute an Action / Command against the Session
  - Add PPRC paths
  - Remove paths with no hardware relationship
- View the following information, regardless of the specific session for which the Session Operator is authorized:
  - All storage subsystems
  - All path information
  - All sessions and session details
  - High availability status and standby servers

5.3.2 Managing access control

This section shows you how to grant, modify, and revoke access to Tivoli Storage Productivity Center for Replication. In order to manage access control, you need to have an Administrator role.

Access for Tivoli Storage Productivity Center for Replication is managed in the Administration panel. You can invoke this panel by clicking **Administration** in the Navigation tree area of the Tivoli Storage Productivity Center for Replication GUI as shown in Figure 5-7.

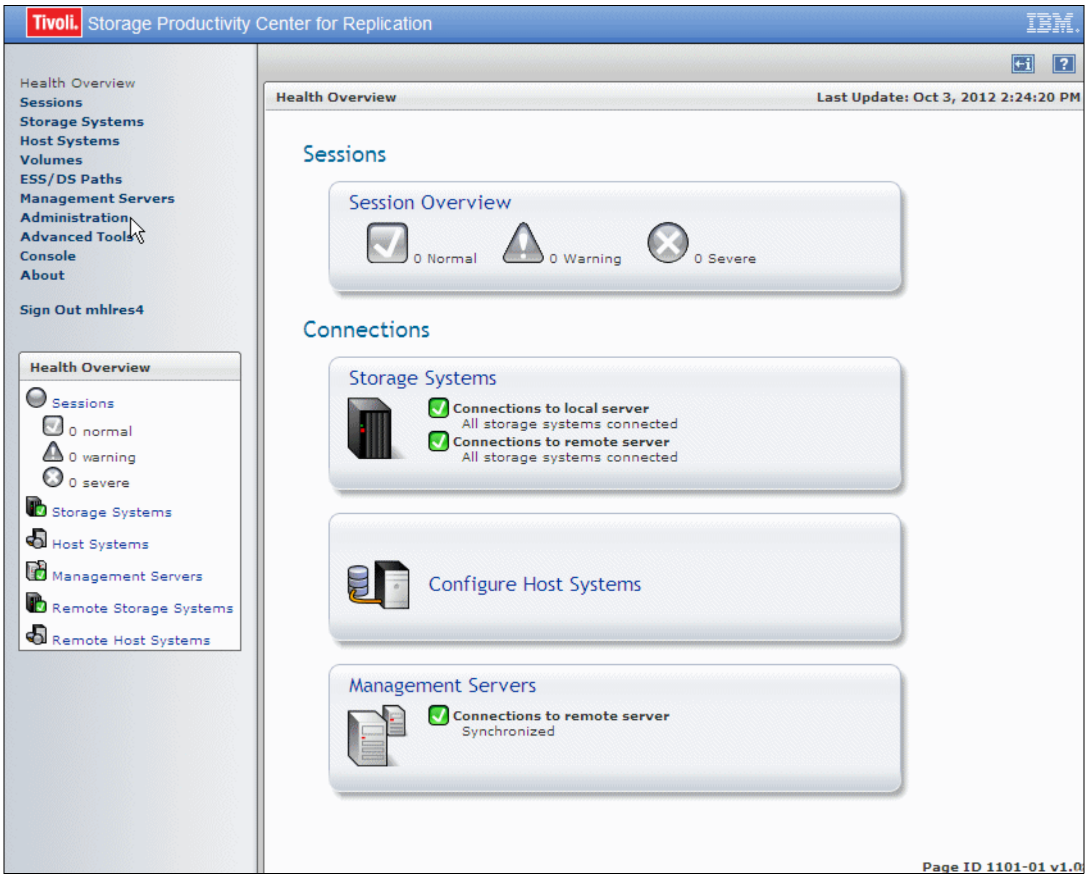

Figure 5-7 Invoke User Administration panel

The Administration panel is displayed as depicted in Figure 5-8. Here you can see a list of all users or user groups that have been granted access to Tivoli Storage Productivity Center for Replication.

If you invoke this panel the first time after installation, you will see only one user with an Administrator role. That is the user you have been asked to provide during the installation process described in 3.5, “Installing Tivoli Storage Productivity Center for Replication using embedded Derby database”.

Granting access

In order to add new access privileges for Tivoli Storage Productivity Center for Replication, proceed as follows:

1. Click **Add Access** in the Administration panel as shown in Figure 5-8.

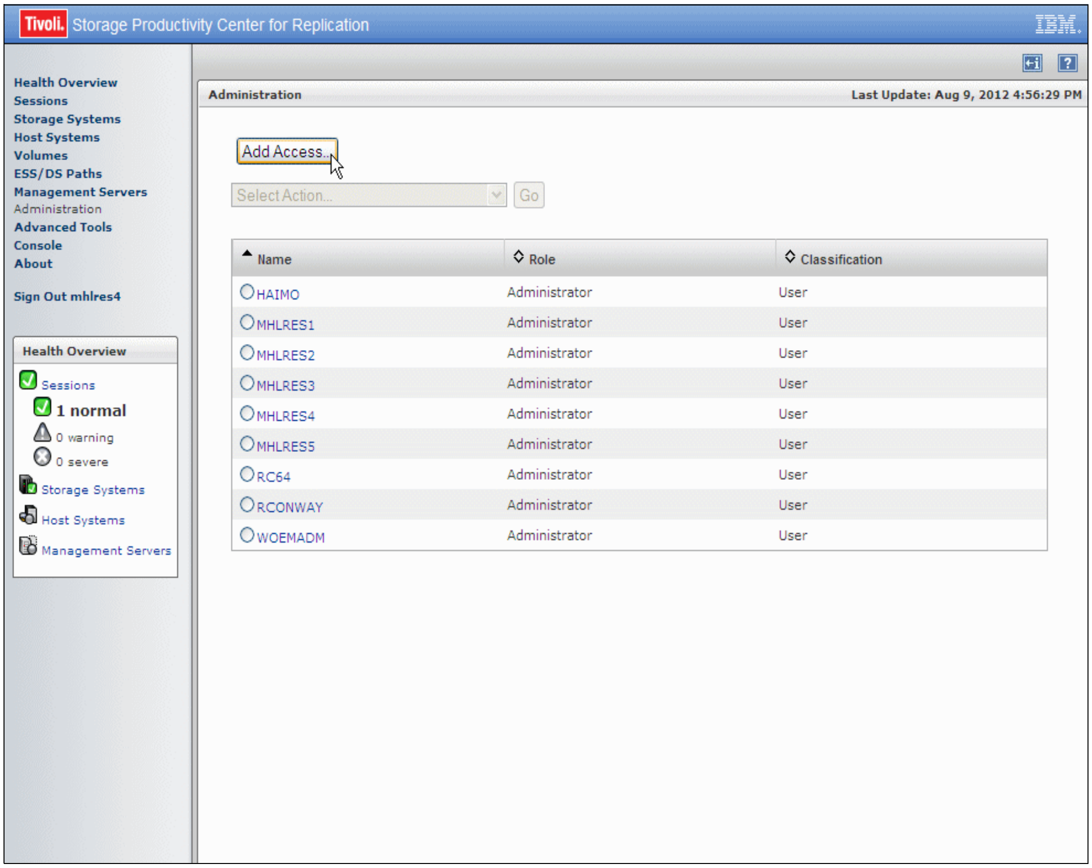

Figure 5-8 Tivoli Storage Productivity Center for Replication Administration panel

2. This will start the Add Access Wizard. As Tivoli Storage Productivity Center for Replication does not maintain its own list of users, it now has to probe to either the local operating system (RACF) or to the LDAP directory to obtain a list of users and groups that are currently present. You can filter the users and groups that will be returned and can specify the maximum results. If you want all users and groups to be displayed, specify an asterisk and click **Next** to continue.

3. You can also select a mask as shown in Figure 5-9. In that example, we are searching for all the user ids beginning with *mhl*.

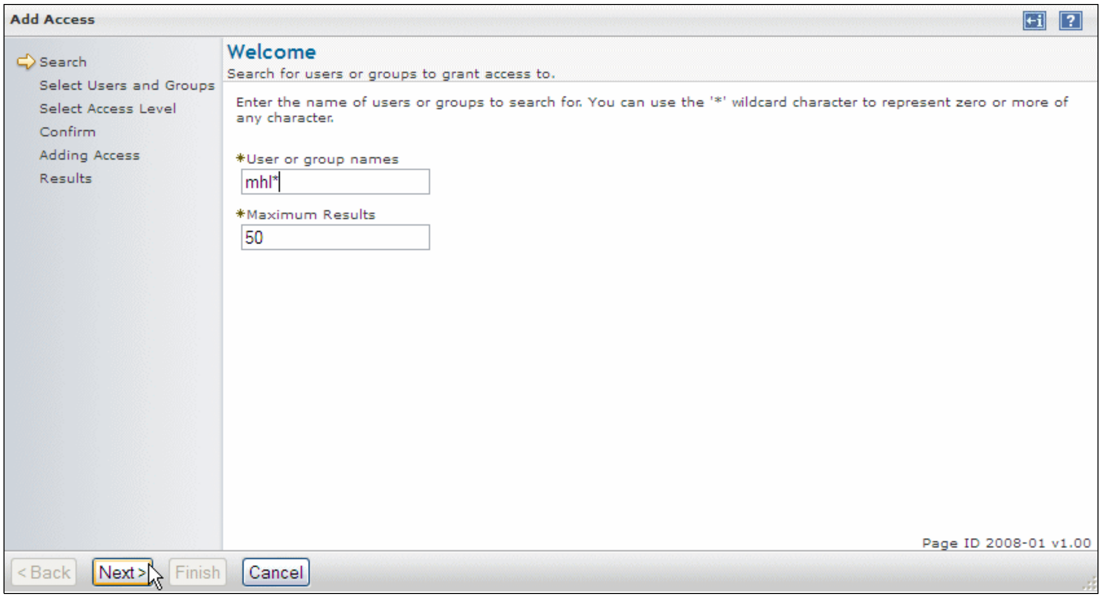

Figure 5-9 Tivoli Storage Productivity Center for Replication Add Access Wizard - filter users and groups

4. Now Tivoli Storage Productivity Center for Replication will actually probe the local operating system or the LDAP directory and retrieve a list of users and groups that match your specifications up to the limit of *maximum results*. You have to select the user or group for which you want to grant access. Note that multiple selections are possible. After having checked your selections, click **Next** to continue as shown in Figure 5-10.

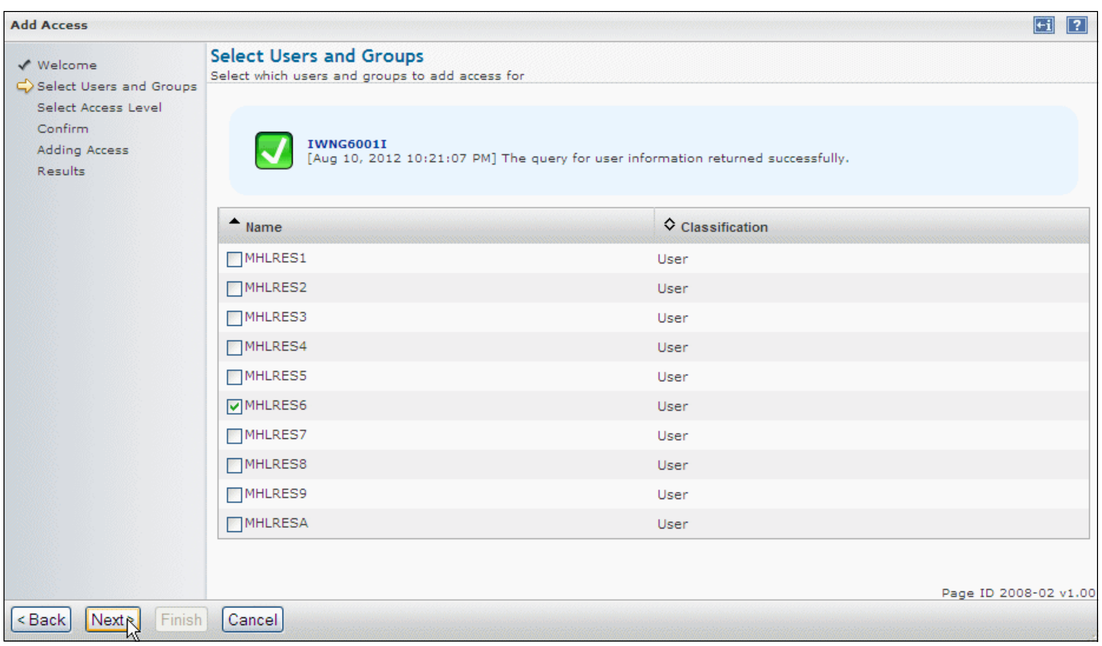

Figure 5-10 Tivoli Storage Productivity Center for Replication Add Access Wizard - select users and groups

5. Next, you are shown a panel where you can define the role that will be assigned to the users and groups that you have selected in the previous panel (Figure 5-10 on page 164). As described before, you can select **Monitor**, **Administrator**, or **Session Operator**. If you select **Session Operator**, you will also have to specify the Tivoli Storage Productivity Center for Replication sessions for which the users will get authorization. Assign a role and, in case of the *Session Operator* role, specify the Sessions and click **Next** to continue.

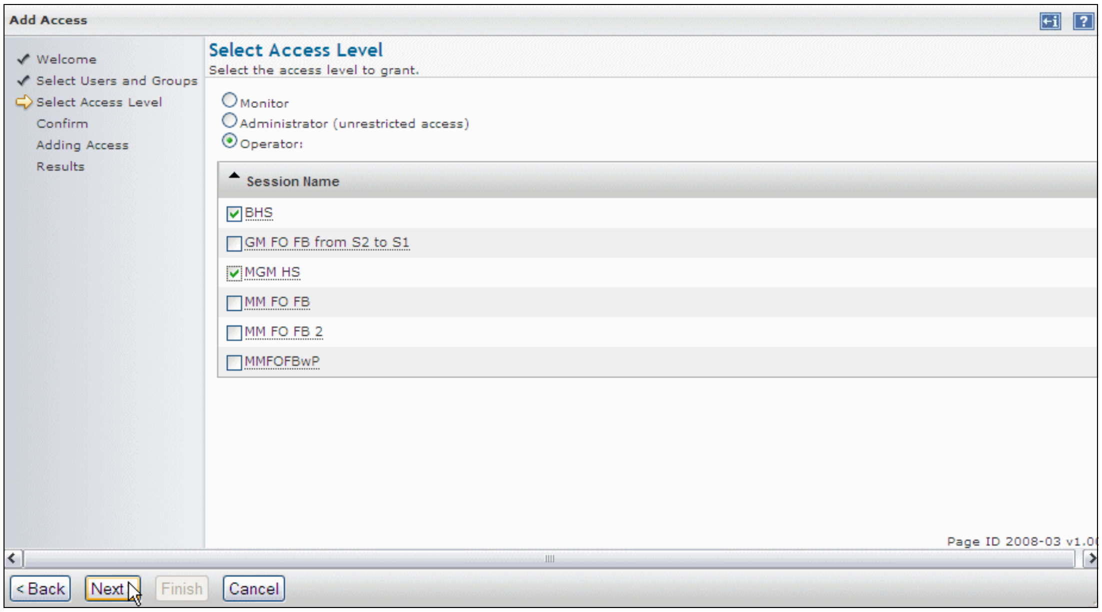

Figure 5-11 Tivoli Storage Productivity Center for Replication Add Access Wizard - select role and sessions

6. A summary panel will be displayed to allow you to review your selections and go back, in case any corrections might be necessary. If you are satisfied with your configuration, click **Next** to perform the actual changes to Tivoli Storage Productivity Center for Replication.

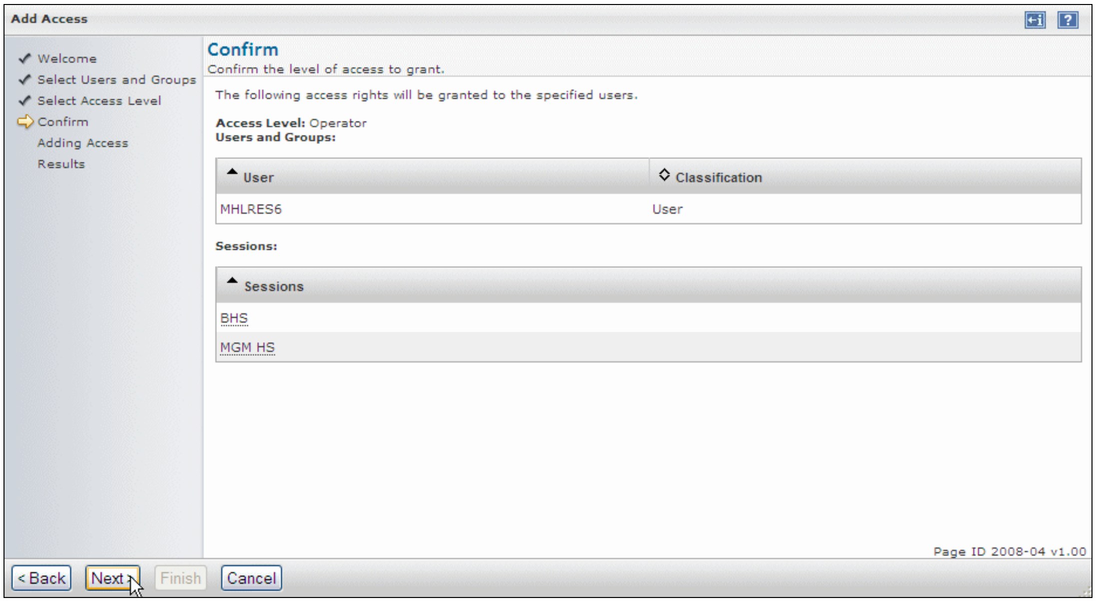

Figure 5-12 Tivoli Storage Productivity Center for Replication Add Access Wizard - confirm panel

7. Finally, you will see a panel informing you that the addition of access for the selected users and groups has been completed successfully. Click **Finish** to exit the Add Access Wizard.

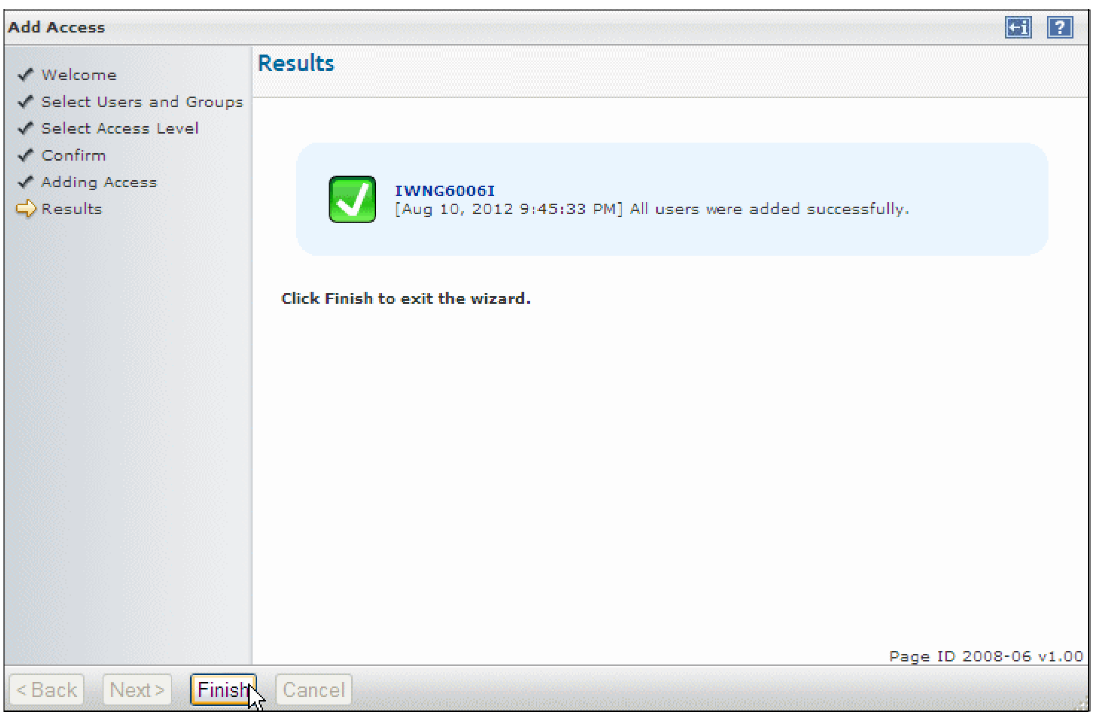

Figure 5-13 Tivoli Storage Productivity Center for Replication Add Access Wizard - success

8. After exiting the Add Access Wizard, you will be taken back to the Administration panel. You will now see the entry or entries for the new user and groups you have just granted access, as shown in Figure 5-14.

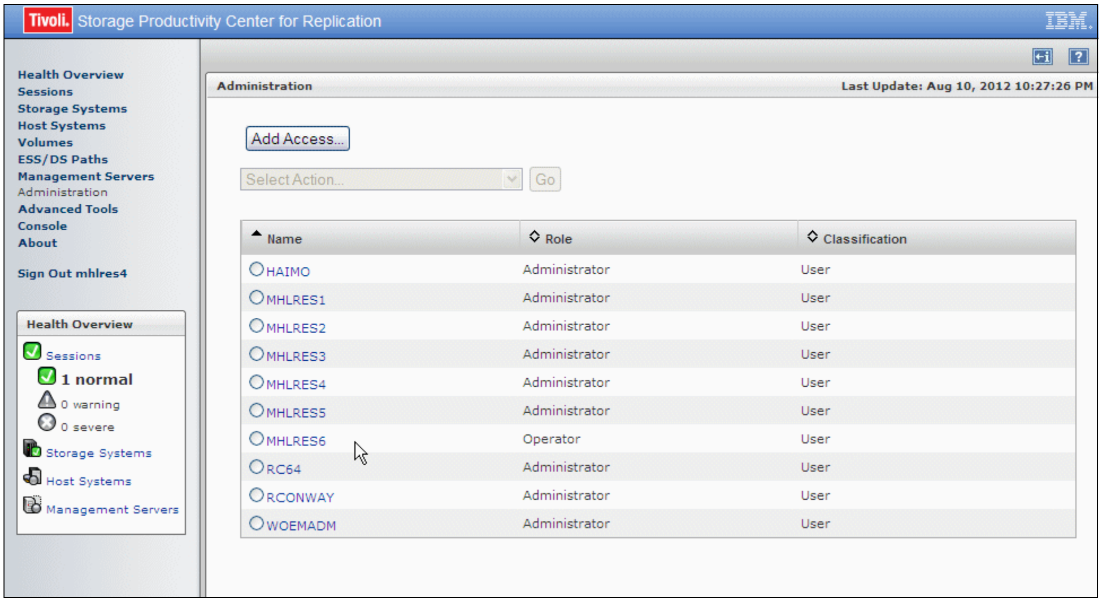

Figure 5-14 Tivoli Storage Productivity Center for Replication Administration panel with newly added user

Modifying access

To view or modify the role and the associated sessions for Tivoli Storage Productivity Center for Replication Session Operators, proceed as follows:

1. Select the user or group in the Administration panel, select **View/Modify Access**, and click **Go** as shown in Figure 5-15.

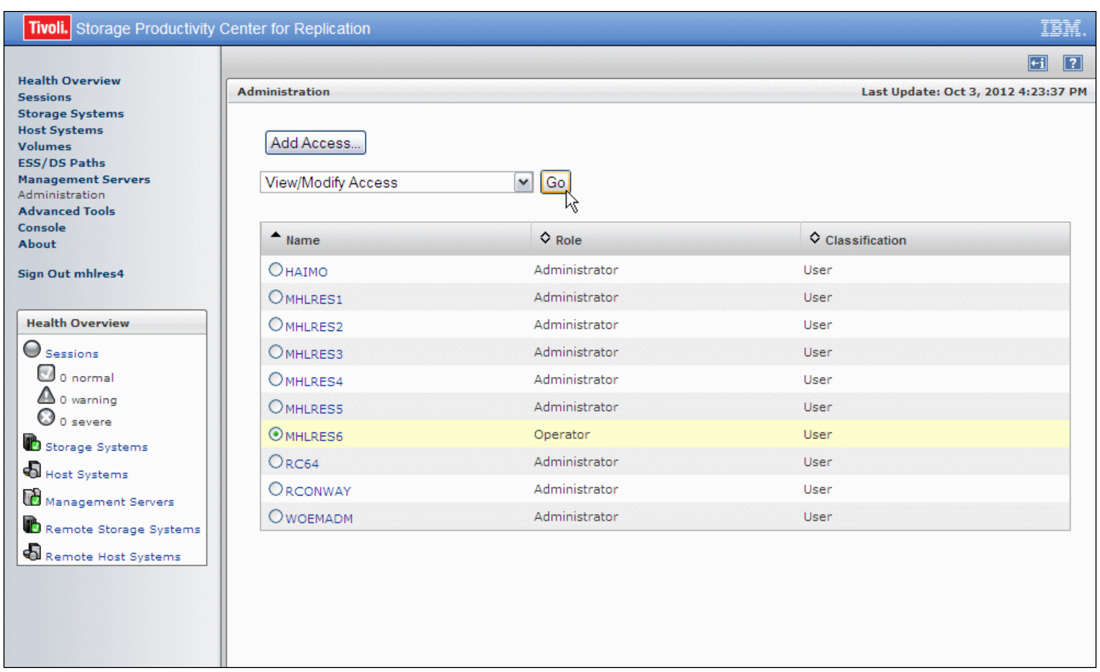

Figure 5-15 Tivoli Storage Productivity Center for Replication Administration panel - select View/Modify Access

2. Next, in Figure 5-16, you a see a panel where you can review and change the user's or group's role and Tivoli Storage Productivity Center for Replication sessions (similar to the Add Access Wizard panel shown in Figure 5-11 on page 165). Review and modify the access level and click **OK** or **Apply**.

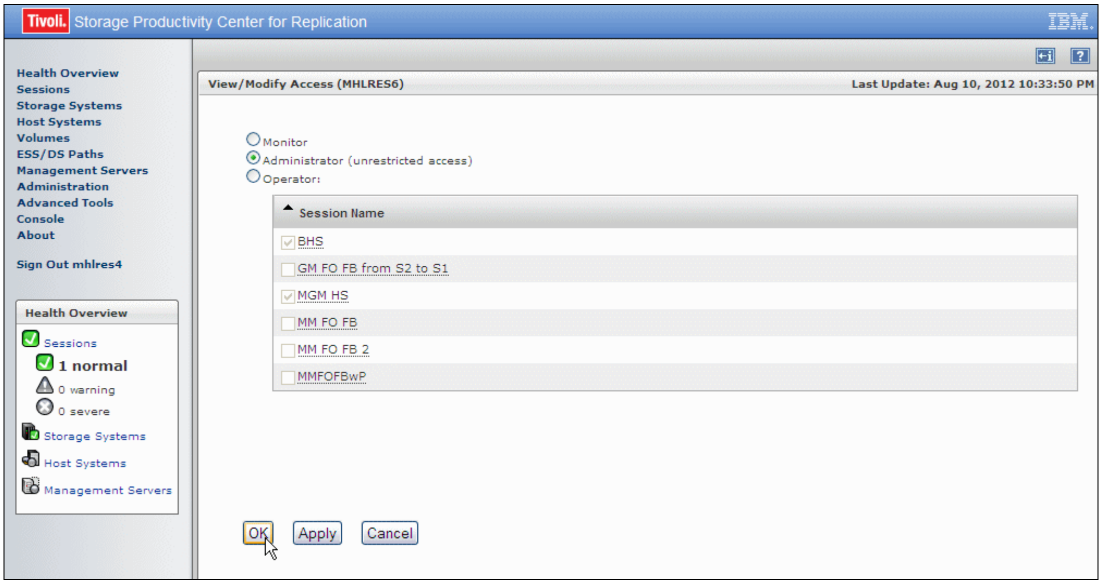

Figure 5-16 Tivoli Storage Productivity Center for Replication Administration panel - View / Modify access

3. You will return to the Administration panel. A message is posted in the message line of the GUI, indicating either success or failure of your modification operation. In our example in Figure 5-17, you can see that the user MHLRES6 now has an Administrator role assigned.

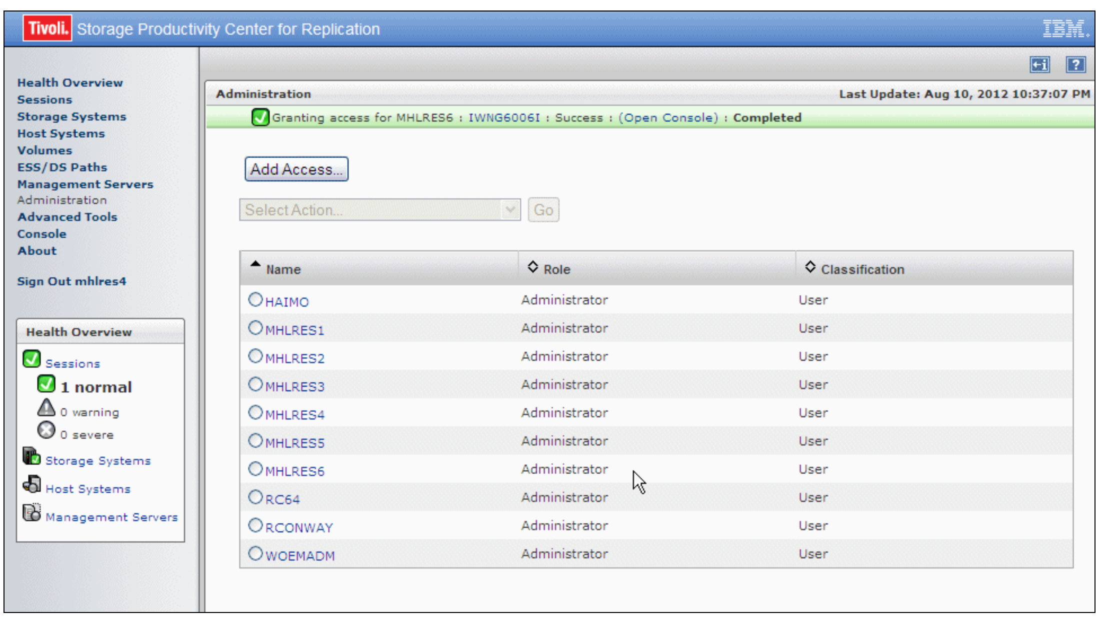

Figure 5-17 Tivoli Storage Productivity Center for Replication Administration panel - modified role for MHLRES6

Removing access

To revoke the access of a user or a group to Tivoli Storage Productivity Center for Replication, proceed as follows:

1. Select the user or group in the Administration panel, select **Remove Access**, and click **Go** as shown in Figure 5-18.

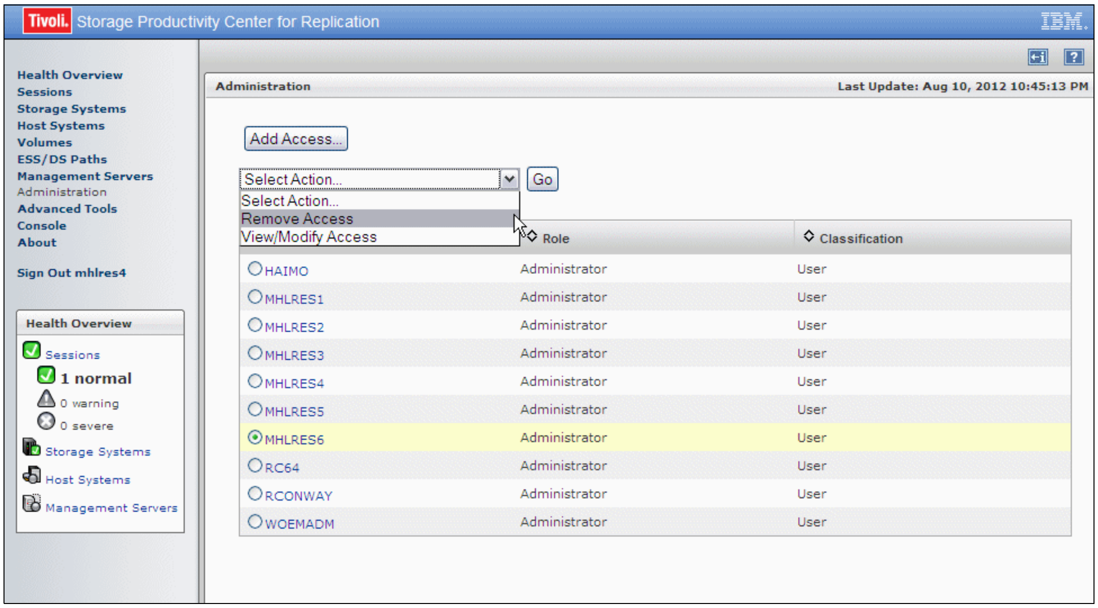

Figure 5-18 Tivoli Storage Productivity Center for Replication Administration panel - select Remove Access

2. Tivoli Storage Productivity Center for Replication will remove all access to the selected user or group without further confirmation. You will see a message line indicating if the access removal has completed successfully or failed, and the selected user will not be seen, as shown in Figure 5-19.

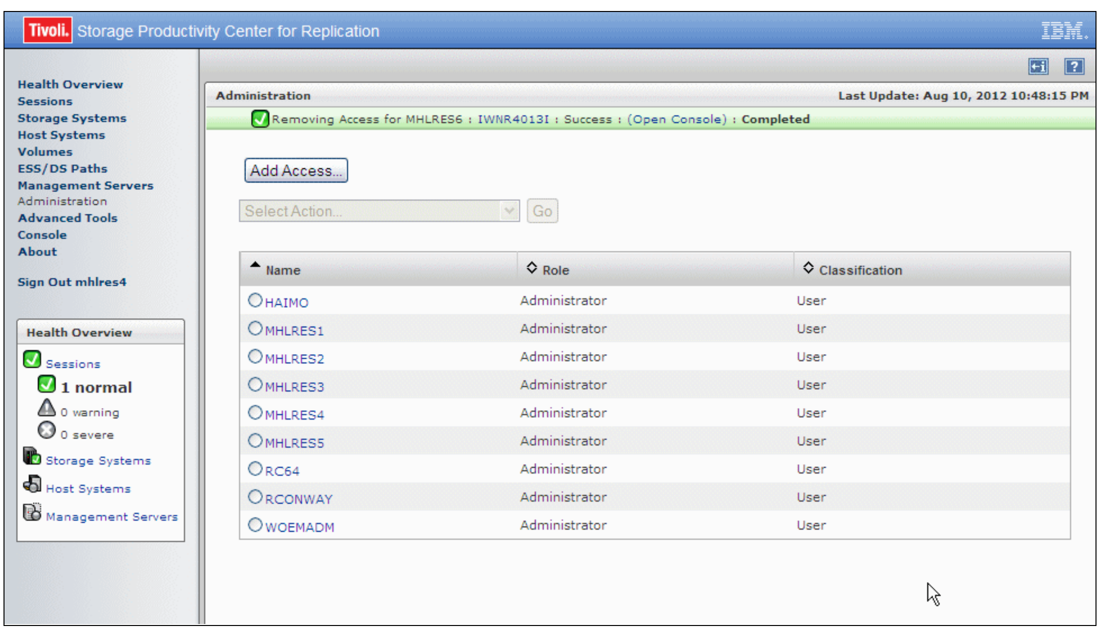

Figure 5-19 Tivoli Storage Productivity Center for Replication Administration panel - access removed successfully

5.4 Tivoli Storage Productivity Center for Replication Advanced Tools

Advanced Tools provide some useful utilities and settings for your work with Tivoli Storage Productivity Center for Replication. You can have the Tivoli Storage Productivity Center for Replication package log files for you, set the browser auto refresh rate, and enable or disable the heartbeat to the storage subsystems (used to monitor connectivity to DS8000 and ESS Systems within remote replication sessions).

To access these tools, proceed as follows:

1. Click **Advanced Tools** in the Navigation Area as shown in Figure 5-20.

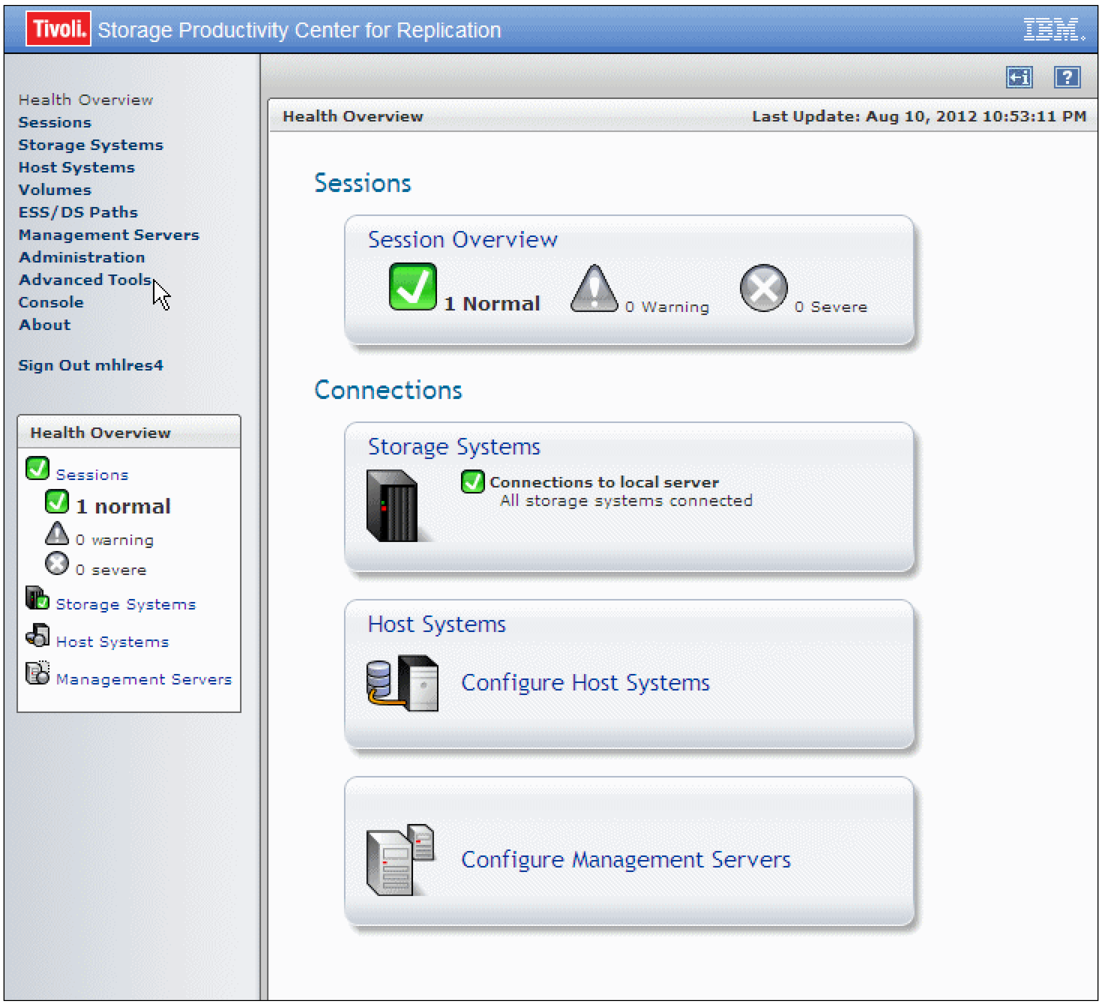

Figure 5-20 Invoke Advanced Tools panel

2. You will be taken to the Advanced Tools panel shown in Figure 5-21.

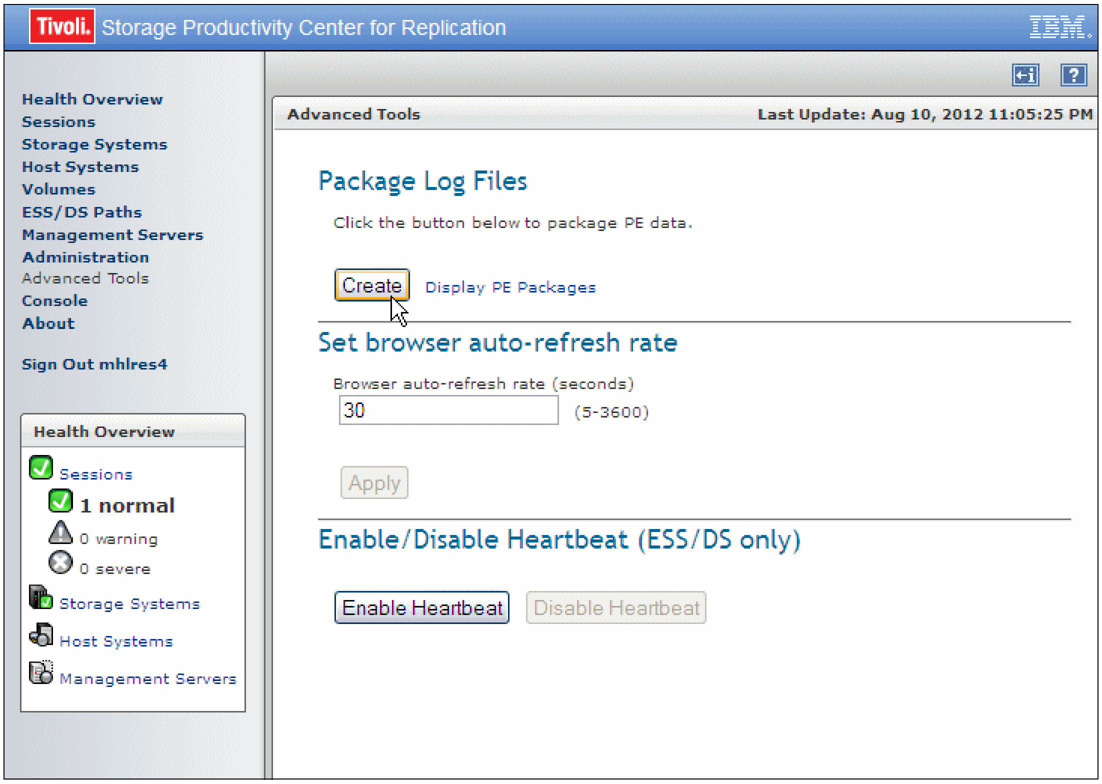

Figure 5-21 Advanced Tools panel

3. In order to create a log file package for diagnostic purposes (for example, to send it to IBM support in case of a problem), just click **Create** in the Package Log Files section. You will see a message that the creation of the log file package has been initiated and is currently running.

4. When Tivoli Storage Productivity Center for Replication finishes creating the package you are notified of the completion and are informed of the location of the diagnostics package. You see a panel similar to Figure 5-22.

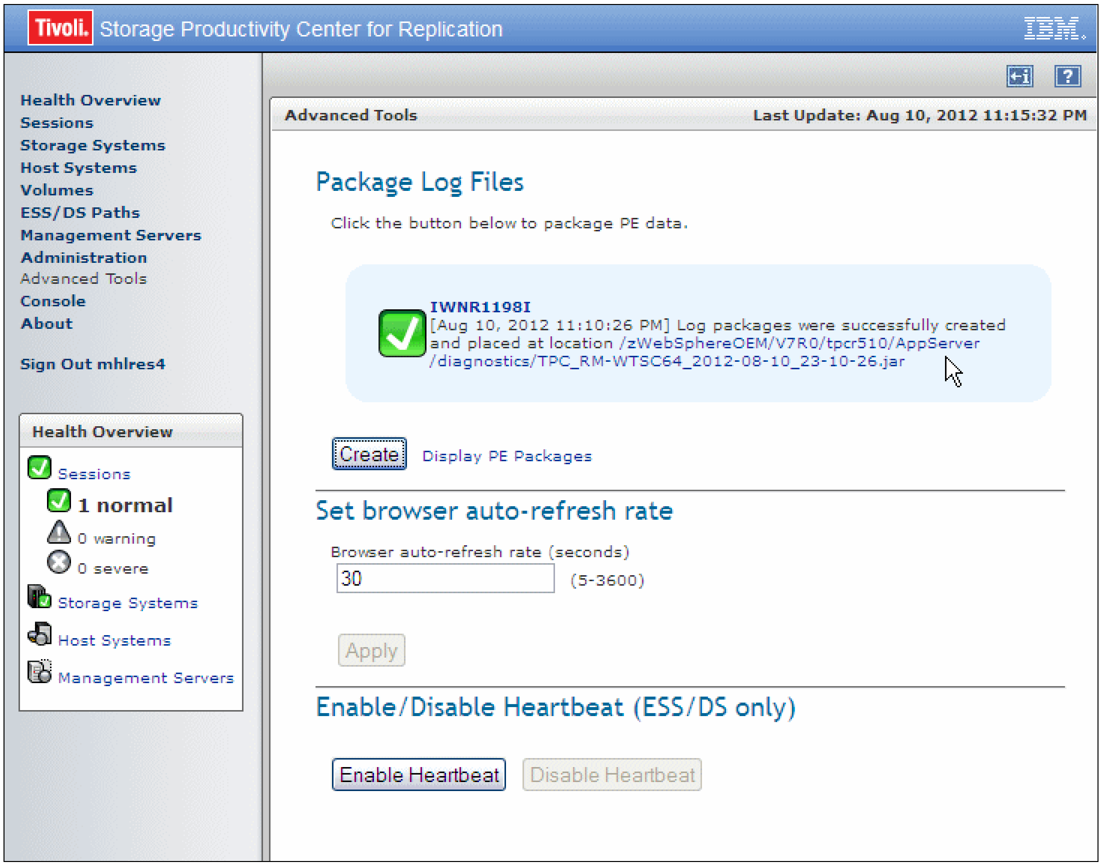

Figure 5-22 Diagnostics package creation completed

The Advanced Tools panel also has the buttons to Enable and Disable the Metro Mirror heartbeat. When it is enabled, Tivoli Storage Productivity Center for Replication checks the heartbeat of all disk storage subsystems that are managed. It relies on the disk subsystem microcode to be able to check this heartbeat.

When a storage subsystem cannot communicate its heartbeat to the Tivoli Storage Productivity Center for Replication server, the microcode in the storage subsystem sends a FREEZE to all its LSSs. As soon as the heartbeat timeout expires in Tivoli Storage Productivity Center for Replication, Tivoli Storage Productivity Center for Replication sends FREEZE commands to all LSS in other disk subsystems that belong to same session. Those FREEZE commands cause the Metro Mirror between all affected LSSs to be suspended, so they keep the data in the secondary disks in a consistent state.

5.5 Tivoli Storage Productivity Center for Replication Console

Tivoli Storage Productivity Center for Replication provides a detailed log of user activity and system activity. This log is called the Tivoli Storage Productivity Center for Replication Console.

The Tivoli Storage Productivity Center for Replication Console will detect dependent messages and group them as so-called child/children messages under the root message for the logged event, improving the readability of the log significantly. The console provides also a hyperlink-based help system for the various messages.

You can invoke the console either by clicking **Console** from the Navigation tree area of the Tivoli Storage Productivity Center for Replication GUI as shown in Figure 5-23 or by clicking the **Open Console** hyperlink in the message lines that appear at the top edge of the Work Area after you have performed specific actions in Tivoli Storage Productivity Center for Replication.

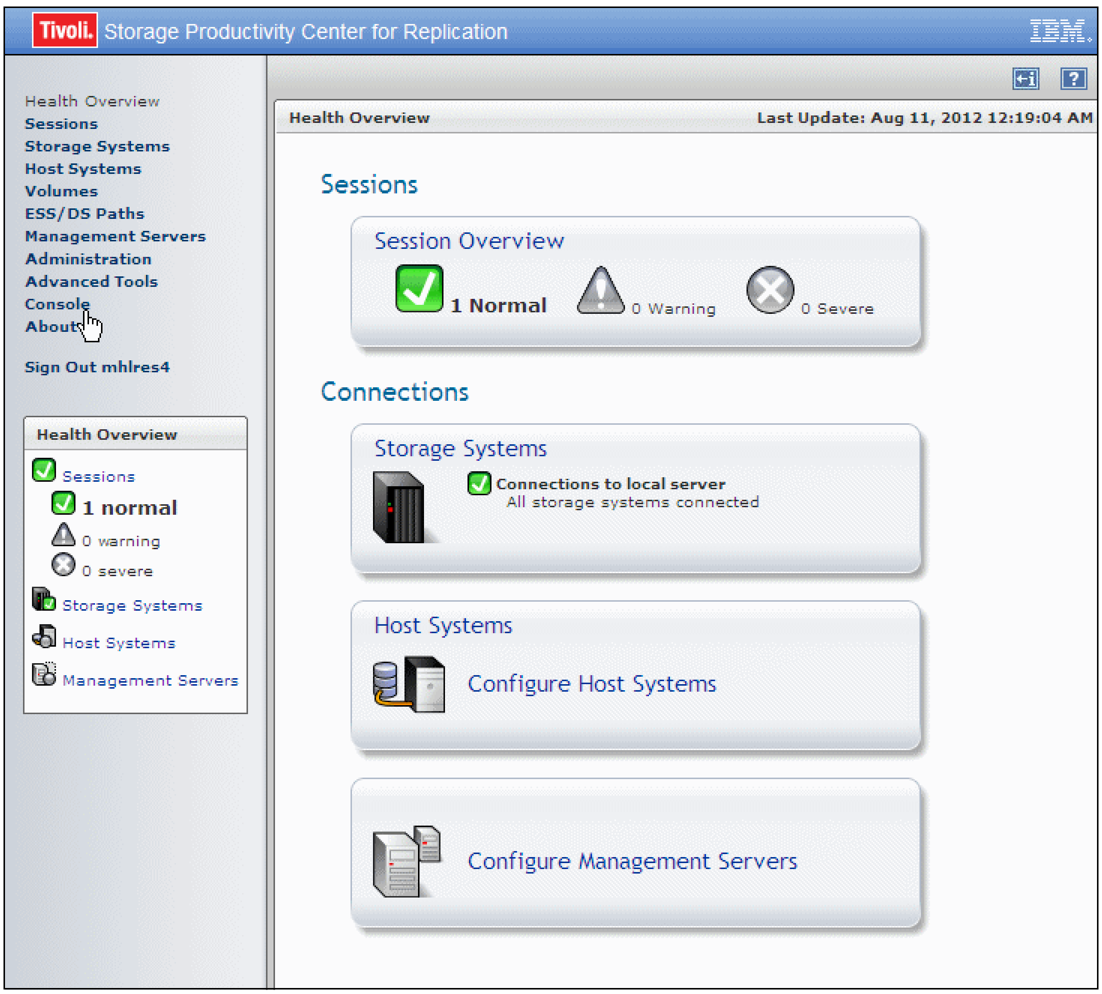

Figure 5-23 Invoke Tivoli Storage Productivity Center for Replication Console

Figure 5-24 shows the Tivoli Storage Productivity Center for Replication Console panel with various roots, as well as a pointer to children messages.

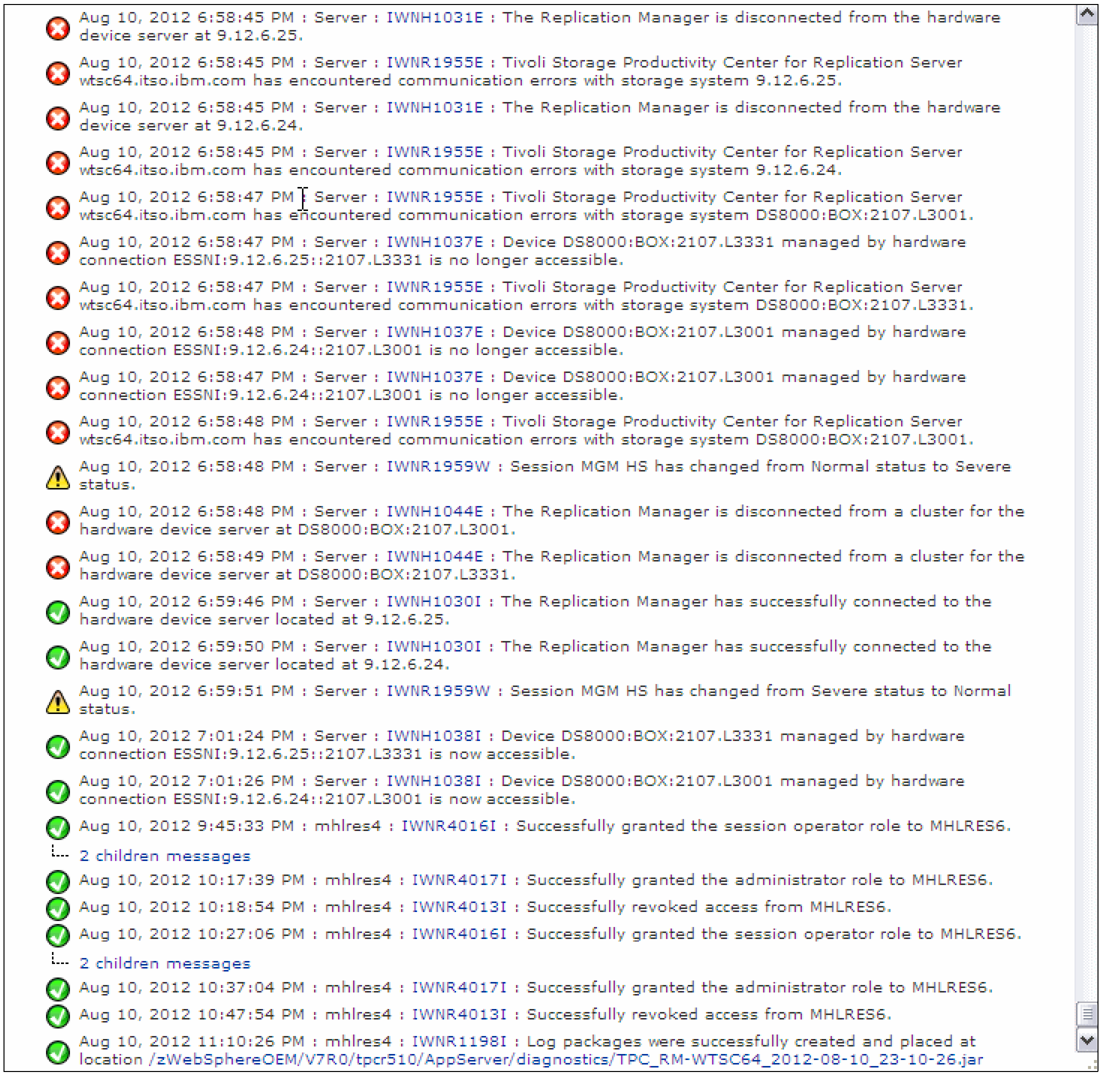

Figure 5-24 Tivoli Storage Productivity Center for Replication Console window

As described above, the console lists the message IDs of the messages as hyperlinks. Clicking these hyperlinks takes you to the associated help panels.

5.6 Tivoli Storage Productivity Center for Replication high availability

Tivoli Storage Productivity Center for Replication for System z offers support for creating a more resilient, highly available Tivoli Storage Productivity Center for Replication environment by utilizing a standby server concept.

In addition to your active Tivoli Storage Productivity Center for Replication server, you can install a second Tivoli Storage Productivity Center for Replication server into your infrastructure (for example, at your remote site) and define it as a Tivoli Storage Productivity Center for Replication (hot) standby server. Tivoli Storage Productivity Center for Replication will then replicate all changes of the active server's database to the database of the standby server.

At any time, a takeover process can be initiated at the standby server. This process will stop any relationship between active and standby server and turn the standby server into an active Tivoli Storage Productivity Center for Replication server with the same configuration as the original server had at the time of takeover. Usually this takeover process occurs after the active server has failed.

A Tivoli Storage Productivity Center for Replication standby server does not necessarily need to reside on the same operating system platform as the active Tivoli Storage Productivity Center for Replication server. Tivoli Storage Productivity Center for Replication for System z supports a standby server running in another platform. However, if you plan to use Basic HyperSwap sessions, both the active server and the standby server must run each one in different z/OS systems in the same Sysplex.

This section guides you through the steps necessary to set up a Tivoli Storage Productivity Center for Replication Server as a standby server and explains how to initiate a takeover process.

Figure 5-25 depicts an overview of a typical two-site storage infrastructure with a highly available Tivoli Storage Productivity Center for Replication installation.

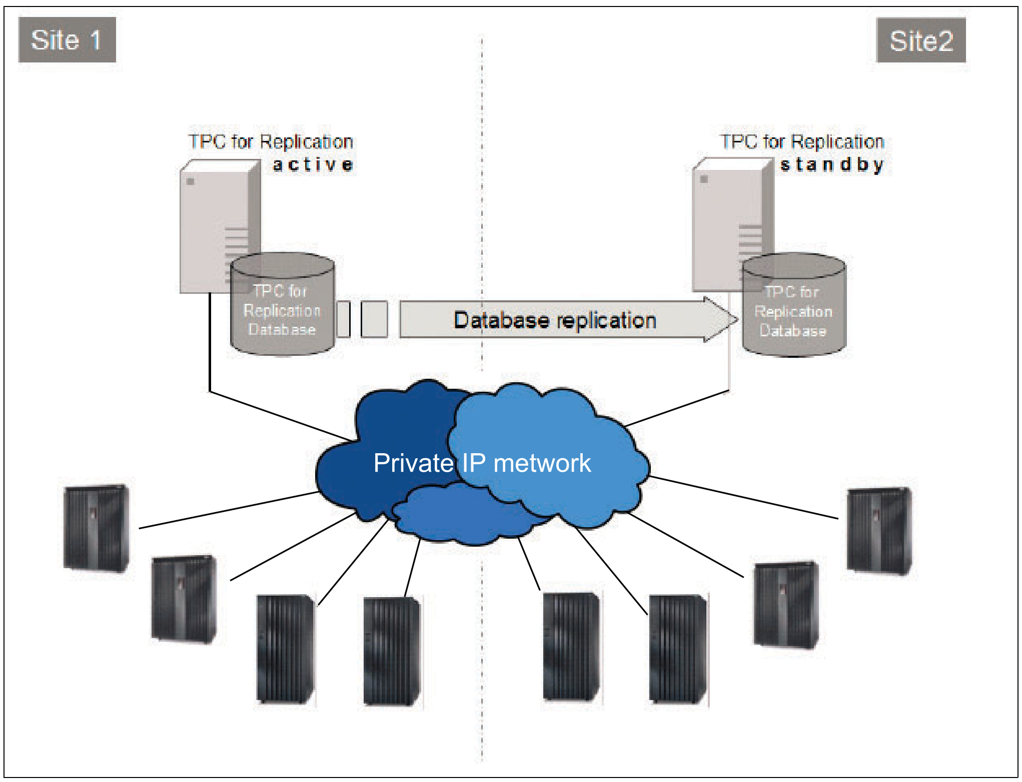

Figure 5-25 Active and standby Tivoli Storage Productivity Center for Replication servers

Figure 5-25 shows that both servers have to have IP connectivity to each other as well as to all storage subsystems managed by Tivoli Storage Productivity Center for Replication.

> **Note:** At the time of writing, Tivoli Storage Productivity Center for Replication supports exactly one standby server for an active server. This is also true for a three-site environment.

5.6.1 Setting up a Tivoli Storage Productivity Center for Replication standby server

In order to set up a Tivoli Storage Productivity Center for Replication standby server for your active server, first install the Tivoli Storage Productivity Center for Replication code as described in 3.5, "Installing Tivoli Storage Productivity Center for Replication using embedded Derby database" on page 50 on your designated standby server.

There are two ways to set up your standby server:

- Setting up a different server as the standby server
- Setting up the server you are logged in at as the standby server

> **Note:** The standby server has the following characteristics:
>
> - It is not available for the Tivoli Storage Productivity Center for Replication for System z Basic Edition license.
> - It only can manage HyperSwap sessions if the standby server is installed in the same Sysplex as active server.
> - It cannot manage sessions running in active server.
> - It has to be configured after you have your high availability plan defined. After setting a server as a standby server, you cannot use this server for any other purpose than a Takeover.

Setting up a different server as the standby server

Generally, you set up a Tivoli Storage Productivity Center for Replication standby server by logging into the active server and define a different server as a standby server. In this example, our standby server is `wtsc70.itso.ibm.com`, on z/OS system SC70, and our active server is `wtsc64.itso.ibm.com`, on z/OS system SC64. Both z/OS systems reside in the same sysplex, which is called SANDBOX.

A Tivoli Storage Productivity Center for Replication server listens on TCP port 5120 for incoming, HA-related communication.

Assume that you have an active Tivoli Storage Productivity Center for Replication server (in SC64 in our example), with some sessions defined as shown in Figure 5-26.

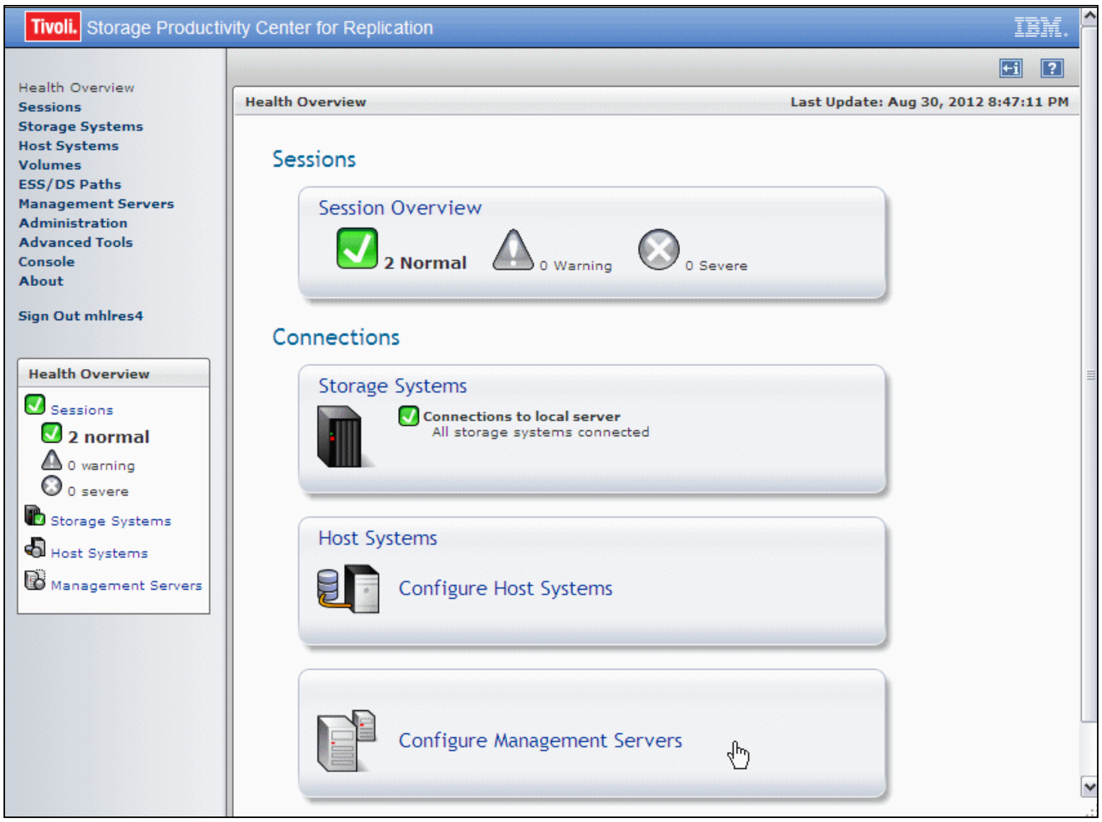

Figure 5-26 Active Tivoli Storage Productivity Center for Replication server with defined sessions

Figure 5-27 shows the Health Overview panel of our Tivoli Storage Productivity Center for Replication just installed in z/OS partition SC70.

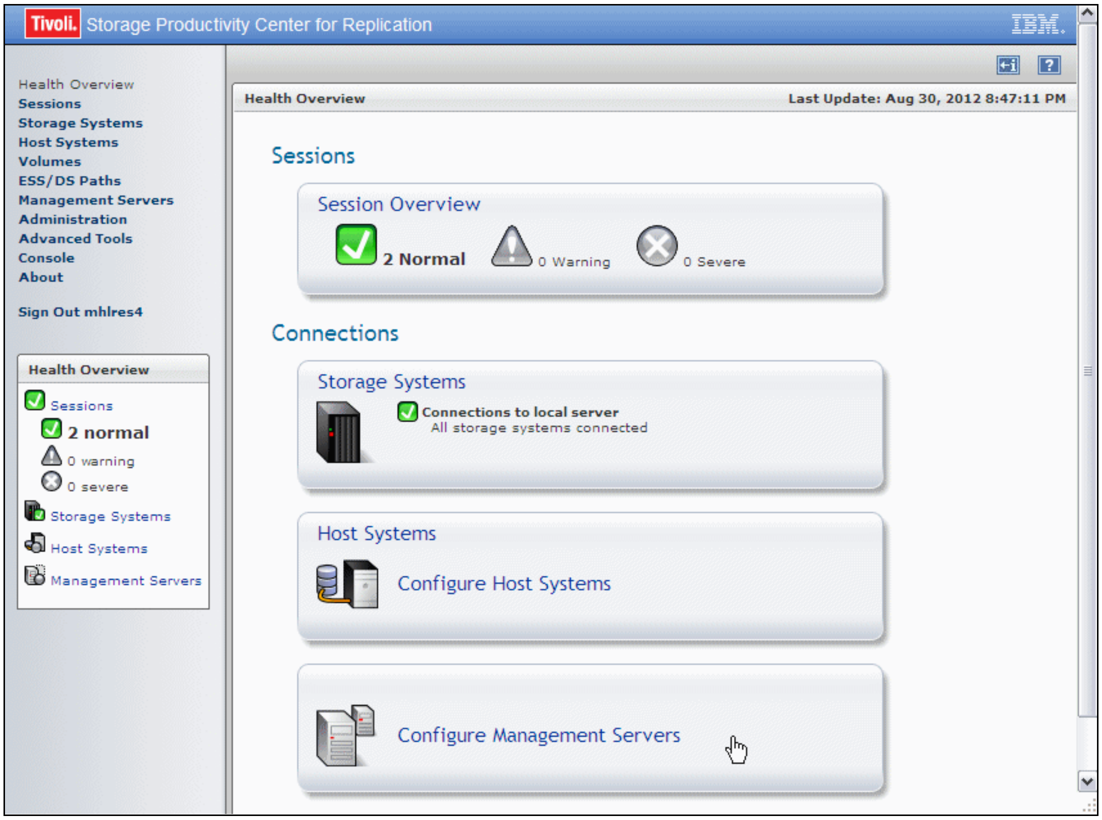

Figure 5-27 Tivoli Storage Productivity Center for Replication server on SC70

To define the Tivoli Storage Productivity Center for Replication server on SC70 (which in this example has the DNS name `wtsc70.itso.ibm.com`) as a standby server, proceed as follows:

1. Select **Management Servers** in the Navigation tree area of your active Tivoli Storage Productivity Center for Replication Server.
2. This will take you to the Management Servers panel of your active server as shown in Active Tivoli Storage Productivity Center for Replication server - Management Servers panel. You can see an entry for your server with its DNS name and the information that it has the active role.

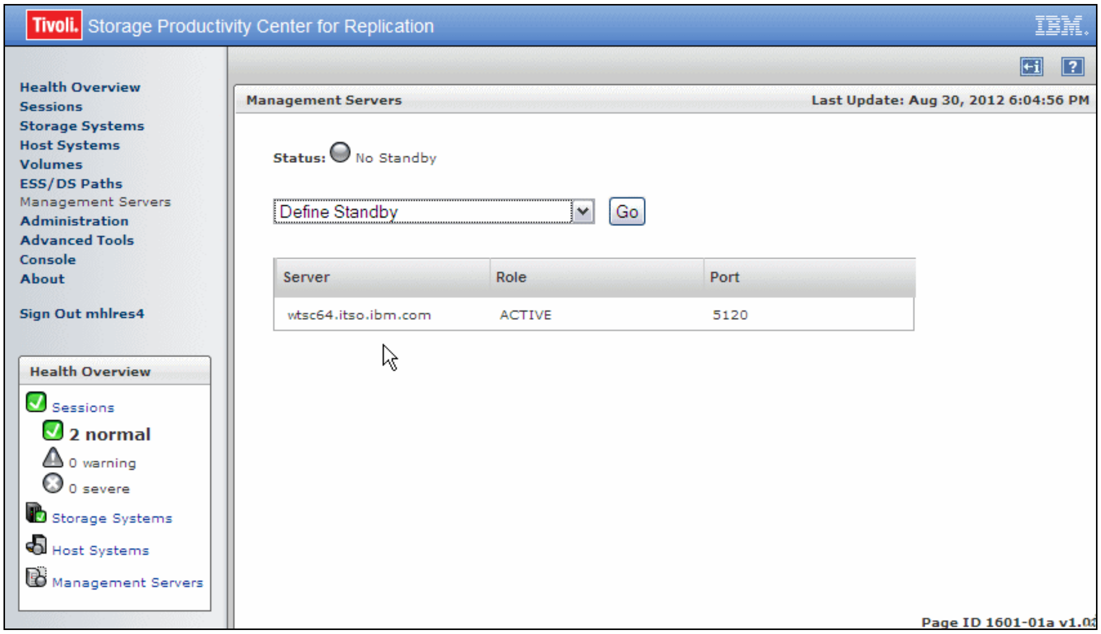

Figure 5-28 Active Tivoli Storage Productivity Center for Replication server - Management Servers panel

3. Next, select **Define Standby** in the drop-down menu of the Management Servers panel of your active server and click **Go** as shown in Figure 5-29.

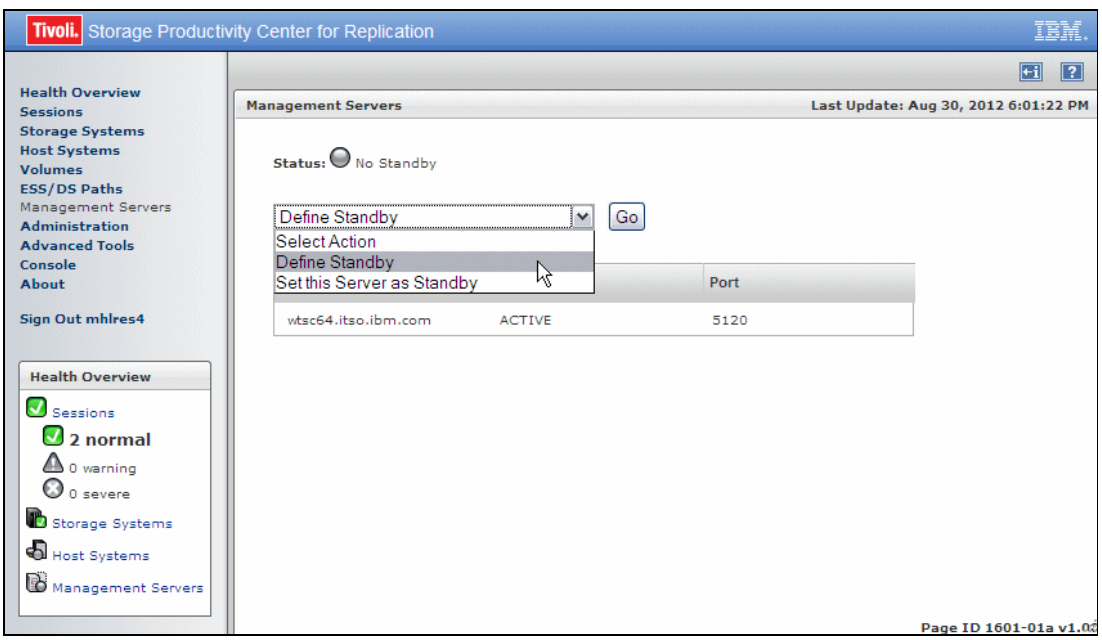

Figure 5-29 Active Tivoli Storage Productivity Center for Replication server - select Define Standby

4. Tivoli Storage Productivity Center for Replication will now show a panel, where you have to enter the IP address or the fully qualified DNS name of your designated Tivoli Storage Productivity Center for Replication standby server (in this example, `wtsc70.itso.ibm.com`). You will also have to enter a user name and a password for the standby server. This user has to be an Tivoli Storage Productivity Center for Replication Administrator. Click **OK** if you have entered and verified your input as shown in Figure 5-29.

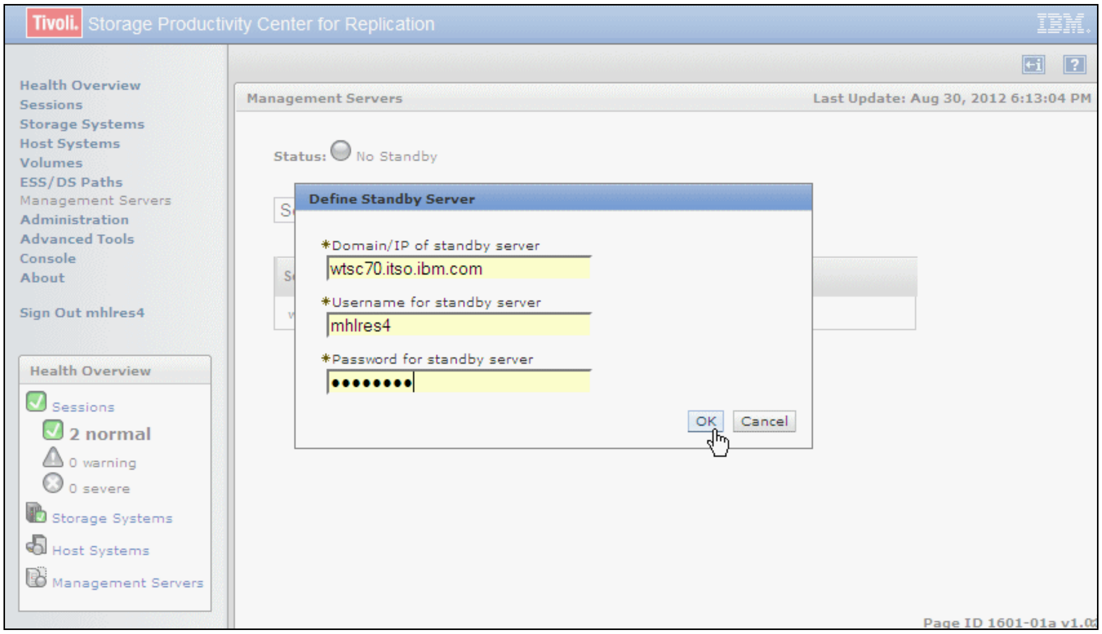

Figure 5-30 Active Tivoli Storage Productivity Center for Replication server - Define address, and user credentials for standby

> **Important:** Defining a Tivoli Storage Productivity Center for Replication server as a standby server will overwrite the complete database of the standby server. There is no way within Tivoli Storage Productivity Center for Replication to recover the configuration, after being overwritten.

5. As you click **OK**, Tivoli Storage Productivity Center for Replication will produce a confirmation message that explains this fact and asks you if you are sure that you want to continue. This message is shown in Figure 5-31. As you are sure that you want to continue, click **Yes**.

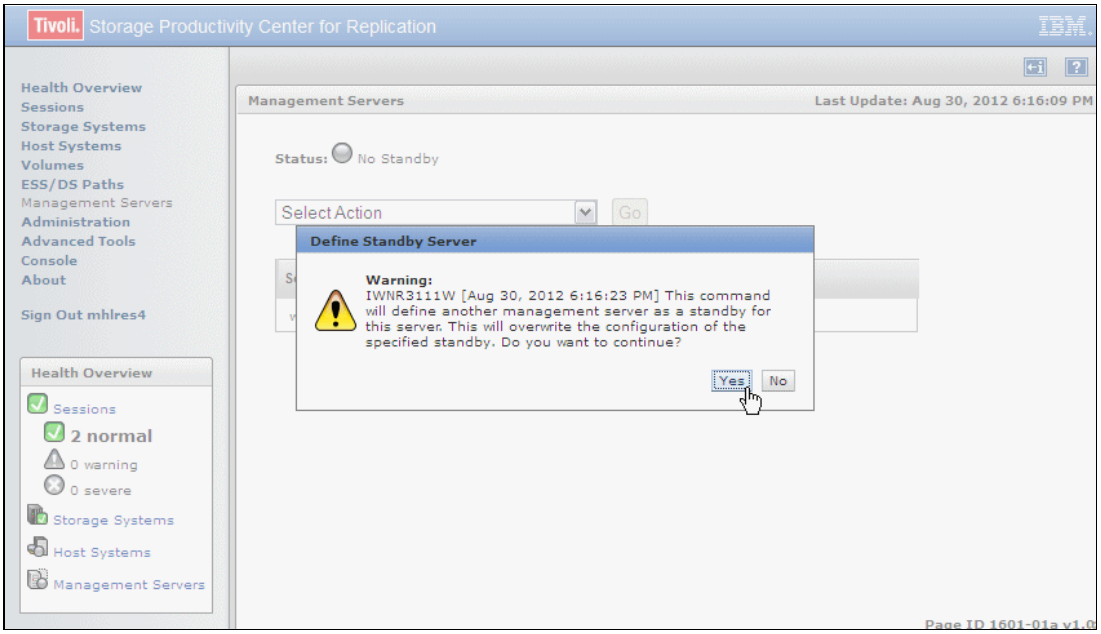

Figure 5-31 Standby server confirmation message

6. Tivoli Storage Productivity Center for Replication will now establish communication with the designated standby server, `wtsc70.itso.ibm.com`, and will turn it into standby mode and start to synchronize the database of the active server with that of the standby server. The Management Servers status will first switch to *Connected status and warning,* as shown in Figure 5-32, while the database of Tivoli Storage Productivity Center for Replication on system SC64 is being copied to the database of Tivoli Storage Productivity Center of Replication on SC70.

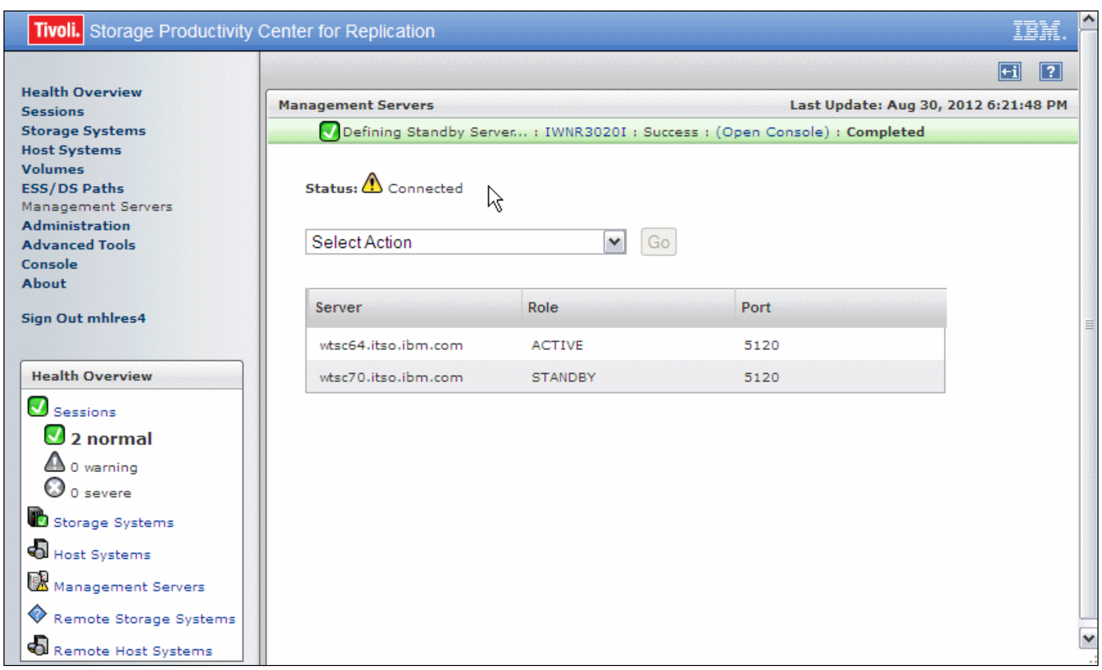

Figure 5-32 Status after define of standby server

7. After synchronization has been finished, the state will turn to *synchronized* and you will see the following content of the Management Servers panel of your active server as shown in Figure 5-33.

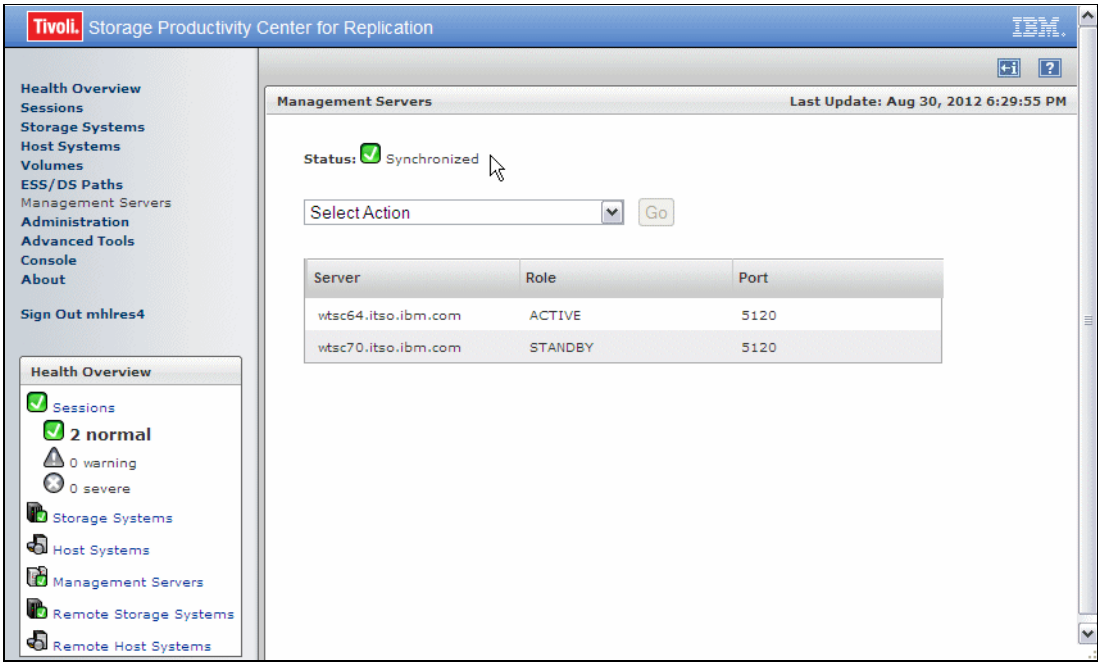

Figure 5-33 Active Tivoli Storage Productivity Center for Replication server after standby Server synchronized

8. The standby server Tivoli Storage Productivity Center for Replication now shows that it is connected to the remote server, as shown in Figure 5-34.

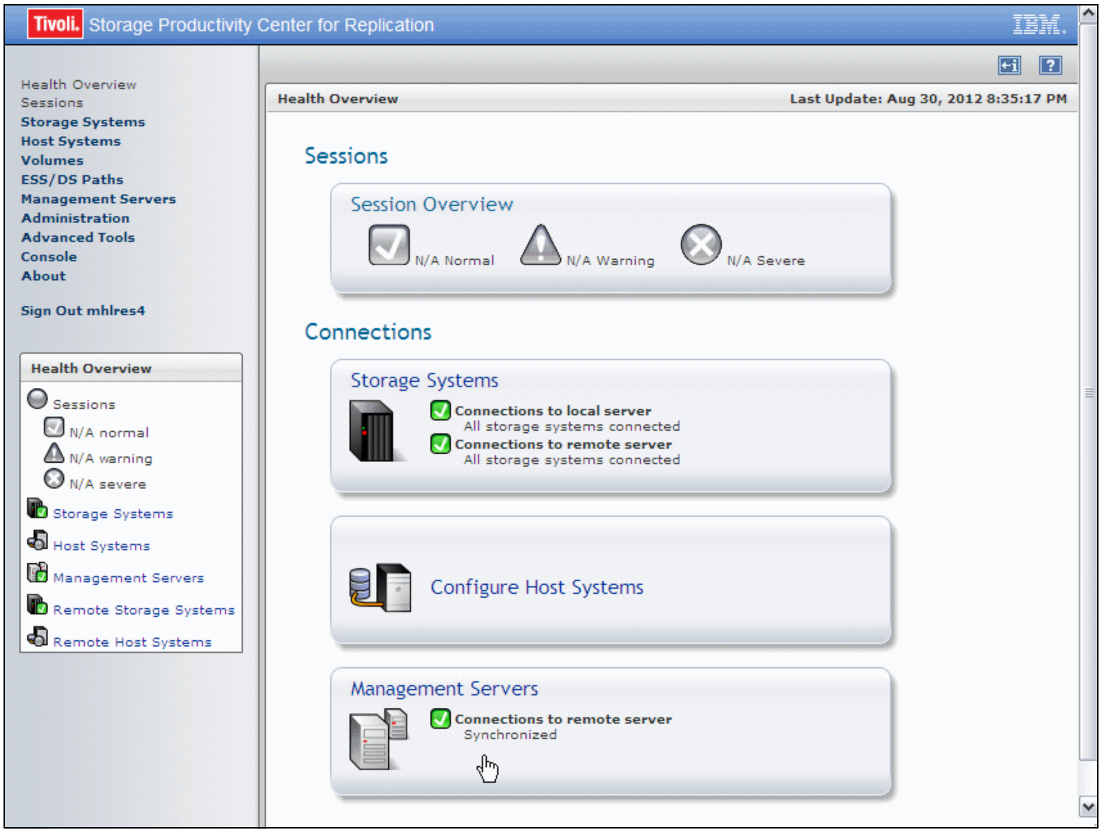

Figure 5-34 standby Tivoli Storage Productivity Center for Replication server - Health Overview panel after standby synch

Setting up the server where you are logged in as the standby server

You can also define your standby server by logging into the designated standby server and set itself as standby. In this example, our standby server is `wtsc70.itso.ibm.com` and our active server is `wtsc64.itso.ibm.com`.

To accomplish this, proceed as follows:

1. From the Management Servers panel of `wtsc63.itso.ibm.com`, select **Set this Server as Standby** in the drop-down menu and click **Go** as shown in Figure 5-35.

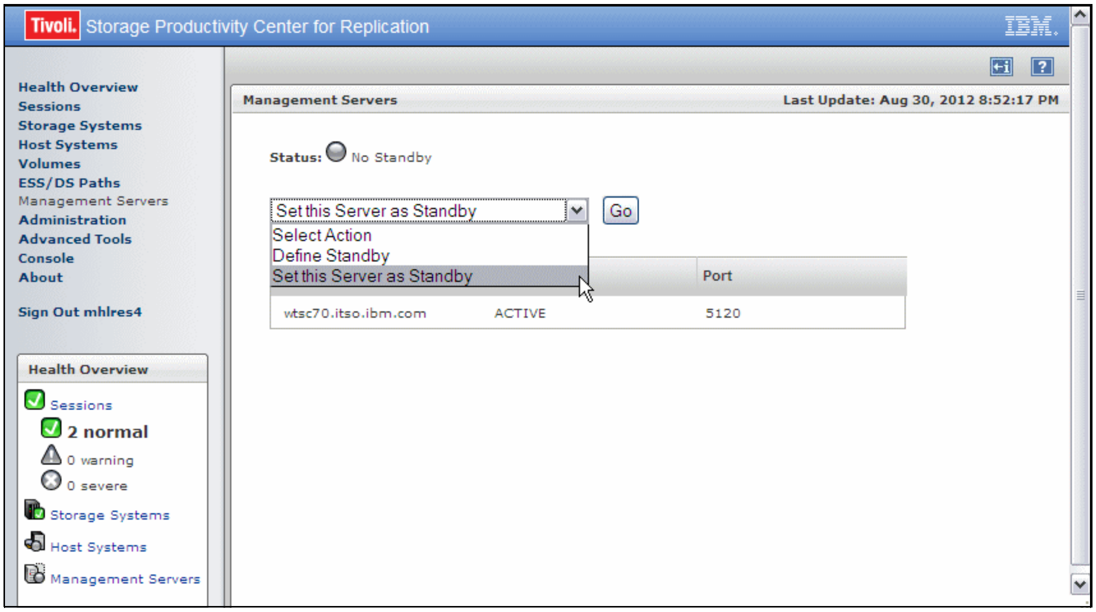

Figure 5-35 Set the current server as a Tivoli Storage Productivity Center for Replication Standby Server

2. In the next panel, you will have to specify the IP address or DNS name of the server for which your current server will act as a standby server. You do not have to supply any user credentials, as you will not cause the configuration of the active server to be overwritten or damaged in any other way. Click **Ok** or **Apply** to define your server as standby. See Figure 5-36.

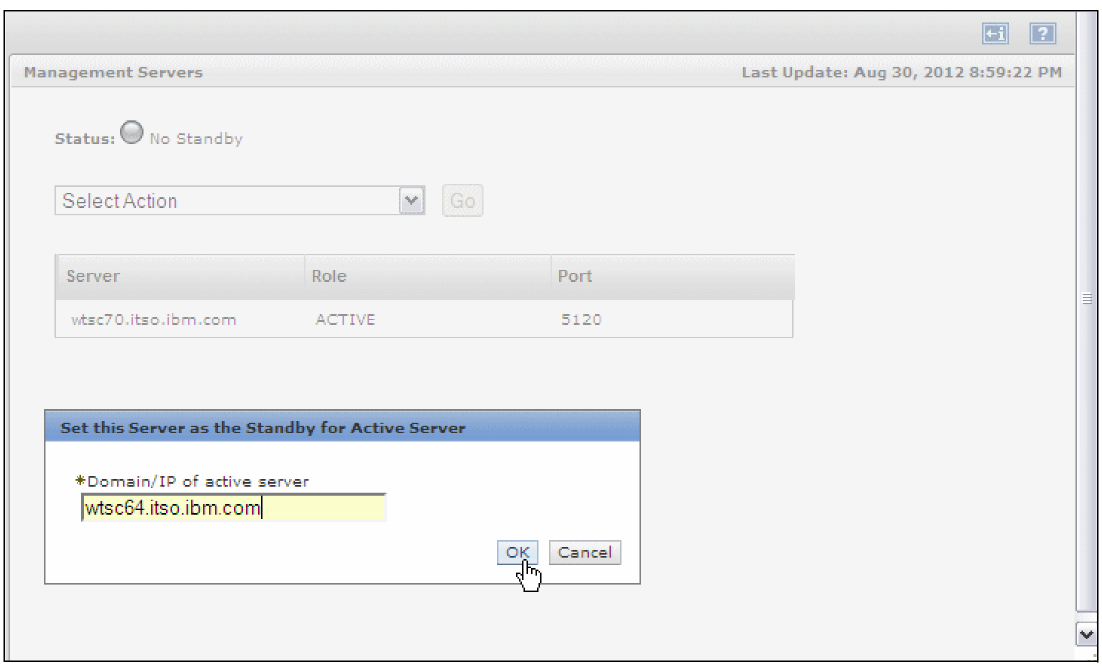

Figure 5-36 Enter the name of the active Tivoli Storage Productivity Center for Replication server

Caution: Defining a Tivoli Storage Productivity Center for Replication server as a standby server will overwrite the complete database of the standby server. *There is no way within Tivoli Storage Productivity Center for Replication to recover the configuration, after being overwritten.*

3. As you click **OK**, Tivoli Storage Productivity Center for Replication will produce a confirmation message that explains this fact and asks if you are sure that you want to continue. This message is shown in Figure 5-37. As you are sure that you want to continue, click **Yes**.

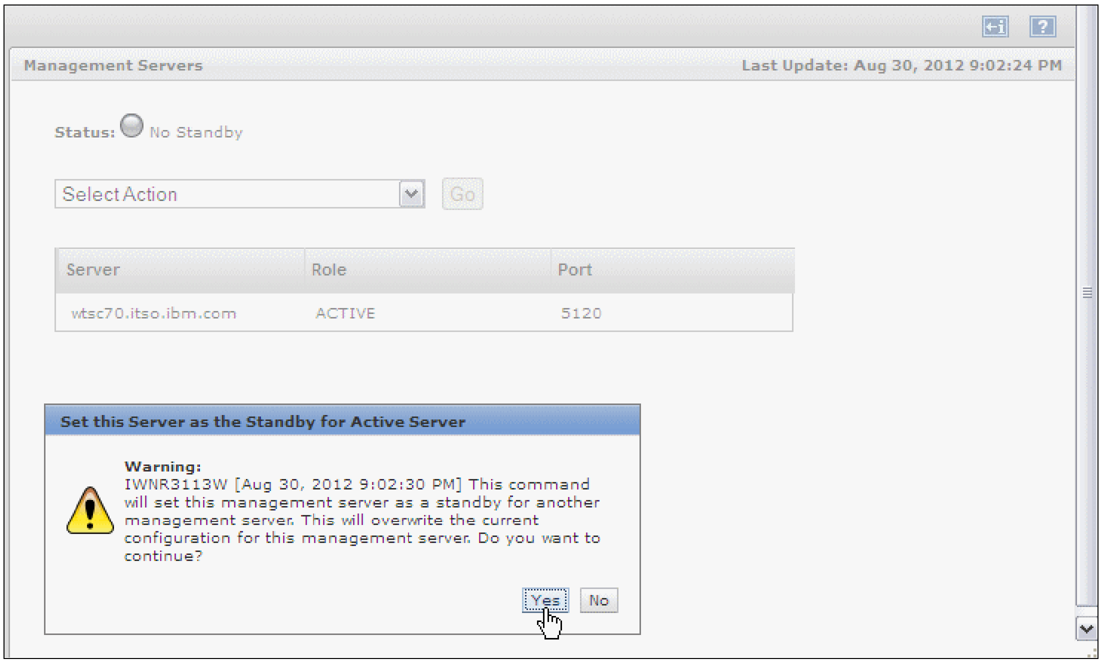

Figure 5-37 Set this Server as Standby confirmation message

4. Tivoli Storage Productivity Center for Replication will now establish communication with the designated active server `wtsc64.itso.ibm.com`, and will start to synchronize the database of the active server with that of the standby server. The Management Servers status switches to *Synchronization Pending* as shown in Figure 5-38.

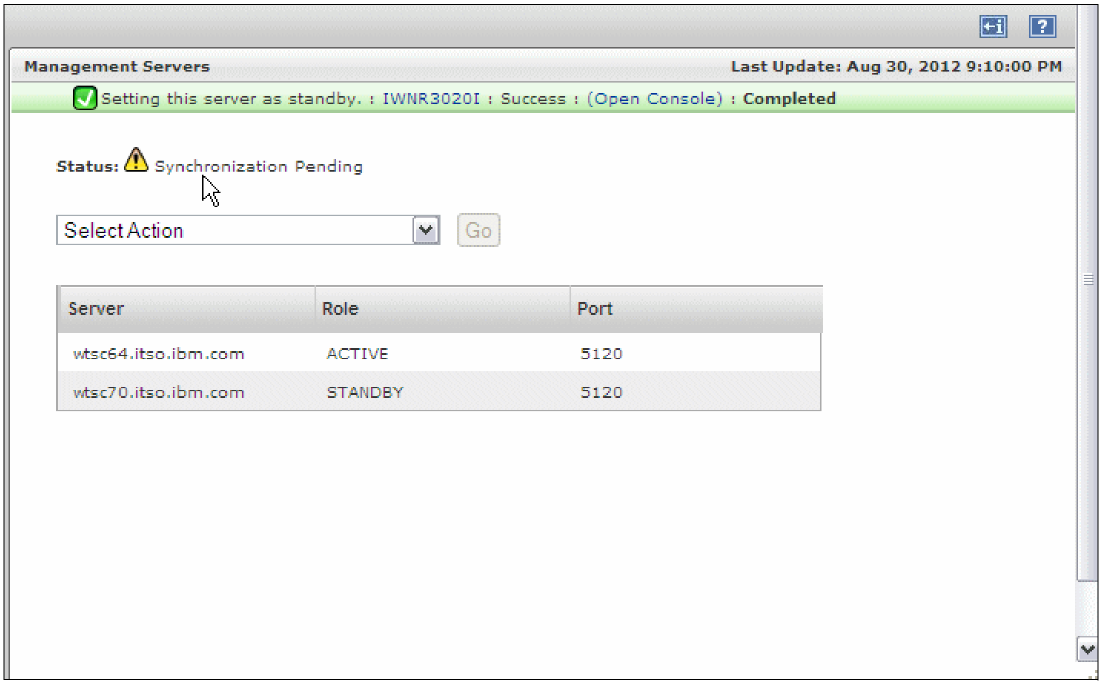

Figure 5-38 Synchronization Pending status

After synchronization has been finished, the state will turn to *synchronized* and you will see the following content of the Management Servers panel of your active server as shown in Figure 5-39.

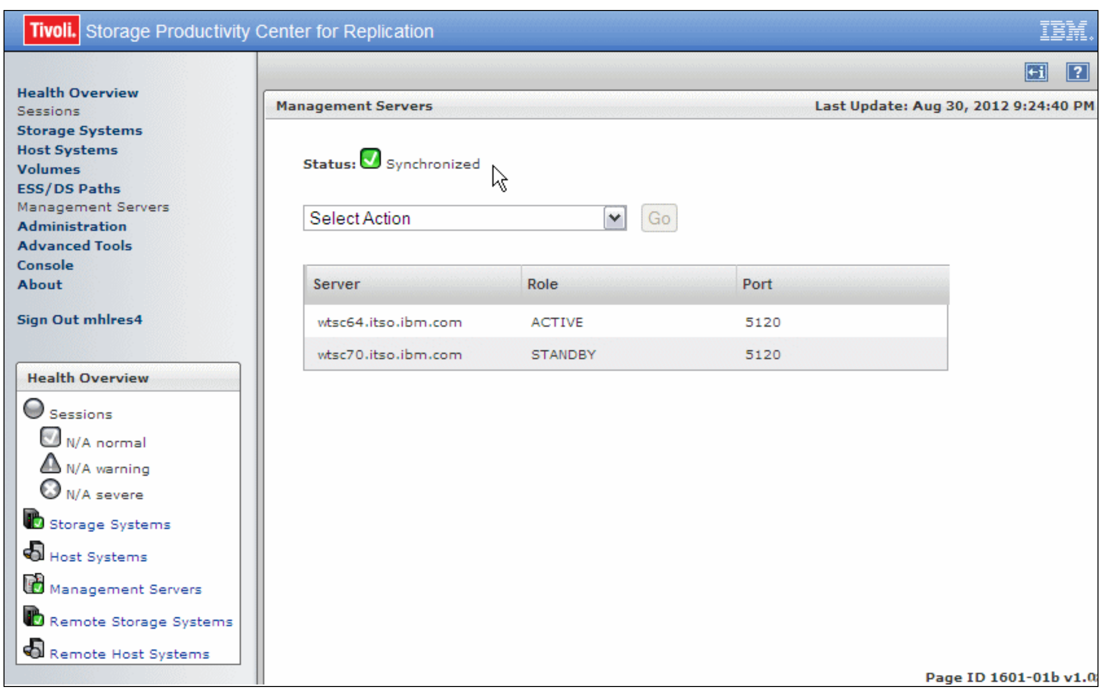

Figure 5-39 Standby Server synchronized

You can also use the Tivoli Storage Productivity Center for Replication Command Line Interface to define a standby server for your active server or to define your current server as a standby server to a different server.

To define a standby server for your active server, open a CLI command shell on your active server `wtsc64.itso.ibm.com` and use the **`setstdby`** CLI command, as described in the following procedure:

1. From OMVS ISPF panel, go to the directory where the csmcli.sh shell is installed. Assuming that you have installed Tivoli Storage Productivity Center for Replication in the default directories, the command to go to that directory is as follow:

   ```
   cd /var/Tivoli/RM/CLI/
   ```

2. Call the csmcli.sh shell by typing `csmcli.sh` and pressing ENTER. The CLI asks your user id and password, if it is not customized as described in 5.2.2, “Setting up automatic login to the CLI” on page 155.
3. Issue the **`lshaservers`** command to verify that your active server is not already connected to a standby server.

   Example 5-3

   ```
   csmcli> lshaservers
   Server              Role   Status     Port
   ==========================================
   wtsc64.itso.ibm.com ACTIVE No Standby 5120
   ```

4. Use the **`setstdby`** command to set the standby server. In our example, we assign `wtsc70.itso.ibm.com` as the standby server for our active server. The CLI tells you that this operation overwrites the contents of the standby server database, and asks you to confirm that you to want to continue.

5. Issue the **lshaservers** command again so that your active server now has a standby server. You can see a sample of this CLI command sequence in Figure 5-40.

```
 Authentication file: /u/mhlres4/tpcr-cli/tpcrcli-auth.properties

csmcli> lshaservers
Server              Role   Status     Port
==========================================
wtsc64.itso.ibm.com ACTIVE No Standby 5120
csmcli> setstdby -server wtsc70.itso.ibm.com -username mhlres4 -password xxxxxx

IWNR3111W ÝAug 30, 2012 6:16:48 PM¨ This command will define another management
server as a standby for this server. This will overwrite the configuration of
th
e specified standby. Do you want to continue? Ýy/n¨:Y
 IWNR3020I ÝAug 30, 2012 6:17:04 PM¨ Connection to the active high-availability
server at wtsc64.itso.ibm.com making the server wtsc70.itso.ibm.com a standby
wa
s successful.
csmcli> lshaservers
Server              Role    Status       Port
=============================================
wtsc64.itso.ibm.com ACTIVE  Synchronized 5120
wtsc70.itso.ibm.com STANDBY Synchronized 5120
csmcli>
 ===>
                                                                          INPUT
ESC=¢   1=Help      2=SubCmd    3=HlpRetrn  4=Top       5=Bottom    6=TSO
        7=BackScr   8=Scroll    9=NextSess 10=Refresh  11=FwdRetr  12=Retrieve
```

Figure 5-40 Selecting Standby server through CLI

At this point in time, you have successfully defined a standby server for your active Tivoli Storage Productivity Center for Replication server. Your active server works as before (except that it propagates all database changes to your standby server). Your standby server, however, has different properties now:

- Configuration of the Tivoli Storage Productivity Center for Replication standby server in terms of Storage Subsystems, ESS/DS Paths, Sessions, and Copy Sets has been overwritten with the configuration of the active Tivoli Storage Productivity Center for Replication server
- The Sessions menu item is disabled, so that you cannot view or modify any Session or Copy Set related configurations from the standby server.
- You can view the Storage Subsystem and ESS/DS Paths configuration but cannot make any changes from the standby server.
- You can access the Advanced Tools menu but cannot alter the Heartbeat setting from the standby server
- You can still access the Tivoli Storage Productivity Center for Replication Console from the standby server.

> **Note:** User access data will not be synchronized between active and standby Tivoli Storage Productivity Center for Replication servers.

5.6.2 Takeover

In case of a failure of your active Tivoli Storage Productivity Center for Replication server or also in case of a planned failover, you have to perform a takeover of the active server role on your standby Tivoli Storage Productivity Center for Replication server.

This takeover is a manual process, which can be initiated either through the GUI or the Command Line Interface on the Tivoli Storage Productivity Center for Replication standby server.

After having performed the manual takeover of the active server on the standby server, the replication of database changes will stop and the Tivoli Storage Productivity Center for Replication standby server will become an active server with the same configuration as the original active server.

This is the case, even when the original active server is still up and running. In this case, you would have two active Tivoli Storage Productivity Center for Replication servers with identical configurations in your environment. You would then be able to manipulate your copy services configurations from both servers, although changes in the Tivoli Storage Productivity Center for Replication databases would no longer be synchronized between the two active servers.

This could lead to inconsistencies in your overall configuration that would have the potential to damage your environment.

Important: Before attempting a Tivoli Storage Productivity Center for Replication takeover, always shut down the active Tivoli Storage Productivity Center for Replication server first.

You can initiate a takeover only from the standby server. In a planned situation, such as for maintenance purposes, you must first shut down the Tivoli Storage Productivity Center for Replication in either of the following ways:

- By stopping the CSM and CSMGUI applications from the WebSphere console (if you had installed Tivoli Storage Productivity Center for Replication under the WebSphere Application Server product)
- By stopping the WebSphere Application Server OEM Edition address spaces as described in 5.8.2, “Stopping WebSphere Application Server OEM Edition” on page 210 (if you had installed Tivoli Storage Productivity Center for Replication under WebSphere Application Server OEM Edition)

After having shut down your active server, proceed as follows:

1. Log into your Tivoli Storage Productivity Center for Replication standby server (`wtsc70.itso.ibm.com` in our example). On the Health Overview Panel, Tivoli Storage Productivity Center for Replication reports a Warning condition, *Disconnected Consistent* regarding the connection to the remote server, which is now down. See Figure 5-41.

   You see also that all Storage Subsystems are connected. The standby server has obtained the configuration of the Storage Subsystems via the database replication process from the active server.

   The Sessions hyperlink in the Navigation tree area is greyed out because you are logged in to a Tivoli Storage Productivity Center for Replication standby server.

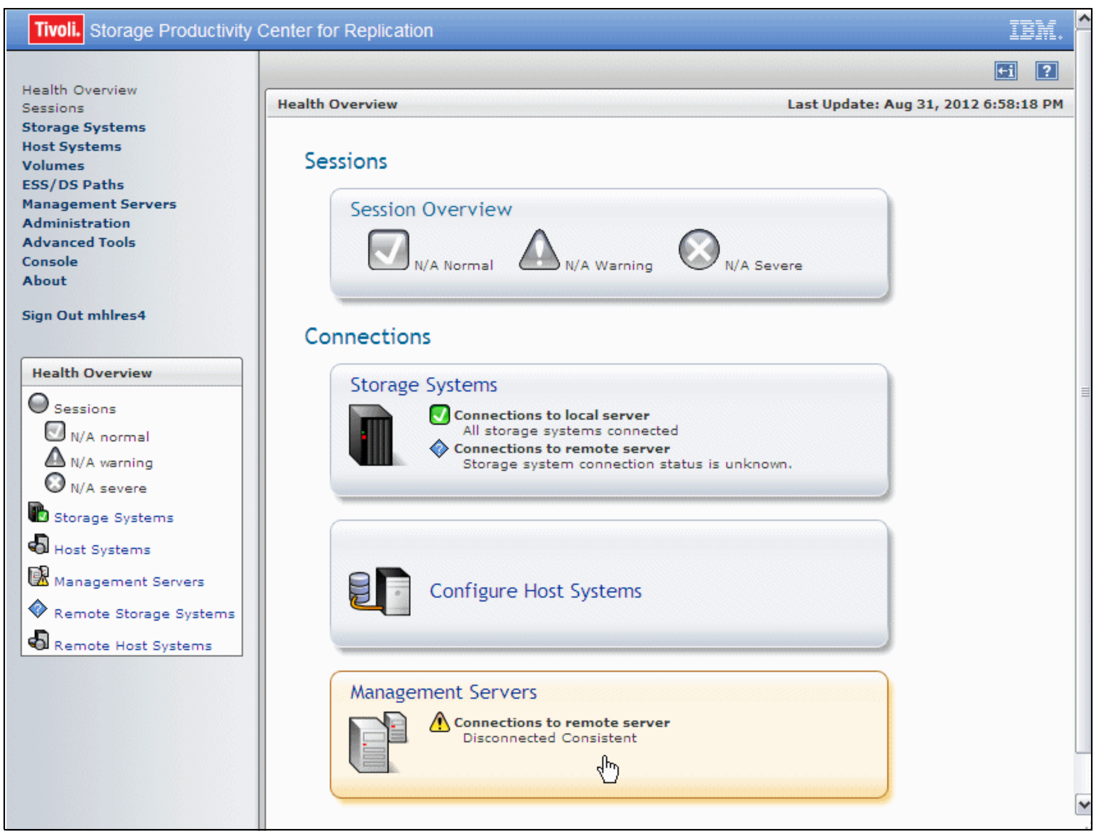

Figure 5-41 Tivoli Storage Productivity Center for Replication standby server Health Overview panel

2. Click **Management Servers**.

   This will take you to the Management Servers panel of your standby server as shown in Figure 5-42.

   You see a list of our two Tivoli Storage Productivity Center for Replication servers, wtsc70.itso.ibm.com having the standby role and `wtsc64.itso.ibm.com` having the active role.

   The status of both management servers is disconnected consistent from the point of view of the standby server. This means, the standby server is not able to communicate with its active server, but it has a consistent database and could take over the role of the active server.

3. In the drop-down menu, select **Takeover** and click **Go** as shown in Figure 5-42 to initiate the takeover process.

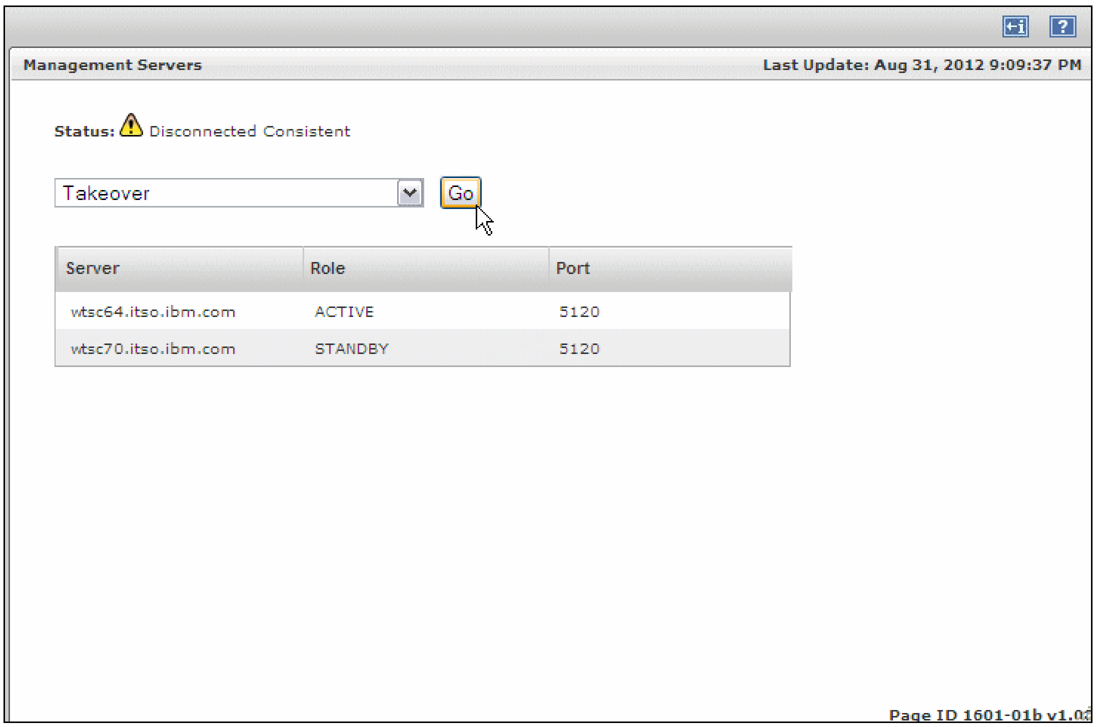

Figure 5-42 Tivoli Storage Productivity Center for Replication standby server Management Servers panel

You have also the opportunity to first try a reconnect to your active server before taking the decision that a takeover is necessary. As you know, the active server is down, you can omit this step.

4. You will first see a confirmation message, warning you about the fact that, if the original active server was still up, you would have two active Tivoli Storage Productivity Center for Replication servers with identical configurations in your environment. See Figure 5-43.

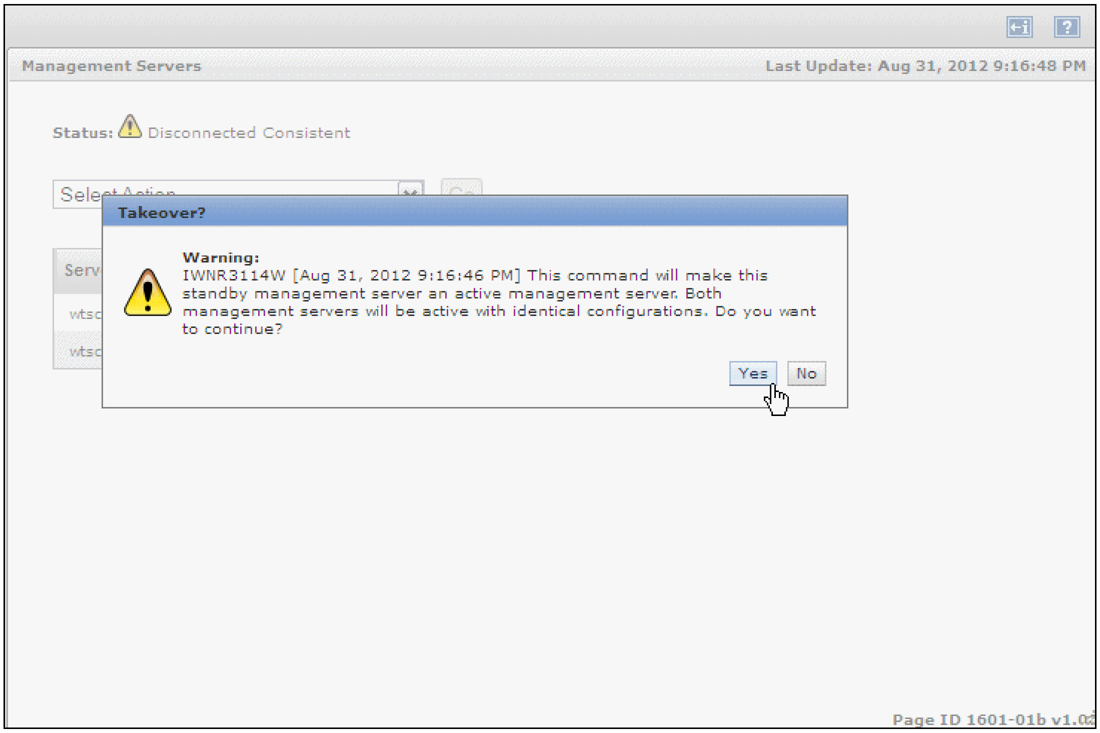

Figure 5-43 Tivoli Storage Productivity Center for Replication standby server Management Servers panel - confirm Takeover

5. As you have shut down your original active server, click **Yes** to continue.

   Tivoli Storage Productivity Center for Replication now changes the role of your standby server to an active server. After few seconds you see the following Management Servers panel. See Figure 5-44.

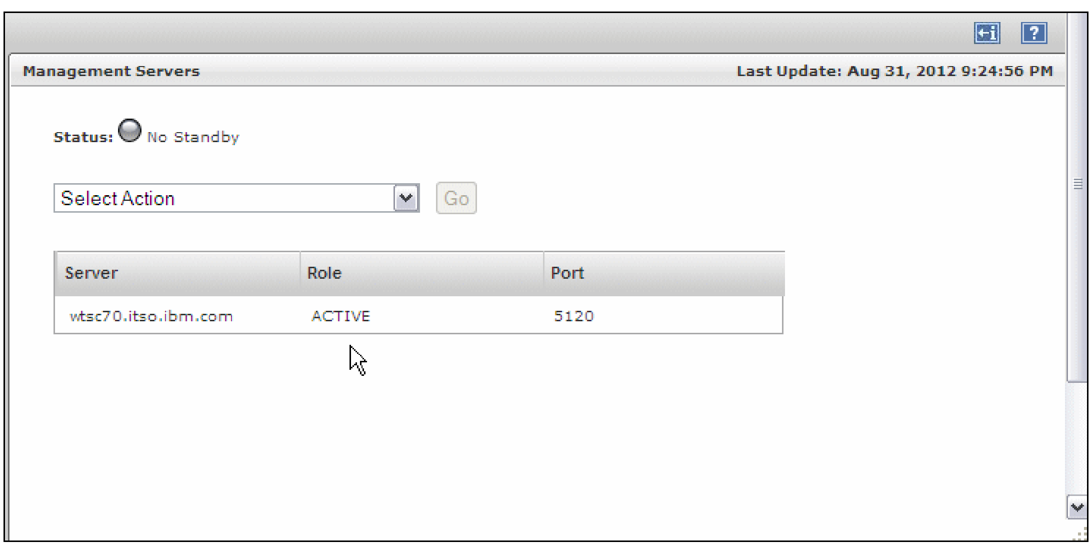

Figure 5-44 Tivoli Storage Productivity Center for Replication standby server Management Servers panel - Takeover complete

Your server *wtsc70.itso.ibm.com* is now an active Tivoli Storage Productivity Center for Replication server. Notice that the Sessions menu item in the Navigation Area has now turned active. You are now able to manipulate your sessions from the activated standby server.

6. Click **Sessions** in the Navigation Area. This will take you to the Sessions Overview panel and present a list of the sessions that were originally configured on the Tivoli Storage Productivity Center for Replication server `wtsc64.ibm.com`. See Figure 5-45.

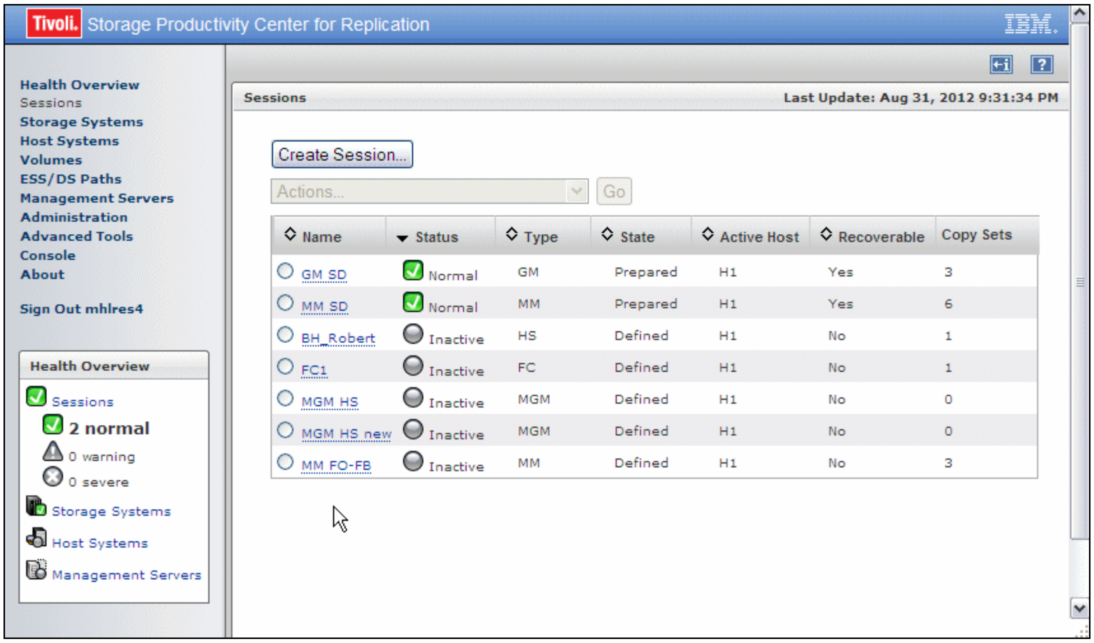

Figure 5-45 Tivoli Storage Productivity Center for Replication standby server Management Servers panel - sessions

7. You can also perform the takeover process via the Tivoli Storage Productivity Center for Replication Command Line Interface with the *hatakeover* command issued at the standby server, as shown in Figure 5-46.

```
csmcli> hatakeover
IWNR3114W ÝAug 31, 2012 6:04:52 PM¨ This command will make this standby
management server an active management server. Both management servers will be
active with identical configurations. Do you want to continue? Ýy/n¨:y
 IWNR3063I ÝAug 31, 2012 6:05:08 PM¨ Successfully issued the takeover to the
standby server wtsc70.itso.ibm.com with the active HA server
wtsc64.itso.ibm.com.
csmcli>
```

Figure 5-46 Takeover via Tivoli Storage Productivity Center for Replication CLI

You have now performed a failover from your active server to your standby server.

Note that Tivoli Storage Productivity Center for Replication does not offer a failback function. If you want to switch back to your original active server, you need to perform the following procedure:

1. Start up your recovered original Tivoli Storage Productivity Center for Replication server.
2. On the original active Tivoli Storage Productivity Center for Replication GUI, select Management Servers and then select **Remove Standby** from the Select Action pull-down menu.
3. After removing the standby server, select **Set this Server as Standby**, from the Select Action pull-down menu. Tivoli Storage Productivity Center for Replication GUI asks you the specify the name or IP address of the Active Server (wtsc70.itso.ibm.com in our example).
4. Wait until both servers reach status `Synchronized`.
5. Perform a takeover on this Tivoli Storage Productivity Center for Replication server after synchronization has completed. Note, that you would have two active servers during this part of the process.
6. On the original standby server, remove standby server by using **Management Servers** → **Remove Standby**.
7. Set your original standby server as a standby server to the original active server.

5.7 Using CSV files for importing and exporting sessions

This topic describes how to import and export a CSV file. You also see how to use a CSV file to record Copy Sets using a text editor or spreadsheet editor.

A Comma Separated Value (CSV) file is a text file, created in a spreadsheet program such as Microsoft Excel. A CSV file includes each of the Copy Sets that you want to add to the session and also can generate CSV files from existing sessions.

In order to manage Import and Export Sessions, you need to have the Administrator or Operator role.

5.7.1 Exporting CSV files

Exporting a CSV file enables you to maintain a backup copy of your copy sets; for example, if you lose your session, or upgrade to a different server. Exporting the copy sets in a session enables you to take a snapshot of your session at a particular point and save the exported file for backup or to be used for import purposes. You export the Copy Sets from a session into a CSV file, which you view or edit in a spreadsheet program.

Access for export activity is managed in the Session panel in the Navigation Area. Proceed as follows:

1. Invoke this panel by clicking **Sessions** in the Navigation Area of the Tivoli Storage Productivity Center for Replication GUI as shown in Figure 5-47.

Figure 5-47 Tivoli Storage Productivity Center for Replication main menu

2. Select the **Session** you want to export by clicking the radio button in the left side of the Session Name. Select **Export Copy Sets** in the drop-down menu and click the **Go** button as shown in Figure 5-48.

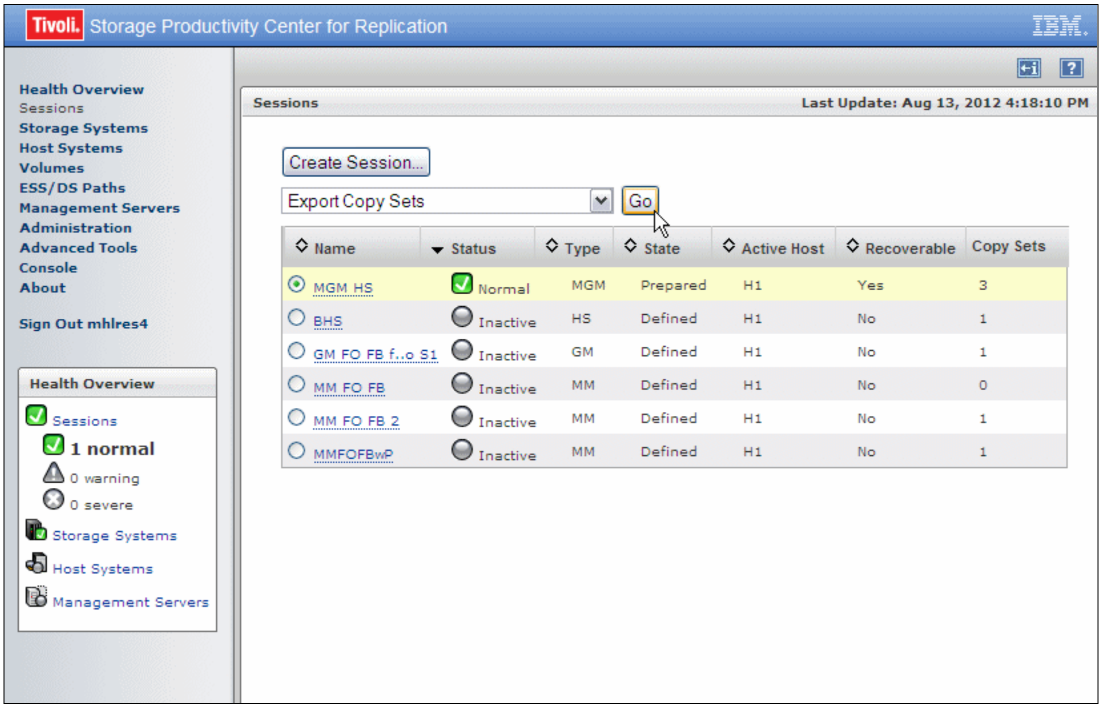

Figure 5-48 Selecting Session to be exported

3. The next panel is the export Copy Sets. Tivoli Storage Productivity Center for Replication creates a CSV file containing the Copy Sets and provides a link to download the CSV file. Click in the **CSV file name link** as shown in Figure 5-49.

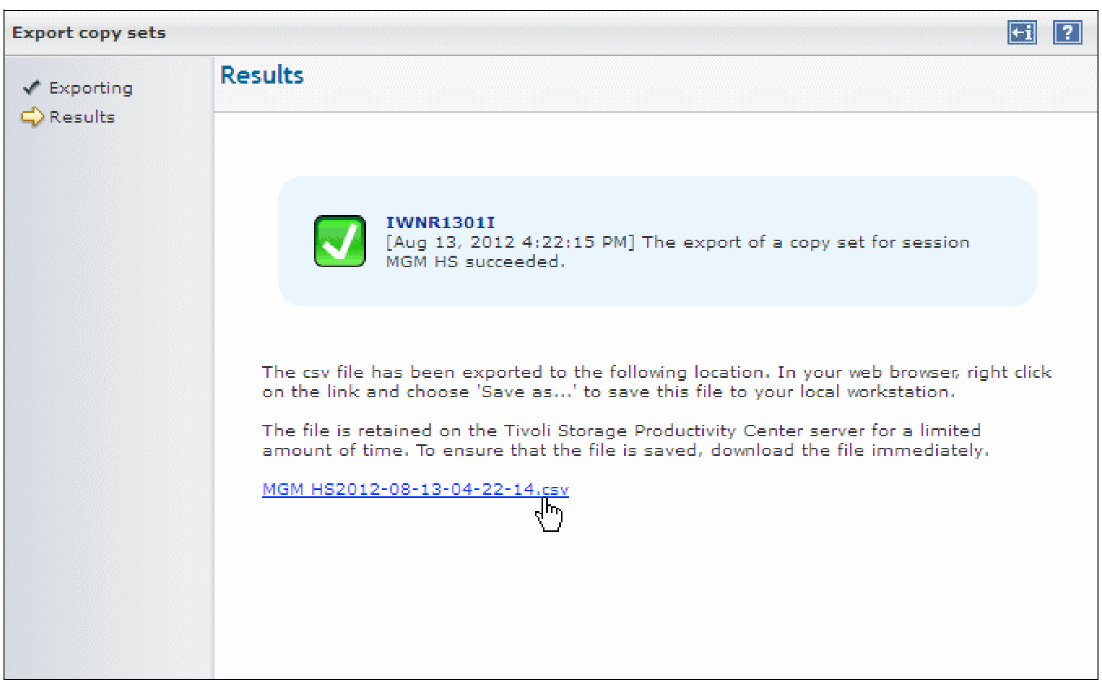

Figure 5-49 Saving CSV exported file

4. You have the option to open this file or save (download) it. However, only open it to see the content. Do not edit it at this time. However, if you want to edit anything, do it after you save the file. Use a spreadsheet program as shown in “Working with CSV files under Microsoft Excel” on page 209 to edit it:

   a. If you are using Microsoft Internet Explorer as your web browser, click the **Save** button. Internet Explorer lets you choose the directory to which you save the CSV file.

   b. If you are using Mozilla Firefox as your web browser, click **Save File** as shown in Figure 5-50. You can choose the directory where you download your files by clicking in the menu bar **Tools** → **Options**. You can specify the directory that you want for saving the files in the *Downloads* area of the *Options* menu. See Figure 5-51 for results.

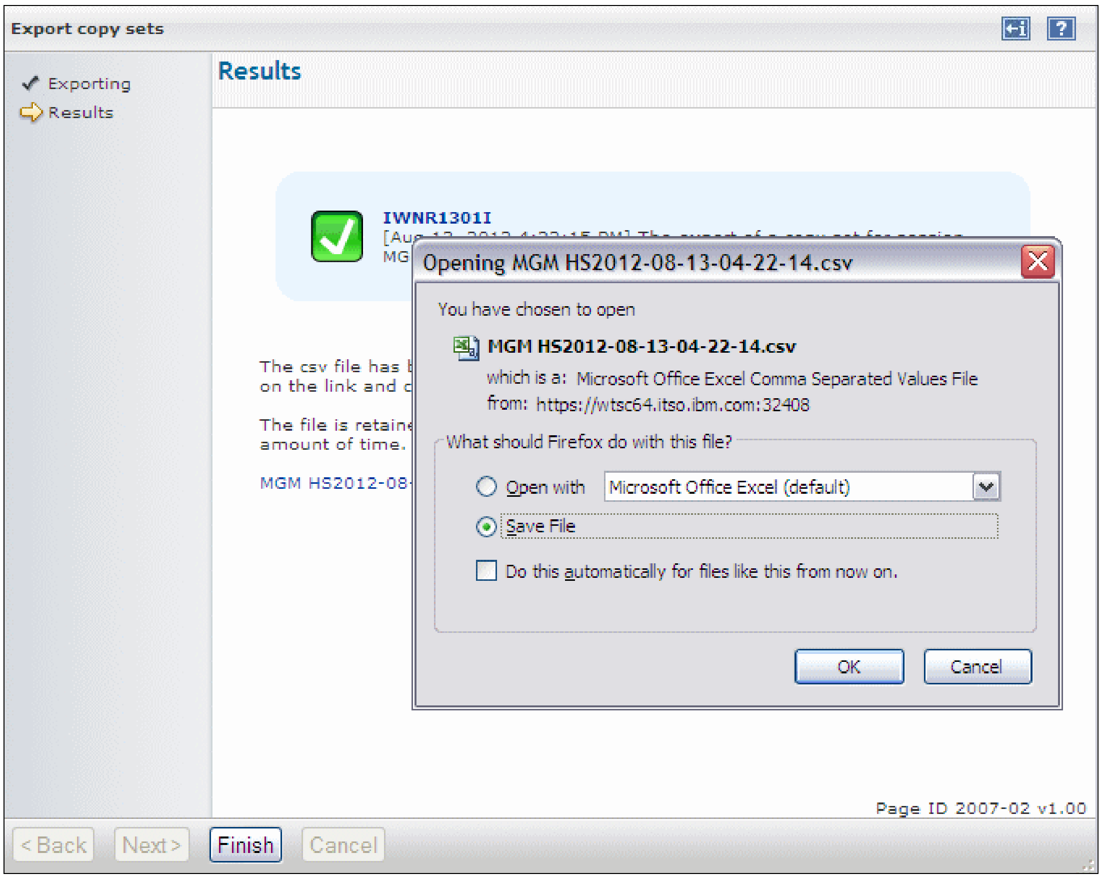

Figure 5-50 Selecting Save file option

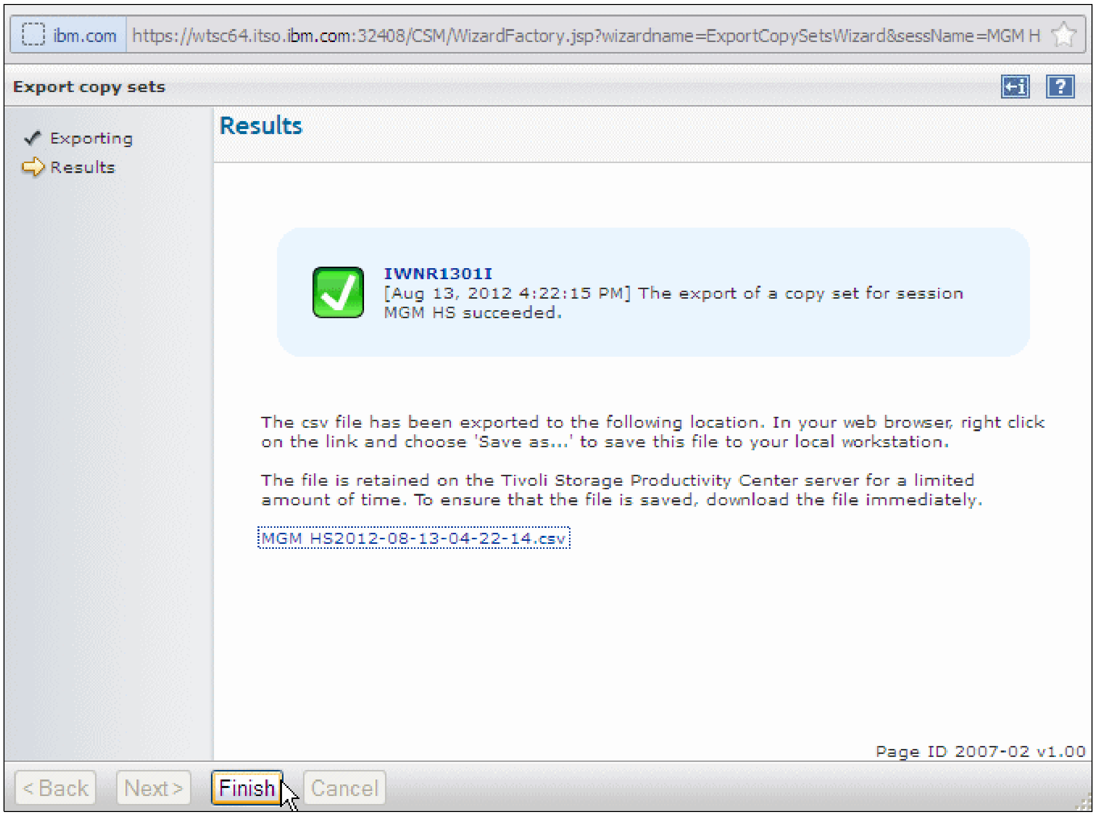

Figure 5-51 Copy Export succeeded

5.7.2 Importing CSV files

Importing a CSV file enables you to recover a backup copy of your Copy Sets; for example, if you lose your session, or upgrade to a different server. It is also enables you to import a previously exported session that you worked with, adding Copy Sets using a spreadsheet program such as Microsoft Excel, as shown in “Working with CSV files under Microsoft Excel” on page 209.

There are two ways to import a Copy Set from a CSV file that you previously created.

- Import a Copy Set in a new Session
- Import a Copy Set in an existing Session

Importing a Copy Set in a new Session

In this section, we take you through the steps needed to import the saved CSV file containing Copy Sets in a new Session:

1. Click the **Create Session** button to proceed as shown in Figure 5-52.

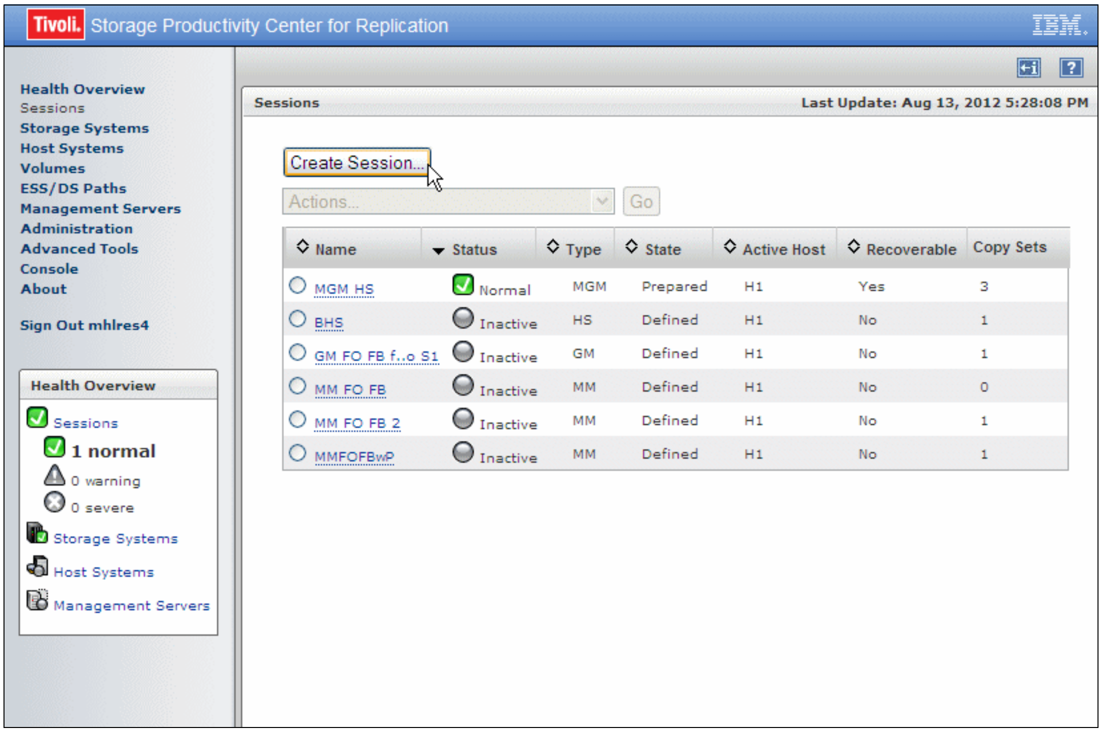

Figure 5-52 Creating Session

2. Select the **Session Type** in a drop-down menu and click **Next**. as shown in Figure 5-53.

Note: The Session Type should have the same Session Type defined into the previously exported CSV file to be imported.

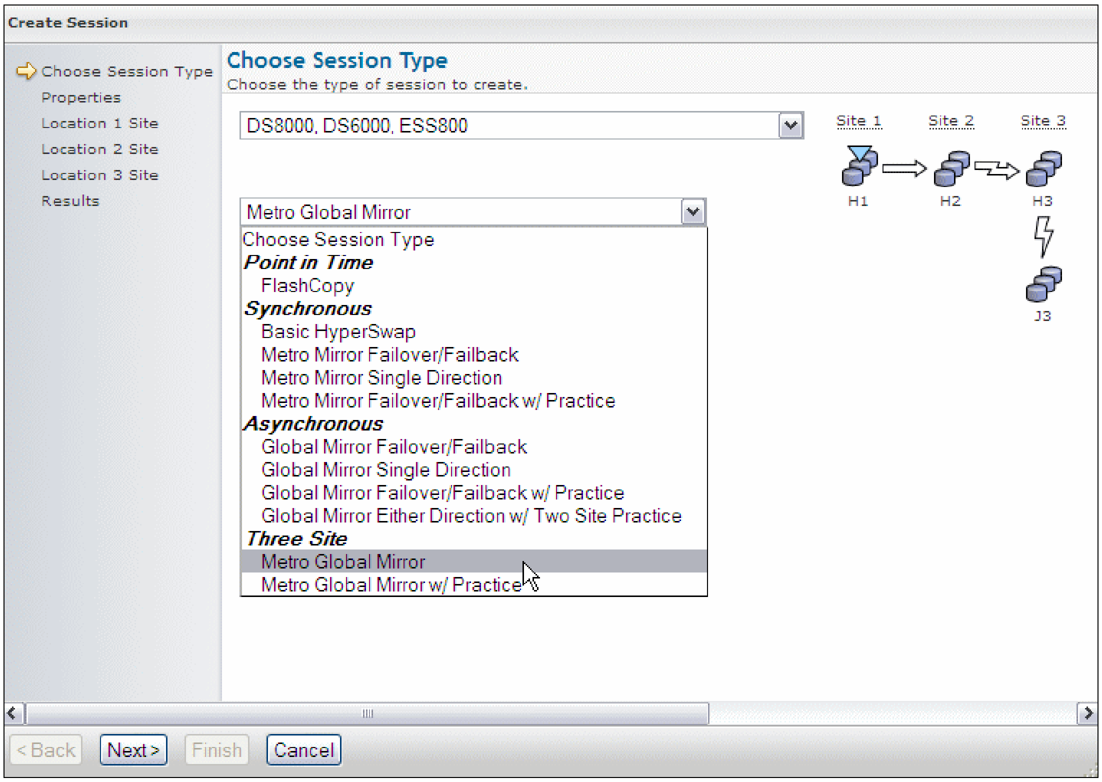

Figure 5-53 Selecting Session Type

3. Fill in the **Session Name**, **Description**, and **Properties** that are available as you require. Figure 5-54 shows an example of how you would specify this information for an MGM with Basic HyperSwap session. Click **Next** to continue.

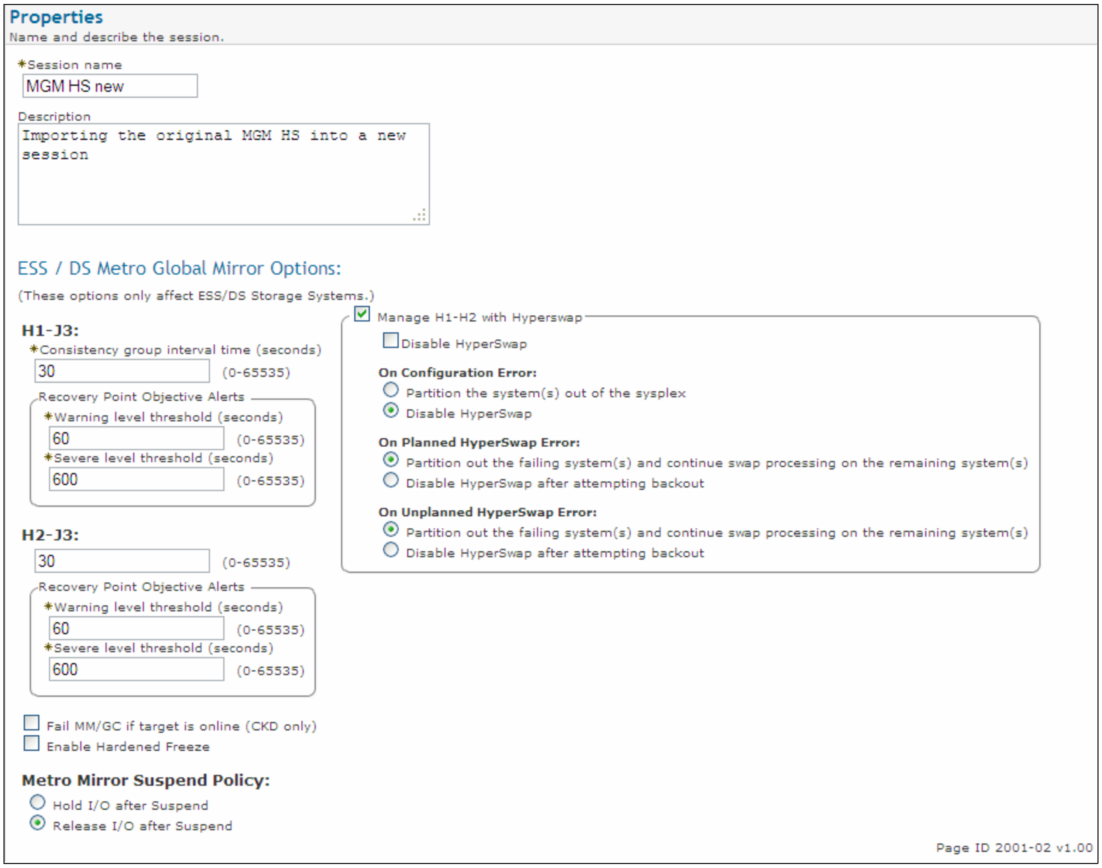

Figure 5-54 Defining Session Name and Properties

4. Next Tivoli Storage Productivity Center for Replication shows you a panel to specify the Site1 Location, as shown in Figure 5-55.
5. Select the Site Location in a drop-down menu and click **Next**.

- **Note:** The Site Locations should be the same as defined in the previously exported Session.

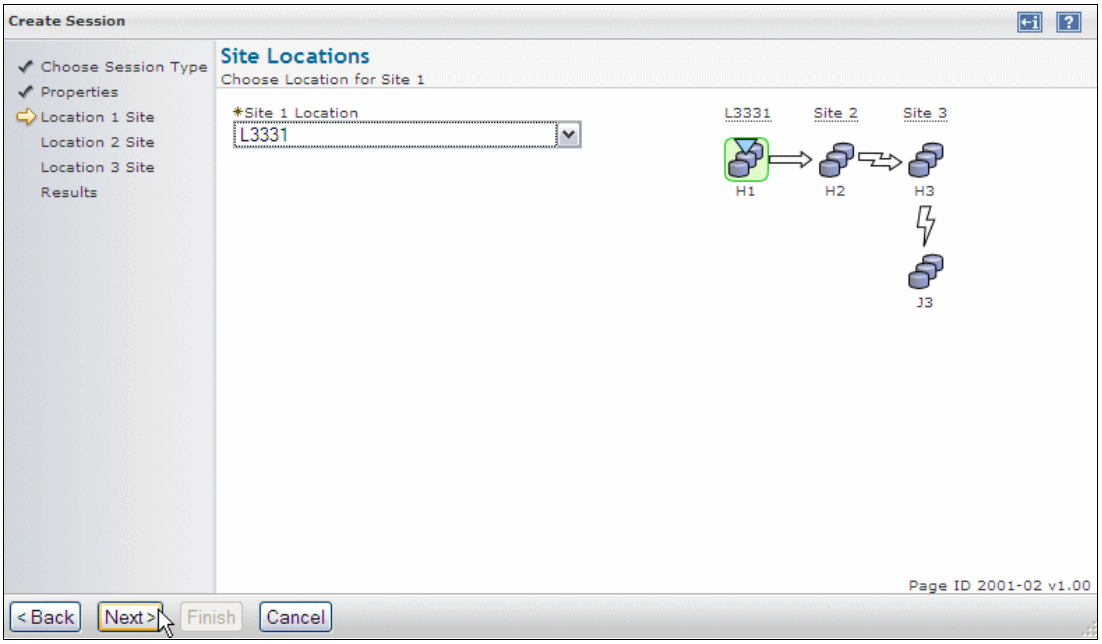

Figure 5-55 Selecting Site1 Location

6. Repeat this process for specifying other Locations as your session needs.
7. A successfully created session message will be displayed. Click the button **Launch Add Copy Set Wizard** at the bottom of the work area, as shown in Figure 5-56.

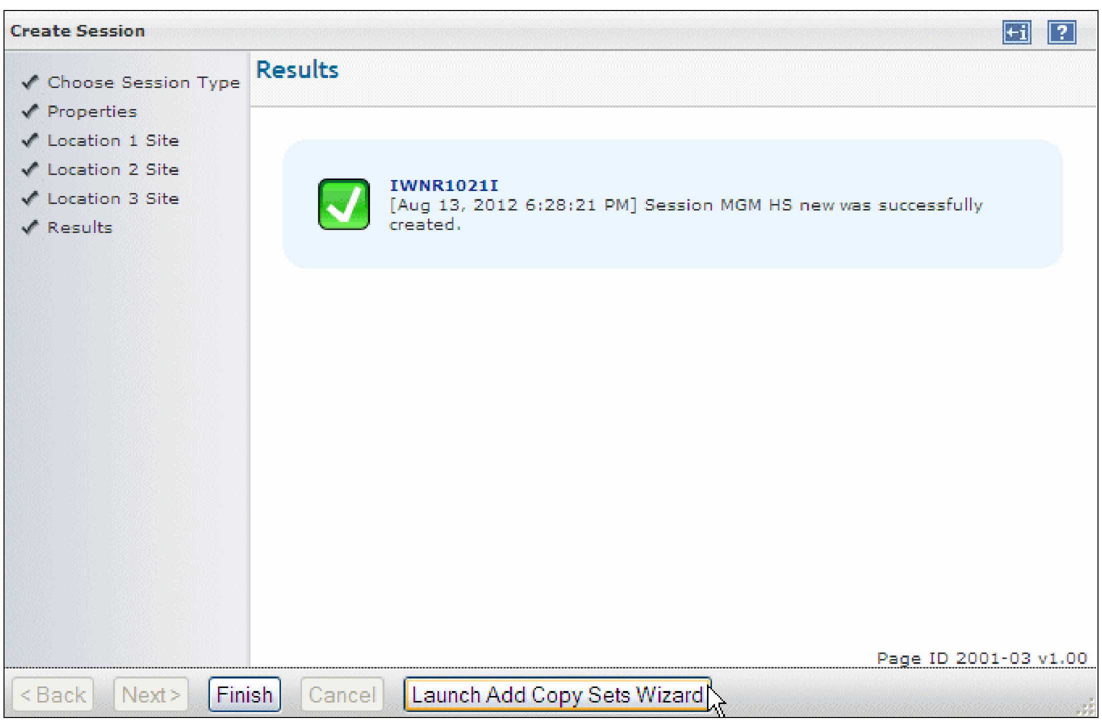

Figure 5-56 Launching Add Copy Sets Wizard

8. In the Add Copy Set Wizard panel, **check** the left box and choose the **CVS file to import Copy Sets** to use a CVS file to import Copy Sets. You can introduce a file name by typing the path and file name directly in the box. Use the Browse option to avoid typing errors. Click the **Browse** button to proceed as shown in Figure 5-57.

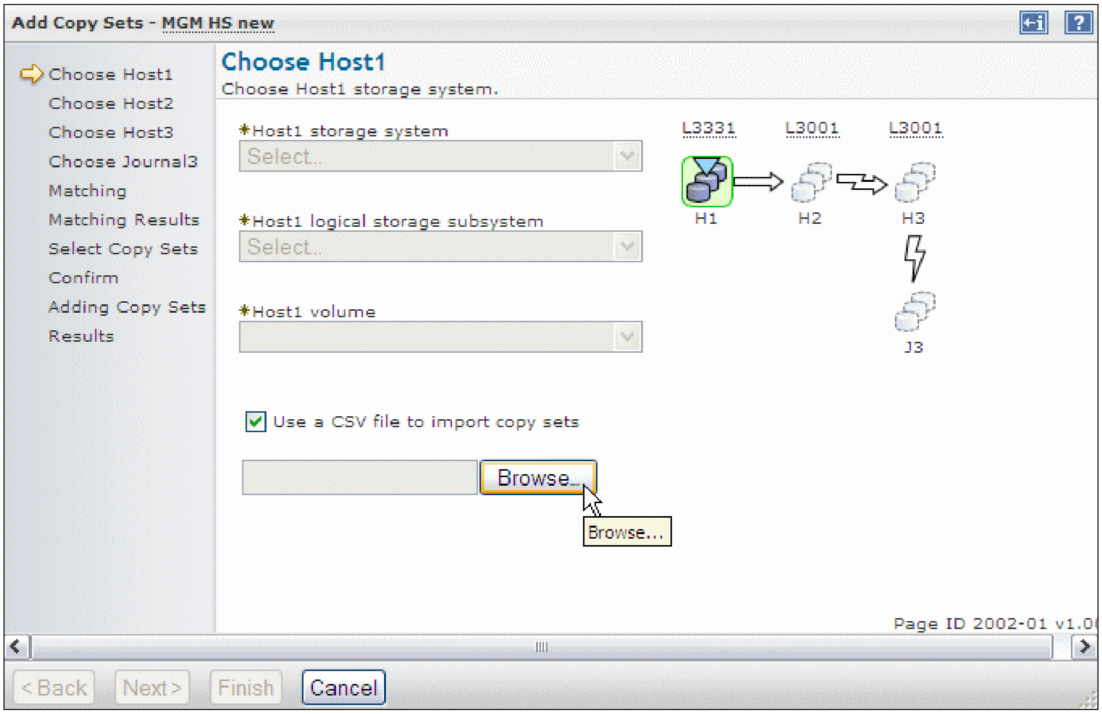

Figure 5-57 Choosing CSV File to be imported

9. Select a previously exported or created CSV file, and then click the **Open** button as shown in Figure 5-58.

Notes:

- It is not possible to choose multiple CSV files in the same operation.
- Using Copy Sets into CSV files has a specific format to address Copy Services functions such as FlashCopy (FC), Metro Mirror (MM), and Metro/Global Mirroring (MGM). In this way, is not possible to Import a CSV file with specific characteristics into another with different characteristics.
- To avoid errors, be sure that the Copy Sets in the CSV file have the same Site Location as defined in the Session that the Copy Sets will be imported into.
- A CSV file name is case sensitive.

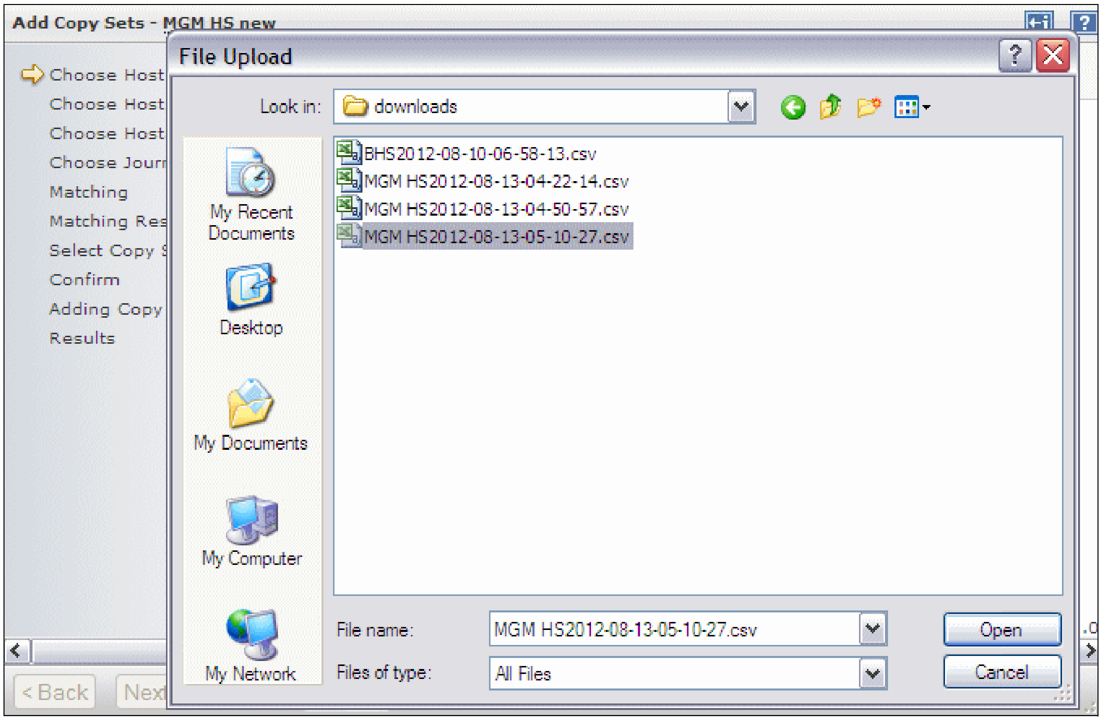

Figure 5-58 Opening exported Copy Set file

10. Click **Next** as shown in Figure 5-59.

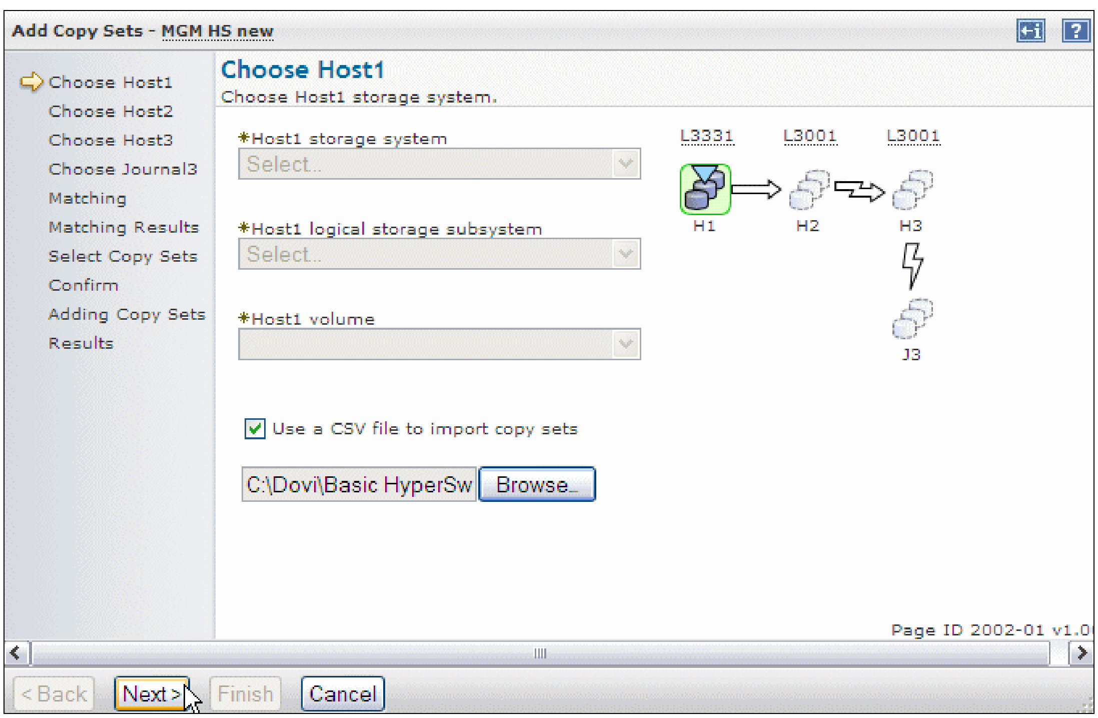

Figure 5-59 Add Copy Sets

11. Tivoli Storage Productivity Center for Replication checks if the volumes are defined in another session. It may show you a warning, as in Figure 5-60. After you click **Next**, Tivoli Storage Productivity Center for Replication shows you the reason for the warning. This warning does not prohibit you from adding this Copy Set;

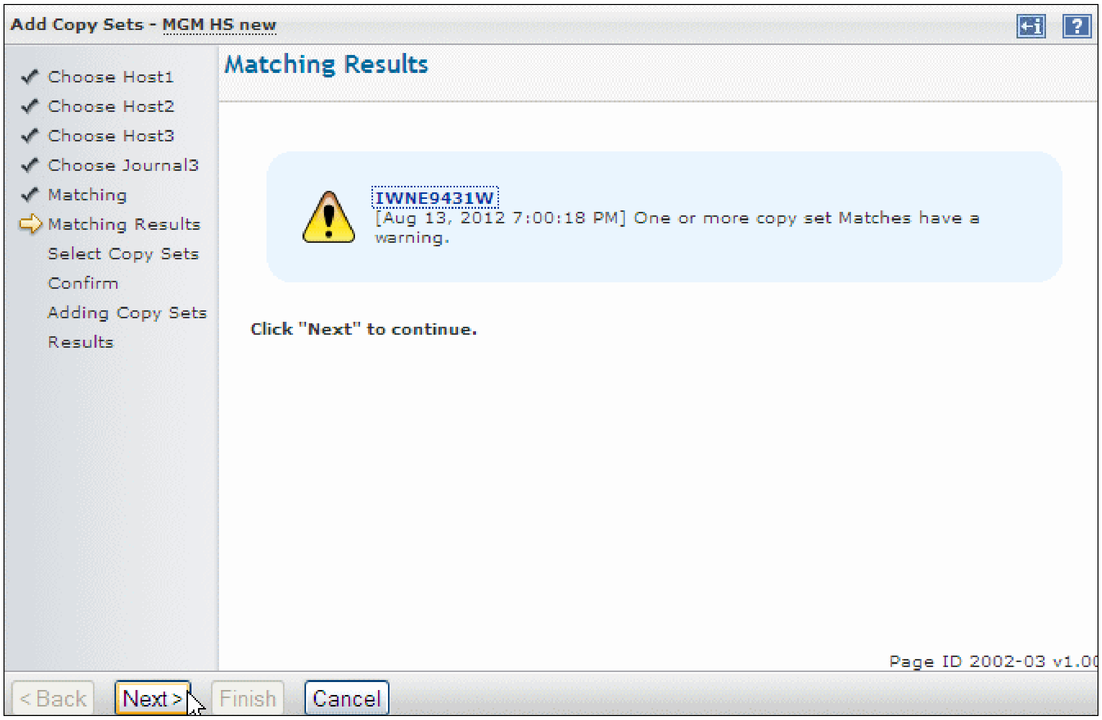

Figure 5-60 Matching results warning

12. After clicking **Next**, Tivoli Storage Productivity Center for Replication shows the panel to select the Copy Sets. It also shows the reasons for the warning message, if there is one. Verify if the selected Copy Set to be imported is checked and click **Next** as shown in Figure 5-61.

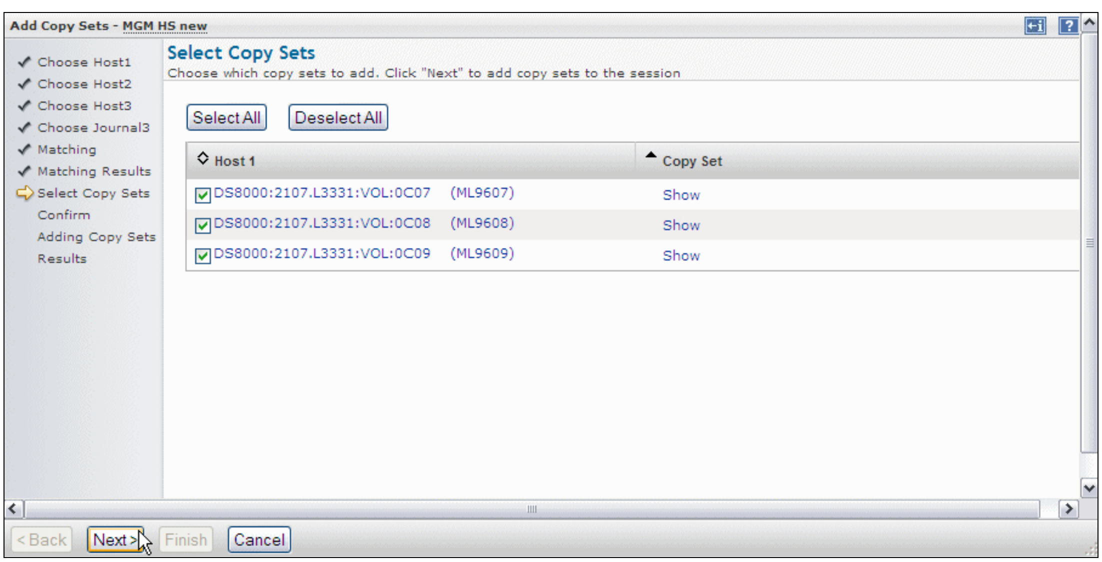

Figure 5-61 Selecting and Checking Copy Sets to be imported

13. Tivoli Storage Productivity Center for Replication shows you the panel to confirm that you want to add the Copy Sets.Click **Next** to confirm that you want to add the Copy Sets. Click **Finish** to conclude Copy Set Import operation for a new session and get back to the previous export session menu in the Work Area as shown in Figure 5-62.

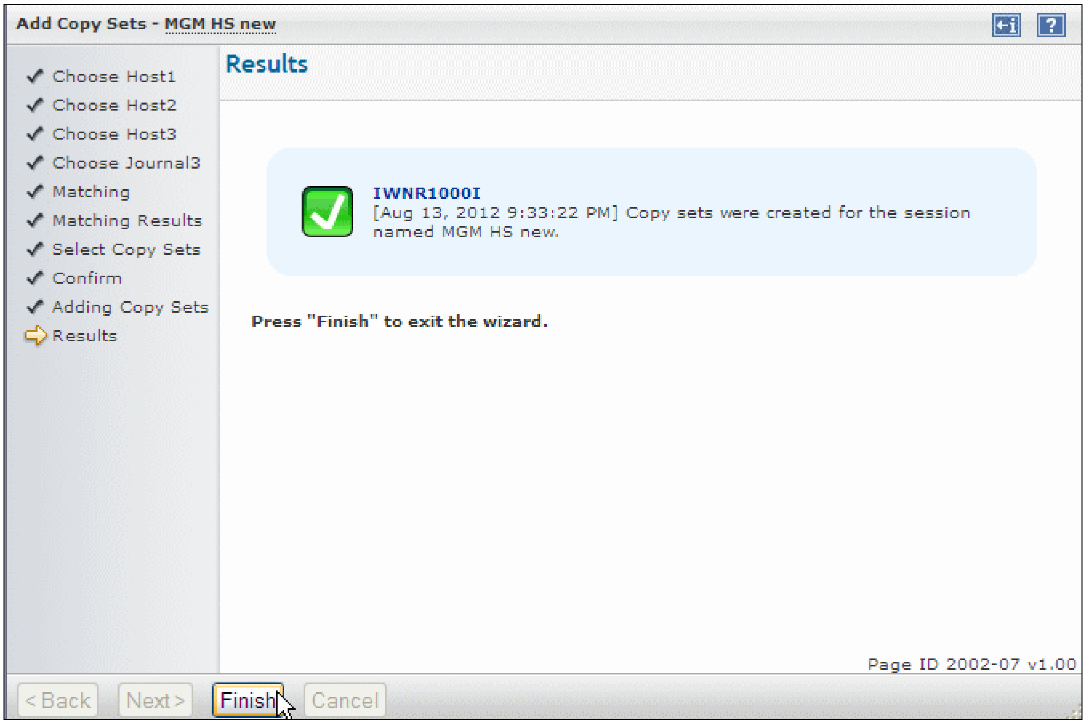

Figure 5-62 Finishing importing Copy Sets

Importing Copy Sets into an existing session

From the Session panel, select the session that you want to add the Copy Sets. Then select the option **Add Copy Sets** in the drop-down menu and click the **Go** button as shown in Figure 5-63.

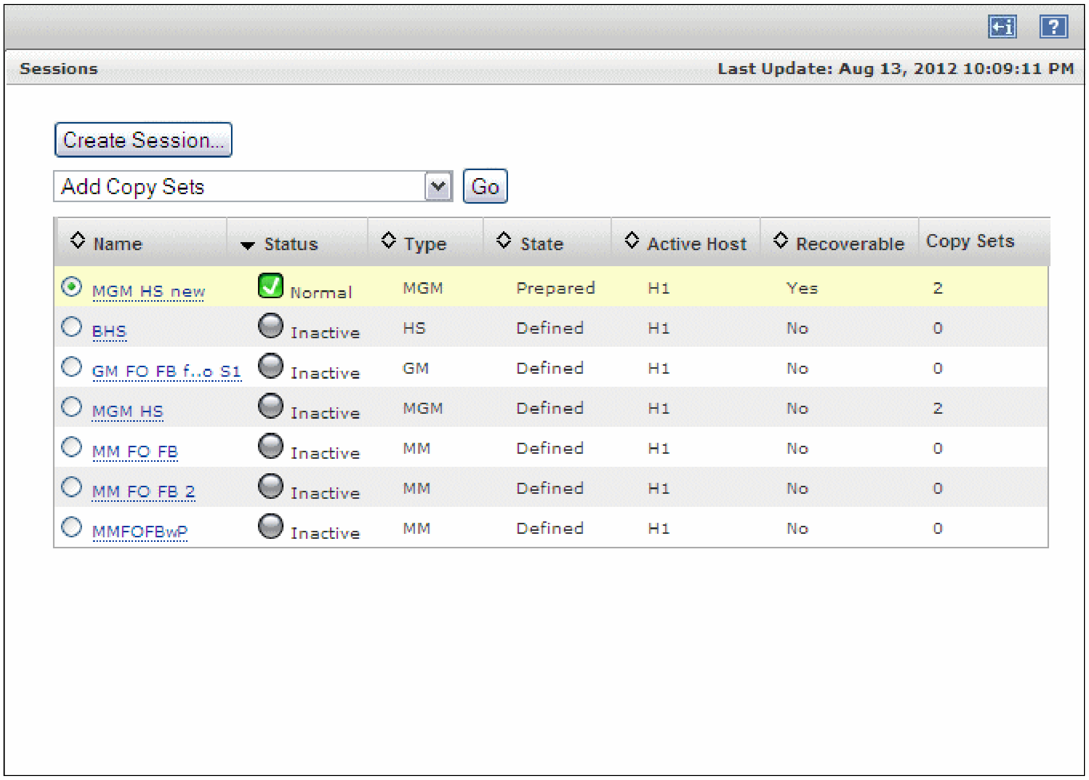

Figure 5-63 Adding Copy Sets to existing Session

The steps to add the Copy Sets are the same as described in the previous topic, from Figure 5-57 on page 203 to Figure 5-62 on page 206.

When you are adding Copy Sets to an existing Session with Copy Sets already active with Status **Normal** and State **Target Available**, the Status will change to **Warning** as shown in Figure 5-64.

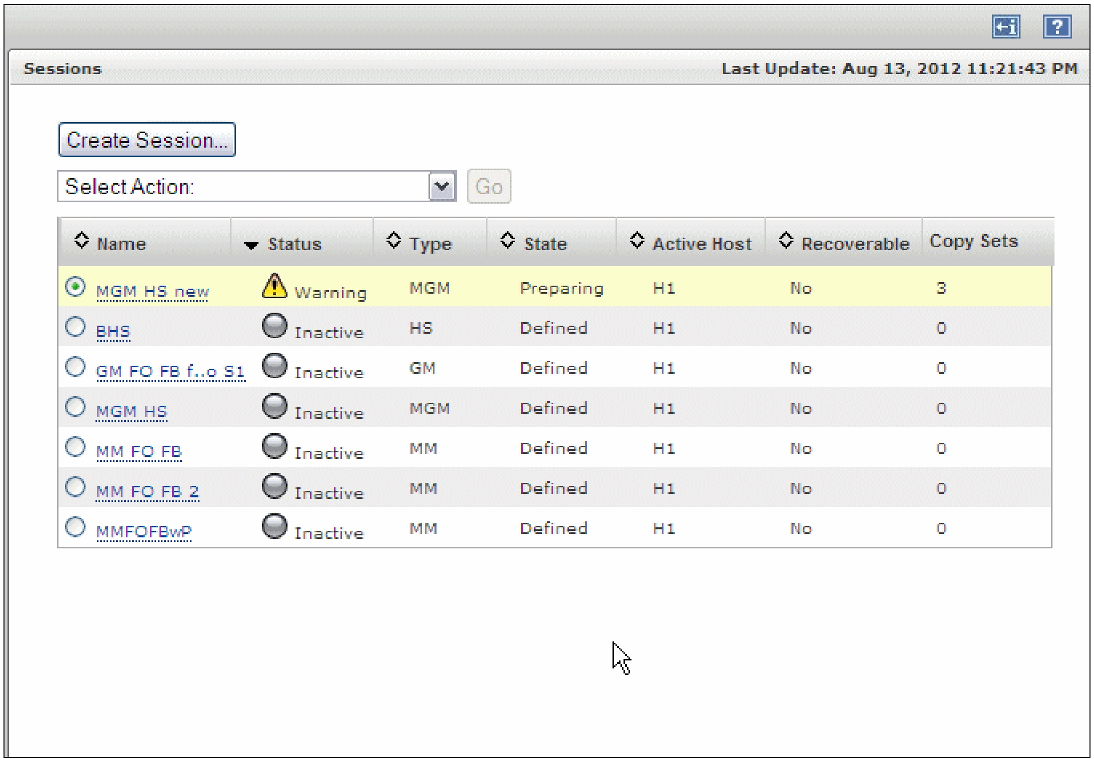

Figure 5-64 Warning when adding Copy Sets to a existing active Session

Tivoli Storage Productivity Center for Replication automatically starts all the copying process. The session changes its status to **Normal** as soon as the new Copy Sets finish their initial copy process and enter Prepared state in the MGM configuration. See Figure 5-65.

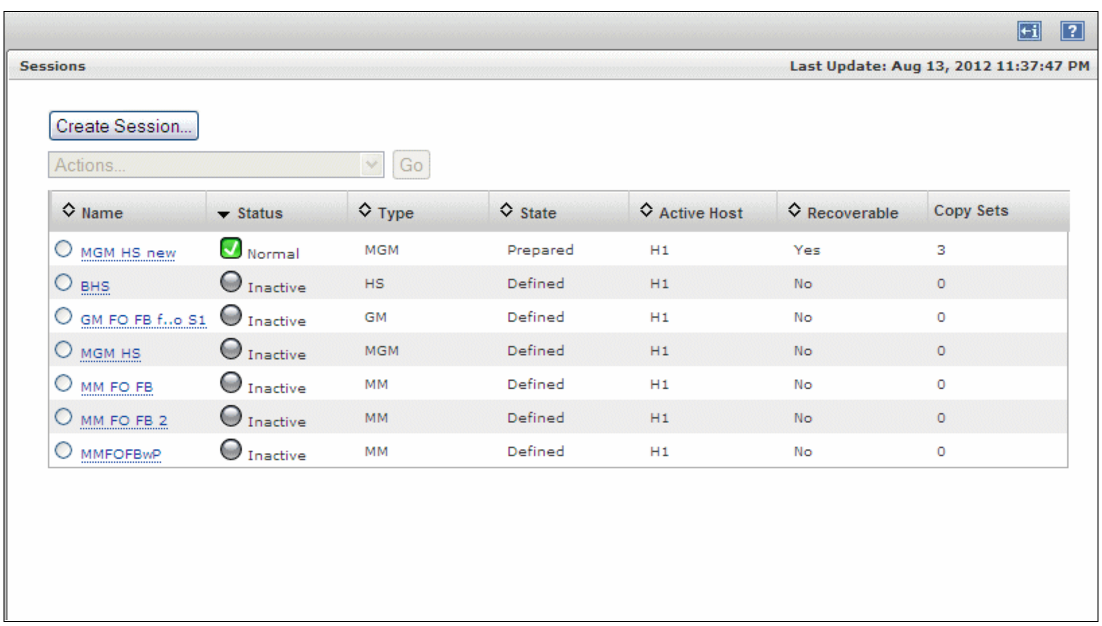

Figure 5-65 Session back to normal

5.7.3 Working with CSV files under Microsoft Excel

In order to simplify the way to create and implement sessions, you can create a session with a small Copy Sets and export this session to be used in the future under Microsoft Excel. To open and edit a Copy Sets Session previously saved in CSV format, you only have to start Microsoft Excel and open this file in the directory where you previously saved the file during the Export Copy Sets.

The Copy Sets Session file name for the MGM HS session exported in our test has the name MGM HS2012-08-13-04-50-57.csv. Notice that Tivoli Storage Productivity Center for Replication creates the exported session with the name of the session appended with date and timestamp. See Example 5-66. This file name will be the file name used when importing the Copy Sets Session file.

As shown in Figure 5-66, you can open and edit the spreadsheet, adding volumes related with the session where you are working and importing the session back to your Tivoli Storage Productivity Center for the Replication session as shown in “Importing CSV files” on page 198.

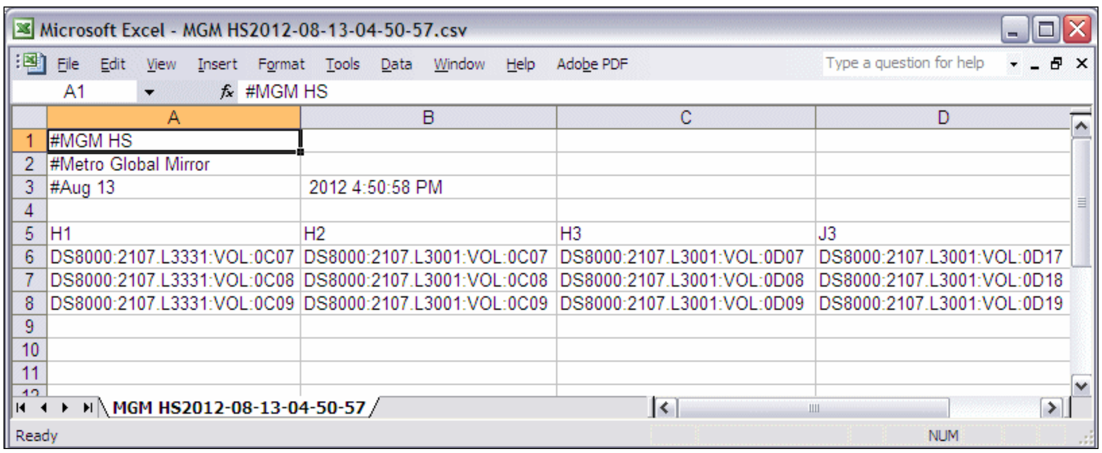

Figure 5-66 MGM HS exported session

Here, the following terminology applies:

- MGM HS Session1 is the exported session name.
- Metro Global Mirror is the session type.
- H1, H2, H3, and J3 are labels describing the Copy Set roles of the disk subsystems and volumes that belong to the exported MGM session. Under those labels, there are the disk subsystems and volumes.

5.8 Starting and stopping the Tivoli Storage Productivity Center for Replication server

You start or stop Tivoli Storage Productivity Center for Replication for System z by starting or stopping the WebSphere Application Server or the WebSphere Application Server OEM Edition, depending on what version of the WebSphere product you have installed.

5.8.1 Starting WebSphere Application Server OEM Edition on z/OS

You can use either the MVS START command, or the **startServer.sh** command to start your IBM WebSphere Application Server OEM Edition for z/OS server instances.

To use the MVS START command, enter the following command:

```
START zControlProcName,JOBNAME=zServerShortName,
ENV=zCellShortName.zNodeShortName.zServerShortName
```

Here, the following terminology applies:

zControlProcName
: Name of the member in your procedure library that you use to start the application server controller region.

zServerShortName
: Job name that you assign to your application server control region.

zCellShortName
: Name that z/OS facilities such as SAF use to identify the WebSphere cell.

zNodeShortName
: Name that z/OS facilities such as SAF use to identify the WebSphere node.

These values are created when you install WebSphere Application Server OEM Edition and run the WASOEM.sh script. They can be found in the default response file or in the override response file, if you choose to use variables that are different from the default variables,

For example, if you are using the default response file, you would issue the following command:

```
START BBN7ACR,JOBNAME=BBNS001,ENV=BBNBASE.BBNNODE.BBNS001
```

5.8.2 Stopping WebSphere Application Server OEM Edition

You must stop all the application servers that are running, and then stop the daemon for that servers.

1. Issue the STOP *server_name* command for each application server control region that you want to stop.

   The STOP command reads the configuration file for the specified server process, and stops that server. For example, issue the following command to stop the server BBNS001 in your system, if you installed WebSphere using the default installation variables:

   ```
   STOP BBNS001
   ```

   This command stops both the control region (BBNS001) and the server region (BBNS001S) of the WebSphere Application Server OEM Edition.

   If the application server does not respond to the STOP command, try using the CANCEL command:

   ```
   F BBNS001,CANCEL
   ```

   You should only use the CANCEL command in situations where the STOP command fails. If the server stops gracefully, it also removes a temporary directory that it creates when it starts. However, if you use the CANCEL command to stop a server, the temp directory is not removed. If you use the CANCEL command too frequently, the HFS that is used for these temp directories eventually becomes full.

2. Stop the daemon.

   After all of your application servers have stopped running, issue the STOP command for the daemon. For example, in order to stop a daemon region called BBN7ACRS, issue this command:

   ```
   STOP BBN7ACRS
   ```

   If the daemon does not respond to the STOP command, try using the CANCEL command:

   ```
   F BBN7ACRS,CANCEL
   ```

   Again, try to avoid using the CANCEL command too frequently, as it does not remove a temporary directory that is created when the daemon is started.

5.9 Tivoli Storage Productivity Center for Replication SNMP setup

Tivoli Storage Productivity Center for Replication servers can send Simple Network Management Protocol (SNMP) traps to registered SNMP managers when various events occur. The following general events are included:

- Session state change
- Configuration change
- Suspending-event notification
- Communication failure
- High-availability state change

You can use the **mksnmp** CLI command to add a specified manager to the list of servers to which SNMP alerts are sent. Details of the **mksnmp** command can be found in the *IBM Tivoli Storage Productivity Center for Replication for System z Version 5.1 Command-line Interface User's Guide,* SC27-4055.

Additionally, the Tivoli Storage Productivity Center for Replication Server can be set up to receive SNMP traps from the IBM ESS 800, DS6000, or DS8000. While not being required, the use of the SNMP alert may reduce the latency between the time when a freeze event occurs and the time that Tivoli Storage Productivity Center for Replication recognizes that this event is occurring.

The SNMP trap destination can be set up on your ESS via the ESS Specialist or the **set snmp** command. Through the respective GUI panels for the DS6000 or DS8000 or the DSCLI command **chsp**, you set SNMP trap destinations for the DS6000 and DS8000.

6

Basic HyperSwap customization and use

After installing Tivoli Storage Productivity Center for Replication, there are tasks that you must complete before using HyperSwap. This chapter steps you through the customization of your z/OS system prior to using Basic HyperSwap and then shows you how to use it.

6.1 z/OS HyperSwap overview

IBM invented HyperSwap technology. HyperSwap was shipped with the full-function GDPS/PPRC HyperSwap solution in 2002 and with the GDPS/PPRC HyperSwap Manager (HM) subset solution in 2005. The GDPS/PPRC HM and full-function GDPS/PPRC offerings provide continuous availability / disaster recovery solutions for single-site and multiple-site z/OS, z/VM®, and z/Linux customer environments.

6.2 Basic HyperSwap: Not so “basic” anymore

When z/OS Basic HyperSwap was first introduced in Tivoli Storage Productivity Center for Replication v3.4 in April 2008, it was a single-site solution that provided a continuous availability solution for disk storage failures. In Tivoli Storage Productivity Center for Replication, this session type was called “Basic HyperSwap”. Since that time, several new session types that exploit z/OS HyperSwap have been added to Tivoli Storage Productivity Center for Replication.

Basic HyperSwap

z/OS Basic HyperSwap is a single-site z/OS-only solution that extends SYSPLEX / IBM Parallel Sysplex® high availability capabilities to data. It is not a Disaster Recovery solution. It is not designed to handle Metro Mirror link failures that can occur in cross site configurations.

Metro Mirror with HyperSwap

Metro Mirror with HyperSwap is a two-site solution that extends the capabilities of Tivoli Storage Productivity Center for Replication Basic HyperSwap to support two-site Disaster Recovery.

Metro Global Mirror with HyperSwap

Metro Global Mirror with HyperSwap is a three-site solution that extends the capabilities of Tivoli Storage Productivity Center for Replication Metro Mirror with HyperSwap to provide Global Mirror from the second site to a third site, which may be thousands of miles away.

Metro Global Mirror with Practice and with HyperSwap

Metro Global Mirror with Practice and with HyperSwap is a three-site solution that extends the capabilities of Metro Global Mirror with HyperSwap to provide an additional set of volumes that may be used to practice your business resumption procedure, while still maintaining full Metro Global Mirror with HyperSwap capabilities.

For the purposes of this chapter, we use the following terms:

- Tivoli Storage Productivity Center for Replication HyperSwap (or just HyperSwap): Used when discussing HyperSwap, when applicable to all Tivoli Storage Productivity Center for Replication HyperSwap enabled session types.
- Basic HyperSwap: Used when discussing the specific Tivoli Storage Productivity Center for Replication HyperSwap session type that provides only single-site disk availability.
- z/OS HyperSwap: Used to describe the component of z/OS that provides HyperSwap support.
- Metro Mirror with HyperSwap: Used when discussing the Tivoli Storage Productivity Center for Replication HyperSwap session type that supports two-site disaster recovery.

- Metro Global Mirror with HyperSwap: Used when discussing the Tivoli Storage Productivity Center for Replication HyperSwap session that supports HyperSwap between sites 1 and 2, and also uses Global mirror to copy data to a remote third site.
- Metro Global Mirror with HyperSwap and with Practice: Used when discussing the Tivoli Storage Productivity Center for Replication HyperSwap session that supports the three-site solution, that extends the capabilities of Metro Global Mirror with HyperSwap to provide an additional set of volumes that may be used to practice your business resumption procedure, while still maintaining full Metro Global Mirror with HyperSwap capabilities. Introduced with Tivoli Storage Productivity Center for Replication for System z v5.1.1 (December 2012).

Table 6-1 shows a comparison of GDPS HyperSwap and Tivoli Storage Productivity Center for Replication for System z Basic HyperSwap.

Table 6-1 GDPS HyperSwap compared to Basic HyperSwap

Features	**GDPS HyperSwap**	**Tivoli Storage Productivity Center for Replication HyperSwap**
Provides fast swapping of UCBs Transparent to application	Yes	Yes
Code hardened to avoid hangs Page faults	Yes	Yes
Failure management provided by	GDPS	z/OS
Cost	Service offering	Tivoli Storage Productivity Center for Replication Basic Edition - No charge[a] Tivoli Storage Productivity Center for Replication for System z -Charge
Platforms supported	z/OS and zLinux	z/OS
Software required	System automation IBM NetView®	Tivoli Storage Productivity Center for Replication v5.1.1 WebSphere Application Server OEM v7.0 (included with Tivoli Storage Productivity Center for Replication)

a. “Tivoli Storage Productivity Center for Replication Basic Edition for System z” is a no-charge disk availability only solution, while there is a charge for “Tivoli Storage Productivity Center for Replication for System z”

HyperSwap volumes are defined to a Tivoli Storage Productivity Center for Replication HyperSwap session. A HyperSwap session is a special Metro Mirror Session that is designed to provide high availability in the event of a Disk Storage Subsystem failure on the same data center floor.

Tivoli Storage Productivity Center for Replication controls all of the activities during the creation and construction of a HyperSwap session. These activities include defining the HyperSwap session itself, populating the session with the appropriate Metro Mirror volume pairs (Copy Sets), and starting the session to fully initialize all of the copy pairs. Eventually all of the Tivoli Storage Productivity Center for Replication copy sets within the session will reach FULL DUPLEX state (that is, the target volumes are now identical copies of the source volumes). When in FULL DUPLEX state, control of the session is transferred to HyperSwap, which is part of the I/O Supervisor (IOS) component of z/OS.

Figure 6-1 illustrates a HyperSwap operation. On the left, we see applications running in z/OS accessing a single primary volume through a z/OS control block called a Unit Control Block (UCB). Every device in z/OS is represented by a unique UCB.

Each UCB in turn points to another control block called a Sub-Channel Information Block (SCHIB) that it is used as to communicate with the I/O device. The HyperSwap operation basically swaps the UCB pointer from the SCHIB that represents the primary device to the SCHIB that represents the secondary device.

On the right we see the result of a HyperSwap operation. The UCB pointer to the SCHIB representing the primary volume is changed to point to the SCHIB representing the secondary volume. Also, the Metro Mirror direction is reversed.

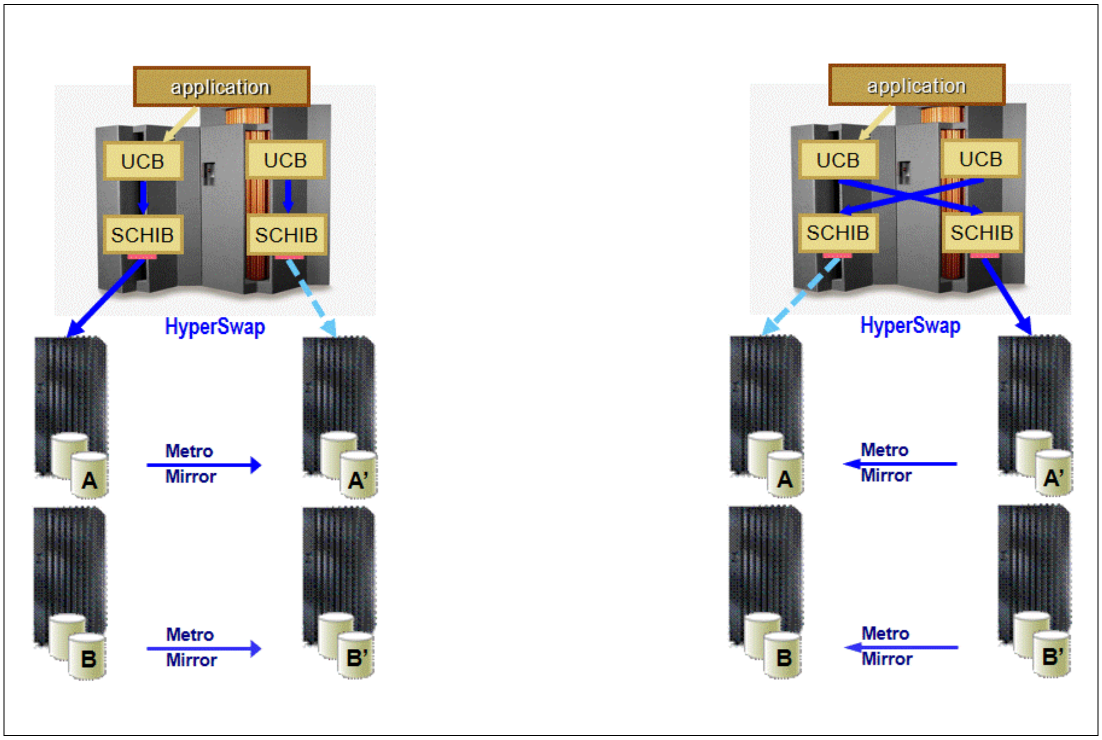

Figure 6-1 Before and after a HyperSwap

Before a HyperSwap takes place, all of the I/O requests to and from the primary devices defined in the HyperSwap session are frozen by z/OS. z/OS does this by calling a function to freeze all of the primary logical subsystems (LSS). This function is equivalent to the **TSO CGROUP FREEZE** command. As soon as a logical subsystem receives a CGROUP FREEZE order, all of the I/Os to its device are placed in an Extended Long Busy (ELB) state.

When all of the logical subsystems are in an ELB state, all of the z/OS images in the sysplex perform the HyperSwap operation for all of the devices. The amount of time that a logical subsystem stays in this ELB state is controlled by a hardware specification in the DS or ESS box. Use the default value, which is 120 seconds. You can ask your IBM hardware representative to verify and change the ELB value if necessary.

6.2.1 Planned and Unplanned HyperSwap

A HyperSwap operation can be planned or unplanned.

Planned HyperSwap

The Planned HyperSwap function provides the following capabilities:

- Transparently switch all primary PPRC disk subsystems with the secondary PPRC disk subsystems for a planned reconfiguration.
- Perform disk configuration maintenance and planned site maintenance without requiring any applications to be quiesced.
- Perform periodic testing of the HyperSwap function

Planned HyperSwaps are usually initiated through Tivoli Storage Productivity Center for Replication, although they may also be initiated by the z/OS command SETHS SWAP.

Unplanned HyperSwap

The Unplanned HyperSwap function provides the ability to transparently switch to use secondary PPRC disk subsystems in the event of unplanned outages of the primary PPRC disk subsystems. The unplanned HyperSwap function allows production systems to remain active during a disk subsystem failure. Disk subsystem failures will no longer constitute a single point of failure for an entire system, sysplex or Parallel Sysplex.

An Unplanned HyperSwap is triggered by the following conditions:

- Any disk subsystem condition that would cause a permanent I/O error to be returned to the application
- The channel subsystem in the zSeries processor detecting that it no longer has a path to a primary disk volume

Tivoli Storage Productivity Center for Replication is not involved in triggering unplanned HyperSwaps.

Event triggers

The sequence of events to trigger an unplanned HyperSwap operation is as follows:

1. An application sends an I/O request to a disk volume.
2. The disk subsystem or the channel subsystem in the zSeries processor return a permanent I/O error or a no path available status to z/OS.
3. z/OS routines that monitor I/O activity determine that this event is a HyperSwap trigger, and send an event notification to the HyperSwap Management address space within the sysplex that is acting as the master to let it know that a HyperSwap trigger has been detected.
4. At this point, the HyperSwap begins.

The execution of a planned or unplanned is very similar. You can find more details in “HyperSwap phases” on page 231.

z/OS performs the HyperSwap transparently to the applications. Applications will experience a delay during the HyperSwap operation, but they will resume running as soon as the HyperSwap completes.

6.3 Customization

In this topic, we explain how to set up Tivoli Storage Productivity Center for Replication HyperSwap in the z/OS environment.

Before using Tivoli Storage Productivity Center for Replication HyperSwap, be certain that no HyperSwap managed volumes are accessed by systems outside of the sysplex (or monoplex).

6.3.1 SYS1.PARMLIB

For more information about any of the following topics, see the publication: *z/OS MVS Initialization and Tuning Reference,* SA22-7592.

IEASYSxx

To accommodate a larger number of log buffers, you may need to increase the amount of extended CSA (ECSA) storage allowed on your systems. Add approximately 150 bytes of additional ECSA for every 1000 additional log buffers. See the second value specification for the **CSA** parameter. (The additional log buffers are specified using the LOGLIM parameter discussed below)

HyperSwap control blocks occupy extended SQA (ESQA) storage and you may need to increase the amount of ESQA available on your systems. Each PPRC device pair requires 32 bytes, and each LSS requires 1100 bytes. A configuration of ten thousand PPRC device pairs will require on the order of 320K. See the second value specification for the **SQA** parameter.

CONSOLxx

During a HyperSwap, a very large number of messages may be produced. To minimize the possibility that Console buffer shortages will impact operations during the HyperSwap, increase the number of Console buffers that you allow. These buffers now occupy above-the-line storage, so you can specify a large value without impacting your system. See the **MLIM** parameter on the **CONSOLxx INIT** statement.

The large number of messages produced during a HyperSwap are also written to the system log (SYSLOG and/or OPERLOG). To minimize the possibility that a log buffer shortage will impact operations during the HyperSwap, increase the number of log buffers that you allow. See the **LOGLIM** parameter on the **CONSOLxx INIT** statement. Note that log buffers occupy extended CSA (ECSA) and you should increase the amount of CSA that you provide through the **IEASYSxx** PARMLIB member.

IECIOSxx

The I/O timing facility can be enabled to trigger a HyperSwap when an I/O timeout occurs for a device that is monitored for HyperSwap. See the **IOTHSWAP** and **IOTTERM** parameters.

MPFLSTxx

All disk subsystems keep the Metro Mirror status of all of their devices. Any change in this status, such as a volume going from DUPLEX to SUSPENDED, causes the disk subsystem to send a *state change interrupt* to all systems that have that volume online. Each z/OS image that receives this interrupt issues the following message to the console:

```
IEA494I devn,volser,PPRC PAIR SUSPENDED,SSID=ssid,CCA=cc
```

This message, and others, will be issued whenever a HyperSwap occurs. You will see this message for each primary device in the HyperSwap session. If you have thousands of volumes in your HyperSwap session, you will see thousands of these messages on your operator consoles, and this can cause WTO buffer shortages and impact the operation of your systems.

You can avoid having large numbers of messages going to your consoles by using the Message Processing Facility (MPF) to keep these messages off of your consoles. The messages will be written to the system log (SYSLOG and/or OPERLOG).

If you want to see the first few instances of messages (but not all of them), you may want to use Message Flood Automation (see the **MSGFLDxx** topic below) instead of or in addition to the Message Processing Facility.

The following messages should always be suppressed from the consoles by using the following MPF specifications:

- IOS000I,SUP(ALL),AUTO(NO)
- IOS017I,SUP(ALL),AUTO(NO)
- IOS109E,SUP(ALL),AUTO(NO)
- IOS251I,SUP(ALL),AUTO(NO)
- IOS444I,SUP(ALL),AUTO(NO)
- IOS450E,SUP(ALL),AUTO(NO)
- IOS291I,SUP(ALL),AUTO(NO)
- IEA476E,SUP(ALL),AUTO(NO)

MSGFLDxx

You can avoid seeing all of the HyperSwap-related messages on your consoles by implementing Message Flood Automation in your sysplex. Message Flood Automation allows you to establish thresholds for certain messages. When the number of these messages reaches the threshold within a specified time interval, Message Flood Automation can take action, such as preventing the messages from going to the consoles.

The following message should be suppressed from the consoles when it is produced in large quantities in a short period of time:

```
MSG IEA494I LOG,NOAUTO,NODISPLAY,NORETAIN,NOIGNORE
```

SCHEDxx

HyperSwap depends on the XCF component of z/OS to communicate with other systems in the sysplex. To ensure that XCF is able to communicate when a HyperSwap is required, see the **CRITICALPAGING** parameter.

6.3.2 Address spaces

z/OS HyperSwap requires two address spaces: the HyperSwap Management address space (HSIB), and the HyperSwap API address space (HSIBAPI). You can start both of these address spaces by adding simple procedures to SYS1.PROCLIB, and then issuing **`'START procmemname'`** commands manually, or by including the commands in the COMMNDxx member of your SYS1.PARMLIB. Following are examples of the PROCLIB members:

- HSIB Management address space example:

```
//HSIB      PROC
//IEFPROC   EXEC  PGM=IOSHMCTL,TIME=NOLIMIT,REGION=0M
```

- HSIB API address space example:

```
//HSIBAPI   PROC
//HSIBAPI   EXEC  PGM=IOSHSAPI,,TIME=NOLIMIT,REGION=0M
```

You must start both address spaces in order to use z/OS HyperSwap. The start commands for these procedures are:

```
S HSIB,SUB=MSTR
S HSIAPI,SUB=MSTR
```

Both of these address spaces must be up and running in all images in the Sysplex.

These started tasks are associated by default with SYSSTC service class in WLM. You must confirm that they have this service class assigned to them.

6.4 Commands

After you have started the HyperSwap address spaces, you can use additional commands for gathering information or controlling a HyperSwap session on z/OS:

- **DISPLAY HS,STATUS**

  Displays the status of HyperSwap. This command also displays any reasons why HyperSwap may be disabled, and the current policies for the HyperSwap session. Figure 6-2 is an example of the **D HS,STATUS** command output.

```
D HS,STATUS
IOSHM0303I HyperSwap Status 772
Replication Session: HS test2
New member configuration load failed: Disable
Planned swap recovery: Disable
Unplanned swap recovery: Disable
HyperSwap disabled:
 Unable to verify PPRC status
One or more members unable to verify PPRC secondary device connectivity
SC75:
 Member unable to verify PPRC secondary device connectivity
```

Figure 6-2 D HS,STATUS output

Table 6-2 gives some hints about the meaning of this output.

Table 6-2 D HS,STATUS fields

Replication Session	The session name as it was defined in Tivoli Storage Productivity Center for Replication
New member configuration load failed	These are the HyperSwap policy options that were specified when the session was created. See "Setting up the HyperSwap session in Tivoli Storage Productivity Center for Replication" on page 229.
Planned swap recovery	
Unplanned swap recovery	
HyperSwap enabled/disabled	The status of HyperSwap. If it is disabled, then additional information is displayed explaining the reason for it to be disabled, and the system that has problems to enable it.

- **D HS,CONFIG(DETAIL,ALL)**

  Displays the detailed configuration for the current Basic HyperSwap session. This will list the volumes and status of all pairs in the Basic HyperSwap configuration. Here is an example of this command output; it shows only one volume pair in the "Basic HyperSwap" session.:

```
IOSHM0304I HyperSwap Configuration 819
Replication Session: Basic HyperSwap
Prim. SSID  UA  DEV#   VOLSER   Sec. SSID  UA  DEV#   Status
       0B   20  DB20   MLDA20         0A   20  DA20
```

- **D HS,CONFIG(EXCEPTION,ALL)**

  Displays all of the volumes in the current Basic HyperSwap session that are experiencing problems, by the problems that they are experiencing.

- **D IOS,CONFIG(ALL)**

  Displays IOS-related configuration information, including information about whether a HyperSwap has occurred.

- **D M=DEV(*nnnnn*)**

  Displays device-related configuration information, including whether the device is being monitored by HyperSwap and whether the device has been swapped by HyperSwap.

- **SETHS ENABLE**

  Enables HyperSwap. This allows a HyperSwap to be performed, either by command or automatically, after being disabled by the operator using "SETHS DISABLE". This command will not enable HyperSwap if it is disabled for other reasons.

- **SETHS DISABLE**

  Disables HyperSwap. This command allows the operator to prevent a HyperSwap from being performed, either by command or automatically.

- **SETHS RESUMEIO**

  Resumes normal I/O to all disk devices that have been quiesced by HyperSwap because STOP was specified in the session policy as the action to be taken on a PPRC suspend event. Note that there is no guarantee that the "SETHS RESUMEIO" will be successful after I/O is quiesced to HyperSwap managed storage. In this case a reIPL will be required.

- **SETHS SWAP**

  Performs a planned HyperSwap. This can be done instead of issuing the **HyperSwap** command from Tivoli Storage Productivity Center for Replication.

6.5 Basic HyperSwap considerations and requirements

In this topic, we discuss some considerations and requirements specific to Basic HyperSwap.

6.5.1 Sysplex requirements

You can enable Basic HyperSwap in the following configurations:

- Parallel sysplex.
- Base sysplex configuration with no Coupling Facilities. You must provide any-to-any CTC connectivity between all the systems. This is required for XCF communications.
- Monoplex configuration. Basic HyperSwap uses XCF couple data sets to save state information. So if you plan to use HyperSwap for just a single z/OS image,

you must set it up as a Monoplex, meaning a sysplex with a single image (that is, “PLEXCFG=MONOPLEX” in PARMLIB), and not just a single, standalone MVS system (that is, “PLEXCFG=XCFLOCAL” in PARMLIB).

You can find more details about implementing sysplex in the manual *Setting Up a Sysplex*, SA22-7625.

6.5.2 Disk subsystems

Here are the requirements for Basic HyperSwap:

- ESS 800, DS6000, or DS8000 Metro Mirror License on both Primary and Secondary Storage subsystems with the current support levels of the LIC code installed. Non-IBM Storage Subsystems supporting Metro Mirror Architecture are not supported in a Basic HyperSwap session.
- z/OS images must have connectivity to both primary and secondary disk subsystems. The same number of FICON links between the hosts and primary disk subsystems must be used for connecting the hosts and the secondary disk subsystems in order to avoid performance problems after a HyperSwap.
- Generally, FlashCopy Targets should not be part of a HyperSwap session. When a FlashCopy relationship is established, the volumes will drop out of full Duplex state and become Duplex Pending until all of the FlashCopy data has been synchronized with the PPRC target devices. While these devices are in Duplex Pending mode, if they are in a HyperSwap session, the HyperSwap session will be disabled until all PPRC pairs have returned to the full Duplex state.
- If FlashCopy targets must be part of a HyperSwap session, use Remote Pair FlashCopy (RPFC).
- Tivoli Storage Productivity Center does not support HyperSwap with Remote Pair Flash Copy (RPFC) in a singles session, so the way to accomplish this is to create three Tivoli Storage Productivity Center for Replication sessions. Two would be FlashCopy sessions, and the third HyperSwap session.

First define the HyperSwap session:

- Define two copysets, one from the “site 1-FC source” to the “site 2-FC source” and one from the “site 1-FC target” to the “site 2-FC target.”
- Select the “Allow FlashCopy target to be Metro Mirror or Global Copy source” check box, and select option 3. These three options correspond to Remote Pair FlashCopy options None, Preferred, and Required respectively:
  – Do not attempt to preserve Metro Mirror consistency.
  – Attempt to preserve Metro Mirror consistency but allow FlashCopy even if Metro Mirror target consistency cannot be preserved.
  – Attempt to preserve Metro Mirror consistency but fail FlashCopy if Metro Mirror target consistency cannot be preserved.

Next define the two FlashCopy sessions:

- For the first FlashCopy session, you will add one copyset from the “site 1-FC source” to the “site 1-FC target.” So in the HyperSwap session you will have twice as many copysets as in the FlashCopy copyset.
- Now if you will want to continue to FlashCopy from FC source to target after you have moved to site 2 (either via HyperSwap or after re-IPLing at site 2), then we need a second FlashCopy session available. This is because Tivoli Storage Productivity Center for Replication knows the volumes by their serial number, not their device number,

and after you move to site 2, the devices you want to issue the FlashCopy against are now the ones at site 2.

Therefore, define a third session:

- For the second FlashCopy session, you will add one copyset from the “site 2-FC source” to the “site 2-FC target.”

For more information, there is an IBM Redpaper™ that may be of value. It is available on the Redbooks web site. *IBM System Storage DS8000 - Remote Pair FlashCopy (Preserve Mirror)*, REDP-4504-00:

http://www.redbooks.ibm.com/abstracts/redp4504.html

Symmetric configuration

Maintain a symmetric Metro Mirror configuration, meaning that it has the following characteristics:

- One-to-one relationship between:
  – Primary and secondary disk subsystems
  – Primary and secondary logical subsystems
  – Primary and secondary volumes.
- The same number of FICON links between the hosts and the primary and secondary disk subsystems.
- The same number of Parallel Access Volumes (PAV) defined in the primary and secondary LSS.
- Secondary disk subsystem Cache and Non-Volatile Storage sizes that are the same as those in its primary disk subsystem partner.

Symmetric configurations are easier to maintain. If you have a symmetric configuration and good naming conventions for your disk volumes, you can easily determine which primary is paired with each secondary.

Another good reason for maintaining a symmetric configuration is that after a HyperSwap, you will continue to have the same performance level that you had when you were experiencing using the primary disks.

6.5.3 JES3 considerations

z/OS HyperSwap supports JES3, including JES3 Managed Devices.

When a new HyperSwap configuration is loaded, all the z/OS images in the sysplex check their secondaries, to confirm that each z/OS image has connectivity to their secondaries and that each volume pair can be dynamically swapped.

When a new HyperSwap configuration is loaded, and during each monitor interval, HyperSwap checks the primary and secondary device pairs. Both devices in any given pair must either be JES3 Managed or both be Non-JES3 Managed. In addition, the “to” device must be offline and not in use.

Determining if a device is JES3 managed

If you issue the **`*I D D=dddd`** command and it returns an answer, as in the following examples, then the device is JES3 managed:

```
*I D D=9607
```

```
IAT8572 9607 (AV ) SC64
IAT8572 9607 (AV ) SC70
IAT8572 9607 (OFF) SC65
 NOT OPR
IAT8500 INQUIRY ON DEVICES COMPLETE

*I D D=9E07
IAT8572 9E07 (AV ) SC64     ML9E07,JES=P,OS=P
IAT8572 9E07 (AV ) SC70     ML9E07,JES=P,OS=P
IAT8572 9E07 (AV ) SC65     ML9E07,JES=P,OS=P
 MOUNTED
IAT8500 INQUIRY ON DEVICES COMPLETE
```

If you issue the *I D D=dddd command and it says "`DEVICE NOT FOUND`," as in the following example, then the device is not JES3 managed:

```
*I D D=001
IAT8570 DEVICE=001      NOT FOUND
IAT8500 INQUIRY ON DEVICES COMPLETE
```

6.5.4 JES2 considerations

During a HyperSwap operation, it is possible that one or more z/OS images will be taken out of the sysplex if they fail to complete the HyperSwap operation.

If a system that is taken out of the sysplex is holding the JES2 checkpoint data set lock at that time, this may result in a damaged checkpoint record, and the following messages will appear in the Syslog:

```
$HASP265 JES2 CKPT1 Data Set — Damaged Record Detected
$HASP285 JES2 Checkpoint Reconfiguration Starting
$HASP275 Member xxxx — JES2 CKPT1 Data Set — I/O Error — Reason Code 00000090
```

To avoid the need to manually reconfigure new checkpoint data sets, always have a valid NEWCKPT1 and NEWCKPT2 definition in-place and that OPVERIFY=NO be specified in the checkpoint definitions. This can be verified by using the **`$CKPTDEF`** command.

6.5.5 HCD and IPL

All primary and secondary disks must be defined through the Hardware Configuration Dialog (HCD).

After a HyperSwap, all the z/OS images in the sysplex will be using the secondary disks as their *primary* disks (and all of their primary disks as their *secondary* disks). Any IPL that is needed after the HyperSwap should be done using the secondary disks instead of the primary disks. You must create IPL profiles in the HMC and procedures to be used when you need to IPL a z/OS image using the secondary disks.

The mirroring of primary disks to secondary disks means that the secondary disks will have the same VOLSER (name) as their primary partners. When the HyperSwap target volumes are being mirrored to, you cannot read or write from these volumes and therefore you cannot accidently IPL off the wrong set of volumes. However, immediately after a HyperSwap occurs, and before you restart mirroring in the reverse direction, both sets of volumes may be read from and written to.

If at this time you IPL a z/OS image using your secondary disks, and you still have connectivity to the primary disks, a lot of Duplicate Volser messages will be produced that you must reply to. Replying to each of these messages will drastically increase the time to IPL a z/OS image.

To reduce the likelihood of IPLing off the wrong volumes and to avoid these Duplicate Volser messages, follow one of the directions described in the following sections.

Alternate subchannel sets

The preferred way to reduce the likelihood of IPLing and using the wrong volumes is to use alternate subchannel sets.

With alternate subchannel sets, your primary devices are in one subchannel set (typically 0), and the secondary devices are in another subchannel set (typically 1 or 2).

All of the primary devices must be in one subchannel set, and all of the secondary devices must be in one other subchannel set. The device numbers of the primary and secondary devices must also be the same, so that for example, device 4500 would be device 04500 in subchannel set 0, and 14500 in subchannel set 1.

When you IPL, the LOADPARM information entered on the hardware console contains the name of the LOADxx member in SYSx.PARMLIB:

LOADPARM

IODF ccuu	LOADxx	IMSI	Alt Nuc
1 - 4	5 - 6	7	8

In LOADxx, you must specify the subchannel set you want to use:

```
*       IODF Suffix                                               *
*       |  IODF HLQ OS Config    Subchannel Set                   *
*       |  |       |             |                                *
*       V  V       V             V                                *
.*--+----1----+----2----+----3----+----4----+----5----+----6----+---
IODF     88 R17FTDIO CONFIG01 00 Y 0
```

When you IPL specifying a subchannel set of 1, this says that all the system is to use the devices in subchannel set 1 if they exist. For devices which are defined only in subchannel set 0 (for example, devices that are not mirrored), then the device defined in subchannel set 0 will be used.

So by specifying the correct IPL volume and the correct LOADPARM, you can avoid duplicate volser messages and accidentally using the wrong volumes.

Starting with z196 (GA2), you can specify a five digit IPL volume (that is, the subchannel set and device number). In this case you have the option of setting the subchannel set number in LOADxx to a value of "*", which means that we are to infer which subchannel set to use based on what you specified as the current IPL volume, (that is, if you IPLed from device 04500, then z/OS will use subchannel set 0, and if you IPLed from device 14500, subchannel set 1 will be used).

Valid values for subchannel set are 0, 1, 2, "*", and blank. If the subchannel set is blank, you will be prompted to enter the subchannel set you want to use.

Maintaining separate I/O configurations

If you do not have a processor that supports alternate subchannel sets, or if you are unable to use them, another method of dealing with this is to maintain two separate I/O configurations (IOCONFIGs in the IODF) in your HCD, one for IPL using the primary disks, and the other for IPL using the secondary disks, as follows:

- HCD I/O configuration for IPL from primary disks:
  - Primary disks defined as ONLINE at IPL
  - Secondary disks defined as OFFLINE at IPL
- HCD I/O configuration for IPL from secondary disks:
  - Primary disks defined as OFFLINE at IPL
  - Secondary disks defined as ONLINE at IPL.

Follow the rules in Table 6-3 in order to create two I/O configurations in the HCD.

Table 6-3 HCD configuration

IPL using	**primary addresses**		**secondary addresses**	
	primary disks	secondary disks	primary disks	secondary disks
HyperSwap volumes	ONLINE	OFFLINE	OFFLINE	ONLINE
CDS volumes (except the Logger)	ONLINE	ONLINE	ONLINE	ONLINE
non-HyperSwap volumes	as required	as requires	as required	as required

6.5.6 Allocation and esoteric names

Esoteric definitions such as SYSDA must specify both primary and secondary devices for allocations to succeed, regardless of which set of disks is currently considered *primary*.

6.5.7 Sysplex CDS

The Sysplex CDS must be allocated on disk volumes that are not HyperSwap managed (that is, in a HyperSwap session). The only exception to this rule is the System Logger CDSs. The Logger CDSs and logstreams must be on volumes defined in the copy sets of the HyperSwap session.

As you can see in Table 6-3, the volumes where the System Logger CDSs and logstreams reside must be defined as ONLINE at IPL in the HCD.

As a general rule for sysplex availability, the placement of the sysplex CDSs (except the Logger) must follow these rules:

- Primary CDS on primary disk
- Alternate CDS on secondary disk
- At least 1 spare CDS on primary disk and at least 1 spare CDS on secondary disk

For more information on system logger data set placement, see “Appendix A. Using the system logger in a Tivoli Storage Productivity Center for Replication for System z environment” in the *IBM Tivoli Storage Productivity Center for Replication for System z Version 5.1.1 - User's Guide”*, SC27-4054-01.

6.5.8 Hardware reserves

HyperSwap does not support hardware reserves on HyperSwap managed volumes. A HyperSwap session cannot be enabled if there is an outstanding hardware reserve against a device that is defined in the session.

Converting RESERVEs to Global ENQs

Basic HyperSwap does not allow HyperSwap managed volumes to hold reserves. All RESERVEs that target HyperSwap managed volumes must be converted to Global ENQs.

There is an ENQ/RESERVE/DEQ Monitoring Tool (ISGAUDIT) that can help you to identify the RESERVEs in your environment, and also help to identify and remove any EXCLusion runs that relate to HyperSwap managed disks. ISGAUDIT is shipped with z/OS, and MVS Planning: Global Resource Serialization, SA22-7600, describes how to use this tool. Run this tool from time to time on your production systems to ensure that there are no RESERVEs taken against your HyperSwap managed disks.

To ensure that all RESERVEs are converted, a PATTERN entry must be used to convert any RESERVEs to global ENQs. You must specify the conversion RNL as follows:

```
RNLDEF RNL(CON) TYPE(PATTERN) QNAME(*)
```

Move RESERVE

Although RESERVEs are not allowed, after the HyperSwap session has been enabled, it will manage the RESERVEs issued to primary devices by attempting to move those RESERVEs from the primary devices to their secondary device partners. However, if the event which triggered the HyperSwap was the loss of all paths from the system holding the RESERVE to the disk, the disk subsystem will clear the RESERVE which will potentially allow other systems to gain the RESERVE before HyperSwap can move it.

In addition, the scope of a HyperSwap is a single sysplex (or monoplex). HyperSwap will assure that all systems accessing HyperSwap managed devices have stopped using the old primaries, before swapping over to the old secondary (new primary). So if RESERVEs are actually being used to serialize devices between two or more Sysplex, there is no guarantee that both Sysplexes will swap at exactly the same time.

For these reasons, RESERVEs are not supported on HyperSwap managed devices.

Sharing volumes with systems outside the sysplex

The sharing of disk volumes with systems outside the sysplex usually requires the use of the hardware Reserve/Release mechanism to serialize the use of these volumes. HyperSwap cannot properly manage RESERVEs coming from outside the sysplex. Systems outside the sysplex are not aware when a HyperSwap takes place and will continue attempts to write to the old primary volumes. This can lead to data integrity exposures.

If you need to share disk volumes with systems outside the sysplex, you must exclude these volumes for the Basic HyperSwap session.

6.5.9 Concurrent Copy

Concurrent Copy is a copy function that allows you to obtain point in time copies of your data concurrent with your normal processing. It is normally invoked by DFDSS Dump or Copy jobs for backup purposes.

Concurrent Copy relies on information that it is stored in a sidefile in the primary disk subsystem cache. This information is not mirrored to the secondary disks. If a HyperSwap occurs when a Concurrent Copy job is running, this job will be terminated, and will have to be restarted after the HyperSwap operation completes.

Eliminate any Concurrent Copy usage if you plan to use Basic HyperSwap.

6.5.10 Cache Fast Write

Cache Fast Write (CFW) is a disk subsystem feature that allows the exploiters of this function to write temporary data to disk subsystem cache, but not to disk. DFSORT exploits this function. If Cache Fast Write is enabled on a PPRC primary, it is executed as a DASD Fast Write (DFW).

When an I/O is received that specifies CFW, it comes with a CFWID. This CFWID is compared to the one stored by the storage controller. If it does not match, the storage controller rejects the I/O and the sort job fails. This mechanism is designed to ensure that if the cache contents are lost, the job knows it. So if one of the CECs in the storage system fails, and you failover to the other, the sort jobs will fail because the cache contents has been lost. Similarly, if there is a HyperSwap to a different storage system, the CFWID will not match and the job will fail. In that case, there has not been any loss of data, but the job still fails. This is why CFW should be disabled.

When PPRC is active, even if CFW is not disabled, the storage system will not honor it; rather, it will convert CFW to DFW in the storage system. So disabling at the host does not change performance at all, it merely allows the sort job to survive the HyperSwap.

Applications that exploit Cache Fast Write include DFSORT and SyncSort.

Eliminate any exploitation of cache fast write if you plan to use HyperSwap.

6.5.11 Products that swap UCB pointers

Products such as the Softek Transparent Data Migration Facility (IBM TDMF®) product or the Innovation FDR Plug and Swap (FDR/PAS) product logically move volumes around by swapping UCB pointers.

Both TDMF and FDR/PAS support HyperSwap by temporarily preventing a HyperSwap from occurring while the perform their swap. Customers should assure that they are running a current version of these products which support HyperSwap.

z/OS Support for TDMF and FDR/PAS was provided in APAR OA26509 for z/OS Releases 9 and above.

The following levels are required:

- TDMF v5.2 or above
- FDRPAS V 5.4/76 or above

6.5.12 Automation

z/OS HyperSwap provides built-in active and passive monitoring of the devices participating in the Basic HyperSwap session.

z/OS HyperSwap automatically coordinates the swapping of primary and secondary devices across all of the z/OS images in the sysplex. z/OS HyperSwap only handles disk subsystem failures; it does not provide automation to handle z/OS image failures.

6.5.13 Audit trail

Messages concerning a HyperSwap are written to the z/OS SYSLOG and/or OPERLOG. z/OS HyperSwap messages all have an IOSHS prefix.

You can prevent very high-volume messages such as the IEA494I message from all being written to the SYSLOG/OPERLOG by using Message Flood Automation (see the MSGFLDxx PARMLIB member).

6.6 Use scenario

In this topic, we describe some details about HyperSwap utilization.

6.6.1 Setting up the HyperSwap session in Tivoli Storage Productivity Center for Replication

The setup of a HyperSwap session in Tivoli Storage Productivity Center for Replication is similar to the setup of a Metro Mirror session, except for the selection of HyperSwap policies. See 7.3, “Metro Mirror Single Direction session using the GUI” on page 287 for more details about the HyperSwap session creation and the addition of the Copy Sets to it.

Here we just give you some more details of the HyperSwap options. Figure 6-3 on page 231 shows the Basic HyperSwap Options menu:

- Disable HyperSwap:

  You can use this option to start the HyperSwap session with HyperSwap disabled. You can use this option for test purposes. You can enable HyperSwap later by modifying this option in the Session properties panel, or by issuing the **SETHS ENABLE** z/OS console command.

- On Configuration Error:

  These options specify what your sysplex should do when a member of the sysplex fails while attempting to load a new HyperSwap configuration:

  – Partition the systems out of the sysplex: Any systems that cannot load the new configuration will be reset. It will enter a *0B5 wait state*, and it will be partitioned out of the sysplex. You will have to re-IPL it.

  – Disable HyperSwap: This option disables HyperSwap when a new HyperSwap configuration cannot be loaded in any system in the sysplex.

  The default for this option is “Partition the systems out of the sysplex.” However, specify *“Disable HyperSwap”* when you are doing your tests in order to avoid unnecessary outages due to systems being reset due to a configuration error. As soon as you are skilled with this process of loading new configurations, you can change it back to “Partition the systems out of the sysplex.”

- On Planned HyperSwap Error:

  These options specify what should be done when a planned HyperSwap cannot be performed on any system in the sysplex. This may occur, for example, if one of the systems does not have access to all of the secondary devices or if one of the two address spaces is not running:

  – The first button specifies that if a system fails to complete a planned HyperSwap, it will be partitioned out of the sysplex. The other images will have their UCBs swapped by the HyperSwap operation.
  – The second button specifies that the HyperSwap operation will be backed out, and HyperSwap will be disabled.

  Choose the *Disable HyperSwap* option for planned HyperSwap errors.

- On Unplanned HyperSwap Error:

  These options specify how the sysplex should behave in case of an unplanned HyperSwap. The choices are the same as for a planned HyperSwap:

  – Partition the system that cannot complete the HyperSwap operation out of the sysplex: That system will enter a 0B5 wait state, and it will be partitioned out of the sysplex. You will have to re-IPL this system.
  – Back out the HyperSwap operation and disable it:

  Select the option to *“Partition the systems out of the sysplex.”* The other systems in the sysplex will survive the planned HyperSwap and will continue to run even if there is a crash in an entire disk subsystem box.

  It should be noted that at a point during the HyperSwap processing, even though the policy might be to back out, HyperSwap can no longer do this and assure data integrity. We call this “the point of no return.” For both planned and unplanned HyperSwap the “point of no return” is when we begin swapping UCBs. At this point, if one system is unable to confirm that it has switched to the target devices it is too late to go back to the primary, and any system not confirming it has successfully swapped must be partitioned out of the sysplex.

  Similarly, after the swap is complete, policy has no effect on how HyperSwap will respond to any errors detected. In this case HyperSwap knows that all systems have swapped to the correct devices, and that HyperSwap is now disabled. In this case we continue processing even if errors are detected or systems are no longer responsive, and rely on the appropriate error recovery. This error recovery may include, for example, an application terminating due to a permanent I/O error, or a system being partitioned out of the sysplex because it is unresponsive.

- Fail MM/GC if target is online:

  Check this option in order to avoid starting a HyperSwap session using secondary volumes that can be online to any system. Unchecking this option allows you to start the session even if there is a secondary volume online to another system, but the execution of a HyperSwap in such conditions can lead to unpredictable results.

If you are unable to start a HyperSwap session because of a secondary volume that is online, check the following possibilities:

1. Check each system in the sysplex to see if the device is online and if so, vary it offline
2. Often this is a result of a volume being shared outside the sysplex. Check to see if any of the systems outside the sysplex has the device online and if so, vary it offline.
3. The online state is determined by the storage system, not z/OS. The storage system will treat a volume as being online if their are paths established to the device. Therefore if the device is the “OFFLINE and Allocated to a System Component” state, then the storage system will view this as online.

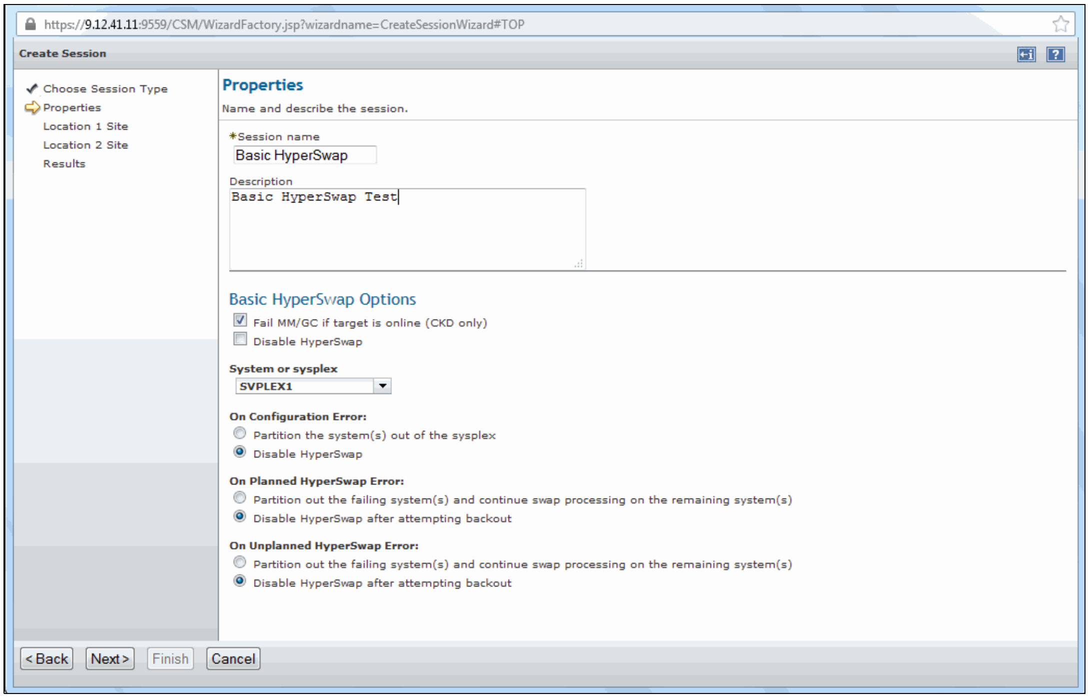

Figure 6-3 Basic HyperSwap Options

Establishing paths

Although Tivoli Storage Productivity Center for Replication can establish the paths between the logical subsystems automatically when you start a session, Define the paths manually, especially if your disk subsystem box is shared between sysplexes. You probably would want to dedicate more links to production sysplexes than for other sysplexes.

You should establish the paths manually in the reverse direction, from secondary to primary. After a HyperSwap, your secondary volumes will be the new *active primary* volumes and your primary volumes are now the *active secondary* volumes. You will need to start a session from your secondary volumes to your primary volumes to allow you to HyperSwap again.

6.6.2 HyperSwap phases

The execution of a HyperSwap operation can be described in phases. z/OS presents messages showing these phases, and the execution status of each phase. Example 6-1 shows a sample of these messages extracted from our system.

Example 6-1 HyperSwap execution messages

```
SETHS SWAP
IOSHM0400I 13:05:12.12 HyperSwap requested
IOSHM0424I Master status = 00000000 00000000 0000001600000000
IOSHM0401I 13:05:12.12 Planned HyperSwap started - Operator
IOSHM0424I Master status = 00000000 00000000 0000001601000000
IOSHM0402I 13:05:12.24 HyperSwap phase - Validation of I/O connectivity starting
IOSHM0424I Master status = 00000000 80000000 0000001602000000
IOSHM0403I 13:05:12.28 HyperSwap phase - Validation of I/O connectivity completed
IOSHM0404I 13:05:12.28 HyperSwap phase - Freeze and quiesce DASD I/O starting
IOSHM0424I Master status = 00000000 80000000 0000001603000000
IOSHM0405I 13:05:12.34 HyperSwap phase - Freeze and quiesce DASD I/O completed
IOSHM0406I 13:05:12.34 HyperSwap phase - Failover PPRC volumes starting
IOSHM0424I Master status = 00000000 80000000 0000001604000000
IOSHM0407I 13:05:12.42 HyperSwap phase - Failover PPRC volumes completed
IOSHM0408I 13:05:12.42 HyperSwap phase - Swap UCBs starting
IOSHM0424I Master status = 00000000 80000000 0000001605000000
IOSHM0409I 13:05:12.47 HyperSwap phase - Swap UCBs completed
IOSHM0410I 13:05:12.47 HyperSwap phase - Resume DASD I/O starting
IEA494I DD21,MLD821,PPRC PAIR SUSPENDED,SSID=89ED,CCA=21
IOSHM0424I Master status = 00000000 80000000 0000001606000000
IOSHM0411I 13:05:12.61 HyperSwap phase - Resume DASD I/O completed
IOSHM0429I 13:05:12.62 HyperSwap processing issued an UnFreeze
IOSHM0412I 13:05:12.62 HyperSwap phase - Cleanup starting
IOSHM0424I Master status = 00000000 80000000 0000001607000000
IOSHM0413I 13:05:12.80 HyperSwap phase - Cleanup completed
IOSHM0414I 13:05:12.80 Planned HyperSwap completed
```

These are the z/OS HyperSwap phases:

1. Validation of I/O connectivity:

   In this phase, z/OS checks connectivity to the secondary volumes. If all the images have connectivity to their secondary volumes, then HyperSwap proceeds. If one or more z/OS images fails this connectivity checking, the action that HyperSwap does depends on the HyperSwap options that you specified when you created the HyperSwap session in Tivoli Storage Productivity Center for Replication. See Example 6-1 on page 232.

   – If you had chosen to partition the systems out of the sysplex, every system failing connectivity validation enters a 0B5 wait state code and is partitioned out of the sysplex. HyperSwap proceeds on the remaining z/OS images.

   – If you had chosen to disable HyperSwap, the HyperSwap operation is backed out. Depending on the type of disk failure, this can lead to a sysplex outage.

2. Freeze and quiesce DASD I/O:

   z/OS internal routines send freeze commands to all of the logical subsystem pairs defined in the HyperSwap session. All I/O to these logical subsystems receive an Extend Long Busy status.

   Also, z/OS stops issuing I/Os to any primary disk volume.

3. Failover PPRC volumes:

   z/OS sends Failover commands to volume pairs defined in the HyperSwap session. The PPRC status for the former secondary volumes are changed from DUPLEX to PRIMARY SUSPENDED.

4. Swap UCBs:

   All z/OS images in the Sysplex swap certain contents of their UCB pairs.

5. Resume DASD I/O:

   z/OS resumes I/O requests to the new primary disk volumes (that is, the old secondary disk volumes). When this step is complete, the system and all applications will resume normal I/O activity.

6. Cleanup:

   In this phase, z/OS tries to release RESERVEs outstanding on the old primaries and perform other cleanup tasks.

6.6.3 Creating a Basic HyperSwap session

You may create a session at any time after the server code is installed and up and running. Again, a session is only a token with a name and certain attributes assigned to this session. This is always the same approach independent on the session type. At this point, you need to have storage subsystems defined to the Tivoli Storage Productivity Center for Replication server as described in "Adding IBM ESS or DS Storage Server to Tivoli Storage Productivity Center for Replication server" on page 137.

Figure 6-4 shows that you always start from *Health Overview* and click the hyperlink `Sessions`. This provides you with an overview of all defined sessions. Click **Create Session** to continue.

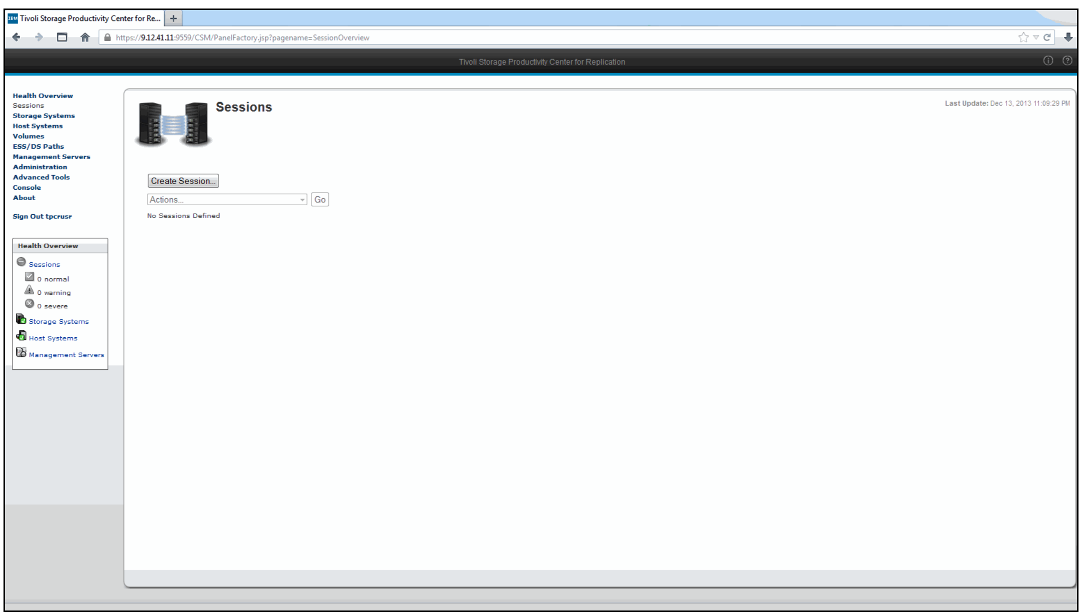

Figure 6-4 Query session through the Session hyperlink in Health Overview

Select the **Basic HyperSwap** session from the pull-down menu as shown in Figure 6-5. On the right side, a pictograph symbolizes the involved sites and their volume types. H1 represents Site 1 volumes and H2 represents Site 2 volumes. When you define Copy Sets this pictograph helps you to orient and understand replication direction. Click **Next** to continue.

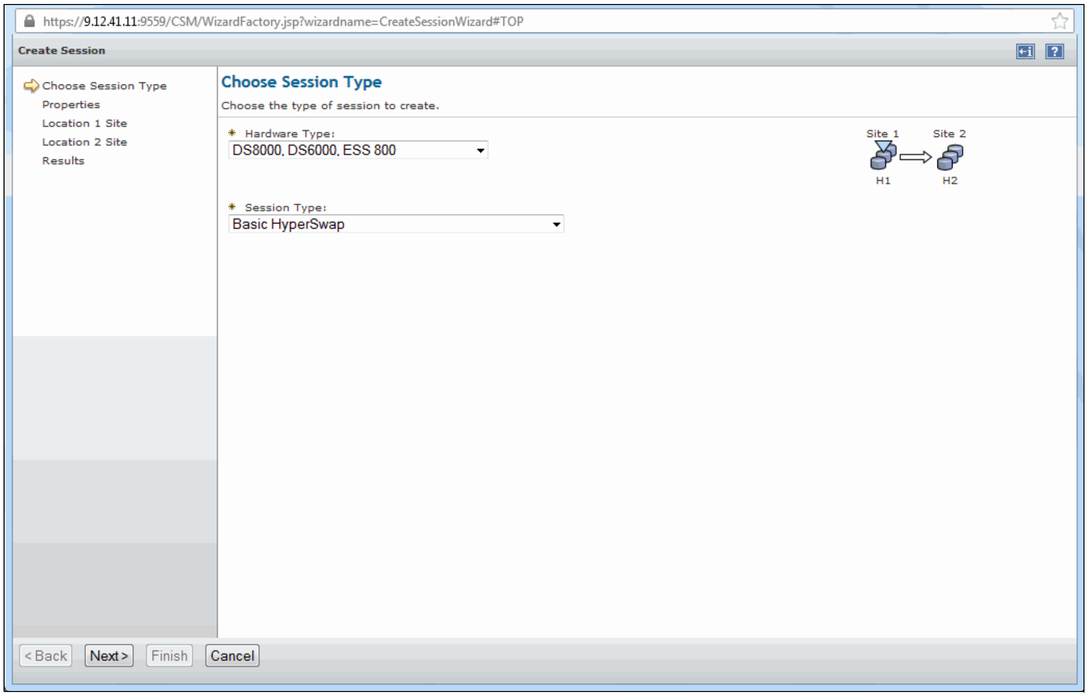

Figure 6-5 Define the Basic HyperSwap session

This leads us to the session Properties panel, as shown in Figure 6-6.

The *Properties* panel is also important because it requires that you specify a name for the session which is about to be created. Adding an optional *Description* is desirable, since the session name may not be sufficient to understand the purpose of the session. In Figure 6-6 we are showing our session definition.

You can choose the following options in a Base HyperSwap session:

- Disable HyperSwap (default: unchecked)
- On Configuration Error (for example when a new member fails to join the sysplex configuration):
  - Partition the systems out of the sysplex (default)
  - Disable HyperSwap
- On Planned HyperSwap Error:
  - Partition out the failing systems and continue swap processing on the remaining systems
  - Disable HyperSwap after attempting backout (default)
- On Unplanned HyperSwap Error:
  - Partition out the failing systems and continue swap processing on the remaining systems (default)
  - Disable HyperSwap after attempting backout
- Fail MM/GC if the target is online (CKD only): This option fails any session commands for a copy set if the target volume in the copy set is online to a host (default: checked).

For the Basic HyperSwap Options On Configuration Error, initially select Disable HyperSwap. Do **not** select **Partition the systems out of the sysplex** until after you have tested your HyperSwap configuration. When partitioned out of the sysplex, the systems will be reset.

After selecting the Basic HyperSwap Options as shown in Figure 6-6, click **Next** to define the location sites. See Figure 6-6.

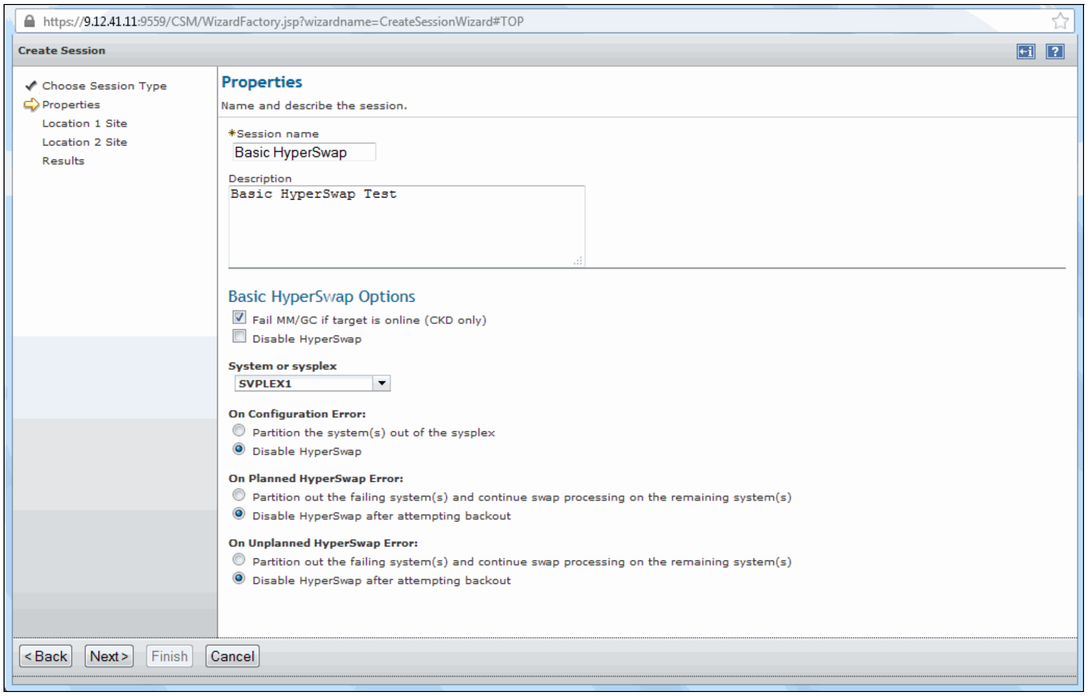

Figure 6-6 Define Basic HyperSwap - Properties

From the pull-down **Site 1 Location** menu (see Figure 6-7) select the location of your H1 storage subsystem previously defined in "Adding IBM ESS or DS Storage Server to Tivoli Storage Productivity Center for Replication server" on page 137 and click **Next** to continue.

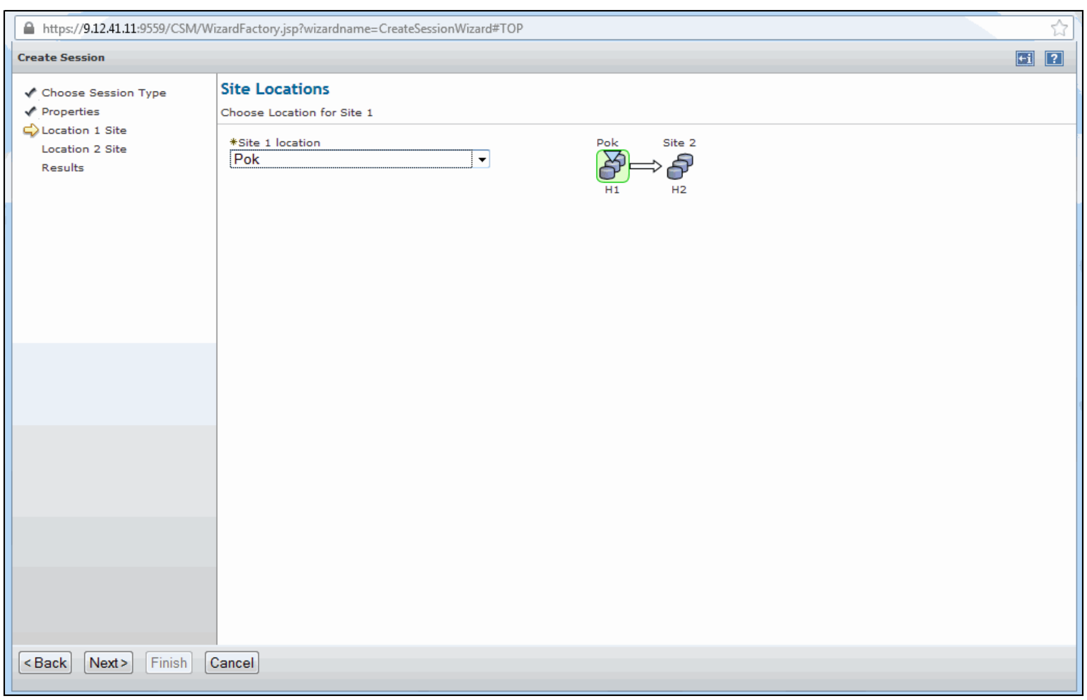

Figure 6-7 Define Basic HyperSwap session Site 1 Location

From the pull-down **Site 2 Location** menu (see Figure 6-8), select the location of your H2 storage subsystem previously defined in "Adding IBM ESS or DS Storage Server to Tivoli Storage Productivity Center for Replication server" on page 137 and click **Next** to continue.

> **Note:** In our example, we are going to create a Basic HyperSwap session inside one DS8000 storage system. That is the reason why Site 1 and Site 2 location logical names are the same. In a production environment, you would have one or more pairs of storage systems. Your "Site 1" location would contain your primary storage systems and your "Site 2" location would contain your target storage systems.
>
> In a HyperSwap environment, both "locations" may actually reside on the same site. In this case, you still want to treat them as two different locations. So you will want name the locations appropriately, for example, "Raised Floor - North" and "Raised Floor - South" if on the same raised floor, or "Building 300" and "Building "500" if both are on the same campus.

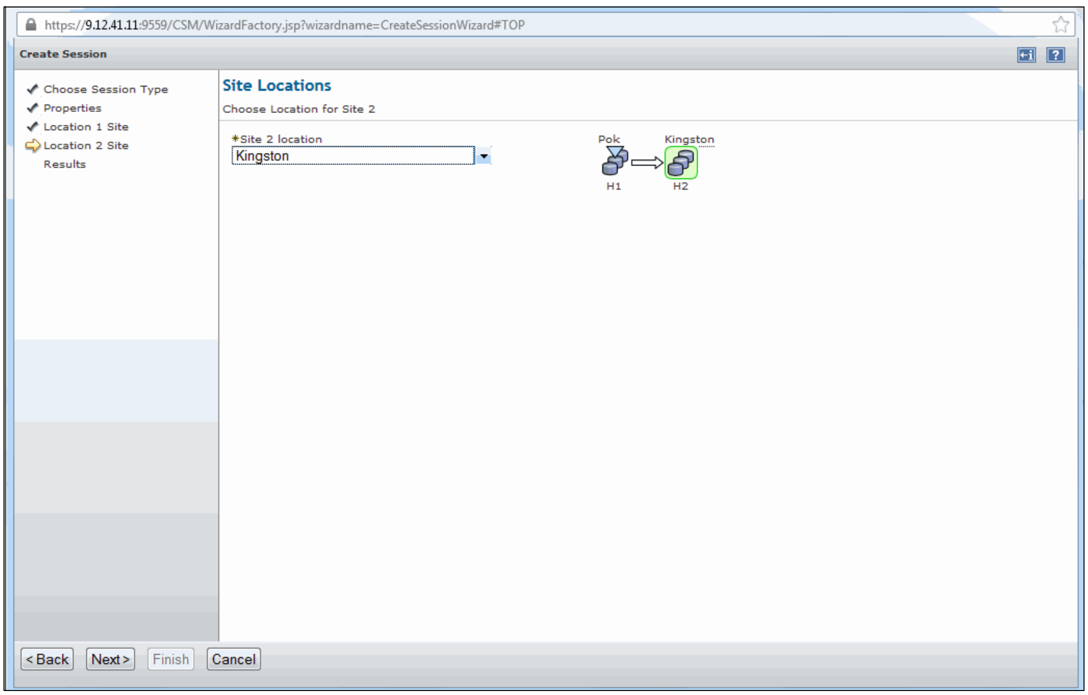

Figure 6-8 Define Basic HyperSwap session Site 2 Location

Figure 6-9 displays the message that the "Basic HyperSwap" session was successfully created. At this stage, you can click **Finish** to exit the *Create Session* wizard.

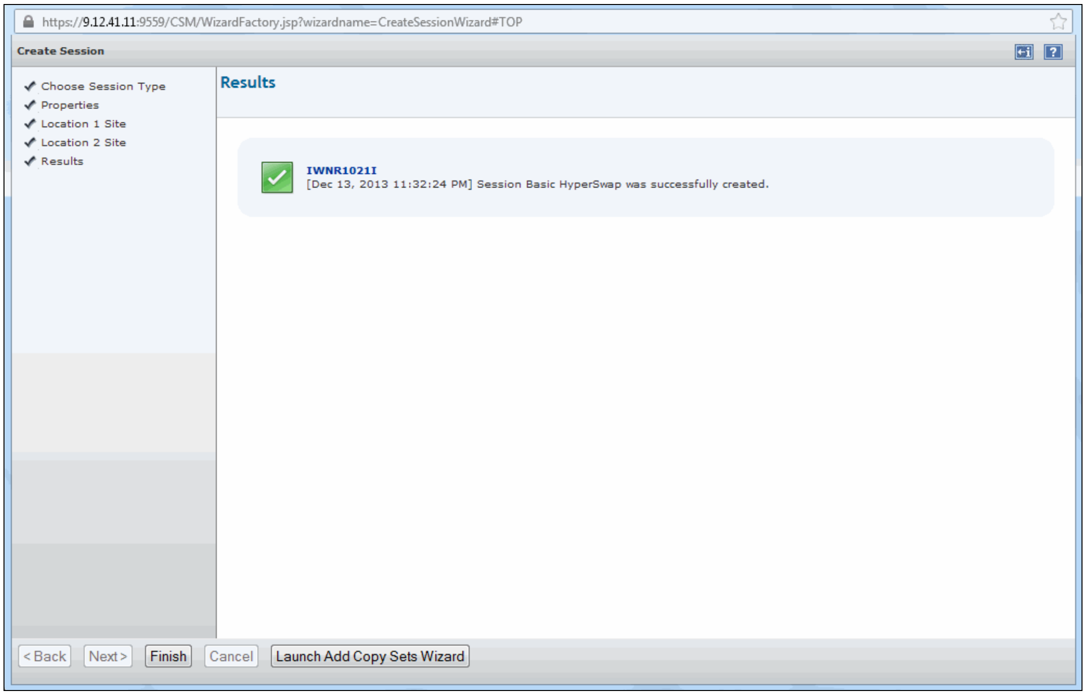

Figure 6-9 Define Basic HyperSwap session - Results

Alternatively, you have an option to add Copy Sets and click the **Launch Add Copy Sets Wizard** as in our example. Then follow the instructions described next in 6.6.4, "Adding Copy Sets to a Basic HyperSwap session".

6.6.4 Adding Copy Sets to a Basic HyperSwap session

After we have defined the Basic HyperSwap session *"Basic HyperSwap,"* we are ready to populate it in the next step with Copy Sets. The source volume and target volumes that contain copies of the same data are collectively referred to as a Copy Set. In a Basic HyperSwap session, a Copy Set consists of one H1 and one H2 volume.

Note that over time, various terminology is introduced for the same thing. Peer-to-Peer Remote Copy or PPRC (known today as Metro Mirror or Global Mirror) started out with primary volumes and secondary volumes. This terminology was fine for a while, but it could sometimes be ambiguous. For example, after a HyperSwap, the volume you swapped to became the primary volume and your old primary became your secondary volume. To help with this problem, Tivoli Storage Productivity Center for Replication introduced a different terminology for these PPRC volumes and their association to a certain site. Host 1 (H1) refers to the host accessible volumes at Site 1, or your preferred primary site.

Some session types, such as Global Mirror contains volumes that should never be accessed by a host. For example, Global Mirror has Journal (J2) volumes at site 2. In Tivoli Storage Productivity Center for Replication terminology, the identification of the volume, H1 or H2 never changes. Instead we say that H1 is the currently the primary volume, or after a HyperSwap that H2 is the primary volume and H1 is now the secondary volume.

Figure 6-10 shows the first panel of the *Add Copy Sets* wizard, which can be invoked from the last panel of Create Session wizard (see Figure 6-9) or from the Tivoli Storage Productivity Center for Replication *Sessions* home page by clicking your session and selecting **Add Copy Sets** from the pull-down menu. It provides details on the primary volumes or local volumes, which are called Host 1 volumes. These are all synonyms and refer to the same environment. Select the desired **Host 1 storage subsystem** from the pull-down menu and wait for to get the **Host 1 logical storage subsystem** list. Select the LSS where your H1 volume resides. After the LSS has been selected, choose the appropriate volumes from the **Host 1 volume** pull-down list.

You also have the option of selecting an entire LSS or storage subsystem at a time (see the following discussion).

The alternative way to add a large number of volumes to this session is to create CSV file as explained in "Using CSV files for importing and exporting sessions" on page 194. In case you have CSV file ready, select the **Use a CSV file to import copysets** check box and provide a path to your CSV file. Note that when importing copysets from a saved CSV file, the session types must be the same.

In our example, we used the following procedure:

1. We selected the DS8000 disk subsystem and appropriate volume as shown in Figure 6-10. Click **Next** to continue.

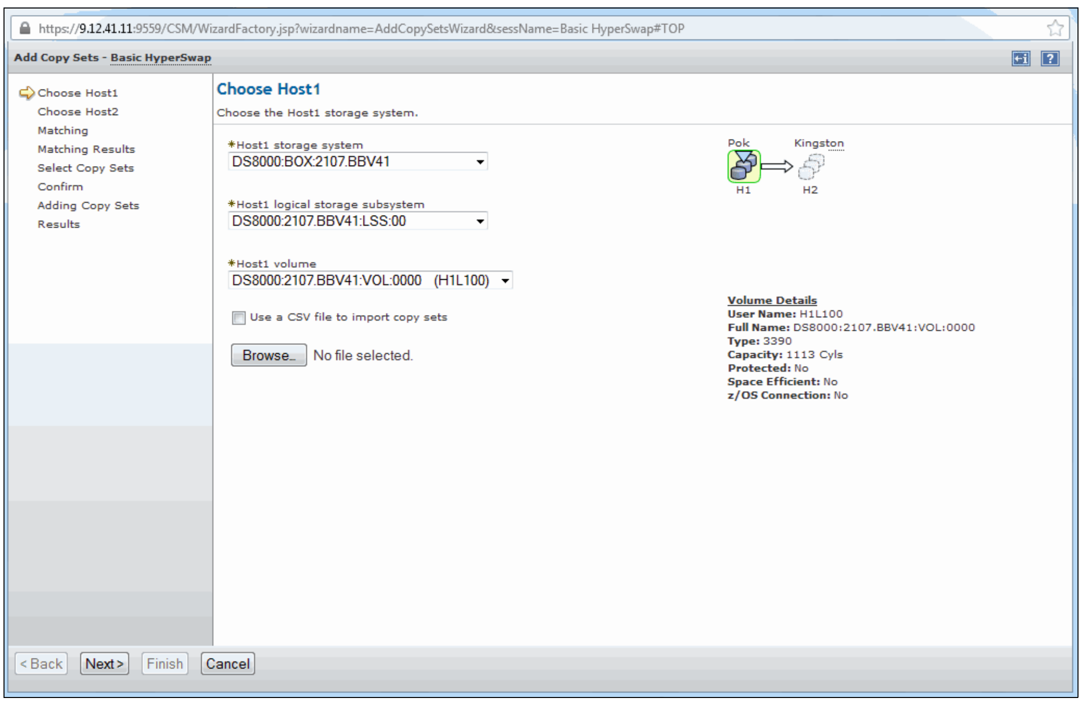

Figure 6-10 Add Copy Sets to a Basic HyperSwap session - Choose Host 1

2. In case you want to define all volumes within a certain LSS for this session, there is an option to select **All Volumes** from the **Host1 volume** list as shown in Figure 6-11. Click **Next** to continue.

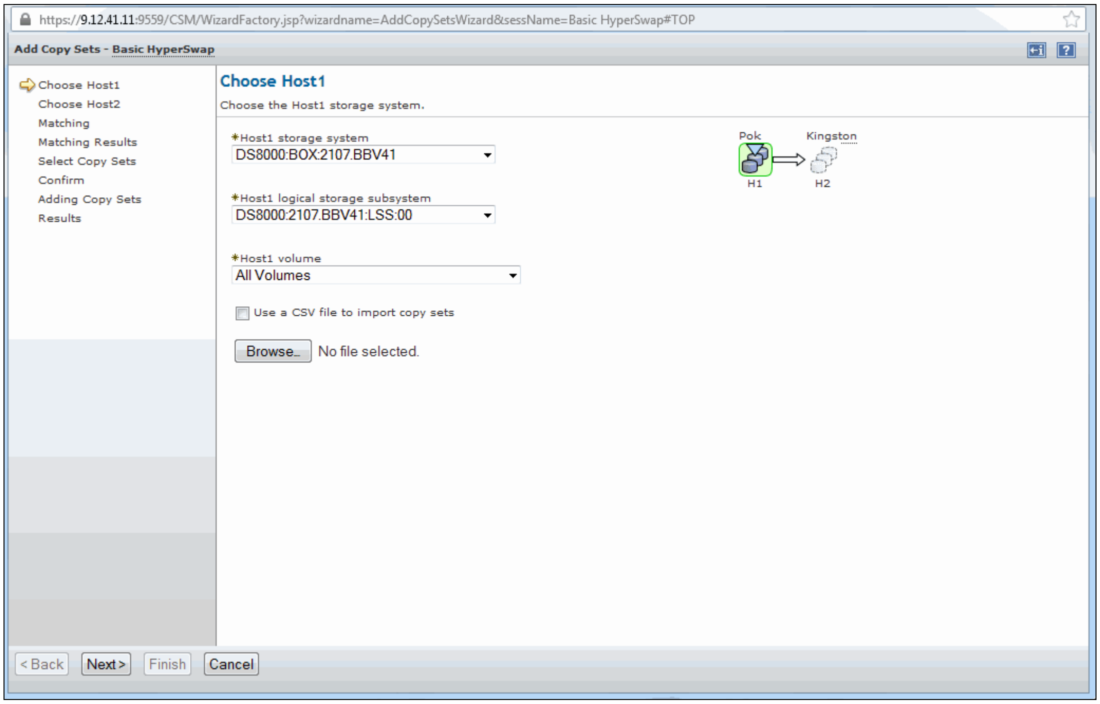

Figure 6-11 Add Copy Sets to a Basic HyperSwap session - Choose Host 1 and All Volumes option

3. The next step is to define Site 2 storage subsystems and volumes as shown in Figure 6-12. Select the desired **Host 2 storage subsystem** from the pull-down menu and wait for the **Host 2 logical storage subsystem** list. Select the LSS where your H2 volumes resides.
4. If **All volumes** for a given LSS were selected in the previous step while defining Host 1 volumes, you do not have an option to select any volume from **Host 2 volumes** list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 1 storage subsystem with all volumes from selected LSS in Host 2 storage subsystem. In our example, we selected **All Volumes** in the *Choose Host1* panel. Click **Next** to continue.

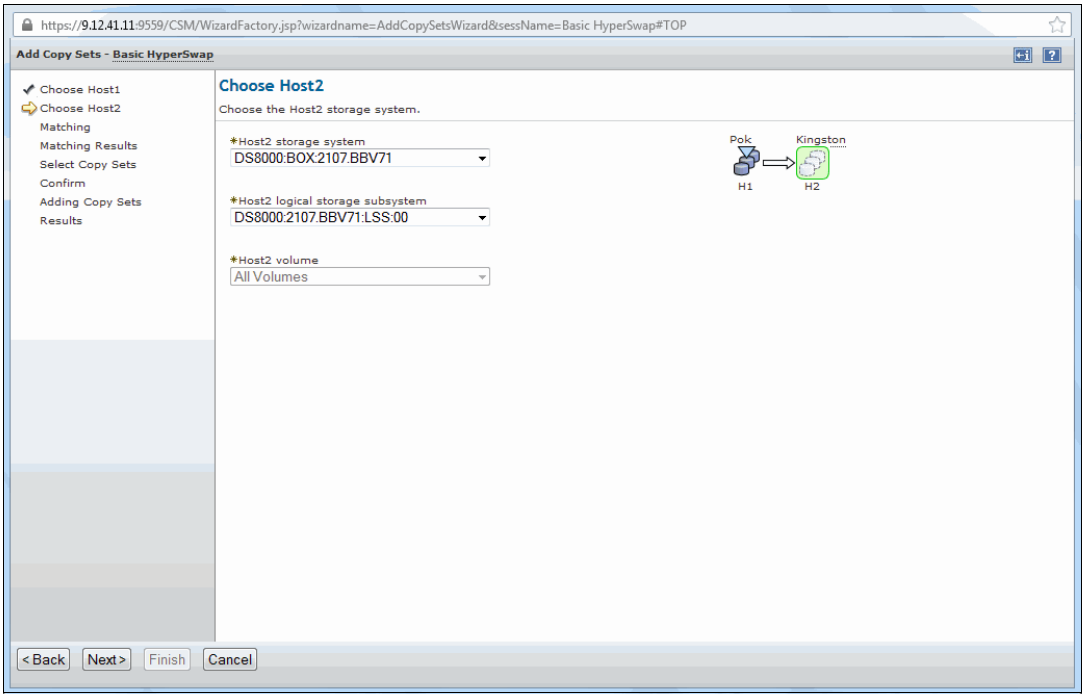

Figure 6-12 Add Copy Sets to a Basic HyperSwap session - Choose Host 2 and All Volumes option

5. The panel shown in Figure 6-13 is a confirmation that Copy Set matches were successfully created.

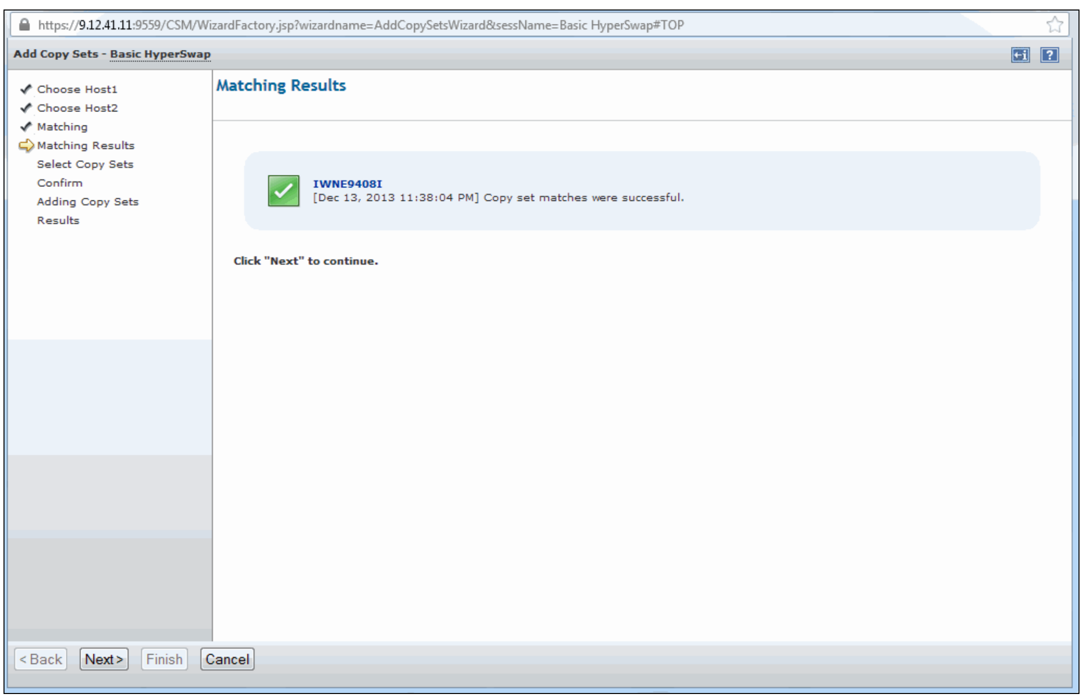

Figure 6-13 Add Copy Sets to a Basic HyperSwap session - Matching Results

6. The next panel in Figure 6-14 displays a message with regard to the matching results. In our example we have a message that all copy sets matching were successful. However, you may see warning messages for one of the following reasons:
   – The number of volumes at Host 1 storage subsystem LSS and the Host 2 storage subsystem LSS are not the same.
   – The volumes at Host 1 storage subsystem LSS are a different size then Host 2 storage subsystem LSS volumes.
   – The volumes are not the same type (that is, ECKD versus SCSI).
   – The Host 1 or Host 2 storage subsystems and volumes are already defined in some other copy services session.
7. The warning message does not mean the failure of Copy Sets creation. Click **Next** to see the list of available Copy Sets.

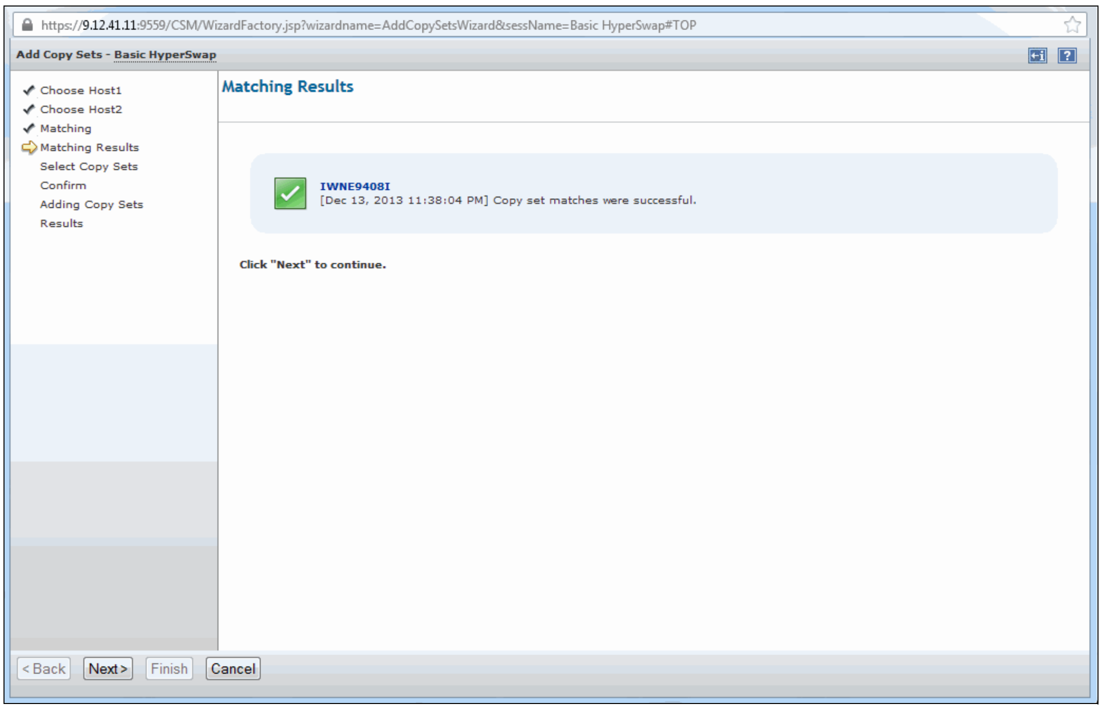

Figure 6-14 Add Copy Sets to a Basic HyperSwap session - Matching Results

8. All copy sets volumes that met the matching criteria are automatically selected. You still have a chance to modify the current selection and deselect any of the volume pair included in the list. The *Show* hyperlink next to each matching volume pair provides Copy Set information. We selected only one copy set as shown in Figure 6-15. Click **Next** to continue.

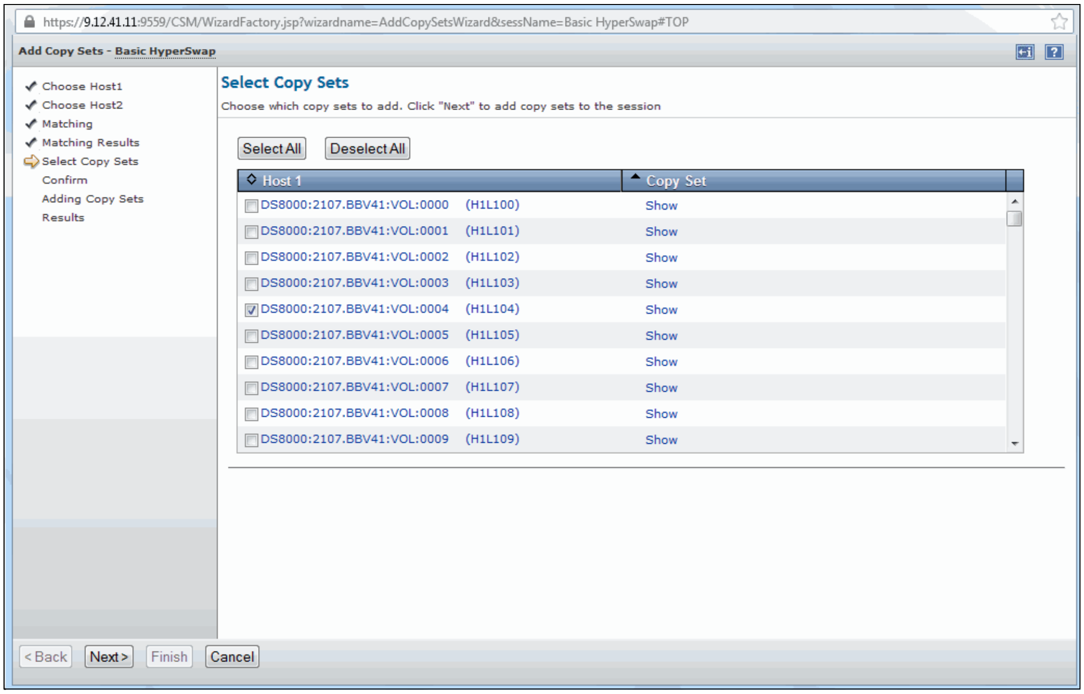

Figure 6-15 Add Copy Sets to a Basic HyperSwap session - Select Copy Sets

9. The next panel displays the number of copy sets that are going to be created as well as the number of unresolved matches (or not selected) as shown in Figure 6-16. Click **Next** to continue.

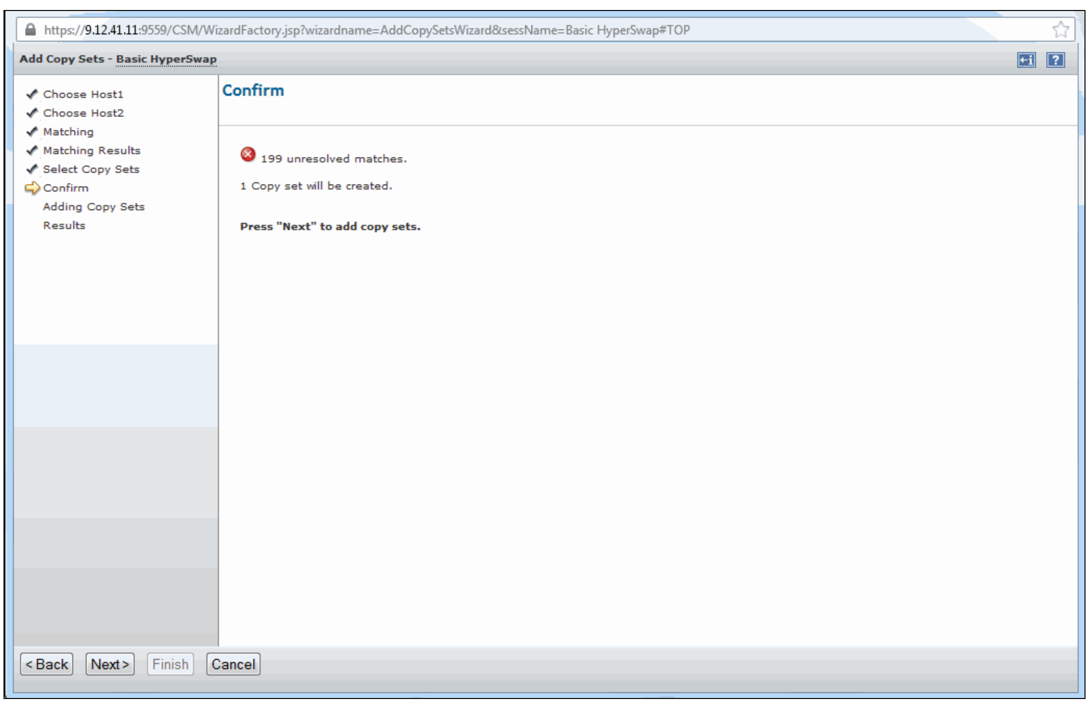

Figure 6-16 Add Copy Sets to a Basic HyperSwap session - Confirm

10. Tivoli Storage Productivity Center for Replication internally adds that copy set to its database and you can monitor it via a progress panel that reports the number of copy sets added to the Tivoli Storage Productivity Center for Replication inventory database. Note that this does not establish HyperSwap copy pairs. It is just a Tivoli Storage Productivity Center for Replication internal process to add this copy set to the Tivoli Storage Productivity Center for Replication inventory database.
11. After a few seconds, the progress panel reaches 100% and leaves the *Adding Copy Sets* panel and progresses to the next panel shown in Figure 6-17. Click **Finish** to exit the *Add Copy Sets* wizard.

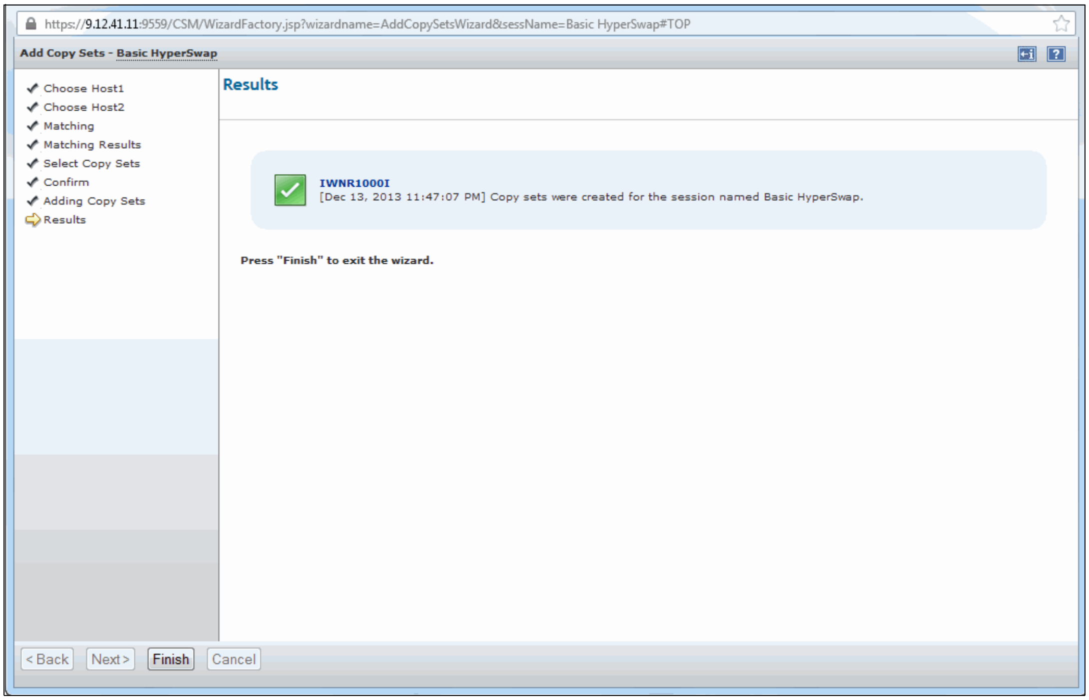

Figure 6-17 All Copy Sets are successfully added to the Tivoli Storage Productivity Center database

12. After the copy set is successfully added to the *"Basic HyperSwap"* session, the session status is still *Inactive* but in *Defined* state as shown in Figure 6-18.

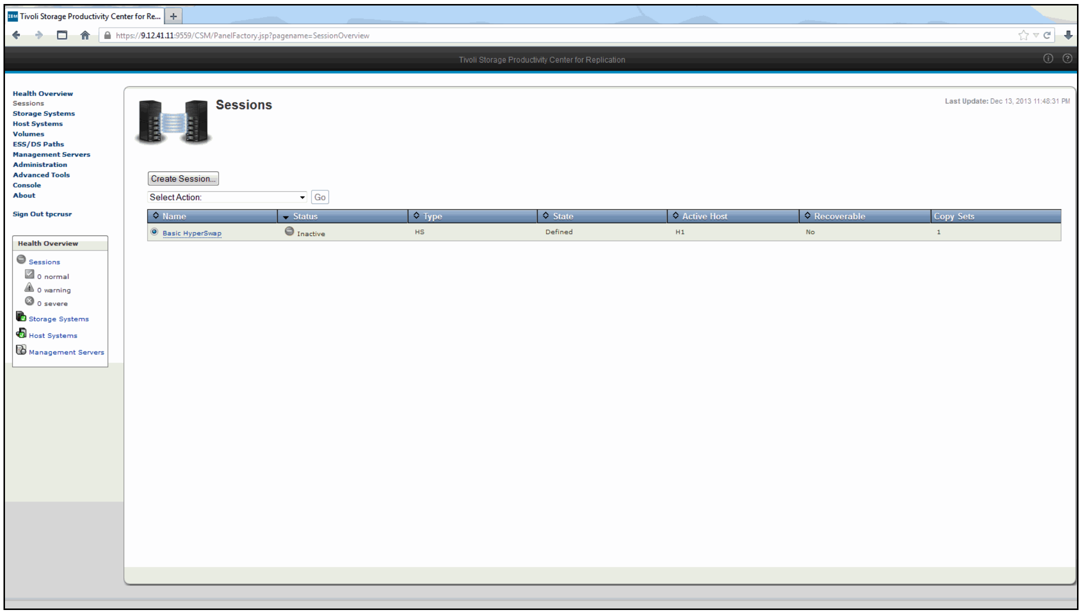

Figure 6-18 "Basic HyperSwap" session status

This concludes the session definition procedure via the GUI. You are ready to start the session as explained in the following section, 6.6.5, "Starting H1->H2 in a Basic HyperSwap session".

6.6.5 Starting H1->H2 in a Basic HyperSwap session

After we have defined a Basic HyperSwap session and populated the session with Copy Sets, we can start the HyperSwap session (assuming that you have enabled Basic HyperSwap on z/OS as described in 6.6.1, "Setting up the HyperSwap session in Tivoli Storage Productivity Center for Replication" on page 229.

Figure 6-19 displays the "Basic HyperSwap" session as we defined it previously. We defined one copy set in our example. Both Host 1 and Host 2 storage subsystems LSS pairs reside in a single DS8000 storage subsystem defined in *Pok* location.

Initially the HyperSwap session can only be started in the direction from Host 1 to Host 2. To start it, proceed as follows:

1. From the **Select Action** pull-down menu, select **Start H1->H2** and click **Go** (see Figure 6-19).

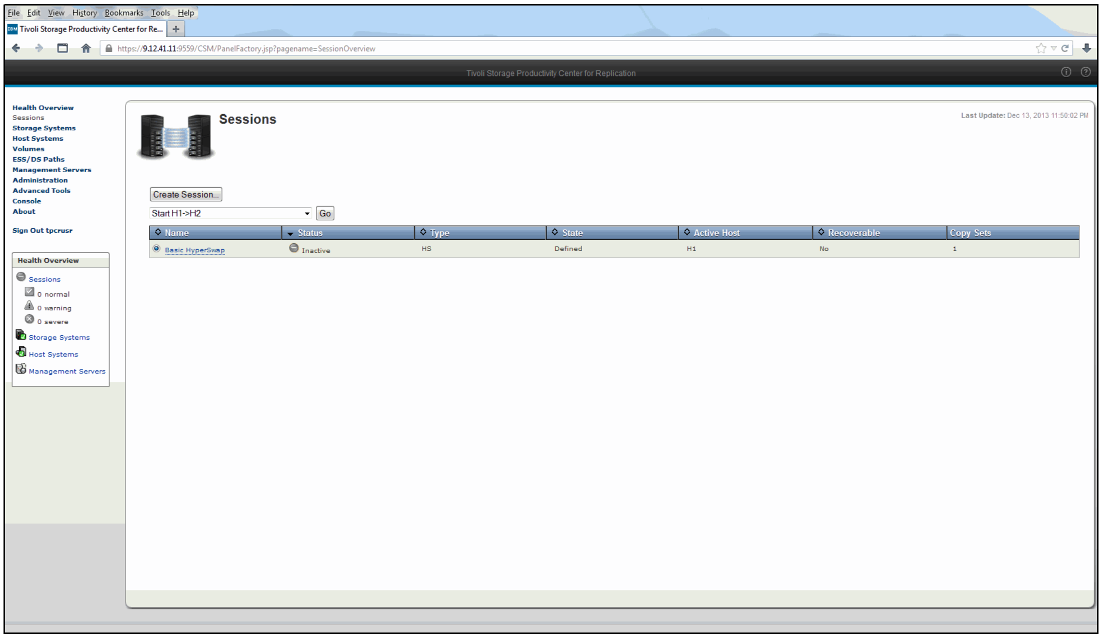

Figure 6-19 Basic HyperSwap session - Start H1->H2 Action

2. The next message shown in Figure 6-20 is a warning that you are about to initiate a basic HyperSwap session that will copy over the H2 volumes. This action established the Metro Mirror relationships between the H1 and H2 volumes. After the relationship is established, copying of data from Site 1 to Site 2 will overwrite all data on H2 volumes.
3. Click **Yes** to continue.

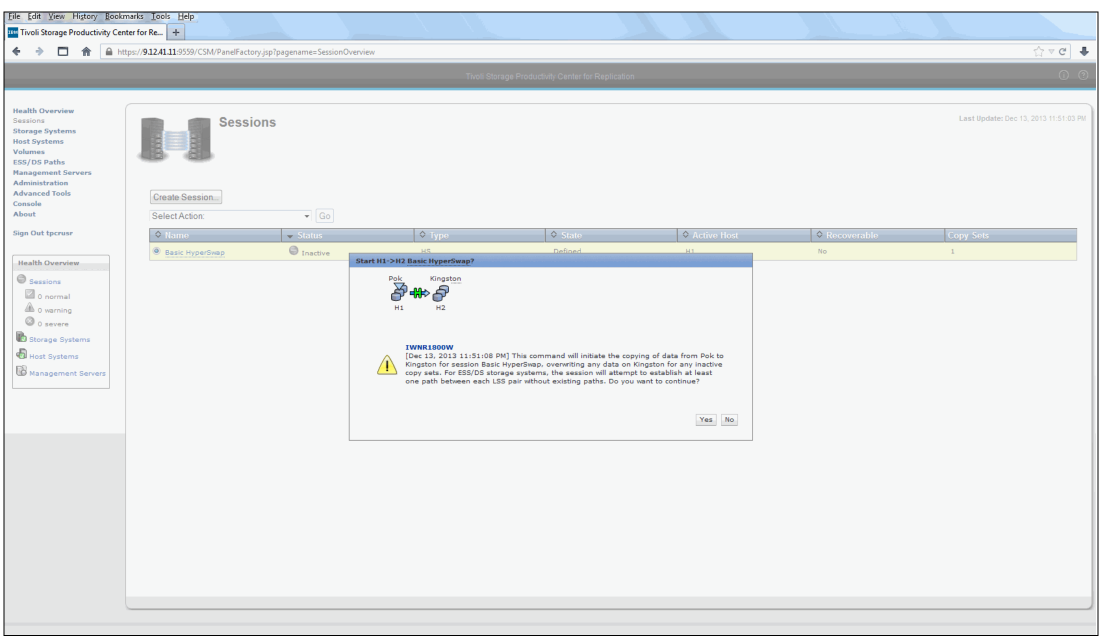

Figure 6-20 Start H1->H2 Basic HyperSwap session

4. The message at the top of the panel in Figure 6-21 confirms that start of the Basic HyperSwap session is completed. The session is in *Preparing* state and *Warning* status. Click the session name hyperlink (**`Basic HyperSwap`** in our example) to find more details about this session.

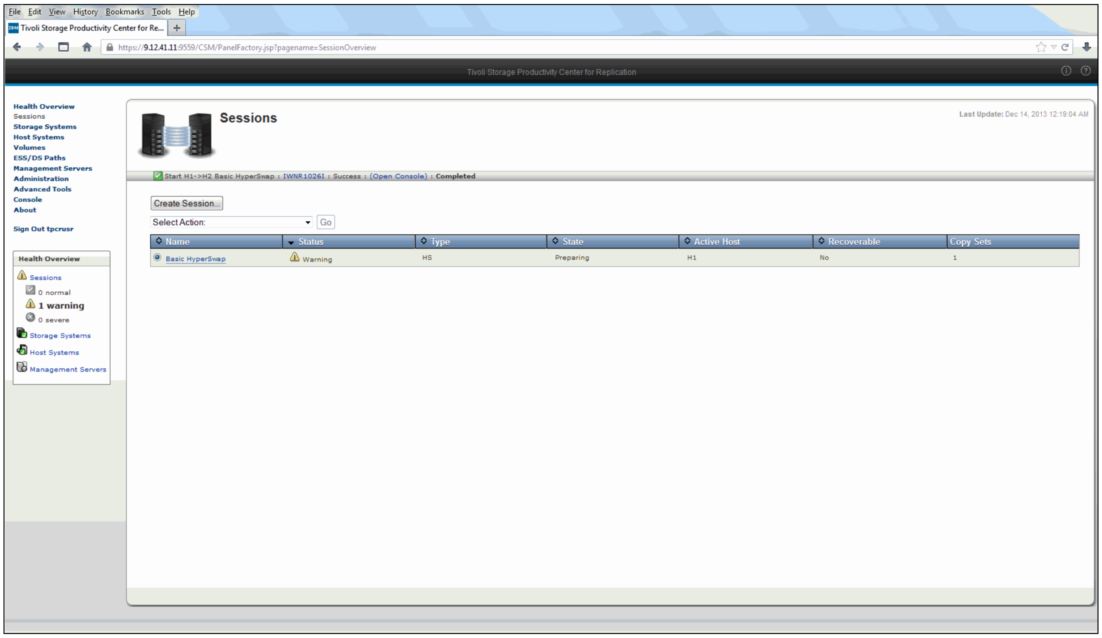

Figure 6-21   Start of HyperSwap session is reported as Completed

5. As shown in Figure 6-22, the Basic HyperSwap session status has changed to *Normal* and there are no errors. The copy progress between H1 and H2 volumes has reached 100%.

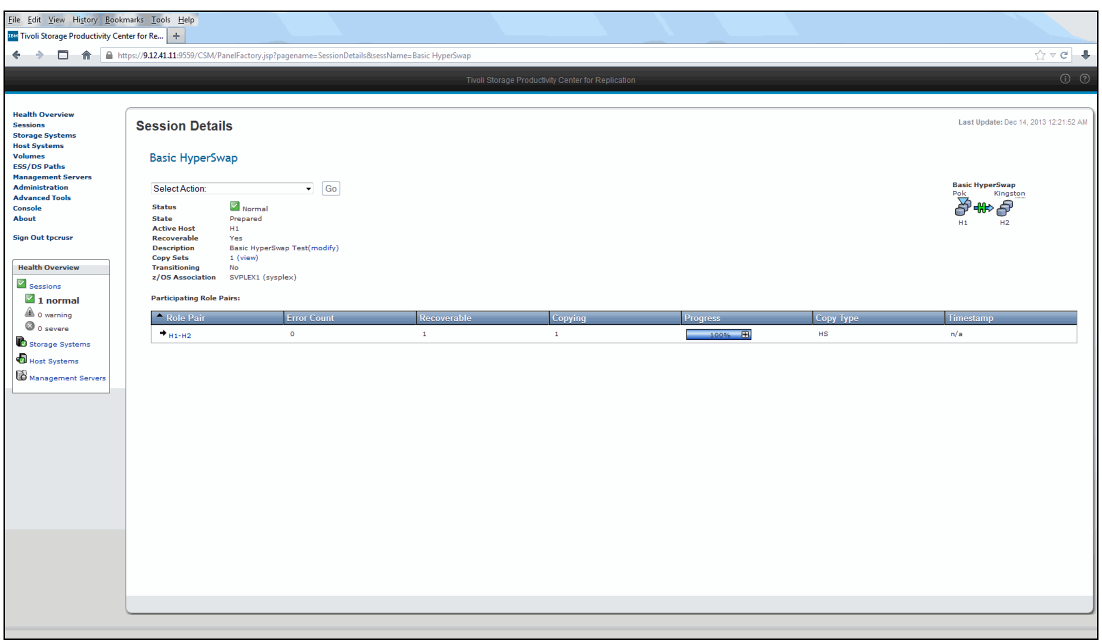

Figure 6-22   HyperSwap session details

After the Basic HyperSwap session is started and it has *Normal* status and is in *Prepared* State, the following options are available:

HyperSwap: Causes a site switch, equivalent to a suspend and recover for a Metro Mirror with Failover/Failback. Because of this, individual suspend and recover actions for HyperSwap session are not available.

Start H1->H2: Starts Metro Mirror relationship (synchronous full copy) between H1 and H2 volumes.

Stop: Stops copying with inconsistent target volumes.

6.6.6 HyperSwap command

During the H1 to H2 data replication direction, the **`HyperSwap`** command swaps the application I/O between the H1 volumes in the session with the H2 volumes in the session. Proceed as follows:

1. From the *Sessions* panel, select your HyperSwap session radio button and **HyperSwap** from the **Select Action** pull-down list and click **Go** as shown in Figure 6-20.

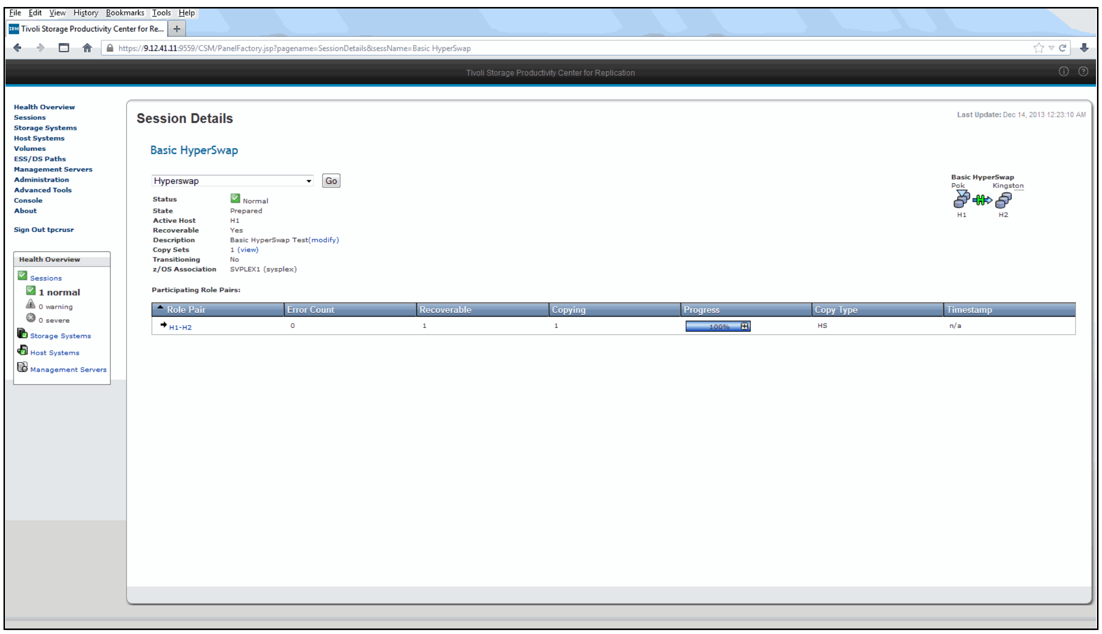

Figure 6-23 Basic HyperSwap session - HyperSwap Action

2. The next message shown in our example in Figure 6-24 is a warning that you are about to move application I/O from H1 volumes to H2 volumes since the current data replication direction is from H1 to H2 volumes. In the case that the **HyperSwap** action is invoked on a Copy Set with the data copying from H2 to H1 volumes, the warning message will indicate that you are about to move application I/O from H2 volumes to H1 volumes. Click **Yes** to continue.

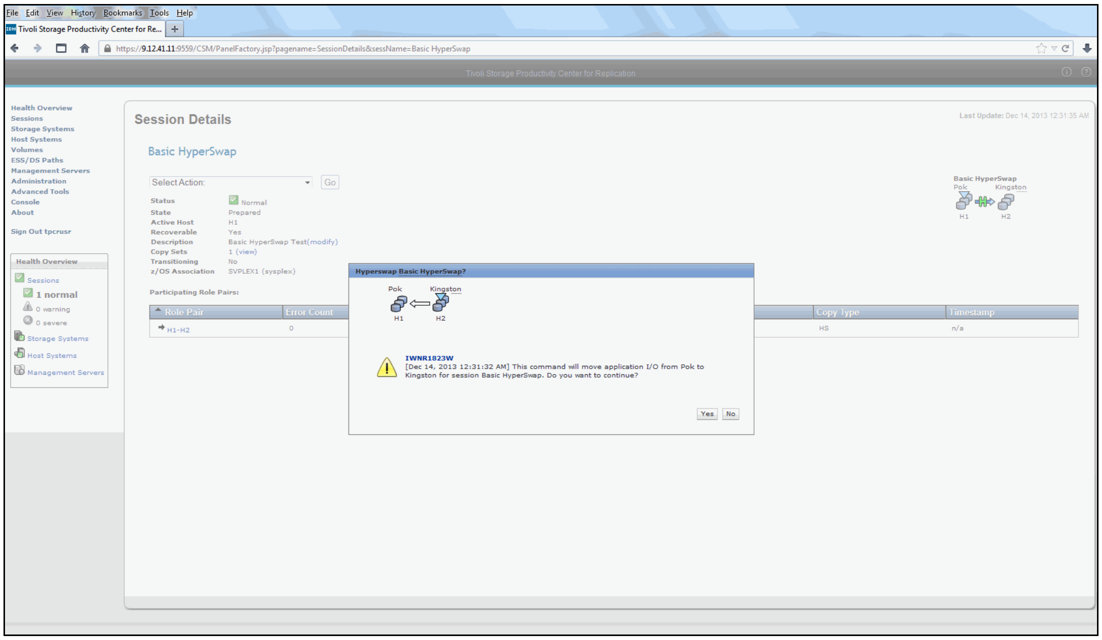

Figure 6-24 Basic HyperSwap session - confirm to initiate HyperSwap

3. The status of our Basic HyperSwap session has still *Normal* status but the state is *Target Available* as indicated in Figure 6-25. Both H1 and H2 volumes are suspended (data is not copied between H1 and H2 volumes). H2 is available to host (online), while H1 is not available to host (offline).

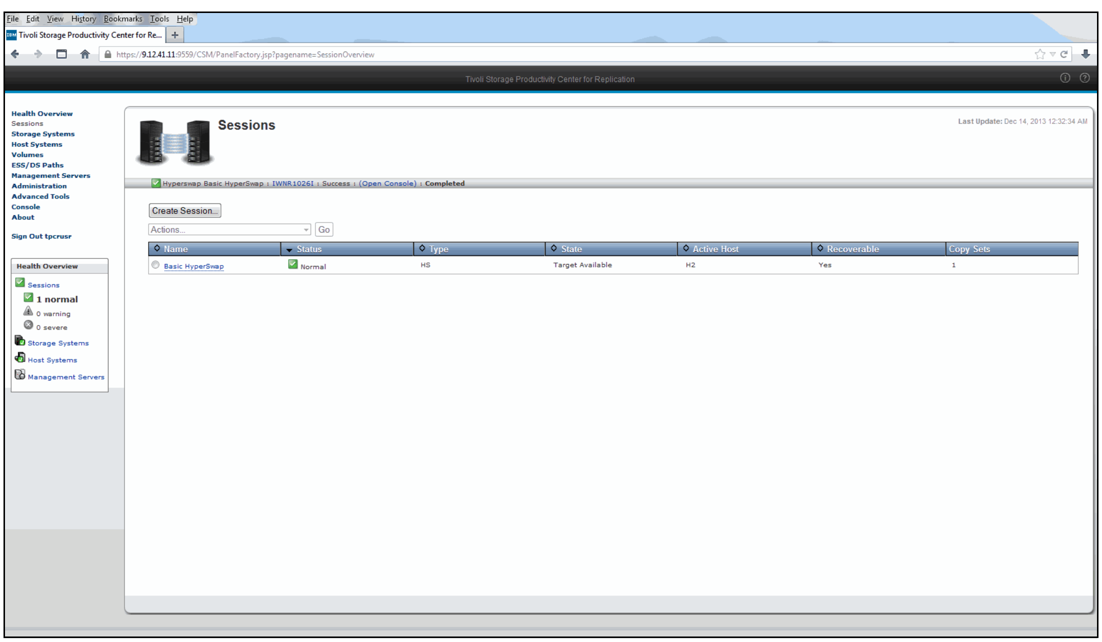

Figure 6-25 Basic HyperSwap session - HyperSwap is reported as Completed

4. Click the session name hyperlink (**`Basic HyperSwap`** in our example) to find more details about this session as shown in Figure 6-26. There is a timestamp for the H1-H2 pair indicating when the session was swapped. It can be used as a reference.

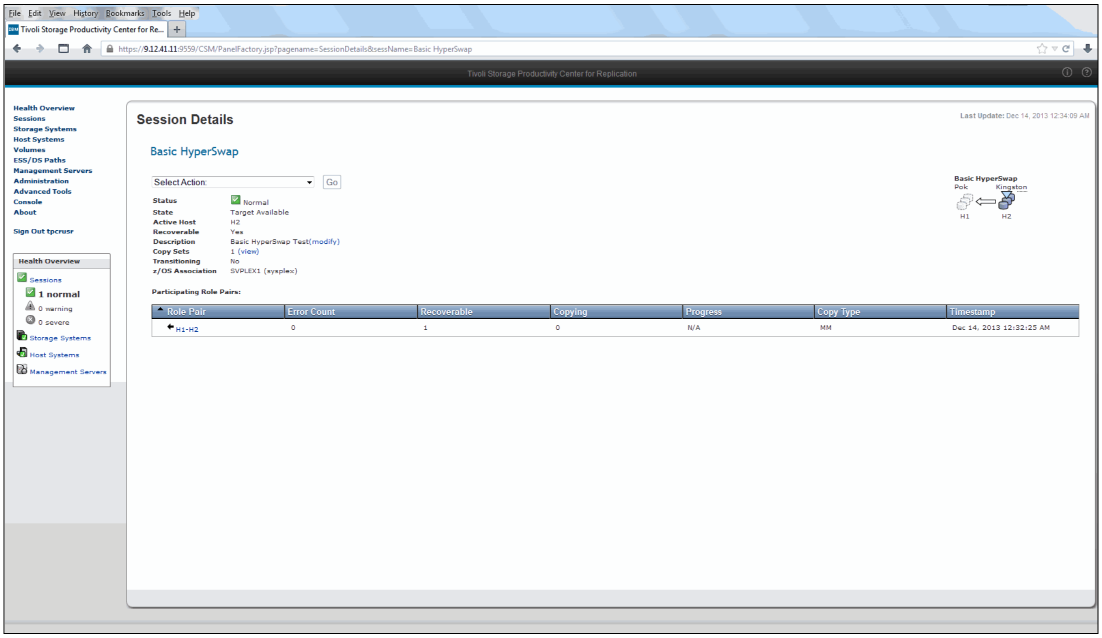

Figure 6-26 Basic HyperSwap session - Details

After the Basic HyperSwap session has *Target Available* state for H2 volumes, the following option is available:

- **Start H2->H1**: This will restart copying from H2 to H1 volumes in a Metro Mirror session.

6.6.7 Starting H2->H1 in a Basic HyperSwap session

This action is used whenever you are ready to start data replication back to the H1 volumes. In order to initiate data copying between H2 and H1 volumes, proceed as follows:

1. Select **Start H2->H1** from the **Select Action** pull-down menu and click **Go** as shown in Figure 6-27.

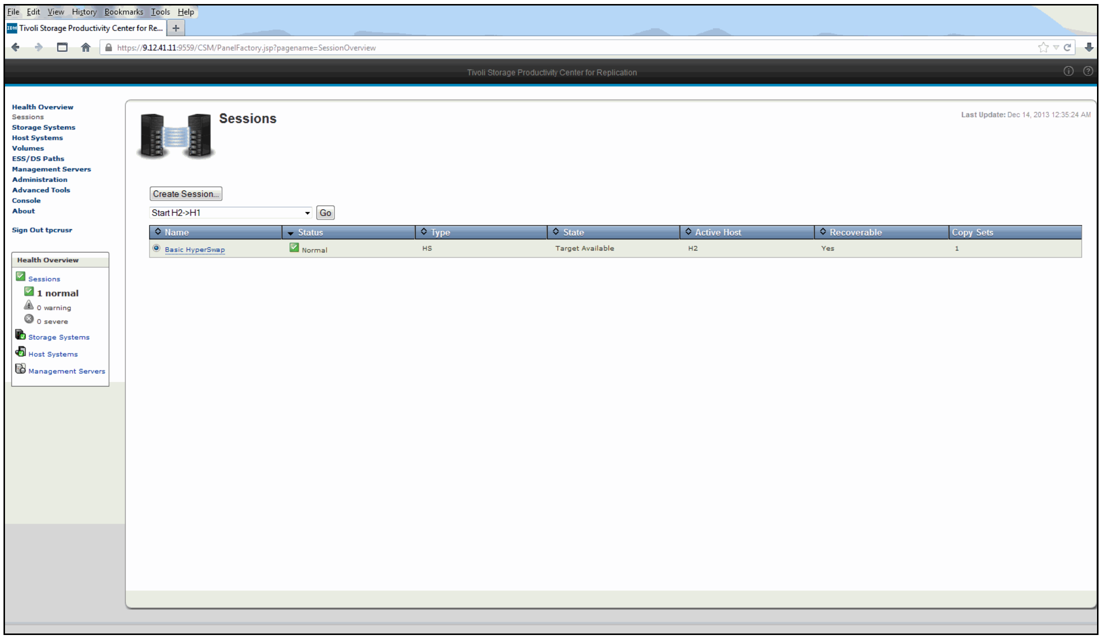

Figure 6-27 Basic HyperSwap session - Start H2->H1 Action

2. The next message shown in Figure 6-28 is a warning that you are about to initiate Metro Mirror between H2 and H1 volumes. Click **Yes** to continue. When the HyperSwap was initiated, the H2 volumes started keeping track of the changed tracks, so when copying resumes only changed tracks will be copied. There will be no need to perform full volume copies.

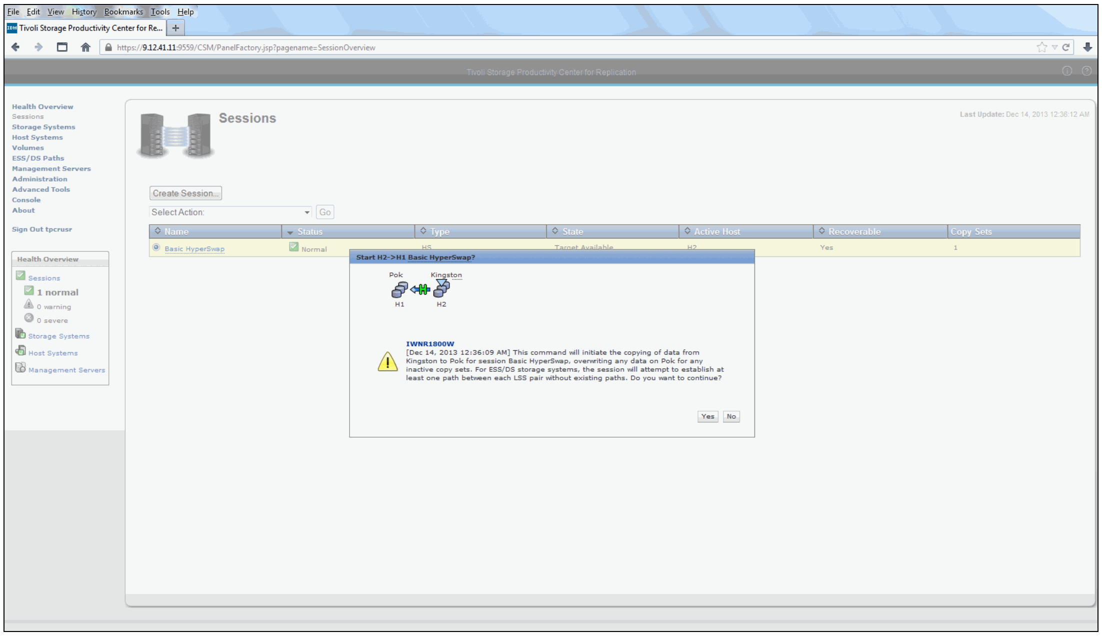

Figure 6-28 Basic HyperSwap session - Start H2->H1 confirmation

3. The message at the top of the panel in Figure 6-29 confirms that the Start H2->H1 action is completed. The session is in *Prepared* state and *Normal* status. Click the session name hyperlink (`Basic HyperSwap` in our example) to find more details about this session.

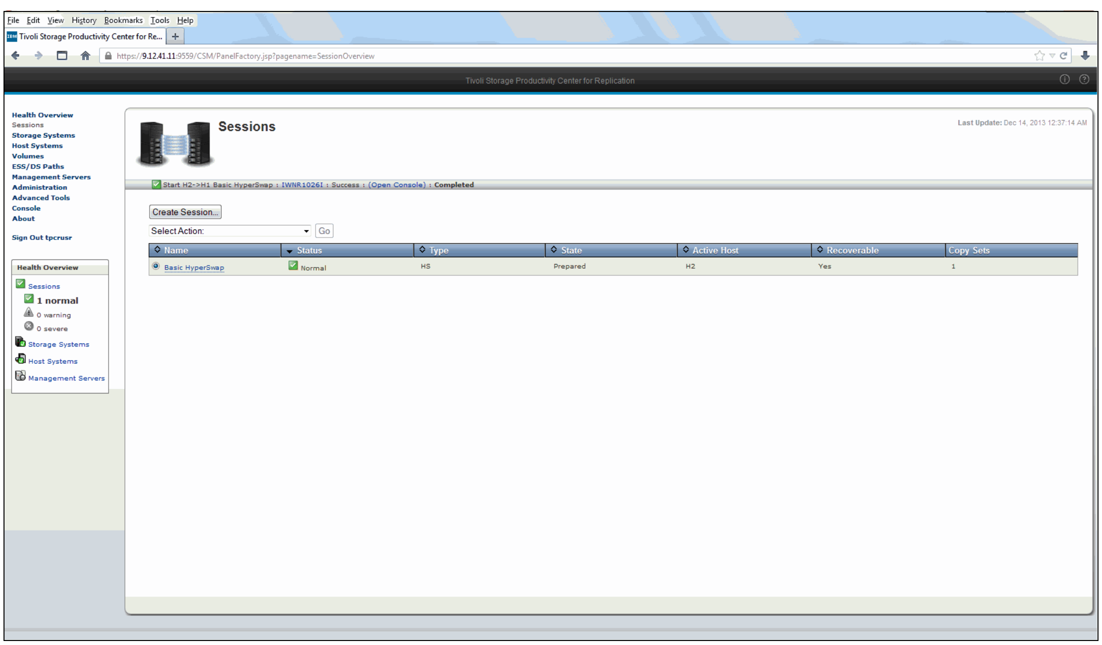

Figure 6-29 Basic HyperSwap session - Start H2->H1 Completed

4. As shown in Figure 6-30, Metro Mirror data copying progress from H2 to H1 volumes reached 100%. Click the **Sessions** hyperlink in the *Health Overview* section at the bottom left side of the panel to go back to the *Sessions* panel.

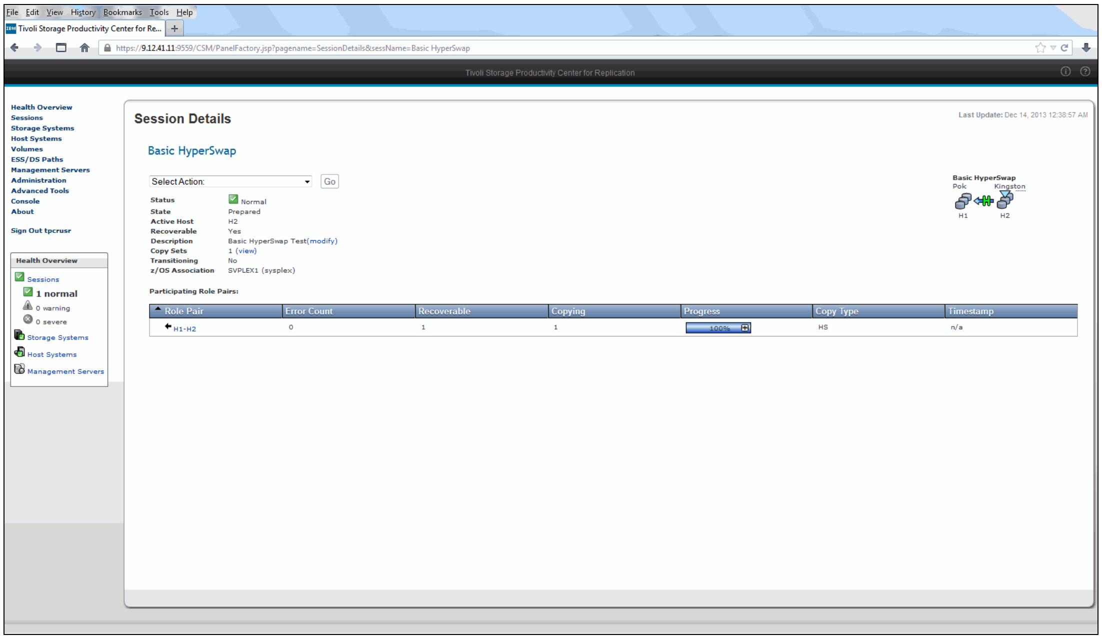

Figure 6-30 Basic HyperSwap session - details

At this stage, the following options are available:

HyperSwap: Causes a site switch, equivalent to a suspend and recover for a Metro Mirror with Failover/Failback. Because of this, individual suspend and recover actions for HyperSwap session are not available.

Start H2->H1: Starts Metro Mirror relationship between H2 and H1 volumes.

Stop: Stops copying with inconsistent secondary volumes.

Suspend: Stops copying, but will do so with consistent secondary volumes which can then be used to recover from. This command is not available in the “Basic HyperSwap” session type, but is available for all other session types where HyperSwap is enabled (such as Metro Mirror with HyperSwap”).

6.6.8 HyperSwap command (after Start H2->H1)

The **HyperSwap** command, invoked while data replication direction is between H2 and H1 volumes, swaps the application I/O between the H2 volumes in the session with the H1 volumes in the session.

To use the **HyperSwap** command, proceed as follows:

1. From the *Sessions* panel, select your HyperSwap session radio button and **HyperSwap** from the **Select Action** pull-down list and click **Go** as shown in Figure 6-31.

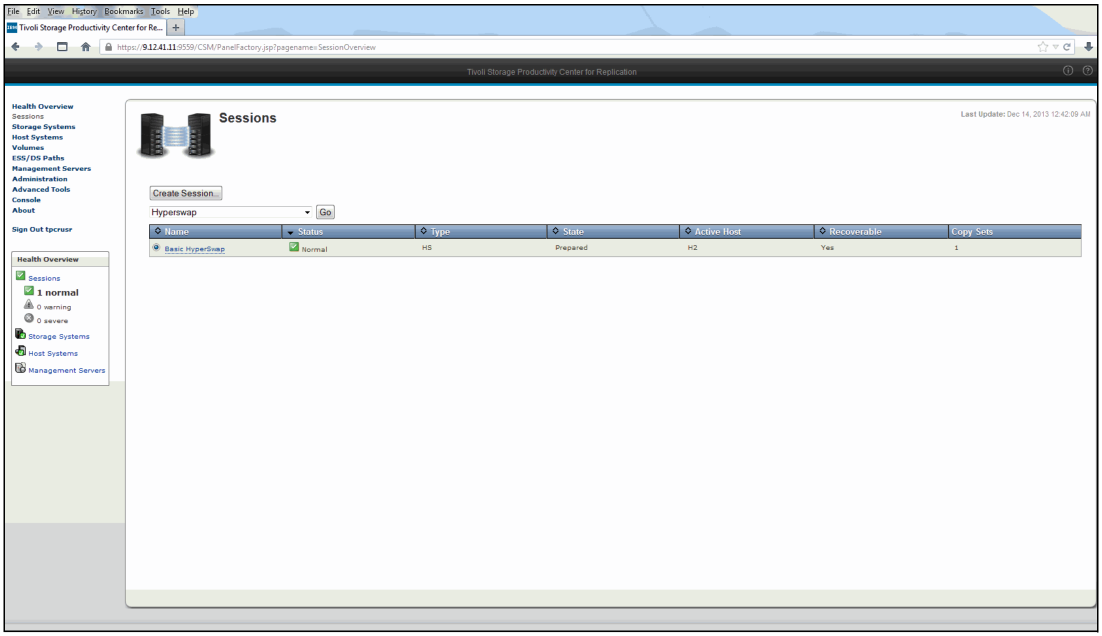

Figure 6-31 Basic HyperSwap session - HyperSwap Action

2. The next message shown in our example in Figure 6-32 is a warning that you are about to move application I/O from H2 volumes to H1 volumes. Click **Yes** to continue.

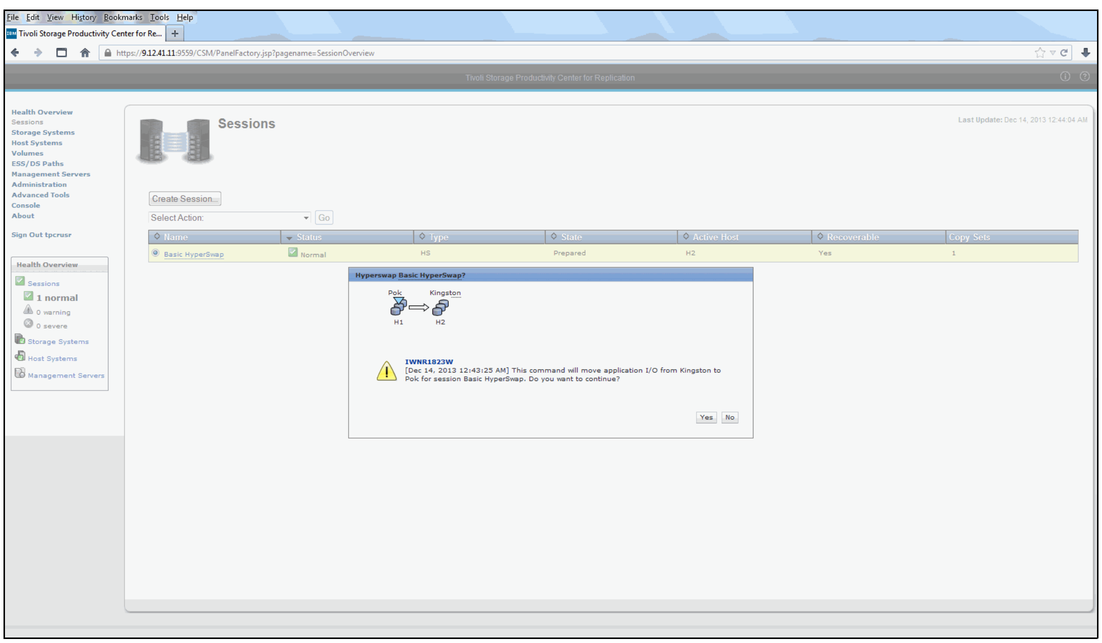

Figure 6-32 Basic HyperSwap session - confirm to initiate HyperSwap

3. The status of our HyperSwap session has still *Normal* status, but the state is *Target Available* as indicated in Figure 6-33. Both H1 and H2 volumes are suspended (data is not copied between H1 and H2 volumes) and H1 is available to host (online), while H2 is not available to host (offline).

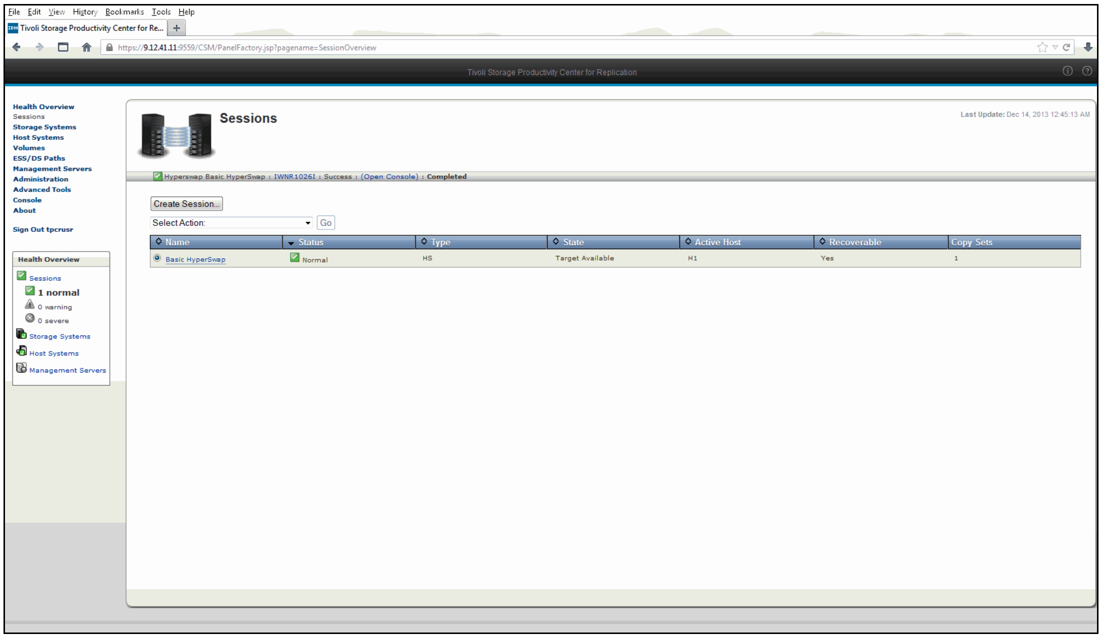

Figure 6-33 Basic HyperSwap session - HyperSwap is reported as Completed

4. Click the session name hyperlink (**`Basic HyperSwap`** in our example) to find more details about this session as shown in Figure 6-34. There is a timestamp for H1-H2 pair indicating when the session was swapped. It can be used as a reference.

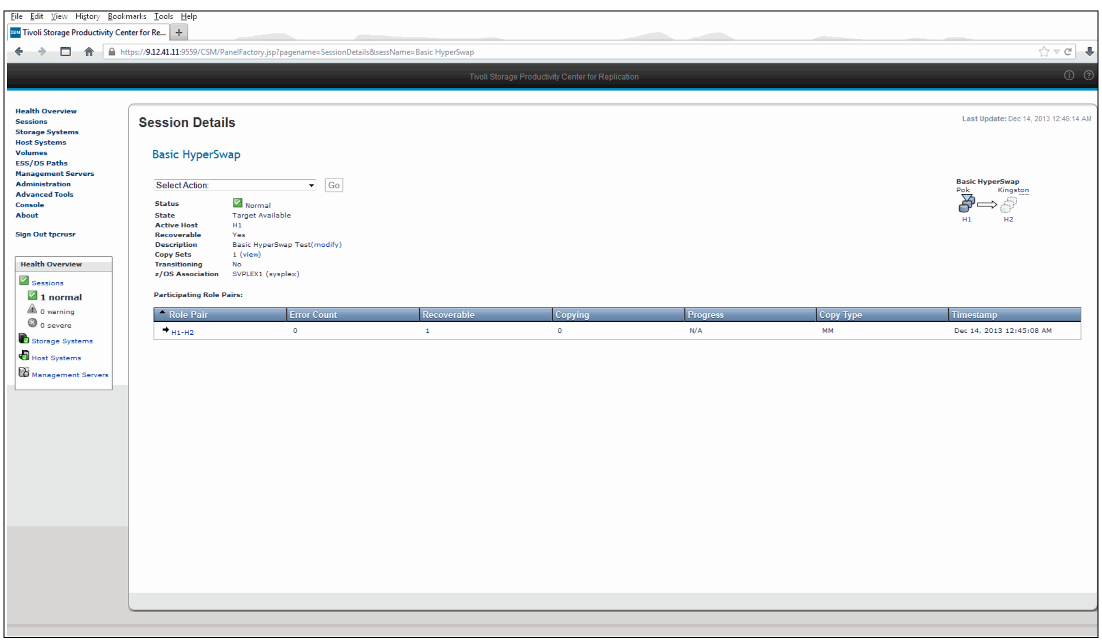

Figure 6-34 Basic HyperSwap session - Details

After the Basic HyperSwap session has the *Target Available* state for H1 volumes, the following option is available:

Start H1->H2: Restarts copying from H1 to H2 volumes in a Metro Mirror session.

6.6.9 Stopping a Basic HyperSwap session

The **Stop** action against a Metro Mirror session suspends updates to H2 or H1 volumes in a Metro Mirror session, depending on the copy direction. This command can be issued at any point during an active HyperSwap session. Stop action is completely transparent to the host I/O since *Freeze* (consistency group creation) is not issued against the volumes. Therefore, secondary volumes (H2 or H1, depending on the copy direction) do not contain a consistent copy of your data.

After a stop command, copy pairs remain defined and bit maps are still maintained in the hardware, so a subsequent start command will result in only changed tracks being copied, not the entire volume.

For a stop command, HyperSwap will detect the suspended pairs and disable HyperSwap if it is not already disabled.

To stop a session, proceed as follows:

1. From the **Select Action** pull-down Menu select **Stop** and click **Go** as shown in Figure 6-35.

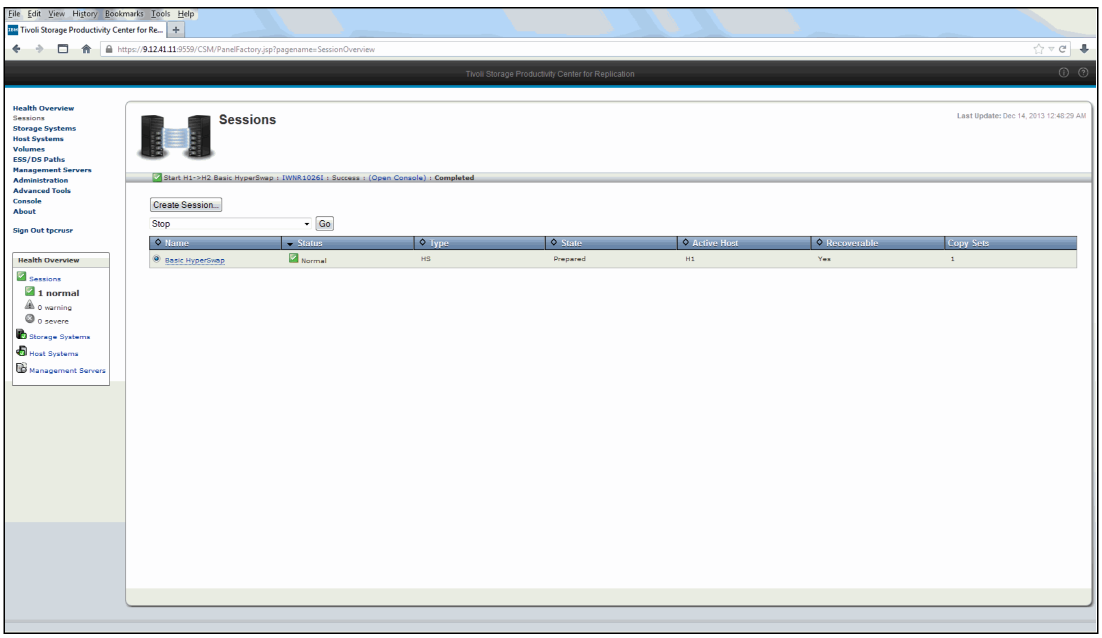

Figure 6-35 Basic HyperSwap session - Stop Action

2. The next message shown in Figure 6-36 is a warning that you are about to stop data copying between H1 and H2 volumes. Click **Yes** to continue.

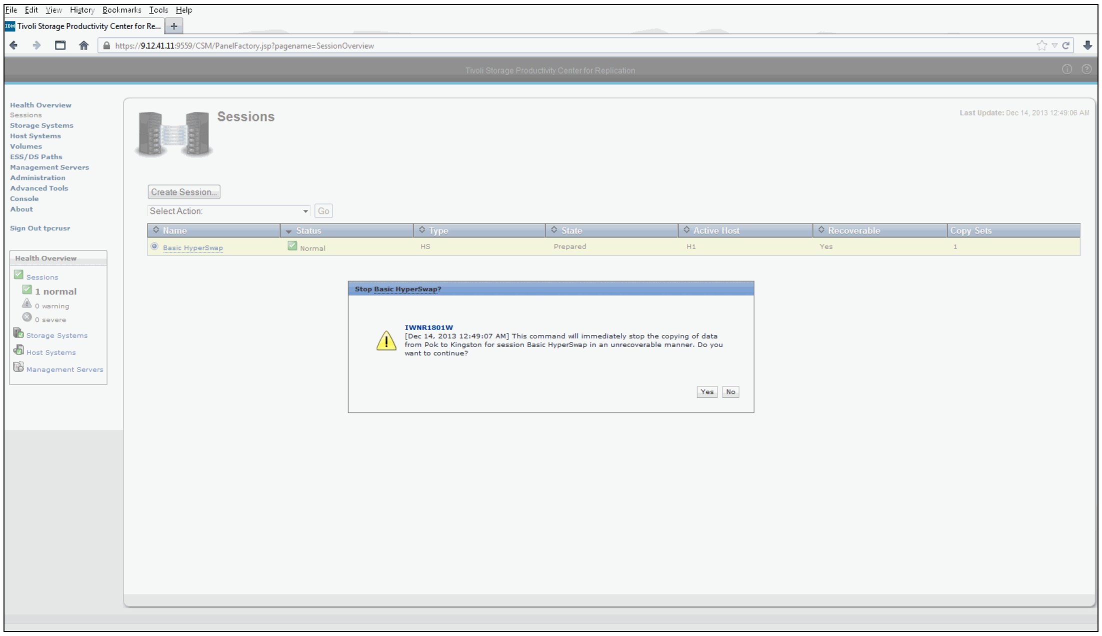

Figure 6-36 Basic HyperSwap session - Stop

3. There is a message at the top of the panel in Figure 6-37 indicating that **Stop** action has been successfully completed. The status of our HyperSwap session is *Severe* and the state is *Suspended*. Column *Recoverable* in Figure 6-37 has value *NO* indicating that H2 storage subsystem volumes are not consistent.

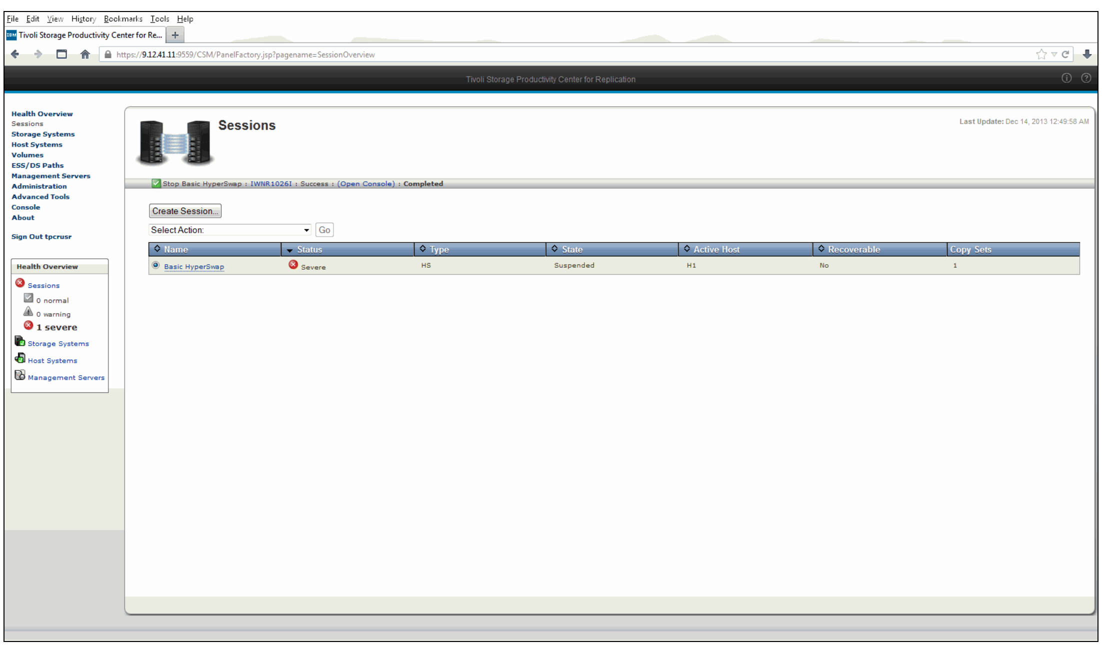

Figure 6-37 Basic HyperSwap session - Stop Completed

4. Click the session name hyperlink (**`Basic HyperSwap`** in our example) to find more details about this session, as shown in Figure 6-38.
5. Click the **`Sessions`** hyperlink in the *Health Overview* section at the bottom left side of the panel to go back to the Sessions panel.

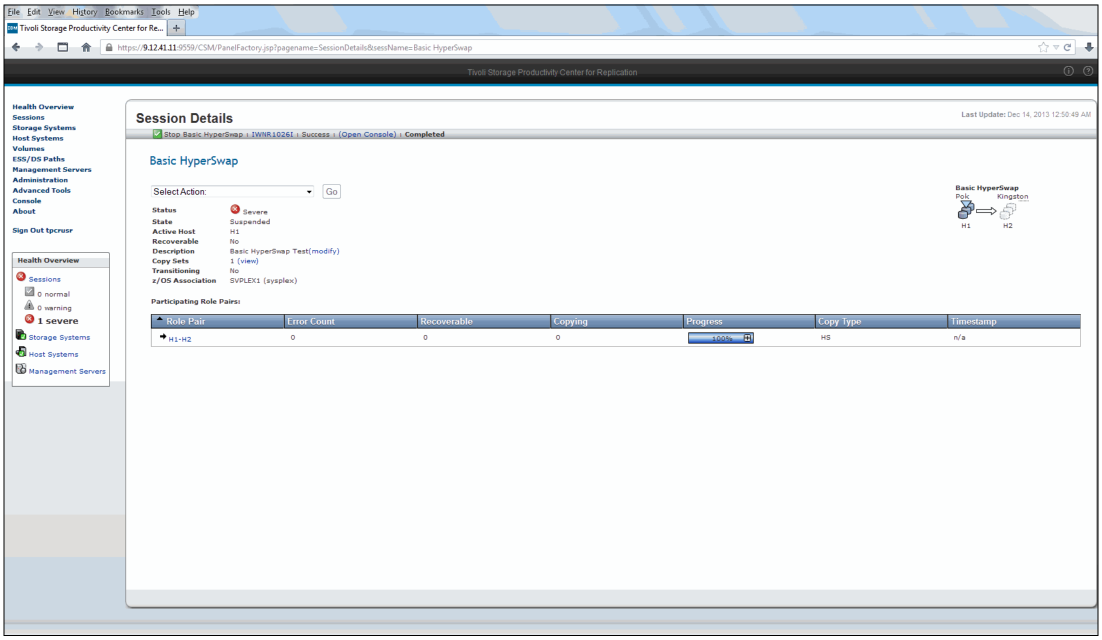

Figure 6-38 Basic HyperSwap session - details

At this stage, the following option is available:

- **Start H1->H2** (or H2->H1, depending on the copy direction): This will restart copying from H1 to H2 (or H2 to H1) volumes in a Metro Mirror session.

6.6.10 Terminating a Basic HyperSwap session

The **Terminate** action breaks the Metro Mirror relationship between H1 and H2 volumes thus terminating data replication. Unlike a stop command, after a terminate command, copy pairs are terminated in the hardware. If you want to start a HyperSwap session after it has been terminated, a full copy will take place from H1 to H2 volumes.

If you want target (secondary) volumes to be data consistent before removing their relationship, you must issue the suspend command, then the recover command, and then the terminate command.

To terminate a session, proceed as follows:

1. Select the HyperSwap session radio button (“Basic HyperSwap” in our example shown in Figure 6-39) and **Terminate** (under *Cleanup* submenu) from the **Select Action** pull-down menu. Click **Go** to continue.

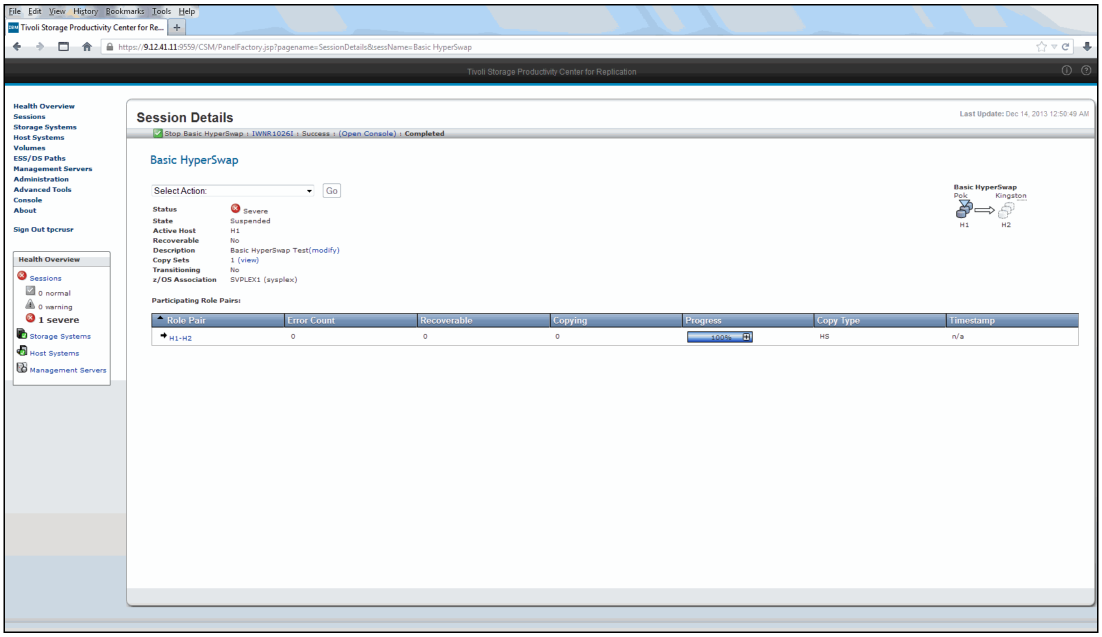

Figure 6-39 Basic HyperSwap session - Terminate action

2. The next message shown in Figure 6-40 is a warning that you are about to terminate Metro Mirror relationship between H1 to H2 volumes. Note that if you need to start the very same HyperSwap session again, a full copy from H1 to H2 volumes will be required. If you want to stop mirroring, but you want to restart mirroring later with incremental copying, see the STOP command described previously. Click **Yes** to continue.

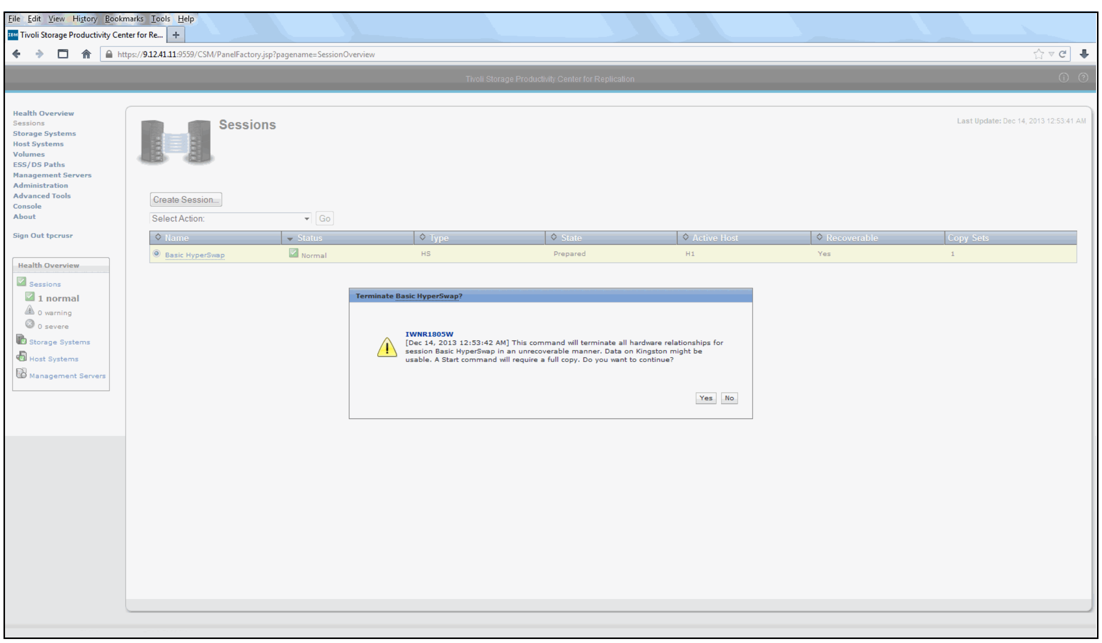

Figure 6-40 Terminate Basic HyperSwap session - confirmation message

3. There is a message at the top of the panel in Figure 6-41 indicating that a **Terminate** action has been successfully completed. The status of our HyperSwap session is now *Inactive* and the state is *Defined*.

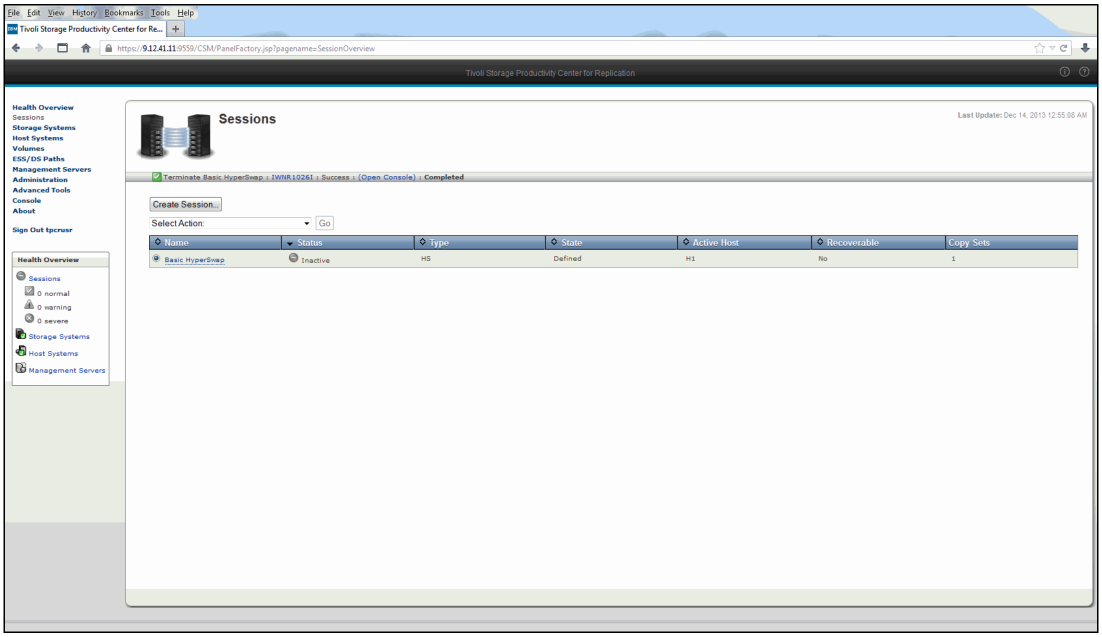

Figure 6-41 Terminate Basic HyperSwap session - Completed

After the Basic HyperSwap session is terminated, the following option is available:

- **Start H1->H2**: This will restart copying from H1 to H2 volumes in a Metro Mirror session.

6.6.11 Testing

Establish a small test environment and thoroughly test your HyperSwap set-up before setting up HyperSwap on your production systems. A test environment will allow you to exercise all of your parameters and operational procedures and allow you to become familiar with the behavior of HyperSwap.

After you have set up HyperSwap on your production systems, always test HyperSwap on your production environment to make sure that it behaves the same way on your production systems as it does in your test environment. Test environments usually do not have the size and complexity of production environments, and sometimes there are important attributes of the production environment that have not been exposed in the test environment. You should test HyperSwap in your production environment so that you can find and fix any problems before you need to do a real HyperSwap.

Perform HyperSwaps on your production environment on a regular schedule to find any new problems (perhaps due to configuration changes) and to exercise your operations staff. It is important to have your operations staff familiar with HyperSwap procedures so that they react properly when a real HyperSwap occurs.

You can issue a `VARY OFFLINE FORCE` command against a PPRC primary device to trigger an unplanned HyperSwap. (This will create a “boxed” condition on the old primary device that you must remove later.)

If you have a dedicated test disk subsystem, you can also test no paths to the device or even loss of the device. You can trigger a “no paths” condition by configuring the last channel path offline to MVS with the “force” option; by disconnecting the fiber; or by blocking a port on the switch. You can trigger a loss of device condition by powering-off the device.

After Tivoli Storage Productivity Center for Replication has loaded the configuration into HyperSwap, which is part of START processing, and the session has reached the “Prepared” state, a HyperSwap will still occur even if Tivoli Storage Productivity Center for Replication is not currently active. One way to test this is to take Tivoli Storage Productivity Center for Replication down and then issue the “SETHS SWAP” MVS operator command which will initiate a planned HyperSwap. You can also test this by triggering an unplanned HyperSwap, such as by boxing a HyperSwap managed volume. To restart HyperSwap in the reverse direction, you will need to restart Tivoli Storage Productivity Center for Replication.

6.6.12 Manual recovery

HyperSwap processing will prevent a HyperSwap from occurring if certain conditions are not satisfied prior to beginning the swap. HyperSwap will only initiate a swap if it has a reasonable expectation that the swap will complete successfully. If there are problems beforehand that it cannot handle, HyperSwap does not want to make the situation worse by performing a swap that cannot succeed since this may lengthen the recovery time.

There are some situations where the swap has been performed successfully but errors occurred that must be cleared manually.

The most common error that you may have to clear manually is that of a “boxed” device. This is typically the result of triggering the swap artificially using a z/OS VARY OFFLINE,FORCE command, or it may have happened as a result of the swap itself. You should see the following message for any device has become boxed:

`IOS451I` *`devn`*`, BOXED, NO ONLINE OPERATIONAL PATHS.`

On the systems where the message appears, you can issue the z/OS D M=DEV(devnum) command to determine the channel numbers used to access the boxed device. You can cause the boxed device to go OFFLINE by issuing a z/OS VARY PATH,ONLINE command for the device and one of the associated channels.

If a failure occurs part way through a HyperSwap operation, further actions depend on when and where the failure occurred. The following situations can occur:

- One or more systems in the SYSPLEX cannot swap. If the swap policy is set to “disable”, which is the default for planned HyperSwaps, the HyperSwap operation is backed out. If the swap policy is set to “partition”, which is the default for unplanned HyperSwaps, the systems that cannot swap are partitioned out of the sysplex, and the swap continues on the systems in the sysplex that are able to proceed. An IPL has to be performed on the systems that were partitioned out of the sysplex.
- Tivoli Storage Productivity Center for Replication may have a standby server. The standby server can be running on another system within the sysplex or outside of the sysplex. If it is running outside of the sysplex, it may be running on z/OS, Windows, IBM AIX®, or Linux. If it is running outside of the sysplex, you will not be able to perform HyperSwap commands, such as restarting HyperSwap after a swap. That must be done from a Tivoli Storage Productivity Center for Replication that is running on a system within the sysplex.

7

Using Tivoli Storage Productivity Center for Replication for DS8000

At this point, you have successfully installed and configured the Tivoli Storage Productivity Center for Replication. In this chapter, we show you how to set up replication sessions and manage these sessions.

The following scenarios are included and document the work we completed in our lab environment:

- Configuring logical paths (required for Basic HyperSwap, Metro Mirror, Global Mirror, and Metro Global Mirror sessions in ESS and DS storage subsystems)
- FlashCopy
- Metro Mirror Single Direction
- Global Mirror Single Direction
- Metro Mirror Failover/Failback
- Metro Mirror Failover/Failback with Practice
- Global Mirror Failover/Failback
- Global Mirror Failover/Failback with Practice
- Metro Global Mirror

7.1 Configuring logical paths

A logical path is a logical connection between the sending Logical Subsystems (LSS) and the receiving LSS for DS8000, DS6000 and ESS copy services relationship. Logical paths need to be created in order to establish HyperSwap, Metro Mirror, Global Mirror, and Metro Global Mirror copy services configurations. An FCP link can accommodate multiple logical paths. Tivoli Storage Productivity Center for Replication for System z automatically creates required logical paths per session accordingly but using only one FCP link. Create logical paths over all available FCP links used for copy services. Therefore, you need to manually create logical paths over other available FCP links. For details about logical paths and DS/ESS copy services design, see the following IBM Redbooks publications:

- *DS8000 Copy Services for IBM System z*, SG24-6787
- *IBM System Storage DS8000: Copy Services in Open Environments*, SG24-6788.

This topic describes the addition, removal, and reestablishment of DS/ESS series storage subsystem logical paths.

7.1.1 Creating logical paths

Ensure that you have defined the appropriate storage subsystems before you start configuring logical paths. For more information about how to configure storage subsystem, see “Adding IBM ESS or DS Storage Server to Tivoli Storage Productivity Center for Replication server” on page 137. Follow these steps:

1. From the Navigation Tree area, click the hyperlink **`ESS/DS Paths`** as shown in Figure 7-1.

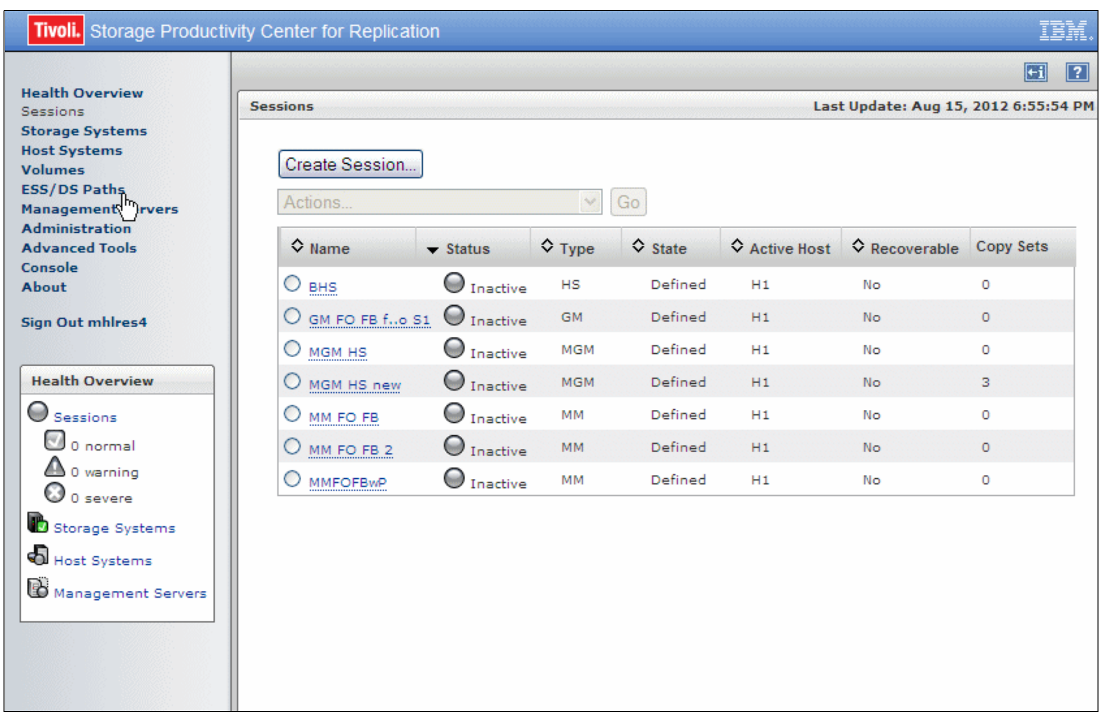

Figure 7-1 Accessing ES/DS Paths

2. Our example has three DS8000 disk subsystem boxes. There are many paths already defined. Click the storage subsystem hyperlink to find more details about each path.
3. Select **Manage Path** to create a new logical path. See Figure 7-2.

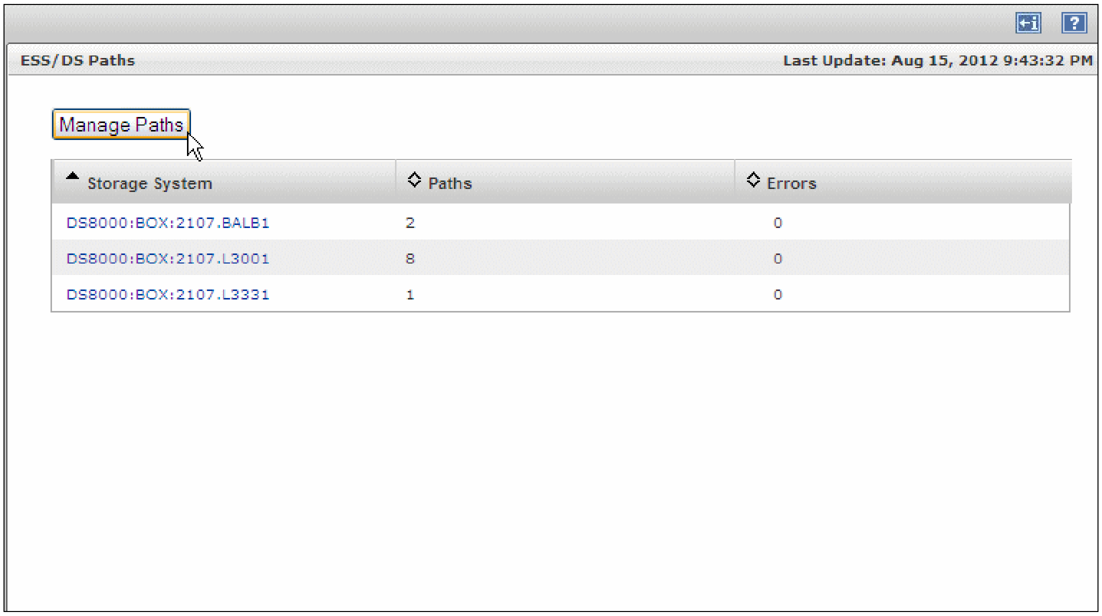

Figure 7-2 ESS/DS logical paths menu - Manage Paths

4. From the drop-down boxes in the Path Management wizard (see Figure 7-3), select the source storage system, source logical storage system (LSS), target storage system, and target logical storage system (LSS). In our example we selected DS8000 as a source and ESS storage system as a target. Click **Next** to continue.

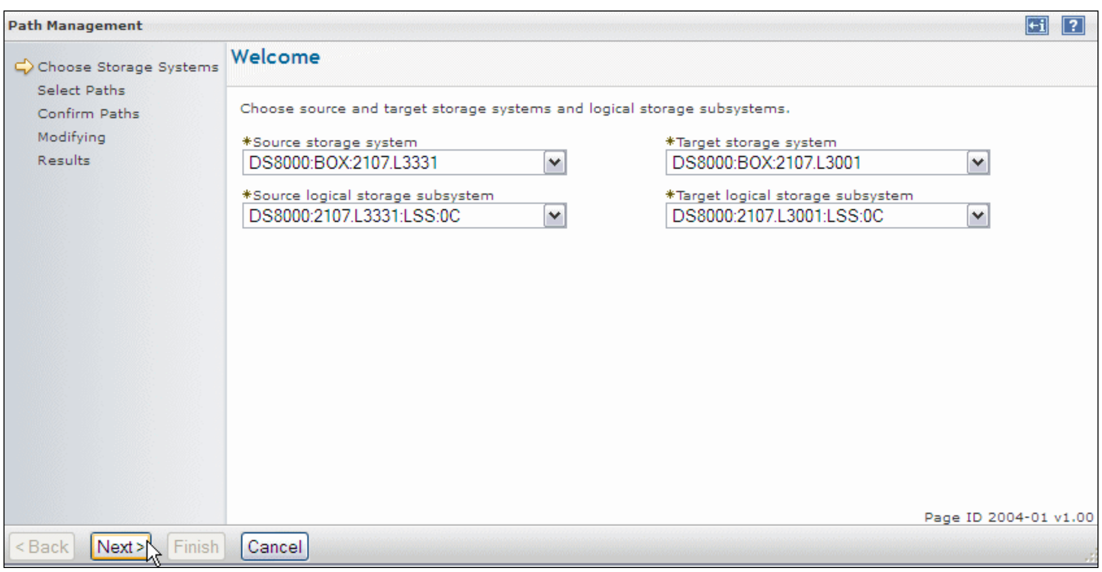

Figure 7-3 Create ESS/DS logical paths - Choose Subsystems

5. From the drop-down boxes in the Select Paths panel, select the source and target FCP port and click **Add** as shown in Figure 7-4.

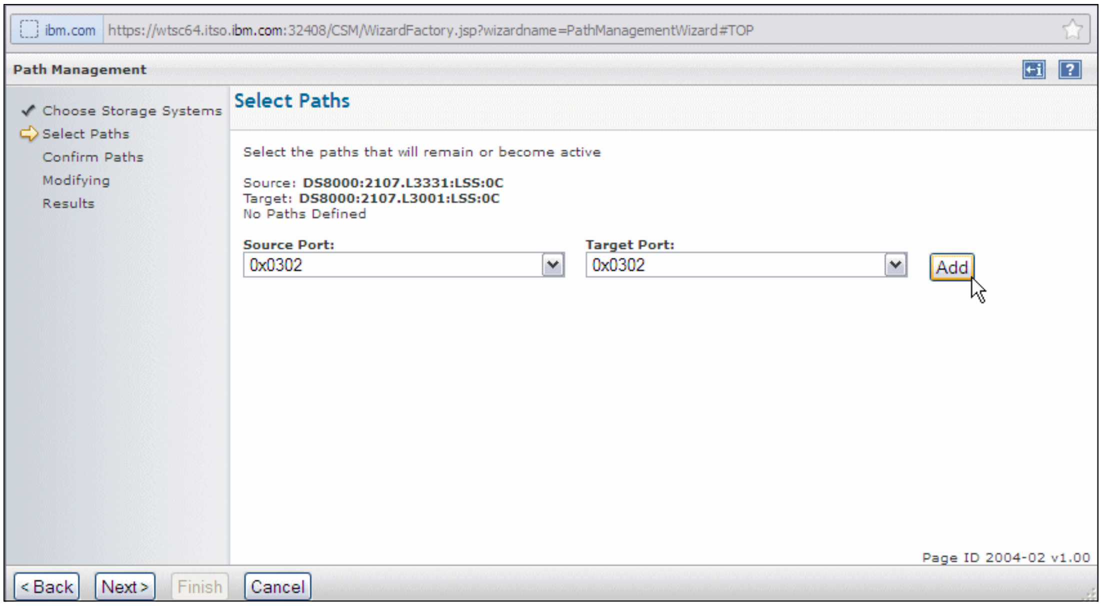

Figure 7-4   Create ESS/DS logical paths - Select Paths

6. You can add multiple FCP ports used for copy services between the disk subsystems, or just one at a time. If you want to create the same logical path over more FCP links, select desired source and target FCP port and click **Add**. After you add all the required paths, click **Next**, as shown in Figure 7-5.

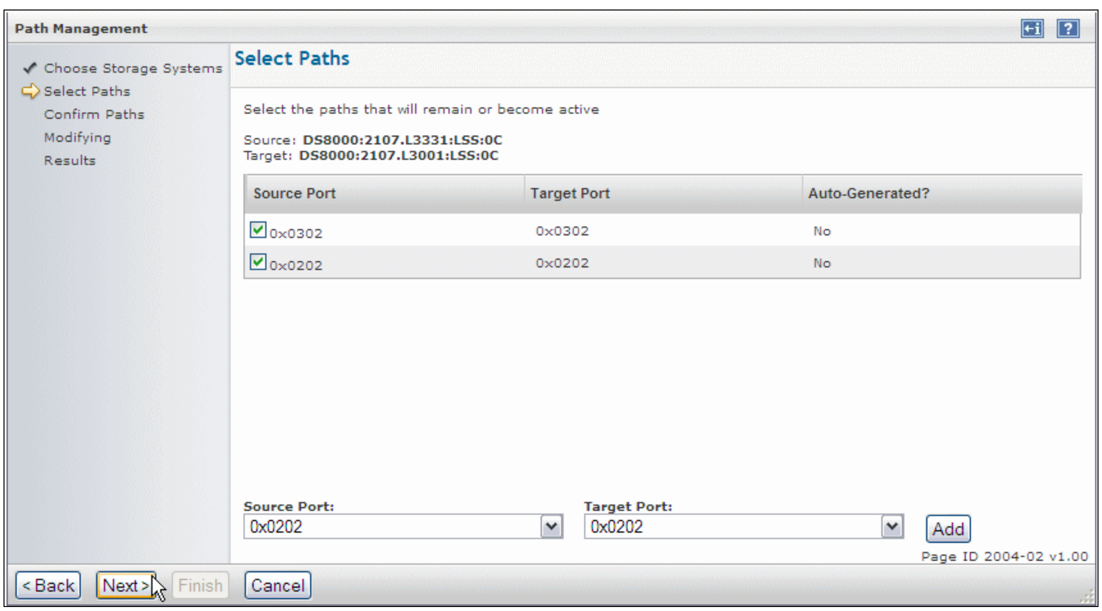

Figure 7-5   Create ESS/DS logical paths- Paths selected

7. The next panel (see Figure 7-6) includes information about logical paths previously selected. Click **Next** in order to confirm logical paths creation.

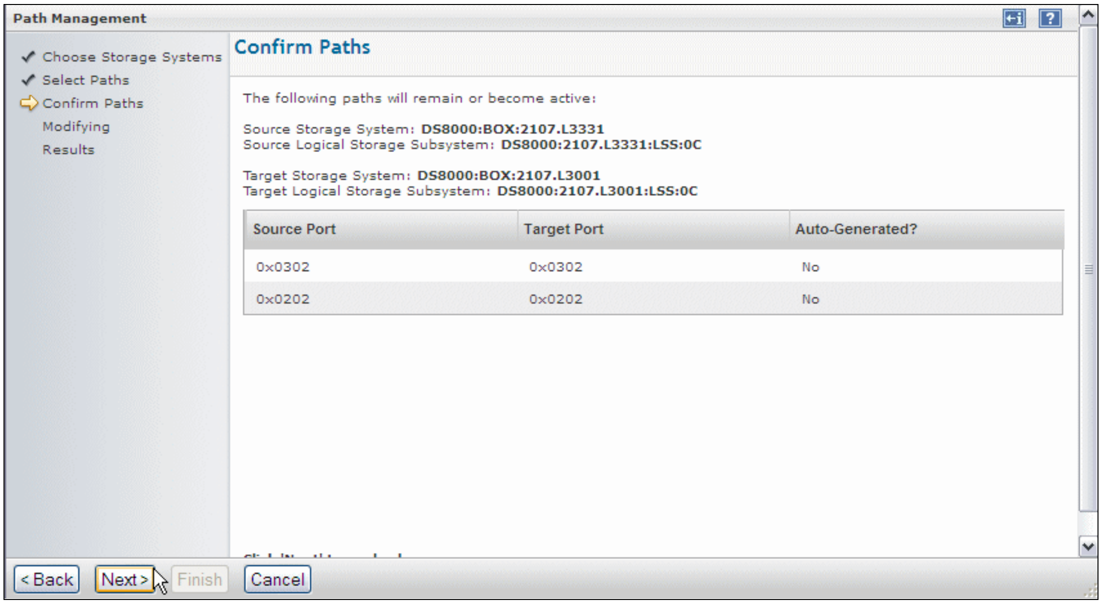

Figure 7-6 Create ESS/DS logical paths - Confirm Paths

Figure 7-7 displays the message that logical paths were successfully created. Click **Finish** to exit the Path Management wizard.

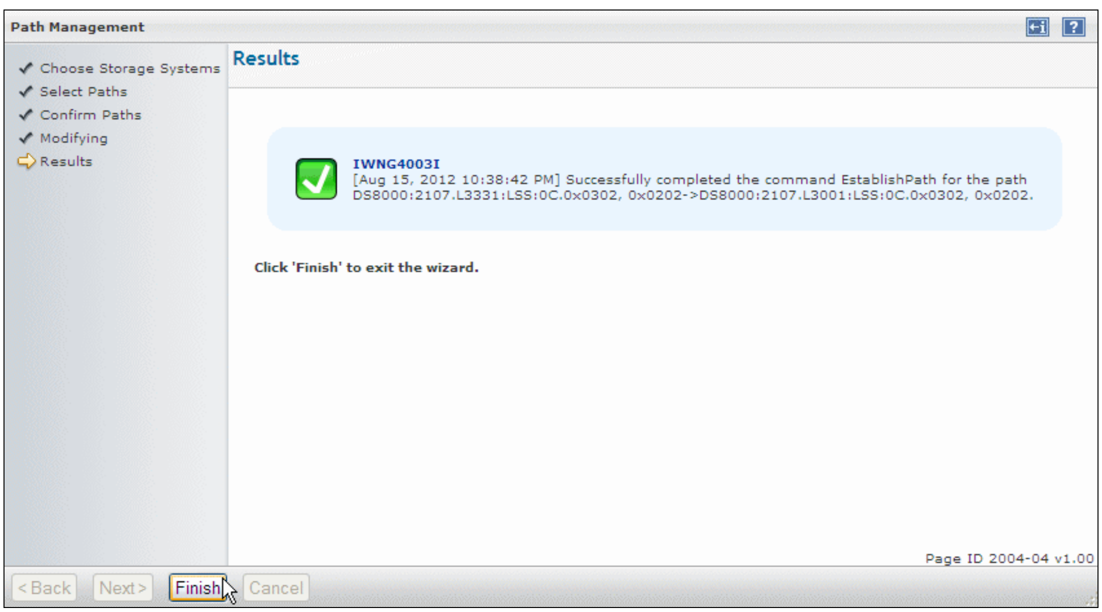

Figure 7-7 Create ESS/DS logical paths - Results

Adding logical paths using a CSV file

You can create a comma separated (CSV) file to define logical paths. This can be handy specially after Suspending a session defined with the *Hold I/O After Suspend* Policy, when all paths between primary and secondary LSSs are removed. The CSV file specifies storage systems pairings and associated port pairings that are used for replication. IBM Tivoli Storage Productivity Center for Replication uses the port pairings defined in the CSV file to establish logical paths.

Perform these steps to add IBM TotalStorage Enterprise Storage Server, IBM System Storage DS8000, and IBM System Storage DS6000 logical paths using a CSV file:

1. Create a CSV file named *portpairings.csv* in the `WAS_HOME/profiles/default/properties` directory. In our system, this directory is `/zWebSphereOEM/V7R0/tpcr510/AppServer/profiles/default/properties/`.
2. Figure 7-8 shows a sample content for this file, as you can see by editing through ISHELL:
   - Each line in this file represents a storage subsystem pairing.
   - All pairing values are separated by a comma.
   - The first pair of values in each line represents a storage subsystems paring:
     - 2107.L3331 is our primary DS8000 box;
     - 2107.L3001 is our secondary DS8000 box.
   - The remaining values are the ports that physical links between them to be used for replicating data between the storage subsystems:
     - 0x0202:0x0202 tells Tivoli Storage Productivity Center for Replication to use port 0x0202 in DS8000 box 2107.L3331 to replicate data to DS8000 2107.L3001 port 0x0202.
     - The same applies to ports 0x0302:0x0302.

```
File  Edit  Edit_Settings  Menu  Utilities  Compilers  Test  Help
---------------------------------------------------------------------------
EDIT       portpairings.csv                              Columns 00001 00072
Command ===>                                                Scroll ===> CSR
****** ***************************** Top of Data *****************************
000001 2107.L3331:2107.L3001,0x0202:0x0202,0x0302:0x0302
****** **************************** Bottom of Data ***************************


 .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .  .
```

Figure 7-8 portpairings.csv file

3. To enable the changes in the file, perform a task that requires new paths to be established. For example, suspend a session, remove the logical paths and then Start a Metro Mirror or Global Mirror session for Tivoli Storage Productivity Center for Replication to use the ports pairings in the CSV file.

7.1.2 Removing logical paths

In this session, we show you how to remove logical paths. Follow these steps:

1. In the Navigation Tree in the Tivoli Storage Productivity Center for Replication panel, click the hyperlink **ESS/DS Paths** as shown in Figure 7-1 on page 262. Tivoli Storage Productivity Center for Replication then shows you the menu to manage the logical paths, as in Figure 7-9.

2. In our example, we are removing the all paths that we previously established between some LSSs in DS8000 Box L3331 and DS8000 Box L3001. So we select Box L3331, which is our source disk subsystem.

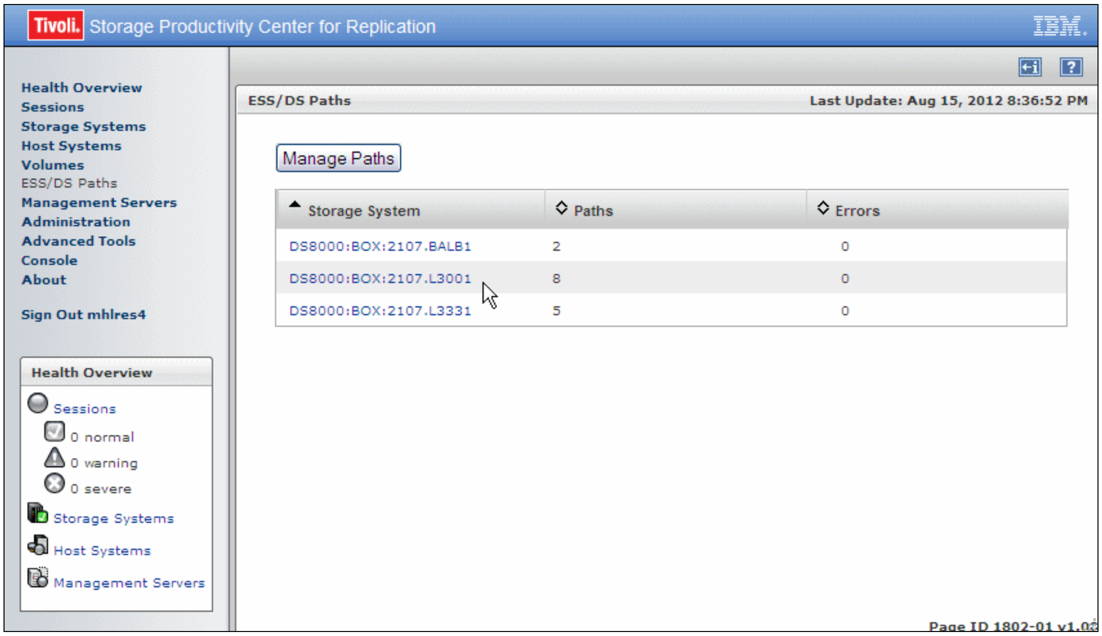

Figure 7-9 ESS/DS logical paths menu

3. Use the check boxes to select the paths that you want to remove as shown in Figure 7-10, and from the drop-down menu, select **Remove**. Click **GO** to continue.

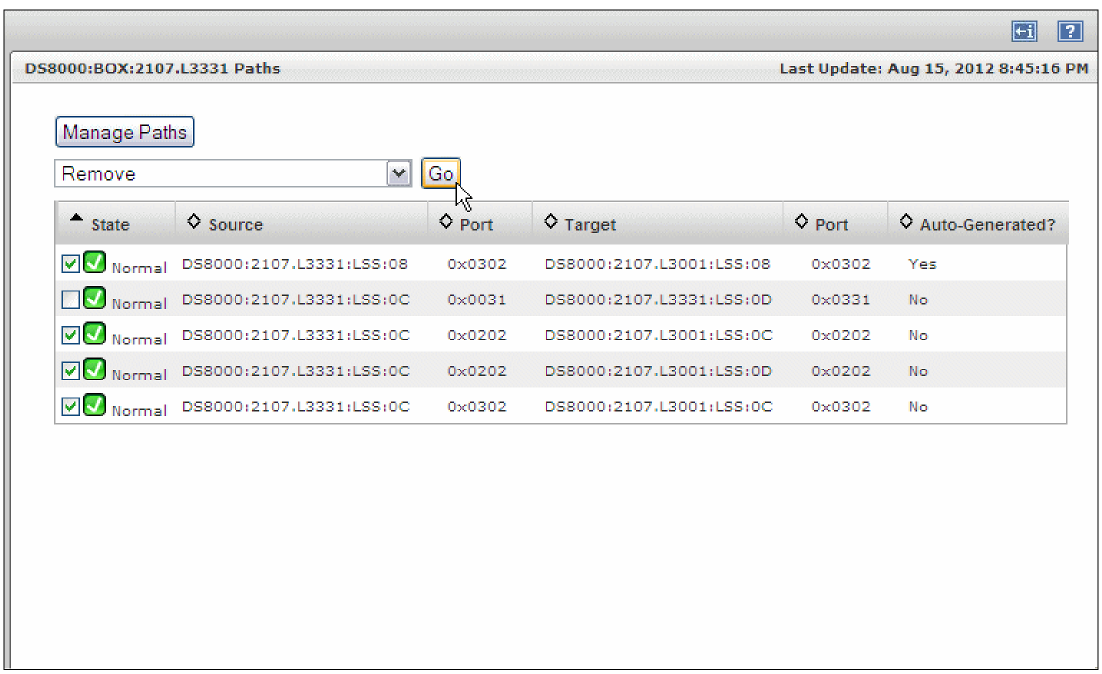

Figure 7-10 Remove ESS/DS logical paths - select

4. The message at the top of the panel in Figure 7-11 confirms that the path has been removed successfully.

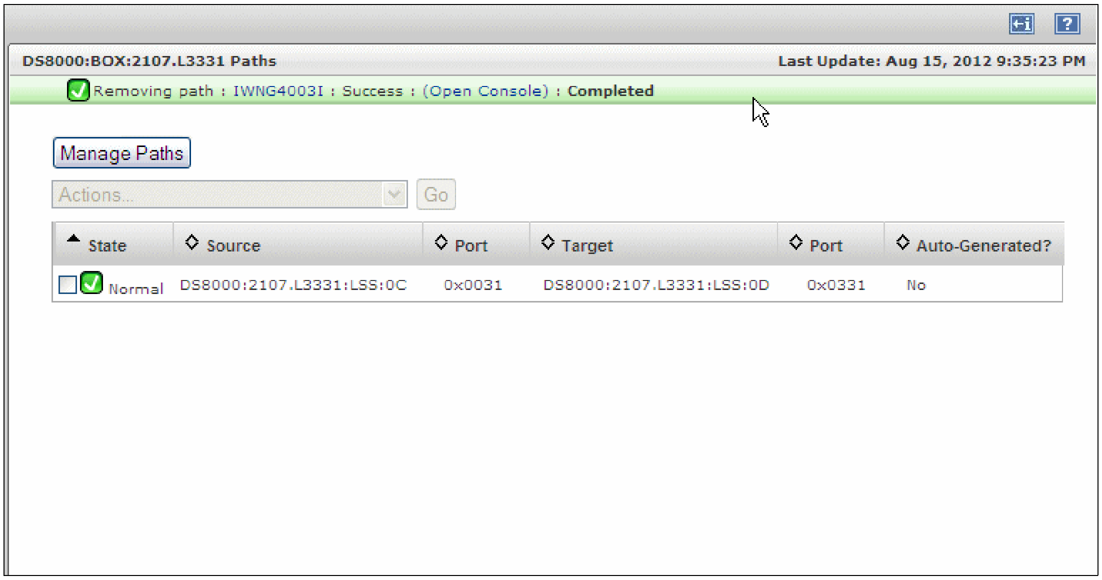

Figure 7-11 ESS/DS logical paths

7.2 FlashCopy session using the GUI

You may create a session at any time after the server code is installed and up and running. Again, a session is only a token with a name and certain attributes assigned to this session. This is always the same approach, independent of the session type. At this point, you need to have one or more storage subsystems defined to the Tivoli Storage Productivity Center for Replication server as described in Chapter 4, “Configuring the DS8000 storage system for use with Tivoli Storage Productivity Center for Replication” on page 123.

7.2.1 Creating a FlashCopy session

After you click the Sessions hyperlink in the Navigation tree area of the Tivoli Storage Productivity Center of Replication GUI, it displays the Sessions panel in the Content area of the GUI, as shown in Figure 7-12. This provides you with an overview of all defined sessions. Follow these steps:

1. Click **Create Session** to create a new session.

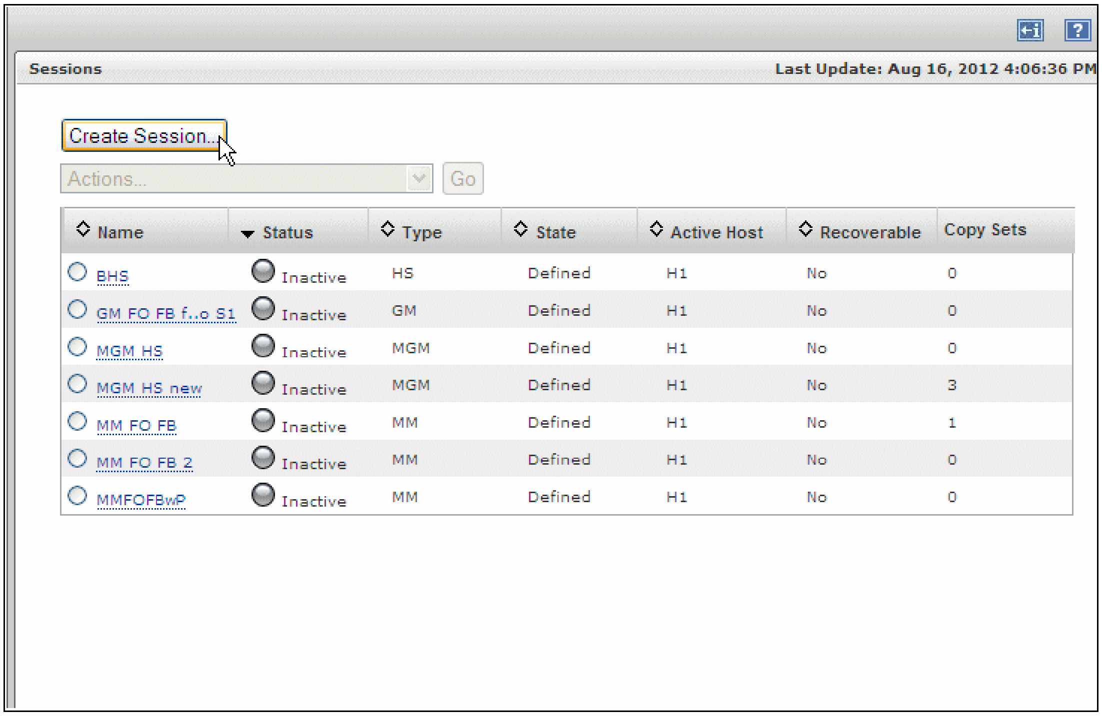

Figure 7-12 Sessions panel

2. In the first pull-down menu that is shown, you specify the type of storage subsystem that you are going to use in this session. In our example, we selected **DS8000, DS6000, ESS800**.
3. Next you select the **FlashCopy** session from the pull-down menu as shown in Figure 7-13. On the right side, a pictograph symbolizes the involved sites and their volume types. H1 represents Host 1 volumes and T1 represents FlashCopy target volumes. When you define Copy Sets, this pictograph helps you to orient and understand the copy direction. Click **Next** to continue.

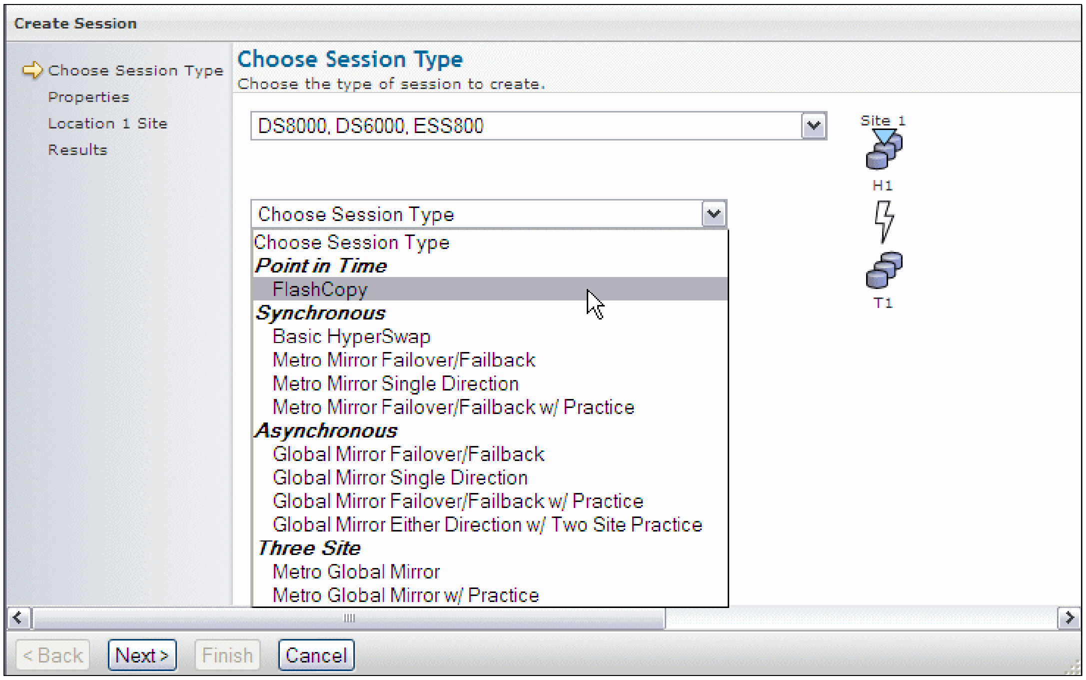

Figure 7-13 Define FlashCopy session

This leads us to the session Properties panel as Figure 7-14 shows.

The *Properties* panel is also important because it requires that you specify at least a name for the session which is about to be created. An optional *description* is desirable to understand the purpose of the session because the session name may not reveal what this session is intended for.

The following FlashCopy options are available:

– Incremental:

  Sets up the FlashCopy relationship for change recording. Any subsequent FlashCopy operation for that session only copies the tracks that have changed since the last flash. Incremental always assumes persistence.

– Persistent:

  Tells the hardware to leave the relationship established after all source tracks are copied to the target. Persistent does not assume incremental.

– No Copy:

  Tells the hardware not to write the background copy until the source track is written to.

– Allow FlashCopy target to be Metro Mirror source:

  Allows you to use a Metro Mirror source volume as a FlashCopy target. If this option is cleared, a FlashCopy to a Metro Mirror source volume fails.

> **Note:** All settings in the *Properties* panel can be changed dynamically at a later time, after the session is defined and it has normal status. For example, if you want to change from Incremental to No Copy, select your FlashCopy session and from the *Select Action* pull-down menu, select **View/Modify Properties** (under the *Modify* submenu) and click **Go** to change the properties.

4. We selected **Incremental** option in our scenario. Click **Next** to continue. See Figure 7-14.

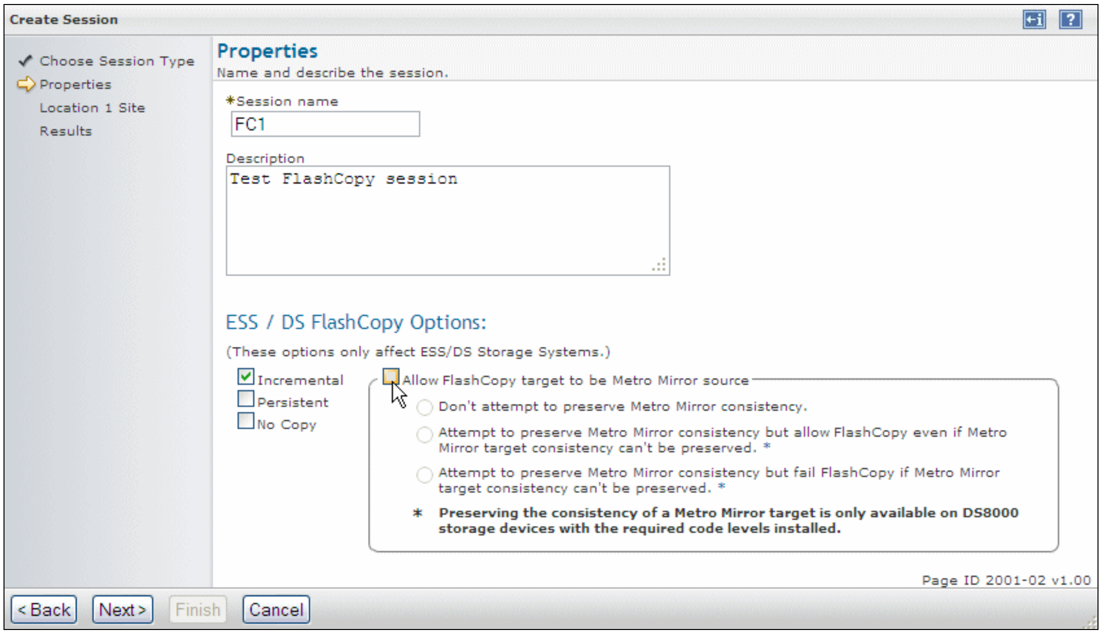

Figure 7-14 Define FlashCopy session - Properties

5. When you select the **Allow FlashCopy target to be a Metro Mirror Source** option, Tivoli Storage Productivity Center for Replication shows you a warning in a pop-up window asking you to reply with **Yes** or **No**. See Figure 7-15.

   This is done because the Metro Mirror pair whose source volume is also the target of a FlashCopy relationship enters a Duplex Pending state when the FlashCopy background copy is taking place. It a Metro Mirror pair enters a Duplex Pending state, its target is inconsistent with all other MM volumes until it reaches Full Duplex again. If we lose the primary volume, we might not be able to use the secondary volume of the MM pair.

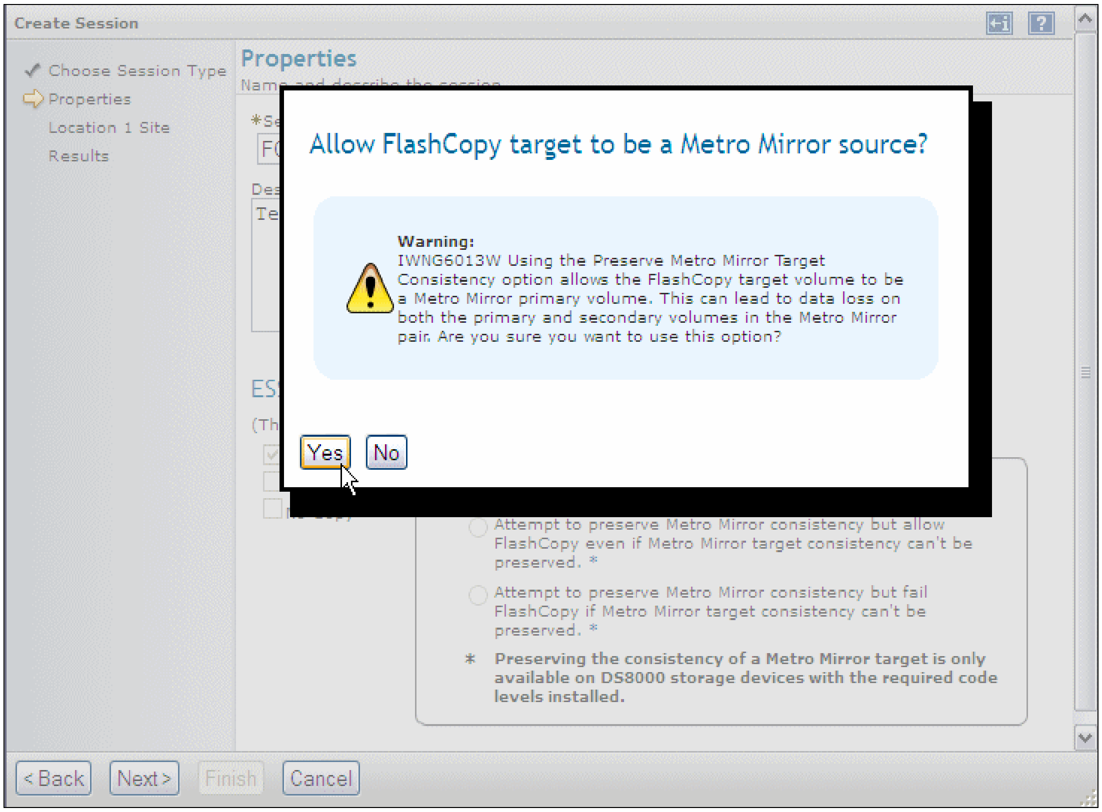

Figure 7-15 FlashCopy/MM warning

6. After you select **Yes**, Tivoli Storage Productivity Center for Replication allows you to choose additional options to use the traditional FlashCopy, or the Remote Pair FlashCopy architecture. See Figure 7-16.

   – Do not attempt to preserve Metro Mirror consistency:

     Uses the traditional FlashCopy architecture. The source FlashCopy volume is copied to its target FlashCopy volume, and replicated across the Metro Mirror links to the secondary Metro Mirror volume.

   – Attempt to preserve Metro Mirror consistency, but allow FlashCopy even if Metro Mirror target consistency cannot be preserved:

     Uses the Remote Pair FlashCopy architecture. It needs both the source and target of a FlashCopy relationship to be also both primary devices of Metro Mirror relationships. When you start a FlashCopy session in the primary DS8000 disk subsystem where the primary volumes of Metro Mirror are, DS8000 sends FlashCopy orders over the Metro Mirror links, to be executed in parallel in the secondary DS8000 where the Metro Mirror secondaries are. If it cannot do the Remote Pair FlashCopy, a full copy is made from the primary to the secondary MM volume.

   – Attempt to preserve Metro Mirror consistency, but fail FlashCopy if Metro Mirror target consistency cannot be preserved:

     Uses the Remote Pair FlashCopy architecture, also like the previous option. However, it will fail the FlashCopy session if it cannot send the orders for the FlashCopy to be done at the secondary DS8000.

7. Click **Next**.

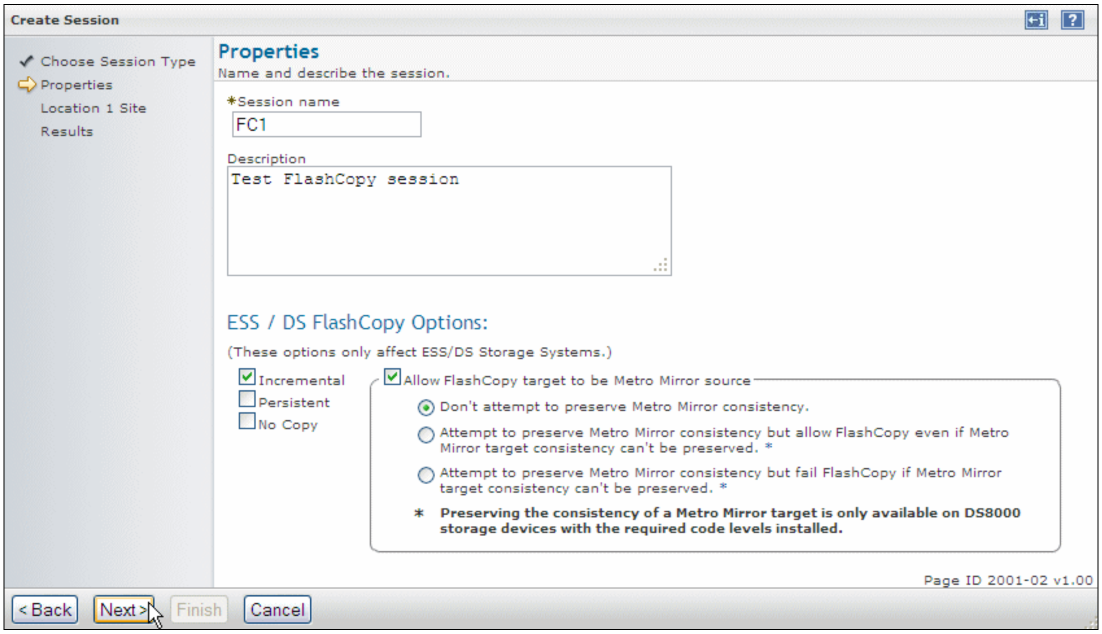

Figure 7-16 Additional FlashCopy options

8. From the pull-down **Site 1 Location** menu (see Figure 7-17) select the location of your H1 storage subsystem previously defined in “Adding an IBM Storage Server using the Tivoli Storage Productivity Center for Replication GUI” on page 137. Click **Next** to continue.

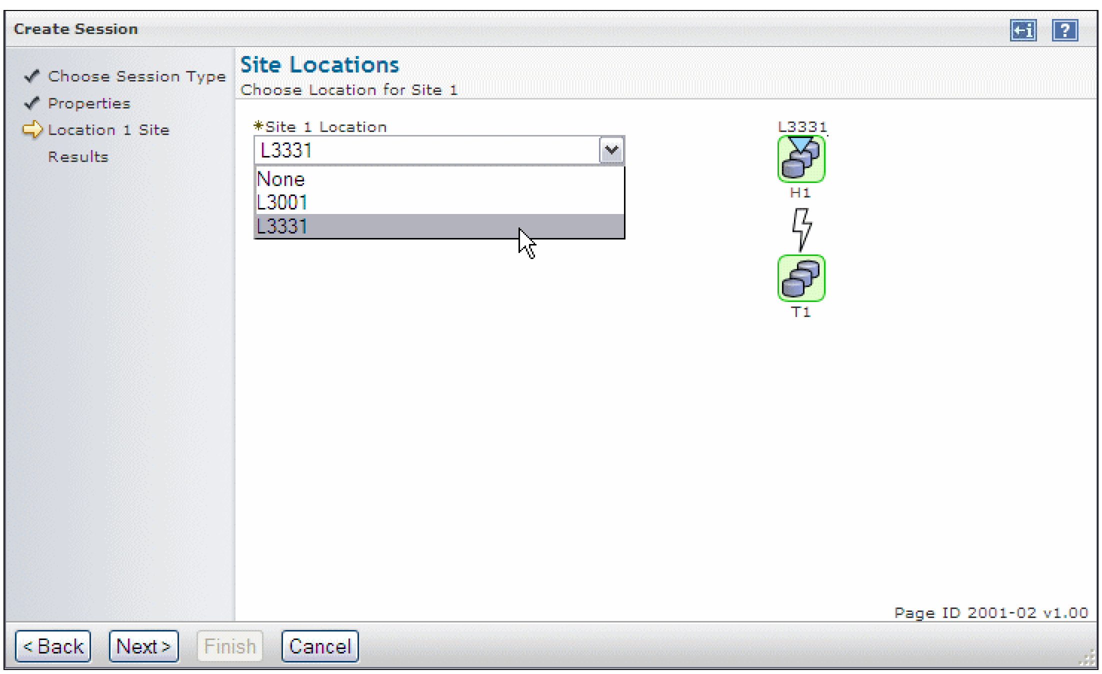

Figure 7-17 Define FlashCopy session Site 1 Location

9. Figure 7-18 displays the message that the FC1 session was successfully created. Click **Finish** to exit the *Create Session* wizard. Alternatively, you have an option to add Copy Sets and click **Launch Add Copy Sets Wizard** and follow the instructions described in 7.2.2, “Adding Copy Sets to a FlashCopy session” on page 274.

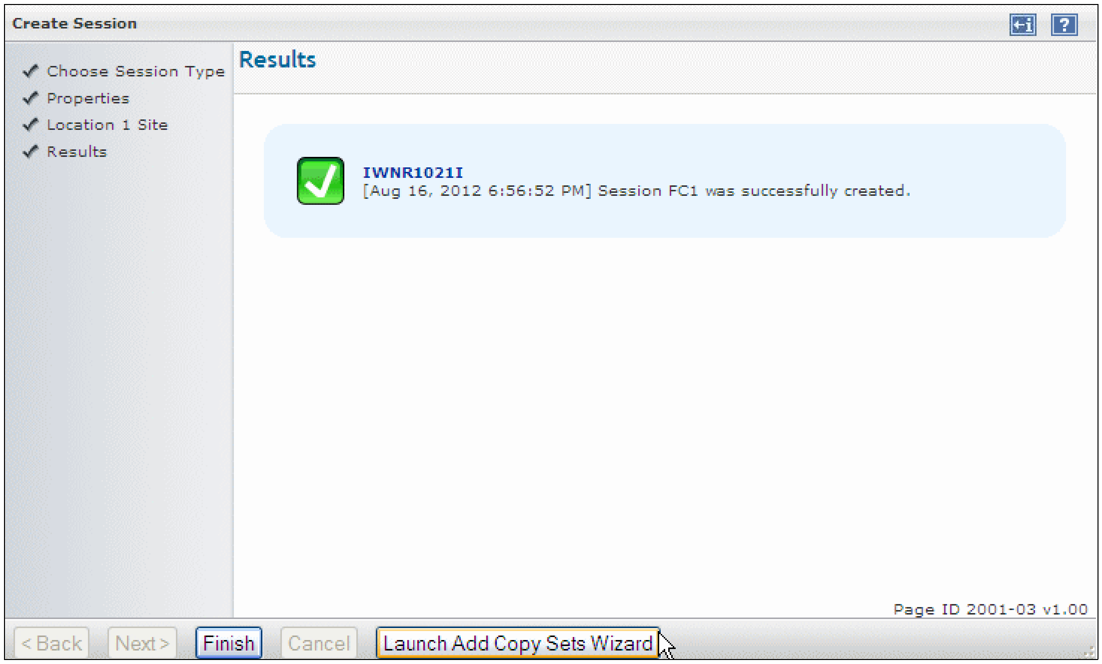

Figure 7-18 Define FlashCopy session - Results

7.2.2 Adding Copy Sets to a FlashCopy session

After we have defined the FlashCopy session FC1, we can populate this session in the next step with Copy Sets. The Copy Sets are Copy Services volume pairs, for example, in a FlashCopy session, a Copy Set consists of one H1 source and one T1 target FlashCopy volume.

Figure 7-19 shows the Sessions panel with the FC1 session which we defined previously. The next logical action that you perform on the FC1 session is to add volume pairs or Copy Sets to it. Follow these steps:

1. Select your FlashCopy session name radio button (FC1 in our example) and choose **Add Copy Sets** from the **Select Action** pull-down menu. Click **Go** to invoke the *Add Copy Sets* wizard.

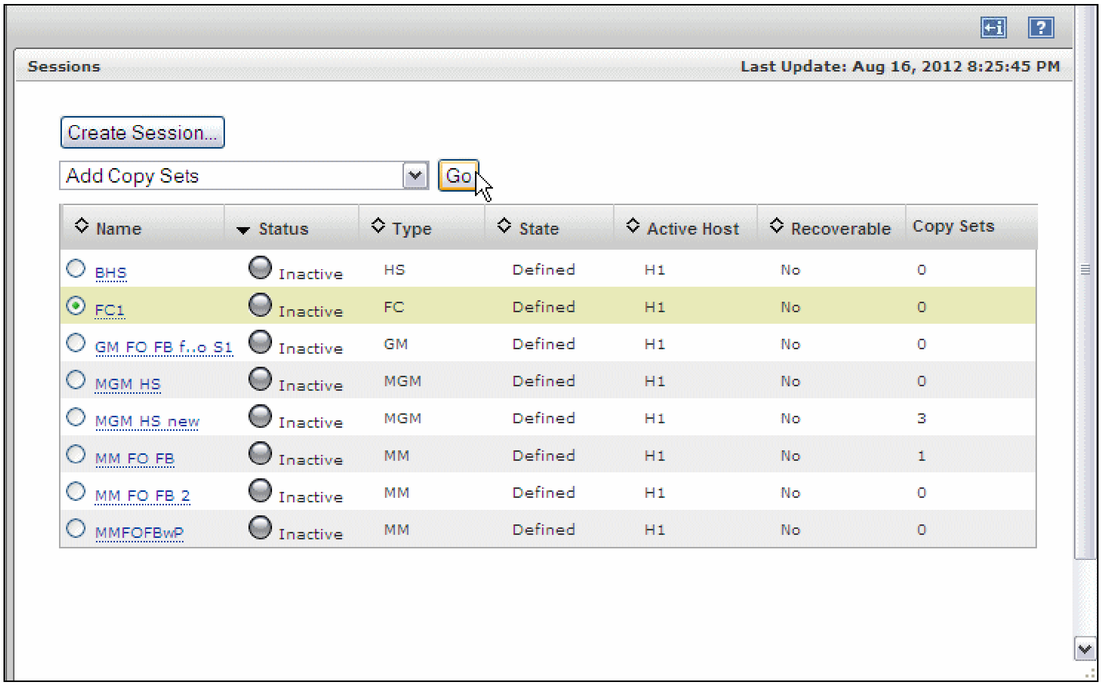

Figure 7-19 Add Copy Sets to FlashCopy session

2. Figure 7-20 displays the panel that provides details on the source FlashCopy volumes, which are called Host 1 volumes. Select the desired **Host 1 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Host 1 logical storage subsystem** list. Select the LSS where your H1 volume resides. After the LSS has been selected, choose the appropriate volume from the **Host 1 volume** pull-down list.
3. The alternative way to add a large number of volumes to this session is to create a CSV file as explained in "Using CSV files for importing and exporting sessions" on page 194. In case you have a CSV file ready, select the **Use a CSV file to import copy sets** check box and provide a path to your CSV file.
4. In our example, we selected DS8000 disk subsystem and appropriate volume as shown in Figure 7-20. Click **Next** to continue.

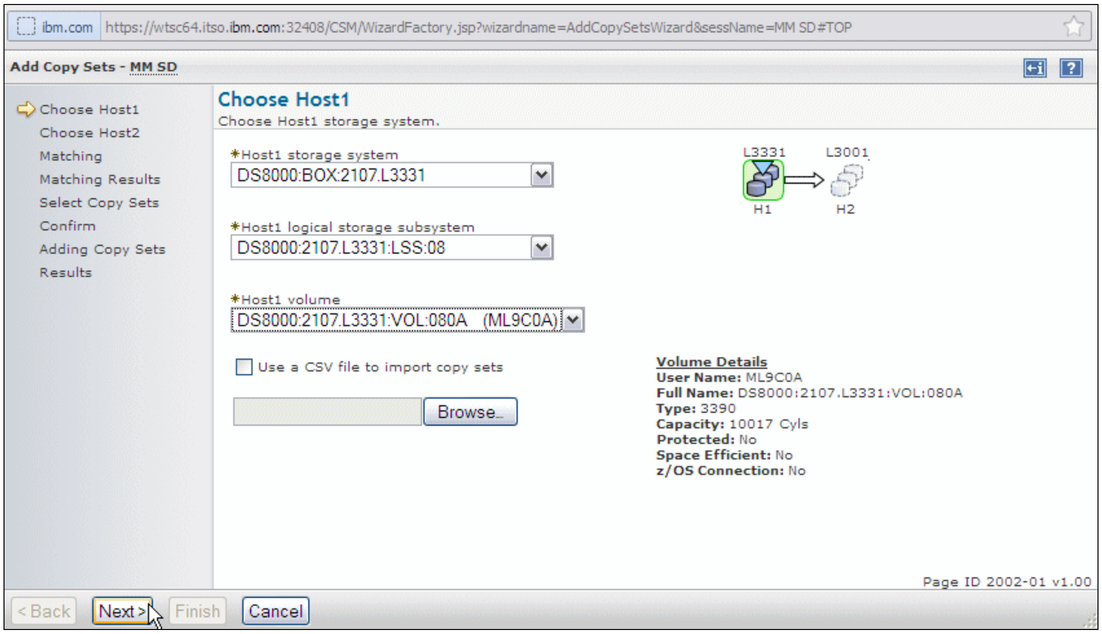

Figure 7-20 Add Copy Sets to FlashCopy Session - Choose Host 1

5. If you want to define all volumes within a certain LSS in the FlashCopy session, there is an option to select **All Volumes** from the **Host1 volume** list
6. The next step is to define Site 2 storage subsystems and volumes as shown in Figure 7-21. Select the desired **Target 1 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Target 1 logical storage subsystem** list. Select the LSS where your T1 target FlashCopy volume resides.

   If **All volumes** for a given LSS were selected in the previous step while defining Host 1 source FlashCopy volumes, you do not have an option to select a volume from **Target 1 volume** list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 1 storage subsystem with all volumes from selected LSS in Target 1 storage subsystem. In our example we selected LSS 0C VOL 08, which has ML9C08 volser. Click **Next** to continue.

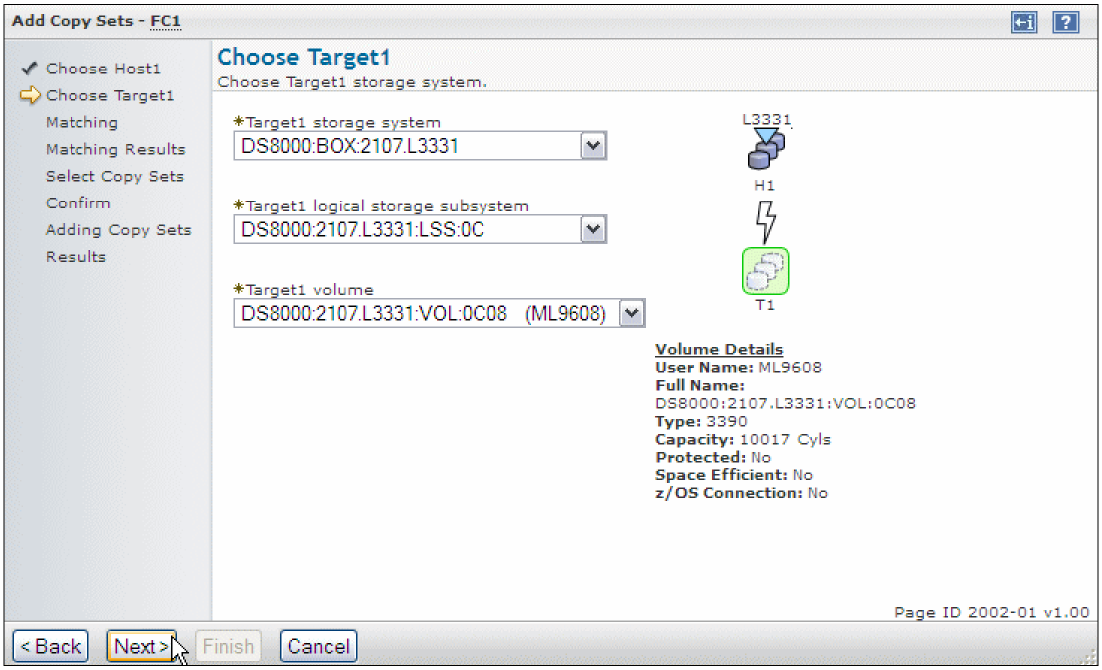

Figure 7-21 Add Copy Sets to FlashCopy session - Choose Target

7. The next panel in Figure 7-22 displays message related to the matching results. If there is a warning, like in our example, you can click **Show** and Tivoli Storage Productivity Center for Replication shows you all the Copy Sets in the session, and the reason for the warning. In our example, the warning is due to the fact that the FlashCopy target volume is already defined in session MGM HS new.
8. This is only a warning; it will not prevent you from creating this new session. Click **Next** to proceed with the creation of the FC1 session.

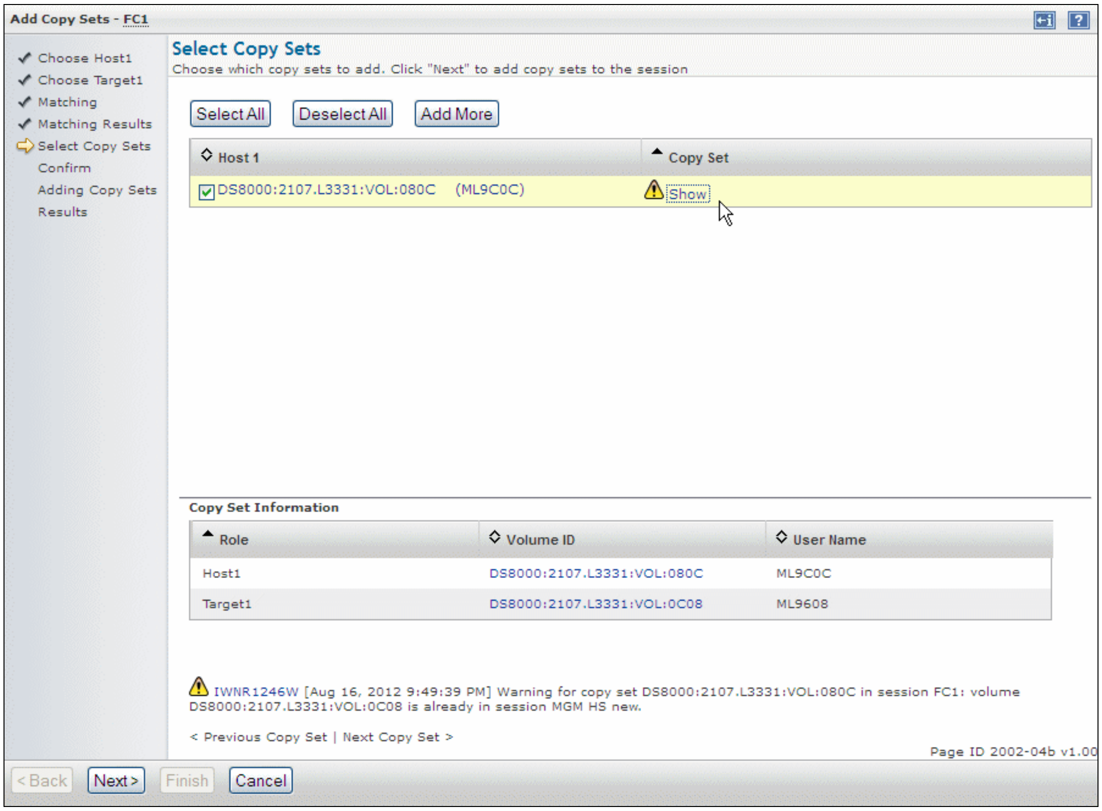

Figure 7-22 Add Copy Sets to FlashCopy session - Warning

9. Tivoli Storage Productivity Center for Replication shows you a confirmation panel, telling the number of Copy Sets that are going to created, as seen in Figure 7-23. Click **Next** to continue.

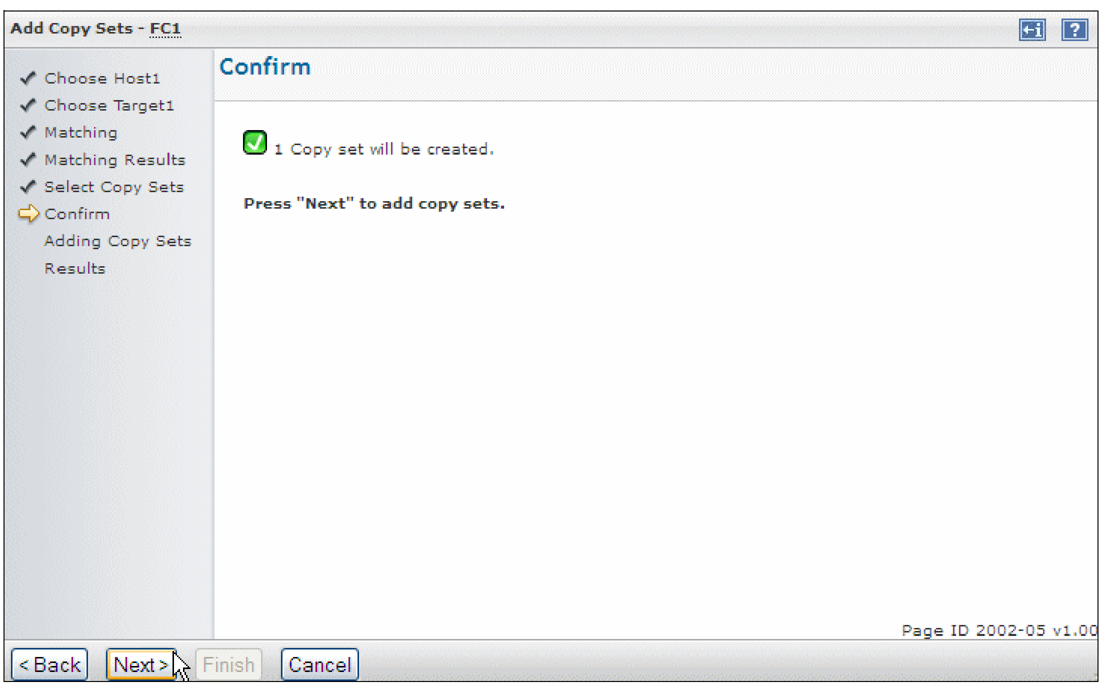

Figure 7-23 Add Copy Sets to FlashCopy session - Confirm

10.It may take some seconds to add all the Copy Sets, depending on how many of them you are adding. After that, you see the Results panel, as shown in Figure 7-24. The Copy Set creation completed successfully with one warning. You can click **View individual results** in this panel if you want to get additional information. Otherwise, click **Finish** to exit the *Add Copy Sets* wizard.

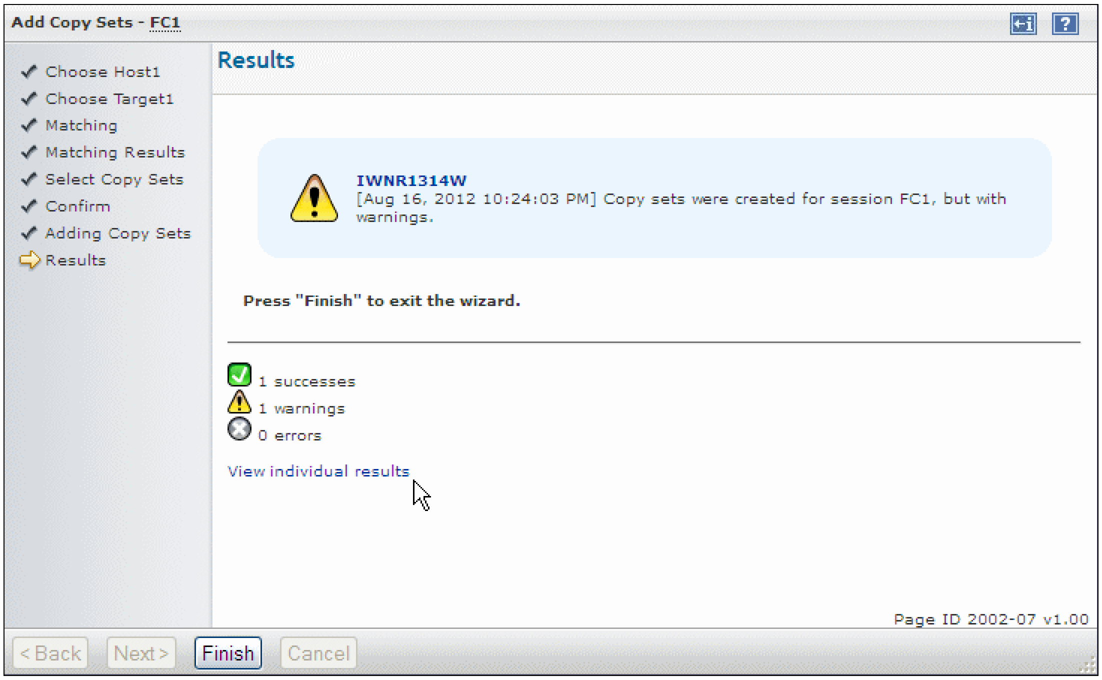

Figure 7-24 All Copy Sets are successfully added to the Tivoli Storage Productivity Center database

11.Figure 7-25 confirms that all Copy Sets are successfully added to the FC1 session and the database is successfully updated. The session status is still *Inactive*.

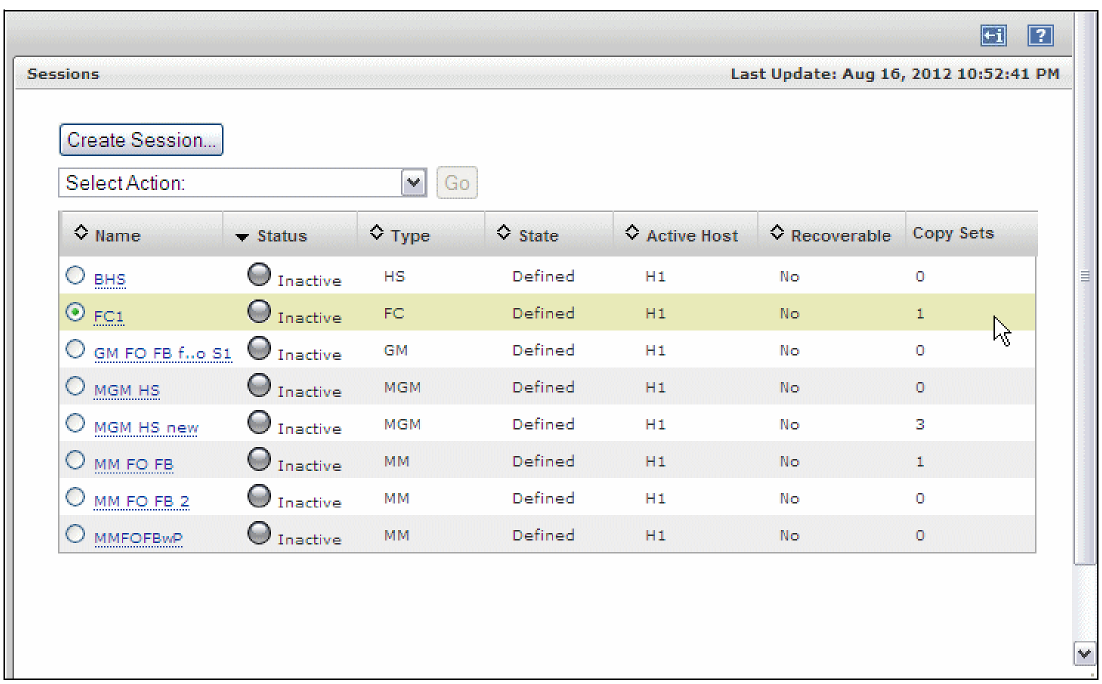

Figure 7-25 Add Copy Sets is completed

This concludes the steps through the GUI when you add Copy Sets to a FlashCopy session.

7.2.3 Initiating a Flash action against a FlashCopy session

After we have defined a FlashCopy session and populated the session with Copy Sets, we can initiate a Flash action against it. Figure 7-26 displays the FC1 session as we defined it previously. We defined just one Copy Set in our example. Follow these steps:

1. From the **Select Action** pull-down menu, select **Flash** and click **Go**.

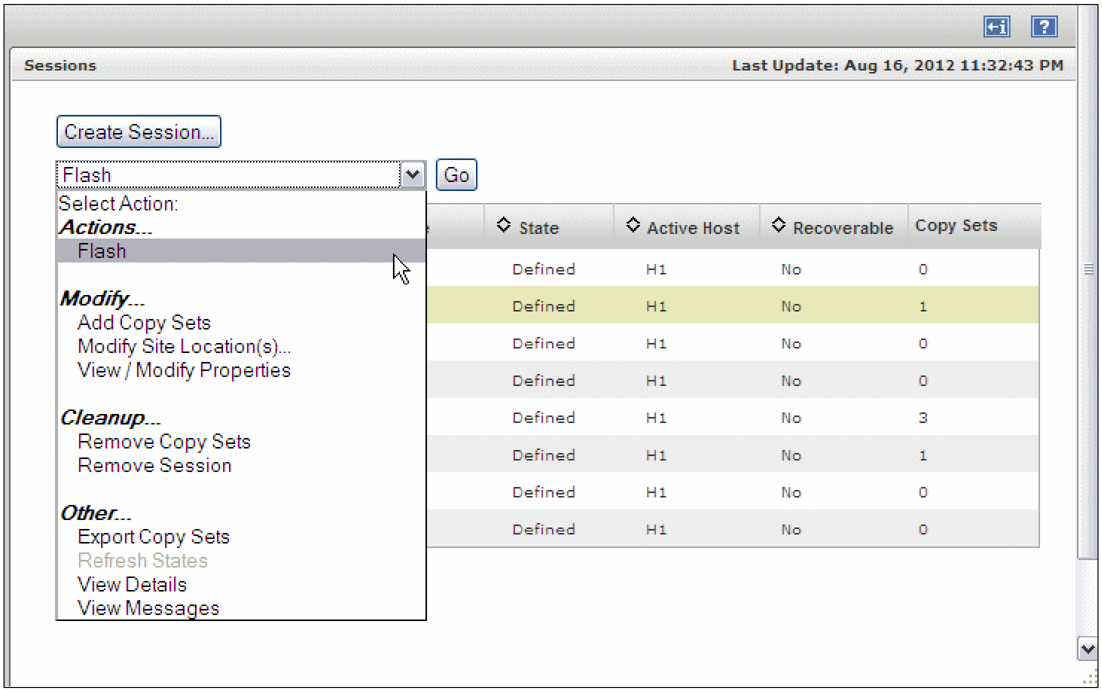

Figure 7-26 FlashCopy session - Flash Action

2. Tivoli Storage Productivity Center for Replication will pop up a window as shown in Figure 7-27, showing a warning that you are about to initiate a FlashCopy session. It will cause a point in time relationship to be established from the source H1 volumes to the target T1 volumes, thus overwriting any data on the target T1 volumes. Click **Yes** to continue.

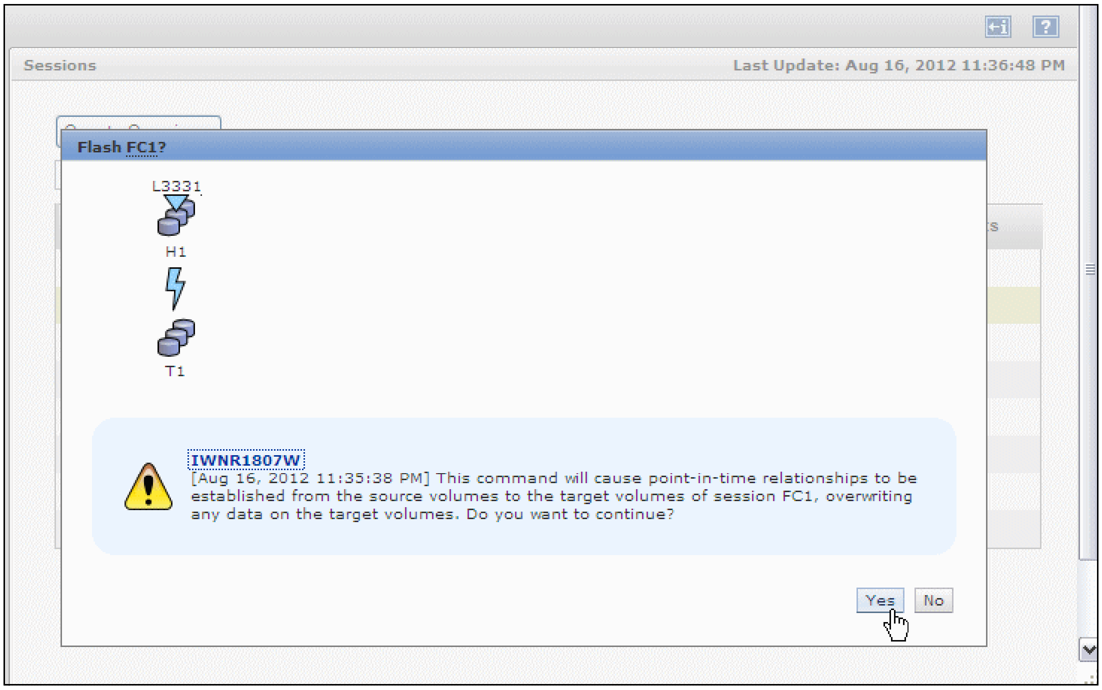

Figure 7-27 Initiate Flash action against FlashCopy session

3. The message at the top of the panel in Figure 7-28 confirms that a FlashCopy session is started. The session has a *Normal* status and the state is *Target Available*. Click the session name hyperlink (*FC1* in our example) to find more details about this session.

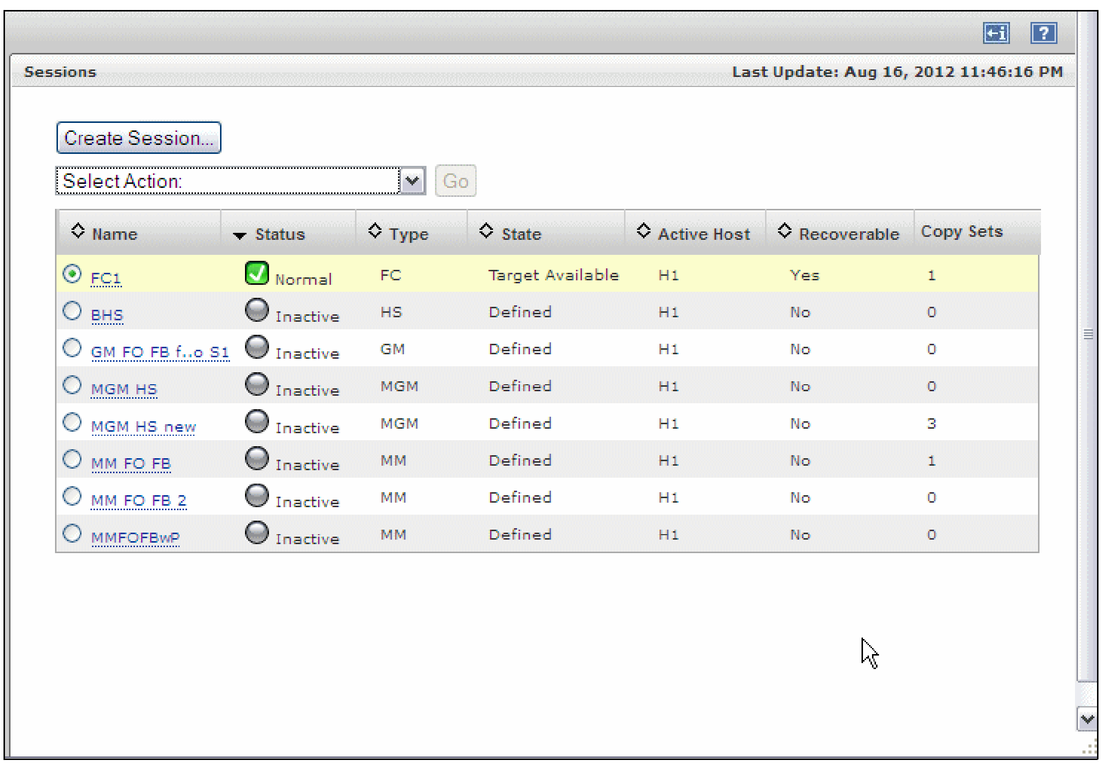

Figure 7-28 Flash action is reported as Completed

After the Flash has been initiated against the FlashCopy session and it has *Normal* status and *Target Available* state, the following options are available:

Initiate Background Copy Copies all tracks from the source H1 volume to the target T1 volume immediately, instead of waiting until the source track is written to.

Flash Performs the FlashCopy operation using the option specified while defining FlashCopy session (Incremental, Persistent or No Copy).

Terminate Terminates the session (see under *Cleanup* submenu).

7.2.4 Initiating a Background Copy against a FlashCopy session

Typically, point in time copy is done using a copy-on-write technique. This technique copies data to the T1 volume before the blocks or tracks of the H1 volume are modified. The point in time volume image is composed of the unmodified data on the H1 volume, and the data that was copied to the T1 volume. If you want a complete point in time copy of the H1 volume to be created on the T1 volume, you should initiate the Background Copy action. This causes the data to be asynchronously copied from the H1 source volume to the T1 target volume. Follow these steps:

1. From the **Sessions** panel, select your FlashCopy session radio button, select **Initiate Background Copy** from the **Action** pull-down list, and click **Go** as shown in Figure 7-29.

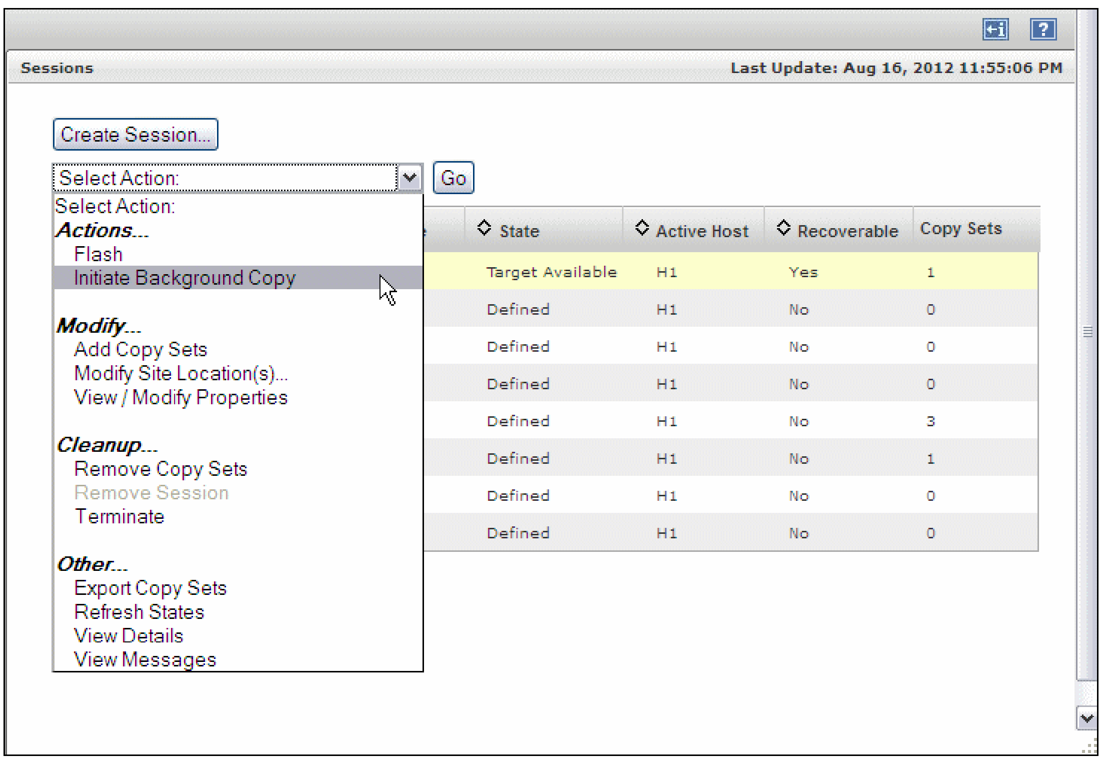

Figure 7-29 FlashCopy session - Initiate Background Copy

2. The next message shown in Figure 7-30 is a warning that you are about to initiate background copy from the source H1 to the target T1 volume. Click **Yes** to continue.

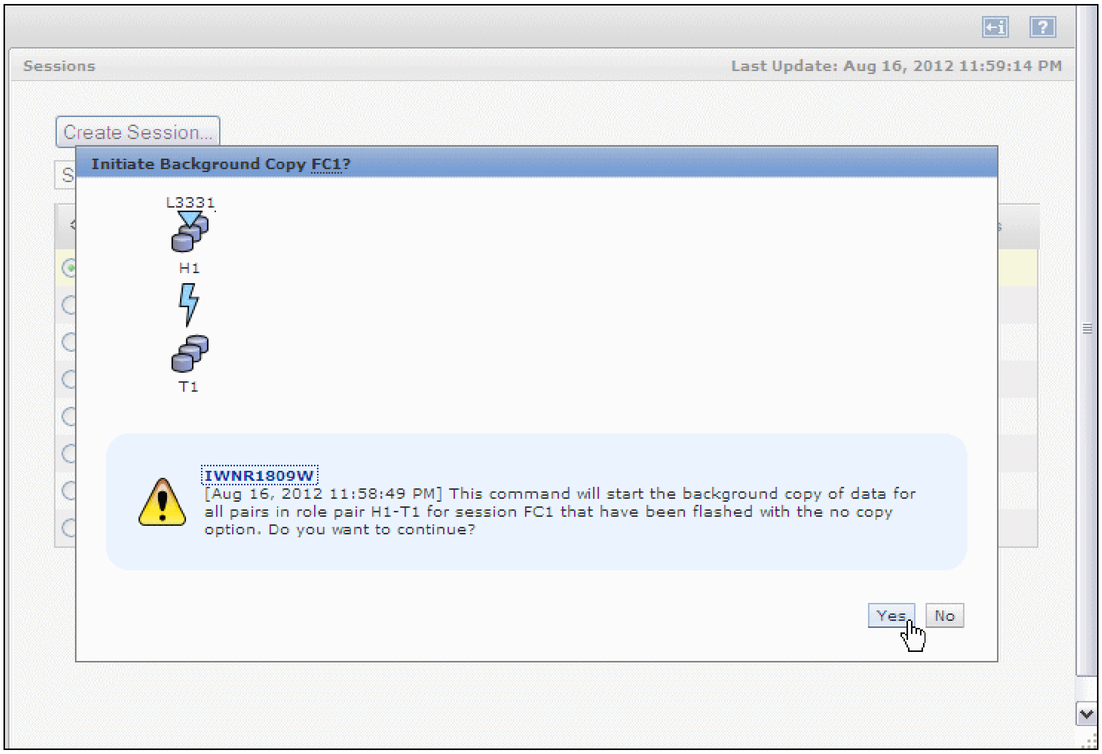

Figure 7-30 FlashCopy session - Confirm background copy action

3. There is a message at the top of the panel in Figure 7-31 indicating that an **Initiate Background Copy** action has been successfully completed. The status of our FlashCopy session is *Normal* and the State is *Target Available*. Click the FlashCopy session name hyperlink (*FC1* in our example) to find out more details and copy progress.

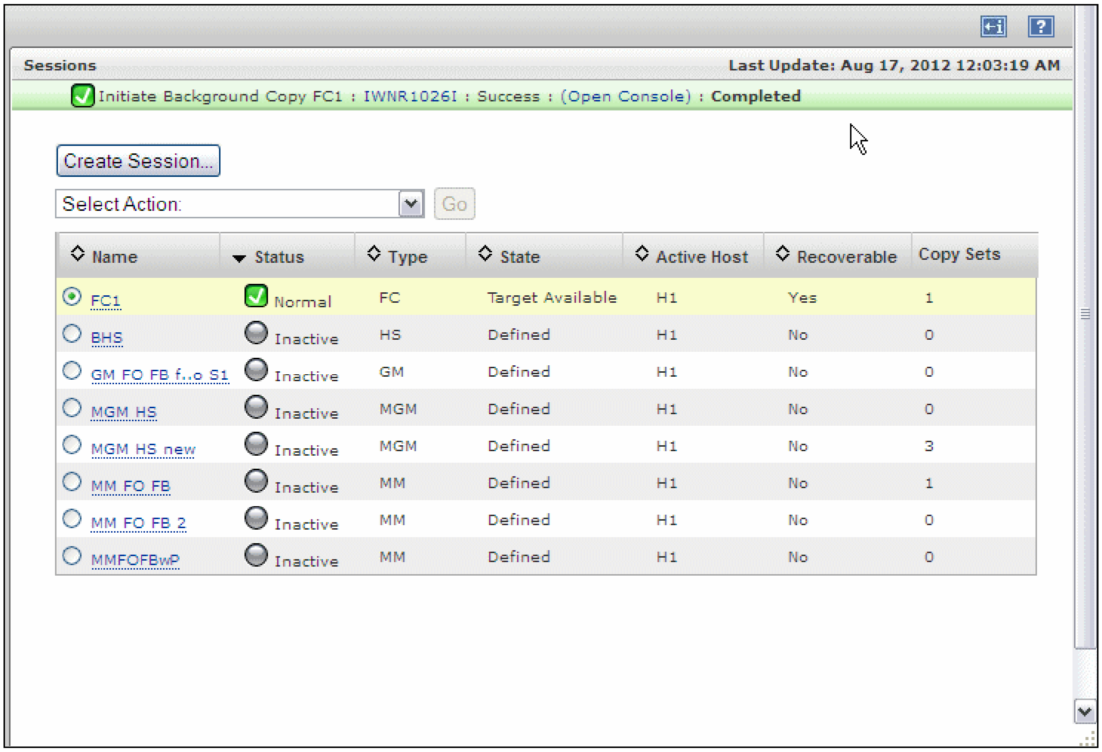

Figure 7-31 Initiate Background Copy action is reported as Completed

4. As shown in Figure 7-32, the copy progress is 100%, indicating that all data from the H1 source volumes has been copied to the T1 target FlashCopy volumes.

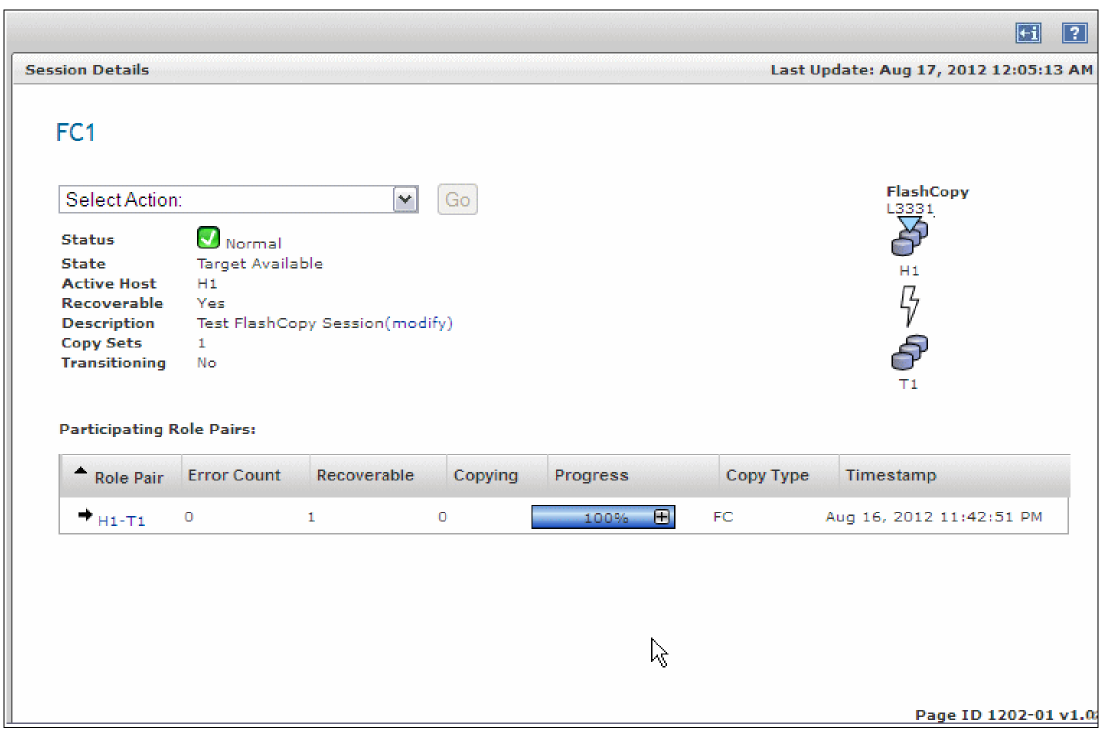

Figure 7-32 FlashCopy session - background copy progress

7.2.5 Terminating a FlashCopy session

The **Terminate** command removes a FlashCopy relationship. This command can be initiated at any point during an active session.

If you want the target T1 volumes to be data consistent before removing their relationship, you must issue the **Initiate Background Copy** action if the **No Copy** option was specified while creating the FlashCopy session, and then wait for the background copy to complete by checking the copying status of the pairs (as described in 7.2.4, “Initiating a Background Copy against a FlashCopy session” on page 282). Follow these steps:

1. Select the FlashCopy session radio button (FC1 in our example shown in Figure 7-33) and the **Terminate** action from the *Select Action* pull-down menu. Click **Go** to continue.

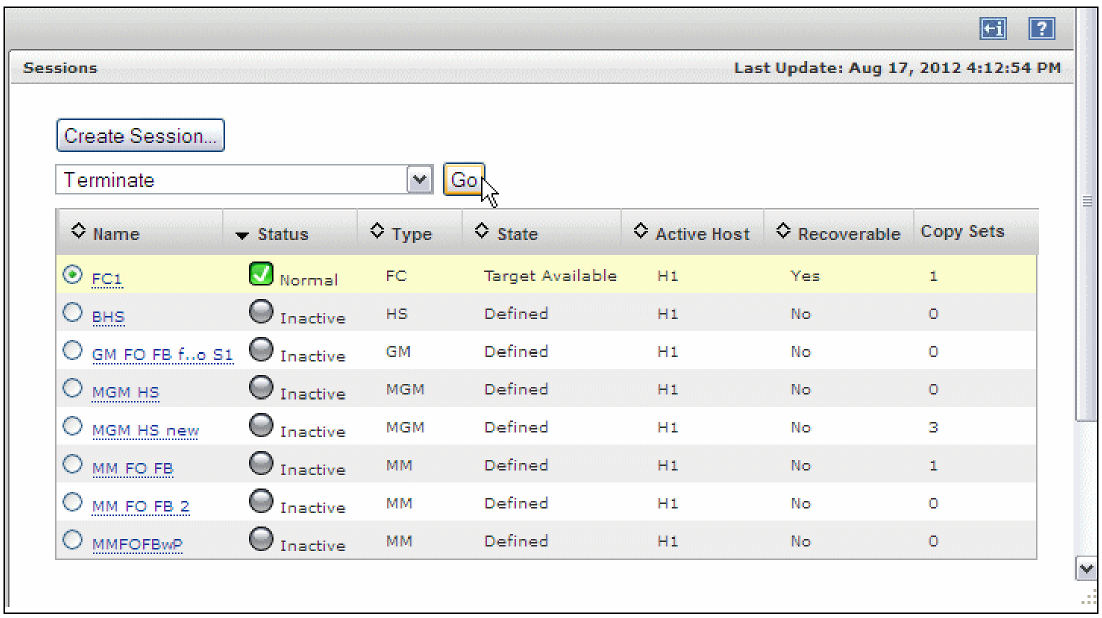

Figure 7-33 FlashCopy session - Terminate action

2. The next message shown in Figure 7-34 is a warning that you are about to terminate the FlashCopy relationship between H1 source and T1 target FlashCopy volumes. Click **Yes** to continue.

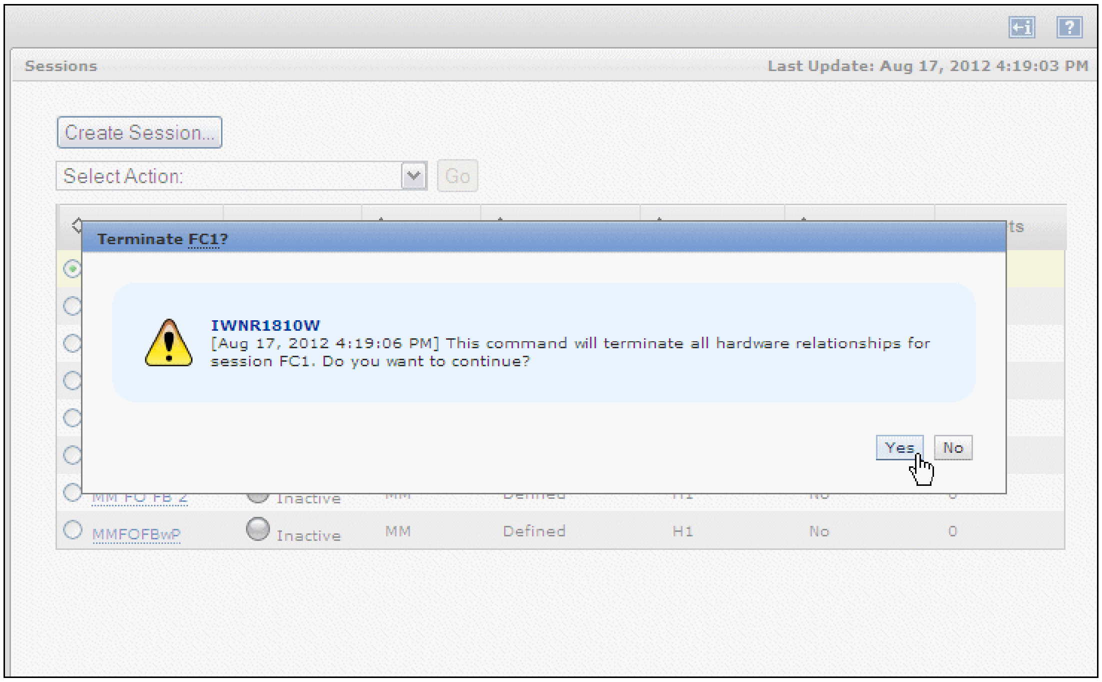

Figure 7-34 Terminate FlashCopy session

3. There is a message at the top of the panel in Figure 7-35 indicating that a **Terminate** action has been successfully completed. The status of our FlashCopy session is now *Inactive* and the state is *Defined*.

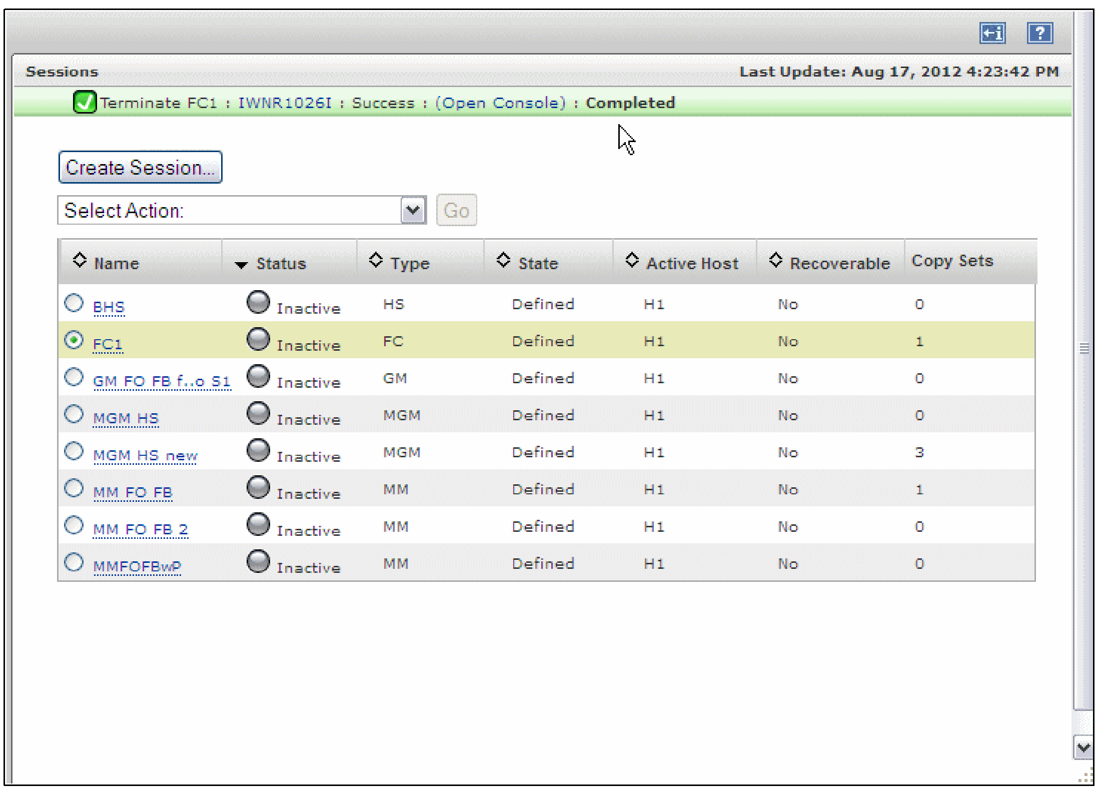

Figure 7-35 Terminate FlashCopy session - Completed

After the FlashCopy session is terminated, the following option is available:

Flash: Performs the FlashCopy operation using the option specified while defining the FlashCopy session (*Incremental*, *Persistent*, or *No Copy*).

7.3 Metro Mirror Single Direction session using the GUI

You may create a session at any time after the server code is installed and up and running. Again, a session is only a token with a name and certain attributes assigned to this session. This is always the same approach independent on the session type. At this point, you need to have storage subsystems defined to the Tivoli Storage Productivity Center for Replication server as described in 4.2.1, "Adding an IBM Storage Server using the Tivoli Storage Productivity Center for Replication GUI".

7.3.1 Creating a Metro Mirror Single Direction session

Figure 7-36 shows that you always start from the Navigation Tree area and click the hyperlink `Sessions`. This provides you with an overview of all defined sessions. We are going to create a new Metro Mirror Single Direction session. Follow these steps:

1. Click **Create Session**.

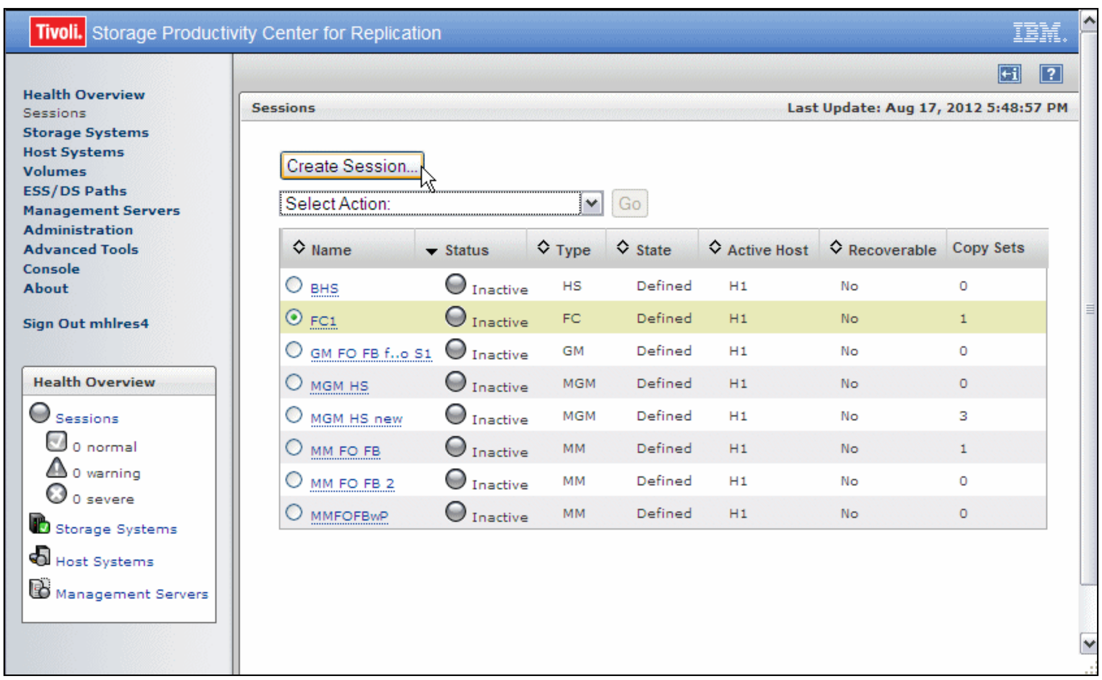

Figure 7-36 Create new session

2. Select the **Metro Mirror Single Direction** session from the pull-down menu as shown in Figure 7-37. On the right side, a pictograph symbolizes the involved sites and their volume types. H1 represents Site 1 volumes and H2 represents Site 2 volumes. When you define Copy Sets, this pictograph helps you to orient and understand the replication direction. Click **Next** to continue.

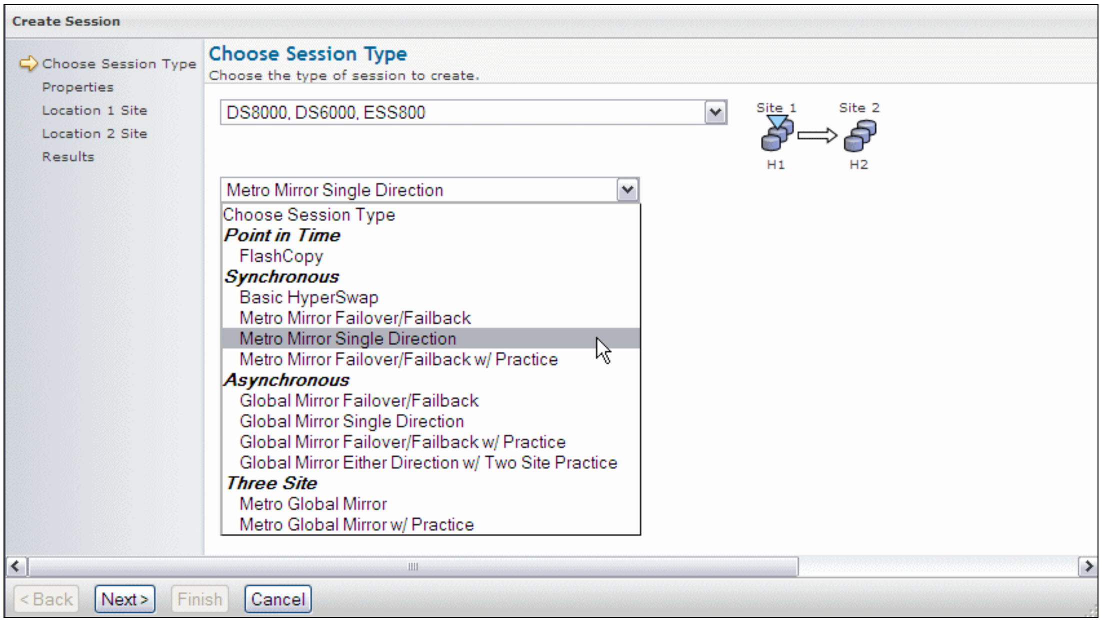

Figure 7-37 Define the Metro Mirror Single Direction session

3. This leads us to the session Properties panel, as Figure 7-38 shows.
4. The *Properties* panel is also important because it requires that you specify at least a name for the session which is about to be created. We choose MM SD as the name for our session. An optional *description* is desirable to understand the purpose of the session because the session name may not reveal what this session is intended for. Figure 7-38 comments are on the storage servers involved in this session. You may add a location of each storage server and a date when the session is created or changed.

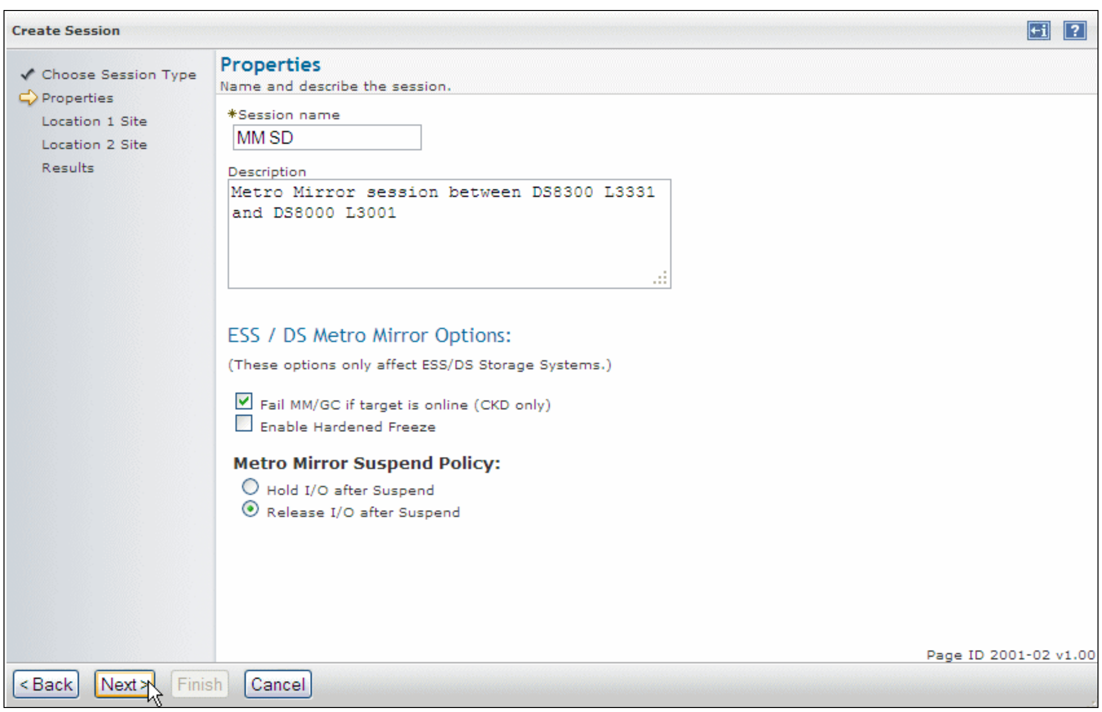

Figure 7-38 Metro Mirror Properties

The Properties panel also gives you the options for you to define the new session. Here we provide some details about what you can specify for a Metro Mirror Single Direction session:

- Fail MM/GC if the target is online (CKD only):

  Use this option to ensure that all target (secondary) volumes in a Metro Mirror session are offline and not visible to any host, otherwise the start of the session task will fail. This applies to CKD volumes only. Use this option since target (secondary) volumes in a Metro Mirror session should be offline to all hosts.

- Enable Hardened Freeze:

  Use this option to let z/OS Input/Output Supervisor (IOS) manage freeze operations for the volumes in the session, which prevents Tivoli Storage Productivity Center for Replication from freezing the volumes and possibly freezing itself. Use this option if you put system volumes, like SYSRES and page data sets, into the Copy Sets of a Metro Mirror session.

  You need the following prerequisites to implement this function:

  – z/OS at 1.13 level, with APAR OA37632 installed, is needed.
  – z/OS address spaces Basic HyperSwap Management (HSIB) and Basic HyperSwap API (HSIBAPI) must be active, even if you are not going to exploit Basic HyperSwap.

- Metro Mirror Suspend Policy:

  Tivoli Storage Productivity Center for Replication, or z/OS IOS if you are using the Enable Hardened Freeze option, issues Freeze commands to all the LSSs defined in an MM session, as soon as a replication error or some primary disk errors occur. All the write I/Os are held at the primary volumes (H1), then the replication between H1 and H2 volumes is suspended. Those Freeze commands thus guarantee that the data in H2 volumes is consistent. The action that Tivoli Storage Productivity Center for Replication, or z/OS, will take subsequent to the Freeze is specified by the Metro Mirror Suspend Policy.
  You basically have two options available:

  – Hold I/O after Suspend, known as Freeze and Stop policy:

    After a freeze, new writes are not allowed to the H1 volumes, thus stopping your production systems.

  – Release I/O after Suspend, known as Freeze and Go policy:

    After a freeze, you can make new writes to the H1 volumes, but no replication will occur to the H2 volumes. This is the default setting for all new sessions.

  Which option you select is really a business decision rather than an IT decision. If your Recovery Point Objective (RPO) is zero (that is, you cannot tolerate any data loss in case of production site disaster), you must select *Hold I/O after Suspend*. This option will hold I/O at the production site on all volumes defined in the session.

  The volumes that belong to a session defined with Hold I/O after Suspend present a Extended Long Busy (ELB) state to all the systems that try to update those volumes. The Extend Long Busy timer is defined in DS8000 or ESS box, at LSS level. The default is 120 seconds. What happens when the timer expires depends on if you are using Enable Hardened Freeze or not:

  If you defined the session without Enable Hardened Freeze, I/Os to the H1 (primary) volumes is automatically resumed after the timer expires. You can, however, allow I/O operations to these primary volumes before the timer expires by performing a Release I/O action in Tivoli Storage Productivity Center for Replication.

  If you defined the session with Enable Hardened Freeze, z/OS holds the I/O operations until you explicitly release them by issuing the z/OS command SETHS RESUMEIO. If you issue this command before the ELB expires, I/O operations continue on hold until either ELB expires or you perform a Release I/O action from Tivoli Storage Productivity Center for Replication.

However, if the event that caused Tivoli Storage Productivity Center for Replication to take **Hold I/O after Suspend** action was a transient event (for example, temporary link lost between sites) rather than a real disaster, you will have brought all production systems down unnecessarily.

If your RPO is higher than zero, you may decide to let the production systems continue operation after the secondary volumes have been protected. This is known as Freeze and Go policy and you need to select *Release I/O after Suspend* option. In this case, if the trigger was only a transient event, you have avoided an unnecessary outage. However, if the trigger was the first sign of an actual disaster, you could continue operating for some amount of time before all systems actually fail (so called ‘Rolling disaster’). Any updates made to the H1 volumes during this time will not have been remote copied, and therefore are lost.

In our example, we use the **Release I/O after Suspend** option as shown previously in Figure 7-38 on page 288.

- Reset Secondary Reserves:

  This option is not shown in the Properties panel when you create a new session. But it can be accessed later using the View/Modify Properties panel.

  Select this option to remove any persistent reserves that might be set on the target volumes of the copy sets being started when a Start command is issued for the session.

  Before enabling the Reset Secondary Reserves option, be aware that this action causes the session to overwrite all data on the target volume.

Defining the location sites

To define the location sites, follow these steps:

1. Click **Next**.
2. From the pull-down **Site 1 Location** menu (see Figure 7-39), select the storage subsystem where your primary volumes reside. Click **Next** to continue.

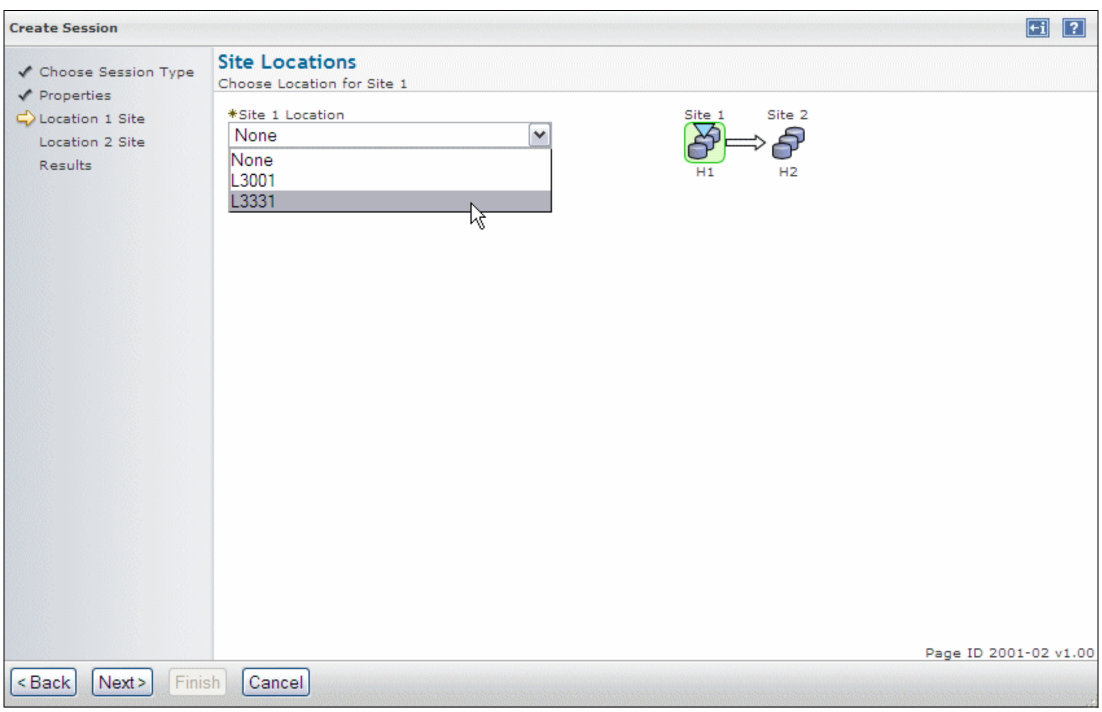

Figure 7-39 Define Metro Mirror session Site 1 Location

3. From the pull-down **Site 2 Location** menu (see Figure 7-40), select your H2 storage subsystem previously defined and click **Next** to continue.

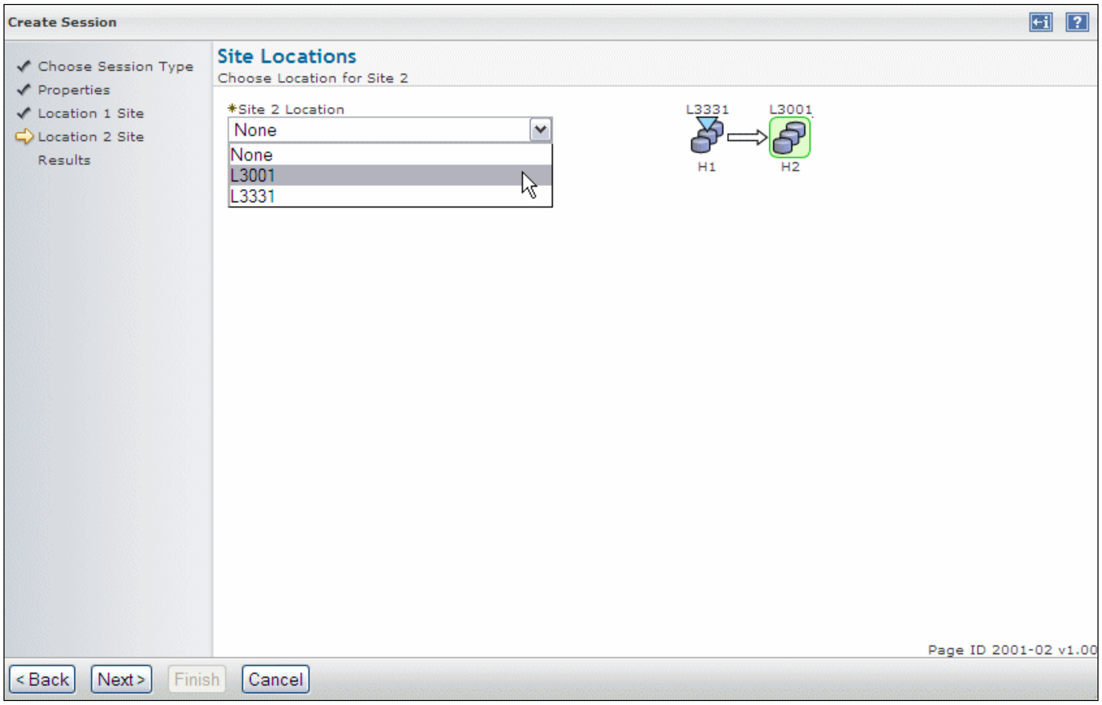

Figure 7-40 Define Metro Mirror session Site 2 Location

4. Figure 7-41 displays the message that the MM SD session was successfully created. Click **Finish** to exit the Create Session wizard. Alternatively, you have an option to add Copy Sets and click **Launch Add Copy Sets Wizard** and follow the instructions described in "Adding Copy Sets to a Metro Mirror session" on page 292.

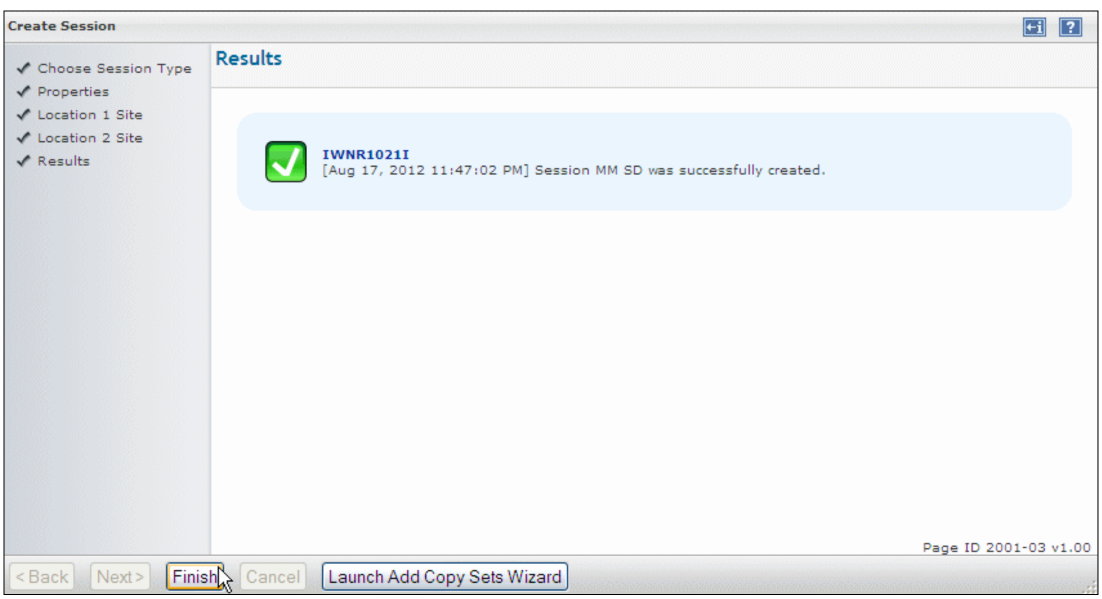

Figure 7-41 Define Metro Mirror session - Results

5. Go back to the Tivoli Storage Productivity Center for Replication home page and select **Sessions** hyperlink to check on the recently created Metro Mirror session. Figure 7-42 now displays the MM SD session, which we successfully created.

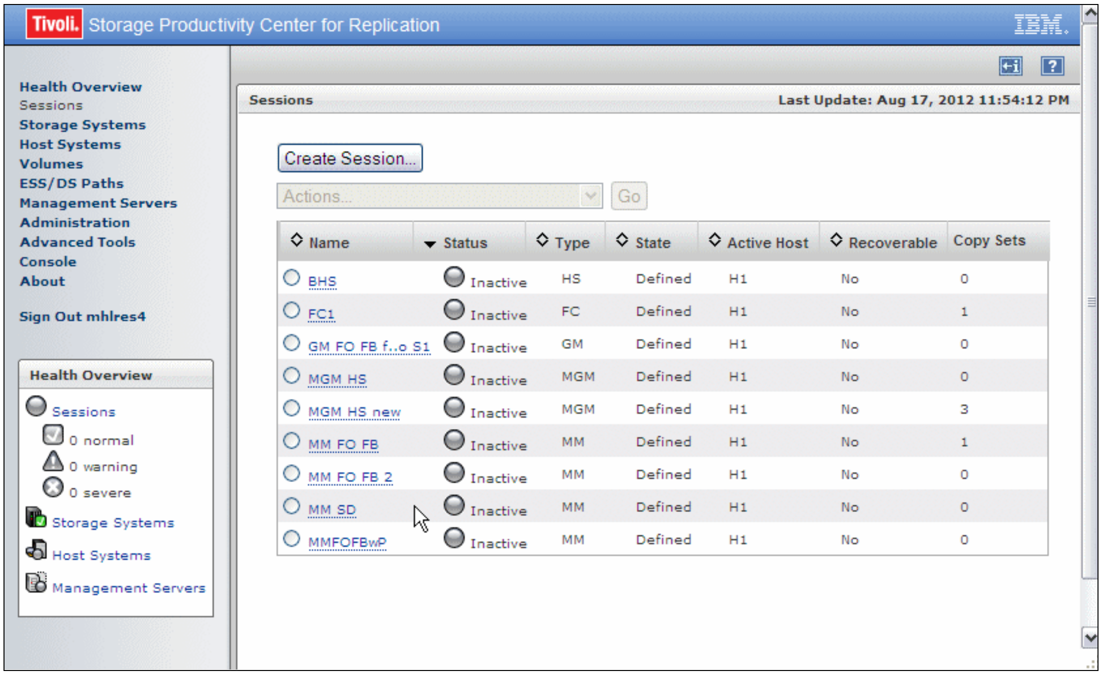

Figure 7-42 Metro Mirror session defined

7.3.2 Adding Copy Sets to a Metro Mirror session

After we have defined the Metro Mirror session MM SD, we can populate this session in the next step with Copy Sets. Copy Sets are Copy Services volume pairs. For example, in a Metro Mirror session a Copy Set consists of one H1 and one H2 Metro Mirror volume.

Figure 7-43 shows the session overview panel with the session MM SD that we defined previously. The next logical action that you perform on session MM SD is to add volume pairs or Copy Sets to it. Follow these steps:

1. Select your Metro Mirror session name radio button (MM SD in our example) and choose **Add Copy Sets** from the **Select Action** pull-down menu. Click **Go** to invoke the Add Copy Sets wizard.

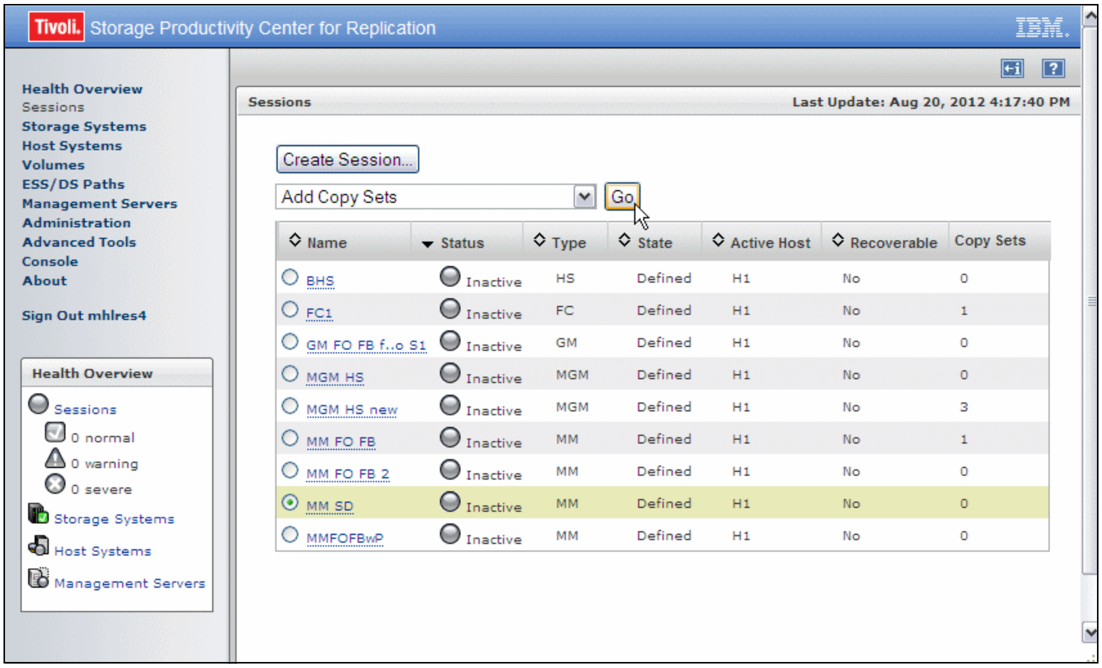

Figure 7-43 Add Copy Sets to Metro Mirror Single Direction session

Note that over time, various terminology is introduced for the same thing. Peer-to-Peer Remote Copy or PPRC (known today as Metro Mirror) started out with primary volumes and secondary volumes. This terminology was fine for a 2-site solution. With the arrival of switching sites from an application viewpoint as well as for the storage subsystem used, Tivoli Storage Productivity Center for Replication introduced a different terminology for these PPRC volumes and their association to a certain site.

Host 1 or Site 1 refers to the primary volumes as a starting point. This may also be the local site or application site. It may always be considered as the customer primary site. But it has the potential to change. A customer may want to switch application sites from Host 1 to Host 2 in Site 2, and also switch at the same time the Copy Services role of the associated storage subsystems. This led to Host 1, Site 1 volumes and Host 2, Site 2 volumes terminology being used in Tivoli Storage Productivity Center for Replication.

2. Figure 7-44 displays the panel which provides details on the primary volumes or local volumes which are called Host 1 volumes relating to the fact that these volumes reside in the Site 1 (also referred to as the application site or local site). These are all synonyms and refer to the same environment. Select the desired **Host 1 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Host 1 logical storage subsystem** list. Select the LSS where your H1 volume resides. After the LSS has been selected, choose the appropriate volume from the **Host 1 volume** pull-down list.
3. The alternative way to add a large number of volumes to this session is to create a CSV file as explained in "Importing Copy Sets into an existing session" on page 207. In case you have an existing CSV file select **Use a CSV file to import copy sets** check box and provide a path to your CSV file.
4. In our scenario, we selected the DS8000 disk subsystem that we defined in our Host 1 location and the appropriate volumes, as shown in Figure 7-44. Click **Next** to continue.

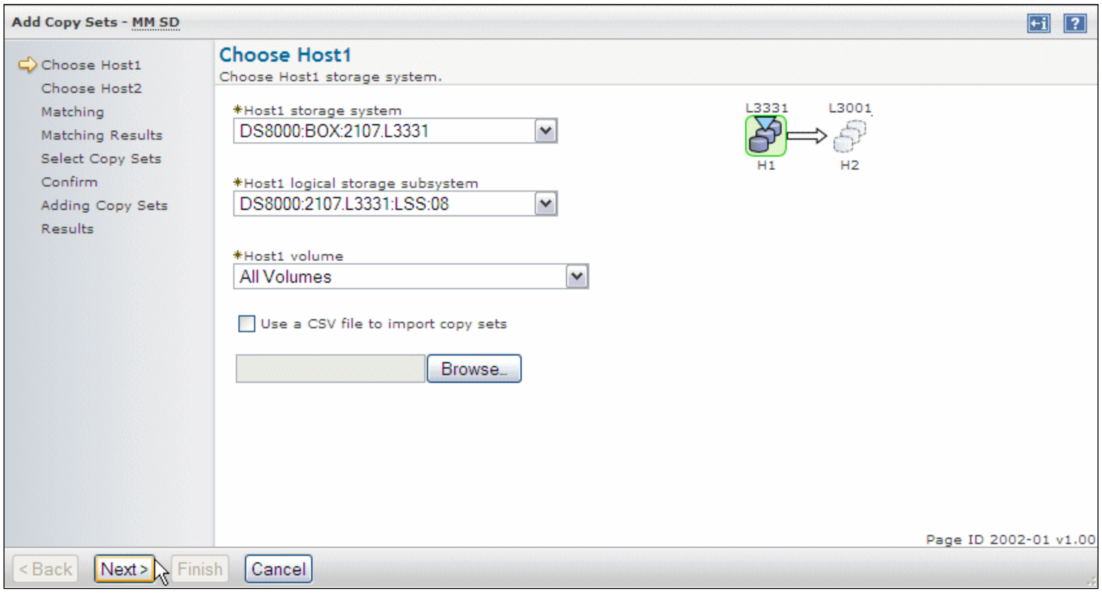

Figure 7-44 Add Copy Sets to Metro Mirror Single Direction Session - Choose Host 1

5. Choosing one volume at a time can be very tedious if you are need to specify a large numbers of volumes. In this case, it worth selecting the option **All Volumes** from the **Host1 volume** list as shown in Figure 7-45. You have the option to deselect the ones that you do not want to be in the session at a later time. Click **Next** to continue.

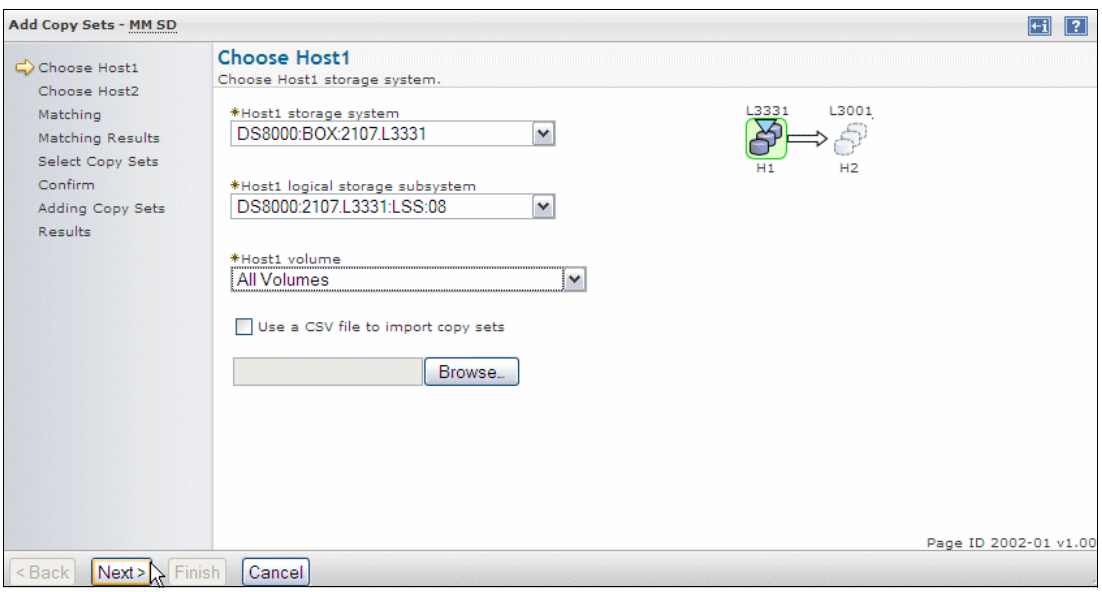

Figure 7-45 Add Copy Sets to Metro Mirror Single Direction session - Host 1 and All Volumes option

6. The next step is to define Site 2 storage subsystems and volumes (Figure 7-46). Select the desired **Host 2 storage subsystem** from the pull-down menu; wait for a few seconds to get the **Host 2 logical storage subsystem** list. Select the LSS where your H2 volume resides. If **All volumes** for a given LSS were selected in the previous step while defining Host 1 volumes, you do not have an option to select any volume from **Host 2 volumes** list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 1 storage subsystem with all volumes from selected LSS in Host 2 storage subsystem. In our scenario, we selected **All volumes** in the Choose Host1 step. Click **Next** to continue.

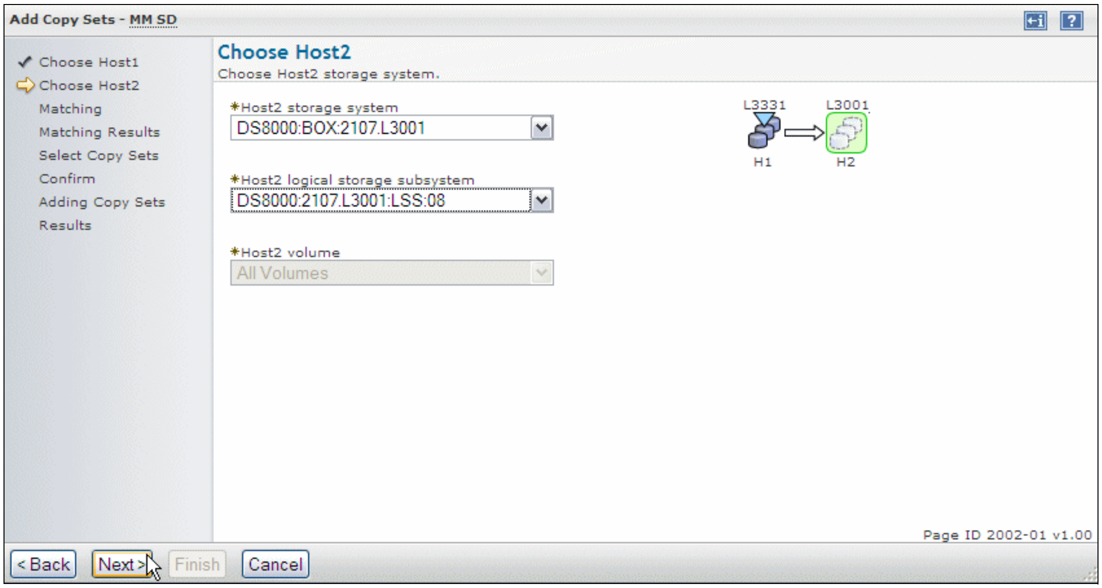

Figure 7-46 Add Copy Sets to Metro Mirror Single Direction session - Host 2 and All Volumes option

7. The next panel in Figure 7-47 displays a message with regard to the matching results. However, this warning message does not mean the failure of Copy Sets creation. Click **Next** to see the list of available Copy Sets and the reasons for the warning message.

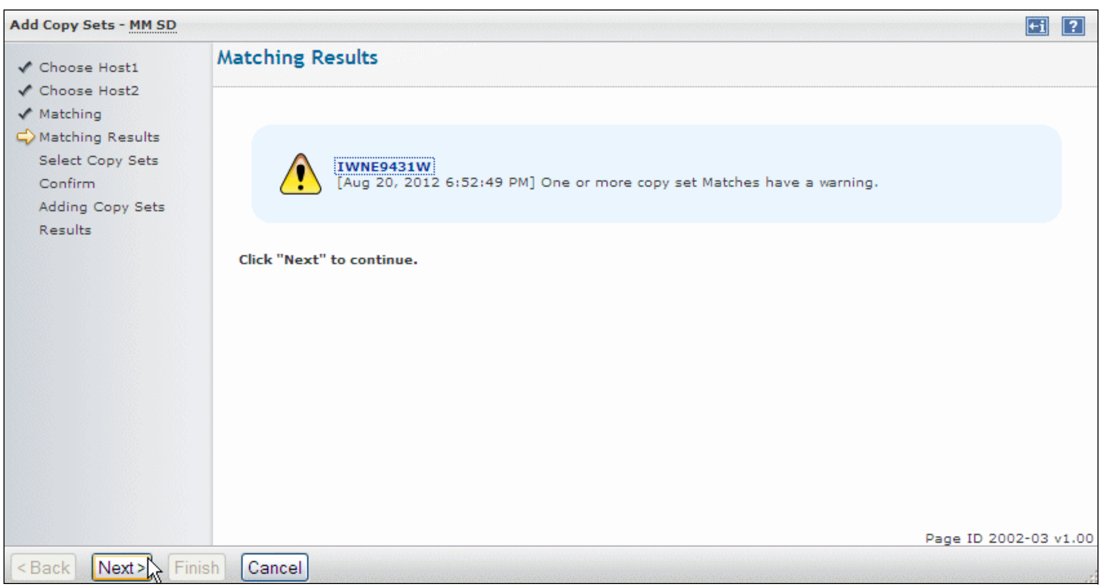

Figure 7-47 Add Copy Sets to Metro Mirror Single Direction Session - Matching Results

8. In our example, one volume pair has a warning and if you click the *Show* hyperlink next to it, the message description appears as shown in Figure 7-48. This particular H1 volume is already defined in the FC1 session that we created previously, as described in topic 7.2, “FlashCopy session using the GUI” on page 268. In our case, we can ignore this warning as we are going to keep FC1 session inactive.

9. The rest of the volumes met the matching criteria and are automatically selected. You still have a chance to modify the current selection and deselect any of the volume pair included in the list. The *Show* hyperlink next to each matching volume pair provides Copy Set information. In our example, we clicked on the **Deselect All** button, then we selected some Copy Sets that were available. Click **Next** to continue.

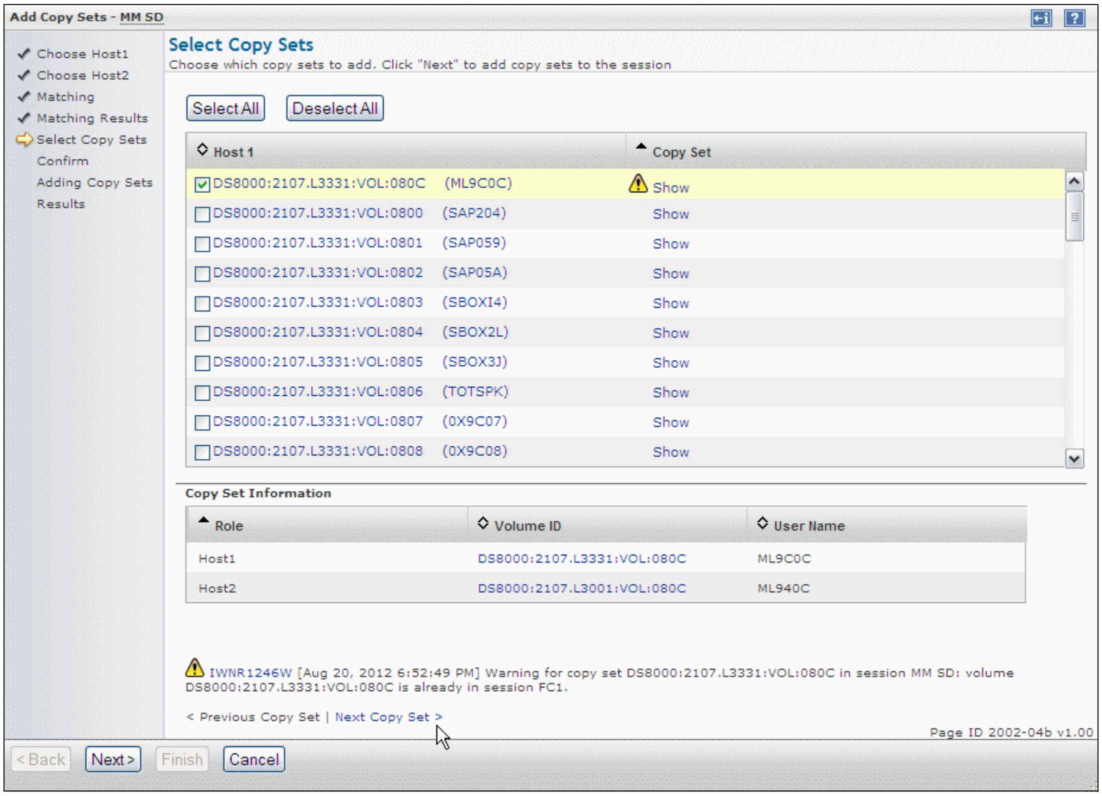

Figure 7-48 Add Copy Sets to Metro Mirror Single Direction Session - Select Copy Sets

10.The next panel displays the number of Copy Sets that are going to be created as well as the number of unresolved matches as shown in Figure 7-49. These unresolved messages are a result of our deselecting 47 volumes from the panel shown in Figure 7-48. Click **Next** to continue.

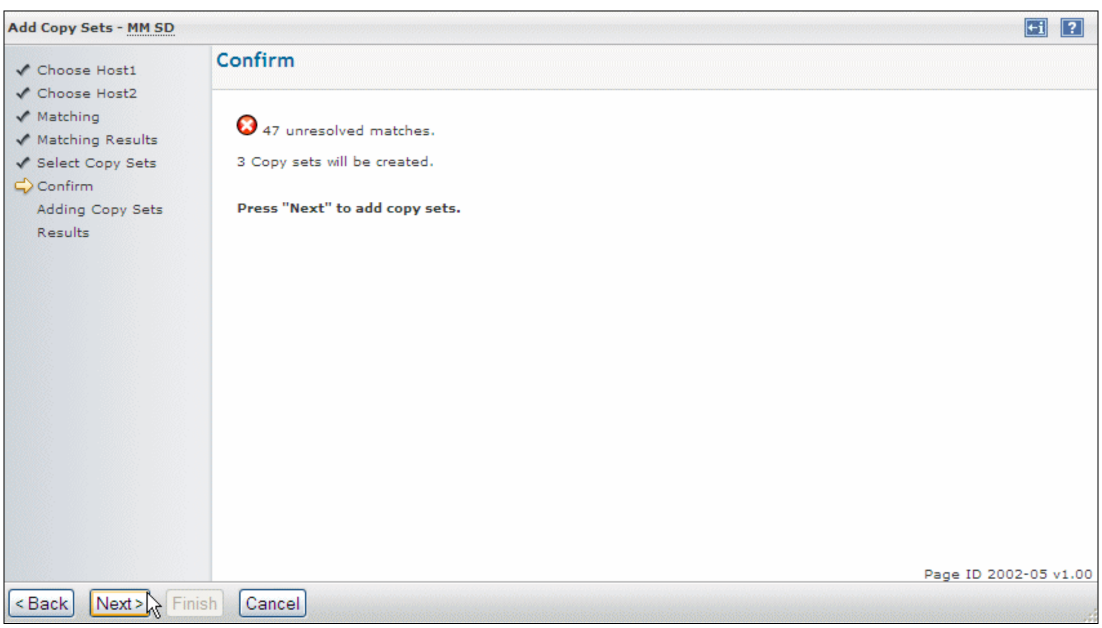

Figure 7-49 Add Copy Sets to Metro Mirror Single Direction session - Confirm

11. Tivoli Storage Productivity Center for Replication internally adds these 3 Copy Sets to its database. Note that this does not start to establish Metro Mirror copy pairs. It is just a Tivoli Storage Productivity Center for Replication internal process to add these Copy Sets to the Tivoli Storage Productivity Center for Replication database inventory database.

12. It takes a few seconds for Tivoli Storage Productivity Center for Replication to add the Copy Sets to this session. After that, it shows a panel as shown in Figure 7-50 with the results. The warning is still present, as we used a volume in one Copy Set in this MM SD session that was also used in another Copy Set for session FC1. Click **Finish** to exit the *Add Copy Sets* wizard.

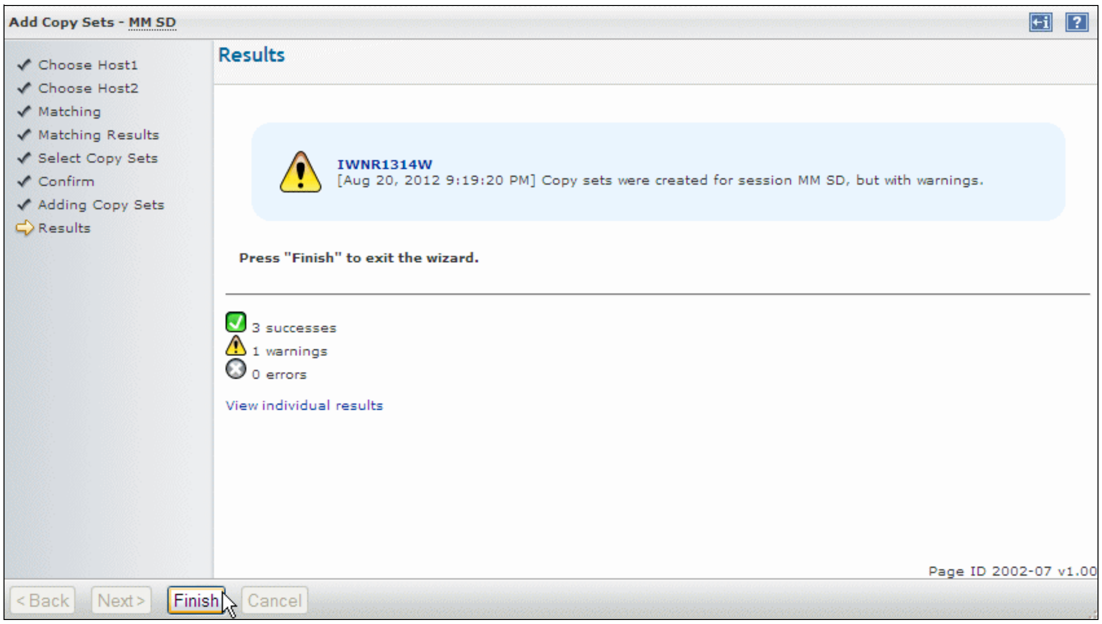

Figure 7-50 All Copy Sets created with warnings

13. Figure 7-51 confirms that all Copy Sets (3) are successfully added to the session MM SD and the database is successfully updated. The session status is still *Inactive*.

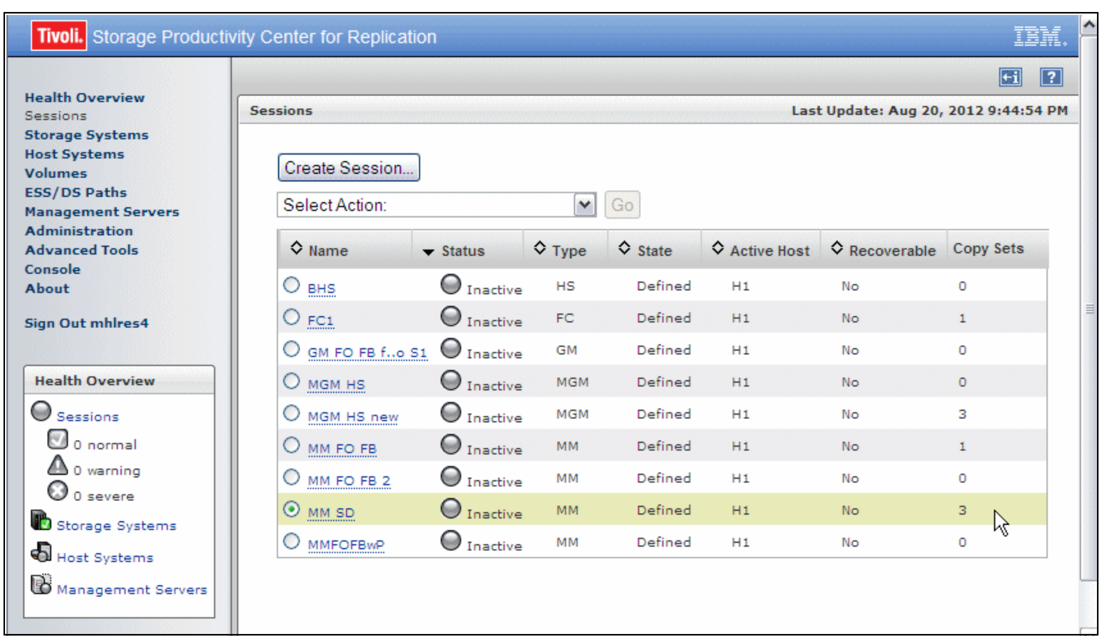

Figure 7-51 Add Copy Sets to MM SD session completed

This concludes the steps through the GUI when you add Copy Sets to a Metro Mirror session.

7.3.3 JES3 considerations

When you select the Enable Hardened Freeze option in the Properties panel, z/OS tries to load a HyperSwap configuration when you start the session, *even if you are not going to exploit Basic HyperSwap*. In order for this load of a HyperSwap configuration to be successful, you must vary offline all the H2 volumes (secondary addresses of a Metro Mirror session) offline to all z/OS systems and also to all JES3 instances. If you do not vary the secondary disks to JES3, JES3 will still own that secondary volumes, and it will not allow the load of a Basic HyperSwap configuration.

You need to issue the JES3 *VARY command, to vary all the secondary volume address offline to JES3 and MVS. The syntax of the JES3 *VARY OFFLINE to all systems in a JESPLEX is:

```
*V devnum,OFF,ALL
```

You can use the JES3 INQUIRY command to display the status of a device address. The following is an example on how to use the INQUIRE command. In this example, we are checking the status of device addresses 948A to 948C.

```
*I D,D=948A
IAT8572 948A (OFF) SC64     ML9C8A,JES=P,OS=P
IAT8572 948A (OFF) SC70     ML9C8A,JES=P,OS=P
IAT8572 948A (OFF) SC65     ML9C8A,JES=P,OS=P
```

The preceding display shows that the device address 948A is offline to the JES3 address spaces on systems SC64, SC70 and SC65.

7.3.4 Starting Metro Mirror session

After we have defined a Metro Mirror session and populated the session with Copy Sets, we can start the Metro Mirror session. Follow these steps:

1. Start the session by choosing **Start** or **StartGC** from the pull-down Selection Action Menu:
   - **Start:**

     Starts the replication between in H1 and H2. As soon as all tracks of a H1 volume are copied to its peer H2 volume, the Copy Set enters Prepared state. At this time, replication between H1 and H2 volumes switches to synchronous replication.

     When all the Copy Sets in a session are in Prepared State, the session itself changes its state to Prepared.
   - **StartGC:**

     Starts Global Copy (asynchronous replication) between H1 and H2 volumes. You can use this option for migrating data from one disk subsystem to another, for example.

     Some large configurations prefer to start the replication from one disk subsystem to another in asynchronous mode, as they are expected to impact less the productions systems during the initial copy phase, when all tracks are copied from H1 to H2 volumes. After all Copy Sets have reached almost 100% of data replicated, they switch to synchronous replication, by choosing Start command from the pull-down menu.

2. Figure 7-52 displays the session MM SD as we defined it previously. We defined only three Copy Sets in our example. From the **Select Action** pull-down menu, select **Start** and click **Go**.

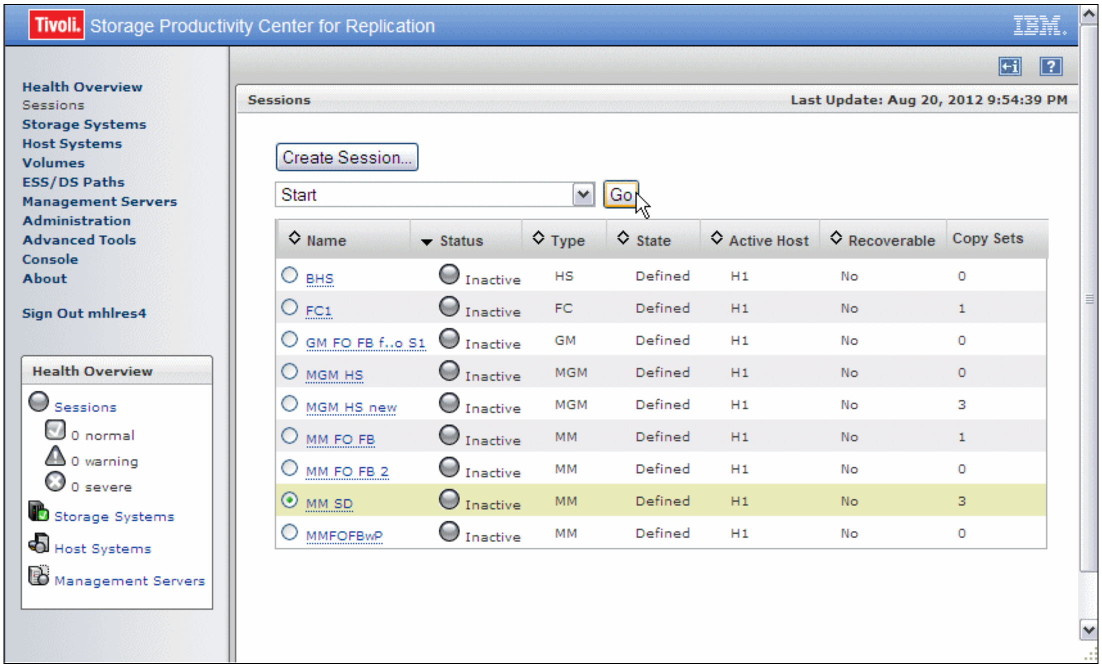

Figure 7-52 Metro Mirror session - Start Action

3. The next message shown in Figure 7-53 is a warning that you are about to initiate a Metro Mirror session. It will start copying data from the Host 1 to Host 2 volume defined previously by adding the Copy Set, thus overwriting any data on Host 2 volume. Click **Yes** to continue.

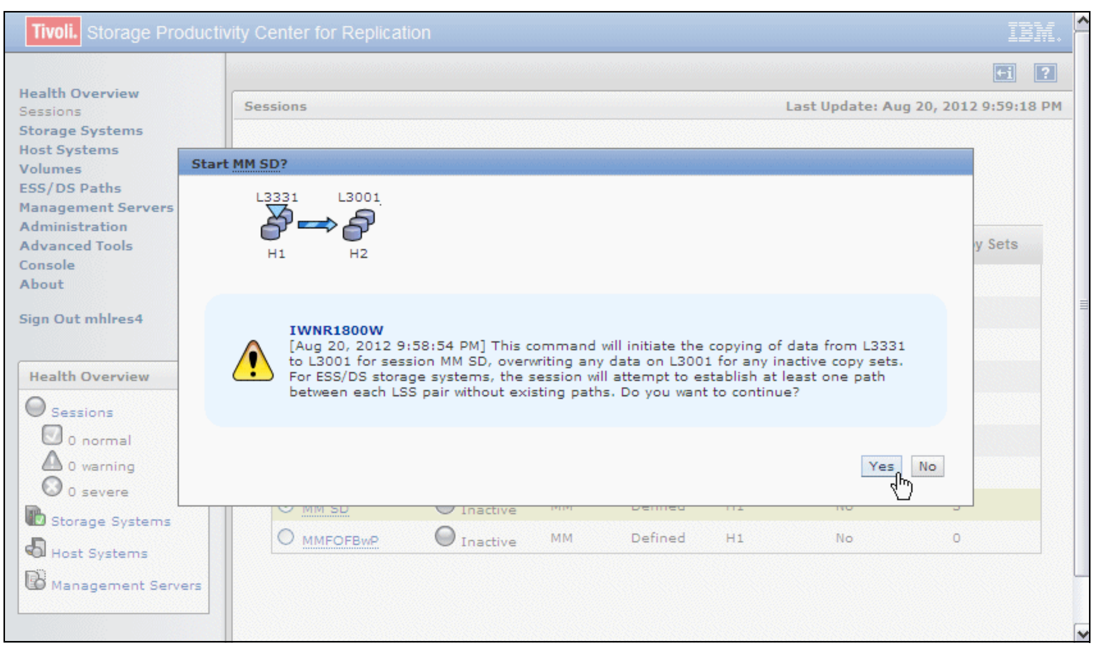

Figure 7-53 Start Metro Mirror Single Direction session

4. The message at the top of the panel in Figure 7-54 confirms that Metro Mirror session is started. The session is in *Preparing* state and *Warning* status. Click the session name hyperlink (**MM SD** in our example) to find more details about this session.

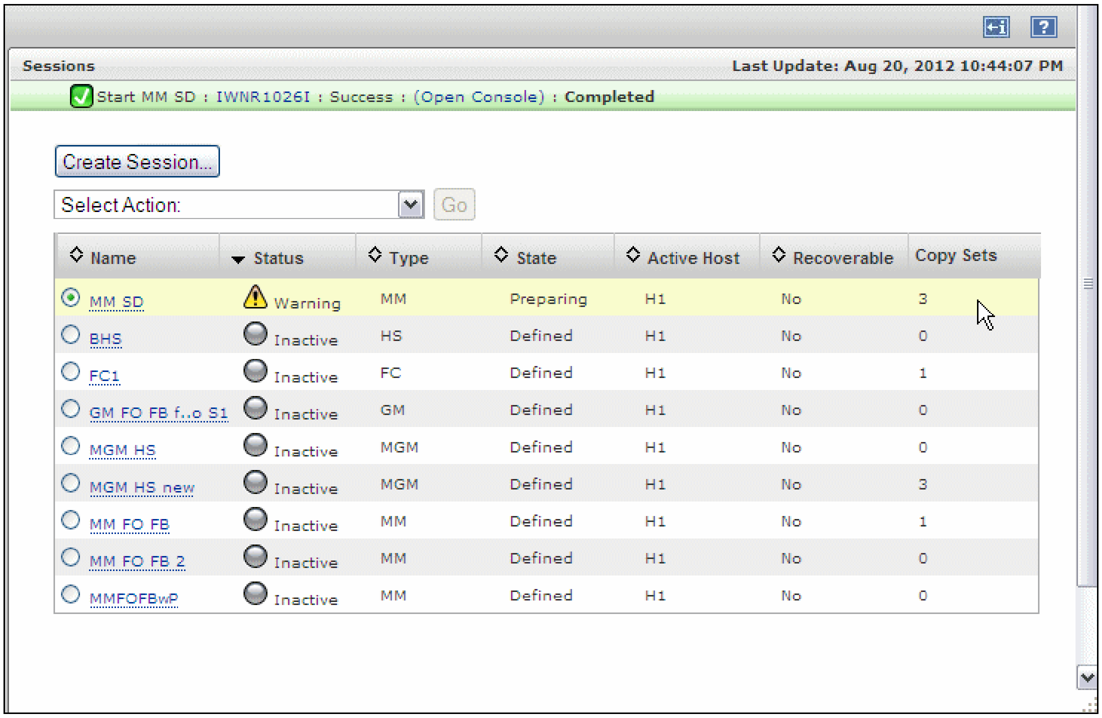

Figure 7-54 Start Metro Mirror session is reported as Completed

5. As shown in Figure 7-55, the Metro Mirror session has *Normal* status and there are no errors. The copy progress is 100% and the session has changed to *Prepared* state. Click the **Sessions** hyperlink in the Navigation tree area.

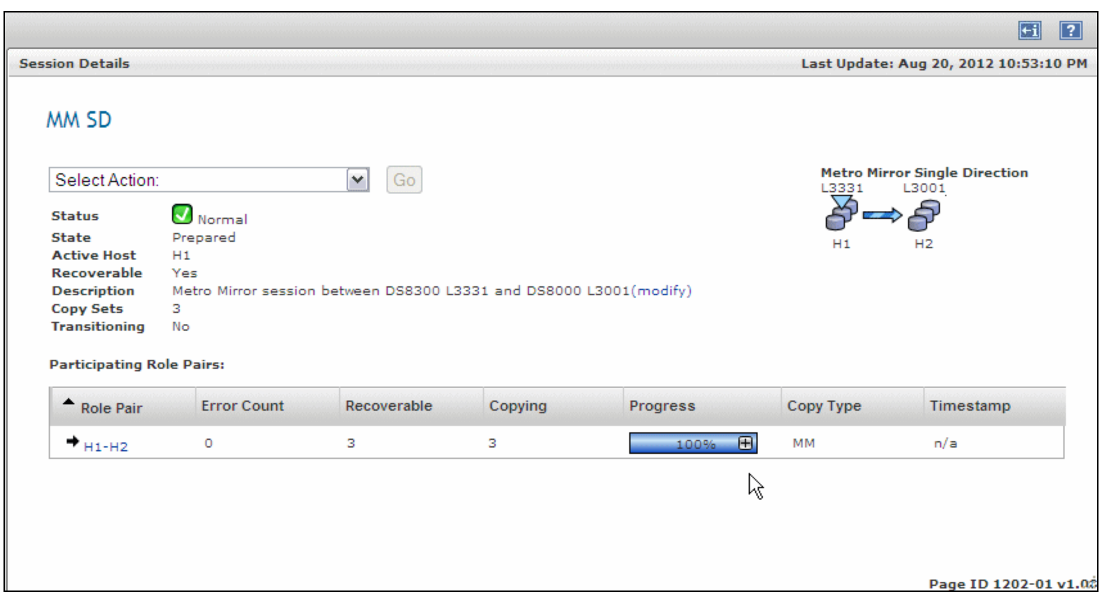

Figure 7-55 Metro Mirror session details

6. Figure 7-56 shows the health overview of our Metro Mirror session.

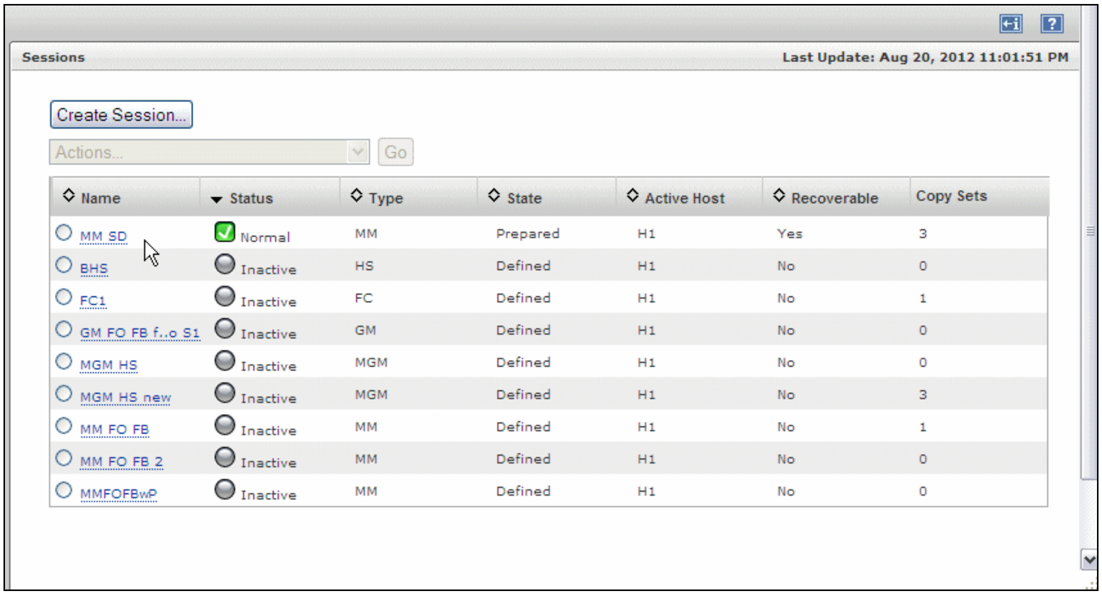

Figure 7-56 Tivoli Storage Productivity Center for Replication - Sessions

If the session was created with the Enable Hardened Freeze option, you see the following set of messages when all Metro Mirror pairs reach Full Duplex state (Prepared).

```
IOSHM0200I MetroMirror Configuration Load complete
IOSHM0808I HyperSwap Configuration Monitoring started, time interval
= 5 minutes
```

Although we are not using Basic HyperSwap, z/OS activates the HyperSwap Configuration Monitoring, in order to watch for all the freeze triggers that can occur in any system in the sysplex.

After the Metro Mirror session is started and it has *Normal* status and is in *Prepared* state. the following actions are available:

StartGC Switches from Metro Mirror to Global Copy between H1 and H2 volumes.

Suspend Suspends the replication. Primary disk subsystems keep a bit map of tracks changed, to be used when you start the replication again.

Stop Stops replication with inconsistent H2 volumes.

Start Reestablishes replication.

Terminate Terminates the session (under Cleanup submenu).

7.3.5 Switching to Global Copy

You can switch the MM SD session from Metro Mirror to Global Copy replication. To do the switch, follow these steps:

1. Select the session that you are working on (MM SD in our example), then choose **StartGC** from the **Action** pull-down list. Click **Go** to continue. See Figure 7-57.

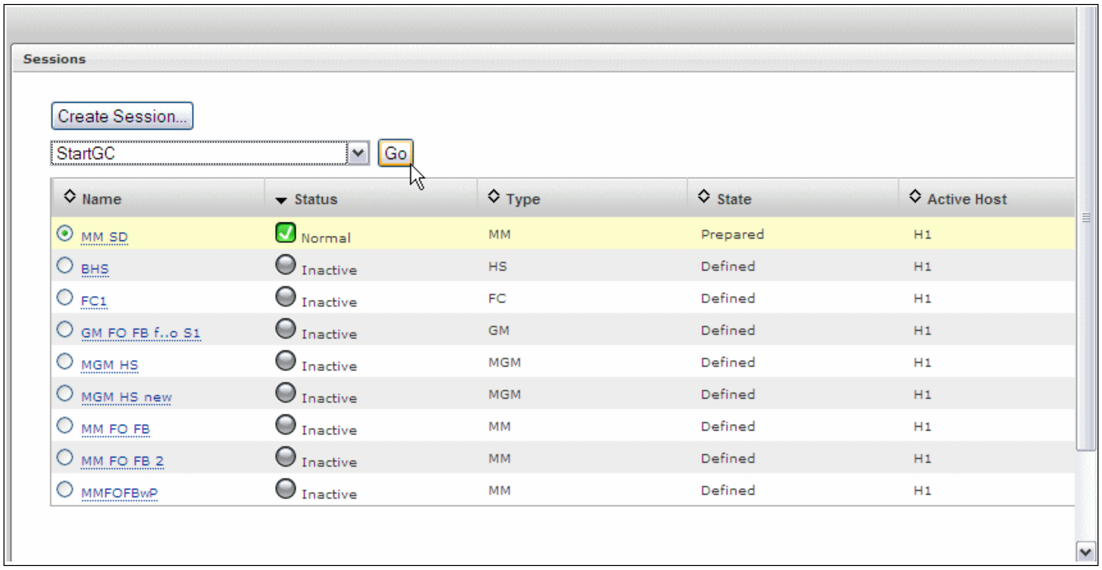

Figure 7-57 Switching from Metro Mirror to Global Copy

2. When you switch from synchronous replication to asynchronous replication, the data on H2 volumes is no longer consistent. Because of this, Tivoli Storage Productivity Center for Replication shows a warning as in Figure 7-58. Click **Yes** to confirm that you really want to convert the session to Global Copy mode.

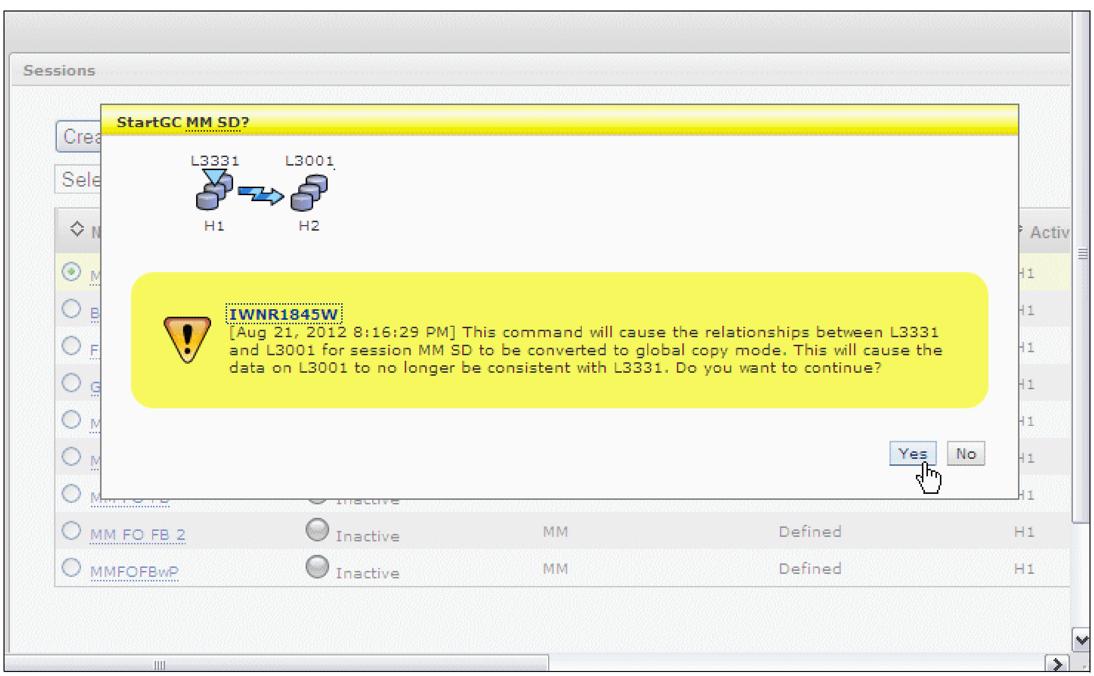

Figure 7-58 Global Copy warning

3. Figure 7-59 shows the Sessions panel. Session MM SD is now shown with a *Warning* status and in *Preparing* state. It shows Preparing state as long as it stays in Global Copy mode.

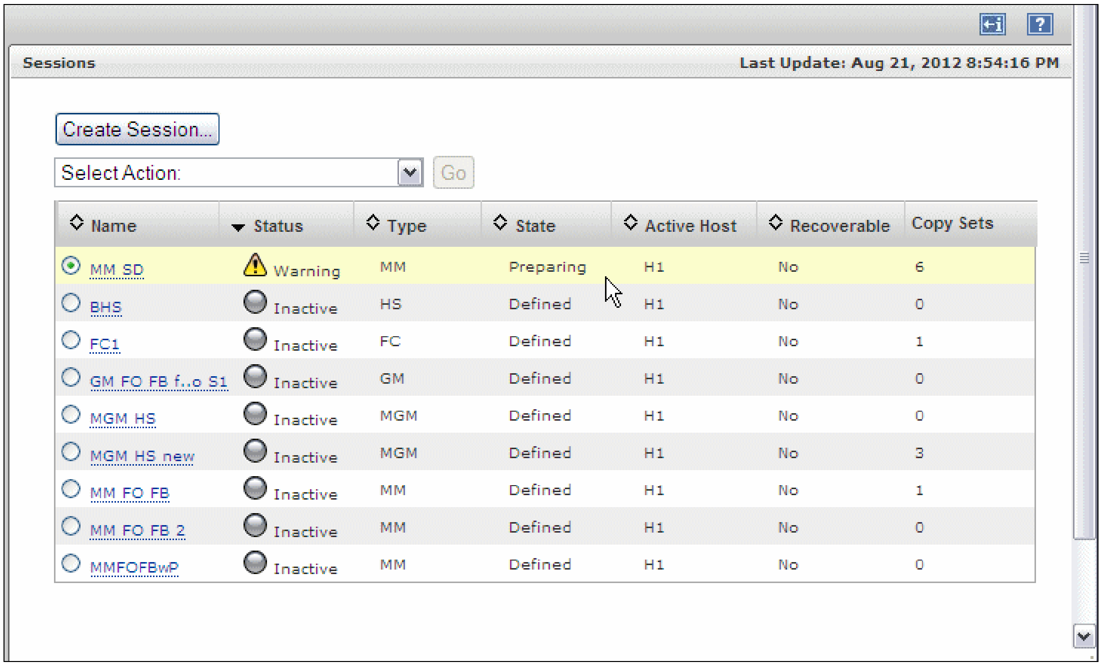

Figure 7-59 Session MM SD in Preparing state

4. You can switch this session back to synchronous replication (Metro Mirror) by selecting the session MM SD radio button, then **Start** from the Select Action pull-down menu and clicking **Go**. Session MM SD status goes back to Normal, and its state changes back to Prepared.

7.3.6 Suspending a Metro Mirror session

You can suspend a Metro Mirror session by using the following procedure:

1. From the **Sessions** panel, select your Metro Mirror session radio button.
2. Select **Suspend** from the **Actions** pull-down list.
3. Click **Go** to continue.

   See Figure 7-60 for details.

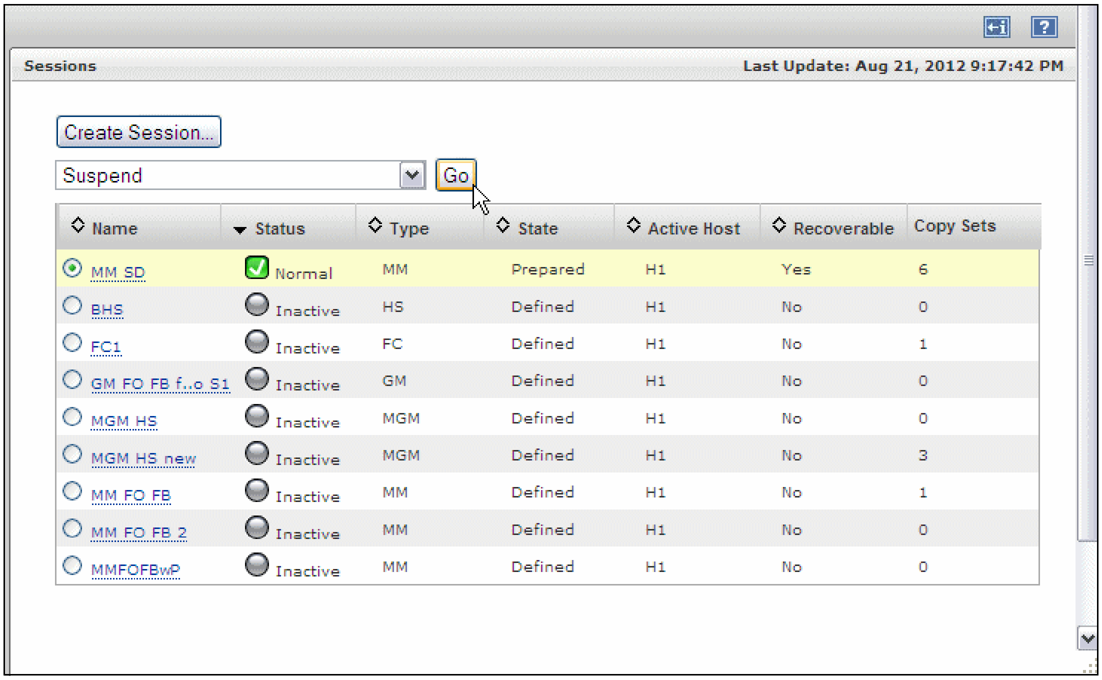

Figure 7-60 Metro Mirror session - Suspend Action

4. The next message shown in Figure 7-61 is a warning that you are about to suspend the Metro Mirror session.

> **Note:** After the Suspend is initiated, all host I/O is temporarily halted if **Release I/O after Suspend** has been selected during the Metro Mirror session creation step (see 7.3.1, “Creating a Metro Mirror Single Direction session” on page 287). In case **Hold I/O after Suspend** policy has been selected, then all systems that can update the H1 volumes that are on hold before the Extended Long Busy (ELB) for CKD volumes ends (default is 120 seconds).

5. Click **Yes** to continue.

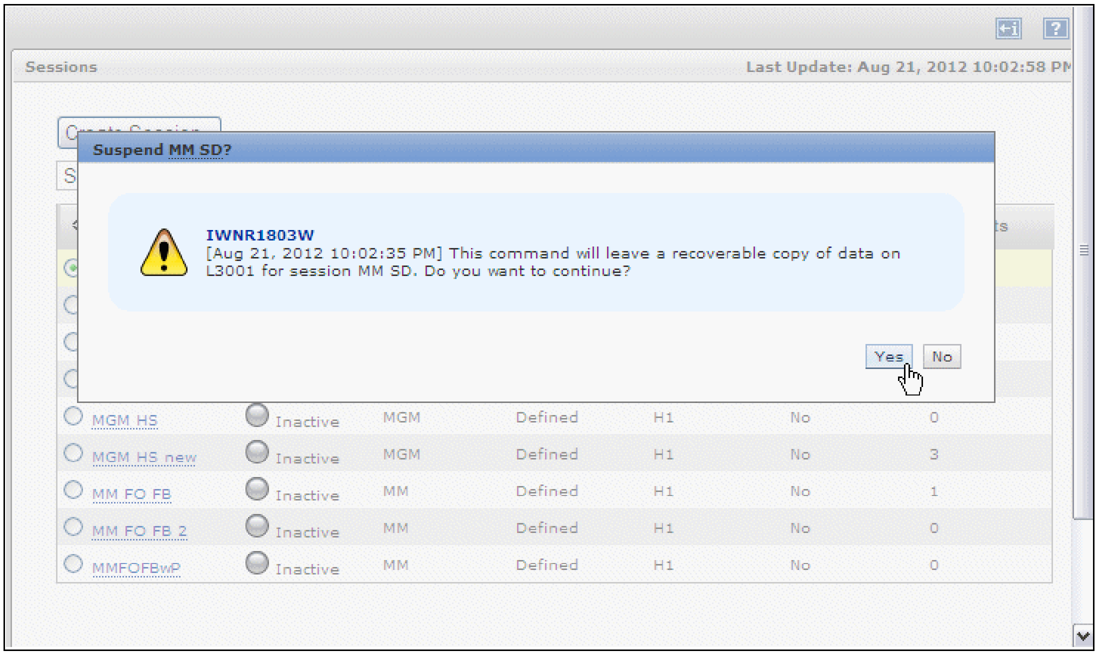

Figure 7-61   *Suspend Metro Mirror session*

The status of our Metro Mirror session has changed from *Normal* to *Severe* status, indicating that data is not replicated anymore between Host 1 and Host 2 volumes. The state of the session is *Suspended* as shown in Figure 7-62.

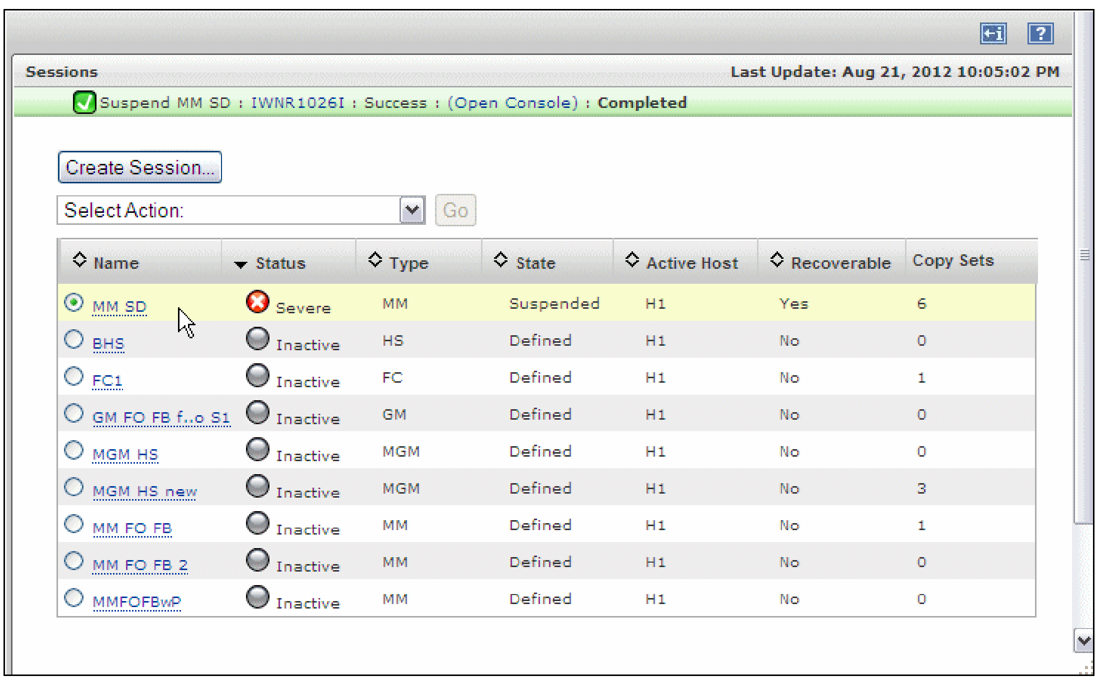

Figure 7-62   *Suspend Metro Mirror session is reported as Completed*

6. If you suspend a Metro Mirror session that was created with **Hold I/O after Suspend** and **Enable Hardened Freeze** options, z/OS will block write operations against the H1 volumes (your application volumes) until you issue the SETHS RESUMEIO command from z/OS. You see a message similar to what is shown in Figure 7-63 when you suspend this session. Although HyperSwap is not enabled (it cannot be enabled in a Metro Mirror Single Direction session), the HyperSwap Monitoring was in effect. This HyperSwap Monitoring watches for all possible freeze triggers that can occur in the systems in the sysplex.

```
IOSHM0200I MetroMirror Configuration Purge complete
IOSHM0809I HyperSwap Configuration Monitoring stopped
IOSHM0308I PPRC suspension requested for replication session MM SD 324
           FreezeAll and Stop completed. Reason: 0000
```

Figure 7-63 Metro Mirror session, with Enabled Hardened Freeze, suspended

7. Figure 7-64 shows a sample of messages that you see when you issue the SETHS RESUMEIO command from any system in the sysplex. Message IOSHM0309I shows you the names of the z/OS images in the sysplex, the total number of devices processed for each system, and, eventually, the number of devices that z/OS could not resume I/O operations.

```
SETHS RESUMEIO
IOSHM0309I SETHS RESUMEIO has completed
          Member: SC63  Total devices: 6  Devices not resumed: 0
          Member: SC64  Total devices: 6  Devices not resumed: 0
          Member: SC70  Total devices: 6  Devices not resumed: 0
          Member: SC65  Total devices: 6  Devices not resumed: 0
```

Figure 7-64 SETHS RESUMEIO

8. If you issue the SETHS RESUMEIO command before the Extend Long Busy (ELB) timer expires in a disk subsystem like DS8000 or ESS, the write operations continues on hold by the disk subsystem. You can perform the Release I/O action in order to release all write I/Os to the application volumes before ELB timer expires.

9. If you suspend a Metro Mirror session which has been created with **Hold I/O after Suspend** policy and without Hardened Freeze enabled (see 7.3.1, “Creating a Metro Mirror Single Direction session” on page 287), then all systems that can update the H1 volumes are on hold before the Extended Long Busy for CKD volumes ends (default is 120 seconds). If you do not want to stop your production for 120 seconds you have an option to release I/O immediately after the Metro Mirror session has been suspended. Select **Release I/O** from **Select Action** pull-down menu and click **Go** to continue (see Figure 7-65).

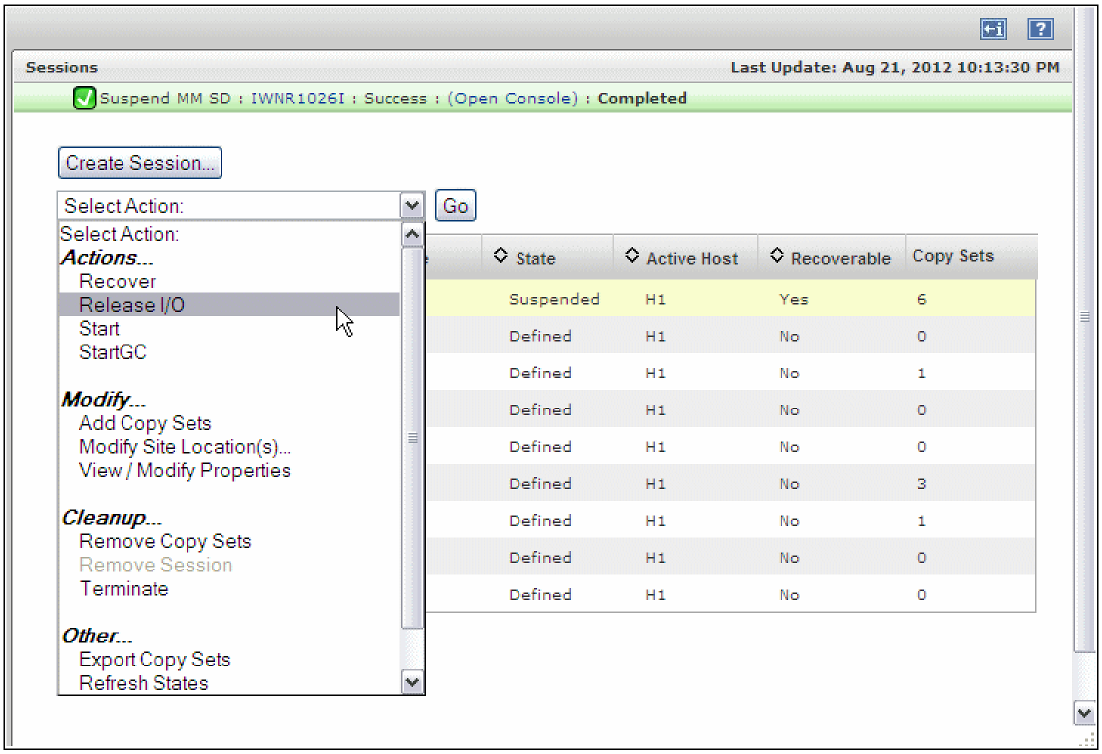

Figure 7-65 Metro Mirror session - Release I/O action

Note: If you suspend a Metro Mirror session that was previously defined with the **Hold I/O After Suspend** policy, all the paths between the LSSs that are defined in this session are also removed.

10. The next message shown in Figure 7-66 is a warning that you are about to allow writes to continue to H1 volumes. Click **Yes** to continue.

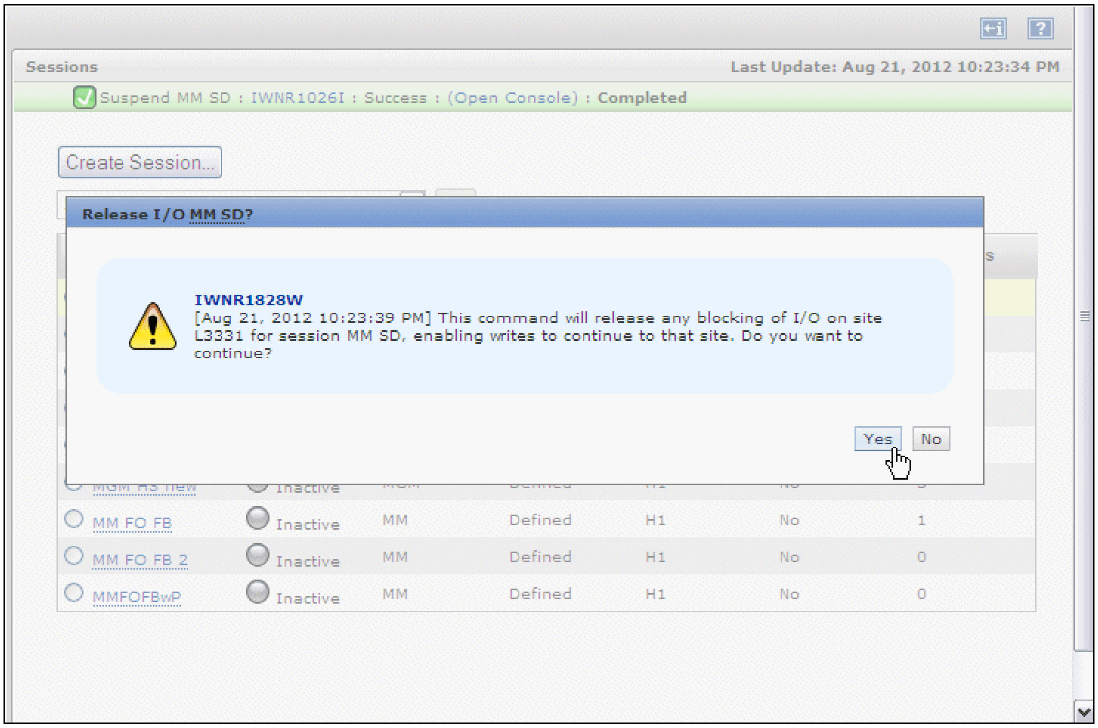

Figure 7-66 Metro Mirror session - Release I/O

After the Metro Mirror session is suspended, the following options are available:

Start Reestablishes copying.

Recover Makes H2 volumes available for host access and stop the copy process.

Release I/O Releases I/O to H1 volumes after Suspend event. This option is available only if the Metro Mirror session is created with **Hold I/O after Suspend** policy.

Terminate Terminates the session (under *Cleanup* submenu).

7.3.7 Recovering a Metro Mirror session

You can recover the session as follows:

1. After the Metro Mirror session and its associated Copy Sets have been suspended, you can initiate a **Recover** action by selecting the Metro Mirror session radio button (MM SD in our example shown in Figure 7-67) and a **Recover** action from the **Select Action** pull-down menu. Click **Go** to continue.

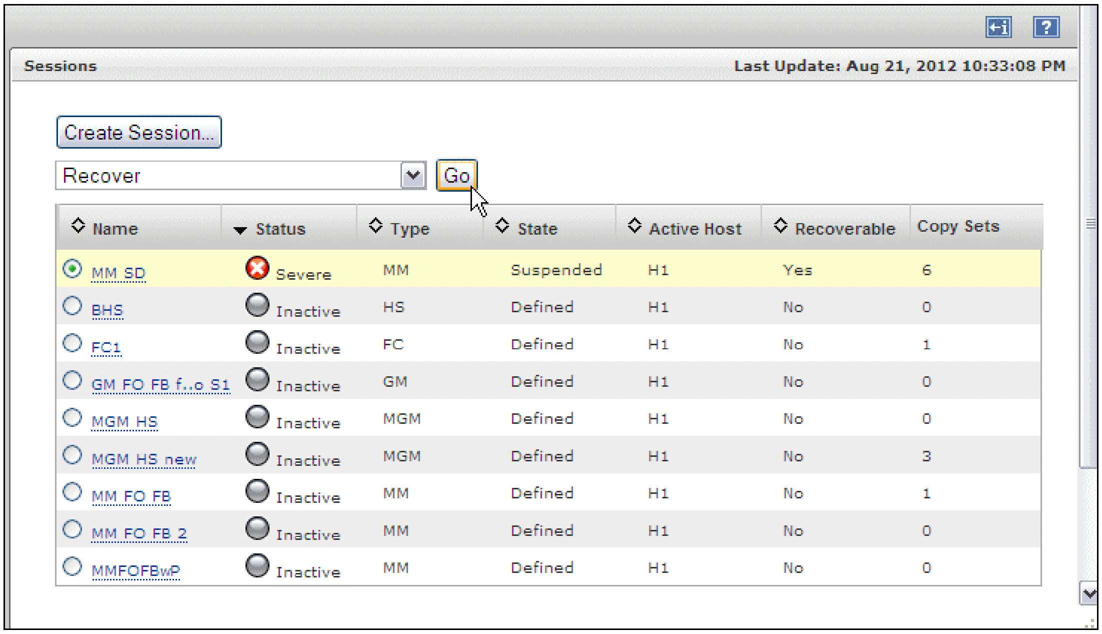

Figure 7-67 Metro Mirror session - Recover action

2. The next message shown in Figure 7-68 is a warning that you will allow H2 volumes available to your hosts. Click **Yes** to continue.

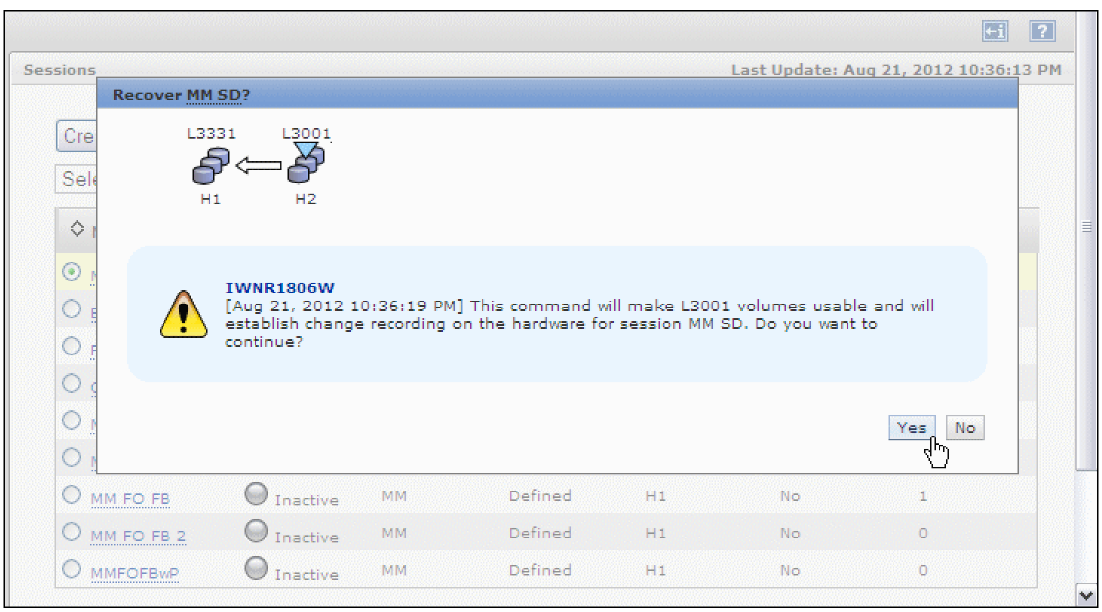

Figure 7-68 Recover Metro Mirror Session

3. There is a message at the top of the panel in Figure 7-69 indicating that a **Recover** action has been successfully completed. The status of our Metro Mirror session is *Normal* and the State is *Target Available*, indicating that the H2 volume is available to your host.

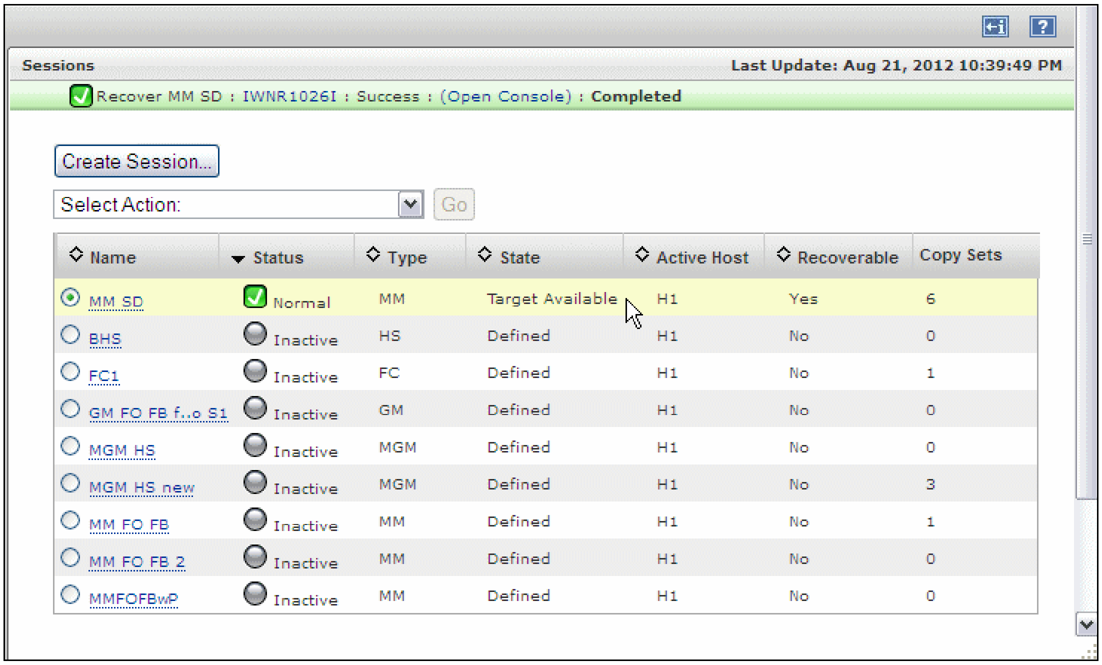

Figure 7-69 Metro Mirror session - H2 storage subsystem volume available to host

After the Metro Mirror session is recovered in *Target Available* state, the following options are available:

Start Reestablishes the replication in synchronous mode (Metro Mirror).

StartGC Reestablishes the replication in global copy mode.

Release I/O Releases I/O to H1 volumes after Suspend event. This option is available only if the Metro Mirror session is created with *Hold I/O after Suspend* policy.

Terminate Terminates the session (under Cleanup submenu).

7.3.8 Stopping a Metro Mirror session

You can issue a **Stop** action against a Metro Mirror session if the session is in *Normal* status, or in global copy mode with a Warning status and Preparing state. It suspends updates to H2 volumes in a Metro Mirror session. This command can be issued at any point during an active session. **Stop** action is completely transparent to the host I/O since *Freeze* is not issued against Copy Set volume pair. Therefore H2 volumes do not contain a consistent copy of your data. Follow these steps:

1. Select the Metro Mirror session radio button (MM SD in our example shown in Figure 7-70) and the **Stop** action from the **Select Action** pull-down menu. Click **Go** to continue.

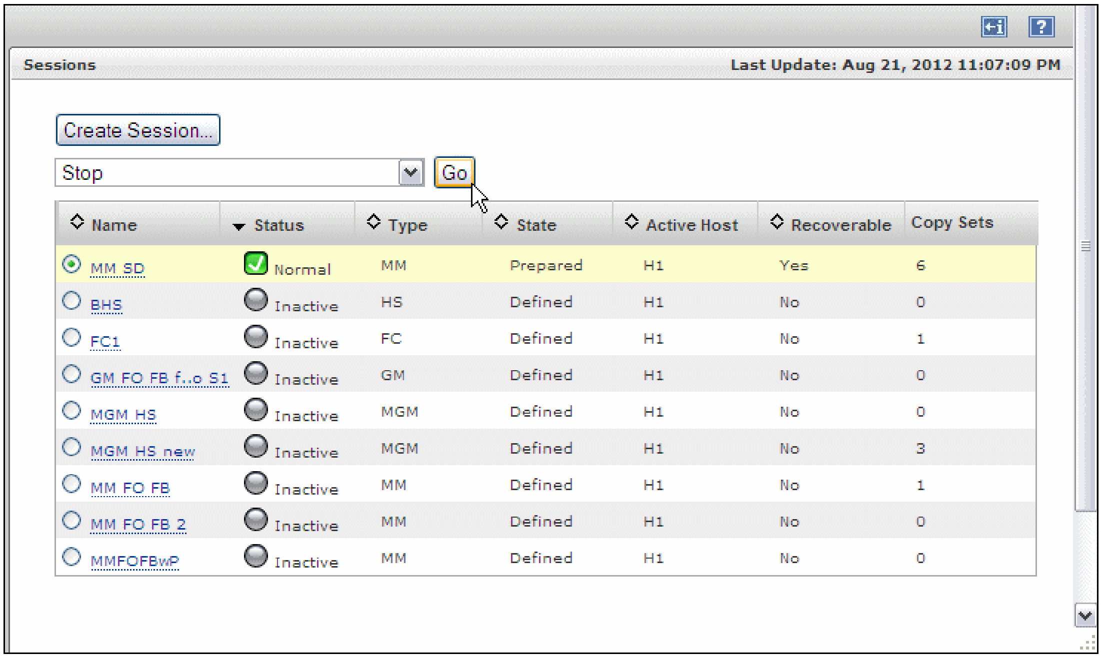

Figure 7-70 Metro Mirror session - Stop action

2. The next message shown in Figure 7-71 is a warning that you will stop data replication from H1 to H2 volumes and the H2 volumes are not consistent. Click **Yes** to continue.

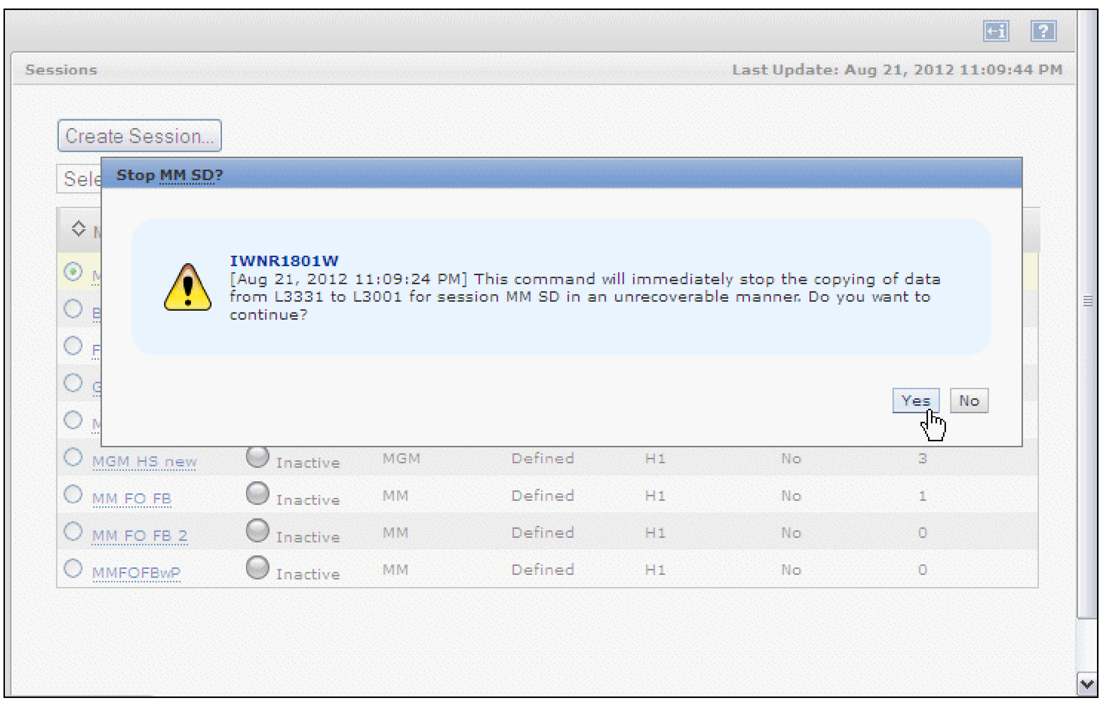

Figure 7-71 Stop Metro Mirror session

3. There is a message at the top of the panel in Example 7-72 indicating that a **Stop** action has been successfully completed. The status of our Metro Mirror session is *Severe* and the state is *Suspended*. Column *Recoverable* in Example 7-72 has the value *NO*, indicating that H2 storage subsystem volumes are not consistent.

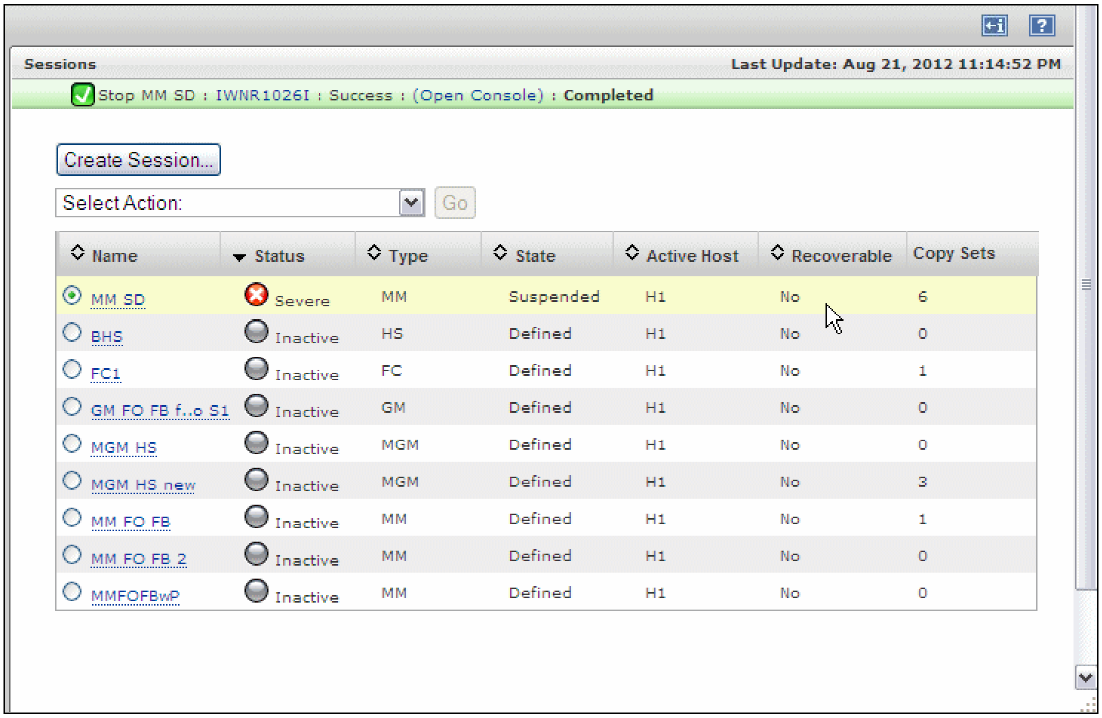

Figure 7-72 Stop Metro Mirror Session - Completed

After the Metro Mirror session is stopped, the following options are available:

Start Reestablishes Metro Mirror replication.

StartGC Reestablishes the replication in global copy mode.

Recover Makes H2 volumes available for host access.

Release I/O Releases I/O to H1 volumes after a Suspend event. This option is available only if the Metro Mirror session is created with the **Hold I/O after Suspend** policy.

Terminate Terminates the session (under Cleanup submenu).

7.3.9 Terminating a Metro Mirror session

Action **Terminate** breaks the Metro Mirror relationship between H1 and H2 volumes thus terminating data replication. If you want H2 volumes to be data consistent before removing their relationship, you must issue the `Suspend` command, then the `Recover` command, and then the `Terminate` command. In case you want to `Start` a Metro Mirror session after it has been terminated, full copy takes place from H1 to H2 volumes. Follow these steps:

1. Select the Metro Mirror session radio button (MM SD in our example shown in Figure 7-73) and the **Terminate** action from the **Select Action** pull-down menu. Click **Go** to continue.

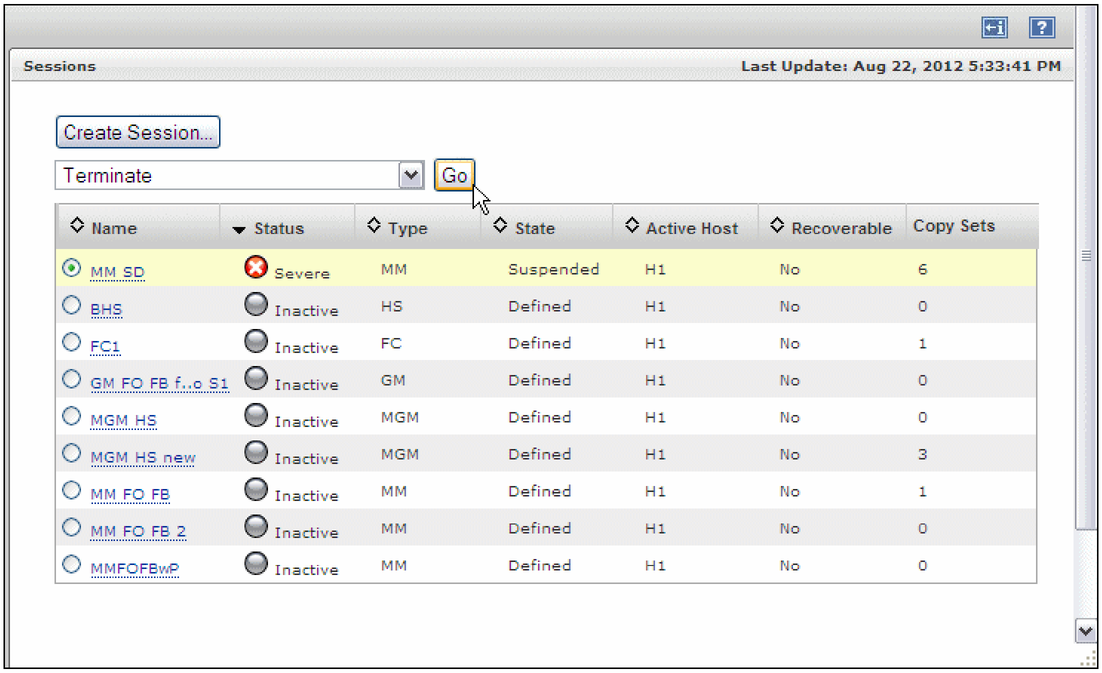

Figure 7-73 Metro Mirror session - Terminate action

2. The next message shown in Figure 7-74 is a warning that you are about to terminate a Metro Mirror relationship between H1 to H2 volumes. Note that if you require to start the very same Metro Mirror session again, a full copy from H1 to H2 volumes will be required. Click **Yes** to continue.

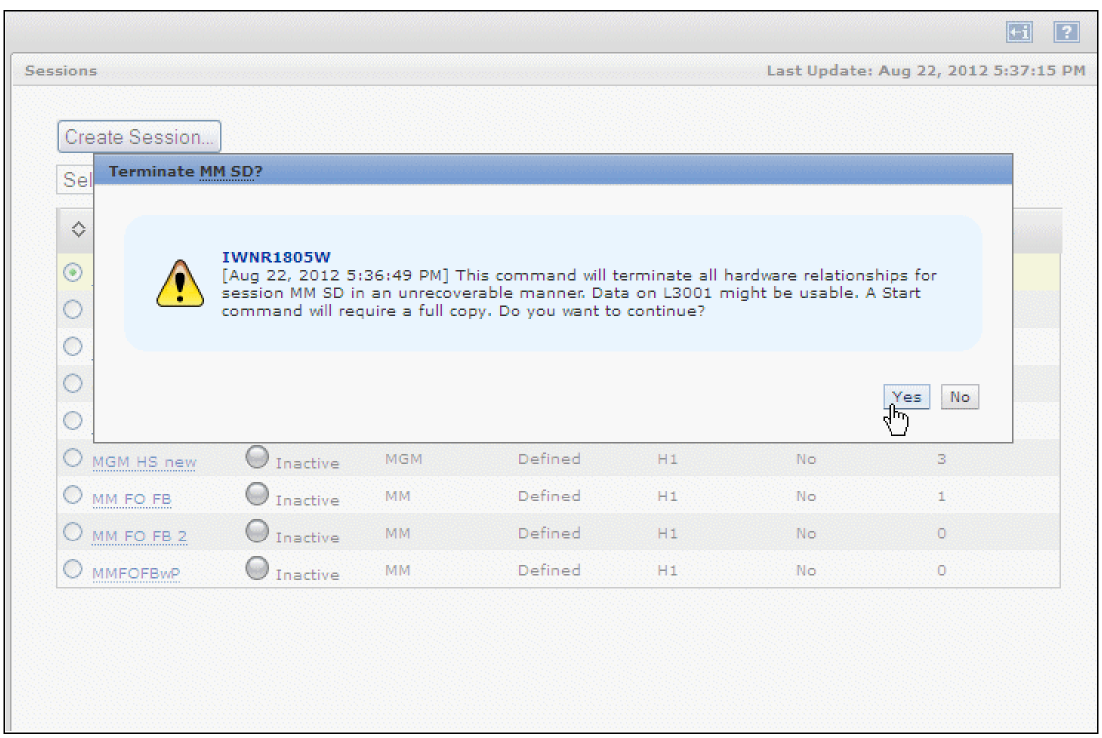

Figure 7-74 Terminate Metro Mirror session

3. There is a message at the top of the panel in Figure 7-75 indicating that a **Terminate** action has been successfully completed. The status of our Metro Mirror session is now *Inactive* and the state is *Defined*.

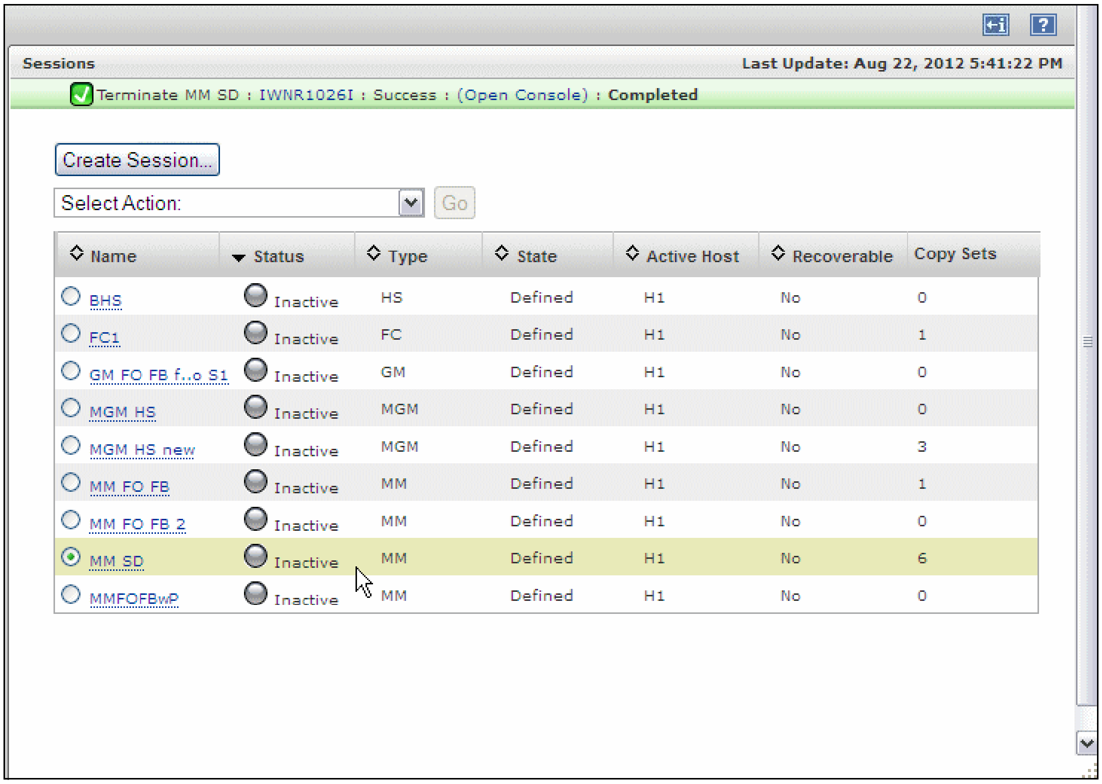

Figure 7-75 Terminate Metro Mirror session - Completed

After the Metro Mirror session is terminated, the following options are available:

Start Reestablishes replication in synchronous mode (Metro Mirror).

StopGC> Reestablishes replication in Global Copy mode.

7.4 Global Mirror Single Direction session using the GUI

You may create a session at any time after the server code is installed and up and running. Again, a session is only a token with a name and certain attributes assigned to this session. This is always the same approach independent on the session type. At this point you need to have storage subsystems defined to the Tivoli Storage Productivity Center for Replication server as described in “Adding IBM ESS or DS Storage Server to Tivoli Storage Productivity Center for Replication server” on page 137.

7.4.1 Creating a Global Mirror Single Direction session

Figure 7-76 shows that you always start from *Navigation Tree* and click the hyperlink `Sessions`. This provides you with an overview of all defined sessions. At this point we have some already defined sessions. Follow these steps:

1. Click **Create Session** to continue.

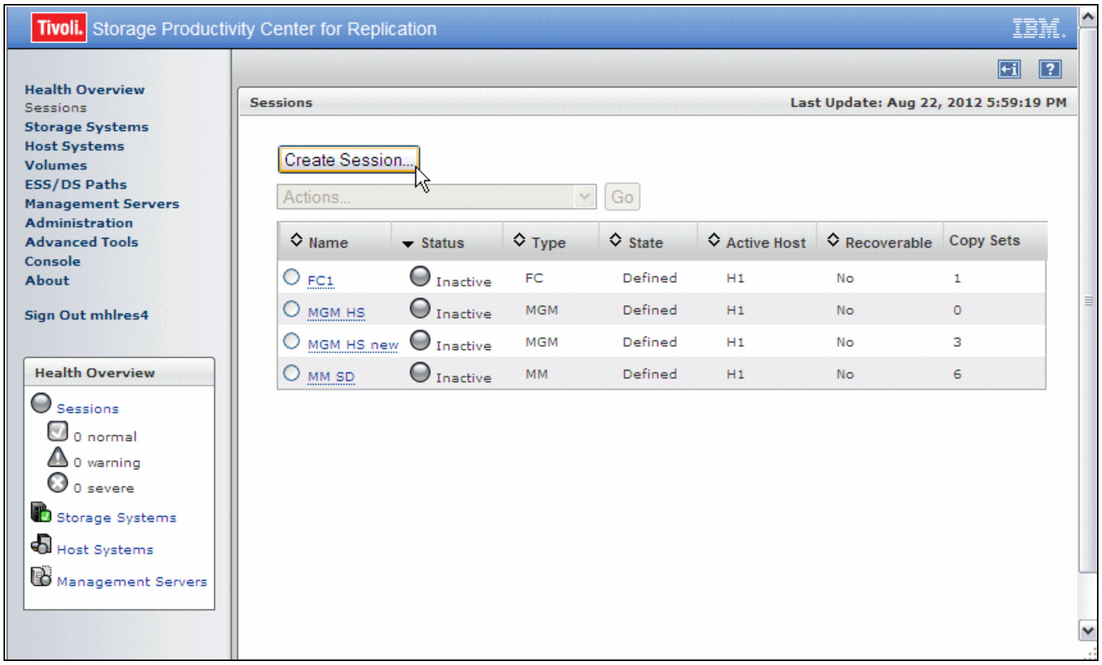

Figure 7-76 Query sessions

2. Select the hardware type of the storage subsystems that you are going to use for this session. In our example, we plan to implement a Global Mirror session between two DS8000 boxes.
3. Select the **Global Mirror Single Direction** session from the pull-down menu as shown in Figure 7-77. On the right side, a pictograph symbolizes the involved sites and their volume types. H1 represents Site 1 volumes, H2 represents Site 2 volumes and J2 represent journal volumes used to restore data to the last consistency point. When you define Copy Sets this pictograph helps you to orient and understand replication direction. Click **Next** to continue.

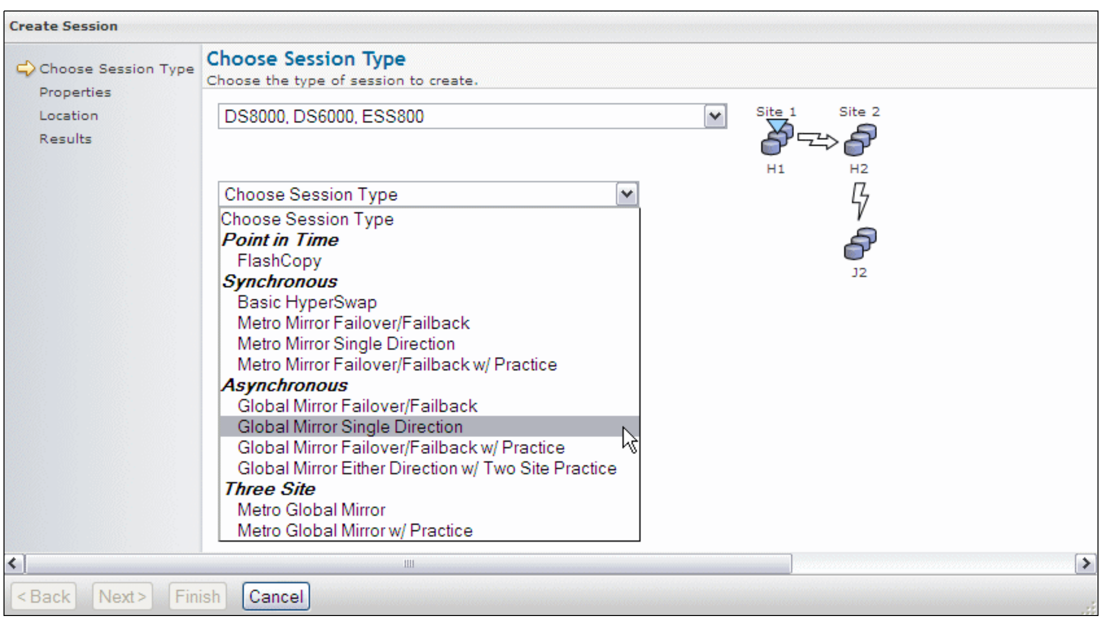

Figure 7-77 Define the Global Mirror Single Direction session

4. This leads us to the session Properties panel as Figure 7-78 shows.

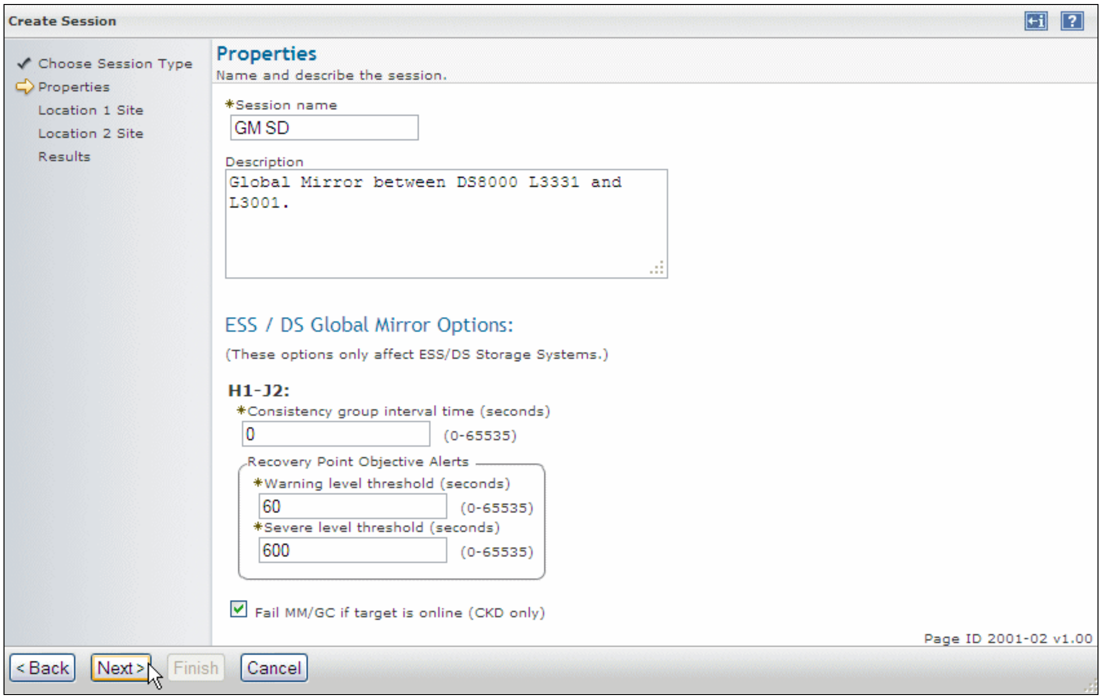

Figure 7-78 Define Global Mirror session Properties

The *Properties* panel is also important because it requires that you specify at least a name for the session which is about to be created. An optional *description* is desirable to understand the purpose of the session because the session name may not reveal what this session is intended for. Figure 7-78 comments on the storage subsystems involved in this session. You may add a location of each storage server and a date when the session is created or changed.

The Properties panel allows you to specify some parameters to monitor and control the Global Mirror session. These parameters are described in the following paragraphs:

– Consistency Group interval time (sec):

  This value specifies how long to wait between the formation of the next Consistency Groups. This is specified in seconds, and the default is zero (0) seconds. Zero seconds means that Consistency Group formation happens constantly. As soon as a Consistency Group is successfully created, the process to create a new Consistency Group starts again immediately.

– Recovery Point Objective Alert:

  This value specifies the length of time that you want to set for the recovery point objective (RPO) thresholds. The values determine whether a Warning or Severe alert is generated when the RPO threshold is exceeded for a role pair. The RPO represents the length of time in seconds of data exposure that is acceptable in the event of a disaster. The thresholds are specified in the following way:

  - *Warning level threshold (seconds):* When the RPO is greater than this value, you want an alert to be generated.
  - *Severe level threshold (seconds):* When RPO is greater than this value, an alert is also generated, and the session status changes to Severe.

– Fail MM/GC if the target is online (CKD only):

This option ensures that all target (secondary) volumes in a Global Mirror session are offline and not visible to any host, otherwise the create session task will fail. This applies to CKD volumes only. Use this option since target (secondary) volumes in a Global Mirror session should be offline to all hosts.

5. From the pull-down **Site 1 Location** menu (see Figure 7-79), select the storage subsystem at your Site 1 location. Click **Next** to continue.

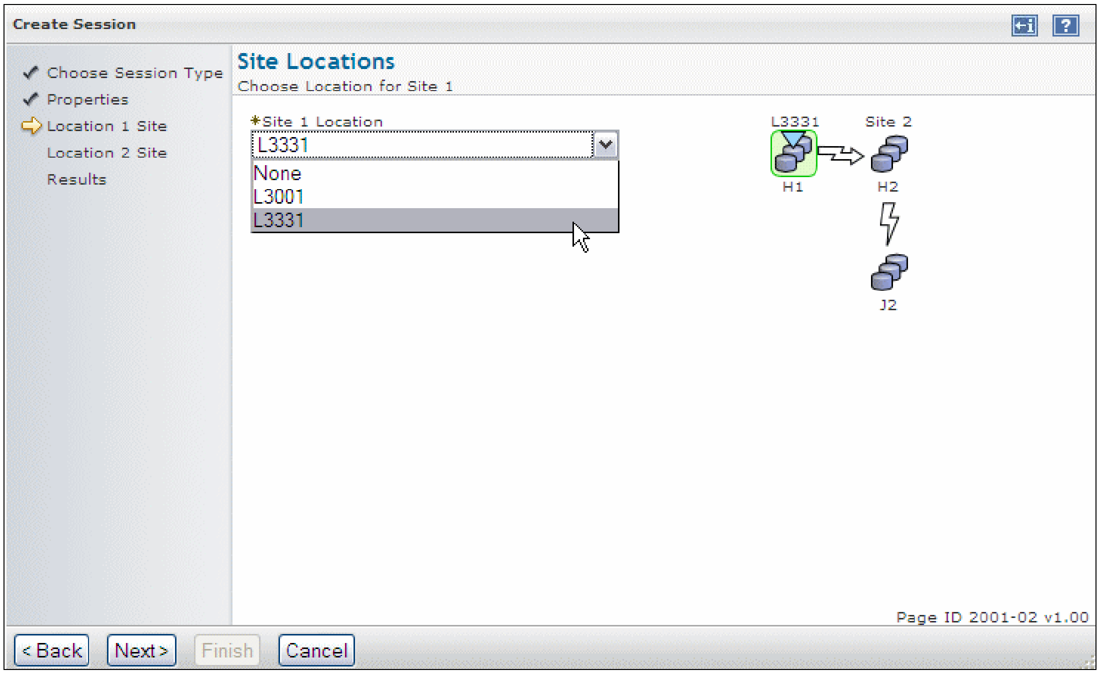

Figure 7-79 Choose Site 1 storage subsystem

6. From the pull-down **Site 2 Location** menu (see Figure 7-80) select the storage subsystem at your site 2 location. Click **Next** to continue.

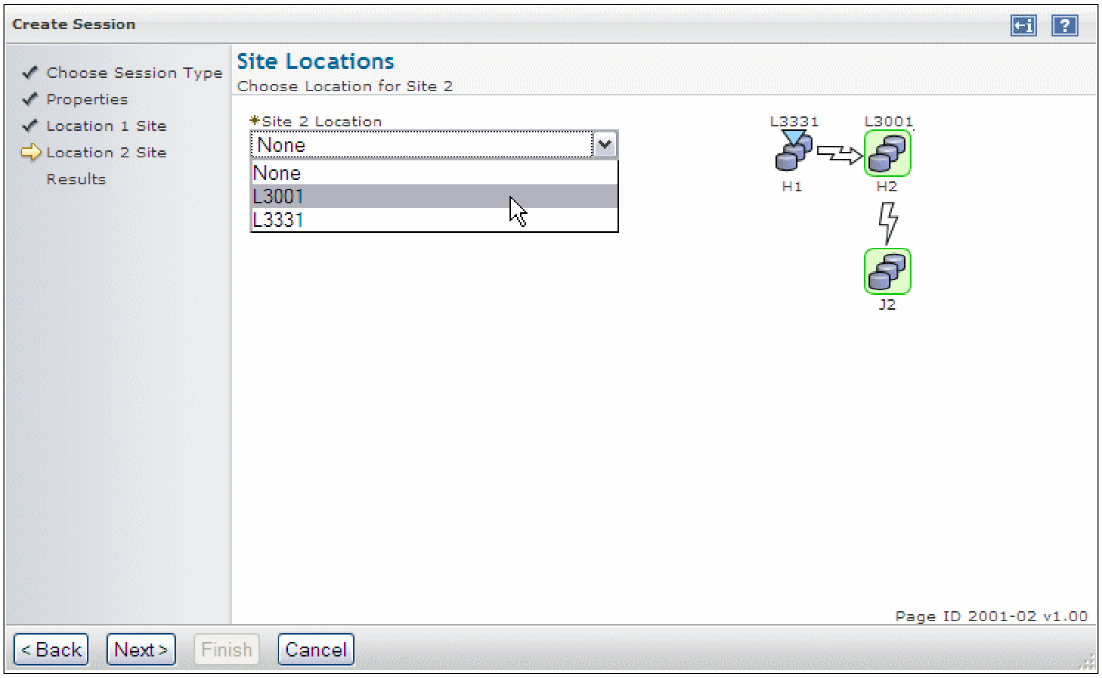

Figure 7-80 Choose Site 2 storage subsystem

7. Figure 7-81 displays the message that the GM SD session was successfully created. Click **Finish** to exit the *Create Session* wizard. Alternatively, you have an option to add Copy Sets by clicking **Launch Add Copy Sets Wizard** and following the instructions described in 7.4.2, "Adding Copy Sets to a Global Mirror session" on page 319.

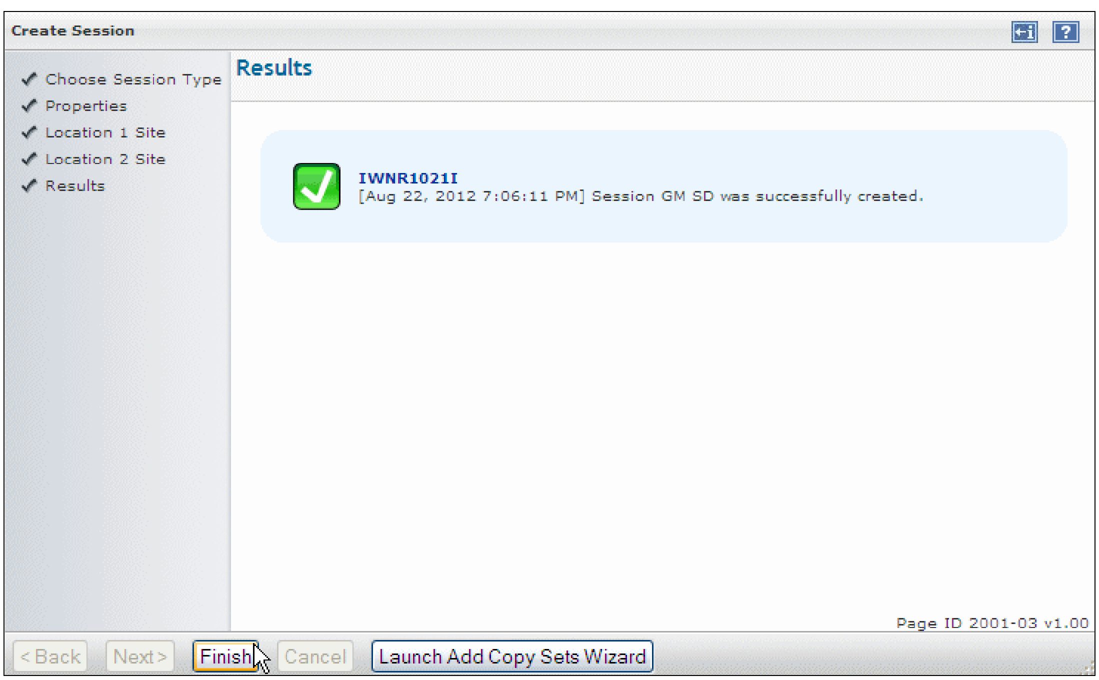

Figure 7-81 Define Global Mirror session - Results

8. Go back to the Tivoli Storage Productivity Center for Replication home page and select the `Sessions` hyperlink to check on recently created Global Mirror session. Figure 7-82 now displays the Global Mirror Single Direction session which we successfully created.

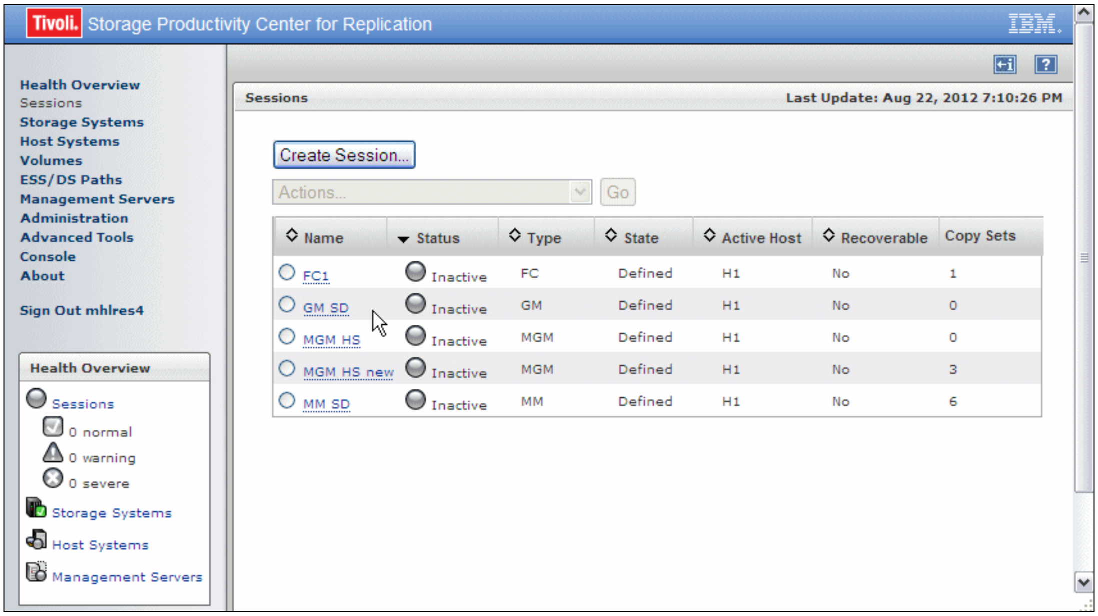

Figure 7-82 Global Mirror session defined

Again, note that this session with its name is just a token and represents a Global Mirror Copy Services type. At this stage, there is not any volume associated with this GM SD session.

7.4.2 Adding Copy Sets to a Global Mirror session

After we have defined the Global Mirror session GM SD, we can populate this session in the next step with Copy Sets. Global Mirror Copy Set consists of one H1, one H2 and one J2 Global Mirror volume.

Figure 7-83 shows the session overview panel with the GM SD session that we defined previously. The next logical action that you perform on GM SD session is to add Copy Sets to it. Follow these steps:

1. Select your Global Mirror session name radio button (GM SD in our example) and choose **Add Copy Sets** from the **Select Action** pull-down menu. Click **Go** to invoke the *Add Copy Sets* wizard.

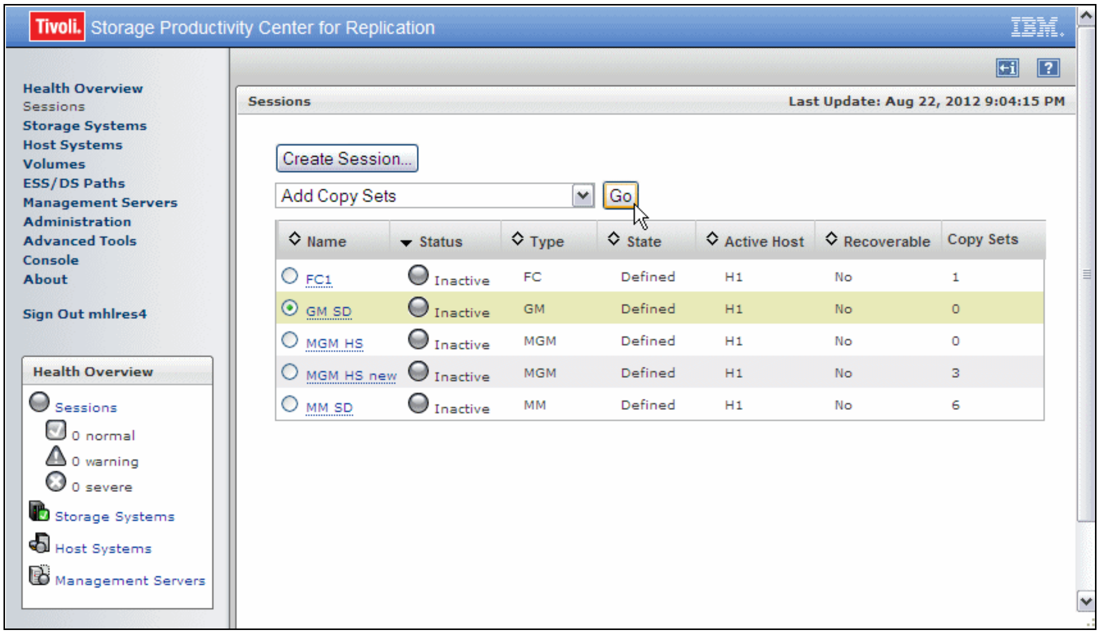

Figure 7-83 Add Copy Sets to Global Mirror Single Direction session

2. Figure 7-84 displays the panel that provides details on the primary volumes or local volumes which are called Host 1 volumes relating to the fact that these volumes reside in the Site 1 or application site or local site. These are all synonyms and refer to the same environment. Select the desired **Host 1 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Host 1 logical storage subsystem** list. Select the LSS where your H1 volumes resides. After the LSS has been selected, choose the appropriate volume from the **Host 1 volume** pull-down list or select **All Volumes**.
3. The alternative way to add a large number of volumes to this session is to create a CSV file as explained in “Using CSV files for importing and exporting sessions” on page 194. In case you have CSV file ready select **Use a CSV file to import copy sets** check box and provide a path to your CSV file. Click **Next** to continue.

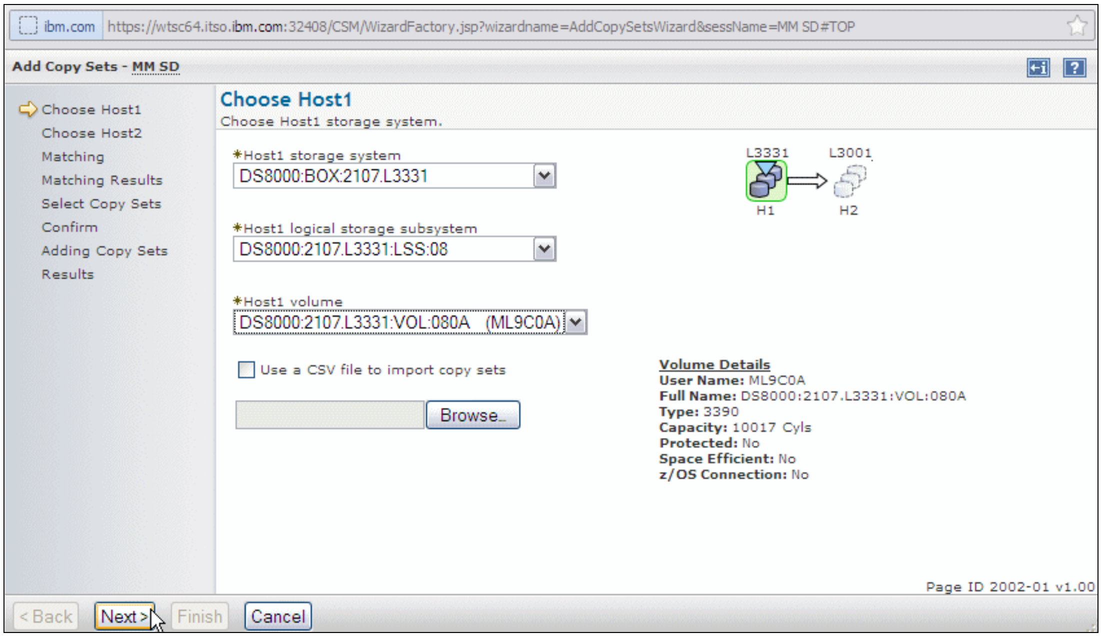

Figure 7-84 Add Copy Sets to Global Mirror Single Direction session - Choose Host 1

4. The next step is to define Site 2 storage subsystems and volumes as shown in Figure 7-85 on page 321. Select the desired **Host 2 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Host 2 logical storage subsystem** list. Select the LSS where your H2 volume resides.If you selected **All volumes** for a given LSS in the previous step while defining Host 1 volumes, you do not have an option to select any volume from **Host 2 volume** list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 1 storage subsystem with all volumes from selected LSS in Host 2 storage subsystem. In our example we selected **All volumes** in *Choose Host1* step. Click **Next** to continue.

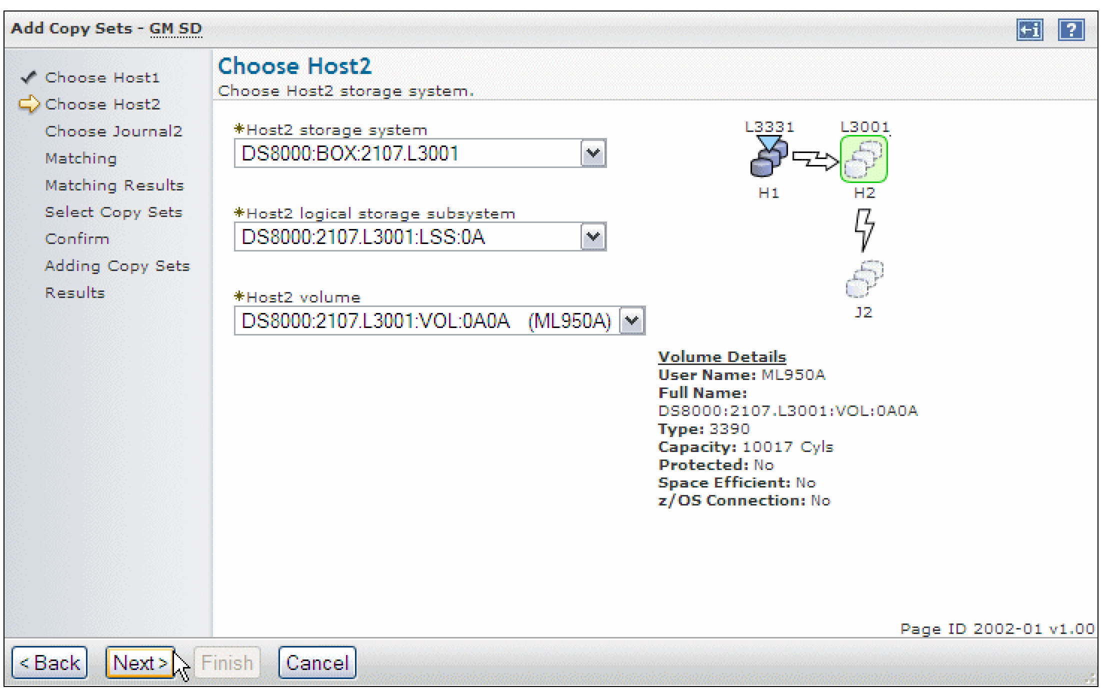

Figure 7-85 Add Copy Sets to Global Mirror Single Direction session - Choose Host 2 volumes

5. In order to complete the Global Mirror Copy Set definition, we need to define J2 journal volume as shown in Figure 7-86. Select the desired **Journal 2 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Journal 2 logical storage subsystem** list. Select the LSS where your J2 volume resides. If you selected **All volumes** for a given LSS in the previous step while defining Host 1 and Host 2 volumes, you do not have an option to select any volume from **Journal 2 volume** list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 2 storage subsystem with all volumes from selected LSS in Journal 2 storage subsystem. Click **Next** to continue.

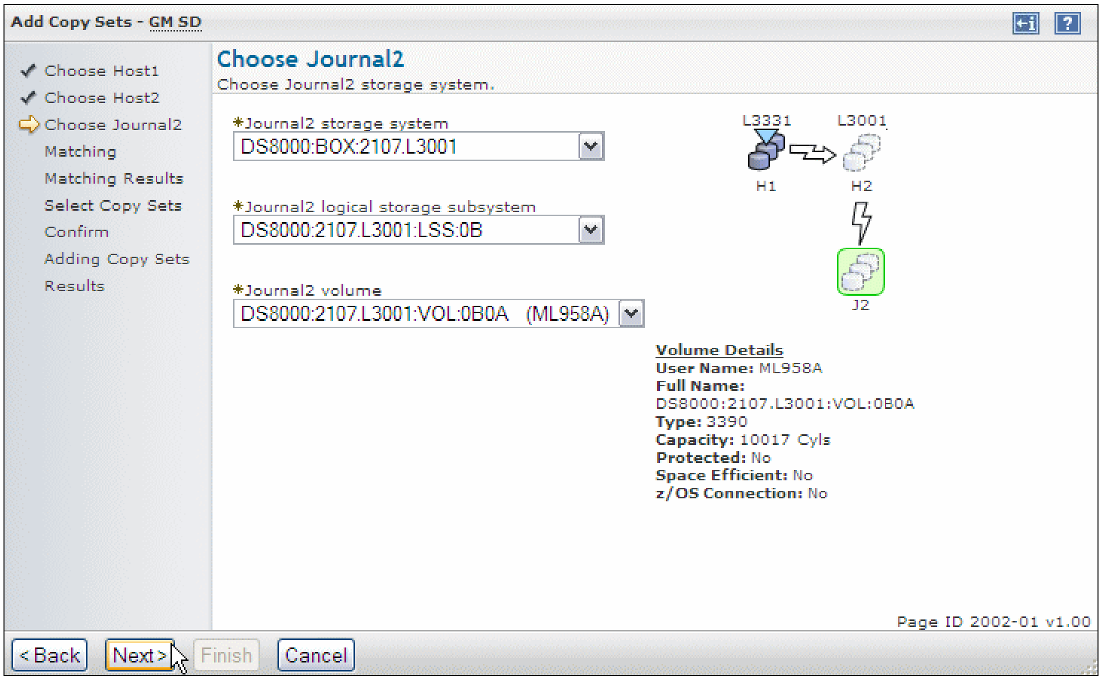

Figure 7-86 Add Copy Sets to Global Mirror Single Direction session - Choose Journal 2 volumes

6. The next panel in Figure 7-87 displays the matching results. You can click the **Add More** button to continue adding Copy Sets to this session.
7. Click **Next** after you have added all the Copy Sets you need.

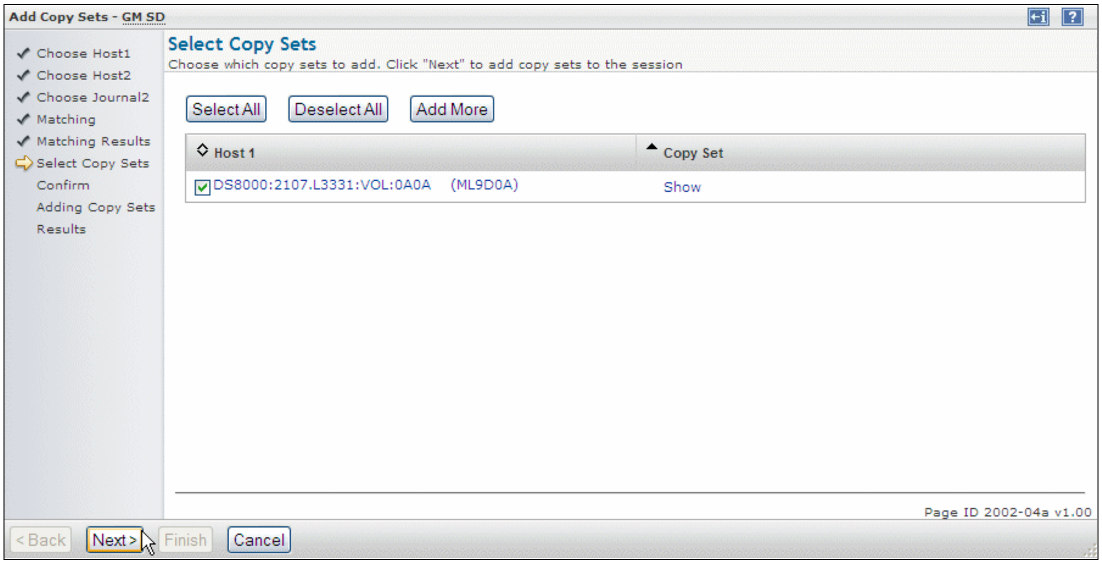

Figure 7-87 Add Copy Sets to Global Mirror Single Direction session - Matching Results

8. The next panel displays the number of Copy Sets that are going to be created, as shown in Figure 7-88. Click **Next** to continue.

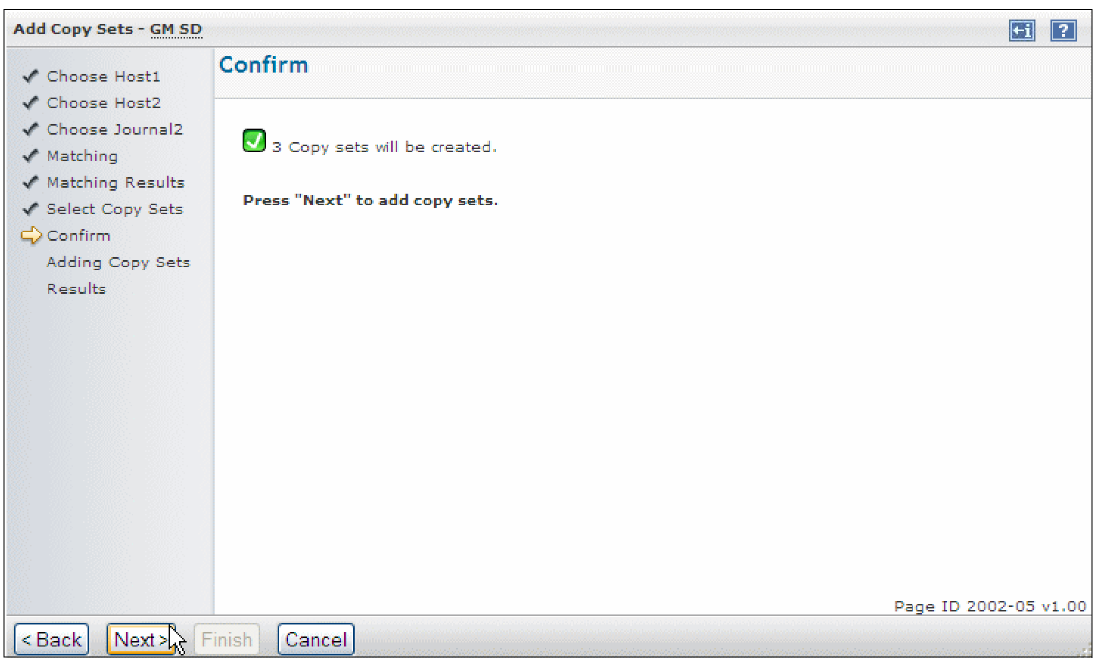

Figure 7-88 Add Copy Sets to Global Mirror Single Direction session - Confirm

9. Tivoli Storage Productivity Center for Replication internally adds Copy Sets to its database. Note that this does not start a Global Mirror relationship between H1, H2, and J2 volumes. It is just a Tivoli Storage Productivity Center for Replication internal process to add these Copy Sets to the Tivoli Storage Productivity Center for Replication inventory database.

10. After a few seconds, Tivoli Storage Productivity Center for Replication displays the Results pane, as shown in Figure 7-89. Click **Finish** to exit the *Add Copy Sets* wizard.

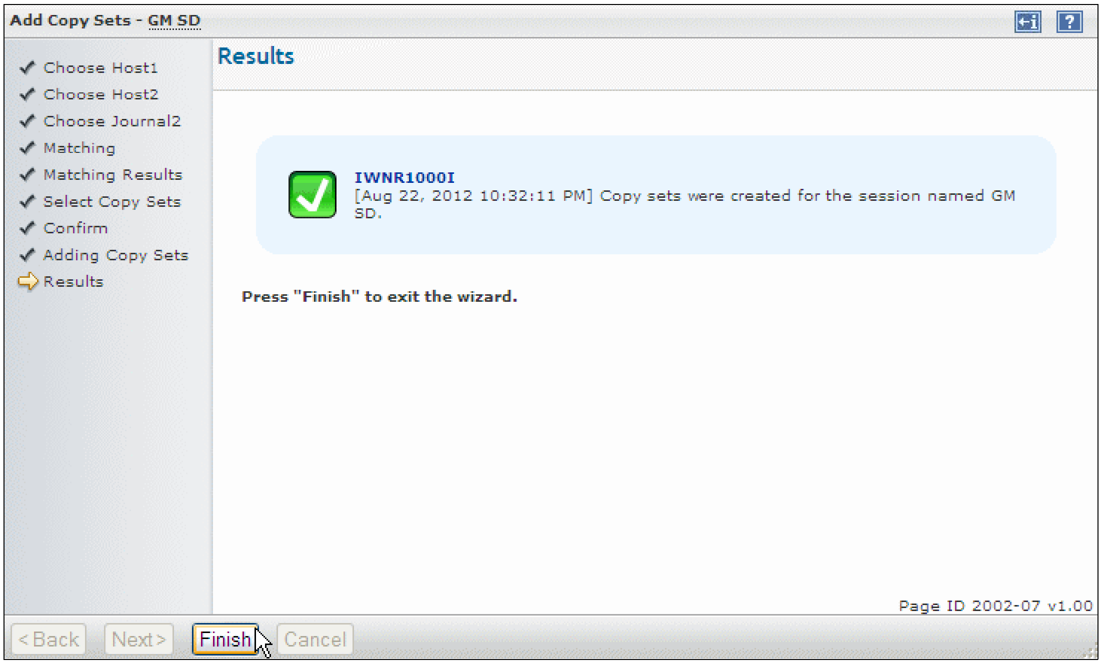

Figure 7-89 All Copy Sets are successfully added to GM SD session

11. Figure 7-90 confirms that all Copy Sets are successfully added to the GM SD session and the Tivoli Storage Productivity Center for Replication repository database is successfully updated. The session status is still *Inactive* and in *Defined* state.

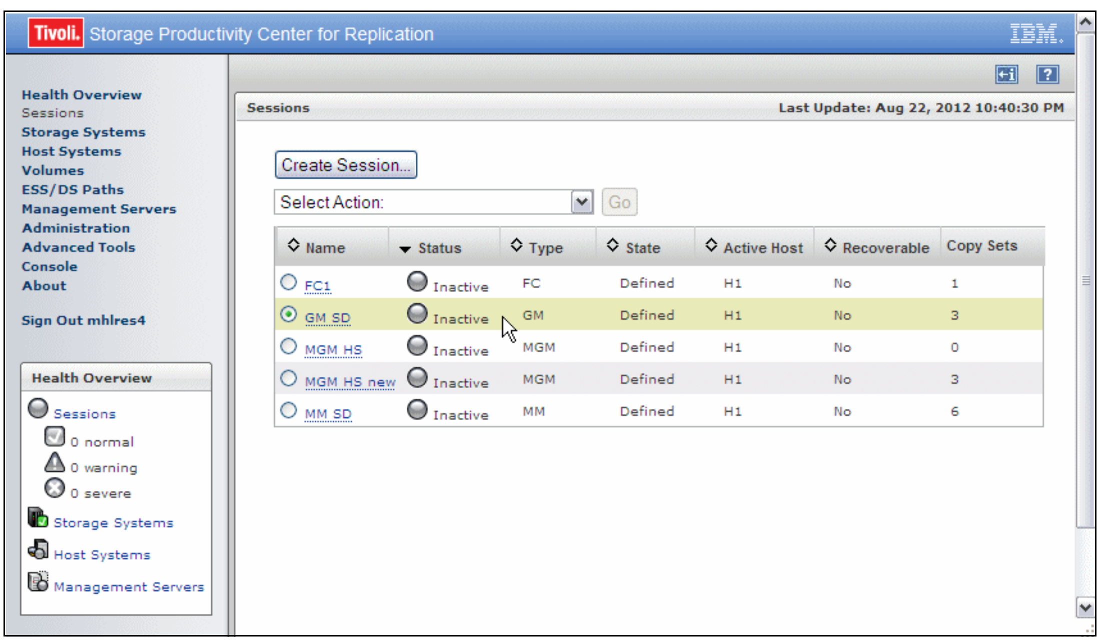

Figure 7-90 Add Copy Sets to GM SD session completed

This concludes the steps through the GUI when you add Copy Sets to a Global Mirror session.

7.4.3 Starting a Global Mirror session

After we have defined a Global Mirror session and populated the session with Copy Sets, we can start the Global Mirror session. Figure 7-91 displays the GM SD session as we defined it previously. We added three Copy Sets previously in our example. Follow these steps:

1. From the **Select Action** pull-down menu, select **Start** and click **Go**.

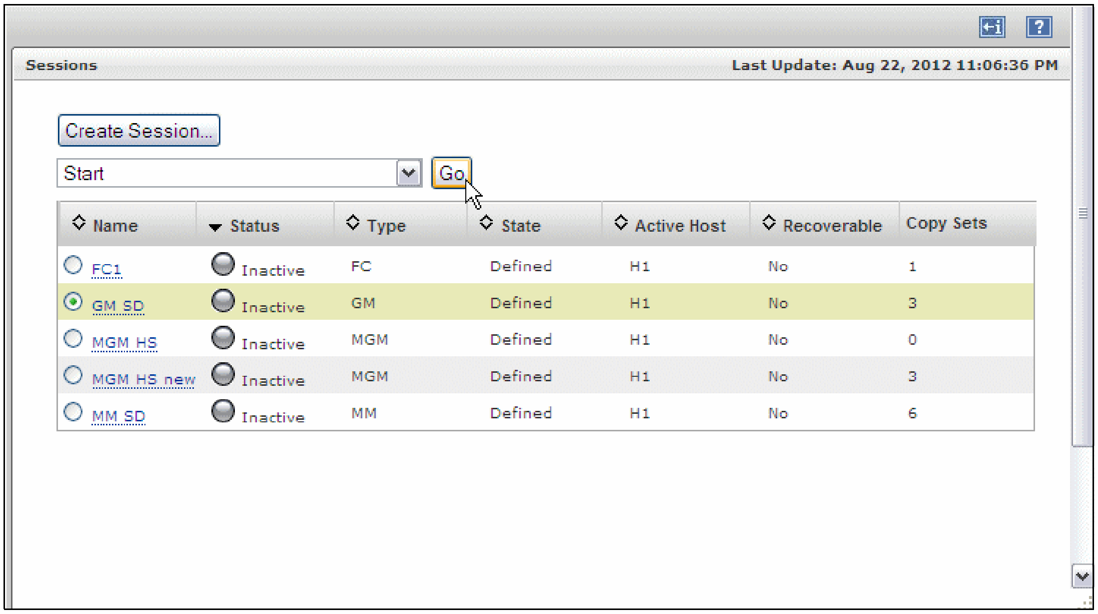

Figure 7-91 Global Mirror session - Start Action

2. The next message shown in Figure 7-92 is a warning that you are about to initiate a Global Mirror session. It will start the copying of data from Host 1 to Host 2 volumes defined previously by adding Copy Set, thus overwriting any data on the Host 2 volumes. Furthermore, it will initiate a FlashCopy to J2 journal volumes. Click **Yes** to continue.

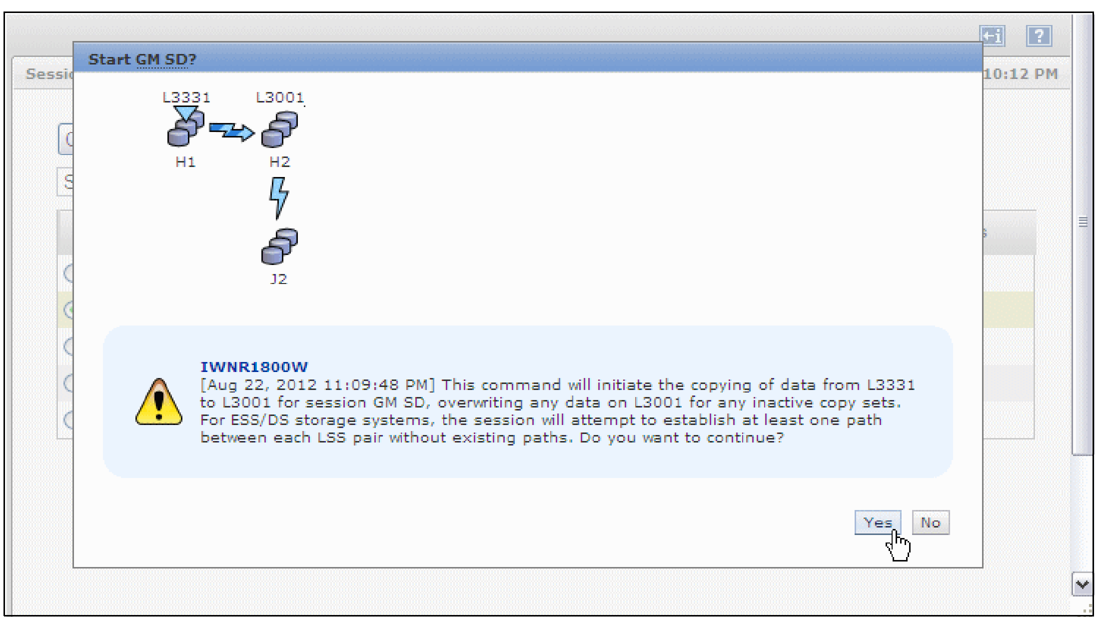

Figure 7-92 Start Global Mirror Single Direction session

3. The message at the top of the panel in Figure 7-93 confirms that Global Mirror session is started. The session is in *Preparing* state and *Warning* status. Click the session name hyperlink (GM SD in our example) to find more details about this session.

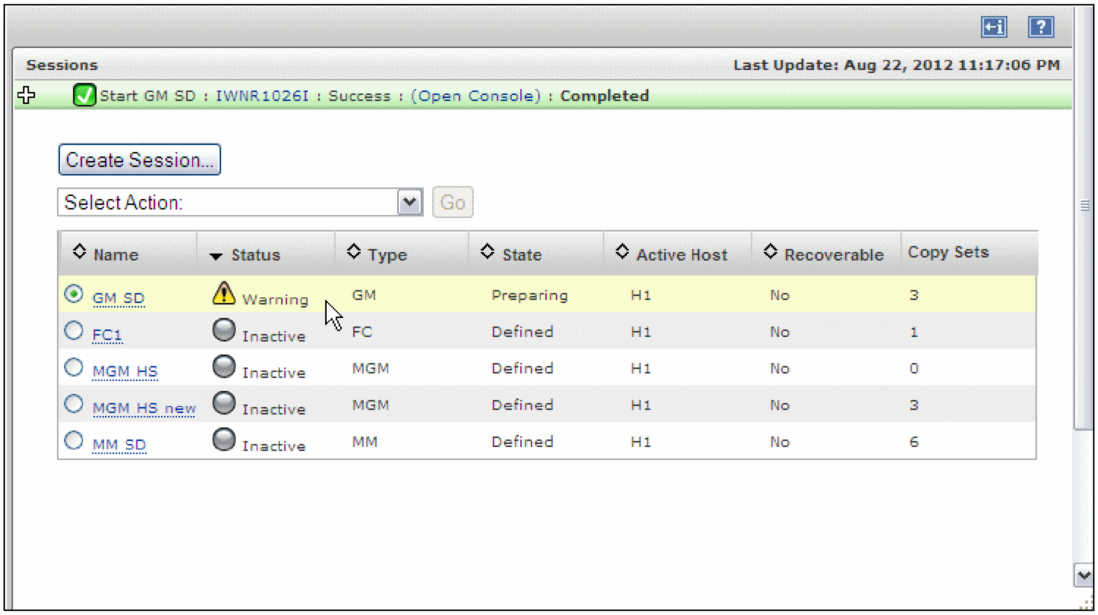

Figure 7-93 Start Global Mirror session is reported as Completed

As shown in Figure 7-94 the Global Mirror session is still in *Preparing* state, since the initial copy of data between H1 and H2 volumes is still in progress, and consistency groups are not yet being formed.

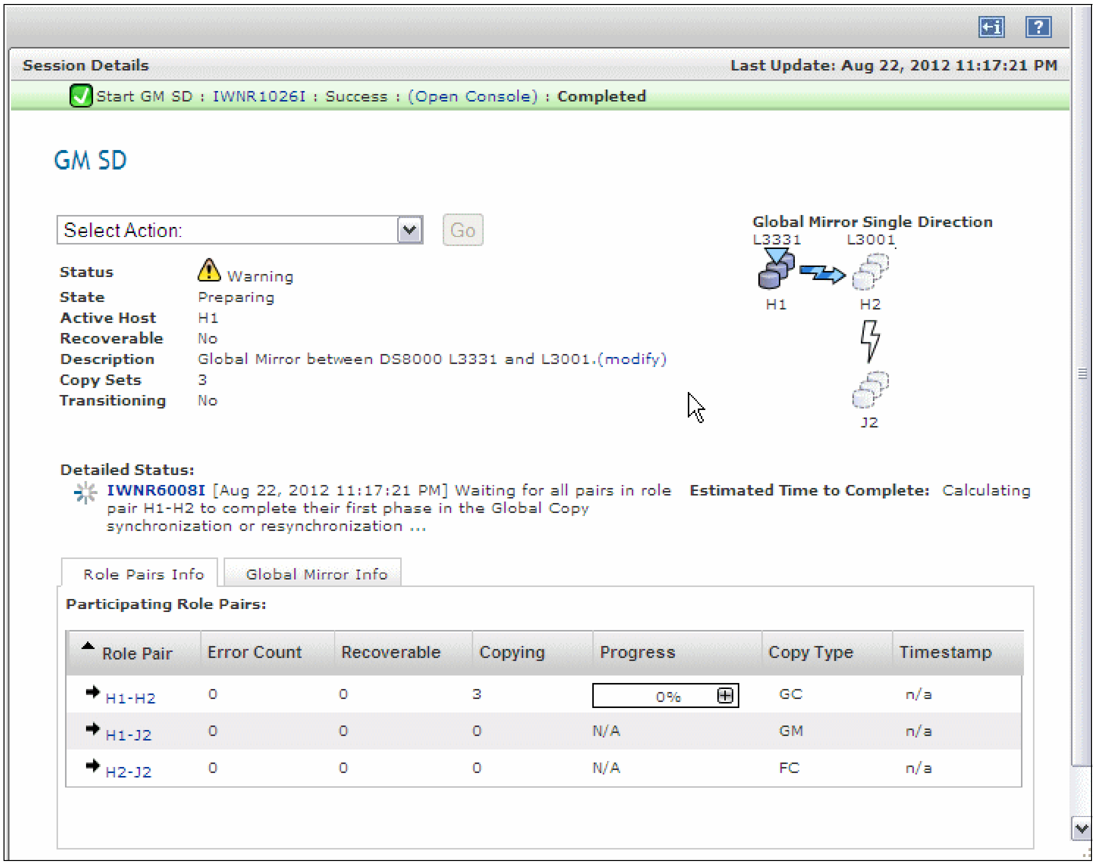

Figure 7-94 Global Mirror session details

4. Wait until session Status changes to *Normal* status as shown in Figure 7-95. It means that the initial copy has finished and the first consistency group has been created.

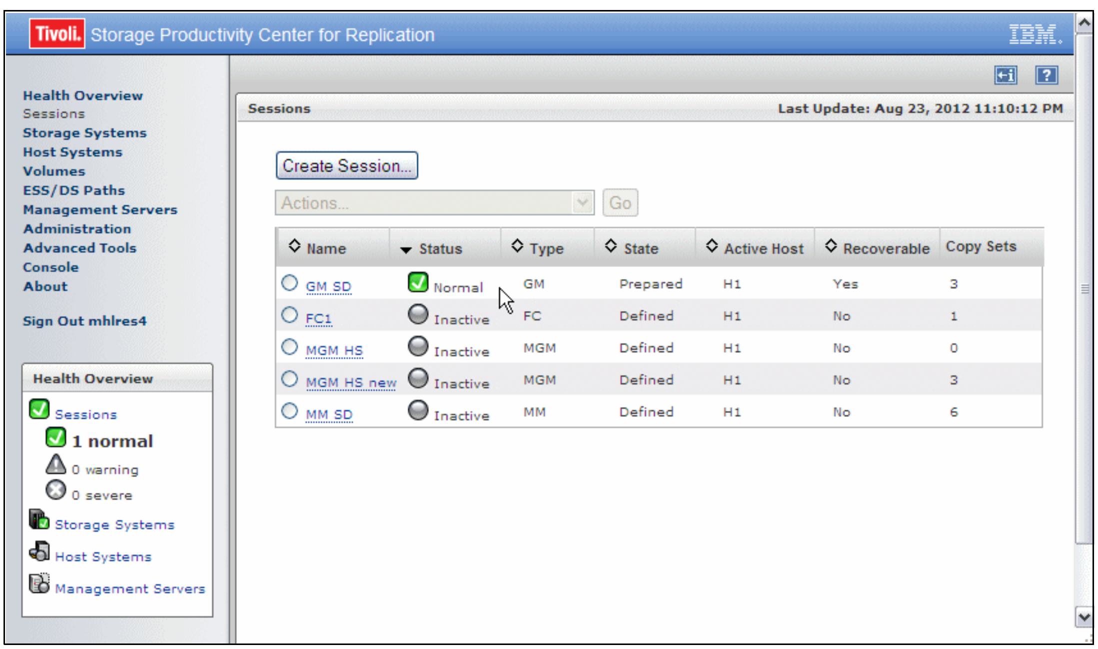

Figure 7-95 Session GM SD in Normal status

After the Global Mirror session is started and it has *Normal* status and is in *Prepared* state, the following options are available:

Suspend Stops replication with H2 volumes, while the Site 1 storage subsystem keeps track of changes being applied to tracks on the H1 volumes.

Start Reestablishes replication.

Terminate Terminates the session (under Cleanup submenu).

7.4.4 Suspending a Global Mirror session

To suspend the session, follow these steps:

1. From the **Sessions** panel, select your Global Mirror session radio button, select **Suspend** from the **Action** pull-down list, and click **Go** as shown in Figure 7-96.

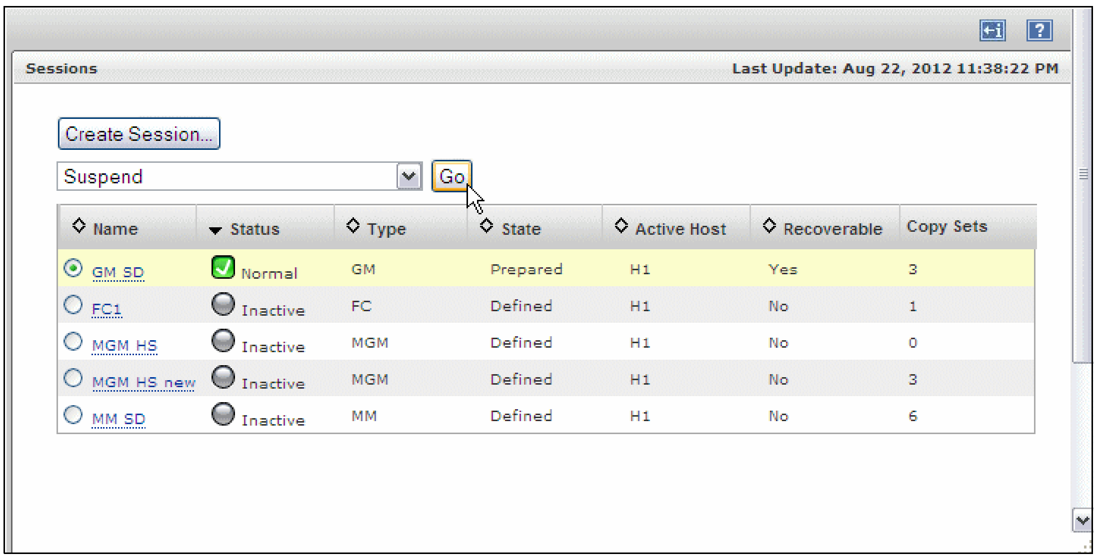

Figure 7-96 Global Mirror session - Suspend Action

2. The next message shown in Figure 7-97 is a warning that you are about to Suspend Global Mirror session. Click **Yes** to continue.

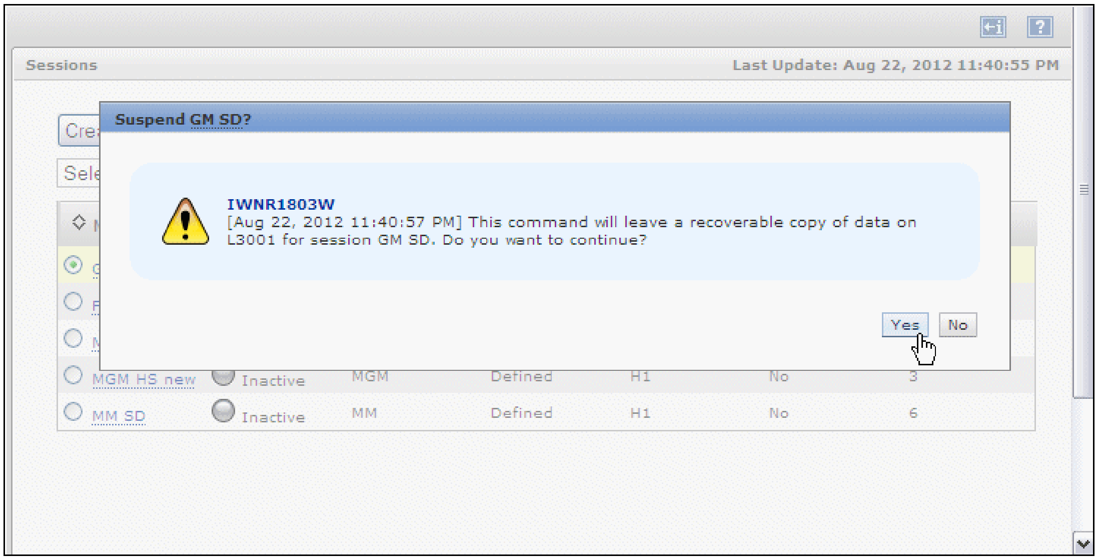

Figure 7-97 Suspend Global Mirror session

3. The status of our Global Mirror session has changed from *Normal* to *Severe* status, indicating that data is not replicated anymore between Host 1 and Host 2 volumes. The state of the session is *Suspended* as indicated in Figure 7-98.

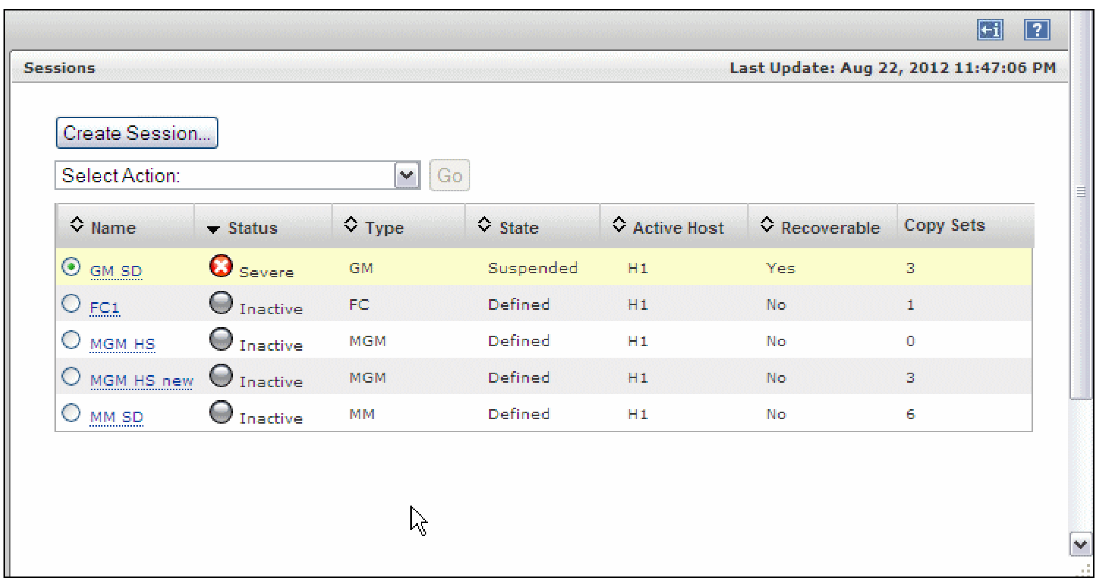

Figure 7-98 Suspend Global Mirror session is reported as Completed

7.4.5 Recovering a Global Mirror session

After the Global Mirror session has been suspended, we can initiate a *Recover* action. Follow these steps:

1. Select the Global Mirror session radio button (GM SD in our scenario shown in Figure 7-99) and select **Recove**r action from the **Select Action** pull-down menu. Click **Go** to continue.

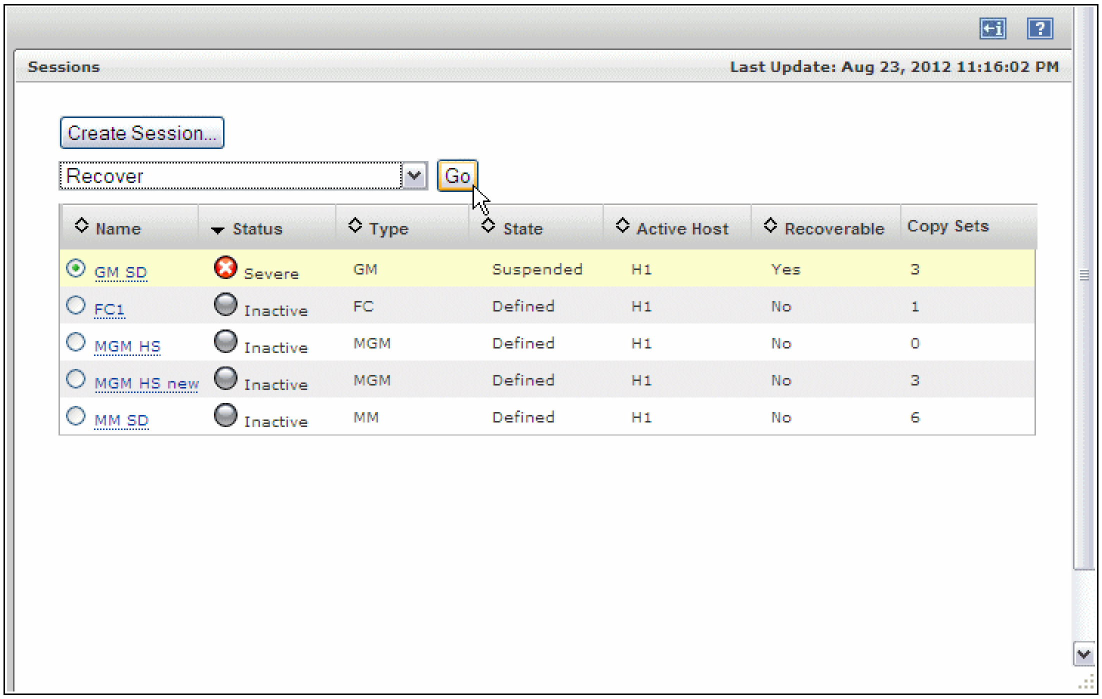

Figure 7-99 Global Mirror session - Recover action

2. The next message shown in Figure 7-100 is a warning that you will allow H2 volumes available to your host. Click **Yes** to continue.

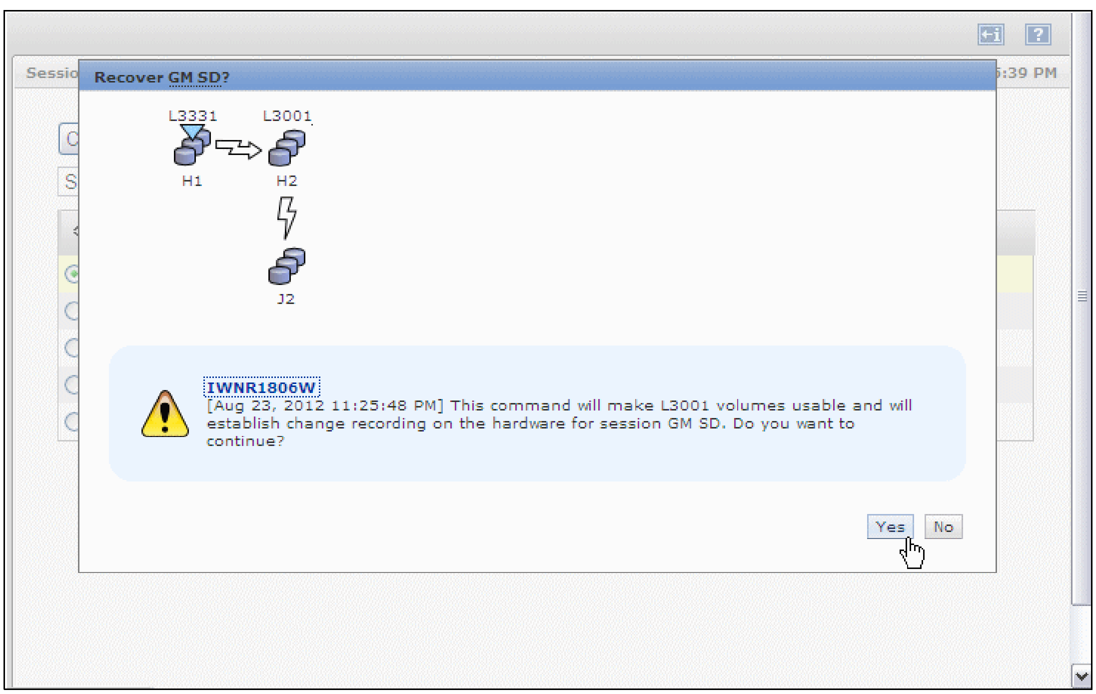

Figure 7-100 Recover Global Mirror session warning

3. There is a message at the top of the panel in Figure 7-101 indicating that a **Recover** action has been successfully completed. The status of our Global Mirror session is *Normal* and the State is *Target Available*, indicating that H2 volumes are available to your hosts.

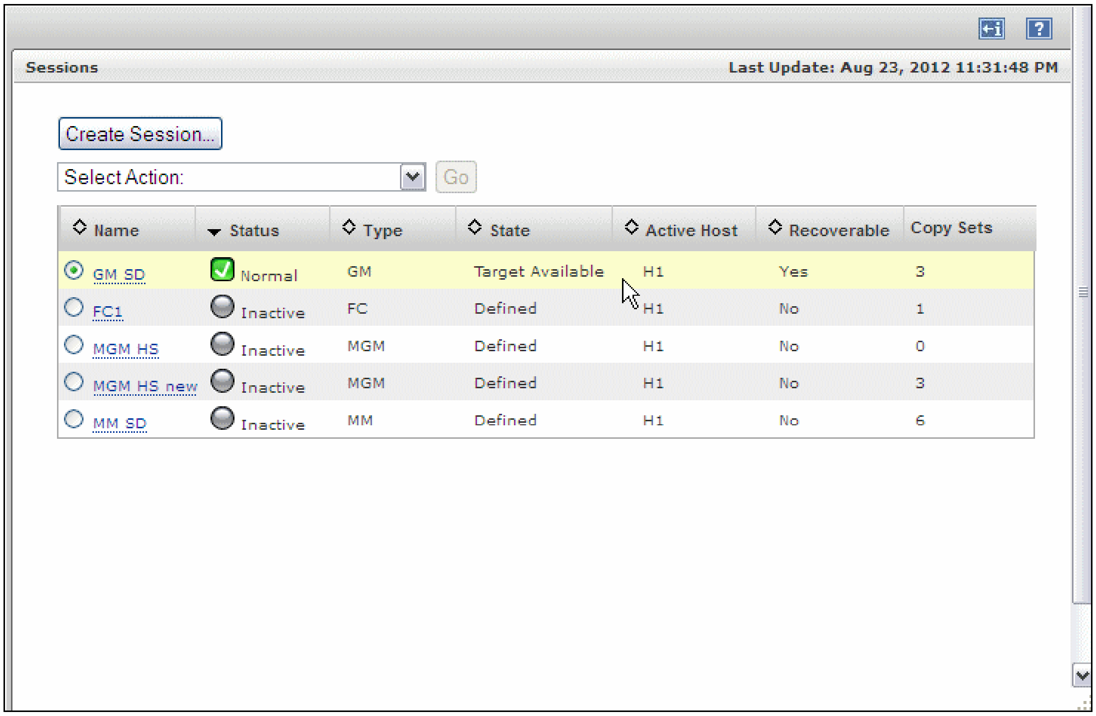

Figure 7-101 Global Mirror session - H2 volumes available to hosts

After the Global Mirror session is recovered in *Target Available* state, the following options are available:

Start Reestablishes replication.

Terminate Terminates the session (under Cleanup submenu).

7.4.6 Terminating a Global Mirror session

The **Terminate** command breaks the Global Mirror relationship between H1, H2, and J2 volumes, thus terminating data replication. Follow these steps:

1. Select the Global Mirror session radio button (GM SD in our example shown in Figure 7-102) and select **Terminate** from the **Select Action** (*Cleanup* submenu) pull-down menu. Click **Go** to continue.

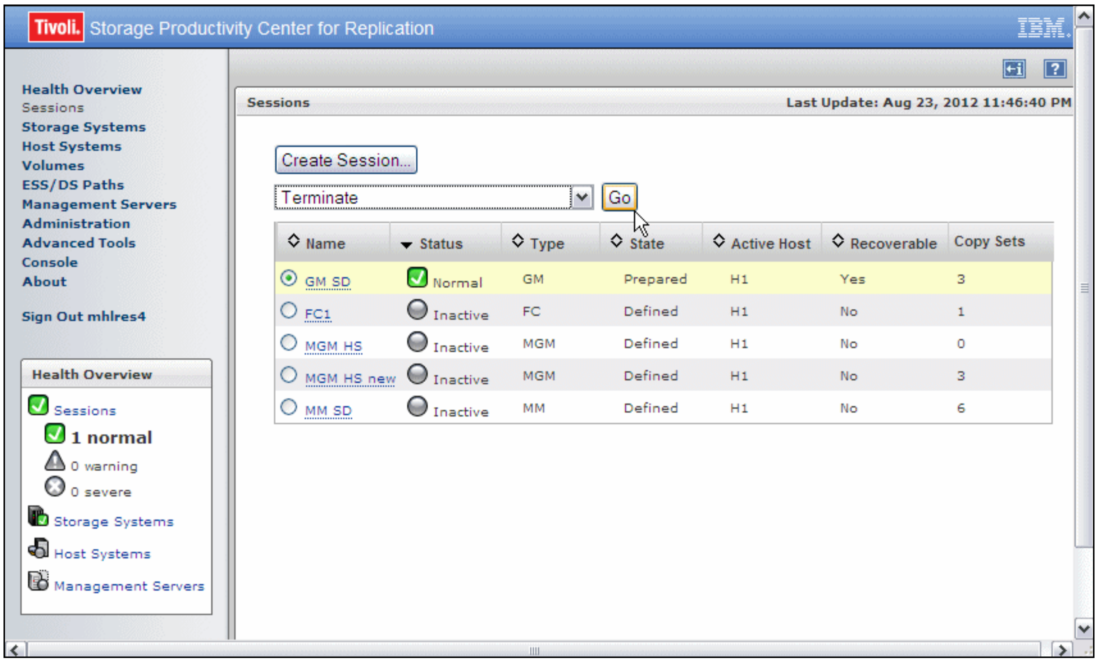

Figure 7-102 Global Mirror session - Terminate action

2. The next message shown in Figure 7-103 is a warning that you are about to terminate the Global Mirror relationship between H1, H2, and J2 volumes. Note that if you require to start the very same Global Mirror session again, a full copy from H1 to H2 volumes will be required. Click **Yes** to continue.

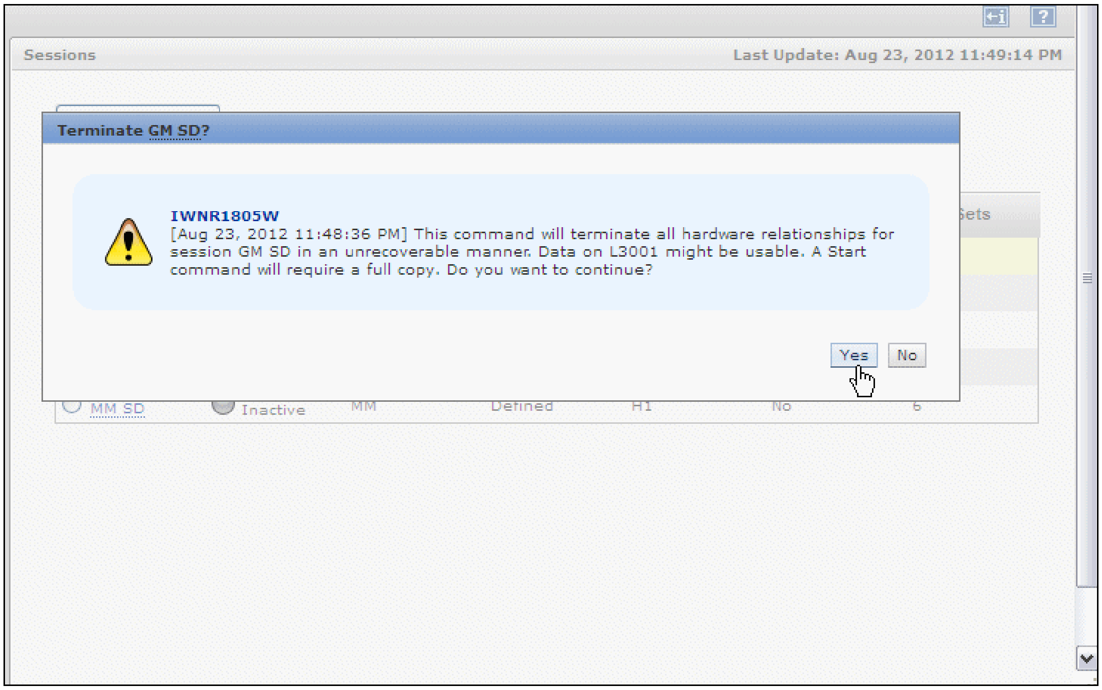

Figure 7-103 Terminate Global Mirror session warning

3. There is a message at the top of the panel in Figure 7-104 indicating that a **Terminate** action has been successfully completed. The status of our Global Mirror session is now *Inactive* and the state is *Defined*.

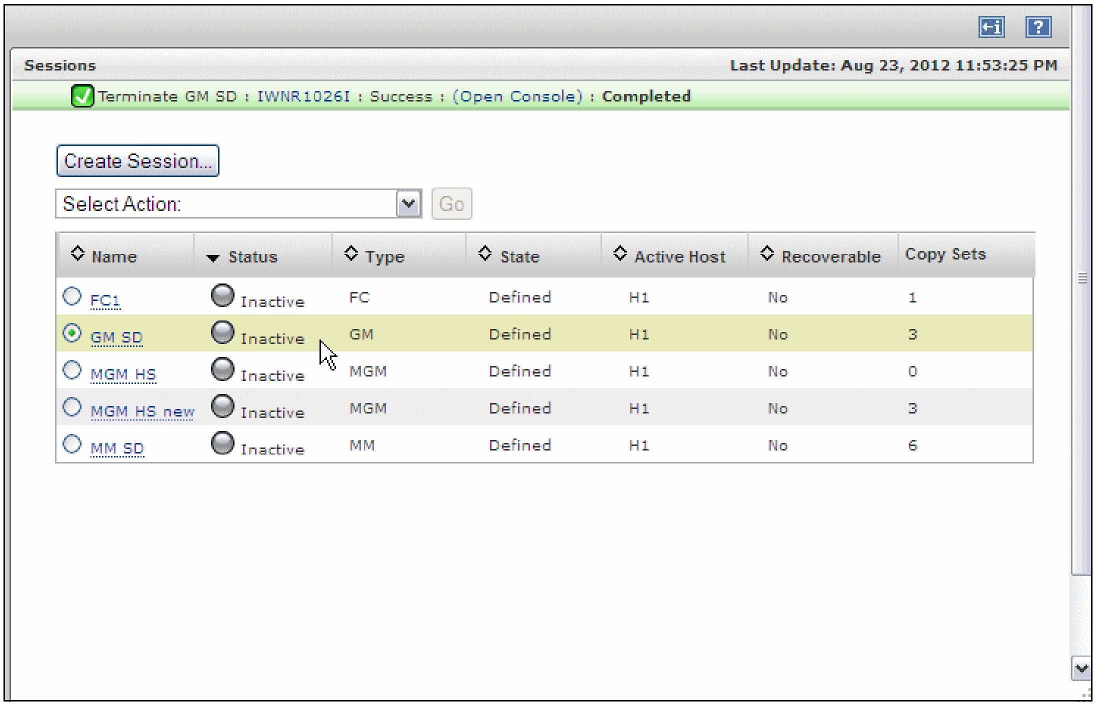

Figure 7-104 Terminate Global Mirror session - Completed

7.5 Metro Mirror Failover/Failback using the GUI

You may create a session at any time after the server code is installed and up and running. Again, a session is only a token with a name and certain attributes assigned to this session. This is always the same approach independent on the session type. At this point you need to have storage subsystems defined to the Tivoli Storage Productivity Center for Replication server as described in Chapter 4, “Configuring the DS8000 storage system for use with Tivoli Storage Productivity Center for Replication” on page 123.

A Metro Mirror Failover/Failback session allows you to switch the flow of replication from **H1 to H2** volumes to **H2 to H1** volumes. When combined with Basic HyperSwap, you can prepare your system for high availability of data and disaster recovery capabilities.

7.5.1 Creating a Metro Mirror Failover/Failback session

Creating a Metro Mirror Failover/Failback session is similar to the creation of a Metro Mirror session, as described in 7.3.1, “Creating a Metro Mirror Single Direction session” on page 287. Follow these steps:

1. From the Sessions panel, click the **Create Session** button, as shown in Figure 7-105.

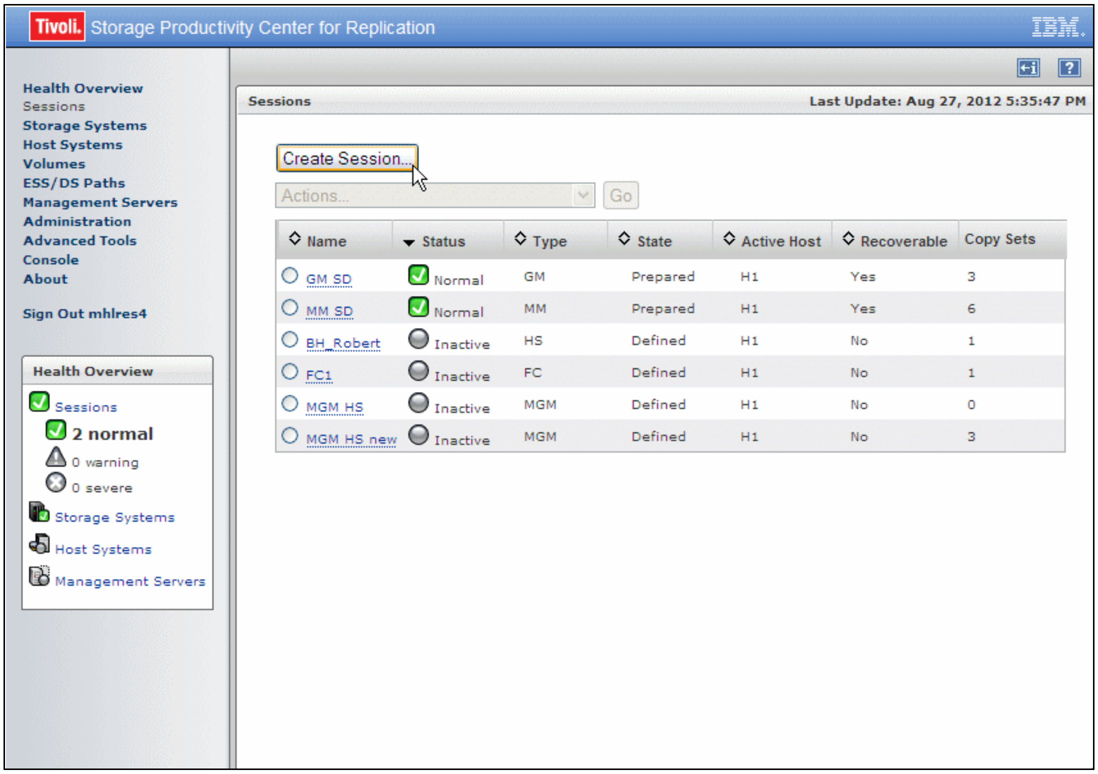

Figure 7-105 Creating a session

2. Select the hardware type (DS8000 in our example) and select **Metro Mirror Failover/Failback** session from the pull-down menu as shown in Figure 7-106 on page 336. On the right side, a pictograph symbolizes the involved sites and their volume types. H1 represents Site 1 volumes and H2 represents Site 2 volumes. When you define Copy Sets this pictograph helps you to orient and understand replication direction. Click **Next** to continue.

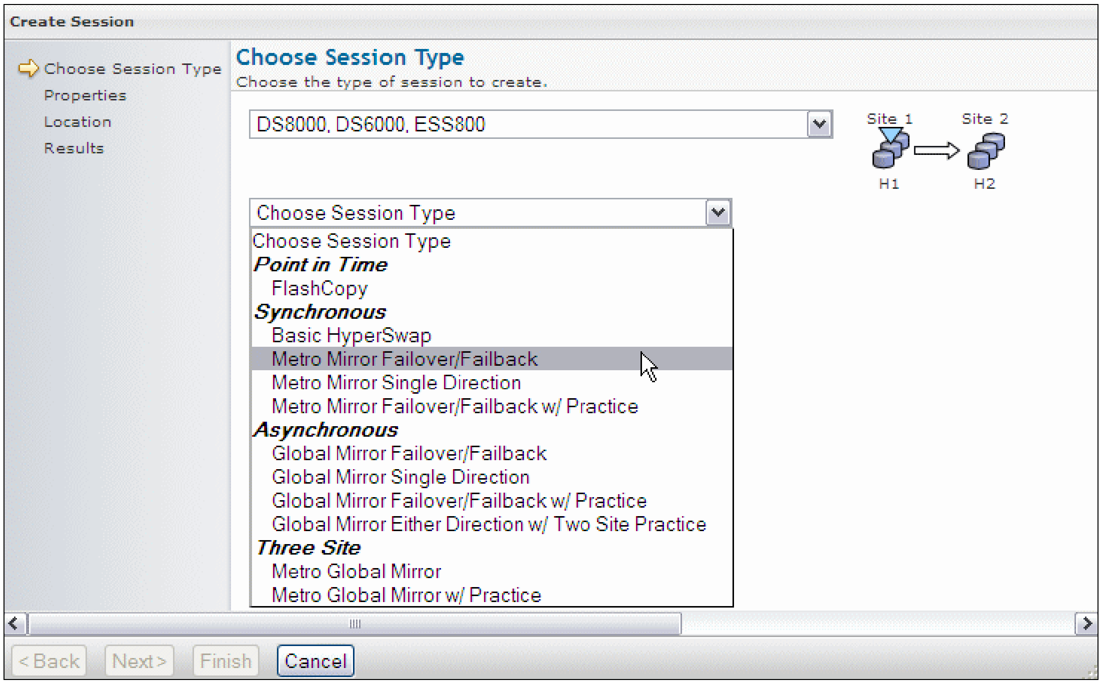

Figure 7-106 Define the Metro Mirror FO/FB session

This leads us to the session Properties panel as Figure 7-107 on page 339 shows.

But first, in the following paragraphs, we describe the fields on this panel.

The *Properties* panel is also important because it requires that you specify at least a name for the session which is about to be created. An optional *Description* is desirable to understand the purpose of the session because the session name may not reveal what this session is intended for.

The Properties panel also gives you the options for you to define the new session. Tivoli Storage Productivity Center for Replication allows you to specify additional options to work with HyperSwap when defining a Metro Mirror Failover/Failback session.

- Fail MM/GC if the target is online (CKD only):

  This option ensures that all target (secondary) volumes in a Metro Mirror session are offline and not visible to any host, otherwise the start of the session task will fail. This applies to CKD volumes only. Use this option since target (secondary) volumes in a Metro Mirror session should be offline to all hosts.

- Enable Hardened Freeze:

  Use this option to let z/OS Input/Output Supervisor (IOS) manage freeze operations for the volumes in the session, which prevents Tivoli Storage Productivity Center for Replication from freezing the volumes and possibly freezing itself. Use this option if you put system volumes, like SYSRES, into the Copy Sets of a Metro Mirror session.

  You need the following prerequisites to implement this function:

  – z/OS at 1.13 level, with APAR OA37632 installed;

  – z/OS address spaces Basic HyperSwap Management and Basic HyperSwap API must be active, even if you are not going to exploit Basic HyperSwap.

- Metro Mirror Suspend Policy:

  Tivoli Storage Productivity Center for Replication, or z/OS IOS if you are using the Enable Hardened Freeze option, issues Freeze commands to all the LSSs defined in a MM session, as soon as a replication error or some primary disk errors occur. All the write I/Os are hold at the primary volumes (H1), and then the replication between H1 and H2 volumes is suspended. Those Freeze commands thus guarantees that the H2 volumes data is consistent. The action that Tivoli Storage Productivity Center for Replication, or z/OS, will take subsequent to the Freeze is specified by the Metro Mirror Suspend Policy. You basically have two options available:

  – *Hold I/O after Suspend:* Known as the *Freeze and Stop* policy

    After a freeze, new writes are not allowed to the H1 volumes, thus stopping your production systems.

  – *Release I/O after Suspend:* Known as the *Freeze and Go* policy

    After a freeze, you can make new writes to the H1 volumes, but no replication will occur to the H2 volumes. This is the default setting for all new sessions.

  Which option you select is really a business decision rather than an IT decision. If your Recovery Point Objective (RPO) is zero (that is, you cannot tolerate any data loss in case of production site disaster), you must select **Hold I/O after Suspend**. This option will hold I/O at the production site on all volumes defined in the session. Because all systems that can update the production site volumes are on hold before the Extended Long Busy (ELB) for CKD volumes (default is 120 seconds), you are sure that no updates are made to the production volumes that are not mirrored to the volumes at the disaster recovery (DR) site. If you do not take any action against this session within this ELB time0, I/O is released to the production volumes when the ELB timer expires.

  However, if the event that caused Tivoli Storage Productivity Center for Replication to take the **Hold I/O after Suspend** action was a transient event (for example, a temporary link lost between sites) rather than a real disaster, you will have brought all production systems down unnecessarily.

  If your RPO is higher than zero, you may decide to let the production systems continue operation after the secondary volumes have been protected. This is known as Freeze and Go policy and you need to select **Release I/O after Suspend** option. In this case, if the trigger was only a transient event, you have avoided an unnecessary outage. However, if the trigger was the first sign of an actual disaster, you could continue operating for some amount of time before all systems actually fail (so called ‘Rolling disaster’). Any updates made to the H1 volumes during this time will not have been remote copied, and therefore are lost.

  In our example we use the **Release I/O after Suspend** option as shown in Figure 7-107 on page 339.

- Reset Secondary Reserves:

  This option is not shown in the Properties panel when you create a new session. But it can be accessed later using the View/Modify Properties panel.

  Select this option to remove any persistent reserves that might be set on the target volumes of the copy sets being started when a Start command is issued for the session.

  Before enabling the Reset Secondary Reserves option, be aware that this action causes the session to overwrite all data on the target volume.

- Manage H1-H2 with HyperSwap:

  Select this option to trigger a HyperSwap, redirecting application I/O to the secondary volumes (H2 volumes), either when an error occurs in one of the primary volumes (H1), or as a part of a planned procedure.

There are some options to control the behavior of z/OS regarding he HyperSwap configuration:

– Disable HyperSwap:

  You can use this option to start the Basic HyperSwap session with HyperSwap disabled. You can use this option for test purposes. You can enable HyperSwap later on by modifying this option in Session properties panel, or by issuing the SETHS ENABLE console command on z/OS.

– On Configuration Error:

  These options tells what your sysplex should do in case a member in the sysplex fails to load a new HyperSwap configuration:

  - Partition the systems out of sysplex: the system that cannot load a new configuration is taken out of the sysplex. It enters a 0B5 wait state, and it will be partitioned out of the sysplex. You have to re-IPL it.
  - Disable HyperSwap: it just disables HyperSwap when a new HyperSwap configuration cannot be loaded in any system in the sysplex.

  The default for this option is Partition the systems out of the sysplex. However, specify Disable HyperSwap when you are doing your tests in order to avoid unnecessary outages due to systems being taken out of the sysplex due to a configuration error. As soon as you get skilled with this process of loading new configurations, you can change it back to the Partition the systems out of the sysplex.

– On planned HyperSwap error:

  These options specify what should be done in case a planned HyperSwap fails in any system in a sysplex:

  - The first radio button specifies that if a system fails to complete a planned HyperSwap, it will be partitioned out of the sysplex. The other images will have their UCBs swapped by the HyperSwap operation.
  - The second radio button specifies that the HyperSwap operation will be backed out, and HyperSwap will be disabled.

  Select the Disable HyperSwap option for planned HyperSwap errors. It allows other partitions to complete the HyperSwap and resume their workload sooner.

– On unplanned HyperSwap error:

  These options dictate how the sysplex should behave in case of an unplanned HyperSwap. The choices are the same as for planned HyperSwap:

  - Partition the system that cannot complete the HyperSwap operation out of the sysplex. That system enters a 0B5 wait state, and it is partitioned out of the sysplex. You have to re-IPL this system.
  - Back out the HyperSwap operation and disable it:

  Use the option to partition the systems out of the sysplex. The others system in the sysplex will survive the planned HyperSwap and will continue to run even if there is a crash in an entire disk subsystem box.

- Manage H1-H2 with Open HyperSwap:

  If volumes are attached to an IBM AIX host, Tivoli Storage Productivity Center for Replication can manage the swapping and flow of replication of H1 and H2 volumes in a Metro Mirror Failover/Failback session using Open HyperSwap. If you select this option, option is selected, a failure on the host accessible volumes triggers a swap, which redirects application I/O to the secondary volumes.

– Disable Open HyperSwap. Select this option to prevent a swap from occurring by a command or event while keeping the configuration on the host system and all primary and secondary volumes coupled.

After you choose all the Properties that are relevant to your environment (as shown in Figure 7-107), follow these steps:

1. Click **Next** to define location sites.

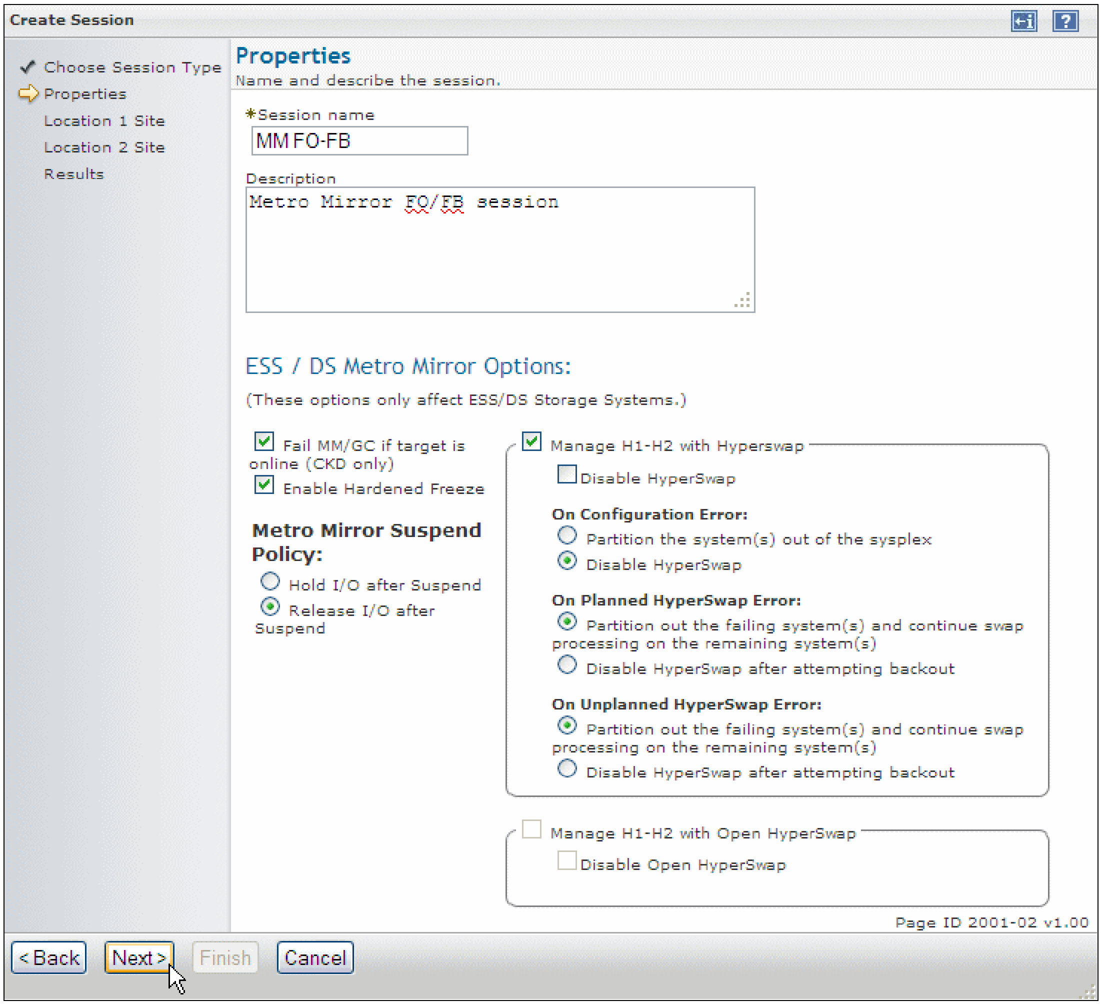

Figure 7-107 Define Metro Mirror FO/FB session Properties

2. From the pull-down **Site 1 Location** menu (see Figure 7-108), select the location of your H1 storage subsystem previously defined in “Adding IBM ESS or DS Storage Server to Tivoli Storage Productivity Center for Replication server” on page 137 and click **Next** to continue.

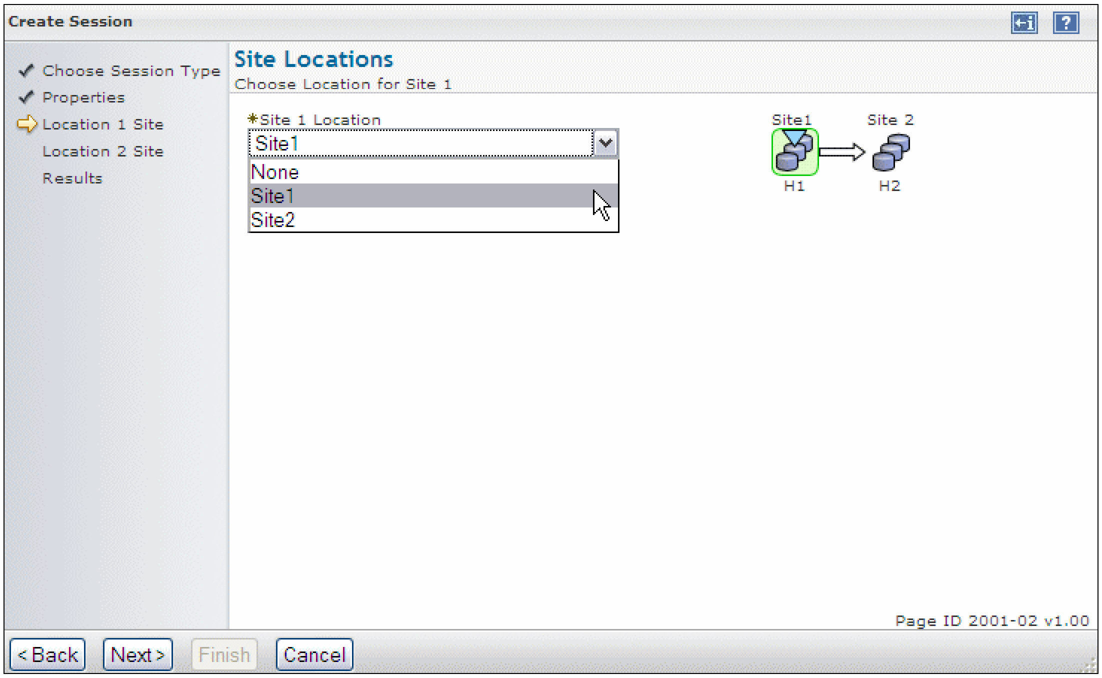

Figure 7-108 Define Metro Mirror FO/FB session Site 1 Location

3. From the pull-down **Site 2 Location** menu (see Figure 7-109) select the location of your H2 storage subsystem previously defined and click **Next** to continue.

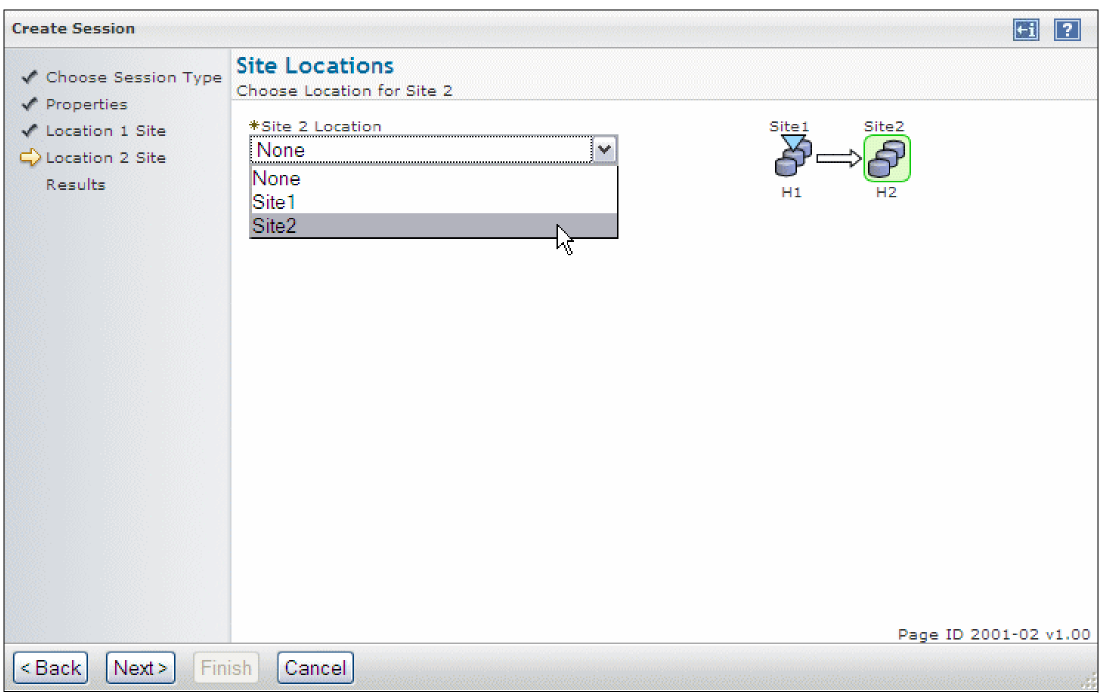

Figure 7-109 Define Metro Mirror FO/FB session Site 2 Location

4. Figure 7-110 displays the message that the MM FO-FB session was successfully created. Click **Finish** to exit the *Create Session* wizard. Alternatively, you have an option to add Copy Sets and click **Launch Add Copy Sets Wizard** and follow the instructions described in 7.5.2, “Adding Copy Sets to a Metro Mirror Failover/Failback session” on page 342.

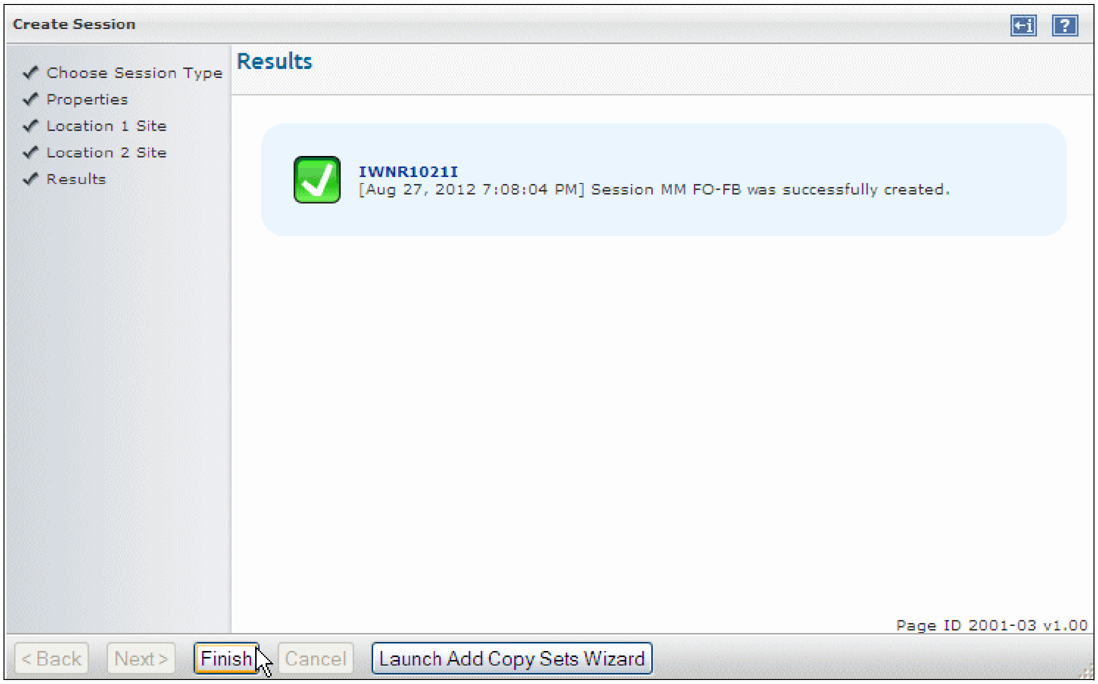

Figure 7-110 Define Metro Mirror FO/FB session - Results

5. Go back to the Tivoli Storage Productivity Center for Replication home page and select Sessions hyperlink to check on the recently created Metro Mirror Failover/Failback session. Figure 7-111 now displays the Metro Mirror Failover/Failback session which we successfully created.

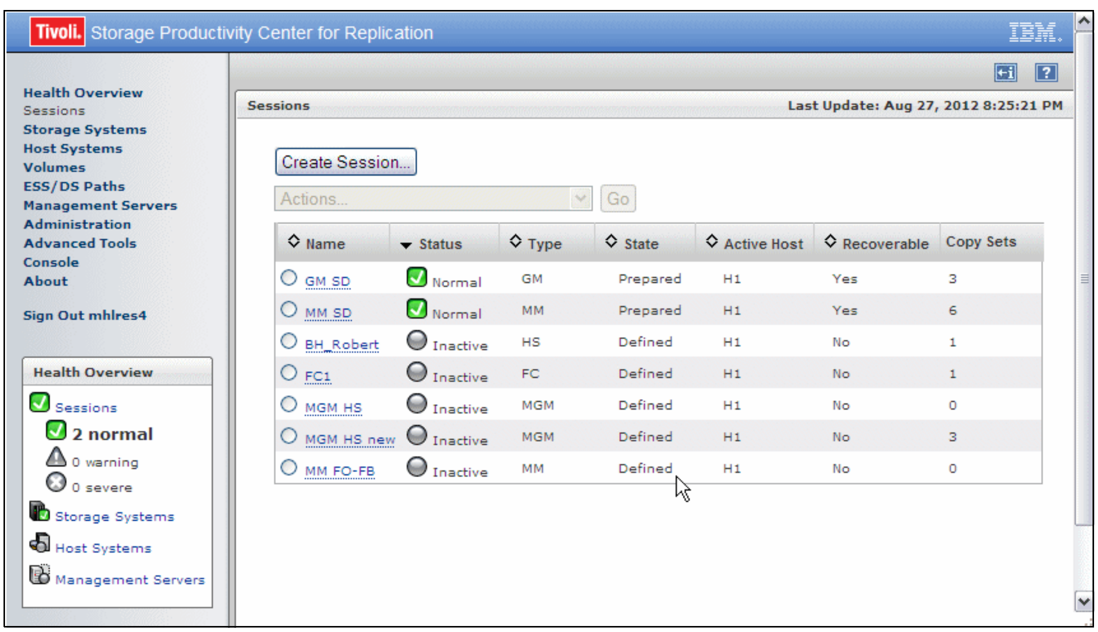

Figure 7-111 Metro Mirror FO/FB session defined

Again, note that this session with its name is just a token and represents a Metro Mirror Failover/Failback Copy Services type. At this stage there is no storage server nor are there any volumes associated with this MM FO-FB session.

See 7.3.3, “JES3 considerations” on page 298 if you intend to exploit the Enable Hardened Freeze or the HyperSwap options in a JES3 environment.

7.5.2 Adding Copy Sets to a Metro Mirror Failover/Failback session

After we have defined the Metro Mirror session MM FO-FB, we populate this session in the next step with Copy Sets, which are Copy Services volumes. In a Metro Mirror Failover/Failback session a Copy Set consists of one H1 and one H2 Metro Mirror volume.

Figure 7-112 shows the session overview panel with the MM FO-FB session that we defined previously. The next logical action that you perform on MM FO-FB session is to add volumes or Copy Sets to it. Follow these steps:

1. Select your Metro Mirror session name radio button (MM FO-FB in our example) and choose **Add Copy Sets** from the **Select Action** pull-down menu. Click **Go** to invoke the *Add Copy Sets* wizard.

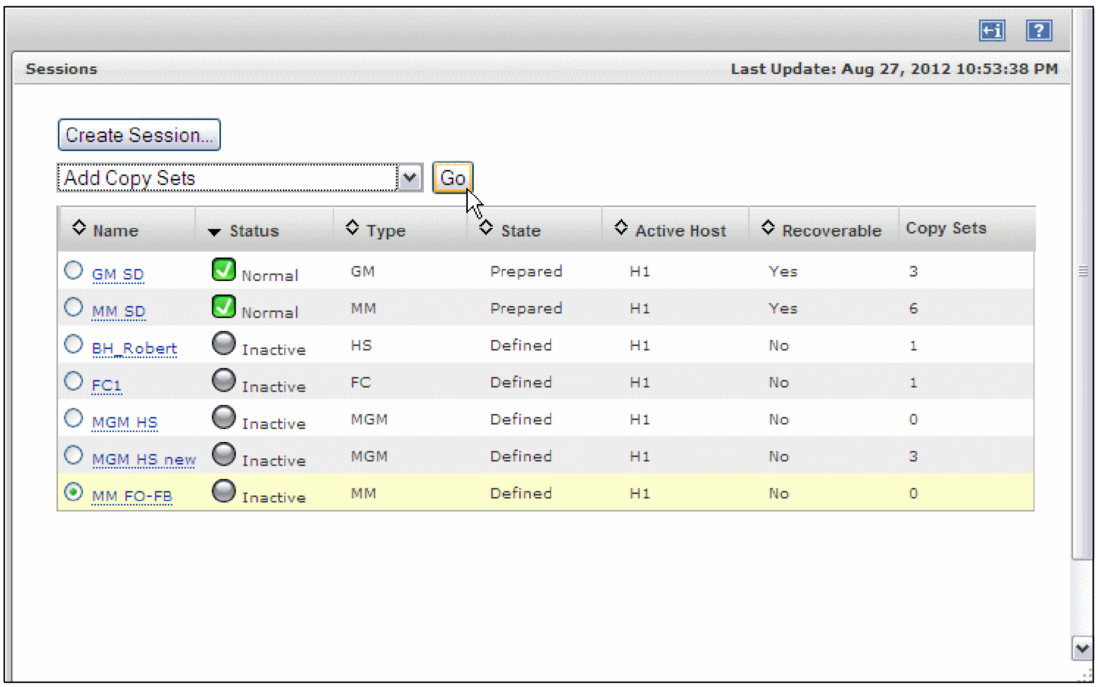

Figure 7-112 Add Copy Sets to Metro Mirror Failover/Failback session

Note that over time, various terminology is introduced for the same thing. Peer-to-Peer Remote Copy or PPRC (known today as Metro or Global Mirror) started out with primary volumes and secondary volumes. This terminology was fine for a 2-site solution. With the arrival of switching sites from an application viewpoint as well as for the storage subsystem used, Tivoli Storage Productivity Center for Replication introduced a different terminology for these PPRC volumes and their association to a certain site.

Host 1 or Site 1 refers to the primary volumes as a starting point. This may be the local site or application site; it is considered to be the primary site. But it has the potential to change. You may want to switch application sites from Host 1 in Site 1 to Host 2 in Site 2 and also switch at the same time the Copy Services role of the associated storage subsystems. This led to Host 1, Site 1 volumes and Host 2, Site 2 volumes terminology being used in Tivoli Storage Productivity Center for Replication.

2. Figure 7-113 displays the panel which provides details on the primary volumes or local volumes which are called Host 1 volumes relating to the fact that these volumes reside in the Site 1 or application site or local site. These are all synonyms and refer to the same environment. Select the desired **Host 1 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Host 1 logical storage subsystem** list. Select the LSS where your H1 volume resides. After the LSS has been selected, choose the appropriate volume from the **Host 1 volume** pull-down list.
3. The alternative way to add a large number of volumes to this session is to create CSV file as explained in "Using CSV files for importing and exporting sessions" on page 194. In case you have a CSV file ready select **Use a CSV file to import copy sets** check box and provide a path to your CSV file.
4. In our example, we selected DS8000 disk subsystem serial number L3331, LSS 0C and volume 07, as shown in Figure 7-113. Click **Next** to continue.

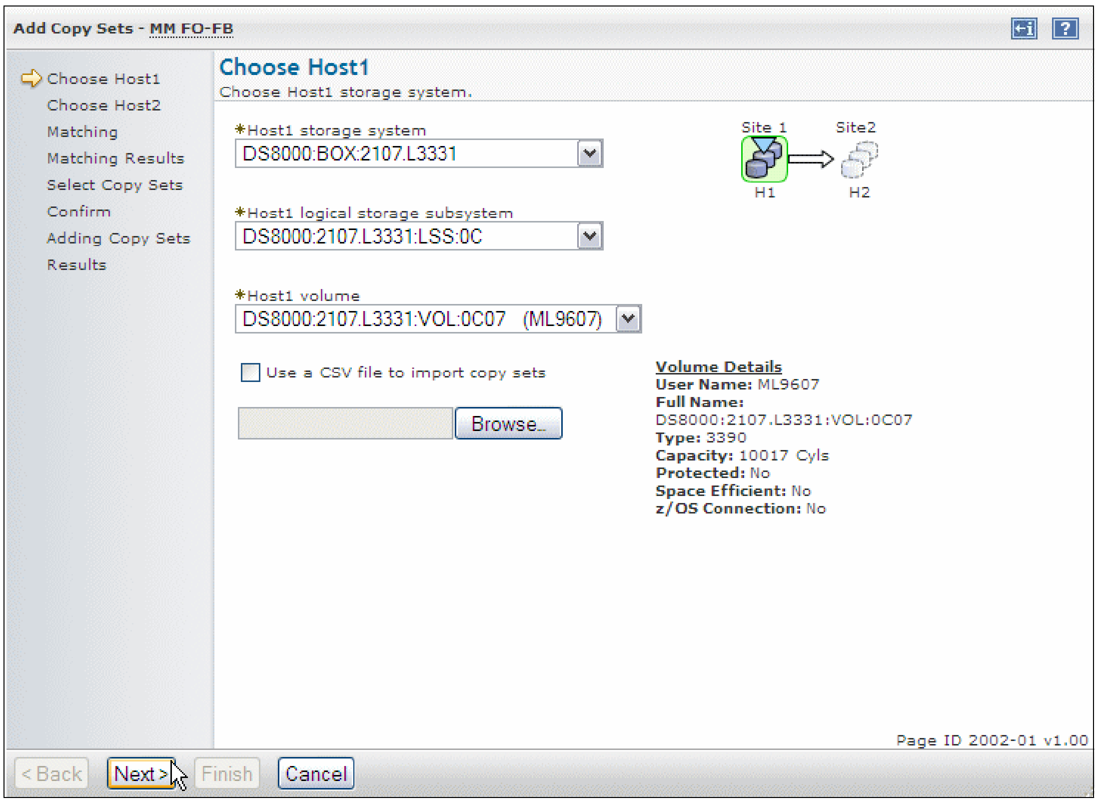

Figure 7-113 Add Copy Sets to Metro Mirror FO/FB session- Choose Host 1

5. In case you want to define all volumes within a certain LSS in the Metro Mirror session, there is an option to select **All Volumes** from the **Host1 volume** list as shown in Figure 7-114. Click **Next** to continue.

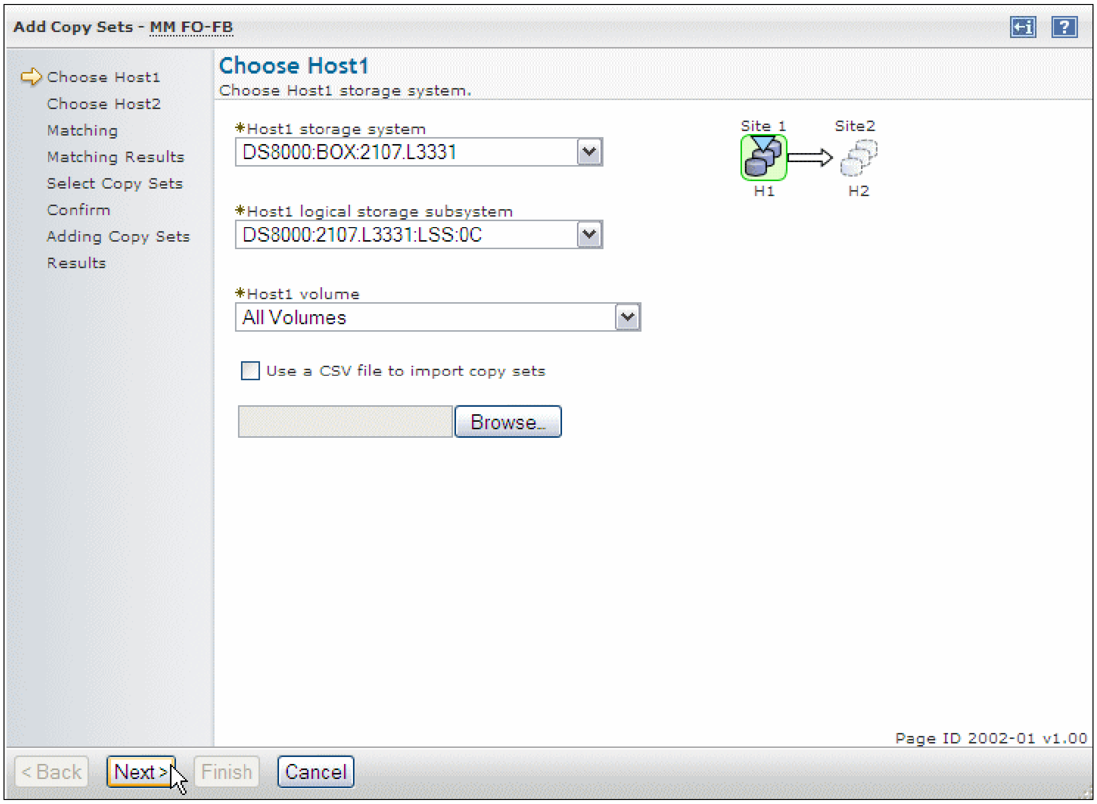

Figure 7-114   Add Copy Sets to Metro FO/FB session - Choose Host 1 and All Volumes option

6. The next step is to define Site 2 storage subsystems and volumes as shown in Figure 7-115. Select the desired **Host 2 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Host 2 logical storage subsystem** list. Select the LSS where your H2 volumes resides. If **All volumes** for a given LSS were selected in the previous step while defining Host 1 volumes, you do not have an option to select any volume from **Host 2 volumes** list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 1 storage subsystem with all volumes from selected LSS in Host 2 storage subsystem. In our example we selected **All Volumes** in Choose Host1 panel. Click **Next** to continue.

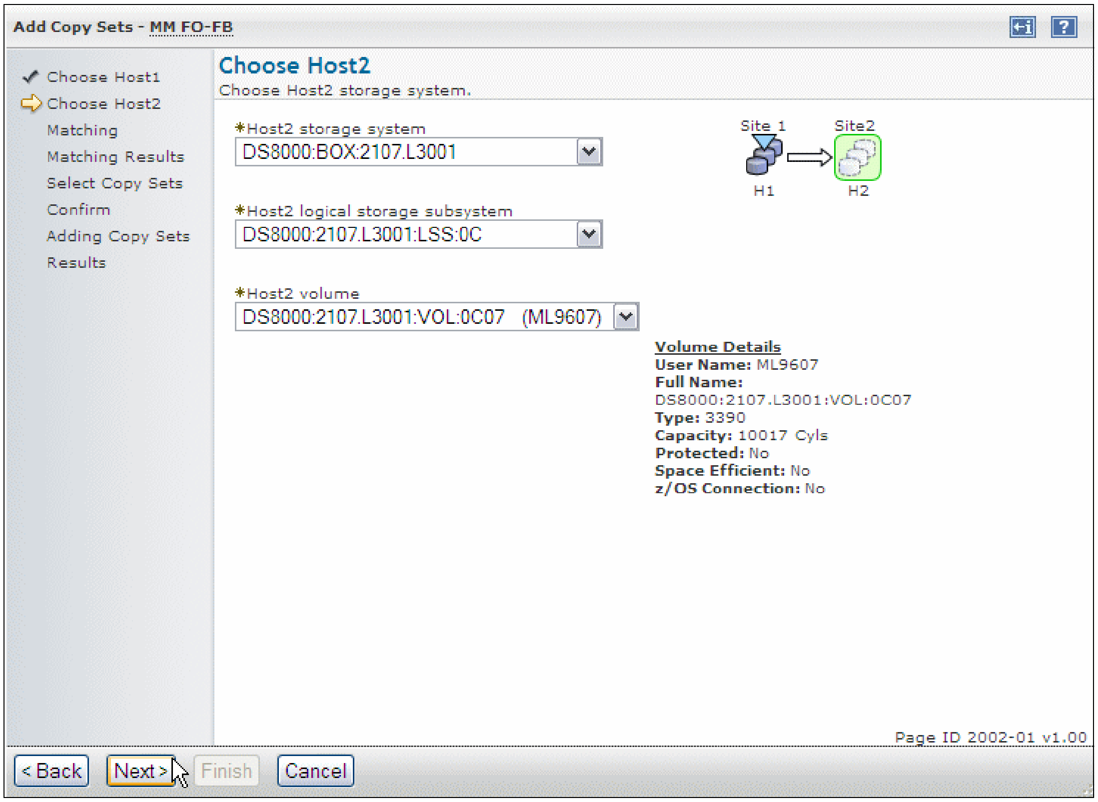

Figure 7-115 Add Copy Sets to Metro Mirror Single FO/FB session - choose Host 2 volume

7. The next panel in Figure 7-116 displays a warning with regard to the matching results. Clicking the hyperlink **Show**, we can see more details about this Copy Set, including the reason for the warning. In our example, we are adding a Copy Set that is already defined in a session called BH_Robert. We can ignore this warning, as long as this session BH_Robert will remain Inactive.
8. You have the option to add more Copy Sets, by clicking the **Add More** button.
9. When you had defined all the Copy Sets that you need, click **Next** to continue.

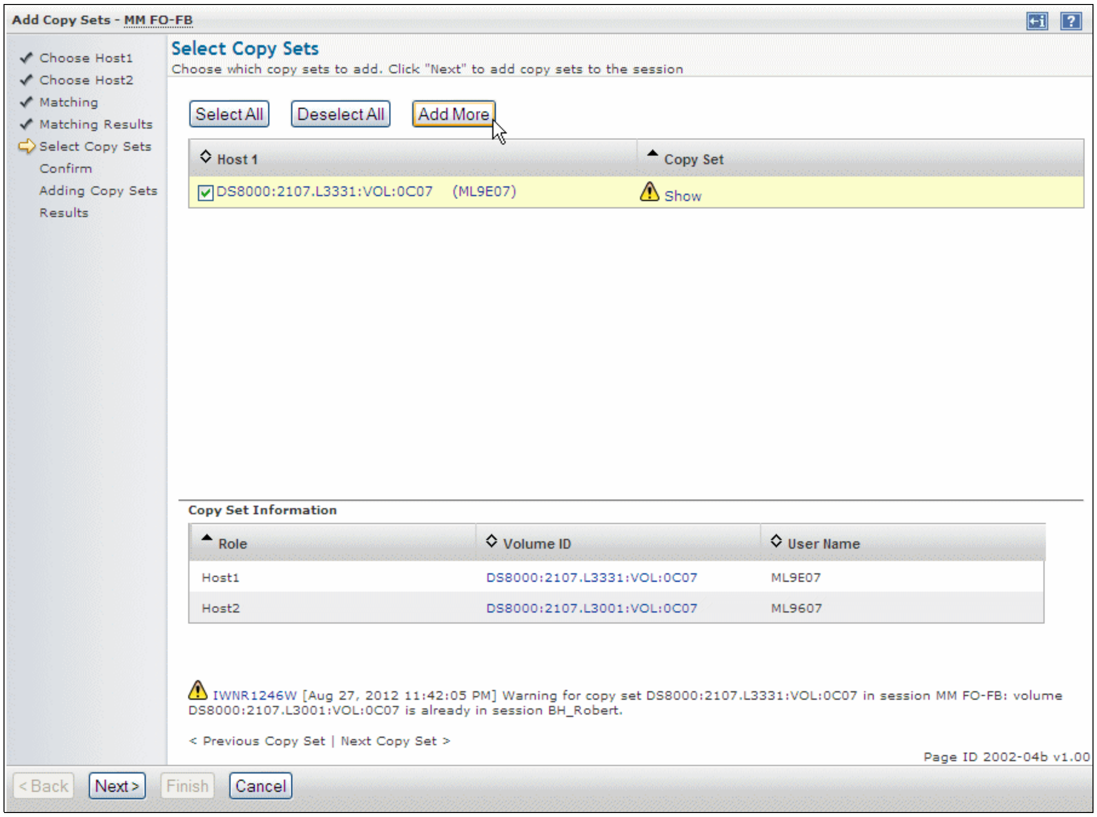

Figure 7-116 Add Copy Sets to Metro Mirror FO/FB session - Matching Results

10. The next panel displays the number of Copy Sets that are going to be created, as well as the number of unresolved matches (or not selected) as shown in Figure 7-117. Click **Next** to continue.

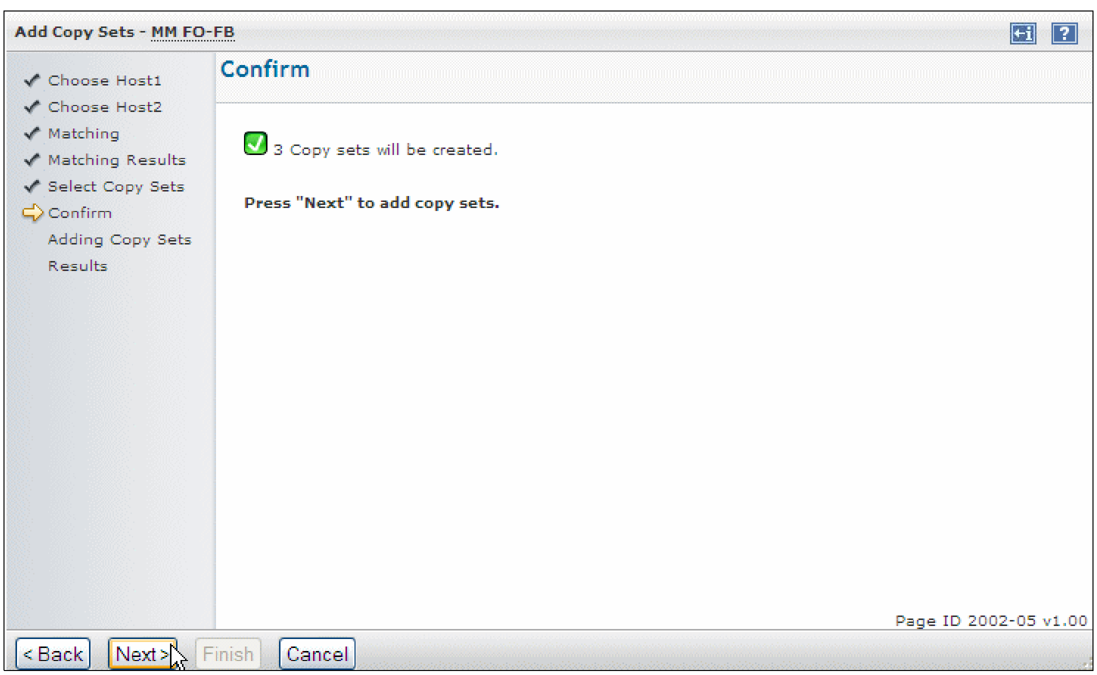

Figure 7-117 Add Copy Sets to Metro Mirror FO/FB session - Confirm panel

11. Tivoli Storage Productivity Center for Replication shows you a progress panel while it adds all the Copy Sets to its database. After a few seconds the progress panel reaches 100% and leaves the *Adding Copy Sets* panel and progress to the next panel shown in Figure 7-118. Click **Finish** to exit the *Add Copy Sets* wizard. You have the opportunity to review and make an appropriate action, if you need to.

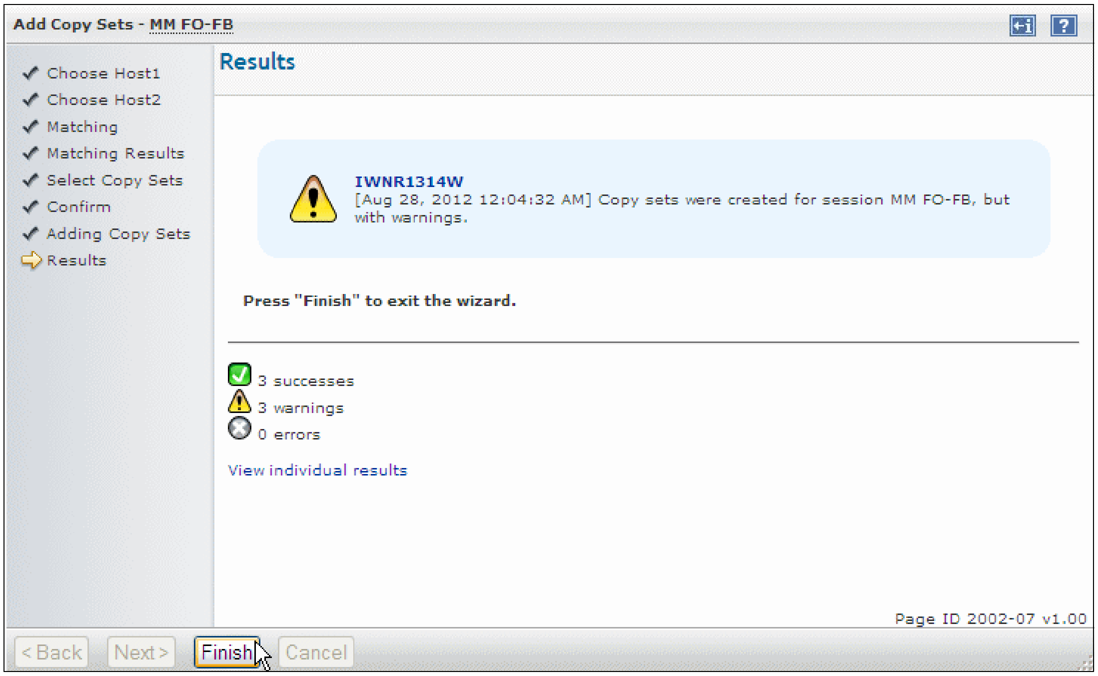

Figure 7-118 All Copy Sets added to the Tivoli Storage Productivity Center for Replication database

12. Figure 7-119 confirms that all Copy Sets are successfully added to the MM FO-FB session and the database is successfully updated. The session status is still *Inactive*.

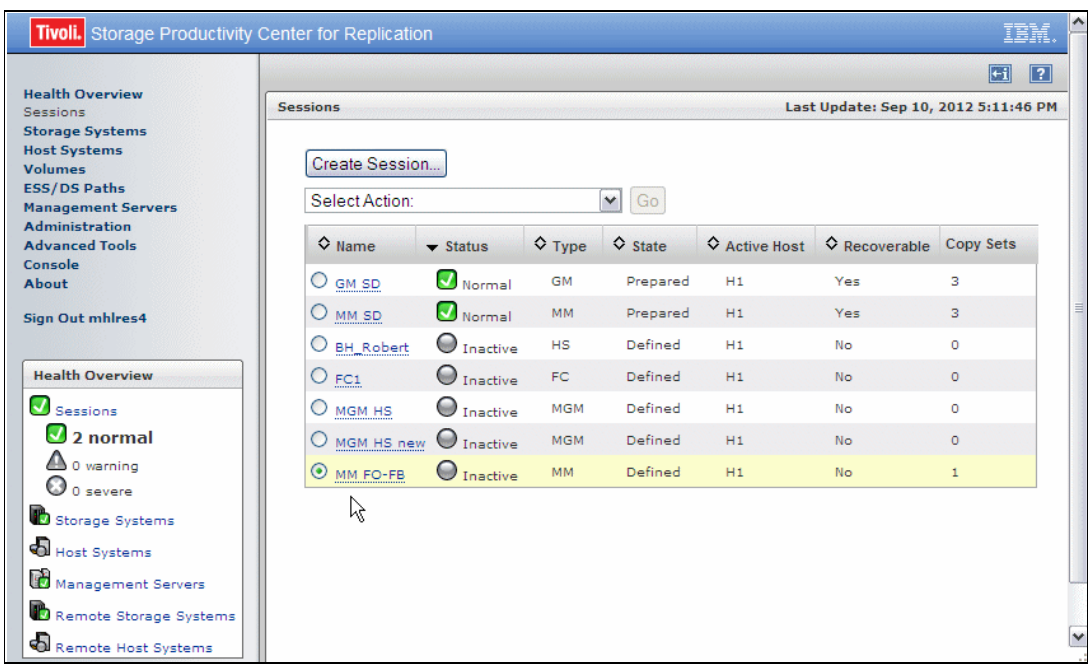

Figure 7-119 Metro Mirror Failover/Failback session status

This concludes the steps through the GUI when you add Copy Sets to a Metro Mirror Failover/Failback session.

7.5.3 Starting H1 to H2 replication

After we have defined a Metro Mirror session and populated the session with Copy Sets, we can start the Metro Mirror session. We can start it by choosing **Start H1** → **H2** or **StartGC H1** → **H2** from the pull-down menu Selection Action:

- **Start H1** → **H2**

  Starts the replication between in H1 and H2. As soon as all tracks of a H1 volume are copied to its peer H2 volume, the Copy Set enters Prepared state. At this time, replication between H1 and H2 volumes switches to synchronous replication.

  When all the Copy Sets in a session are in Prepared State, the session itself changes its state to Prepared.

- **StartGC H1** → **H2**

  Starts Global Copy (asynchronous replication) between H1 and H2 volumes. You can use this option for migrating data from one disk subsystem to another, for example.

  Some large configurations prefer to start the replication from one disk subsystem to another in asynchronous mode, as asynchronous replication is expected to impact less the productions systems during the initial copy phase, when all tracks are copied from H1 to H2 volumes. After all Copy Sets have reached almost 100% of data replicated, they switch to synchronous replication, by choosing Start command from the pull-down menu.

Figure 7-120 displays the MM FO-FB session as we defined it previously. We defined only one Copy Set in our example. As this is Failover/Failback type of a session it can be started in direction from Host 1 to Host 2 and in direction from Host 2 to Host 1. Initially the session can only be started in the direction from Host 1 to Host 2. Follow these steps:

1. To start it, from the **Select Action** pull-down menu select **Start H1** → **H2** and click **Go**.

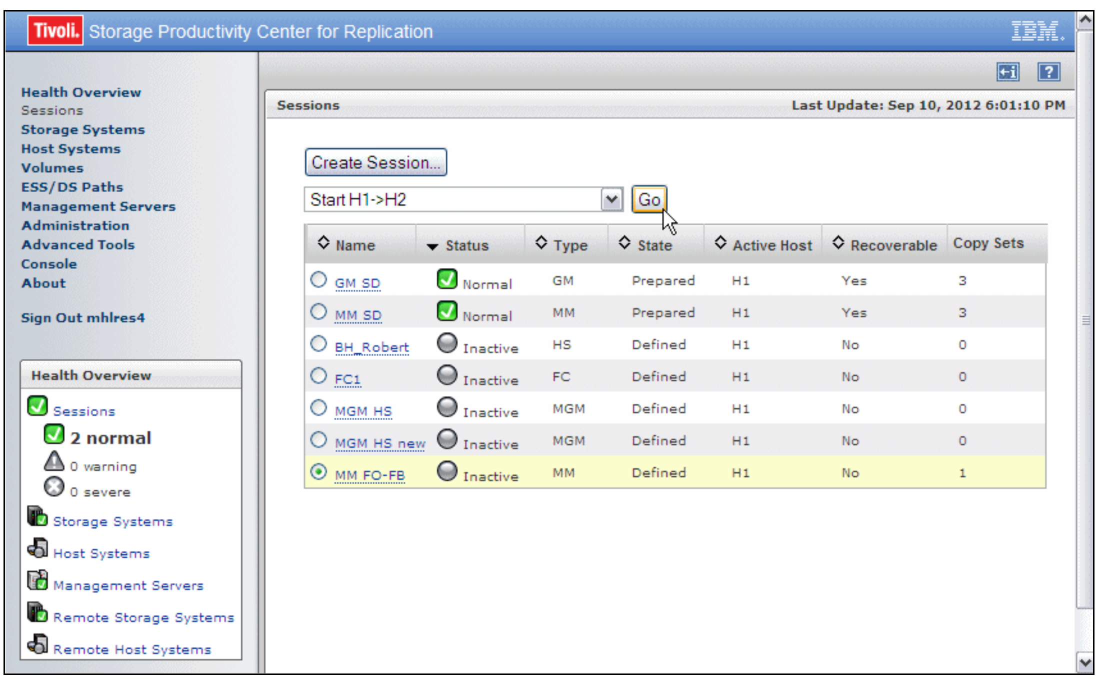

Figure 7-120 Metro Mirror session - Start H1 → H2 action

2. The next message shown in Figure 7-121 is a warning that you are about to initiate a Metro Mirror session. It will start the copying of data from Host 1 to Host 2 volumes defined previously by adding Copy Sets, thus overwriting any data on Host 2 volumes. Click **Yes** to continue.

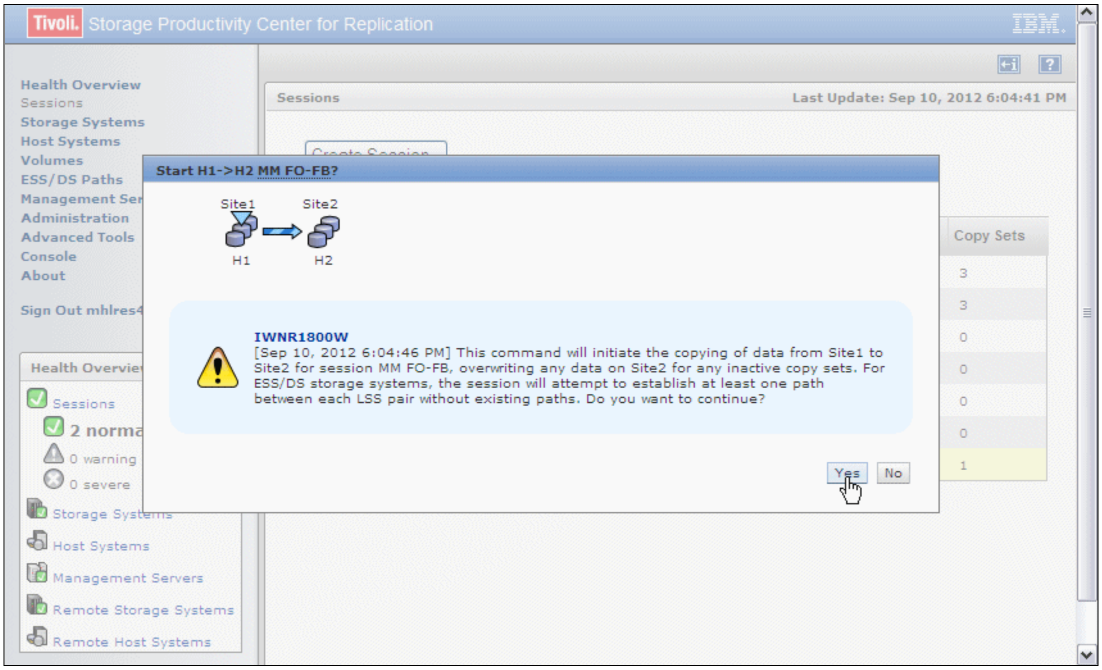

Figure 7-121 Start H1 → H2 Metro Mirror FO/FB session

3. The message at the top of the panel in Figure 7-122 confirms that start of the Metro Mirror session is completed. The session is in *Preparing* state and *Warning* status. You can click the session Name hyperlink (*MM FO-FB* in our example) to find more details on this session and track the progress of the initial copy.

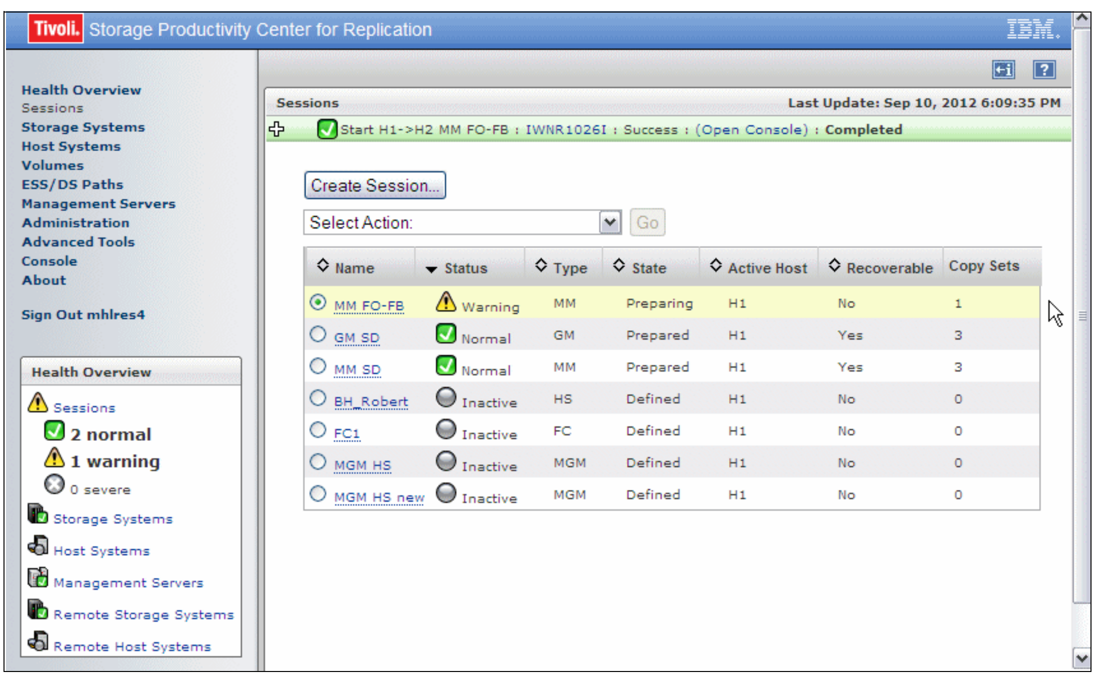

Figure 7-122 Start of Metro Mirror session is reported as Completed

4. When all Copy Sets in the session reaches Full Duplex (Prepared State), the State of the session changes to *Prepared*, and its Status to *Normal*, as shown in Figure 7-123.

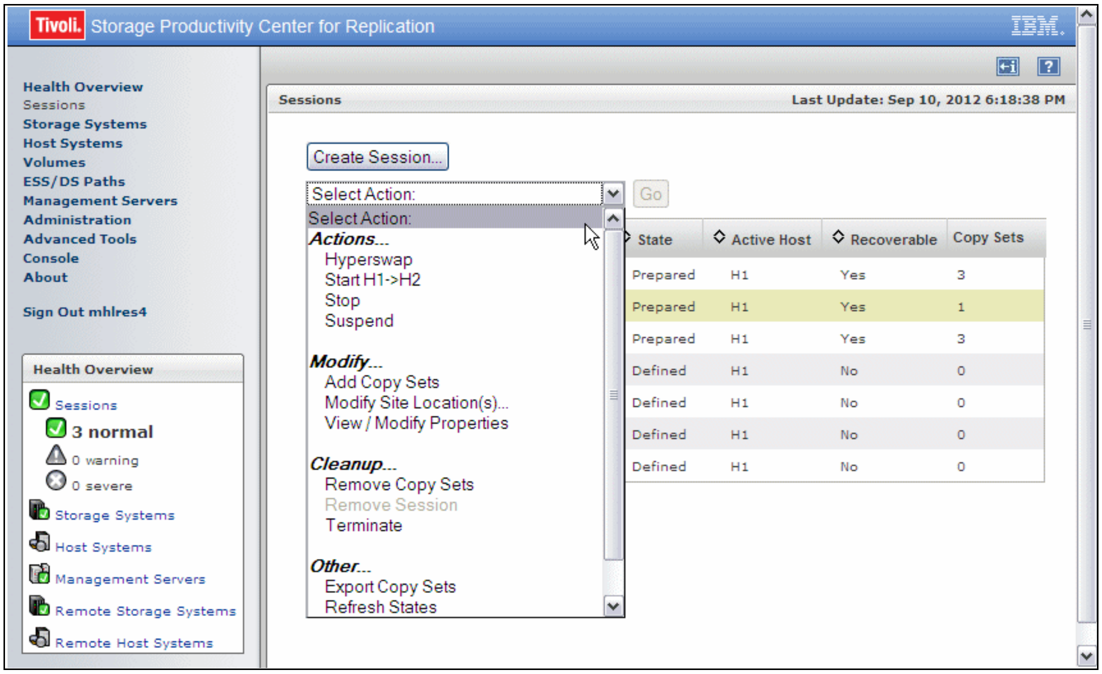

Figure 7-123 Metro Mirror FO/FB session actions

After the Metro Mirror session is started and it has *Normal* status and is in *Prepared* State, the following options are available:

HyperSwap Performs Basic HyperSwap, directing application I/Os to the H2 volumes.

Start H1 → H2 Restarts replication from H1 to H2 volumes.

Stop Stops replication with inconsistent H2 volumes.

Suspend Stops replication with consistent H2 volumes.

Terminate Terminates the session (under *Cleanup* submenu).

7.5.4 HyperSwap

You can perform a planned HyperSwap from the Tivoli Storage Productivity Center for Replication GUI. This can be useful when you need to do some maintenance in the site where your applications are running now, and you need to keep them active during the maintenance period. Follow these steps:

1. From the Sessions panel, select the Metro Mirror session radio button you are working on (*MM FO-FB* in our example), **HyperSwap** from the **Select Action** pull-down list, and click **Go**, as shown in Figure 7-124.

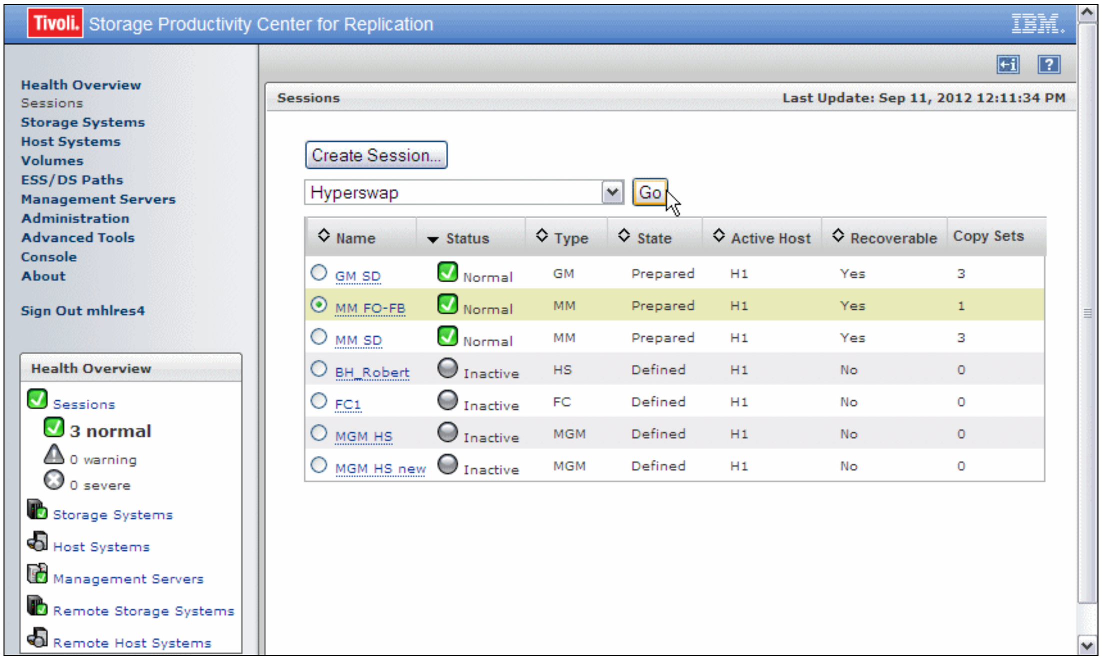

Figure 7-124 HyperSwap H1 to H2

2. Tivoli Storage Productivity Center for Replication shows you a warning. This warning tells you that your application I/Os are going to be moved from Site1 volumes to Site2 volumes. Click **Yes** to confirm that you want this swap to happen, as shown in Figure 7-125.

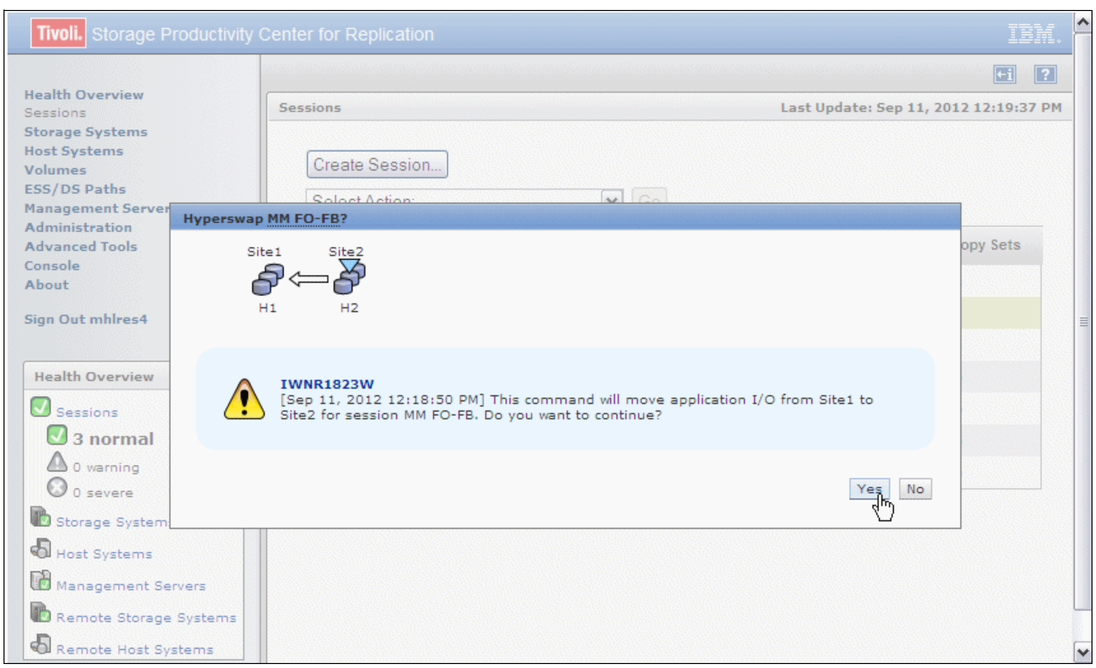

Figure 7-125 HyperSwap warning

3. After successful execution of HyperSwap, you see your session in a *Target Available* state, and Active Host H2, meaning that your application I/Os are now directed to the H2 volumes, in Site2, as shown in Figure 7-126.

The Metro Mirror replication is now suspended. The disk subsystems (ESS or DS8000) in Site2 create bit maps to track all updates that your application systems do to the volumes on Site2 and are not yet replicated to Site1 volumes.

HyperSwap is disabled at this time.

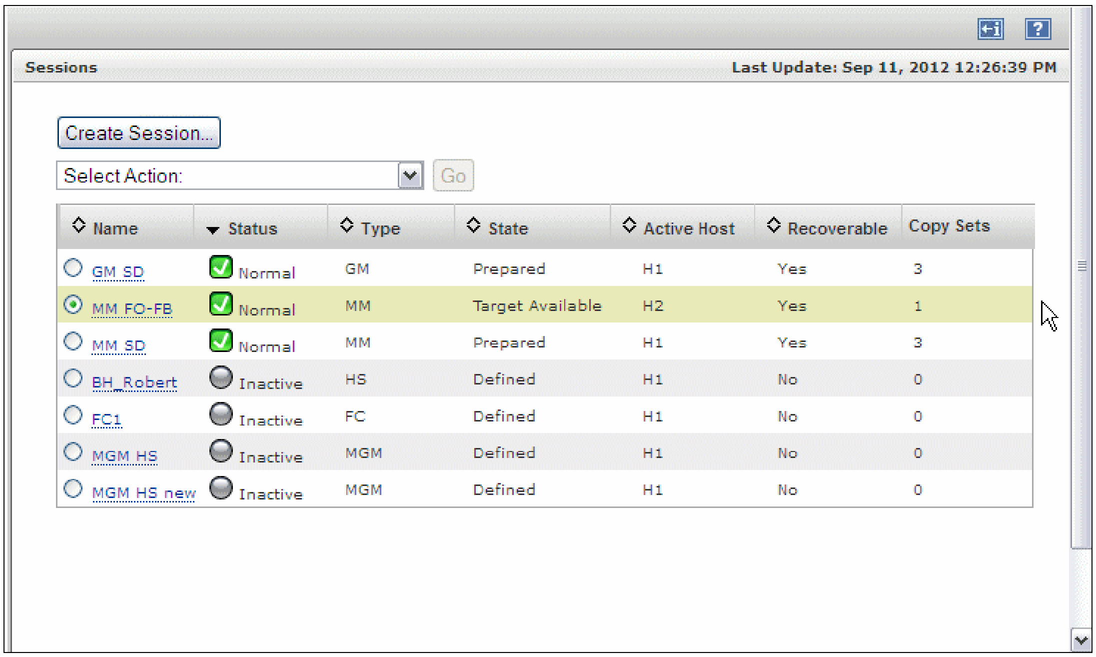

Figure 7-126 Application I/O moved to Site2 disks

Return to Site1

After the maintenance on Site1 is finished, you would probably move your application I/Os back to the H1 (Site1) volumes. The first step to go home is to establish replication from H2 to H1 volumes. You can start the replication in two ways:

- **Start H2 → H1**

  Starts Metro Mirror replication from H2 to H1 volumes. If you start the session by using the Start H2 → H1 action, the session enters Normal State and Prepared Status as soon as all updated tracks from H2 volumes are copied to the H1 volumes, and the replication enter synchronous mode for all the Copy Sets in the session.

- **StartGC H2 → H1**

  Starts Global Copy replication from H2 to H1 volumes. The replication stays in asynchronous until you perform a **Start H2 → H1** action.

In our example, we restart our session by performing the **StartGC H2 → H1** action. Follow these steps:

1. From the sessions panel, you can start the replication in Global Copy mode, by choosing **StartGC H2 → H1** from the **Select Action** pull-down menu, and clicking **Go**, as shown in Figure 7-127.

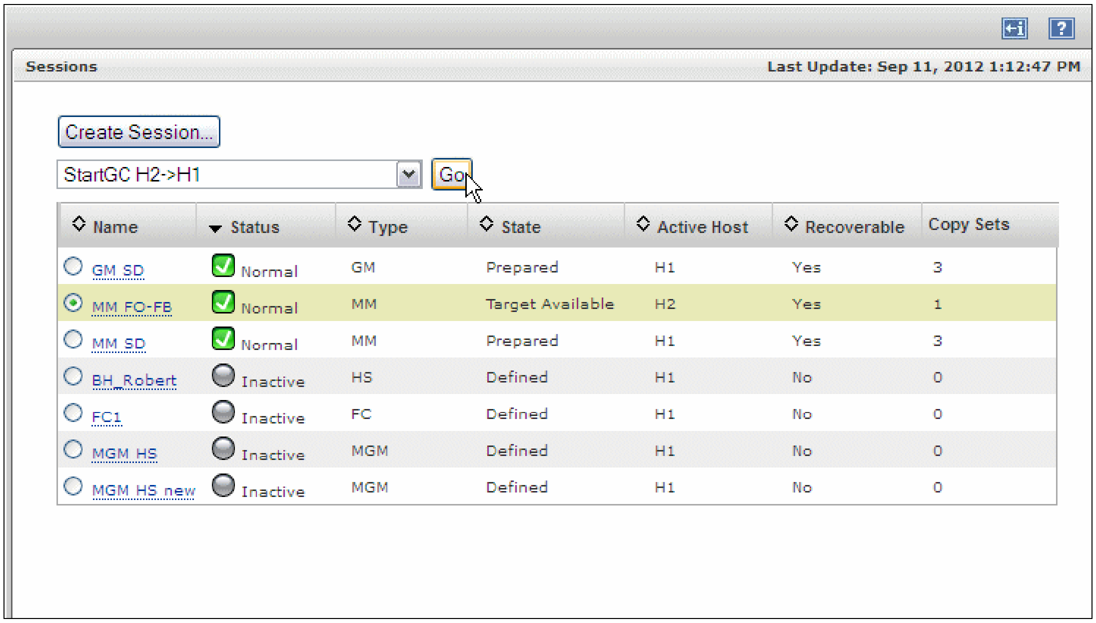

Figure 7-127 StartGC H2 to H1

2. Tivoli Storage Productivity Center for Replication asks you confirm this operation. It shows you a warning that data will be overwritten on Inactive Copy Sets. This is just warning for Copy Sets that could be added to this session after the execution of the HyperSwap. Tivoli Storage Productivity Center for Replication also warns you that it will try to establish at least one path for each LSS pair defined in the session. Click **Yes** to continue. See Figure 7-128.

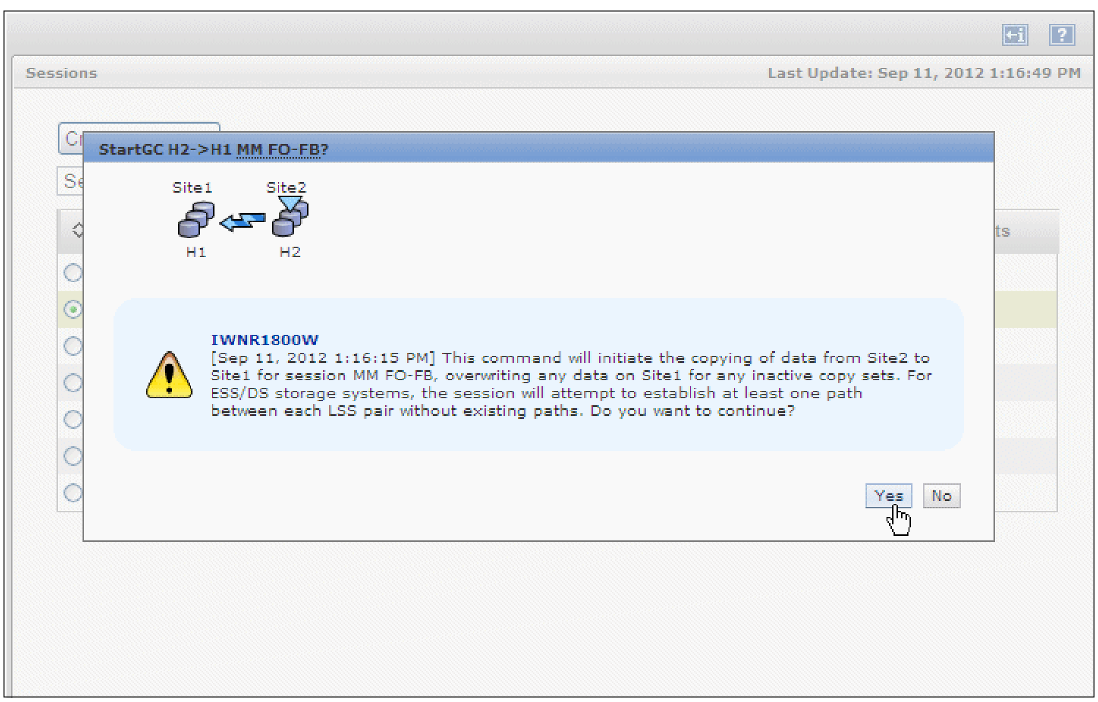

Figure 7-128 StartGC warning

3. The session enters a *Warning* Status and *Preparing* State. You can monitor the progress of the copying of tracks between the H2 and H1 volumes by clicking the session name hyperlink in the Sessions panel. You see details for the session as shown in Figure 7-129.

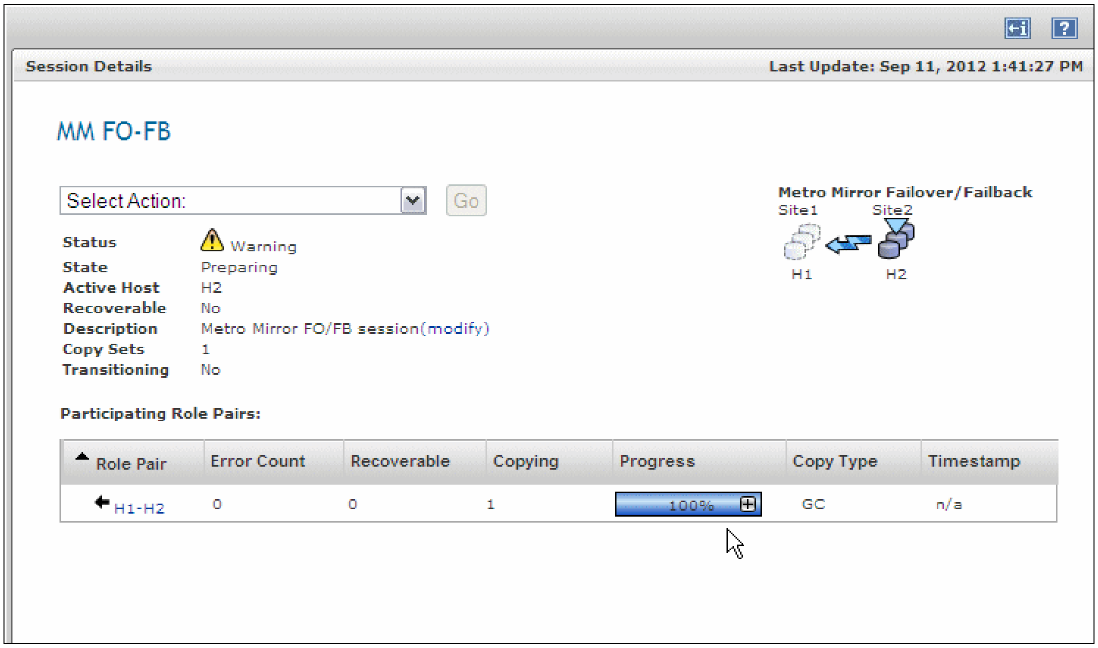

Figure 7-129 Session Details

4. When the Progress bar reaches near 100%, you can switch from the replication mode from Global Copy to Metro Mirror by selecting **Start H2** → **H1** from the Select Action pull-down list, as seen in Figure 7-130.

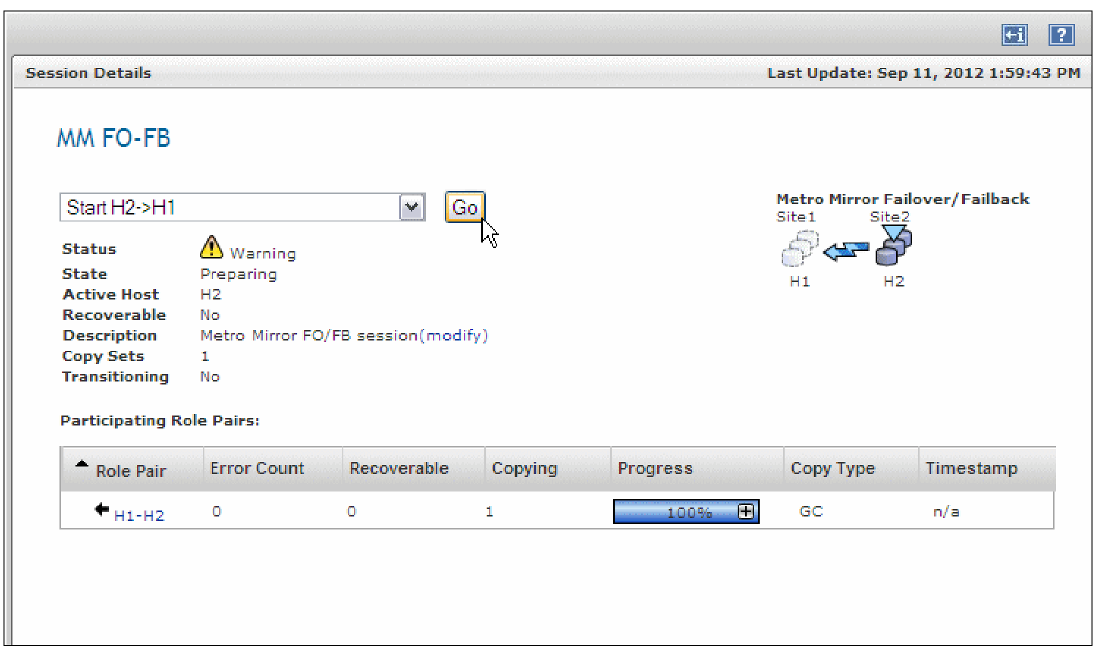

Figure 7-130 Start H2 to H1

5. Again Tivoli Storage Productivity Center for Replication will show you a warning saying that is going to overwrite any data that can exist on H1 volumes that were added recently, after the HyperSwap, and ask your confirmation for this information. Click **Yes** to continue.
6. Session reaches Normal Status and Prepared State as soon as all Copy Sets are in synchronous mode (Full Duplex). Also, HyperSwap is enabled again, as seen in Figure 7-131.

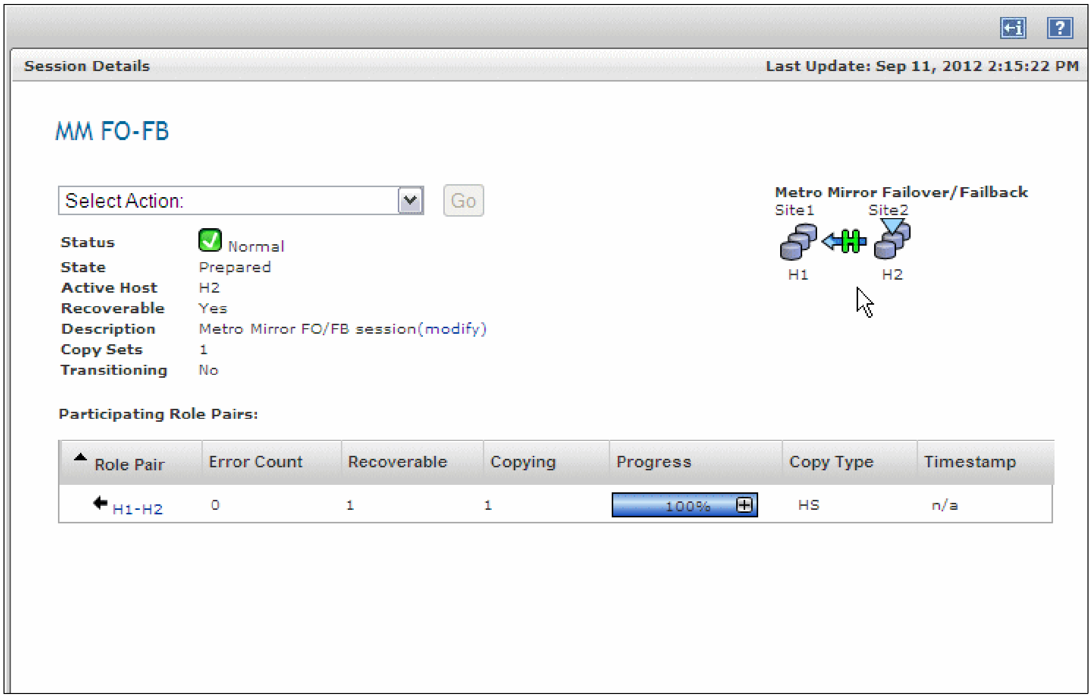

Figure 7-131 HyperSwap enabled

7. In order for you to proceed with the go home activities, you need to do a HyperSwap again, in order for your application I/Os to be directed to the H1 volumes again. You can perform the HyperSwap action from the Session Details panel, by selecting HyperSwap from the Select Action pull-down menu and clicking **Go**, as seen in Figure 7-132.

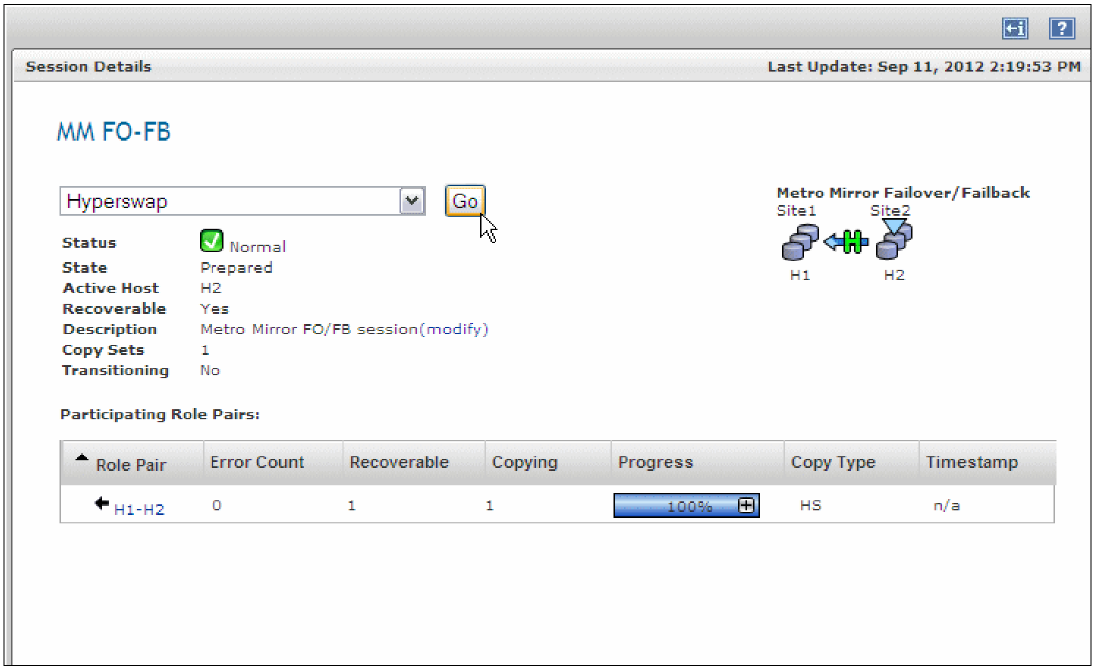

Figure 7-132 HyperSwap H2 to H1

8. Tivoli Storage Productivity Center for Replication warns you that this HyperSwap will move application I/Os to Site1 as shown in Figure 7-133. Click **Yes** to continue.

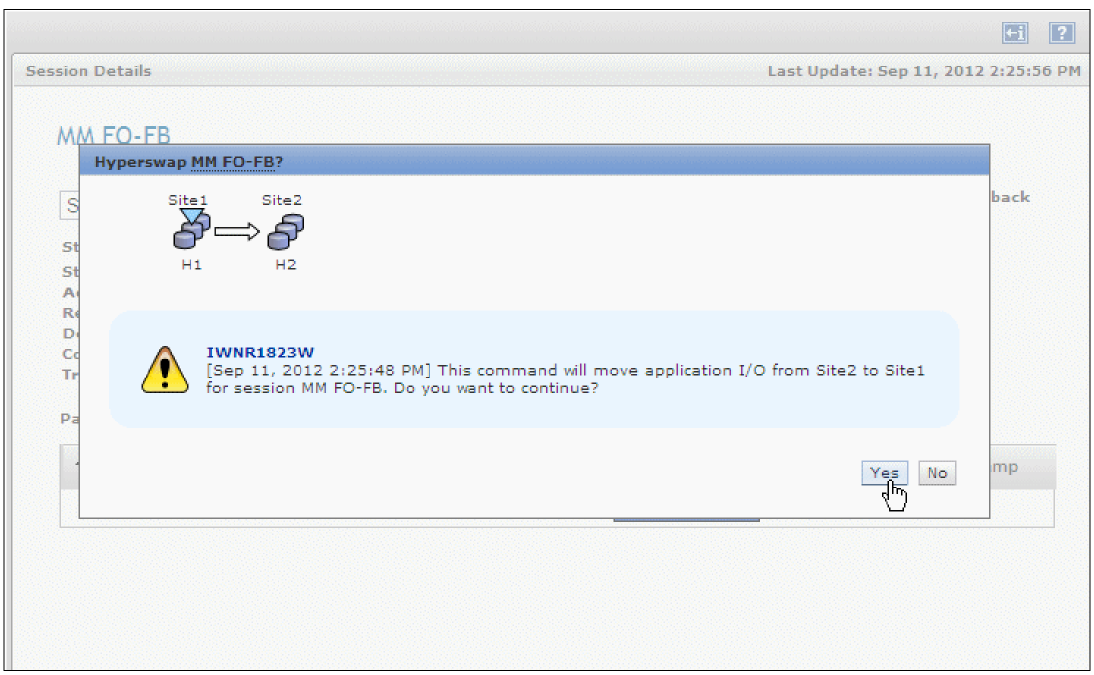

Figure 7-133 HyperSwap H2 to H1 warning

9. After the HyperSwap completes successfully, you see the session in *Normal* status and *Target Available* state, as shown in Figure 7-134.

10. Your application I/Os are directed to the H1 volumes, and the replication between H1 and H2 volumes is suspended. HyperSwap is disabled at this time.

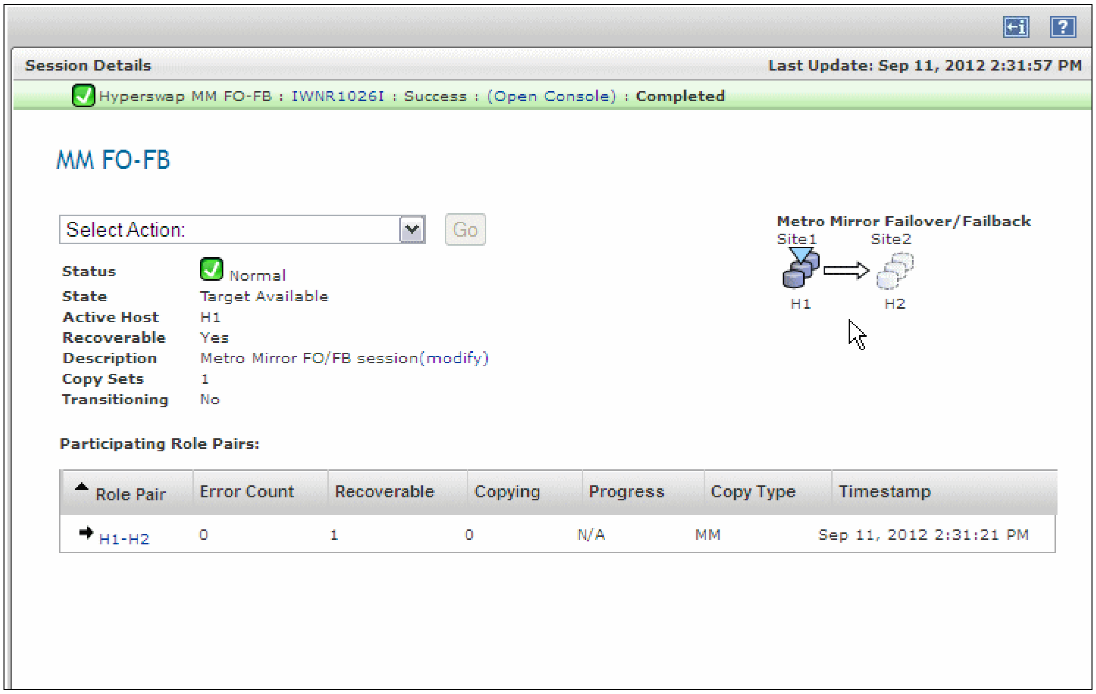

Figure 7-134 HyperSwap completed

11. It is time now for you to reestablish the replication between H1 and H2 volumes by using either Start H1 → H2 or StartGC H1 → H2. We choose **Start H1** → **H2**, as shown Figure 7-135.

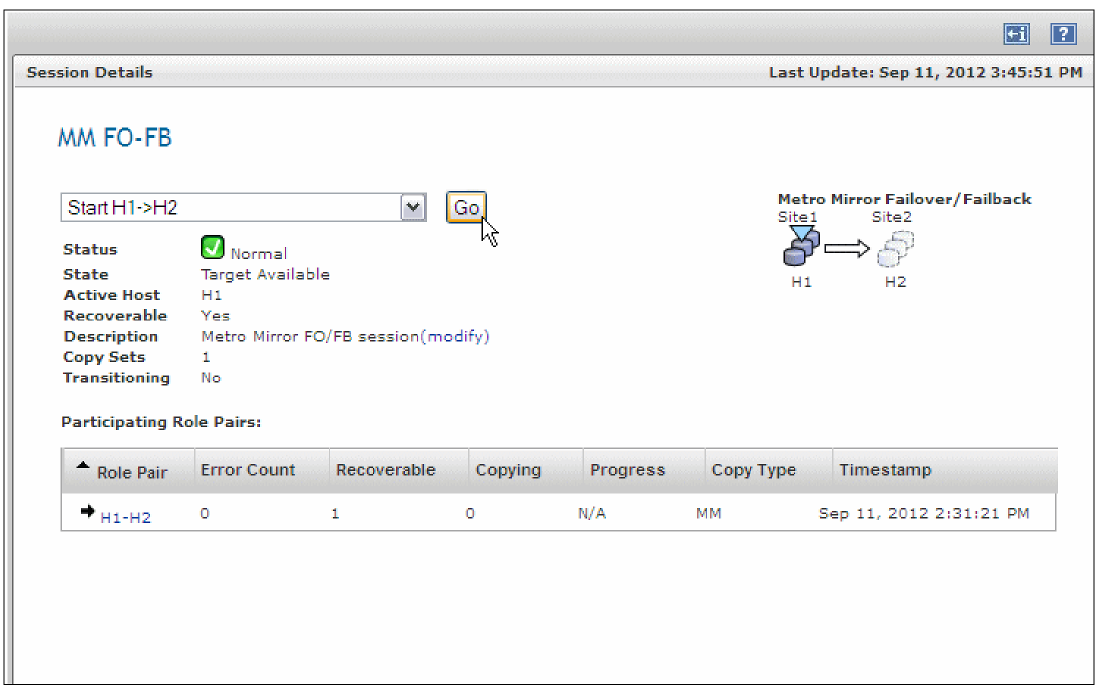

Figure 7-135 Start H1 to H2 replication

12. Tivoli Storage Productivity Center for Replication shows you a warning telling that this operation can overwrite any data on Site2 disks that are in Copy Sets inactive at the

moment. It also warns you that it is going to establish at least one path between each LSS pair in this session. Click **Yes** to continue.

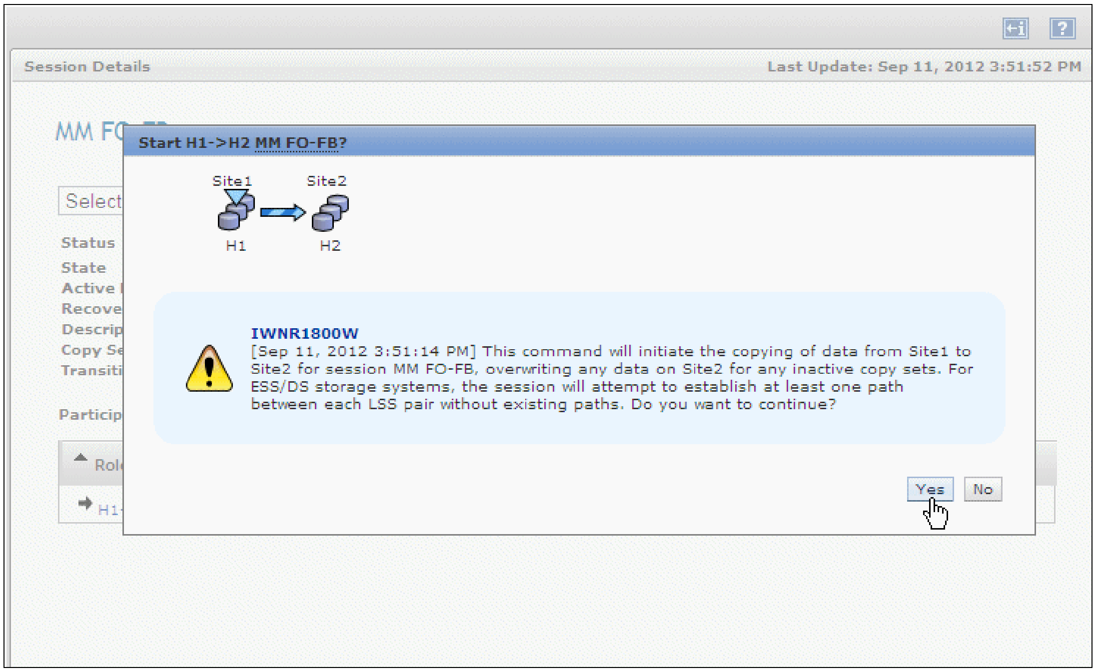

Figure 7-136 Start H1 to H2 warning

13. After all the Copy Sets are in synchronous replication, the session status is *Normal*, and its state is *Prepared* again as seen in Figure 7-137. HyperSwap is also enabled again.

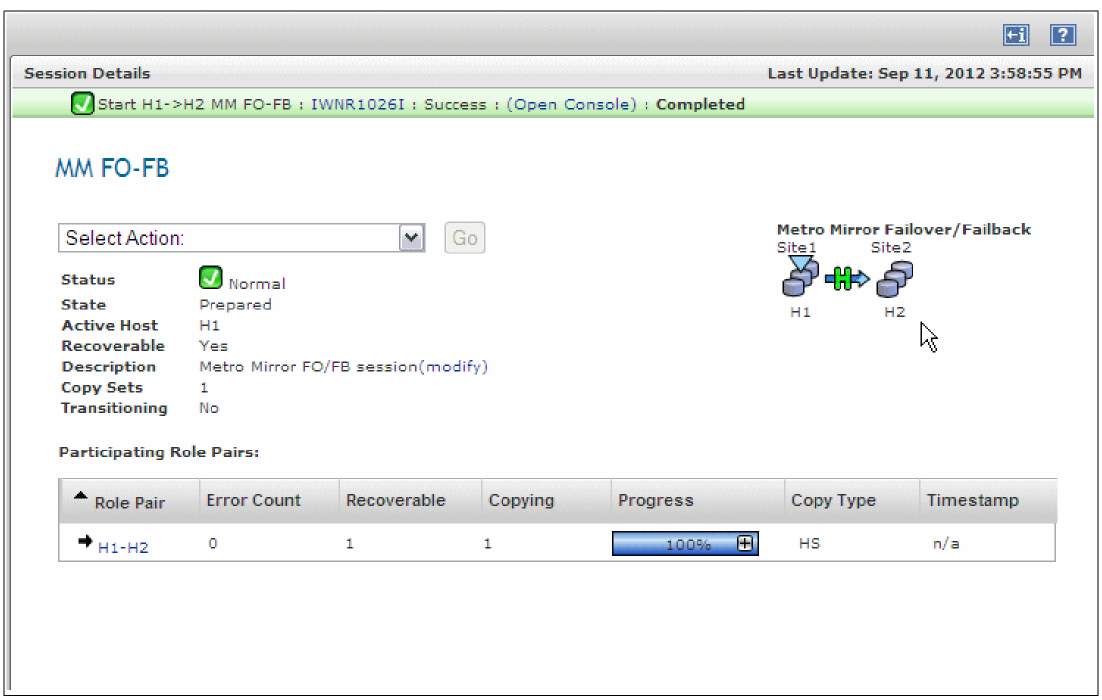

Figure 7-137 Return to original configuration

7.5.5 Suspending a Metro Mirror session

After the volumes of the session are synchronized, we can initiate **Suspend** action. Follow these steps:

1. From the **Sessions** panel, select your Metro Mirror session radio button, select **Suspend** from the **Select Action** pull-down list, and click **Go** as shown in Figure 7-138.

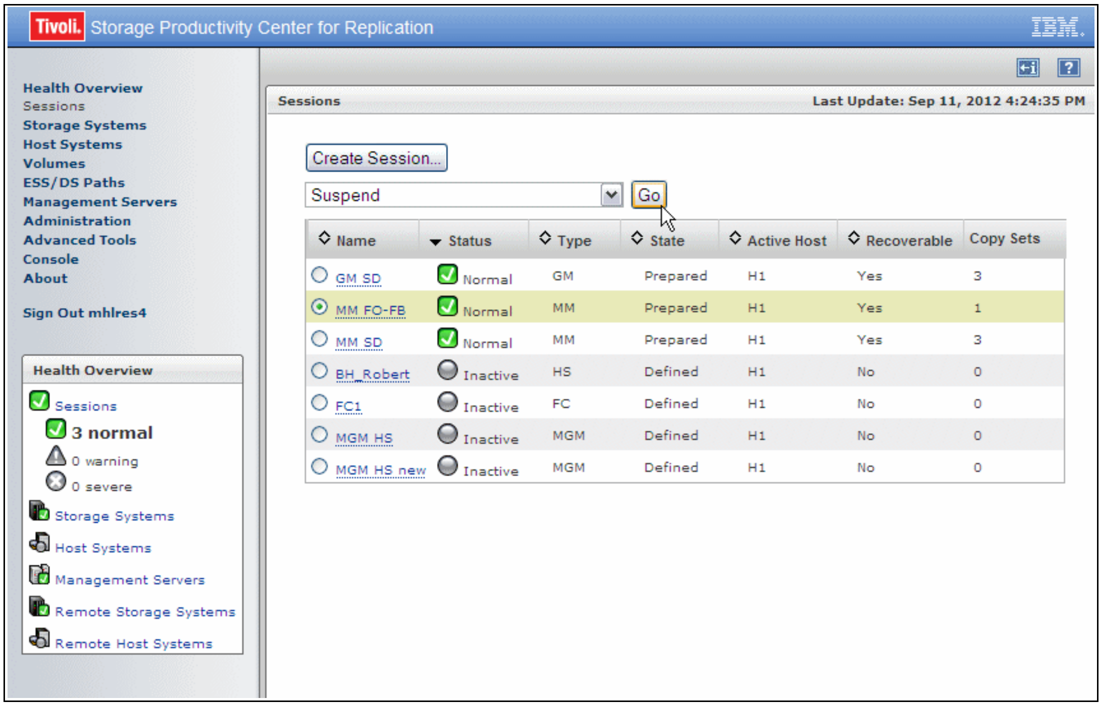

Figure 7-138 Metro Mirror FO/FB session - Suspend Action

2. The next message shown in Figure 7-139 is a warning that you are about to Suspend Metro Mirror session. Click **Yes** to continue.

> **Note:** After the Suspend is initiated, all host I/O is temporarily halted if **Release I/O after Suspend** has been selected during the Metro Mirror session creation step (see Figure 7-107 on page 339). In case **Hold I/O after Suspend** policy has been selected, then all systems that can update the H1 volumes are on hold before the Extended Long Busy (ELB) for CKD volumes ends (default is 120 seconds).

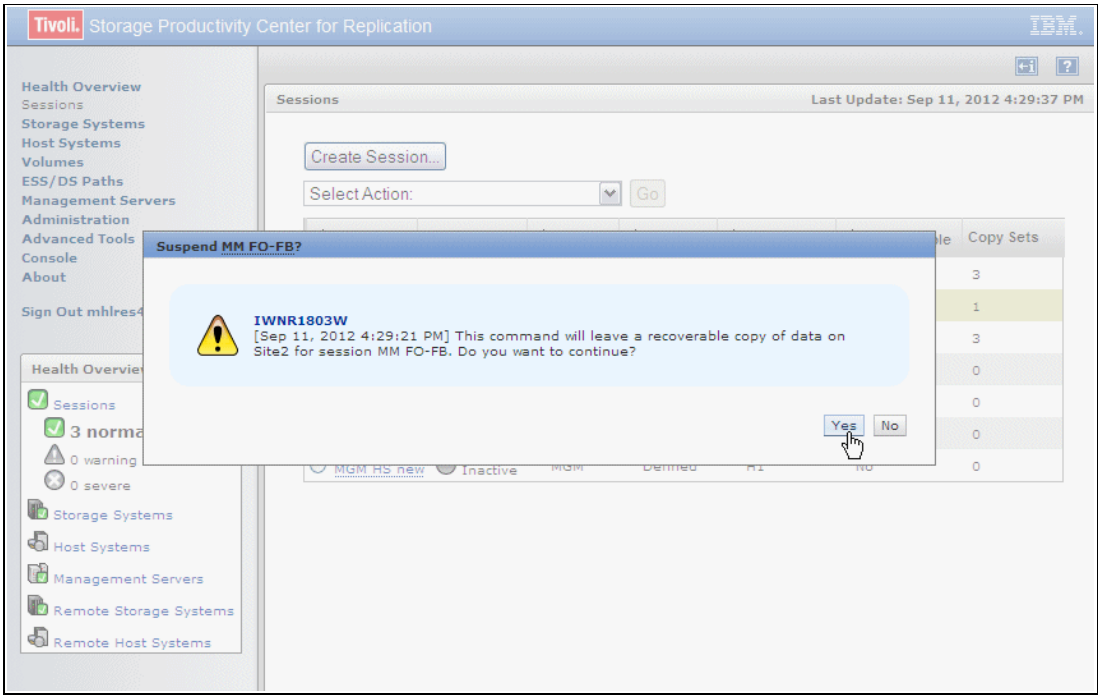

Figure 7-139 Suspend Metro Mirror FO/FB session

3. The status of our Metro Mirror session has changed from *Normal* to *Severe* status indicating that data is not replicated anymore between Host 1 and Host 2 volumes. The state of the session is *Suspended* as indicated in the Session Details panel shown in Figure 7-140.

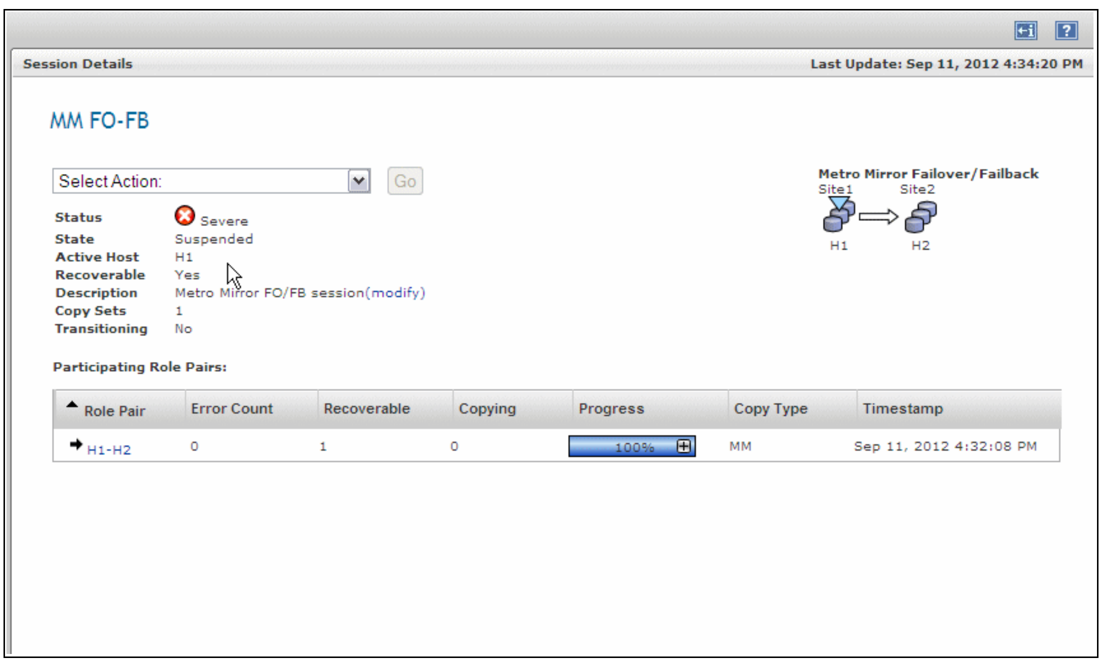

Figure 7-140 Metro Mirror FO/FB session suspended

4. If you suspend a Metro Mirror session that was created with **Hold I/O after Suspend** and **Enable Hardened Freeze** or **Manage H1-H2 with HyperSwap** options, z/OS will block write operations against the H1 volumes (your application volumes) until you issue the SETHS RESUMEIO command from a z/OS console. You can find more details about that command in 7.3.6, "Suspending a Metro Mirror session" on page 304.
5. If you suspend a Metro Mirror session which has been created with **Hold I/O after Suspend** policy and neither the **Enable Hardened Freeze** or **Manage H1-H2 with HyperSwap** options, all systems that can update the H1 volumes are on hold before the Extended Long Busy (ELB) status that the disk subsystems (ESS or DS8000) present. The default ELB is 120 seconds. If you do not want to stop your production for 120 seconds you have an option to release I/O immediately after the Metro Mirror session has been suspended. Select **Release I/O** from **Select Action** pull-down menu and click **Go** to continue (see Figure 7-141).

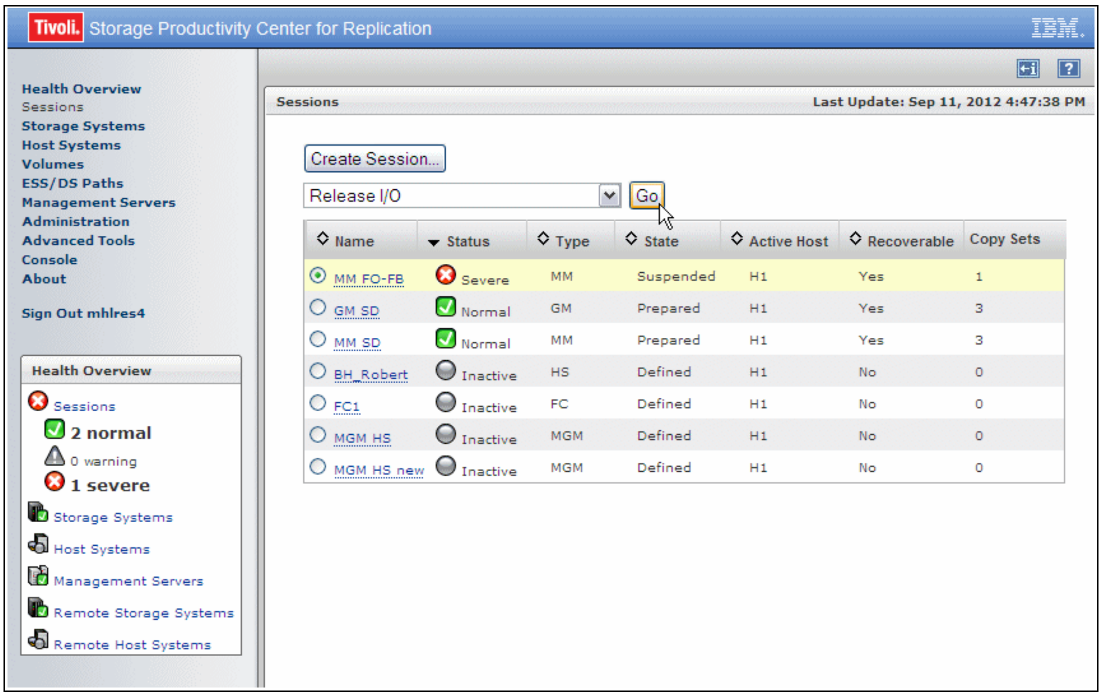

Figure 7-141 Metro Mirror session - Release I/O action

6. The next message shown in Figure 7-142 is a warning that you are about to allow writes to continue to H1 volumes. Click **Yes** to continue.

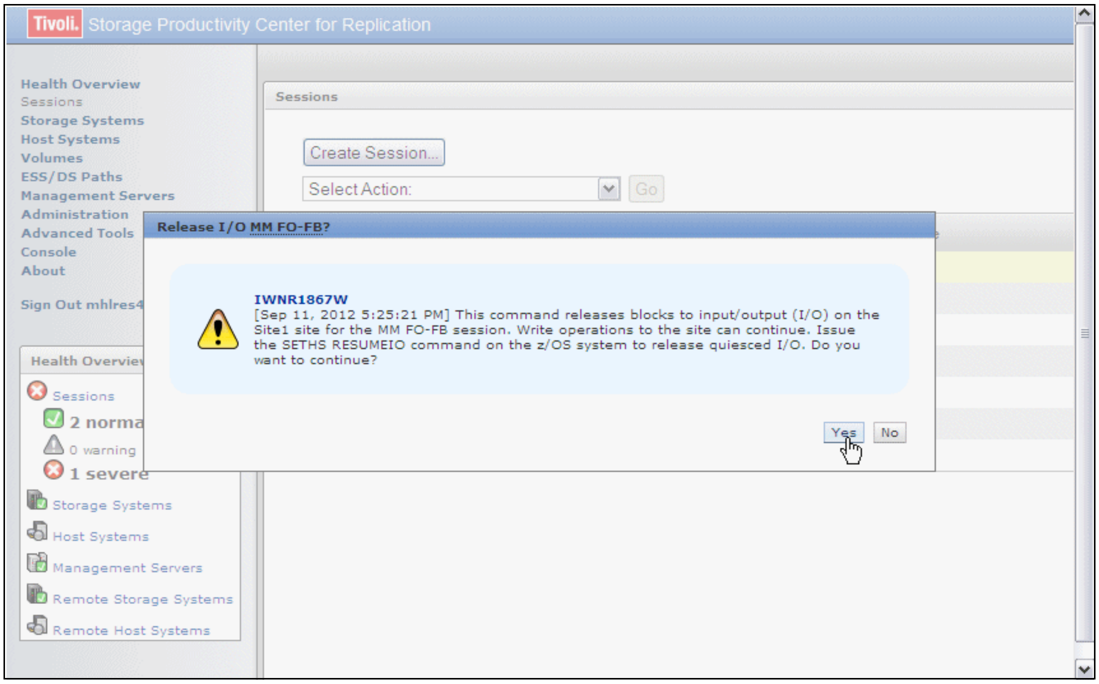

Figure 7-142 Metro Mirror FO/FB session - Release I/O Warning

After the Metro Mirror session is suspended, the following options are available:

Start H1 → H2 Restarts Metro Mirror from H1 to H2 volumes.

StartGC H1 → H2 Restarts Global Copy replication from H1 to H2 volumes.

Recover Makes H2 volumes available for application systems.

Release I/O Releases I/O to H1 volumes after Suspend event. This option is available only if the Metro Mirror session is created with **Hold I/O after Suspend** policy.

Terminate Terminates the session (under *Cleanup* submenu).

7.5.6 Recovering a Metro Mirror session

After the Metro Mirror session and its associated Copy Sets have been suspended, we can initiate a *Recover* action. Follow these steps:

Select the Metro Mirror session radio button (MM FO-FB in our example shown in Figure 7-143) and select the **Recove**r action from the **Select Action** pull-down menu. Click **Go** to continue.

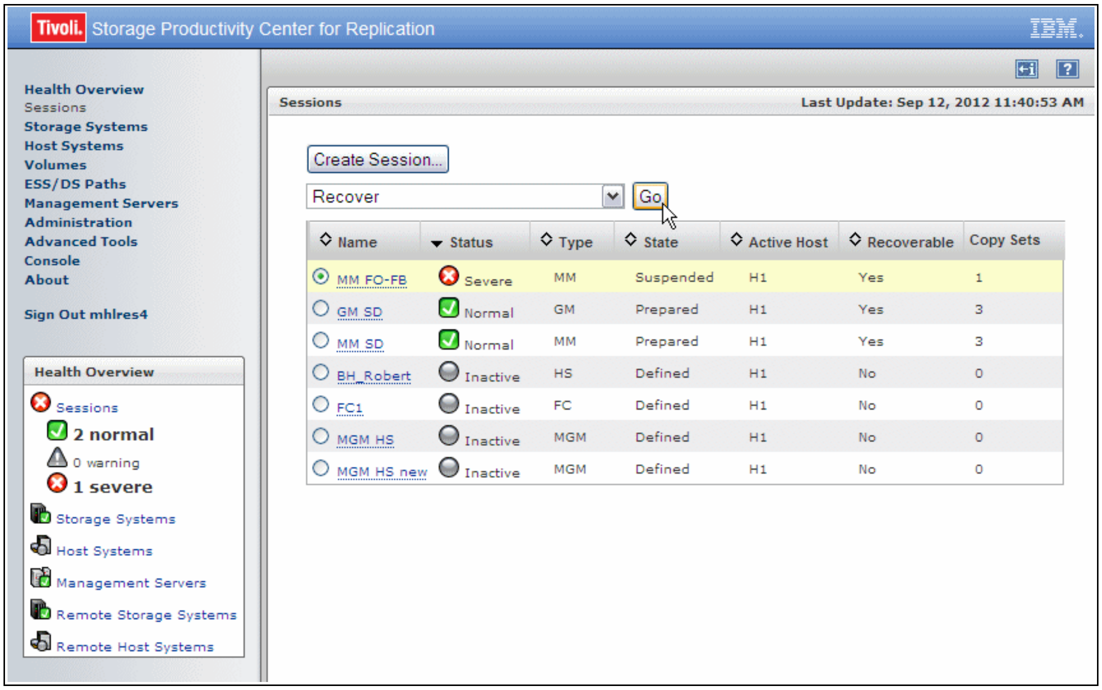

Figure 7-143 Metro Mirror FO/FB session - Recover action

The next message shown in Figure 7-144 is a warning that you will allow H2 volumes available to your host. Click **Yes** to continue.

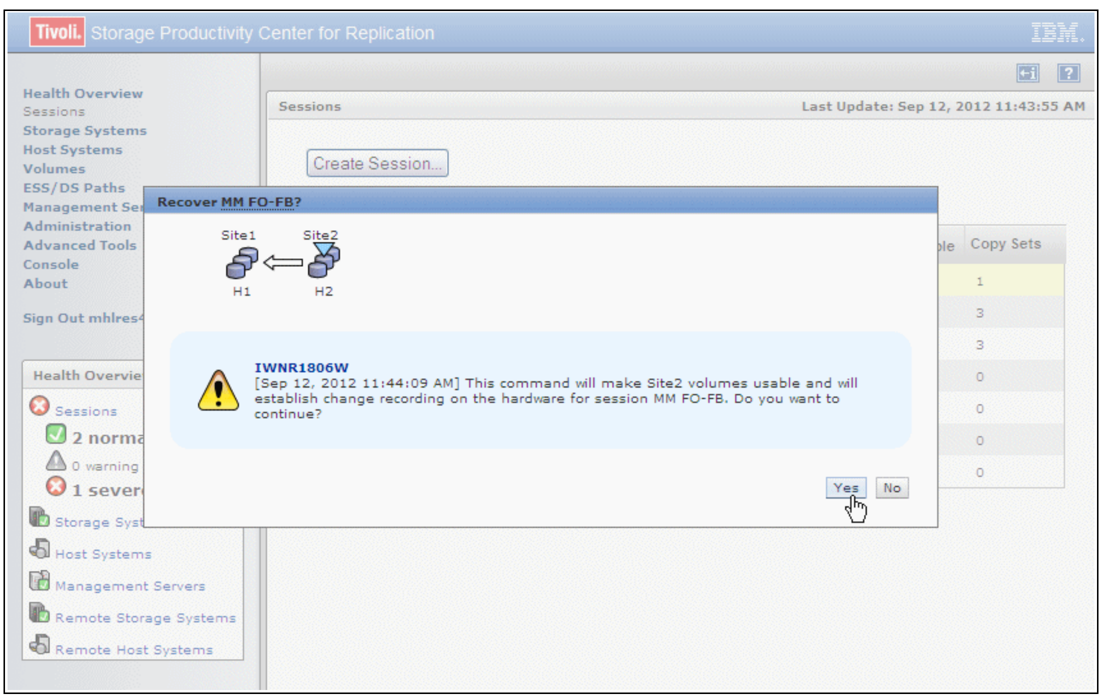

Figure 7-144 Recover Metro Mirror Session warning

7. There is a message at the top of the panel in Figure 7-145 indicating that a **Recover** action has been successfully completed. The status of our Metro Mirror session is *Normal* and the State is *Target Available* indicating that H2 volume is available to your host.

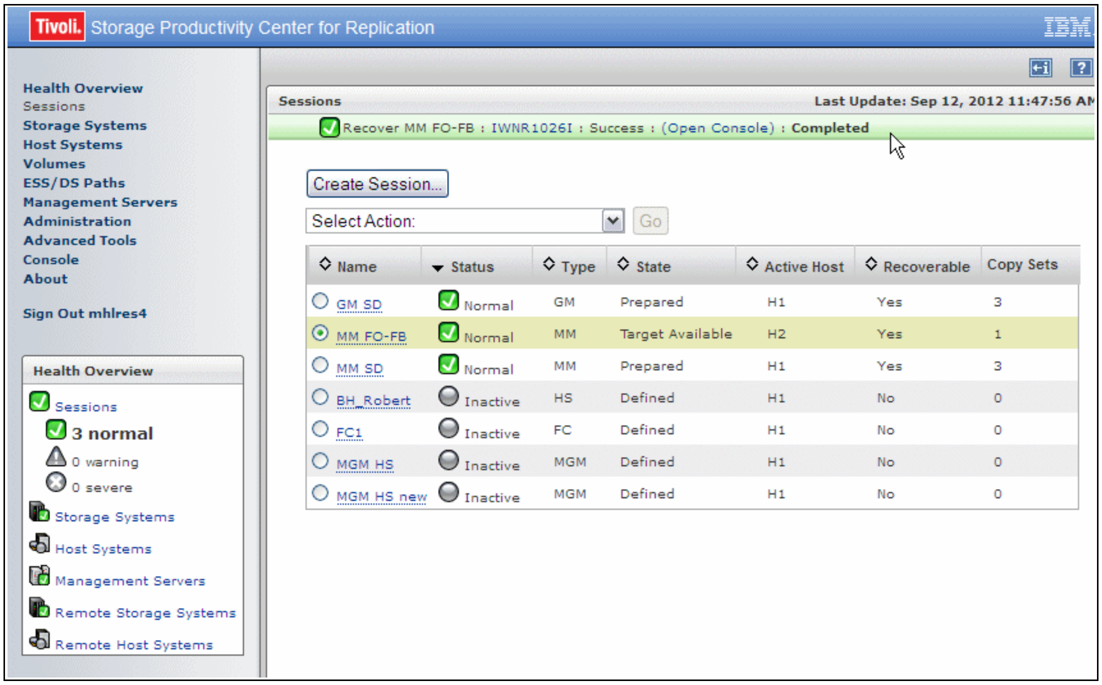

Figure 7-145 Metro Mirror FO/FB session - H2 storage subsystem volume available to host

After the Metro Mirror session is recovered in *Target Available* state, the following options are available:

Start H1 → H2 Restarts the replication from H1 to H2 volumes in Metro Mirror mode.

StartGC H1 → H2 Restarts the replication from H1 to H2 volumes in Global Copy mode.

Release I/O Releases I/O to H1 volumes after Suspend event. This option is available only if the Metro Mirror session is created with **Hold I/O after Suspend** policy.

Enable Copy to Site 1 Before reversing the direction of copying in a failover and failback session, you must run this command, and confirm that you want to reverse the direction of replication.

Terminate Terminates the session (under *Cleanup* submenu).

7.5.7 Enabling Copy to Site 1

After a **Recover** action, Host 2 volumes are active (assuming H1 to H2 replication direction). As the Host 2 site is now the active site, you can reverse the direction of copying in a Metro Mirror Failover/Failback session. Follow these steps:

1. Before you can initiate copying from Host 2 to Host 1 volumes, you need start the **Enable Copy to Site 1** command. To achieve this, from the **Select Action** pull-down menu, select **Enable Copy to Site 1** and click **Go** as shown in Figure 7-146.

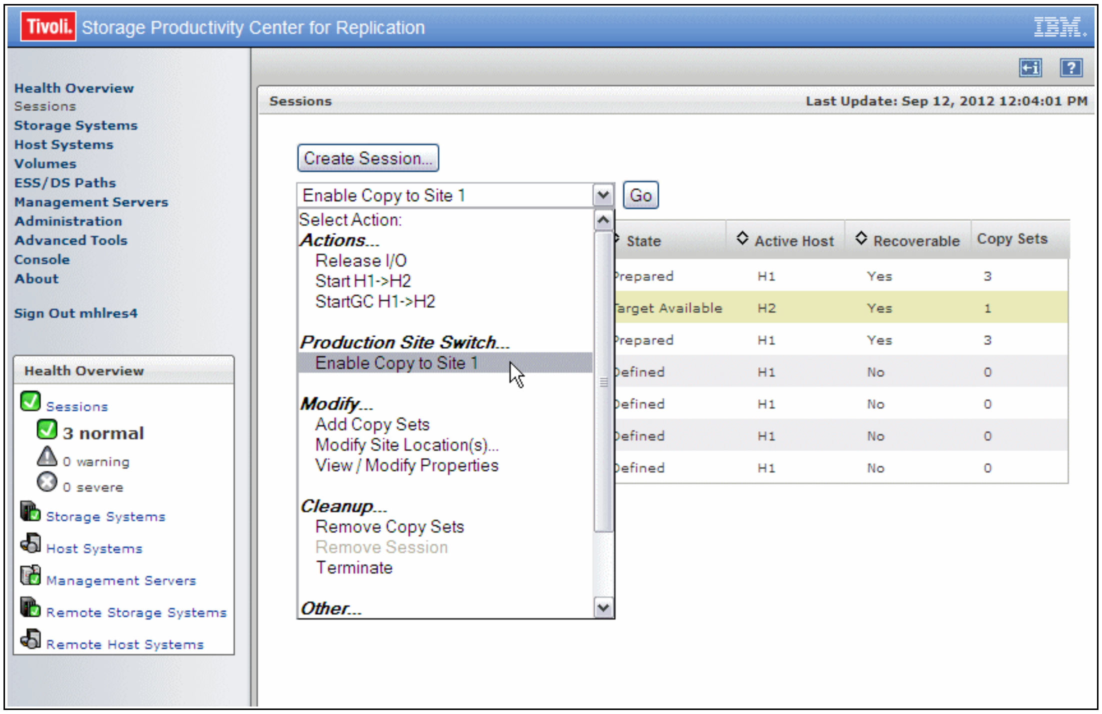

Figure 7-146 Metro Mirror session - Enable Copy to Site 1

2. The next message shown in Figure 7-147 is a warning that you are about to enable the command which initiates copying data from H2 to H1 volumes. This command is disabled to protect against accidentally copying over production data. Ensure that all of the volumes in this session located at Site 1 are not being used by any application prior to enabling the command that allows copying data to Site 1. Click **Yes** to continue.

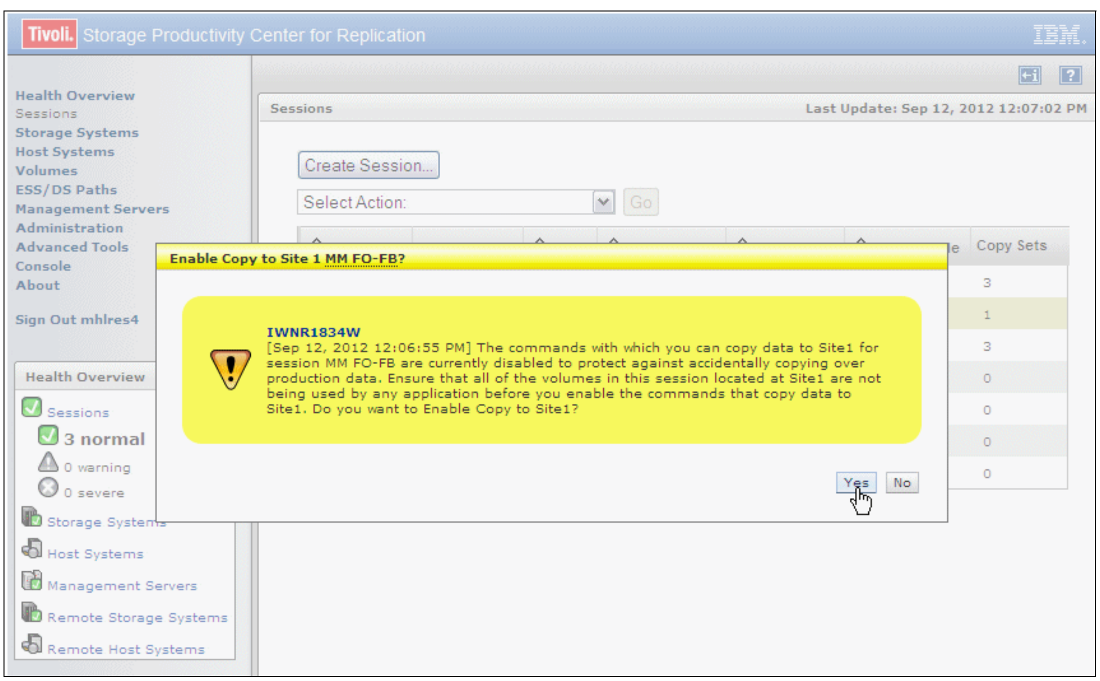

Figure 7-147 Enable Copy to Site 1 warning

3. The message at the top of the panel in Figure 7-148 confirms that Enable Copy to Site 1 command is completed. The status of our Metro Mirror session is the same as it was after **Recover** command: *Normal* status and *Target Available* state, indicating that H2 volume is available to your host.

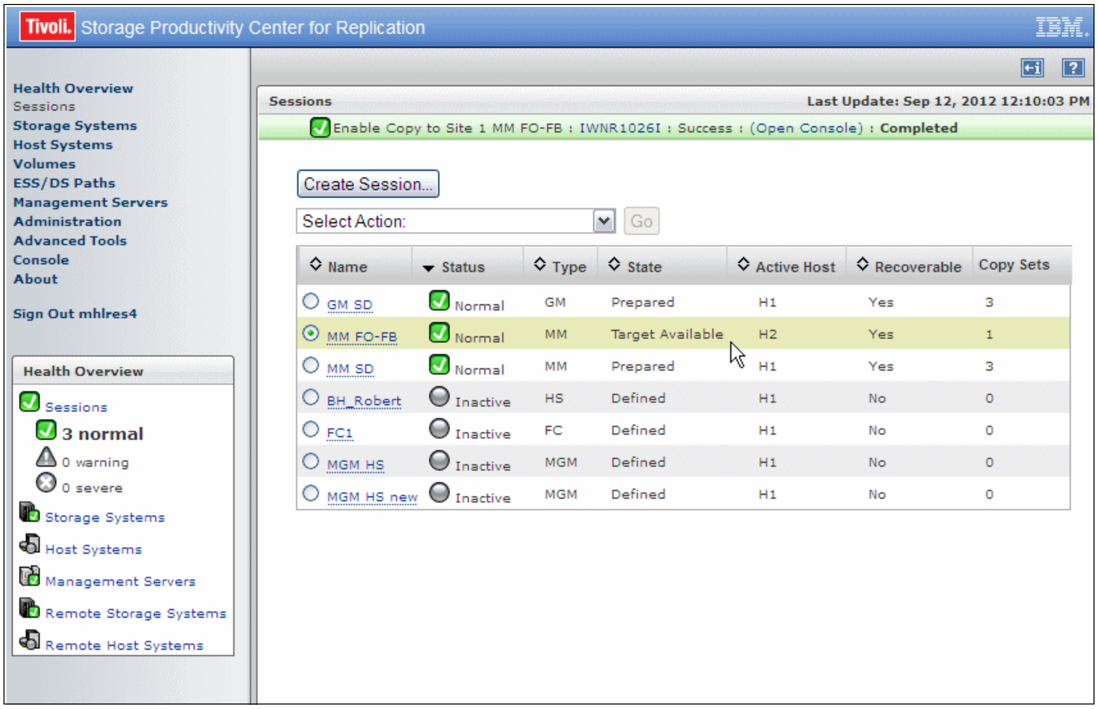

Figure 7-148 Enable Copy to Site 1 is reported as Completed

The following options are available at this stage:

Start H2 → H1	Starts replication from H2 to H1 volumes in Metro Mirror mode.
StartGC H2 → H1	Starts replication from H2 to H1 volumes in Global Copy mode.
Release I/O	Releases I/O to H1 volumes after Suspend event. This option is available only if the Metro Mirror session is created with **Hold I/O after Suspend** policy.
Re-enable Copy to Site 2	Enables **Start H1 → H2** and **StartGC H1 → H2** actions.
Terminate	Terminates the session (under *Cleanup* submenu).

7.5.8 Start H2 → H1 replication

After the **Recover** action and **Enable Copy to Site 1** command, Host 2 volumes are active (assuming H1 to H2 replication direction). As the Host 2 site is now the active site you can initiate replication from Host 2 to Host 1 volumes. You can choose to start the replication either in Metro Mirror mode (**Start H2 → H1**) or Global Copy mode (**StartGC H2 → H1**). Follow these steps:

1. In our example, we choose to start the replication in Metro Mirror mode. To achieve this, from the **Select Action** pull-down menu, select **Start H2 → H1** and click **Go** as shown in Figure 7-149.

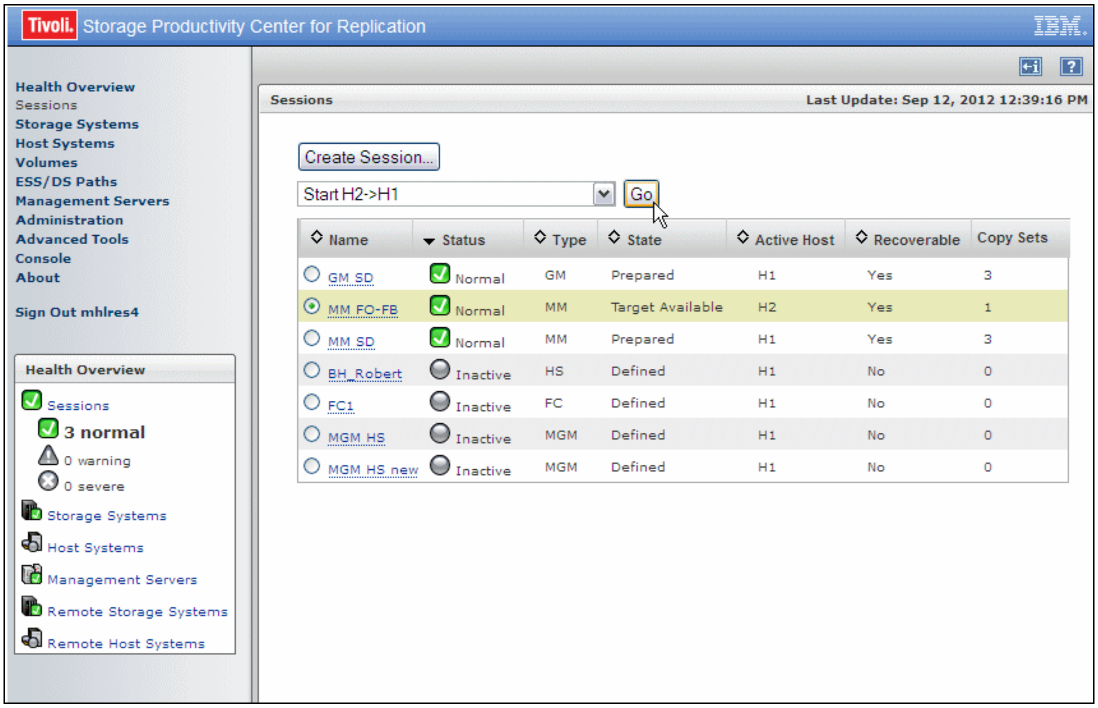

Figure 7-149 Metro Mirror session - Start H2 → H1 Action

2. The next message shown in Figure 7-150 is a warning that you are about to initiate starting of Metro Mirror session. It will start copying of data from Host 2 to Host 1 volumes, thus overwriting any data on Host 1 volumes. Click **Yes** to continue.

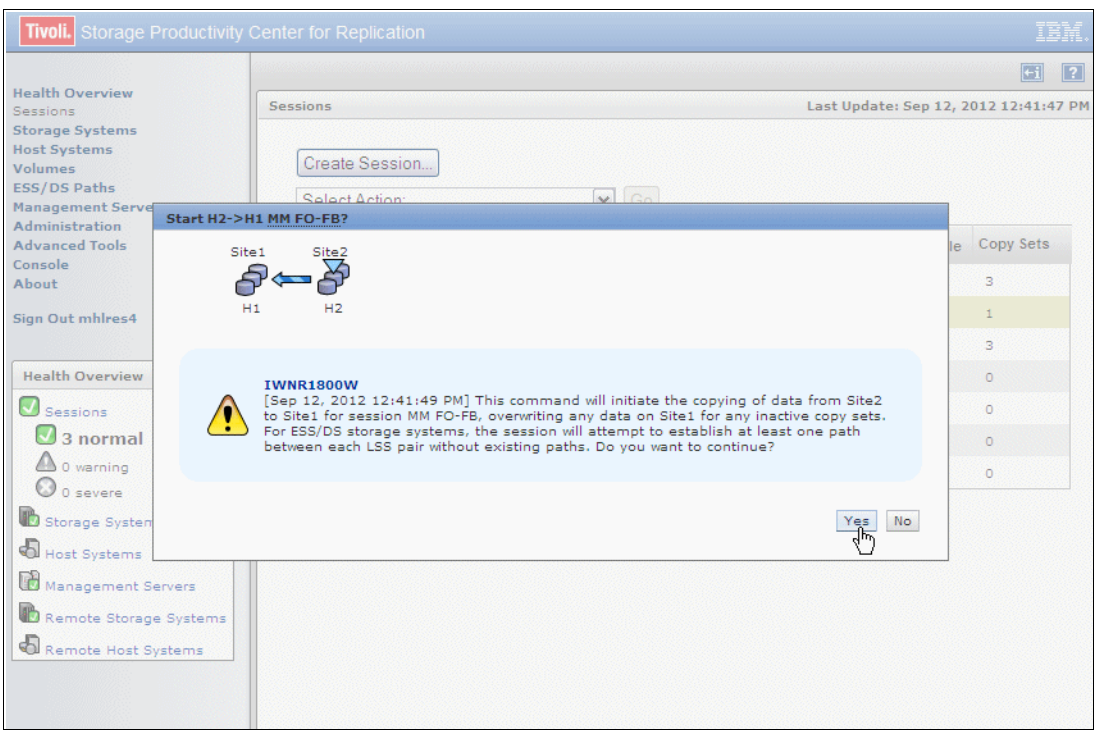

Figure 7-150 Start H2 → H1 Metro Mirror FO/FB session warning

3. After all H2-H1 pairs are synchronized again, the session status changes to *Normal*, and its state changes to *Prepared*, as seen in the Session Details panel shown in Figure 7-151.

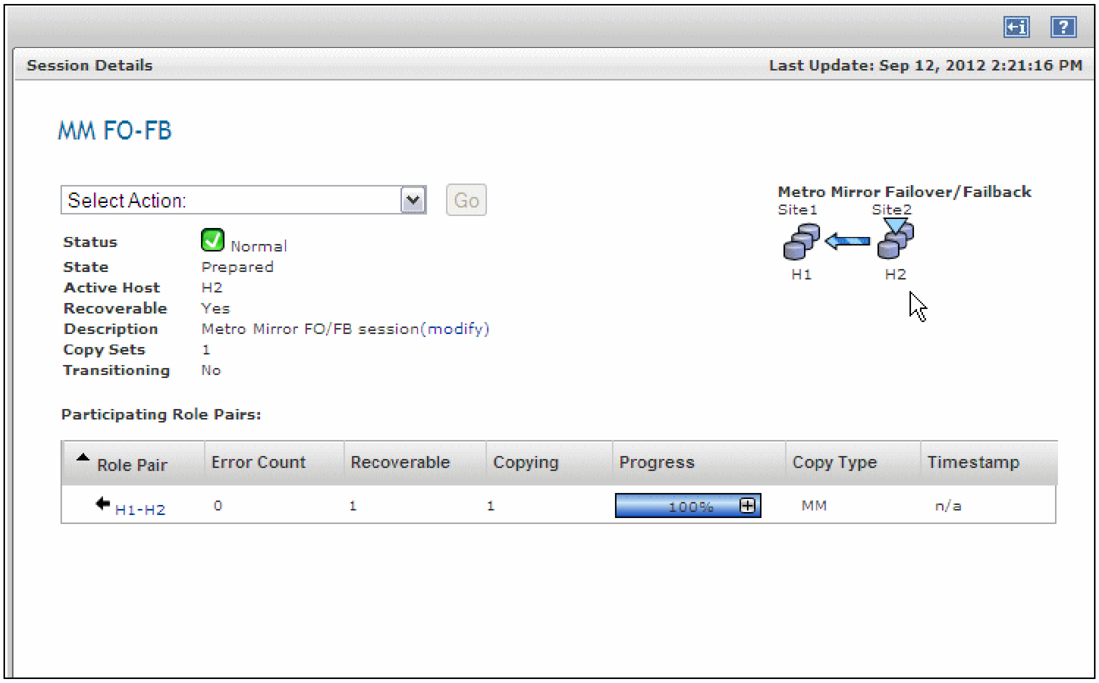

Figure 7-151 Metro Mirror FO/FB session detail

After the Metro Mirror session is started and it has *Normal* status and is in *Prepared* state, the following options are available:

Start H2 → H1 Restarts replication from H2 to H1 volumes in Metro Mirror Mode.

StartGC H2 → H1 Converts the replication from H2 to H1 volumes to Global Copy mode.

Stop Stops replication with inconsistent H1 volumes.

Suspend Stops replication with consistent H1 volumes.

Terminate Terminates the session (under *Cleanup* submenu).

7.5.9 Enabling Copy to Site 2

If we assume that the current copying direction is from Site 2 to Site 1 and you want to reverse the copying direction back from Site 1 to Site 2 you need to issue **Suspend** command as we described in 7.5.5, “Suspending a Metro Mirror session” on page 359 and then **Recover** command (see 7.5.6, “Recovering a Metro Mirror session” on page 362). But this time the **Recover** command will make H1 volumes available to applications since the data replication direction is from H2 to H1 volumes. After the **Recover** command is completed, Host 1 site is now active site and you can reverse direction of replication in a Metro Mirror Failover/Failback session. Follow these steps:

1. Before you can initiate replication from Host 1 to Host 2 volumes, you need to start the **Enable Copy to Site 2** command. To achieve this, from the **Select Action** pull-down menu, select **Enable Copy to Site 2** and click **Go** as shown in Figure 7-152.

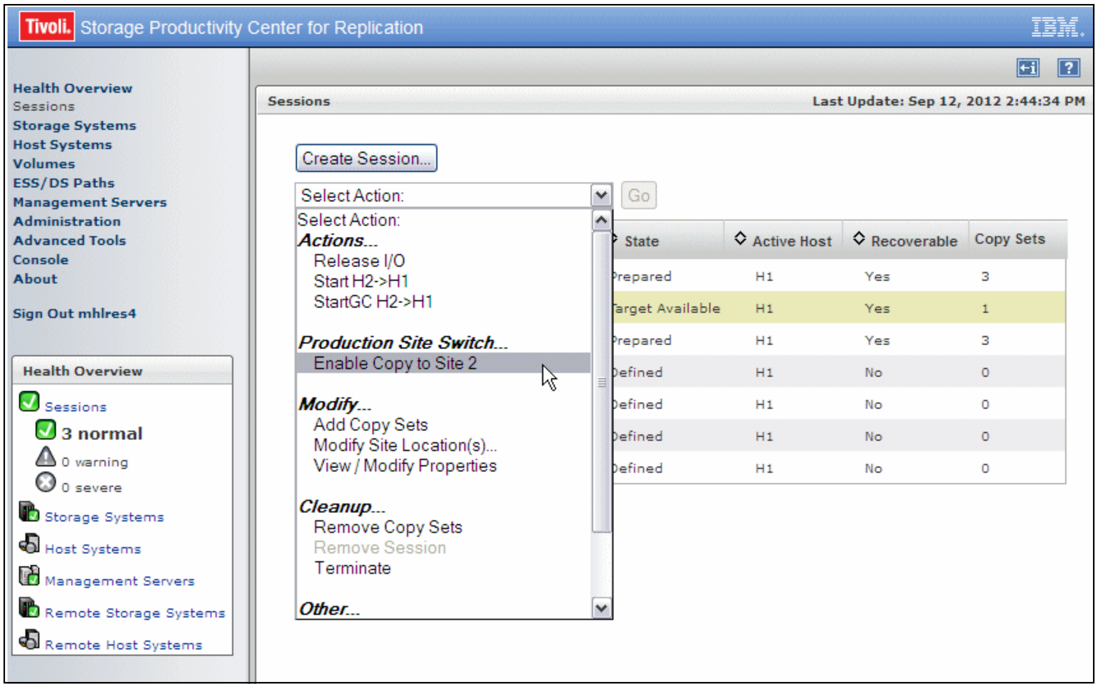

Figure 7-152 Metro Mirror session - Enable Copy to Site 2

2. The next message shown in Figure 7-153 is a warning that you are about to enable the command which initiates copying data from H1 to H2 volumes. This command is disabled to protect against accidentally copying over production data. Ensure that all of the volumes in this session located at Site 2 are not being used by any application prior to enabling the command that allows copying data to Site 2. Click **Yes** to continue.

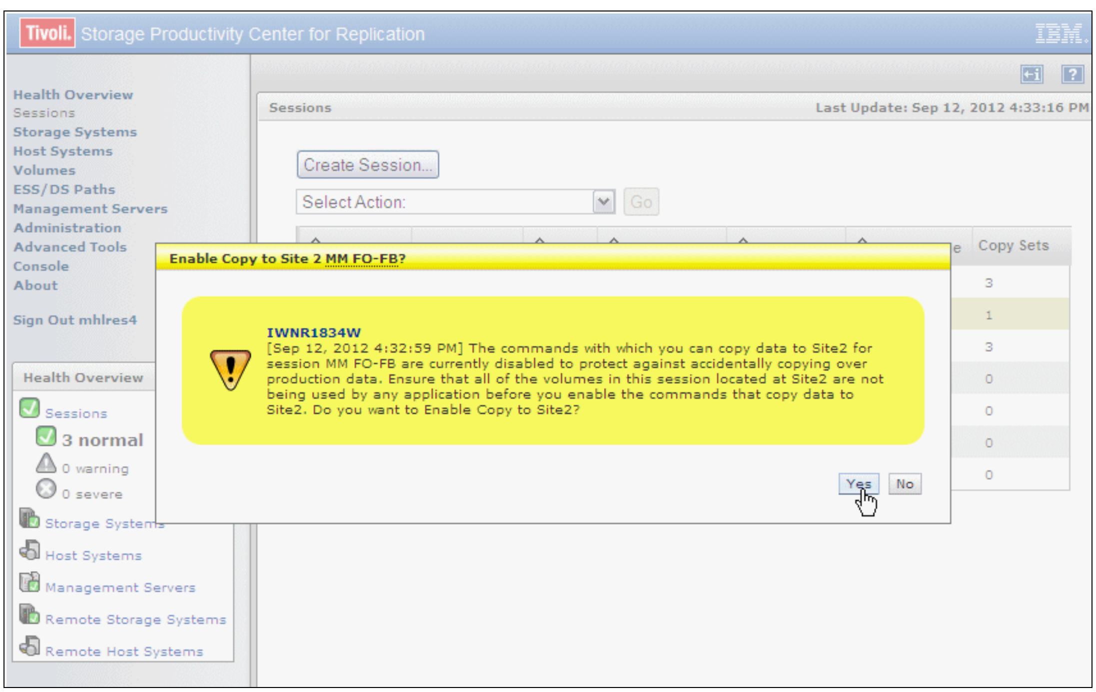

Figure 7-153 Enable Copy to Site 2 warning

3. The status of our Metro Mirror session is the same as it was after the **Recover** command, *Normal* status and *Target Available* state, as seen in the Session Details panel shown in Figure 7-154, and the H1 volumes are available to your system applications.

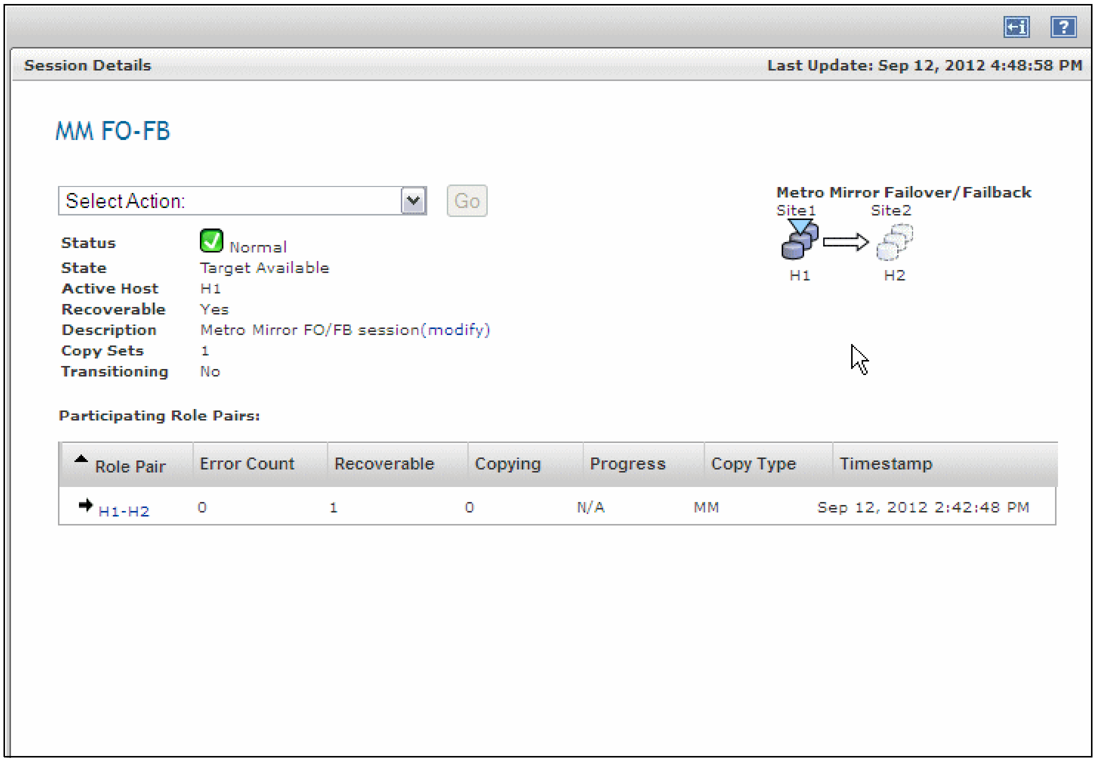

Figure 7-154 Ready to Start H1 → H2 or StartGC H1 → H2

The following options are available at this stage:

Start H1 → H2 Restarts replication from H1 to H2 volumes in Metro Mirror mode.

StartGC H1 → H2 Restarts replication from H1 to H2 volumes in Global Copy mode.

Release I/O Releases I/O to H1 volumes after Suspend event. This option is available only if the Metro Mirror session is created with **Hold I/O after Suspend** policy.

Re-enable Copy to Site 1 Enables **Start H2 → H1** and **StartGC H2 → H1** actions.

Terminate Terminates the session (under *Cleanup* submenu).

7.5.10 Stopping a Metro Mirror session

It is possible to issue a **Stop** action against Metro Mirror session if the session is in *Normal* state. It suspends the replication from H1 to H2 volumes, or H2 to H1 volumes, depending on the copy direction. This command can be issued at any point during an active session. The **Stop** action is completely transparent to the host I/O since *Freeze* is not issued against volumes. Therefore H2 or H1 volumes depending on the copy direction do not contain a consistent copy of your data. Follow these steps:

1. Select the Metro Mirror session radio button (MM FO-FB in our example shown in Figure 7-155) and the **Stop** action from the **Select Action** pull-down menu. Click **Go** to continue. In our example, we stopped the session when copy direction was from H1 volumes to H2 volumes.

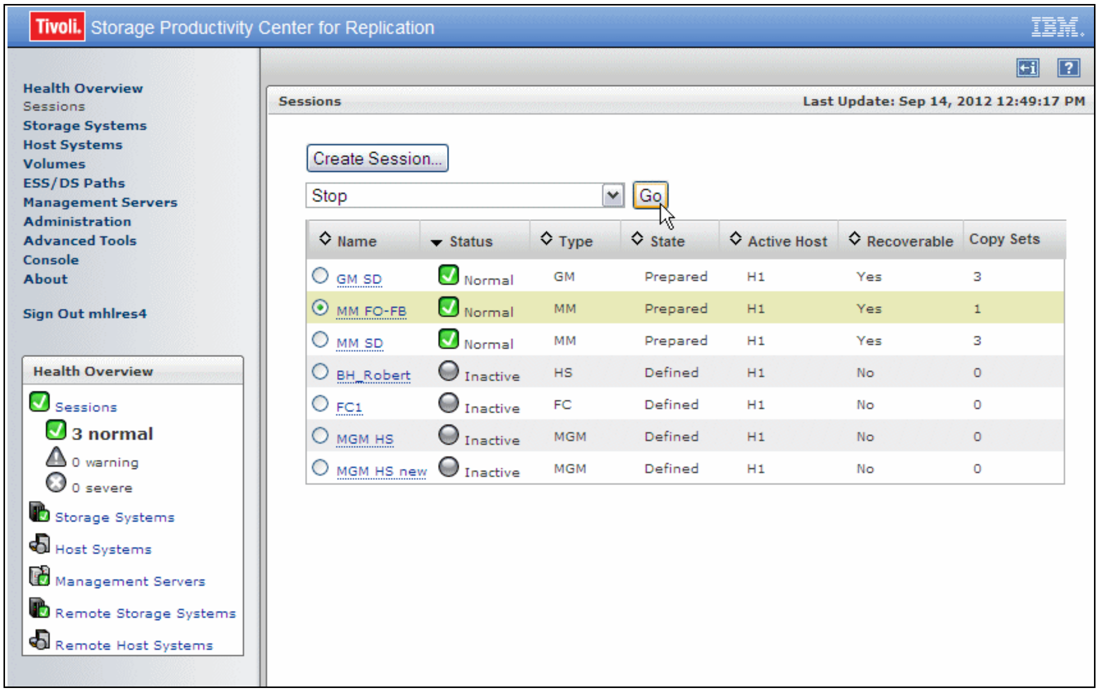

Figure 7-155 Metro Mirror FO/FB session - Stop action

2. The next message shown in Figure 7-156 is a warning that you will stop data replication from H1 to H2 volumes and H2 volumes are not consistent. Click **Yes** to continue.

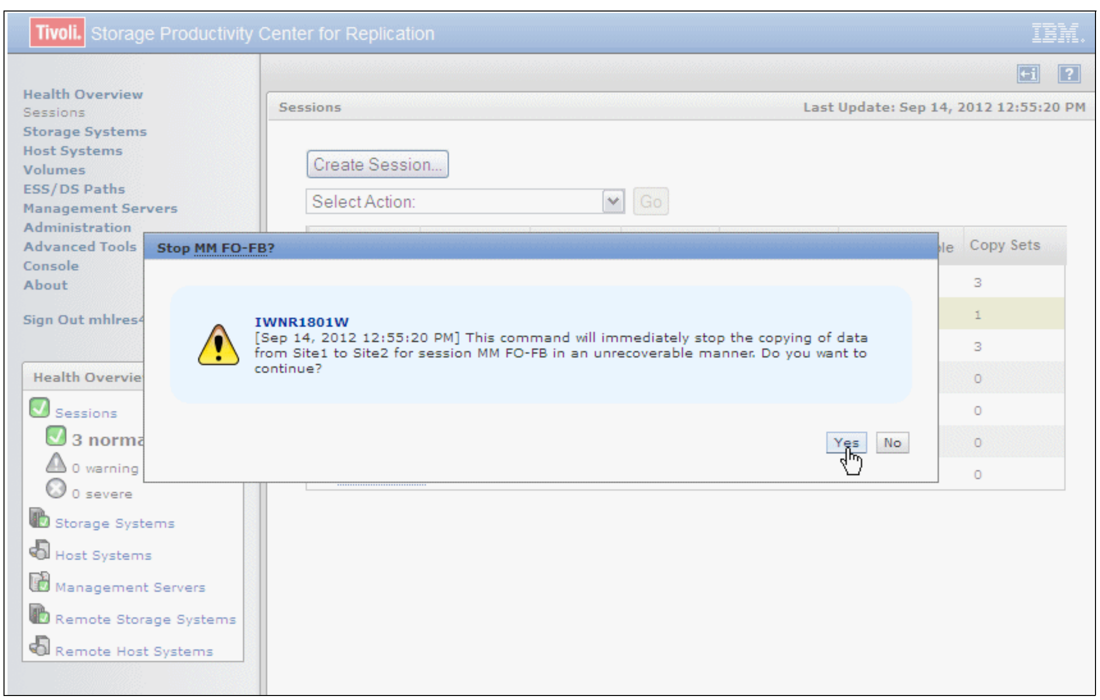

Figure 7-156 Stop Metro Mirror FO/FB session warning

3. There is a message at the top of the Session panel, or Session Details panel as shown in Figure 7-157 on page 372) indicating that a **Stop** action has been successfully completed. The status of our Metro Mirror session is *Severe* and the state is *Suspended.* Column *Recoverable* in Figure 7-157 has the value *NO*, indicating that H2 storage subsystem volumes are not consistent.

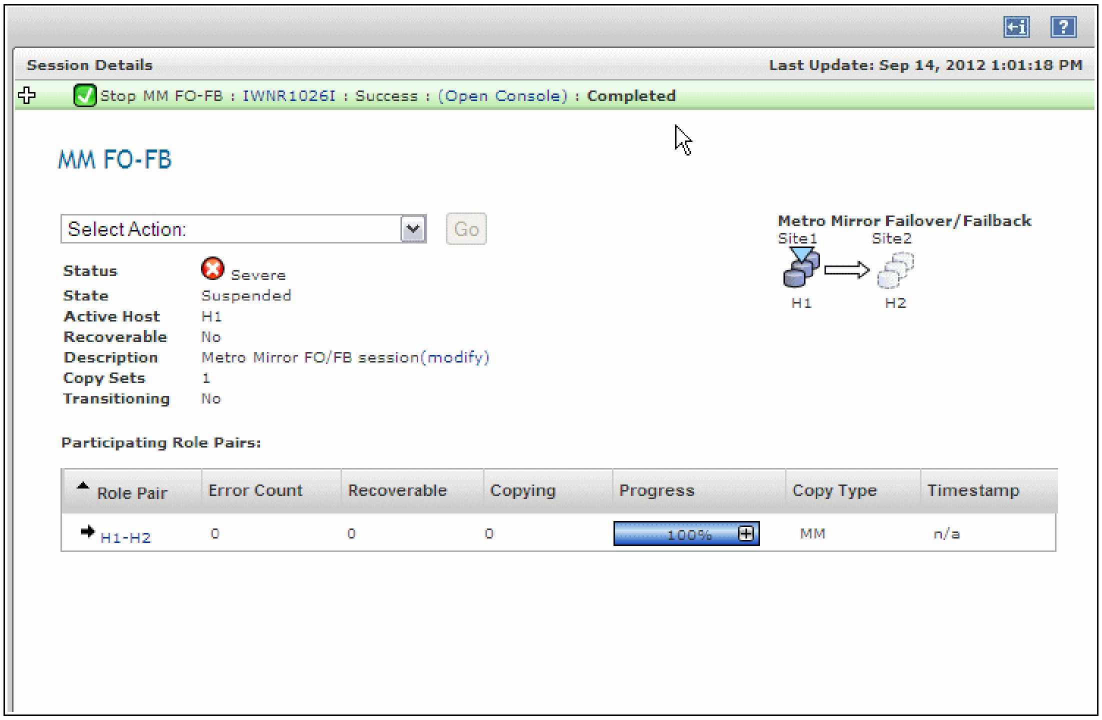

Figure 7-157 Stop Metro Mirror FO/FB Session - Completed

After the Metro Mirror session is stopped, the following options are available:

Start H1 → H2 (If the stop was issued with H1 active volumes)
Restarts replication from H1 to H2 volumes in Metro Mirror mode.

StartGC H1 → H2 (If the stop was issued with H1 active volumes)
Restarts replication from H1 to H2 volumes in Global Copy mode.

Start H2 → H1 (If the stop was issued with H2 active volumes)
Restarts replication from H2 to H1 volumes in Metro Mirror mode.

StartGC H2 → H1 (If the stop was issued with H2 active volumes)
Restarts replication from H2 to H1 volumes in Global Copy mode.

Recover Makes target (secondary) volumes available for host access.

> **Attention:** Target (secondary) volumes may be not consistent after a **Stop** action.

Release I/O Releases I/O to H1 or H2 volumes after a Suspend event. This option is available only if the Metro Mirror session is created with **Hold I/O after Suspend** policy.

Terminate Terminates the session (under *Cleanup* submenu).

7.5.11 Terminating a Metro Mirror session

The *Terminate* action breaks the Metro Mirror relationship between H1 and H2 volumes, thus terminating data replication. If you want H2 or H1 volumes, depending on the copy direction, to be data consistent before removing their relationship, you must issue the **`Suspend`** command, then the **`Recover`** command, and then the **`Terminate`** command. In case you want to Start a Metro Mirror session after it has been terminated, full copy will take place from H1 to H2 volumes, or from H2 to H1 volumes, depending on the copy direction. Follow these steps:

1. Select the Metro Mirror session radio button (MM FO-FB in our example shown in Figure 7-158) and select the **Terminate** action from the **Select Action** pull-down menu. Click **Go** to continue. In our example, we terminated the session when the copy direction was from H1 volumes to H2 volumes.

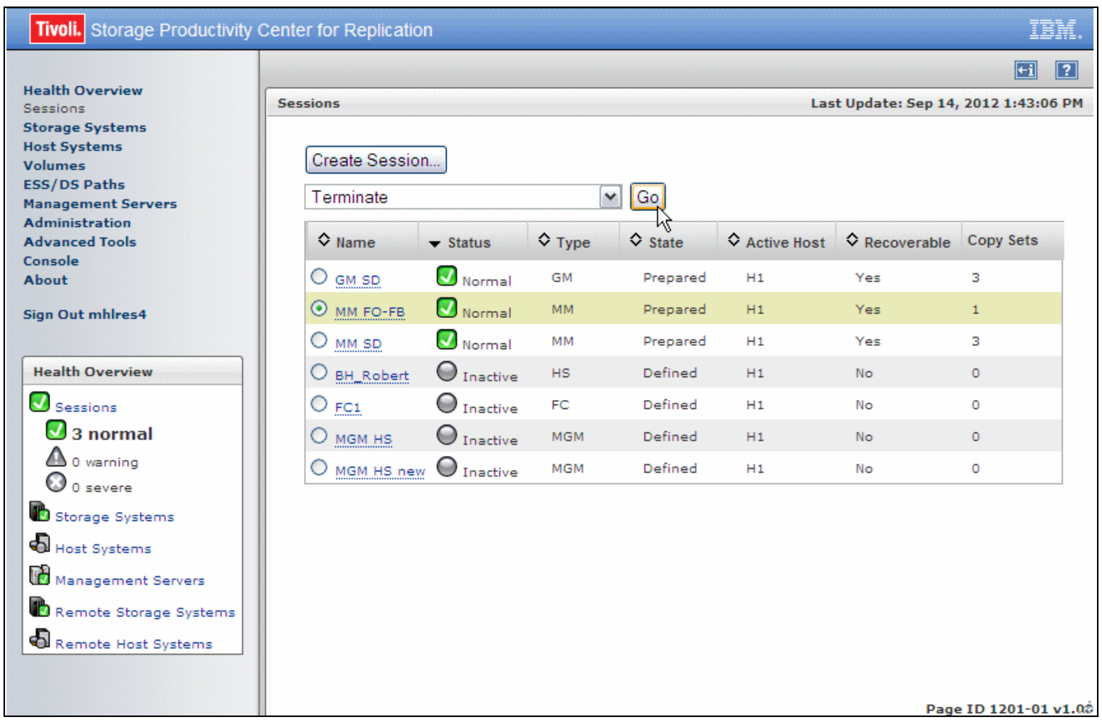

Figure 7-158 Metro Mirror FO/FB session - Terminate action

2. The next message shown in Figure 7-159 on page 374 is a warning that you are about to terminate Metro Mirror relationship between H1 and H2 volumes. Note that if you require to start the very same Metro Mirror session again a full copy between volumes in a Metro Mirror session will be required. Click **Yes** to continue.

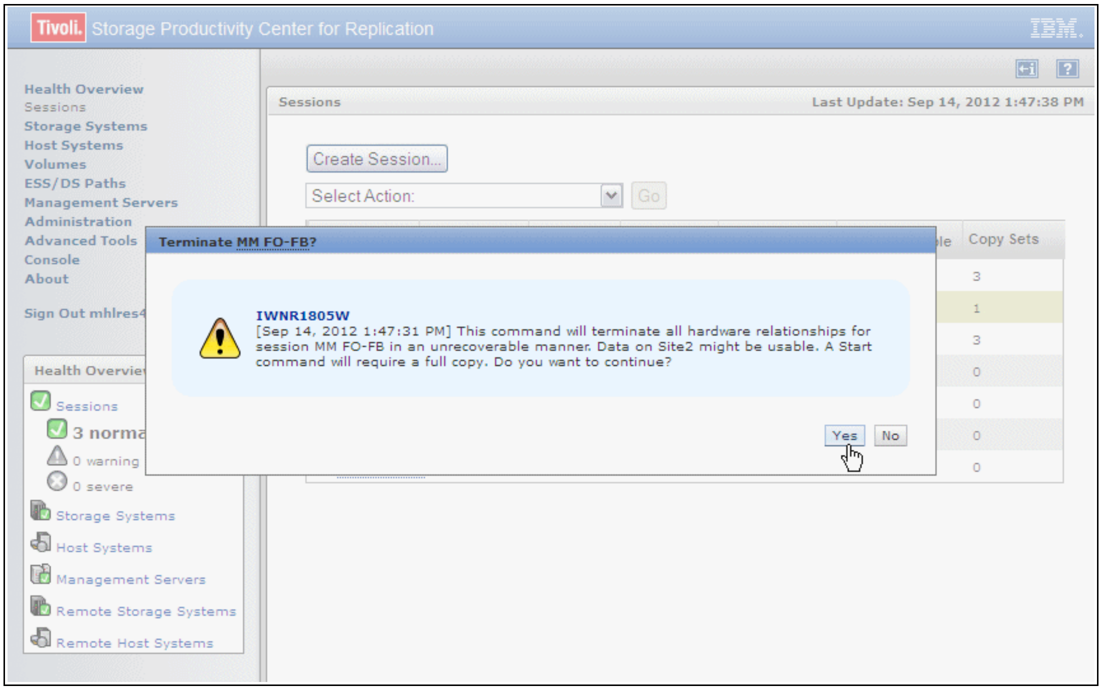

Figure 7-159 Terminate Metro Mirror FO/FB session

3. There is a message at the top of the panel, as shown in the Session Details panel in Figure 7-160, indicating that a **Terminate** action has been successfully completed. The status of our Metro Mirror session is now *Inactive* and the state is *Defined*.

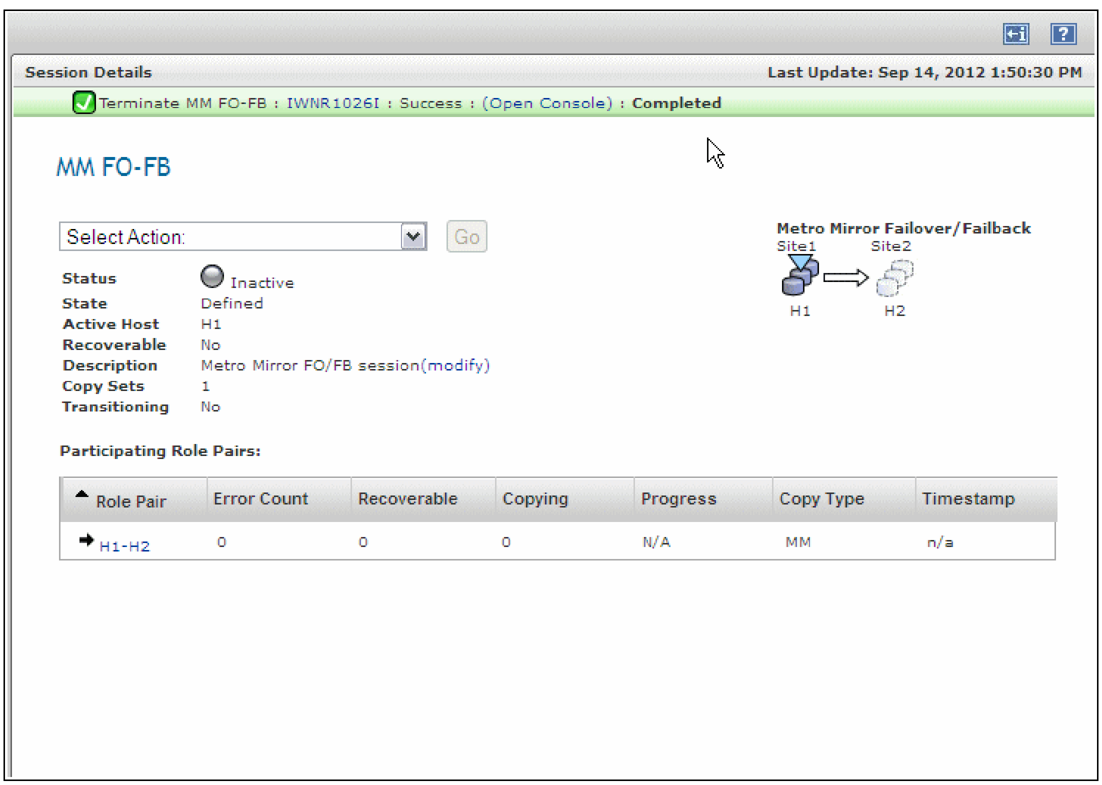

Figure 7-160 Terminate Metro Mirror FO/FB session - Completed

After the Metro Mirror session is terminated, the following options are available:

Start H1 → H2 Starts replication from H1 to H2 volumes in Metro Mirror mode.

StartGC H1 → H2 Starts replication from H1 to H2 volumes in Global Copy mode.

7.6 Metro Mirror Failover/Failback with Practice

A Metro Mirror Failover/ Failback session with Practice combines Metro Mirror and FlashCopy to provide a point in time copy of the data on Site 2. You can use this to practice what you might do if a disaster occurred, without losing your disaster recovery capability.

The Metro Mirror replication goes on from H1 volumes in Site 1, to intermediate volumes I2 in Site 2. Whenever you can do disaster recovery tests, you issue a Flash command, that stops the replication from Site 1 to Site 2, takes a point in time copy from the I2 volumes to the H2 volumes and resumes the replication from H1 to I2 volumes.

7.6.1 Creating a Metro Mirror Failover/Failback with Practice session

Figure 7-161 shows you the *Sessions* panel. Follow these steps:

1. Click **Create Session** to create a new session.

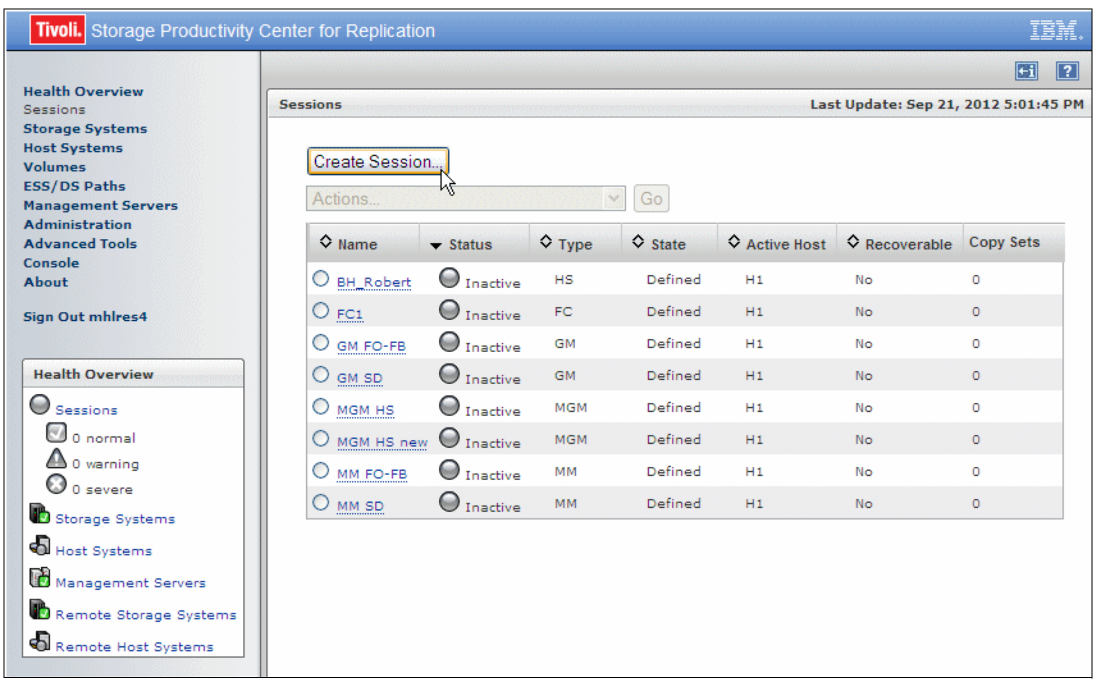

Figure 7-161 Creating a session

2. Choose the Hardware Type and choose **Metro Mirror Failover/Failback w/ Practice** session from the pull-down menus as shown in Figure 7-162. On the right side, a pictograph symbolizes the involved sites and their volume types. H1 represents Site 1 volumes, H2 represents Site 2 volumes and I2 represents Site 2 Intermediate volumes which are actually used as copy target. When you define Copy Sets this pictograph helps you to orient and understand replication direction. Click **Next** to continue.

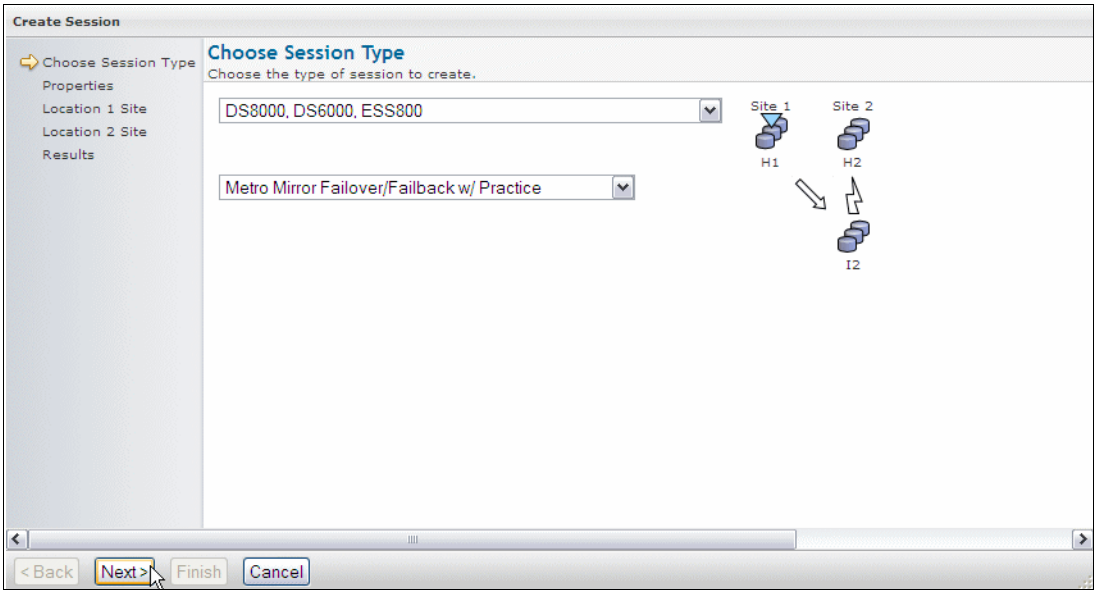

Figure 7-162 Define the Metro Mirror FO/FB w/ Practice session

This leads us to the session Properties panel as Figure 7-163 shows.

The *Properties* panel for a Metro Mirror Failover/Failback session with Practice is similar to the Properties panel of a Metro Mirror Single Direction session. See 7.3.1, “Creating a Metro Mirror Single Direction session” on page 287 for a description of the options in this panel.

In addition, it allows you to specify a *persistent* FlashCopy relationship between I2 and H2 volumes.

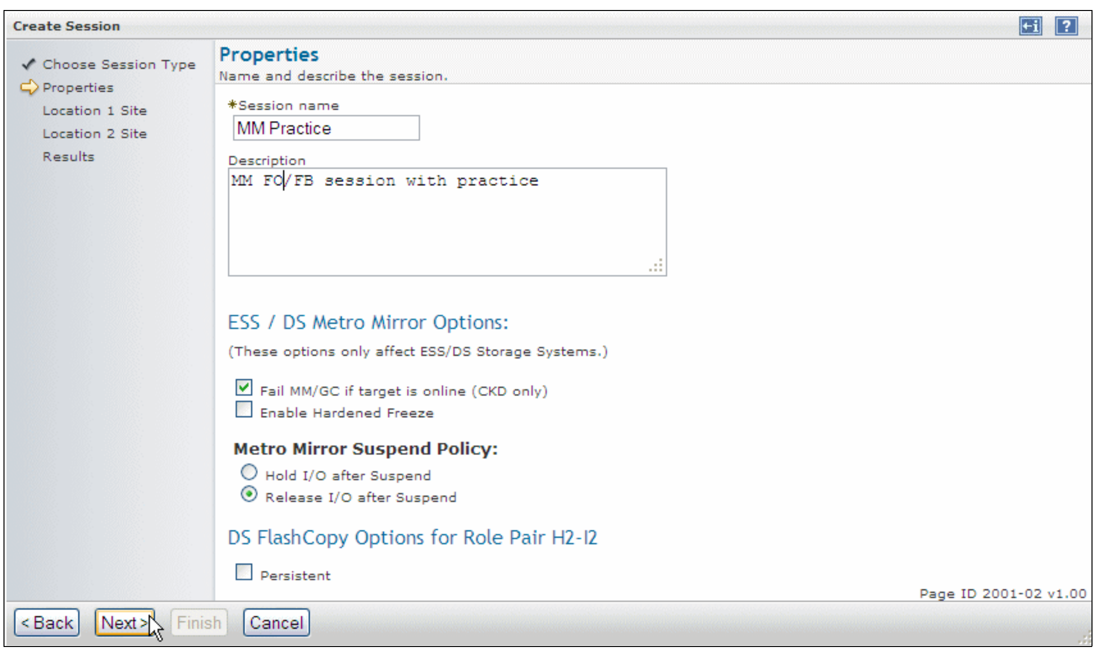

Figure 7-163 Define Metro Mirror FO/FB w/ Practice session Properties

3. From the pull-down **Site 1 Location** menu (see Figure 7-164), select the location of your H1 storage subsystem previously defined and click **Next** to continue.

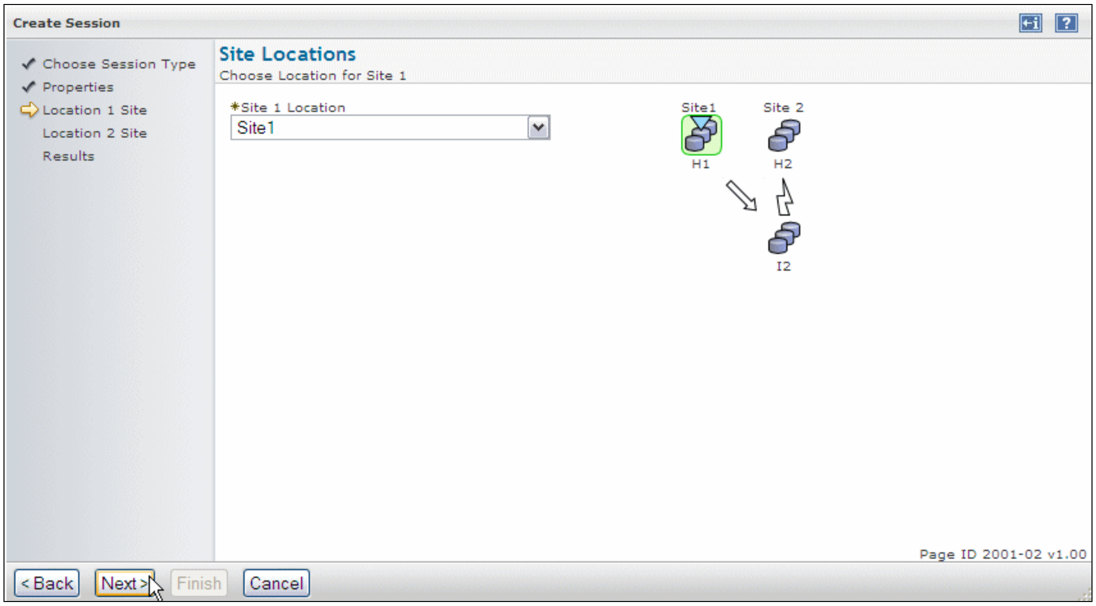

Figure 7-164 Define Metro Mirror FO/FB w/Practice session Site 1 Location

4. From the pull-down **Site 2 Location** menu (see Figure 7-165), select the location of your H2 storage subsystem previously defined and click **Next** to continue.

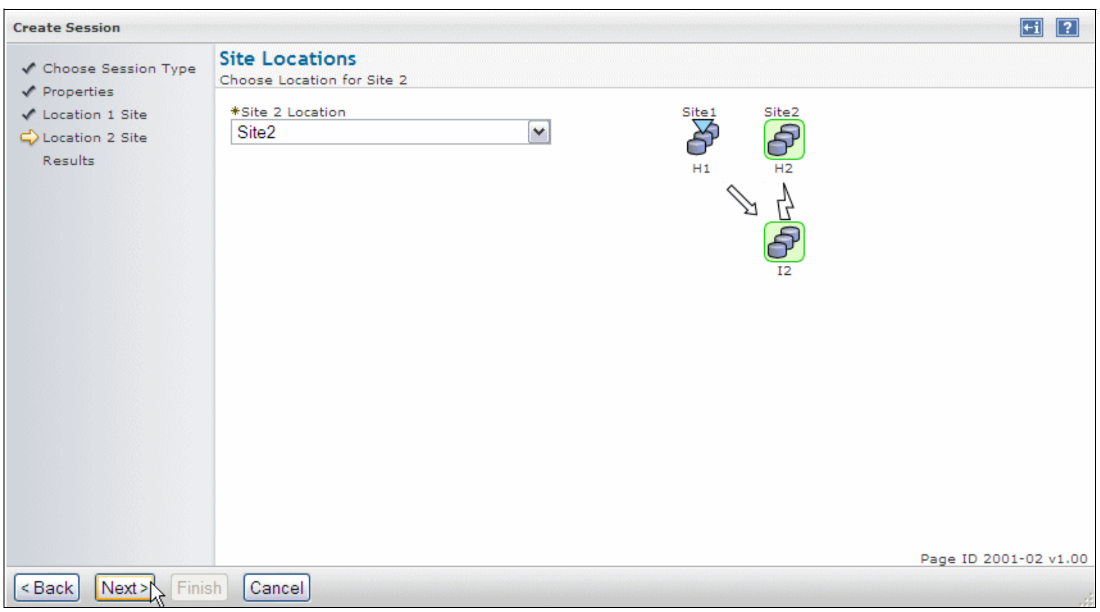

Figure 7-165 Define Metro Mirror FO/FB w/ Practice session Site 2 Location

5. Figure 7-166 displays the message that the MM Practice session was successfully created. Click **Finish** to exit the *Create Session* wizard. Alternatively, you have an option to add Copy Sets and click **Launch Add Copy Sets Wizard** and follow the instructions described in 7.6.2, “Adding Copy Sets to a Metro Mirror Failover/Failback with Practice session” on page 379.

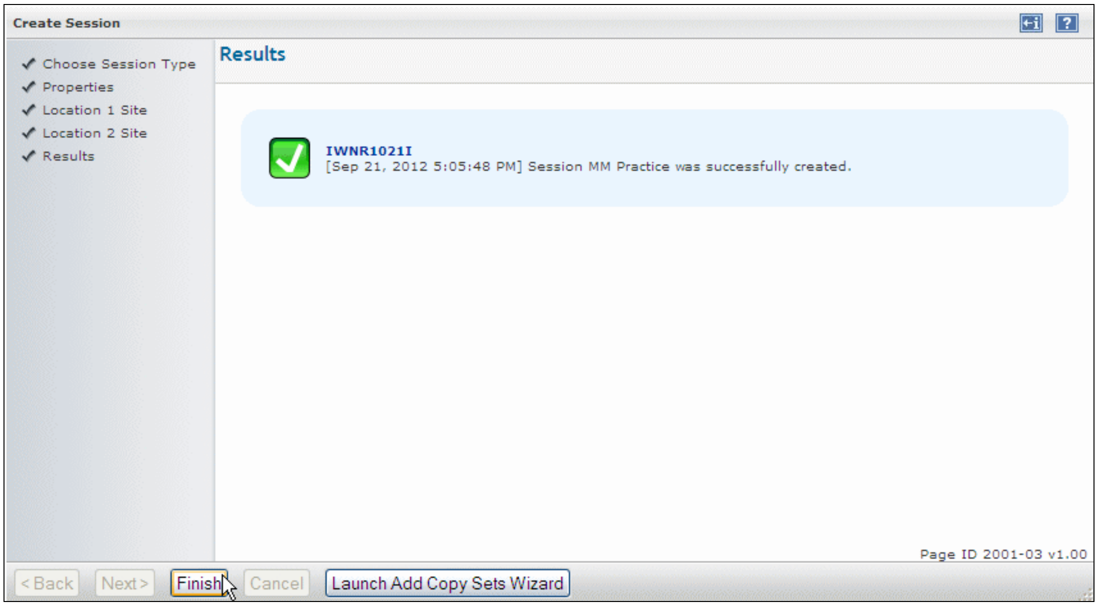

Figure 7-166 Define Metro Mirror FO/FB w/Practice session - Results

6. Going back to the Sessions panel, you can check the status of the recently created Metro Mirror Failover/Failback w/ Practice session. Figure 7-167 now displays the Metro Mirror Failover/Failback w/ Practice session which we successfully created.

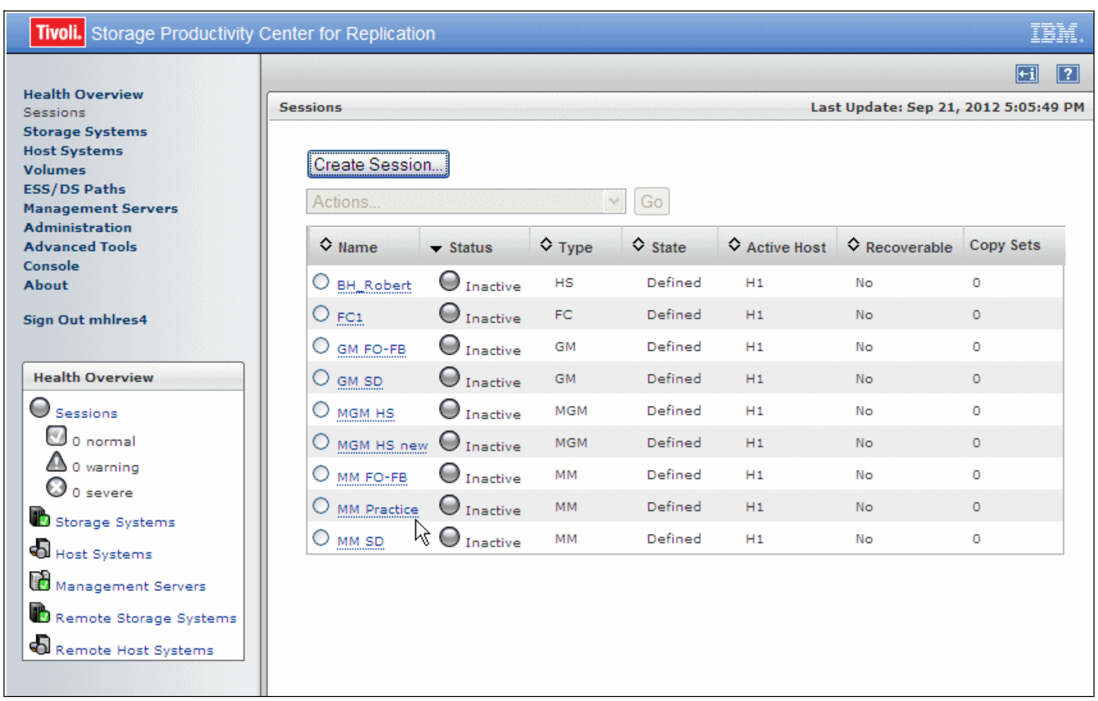

Figure 7-167 Metro Mirror FO/FB w/ Practice session defined

7.6.2 Adding Copy Sets to a Metro Mirror Failover/Failback with Practice session

After we have defined the Metro Mirror session MM Practice, we populate this session in the next step with Copy Sets. in a Metro Mirror Failover/Failback w/ Practice session a Copy Set consists of one H1, one H2 and one I2 volume.

Figure 7-168 shows the Sessions panel with the session MM Practice which we defined previously. The next logical action which you perform on session MM Practice is to add volumes or Copy Sets to it. Follow these steps:

1. Select your Metro Mirror session name radio button (MM Practice in our example) and choose **Add Copy Sets** from the **Select Action** pull-down menu. Click **Go** to invoke the *Add Copy Sets* wizard.

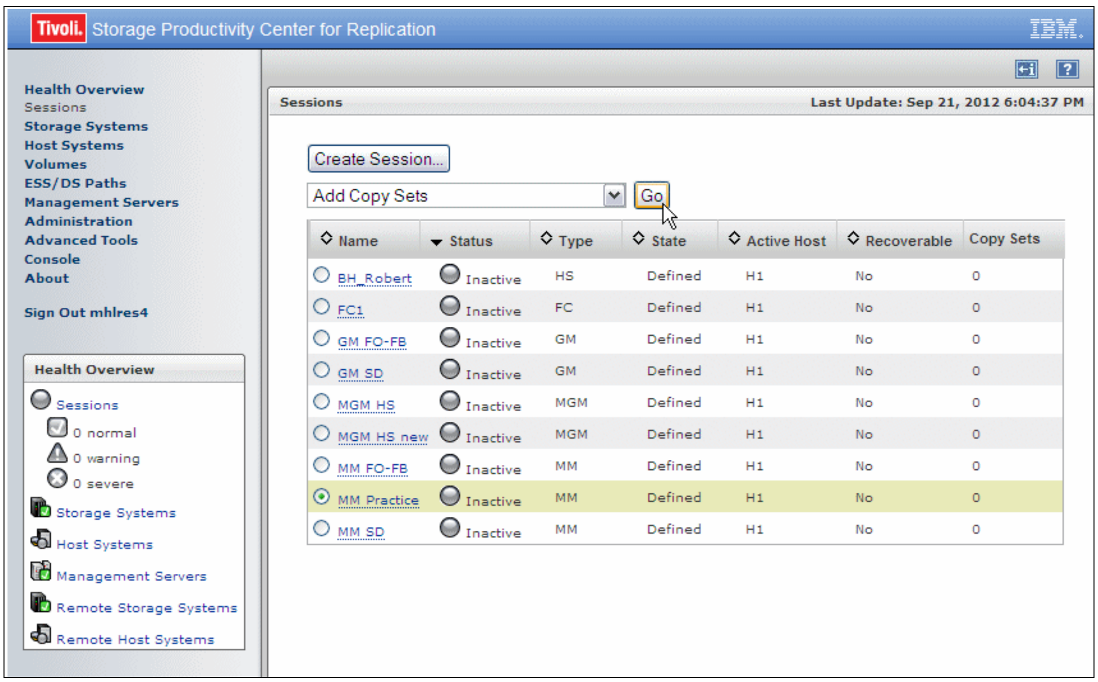

Figure 7-168 Add Copy Sets to Metro Mirror Failover/Failback with Practice

2. Figure 7-169 displays the panel which provides details on the primary volumes or local volumes which are called Host 1 volumes relating to the fact that these volumes reside in the Site 1 or application site or local site. These are all synonyms and refer to the same environment. Select the desired **Host 1 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Host 1 logical storage subsystem** list. Select the LSS where your H1 volume resides. After the LSS has been selected, choose the appropriate volume from the **Host 1 volume** pull-down list.
3. The alternative way to add a large number of volumes to this session is to create CSV file as explained in “Using CSV files for importing and exporting sessions” on page 194. In case you have a CSV file ready, select **Use a CSV file to import copy sets** check box and provide a path to your CSV file.
4. In our example we selected DS8000 disk subsystem and appropriate volume as shown in Figure 7-169. In case you want to define all volumes within a certain LSS in the Metro Mirror session, there is an option to select **All Volumes** from the **Host1 volume** list. Click **Next** to continue.

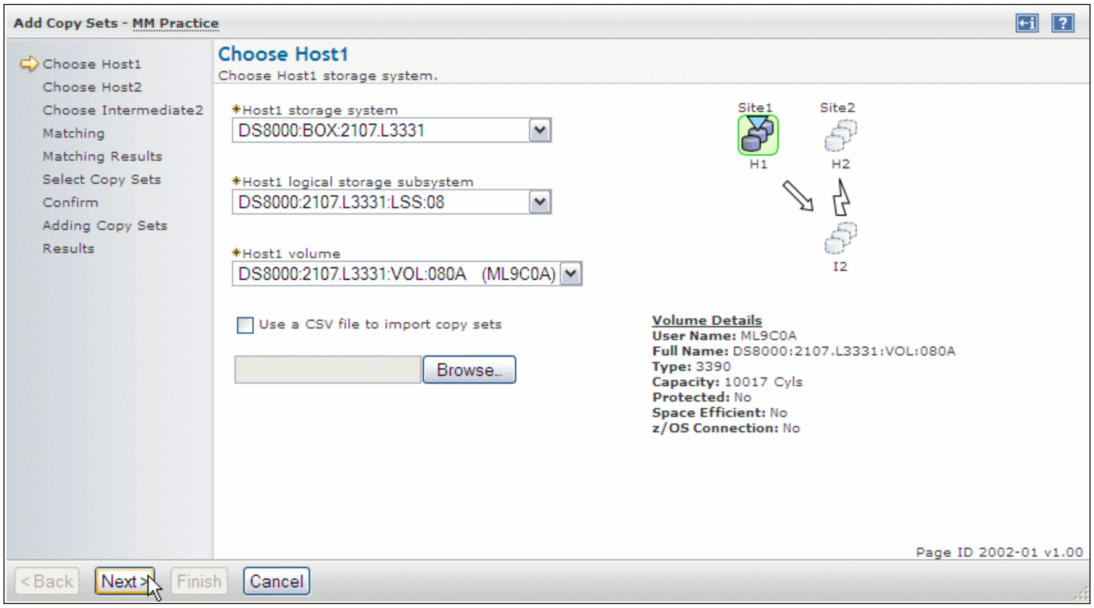

Figure 7-169 Add Copy Sets to Metro Mirror FO/FB w/ Practice session - Choose Host 1

5. The next step is to define Site 2 storage subsystems and volumes as shown in Figure 7-170. Select the desired **Host 2 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Host 2 logical storage subsystem** list. Select the LSS where your H2 volumes resides. If **All volumes** for a given LSS were selected in the previous step while defining Host 1 volumes, you do not have an option to select any volume from **Host 2 volumes** list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 1 storage subsystem with all volumes from selected LSS in Host 2 storage subsystem. Click **Next** to continue.

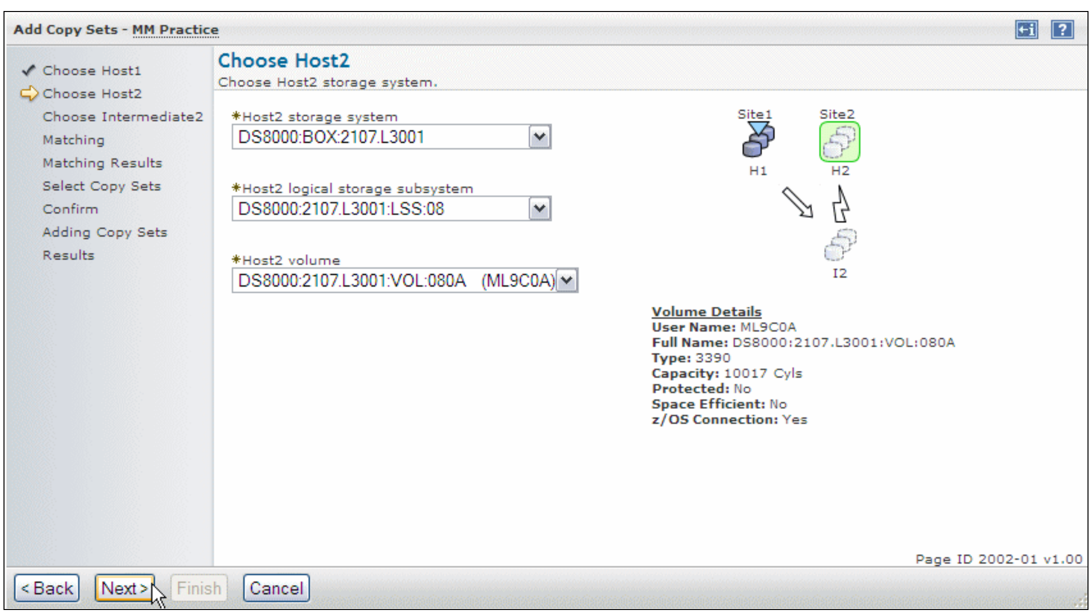

Figure 7-170 Add Copy Sets to Metro Mirror FO/FB w/ Practice session - Choose Host 2

6. The next step is to define Site 2 storage subsystems and Intermediate volumes as shown in Figure 7-171. Select the desired **Intermediate 2 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Intermediate 2 logical storage subsystem** list. Select the LSS where your I2 volumes resides. If *All volumes* for a given LSS were selected in the step while defining Host 1 volumes, you do not have an option to select any volume from Intermediate 2 volumes list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 1 storage subsystem with all volumes from selected LSS in Intermediate 2 storage subsystem. Click **Next** to continue.

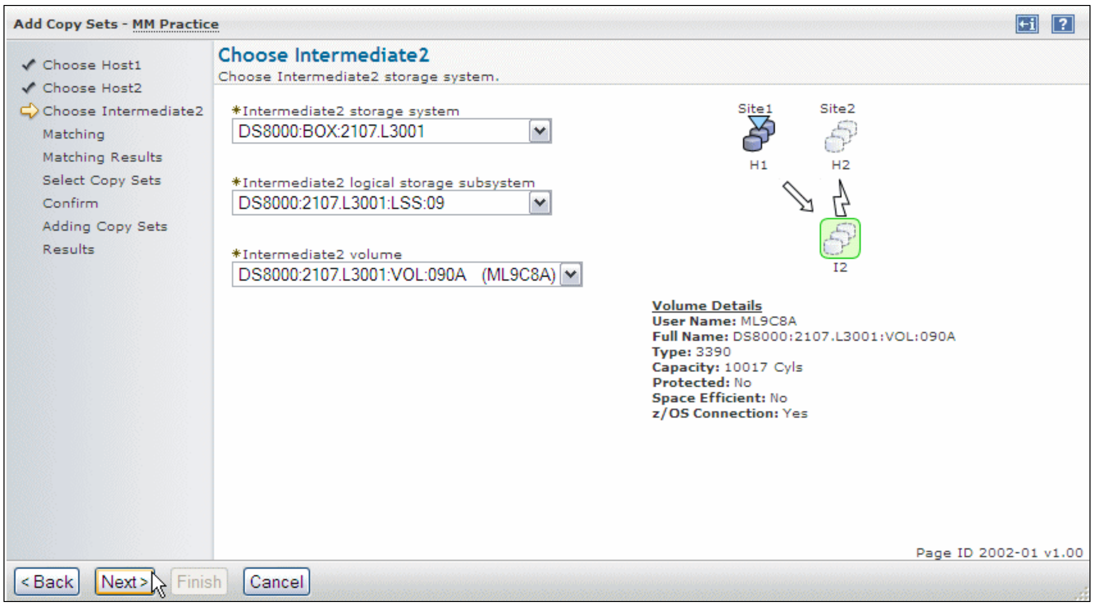

Figure 7-171 Add Copy Sets to Metro Mirror FO/FB w/ Practice session - Choose Intermediate 2

The next panel shown in Figure 7-172 allows to select, deselect and add more Copy Sets to this session. Click **Next** after you finish selecting your Copy Sets.

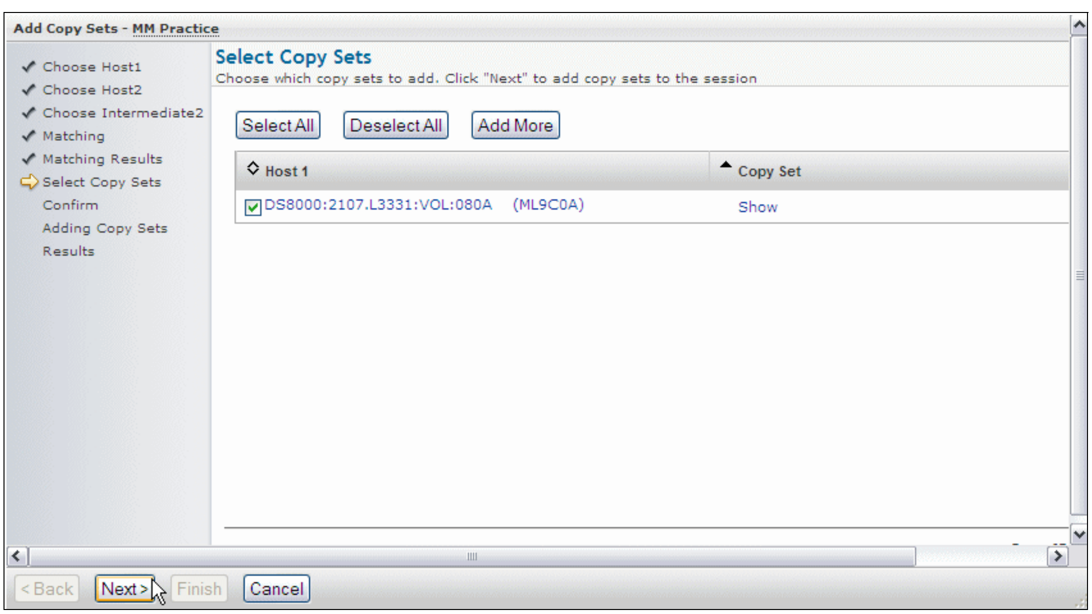

Figure 7-172 Add Copy Sets to Metro Mirror FO/FB w/ Practice session - Select Copy Sets

7. The next panel displays the number of Copy Sets that are going to be created, as shown in Figure 7-173. Click **Next** to continue.

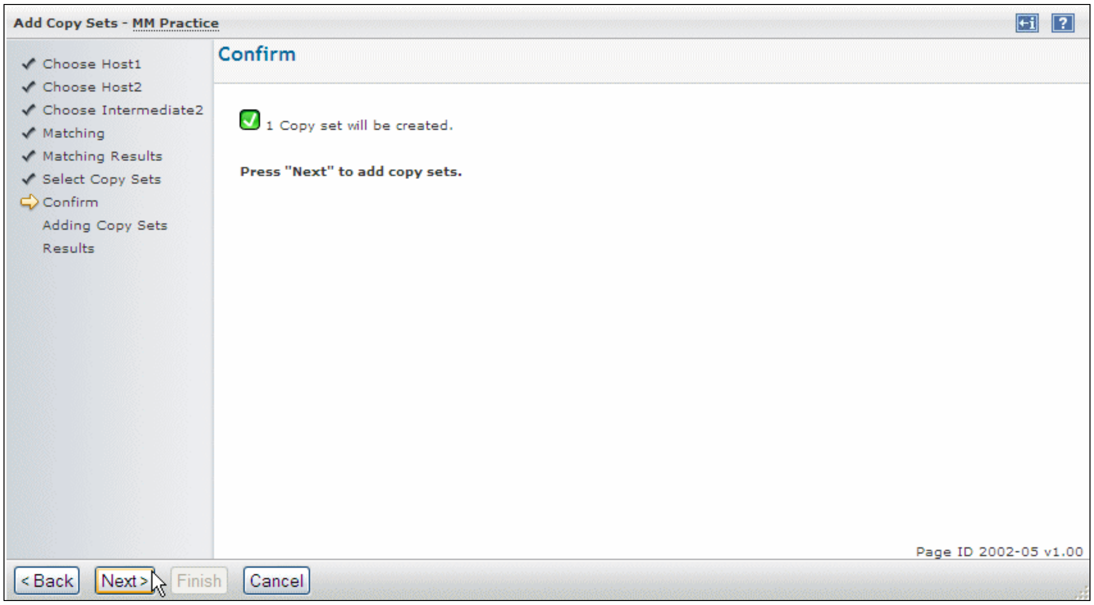

Figure 7-173 Add Copy Sets to Metro Mirror FO/FB w/ Practice session - Confirm

8. Tivoli Storage Productivity Center for Replication internally adds this Copy Sets to its database. After a few seconds, Tivoli Storage Productivity Center for Replication shows the results of the adding the Copy Sets, as shown in Figure 7-174. Click **Finish** to exit the *Add Copy Sets* wizard.

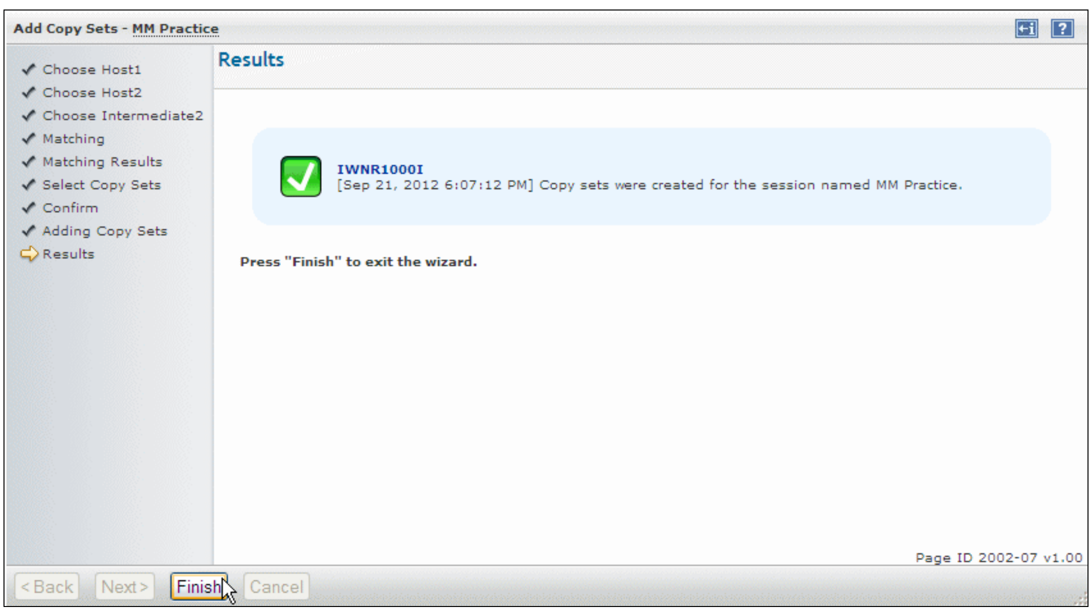

Figure 7-174 All Copy Sets are successfully added to the Tivoli Storage Productivity Center database

9. Figure 7-175 confirms that all Copy Sets are successfully added to the session MM Practice and the database is successfully updated. The session status is still *Inactive*.

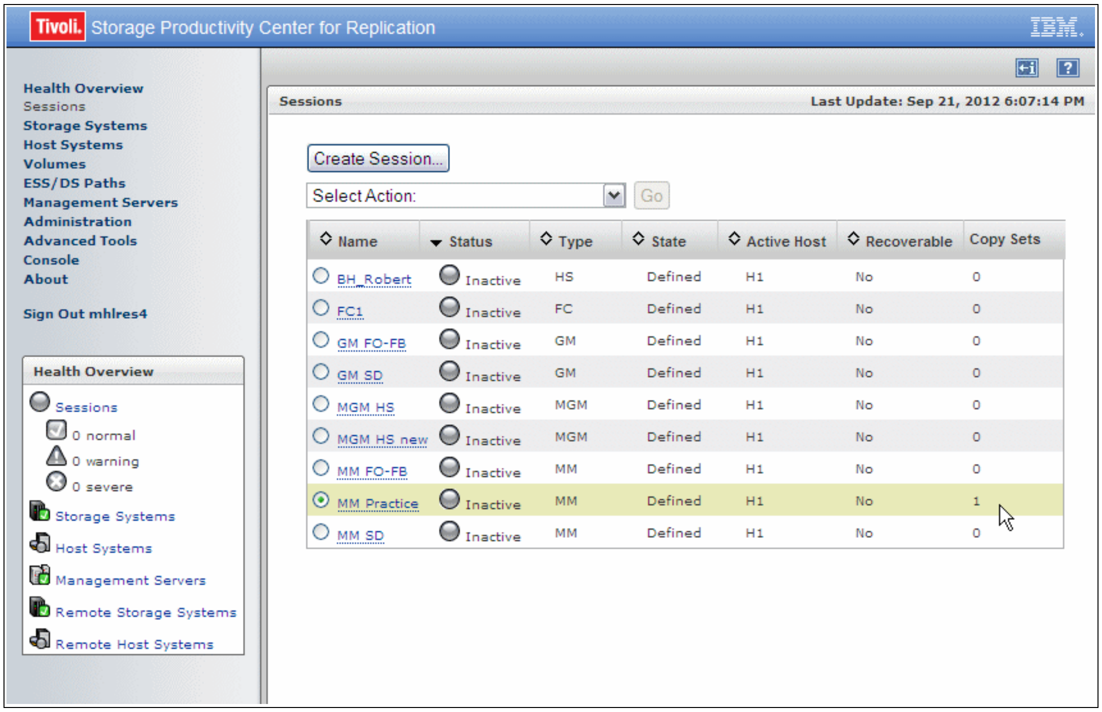

Figure 7-175 Add Copy Sets is completed

This concludes the steps through the GUI when you add Copy Sets to a Metro Mirror session.

7.6.3 Starting the session

After we have defined a Metro Mirror session and populated the session with Copy Sets, we can start the Metro Mirror session.

Figure 7-176 displays the session MM Practice as we defined it previously. We defined only one Copy Set in our example. As this is Failover/Failback type of a session it can be started in direction from Host 1 to Host 2 and in direction from Host 2 to Host 1. Initially a session can only be started in direction from Host 1 to Host 2. Follow these steps:

1. To start a session, from the **Select Action** pull-down menu select **Start H1** → **H2** or **StartGC H1** → **H2** (to start the replication in Global Copy mode) and click **Go** to continue.

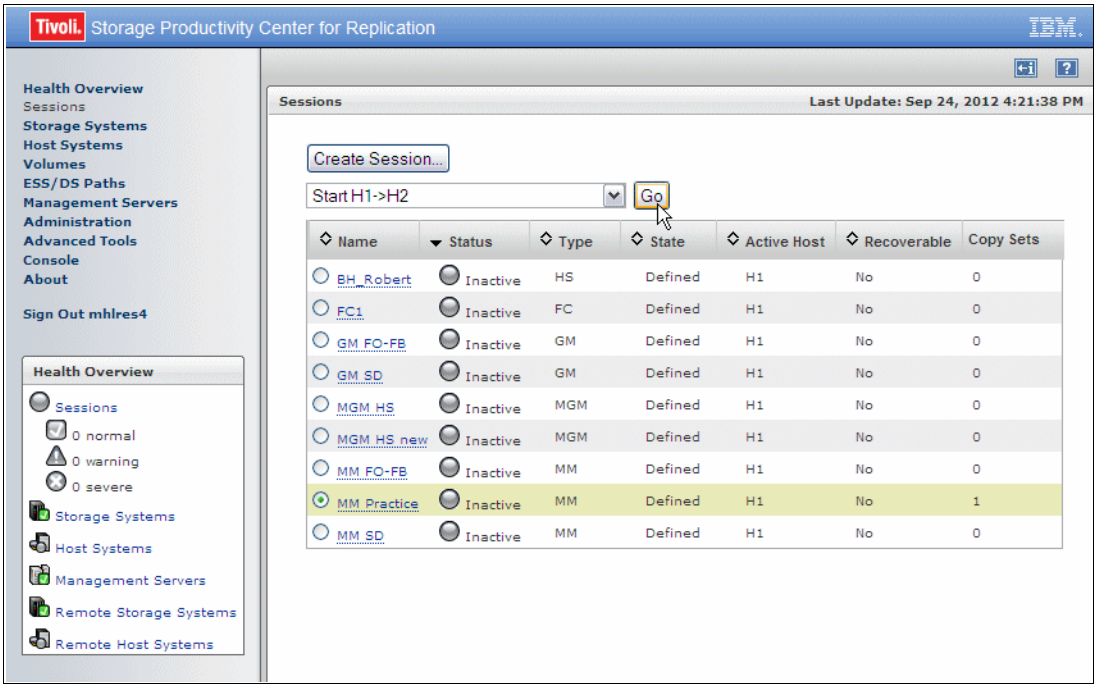

Figure 7-176 Metro Mirror session - Start H1 → H2 Action

2. The next message shown in Figure 7-177 is a warning that you are about to initiate a Metro Mirror session. It will start copying of data from Host 1 to Intermediate 2 volumes defined previously by adding Copy Sets, thus overwriting any data on Intermediate 2 volumes. At this stage, data on Host 2 volumes is not yet overwritten. Click **Yes** to continue.

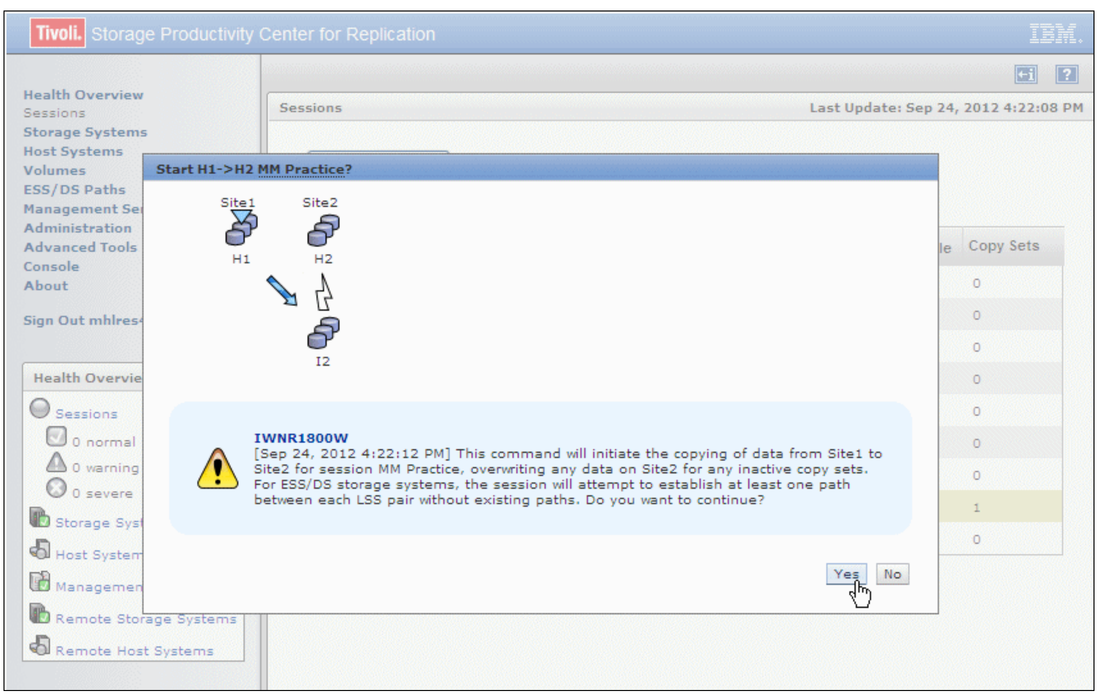

Figure 7-177 Start H1 → H2 Metro Mirror FO/FB w/ Practice session

3. After the copy progress reaches 100%, session goes into *Normal* status. As shown in the Session Details panel in Figure 7-178 on page 385 the Metro Mirror session has *Normal* status and there are no errors. The copy progress is 100% and the session has changed to *Prepared* state. Metro Mirror replication is going on from H1 to I2 volumes.

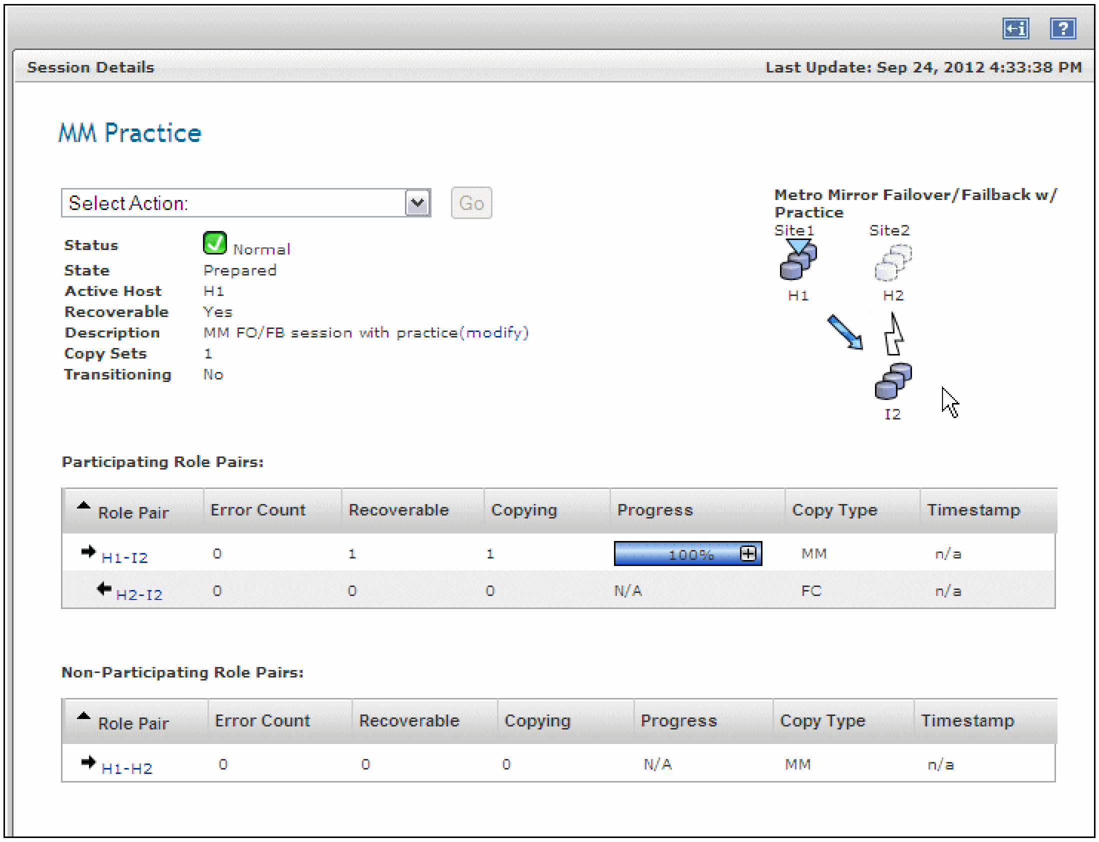

Figure 7-178 Metro Mirror session details

After the Metro Mirror session is started and it has *Normal* status and is in *Prepared* State, the following options are available:

Flash Creates consistent point in time copy on H2 volumes, continuing replication from H1 to I2 volumes.

Start H1 → H2 Restarts replication from H1 to I2 volumes.

StartGC H1 → H2 Starts replication in Global Copy Mode.

Stop Stops replication with inconsistent H2 volumes.

Suspend Stops replication with consistent H2 volumes.

Terminate Terminates the session (under *Cleanup* submenu).

7.6.4 Flashing a Metro Mirror session

Now that the volumes of the session are synchronized, we can initiate different actions against the Metro Mirror session. One of them is **Flash**. With the **Flash** action, you create a consistent copy of I2 volumes on H2 volumes. With this action, you will overwrite data on Host 2 volumes.

> **Attention:** If the Host 2 volumes are active on the server, the **Flash** action will fail.

Follow these steps:

1. From the **Sessions** panel, select your Metro Mirror session radio button, select **Flash** from the **Select Action** pull-down list, and click **Go**, as shown in Figure 7-179.

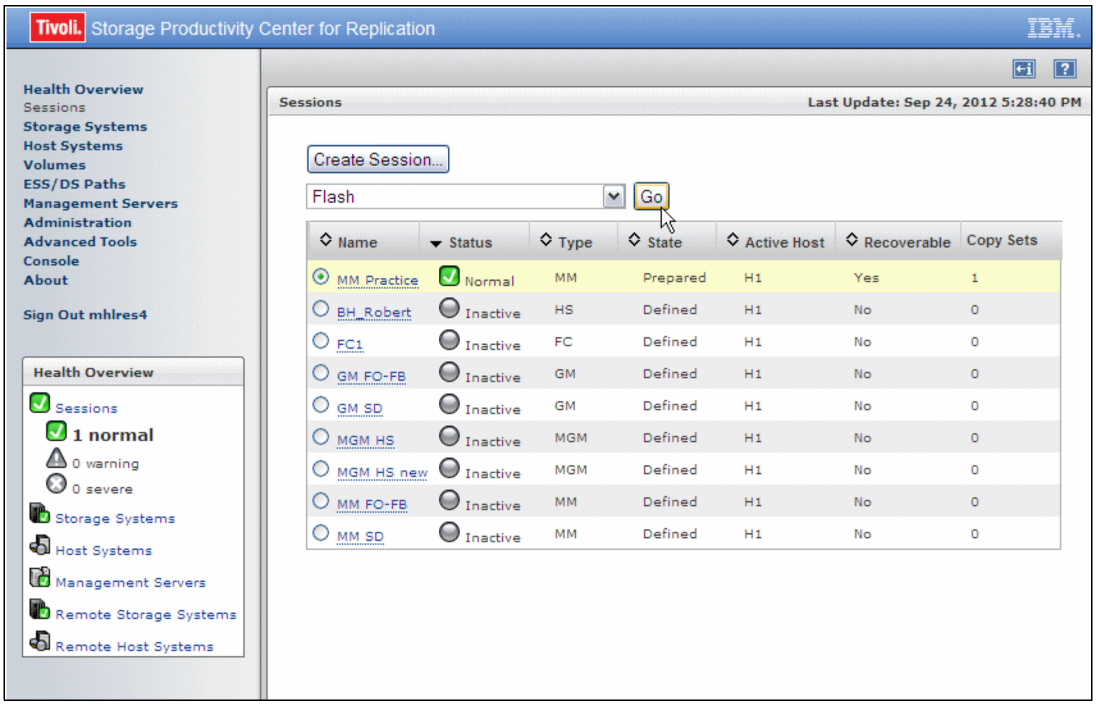

Figure 7-179 Metro Mirror session - Flash Action

2. The next message shown in Figure 7-180 is a warning that you are about to Flash a Metro Mirror session. Click **Yes** to continue.

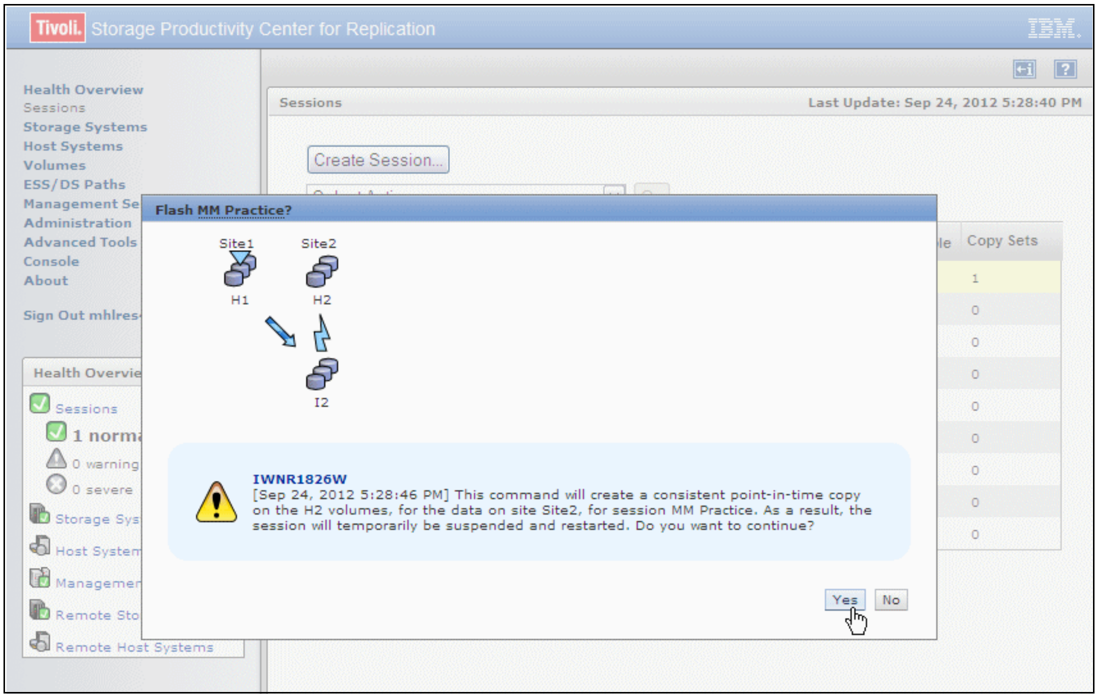

Figure 7-180 Flash Metro Mirror session

3. The status of our Metro Mirror session briefly changed to Warning status while an initial point in time copy was established. After copy is established, session status is returned to *Normal*. in Figure 7-181 you can see the session details after executing the **Flash** action.

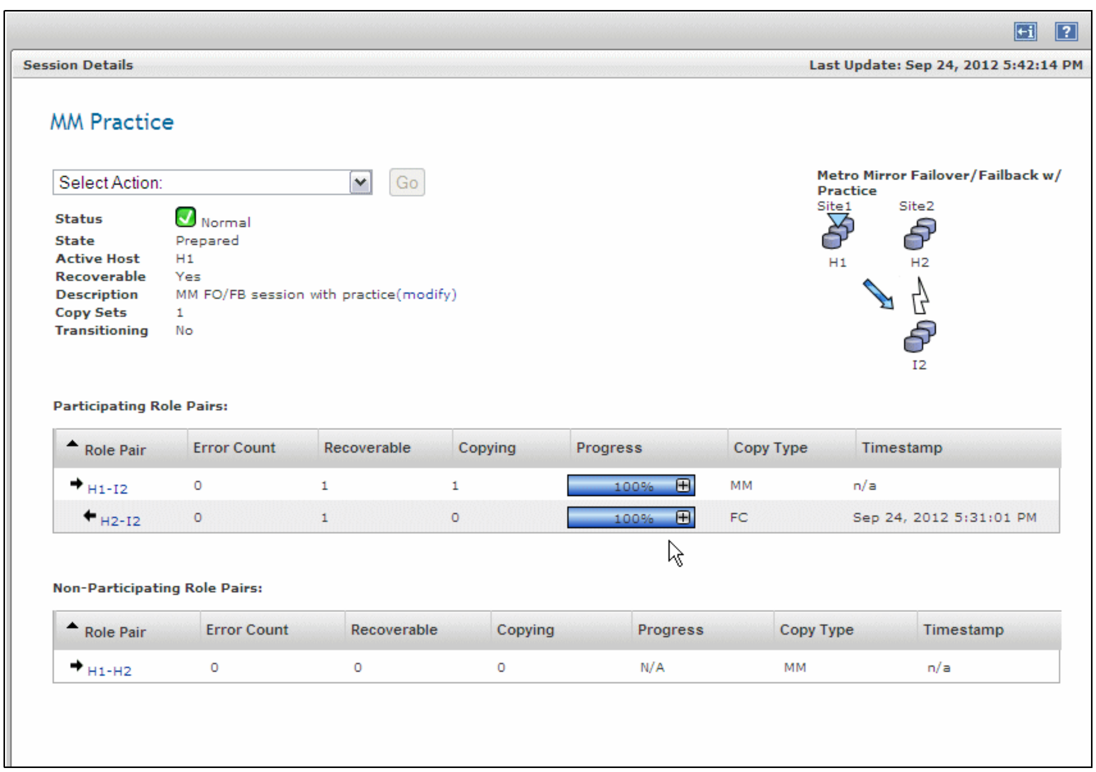

Figure 7-181 Flash Metro Mirror session details

In the line of the H2-I2 role pair, you can see the timestamp when point in time copy was created. This can be used as a reference.

After **Flash** action completed, you can start using the Host 2 volumes. The point in time copy is created with background copy option. This means it will be copied completely after creation.

You can use **Flash** action anytime in the life span of the session.

After the Metro Mirror session is flashed, the following options are available:

Flash Creates another consistent point in time copy on H2 volumes, continuing copying from H1 to I2 volumes.

Start H1 → H2 Restarts copying from H1 to H2 volumes.

StartGC H1 → H2 Converts the replication from Site 1 to Site 2 to Global Copy mode.

Stop Stops copying with inconsistent H2 volumes.

Suspend Stops copying with consistent H2 volumes.

Terminate Terminates the session (under *Cleanup* submenu).

7.6.5 Suspending a Metro Mirror session

After the volumes of the session are synchronized, we can initiate a **Suspend** action. Follow these steps:

1. From the **Sessions** panel, select your Metro Mirror session radio button, select **Suspend** from the **Select Action** pull-down list, and click **Go** as shown in Figure 7-182.

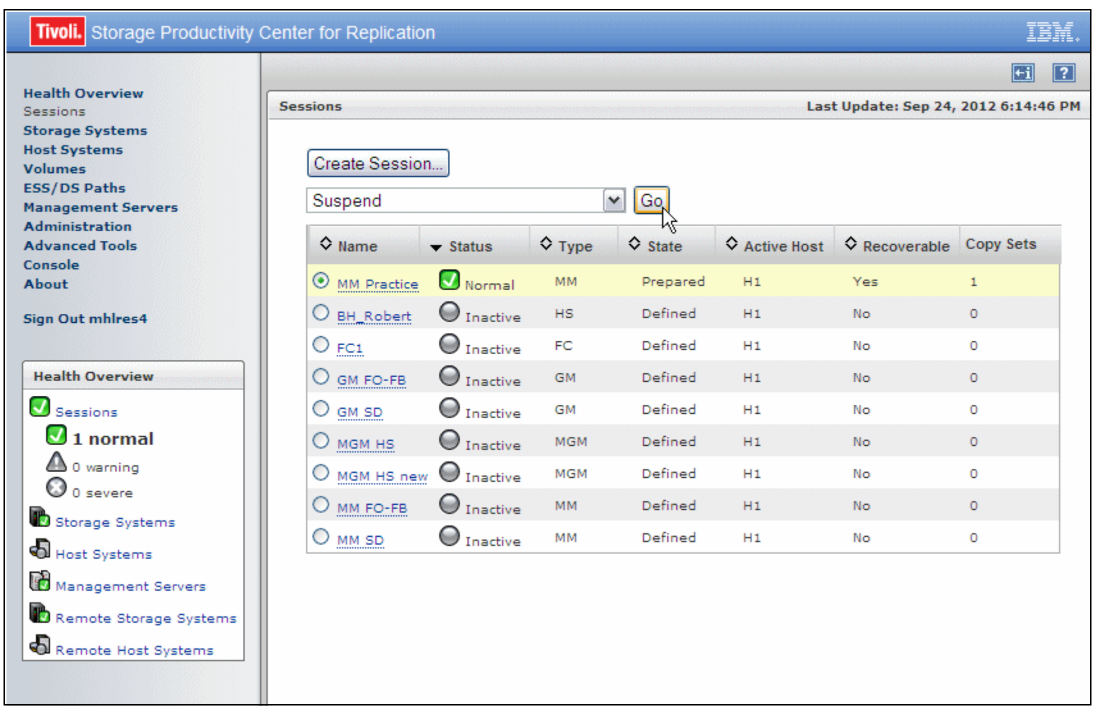

Figure 7-182 Metro Mirror session - Suspend Action

2. The next message shown in Figure 7-183 is a warning that you are about to Suspend Metro Mirror session. Click **Yes** to continue.

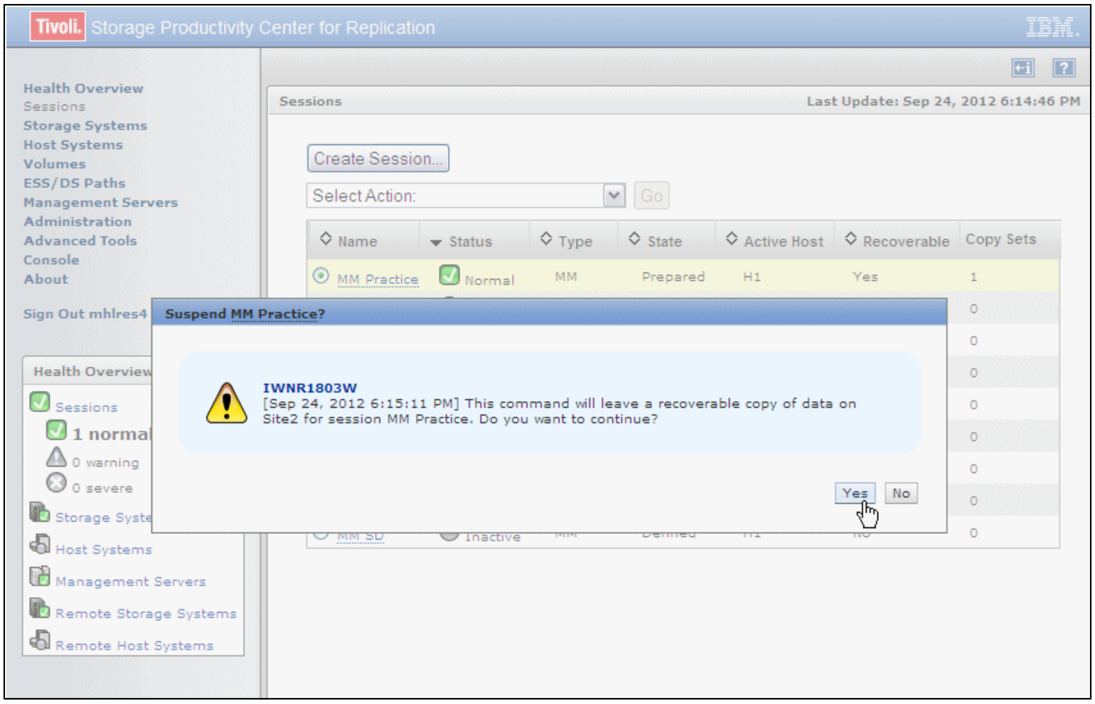

Figure 7-183 Suspend Metro Mirror session

3. The status of our Metro Mirror session has changed from *Normal* to *Severe* status, indicating that data is no longer replicated between Host 1 and Host 2 volumes. The State of the session is *Suspended* as indicated in Figure 7-184.

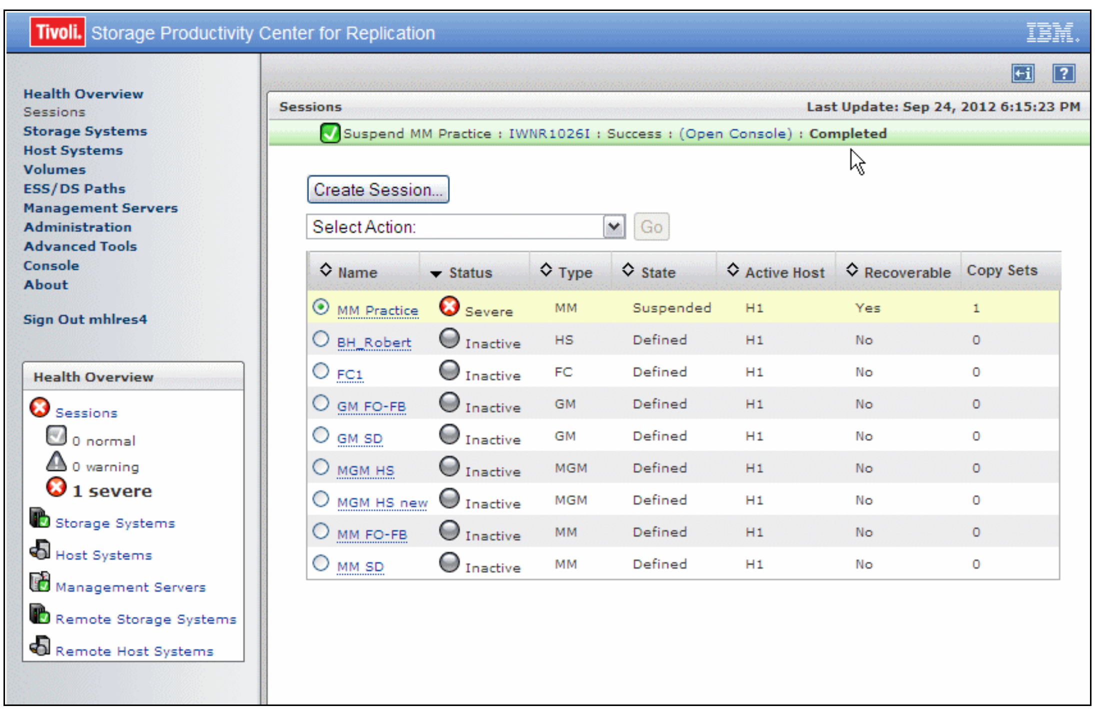

Figure 7-184 Suspend Metro Mirror session is reported as Completed

4. If you are going to suspend the Metro Mirror session that has been created with the **Hold I/O after Suspend** policy, then all systems that can update the H1 volumes are on hold before the Extended Long Busy (ELB), which defaults to 120 seconds. If you do not want to stop your production for 120 seconds, you can perform the **Release I/O** action, by selecting it from the actions pull-down menu. Also, if the session has *Enable Hardened Freeze* option defined, you must issue the SETHS RESUMEIO command from any z/OS console in the sysplex.

After the Metro Mirror session is suspended, the following options are available:

Recover Makes H2 volumes available for application systems.

Start H1 → H2 Restarts copying from H1 to I2 volumes.

StartGC H1 → H2 Restarts replication from H1 to I2 volumes in Global Copy mode.

Terminate Terminates the session (under *Cleanup* submenu).

7.6.6 Recovering a Metro Mirror session

After the Metro Mirror session and its associated Copy Sets have been suspended, we can initiate a **Recover** action. Follow these steps:

1. Select the Metro Mirror session radio button (MM Practice in our example shown in Figure 7-185) and select the **Recover** action from the **Select Action** pull-down menu.
2. **Recover** action takes a point in time copy of the data on I2 to the H2 volumes, enabling the application systems to be attached and run from the H2 volumes on site 2.
   Click **Go** to continue.

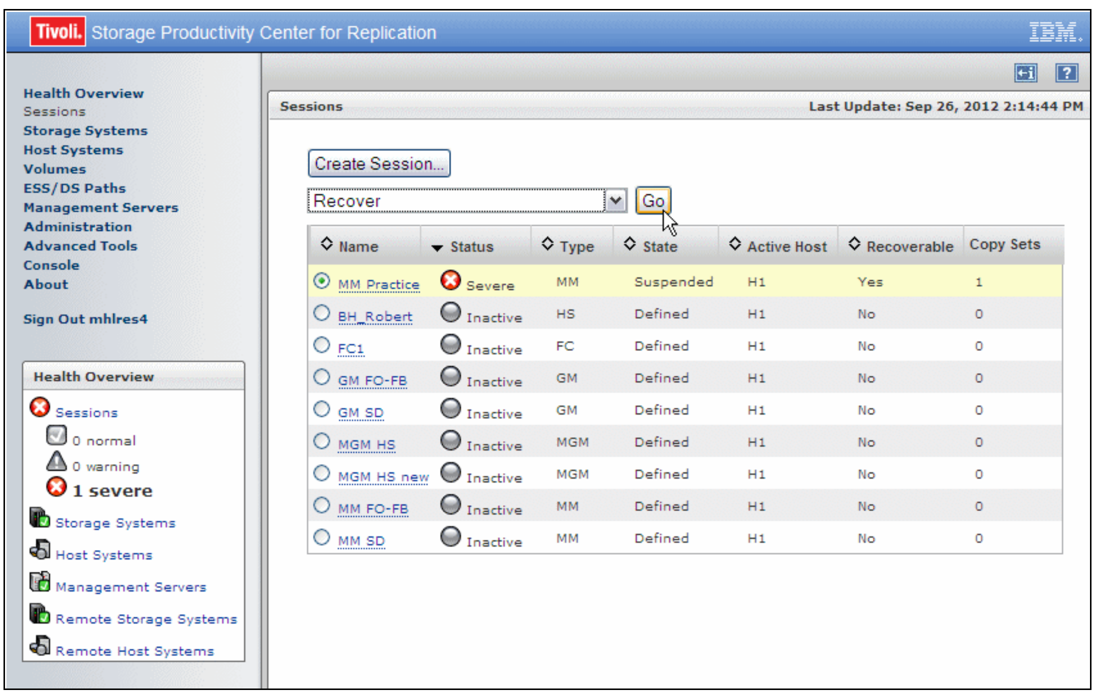

Figure 7-185 Metro Mirror session - Recover action

3. The next message shown in Figure 7-186 is a warning that you will allow target (secondary) volumes available to your host. In our example we initiated **Recover** command while data replication direction was from H1 to H2 volumes. Therefore, H2 as target (secondary) volumes in a Metro Mirror relationship will be available to host. Click **Yes** to continue.

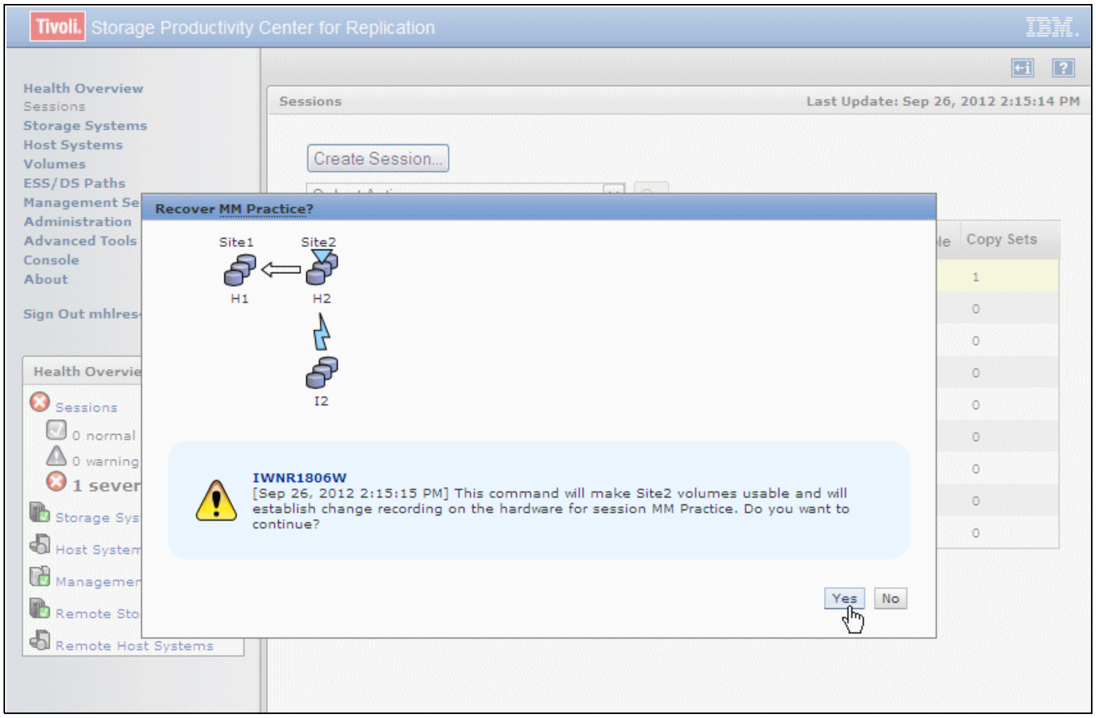

Figure 7-186 Recover Metro Mirror Session

4. There is a message at the top of the panel in Figure 7-187 indicating that a **Recover** action has been successfully completed. The status of our Metro Mirror session is *Normal* and the State is *Target Available*, indicating that H2 volume is available to your host.

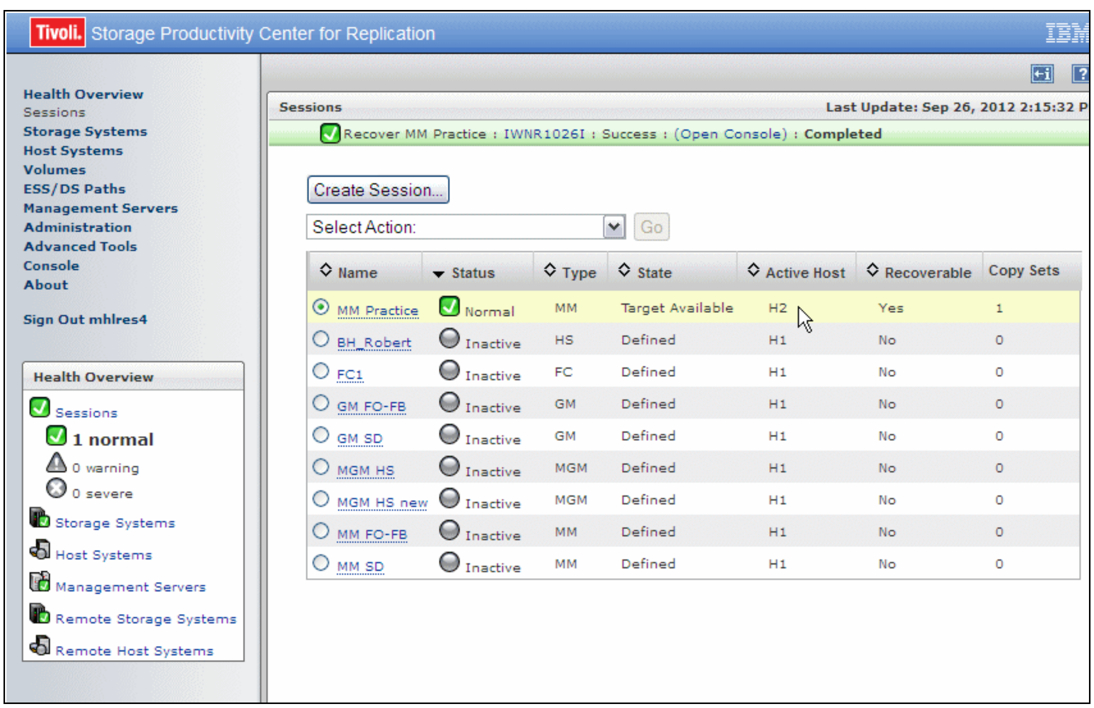

Figure 7-187 Metro Mirror session - H2 storage subsystem volume available to host

After the Metro Mirror session is recovered in *Target Available* state, the following options are available:

Flash Creates consistent point in time copy on H2 volumes from I2 volumes. With this you can always return to the state after suspend.

Release I/O Releases I/O to H1 volumes after Suspend event. This option is available only if the Metro Mirror session is created with **Hold I/O after Suspend** policy.

Start H1 → H2 Restarts copying from H1 to I2 volumes in Metro Mirror mode.

StartGC H1 → H2 Restarts copying from H1 to I2 volumes in Global Copy mode.

Enable Copy to Site 1 Before reversing the direction of copying in a failover and failback session, you must run this command, and confirm that you want to reverse the direction of replication. It will enable **Start H2 → H1** and **StartGC H2 → H1** actions.

Terminate Terminates the session (under *Cleanup* submenu).

7.6.7 Enabling Copy to Site 1

After a **Recover** action, Host 2 (target or secondary) volumes are active (assuming H1 to H2 replication direction). As Host 2 site is now the active site, you can reverse the direction of copying in a Metro Mirror Failover/Failback w/ Practice session. Follow these steps:

1. Before you can initiate copying from Host 2 to Host 1 volumes, you need to start the **Enable Copy to Site 1** command. To achieve this, from the **Select Action** pull-down menu, select **Enable Copy to Site 1** and click **Go** as shown in Figure 7-188.

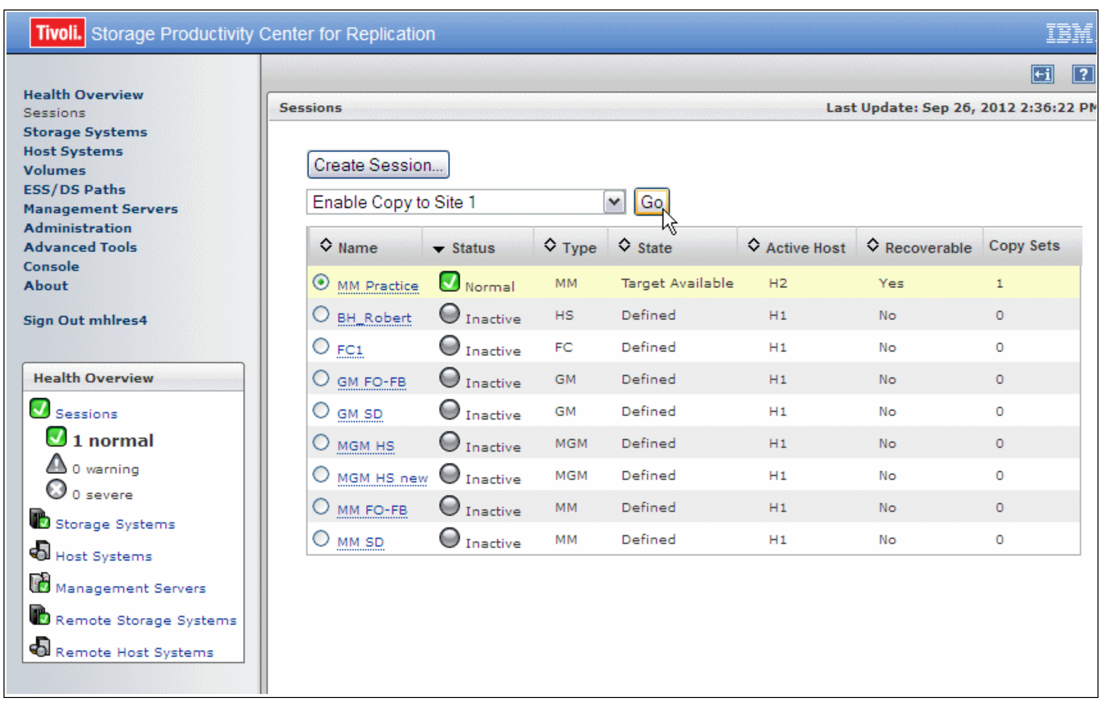

Figure 7-188 Metro Mirror session - Enable Copy to Site 1

2. The next message shown in Figure 7-189 is a warning that you are about to enable the command which initiates copying data from H2 to H1 volumes. This command is disabled

to protect against accidentally copying over production data. Ensure that all of the volumes in this session located at Site 1 are offline to all systems prior to enabling the command that allows copying data to Site 1. Click **Yes** to continue.

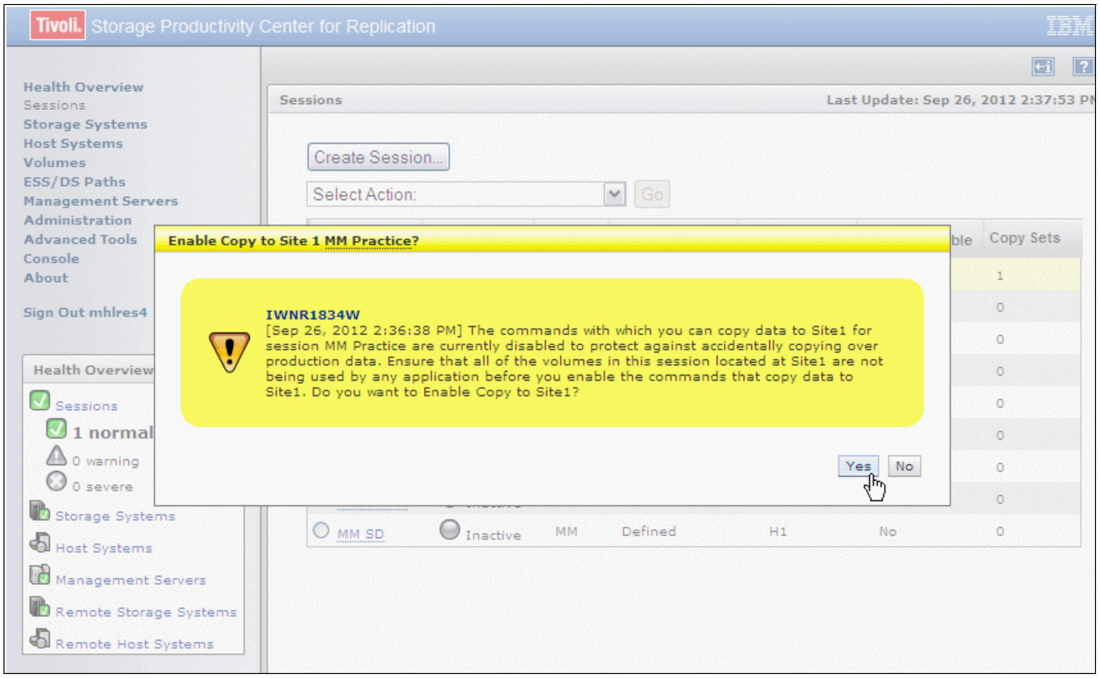

Figure 7-189 Enable Copy to Site 1

3. The message at the top of the panel in Figure 7-190 confirms that the Enable Copy to Site 1 command is completed. The status of our Metro Mirror session is the same as it was after the **Recover** command, *Normal* status, and *Target Available* state, indicating that H2 volume is available to your host.

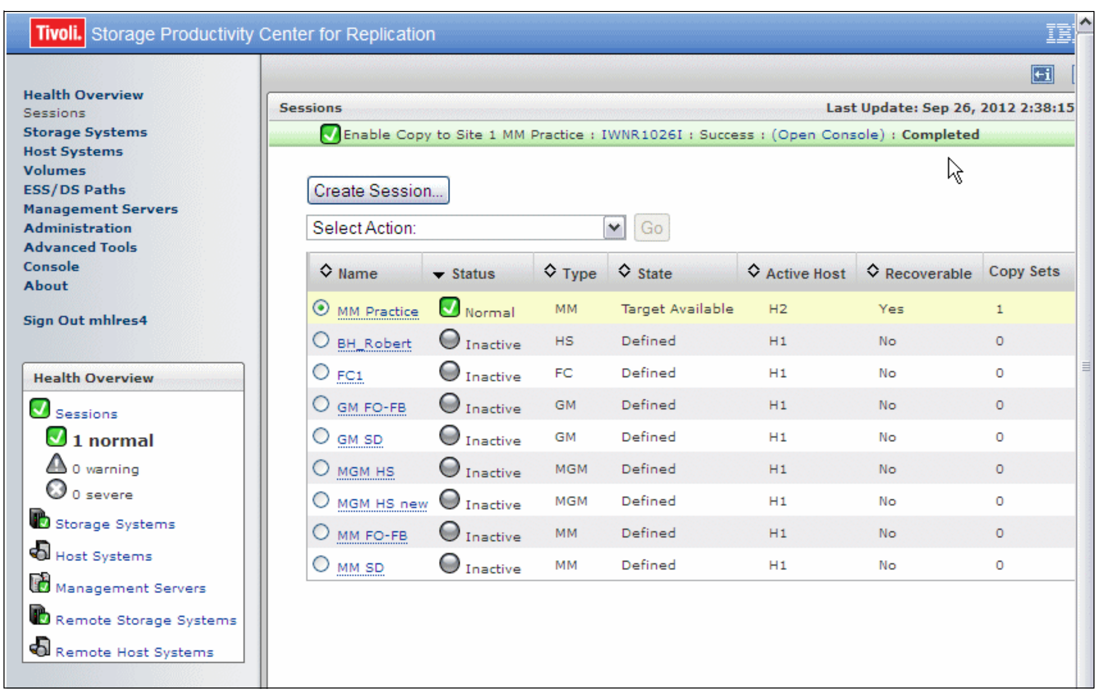

Figure 7-190 Enable Copy to Site 1 is reported as Completed

The following actions are available at this stage:

Flash Creates consistent point in time copy on H2 volumes from I2 volumes. With this you can always return to the state after suspend.

Release I/O Releases I/O to H1 volumes after Suspend event. This option is available only if the Metro Mirror session is created with **Hold I/O after Suspend** policy.

Start H2 → H1 Starts replication from H2 to H1 volumes in Metro Mirror mode.

StartGC H2 → H1 Starts replication from H2 to H1 volumes in Global Copy mode.

Re-enable Copy to Site 2 Re-enables replication from H1 to I2 volumes.

Terminate Terminates the session (under *Cleanup* submenu).

7.6.8 Starting an H2 → H1 Metro Mirror session

After a **Recover** action and **Enable Copy to Site 1** command, Host 2 volumes are active (assuming H1 to H2 replication direction). As the Host 2 site is now the active site, you can initiate replication from Host 2 to Host 1 volumes. You can choose to start the replication either in Metro Mirror mode (**Start H2 → H1**) or Global Copy mode (**StartGC H2 → H1**). Follow these steps:

1. In our example, we choose to start the replication in Metro Mirror mode. To achieve this, from the **Select Action** pull-down menu, select **Start H2 → H1** and click **Go** as shown in Figure 7-191.

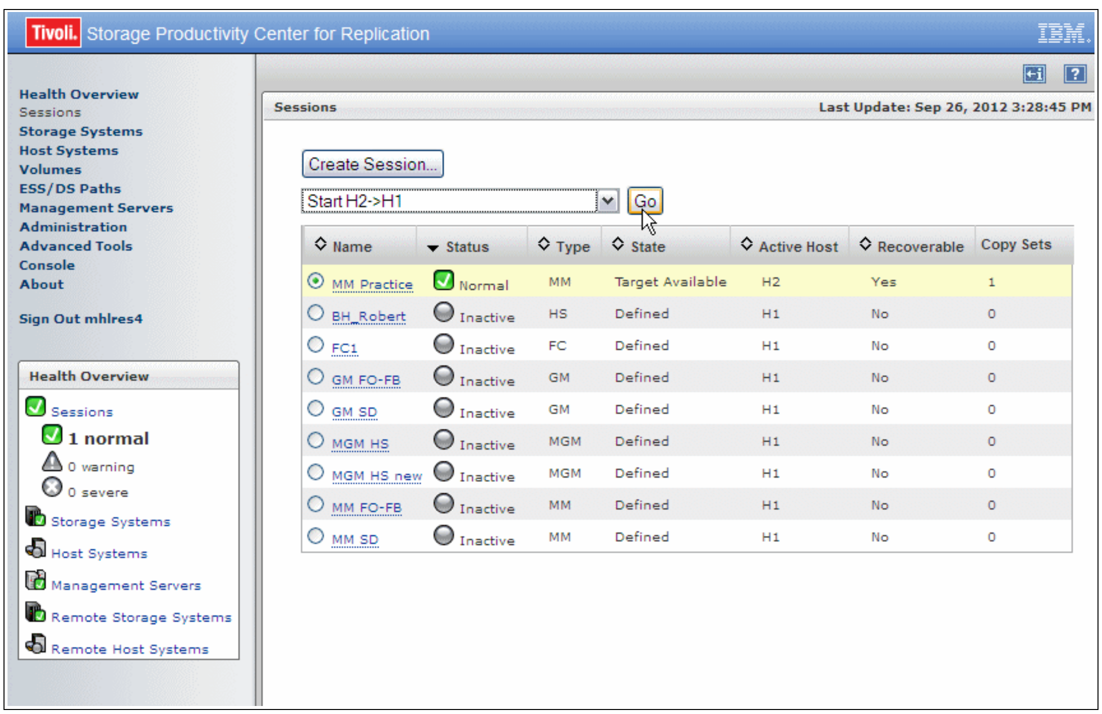

Figure 7-191 Metro Mirror session - Start H2 → H1 Action

2. The next message shown in Figure 7-192 is a warning that you are about to initiate starting of the Metro Mirror session. It will start copying of data from Host 2 to Host 1 volumes, thus overwriting any data on Host 1 volumes. At this stage data on Intermediate 2 volumes is not changed. Click **Yes** to continue.

Figure 7-192 Start H2 → H1 Metro Mirror FO/FB w/ Practice session

3. After all the updated tracks in H2 volumes are copied to H1 volumes, the replication between H2 and H1 volumes become synchronous. At this stage, the Metro Mirror session has *Normal* status and *Prepared* state. Figure 7-193 shows the Session Details panel. As you can see when the copy direction is from Host 2 volumes to Host1 volumes, Intermediate volumes are not used.

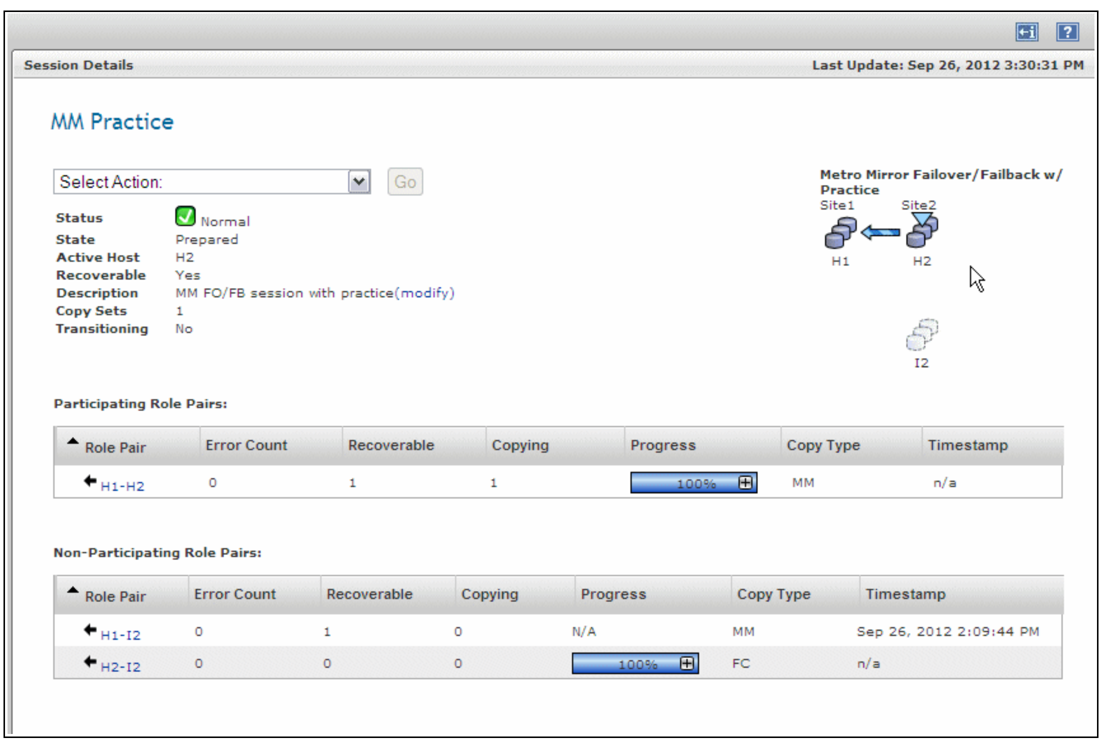

Figure 7-193 Metro Mirror session details

After the Metro Mirror session is started and it has *Normal* status and is in *Prepared* State, the following options are available:

Start H2 → H1 Restarts copying from H2 to H1 volumes in Metro Mirror Mode.

StartGC H2 → H1 Restarts copying from H2 to H1 volumes in Global Copy mode.

Stop Stops copying with inconsistent H1 volumes.

Suspend Stops copying with consistent H1 volumes.

Terminate Terminates the session (under *Cleanup* submenu).

7.6.9 Enabling Copy to Site 2

If we assume that the current copy direction is from Site 2 to Site 1 and you want to reverse the copy direction back from Site 1 to Site 2, you need to issue a **Suspend** command as we described in 7.6.5, “Suspending a Metro Mirror session” on page 388 and then a **Recover** command (see 7.6.6, “Recovering a Metro Mirror session” on page 390). But this time, the **Recover** command will make H1 volumes available to applications since the data copying direction is from H2 to H1 volumes. After the **Recover** command is completed, the Host 1 site is now the active site and you can reverse direction of copying in a Metro Mirror Failover/Failback session. Follow these steps:

1. Before you can initiate copying from Host 1 to Host 2 volumes, you need to start the **Enable Copy to Site 2** command. To achieve this, from the **Select Action** pull-down menu, select **Enable Copy to Site 2** and click **Go** as shown in Figure 7-194.

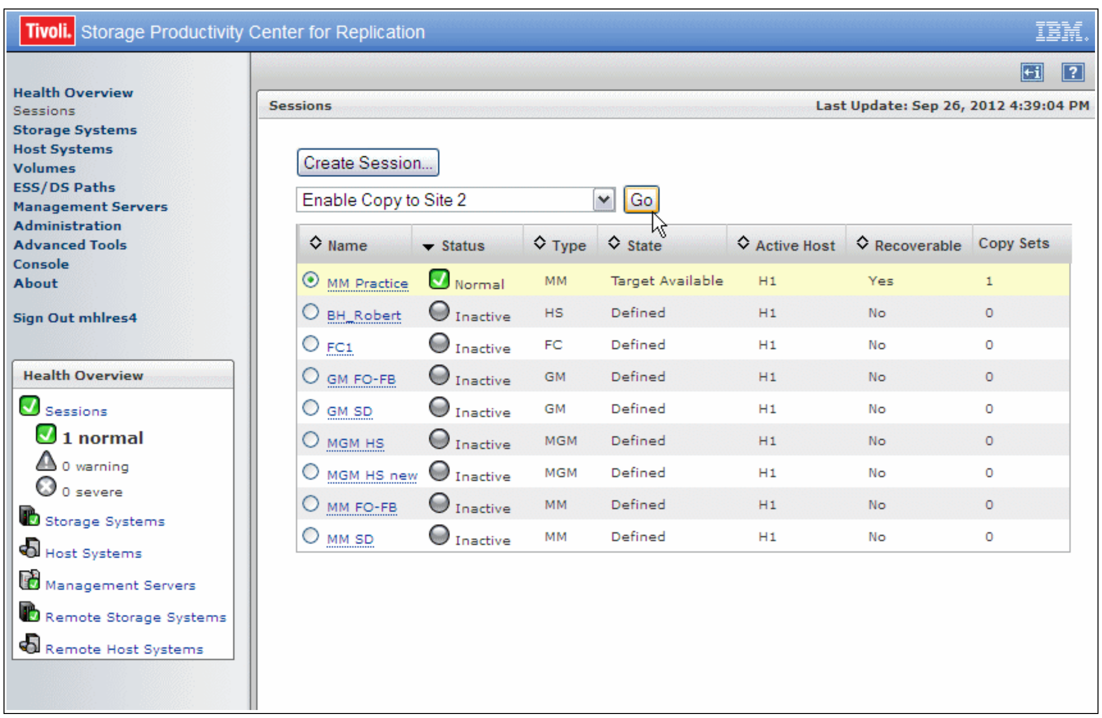

Figure 7-194 Metro Mirror session - Enable Copy to Site 2

2. The next message shown in Figure 7-195 is a warning that you are about to enable the command that initiates copying data from H1 to H2 volumes. This command is disabled to protect against accidentally copying over production data. Ensure that all of the volumes in this session located at Site 2 are not being used by any application prior to enabling the command that allows copying data to Site 2. Click **Yes** to continue.

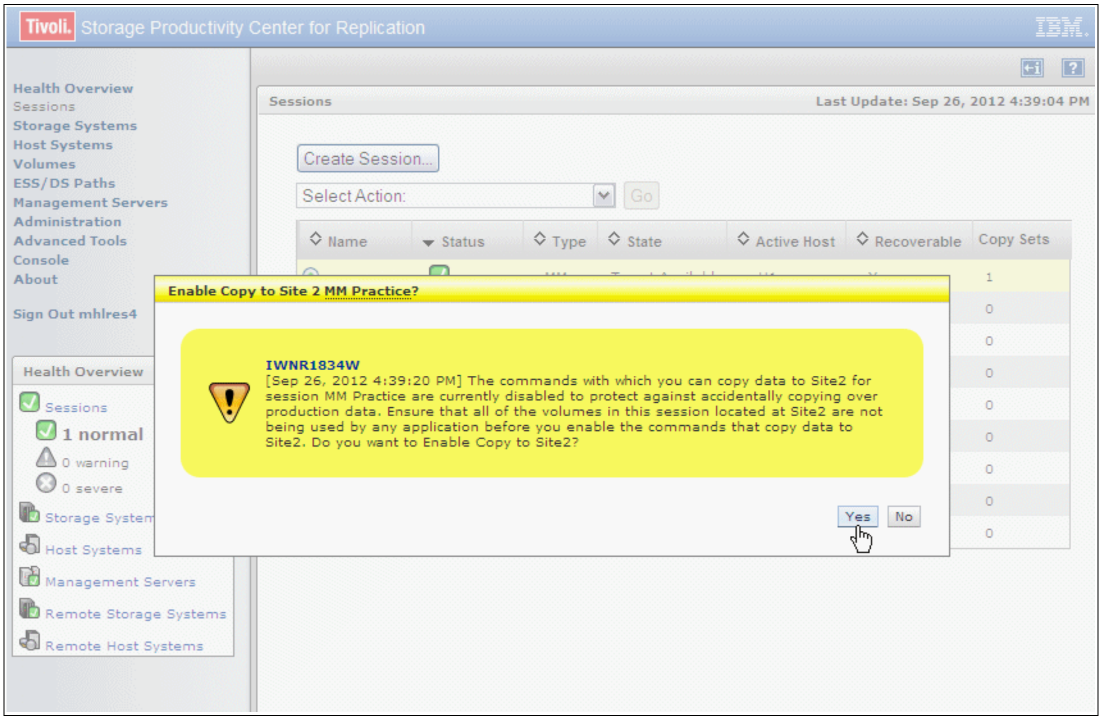

Figure 7-195   Enable Copy to Site 2

3. The message at the top of the panel in Figure 7-196 confirms that the Enable Copy to Site 2 command is completed. The status of our Metro Mirror session is the same as it was after **Recover** command: *Normal* status and *Target Available* state, indicating that H1 volume is available to your host.

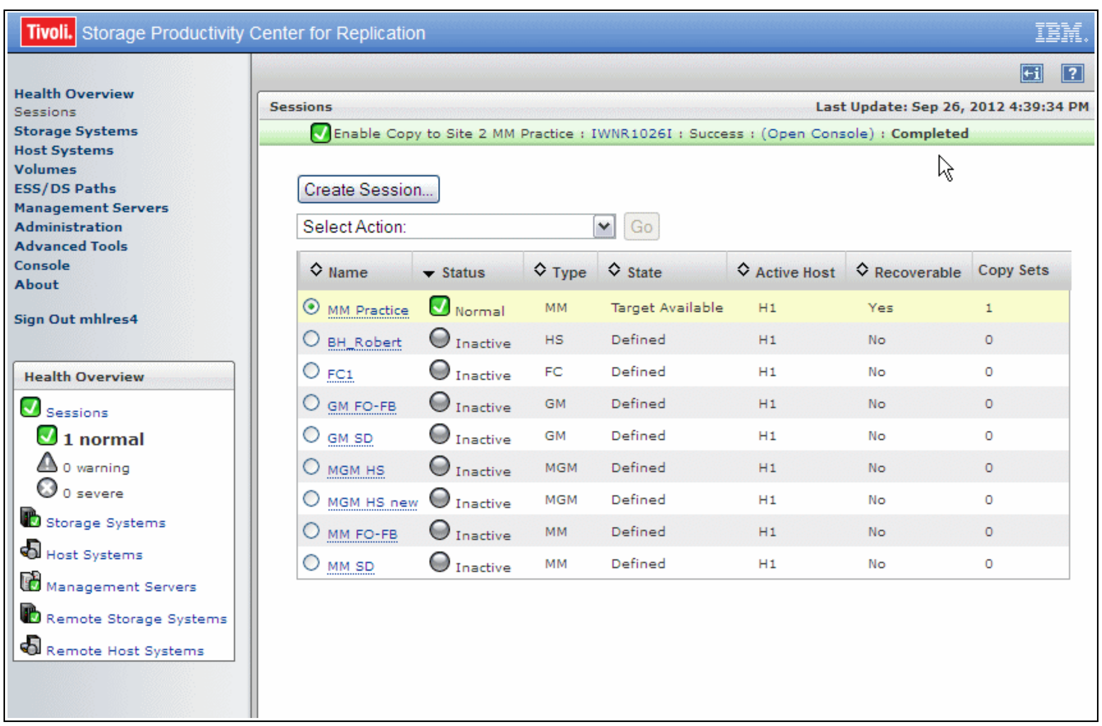

Figure 7-196   Enable Copy to Site 2 is reported as Completed

The following options are available at this stage:

Release I/O Releases I/O to H2 volumes after Suspend event. This option is available only if the Metro Mirror session is created with **Hold I/O after Suspend** policy.

Start H1 → H2 Restarts copying from H1 to I2 volumes in Metro Mirror mode.

StartGC H1 → H2 Restarts copying from H1 to I2 volumes in Global Copy mode.

Re-enable Copy to Site 1 Re-enables replication from Site 2 to Site 1.

Terminate Terminates the session (under *Cleanup* submenu).

7.6.10 Stopping a Metro Mirror session

It is possible to issue a **Stop** action against a Metro Mirror session if the session is in *Normal* state. It suspends updates to I2 or H1 volumes in a Metro Mirror session depending on the copy direction. This command can be issued at any point during an active session. **Stop** action is completely transparent to the host I/O since *Freeze* is not issued against volumes. Therefore I2 or H1 volumes, depending on the copy direction, do not contain a consistent copy of your data. Follow these steps:

1. Select the Metro Mirror session radio button (MM Practice in our example shown in Figure 7-197) and select the **Stop** action from the **Select Action** pull-down menu. Click **Go** to continue. In our example, we stopped the session when the copy direction was from H1 volumes to I2 volumes.

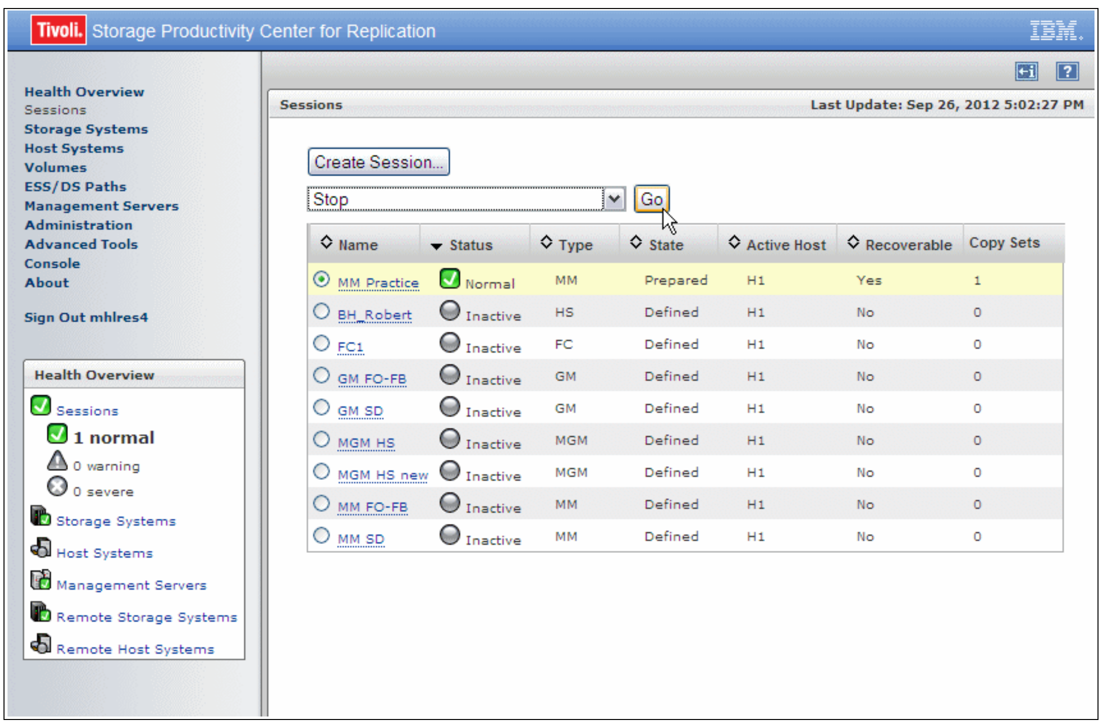

Figure 7-197 Metro Mirror session - Stop action

2. The next message shown in Figure 7-198 is a warning that you will stop data replication from H1 to H2 volumes and H2 volumes are not consistent. Click **Yes** to continue.

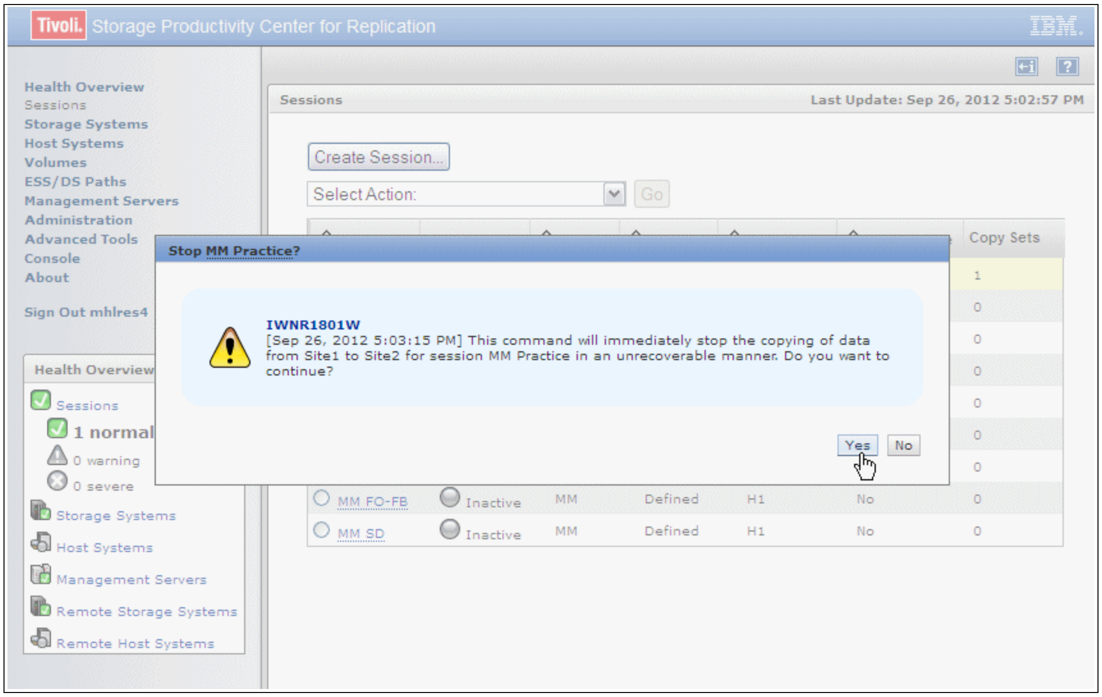

Figure 7-198 Stop Metro Mirror session

3. There is a message at the top of the panel in Figure 7-199 indicating that a **Stop** action has been successfully completed. The status of our Metro Mirror session is *Severe* and the state is Suspended. Column *Recoverable* in Figure 7-199 has value *NO* indicating that I2 and H2 volumes are not consistent.

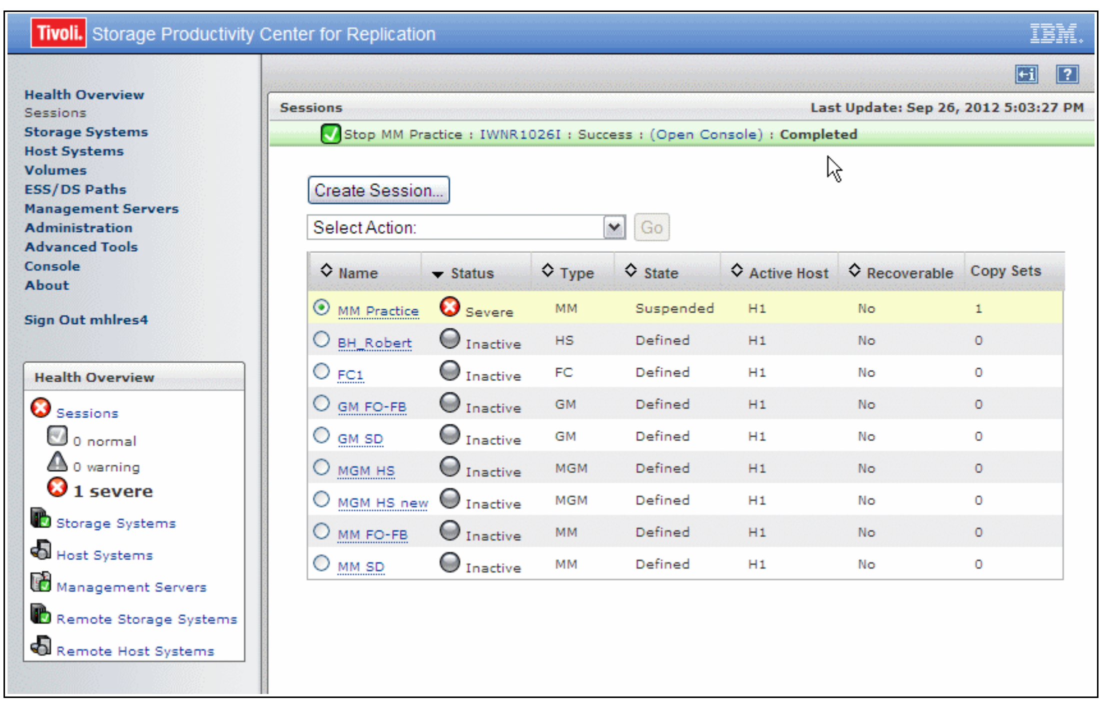

Figure 7-199 Stop Metro Mirror Session - Completed

After the Metro Mirror session is stopped, the following options are available:

Recover Makes target (secondary) volumes available for host access.

Release I/O Releases I/O to primary Metro Mirror volumes after Suspend event. This option is available only if the Metro Mirror session is created with **Hold I/O after Suspend** policy.

Start H1 → H2 Restarts copying from H1 to I2 volumes (if the Stop was issued with active H1 volumes), in Metro Mirror mode.

StartGC H1 → H2 Restarts copying from H1 to I2 volumes (if the Stop was issued with active H1 volumes), in Global Copy mode.

Start H2 → H1 Restarts copying from H2 to H1 volumes (if the Stop was issued with active H2 volumes), in Metro Mirror Mode.

StartGC H2 → H1 Restarts copying from H2 to H1 volumes (if the Stop was issued with active H2 volumes), in Global Copy mode.

Terminate Terminates the session.

7.6.11 Terminating a Metro Mirror session

The **Terminate** action breaks the Metro Mirror relationship between H1 and H2 volumes, thus terminating data replication. If you want H2 or H1 volumes, depending on the copy direction, to be data consistent before removing their relationship, you must issue the **`Suspend`** command, then the **`Recover`** command, and then the **`Terminate`** command. If you want to issue Start Metro Mirror session after it has been terminated, full copy will take place from H1 to H2, or from H2 to H1 volumes, depending on the copy direction. Follow these steps:

1. Select the Metro Mirror session radio button (MM Practice in our example as shown in Figure 7-200) and select the **Terminate** action from the **Select Action** pull-down menu. Click **Go** to continue. In our scenario, we terminated the session when the copy direction was from H1 volumes to I2 volumes.

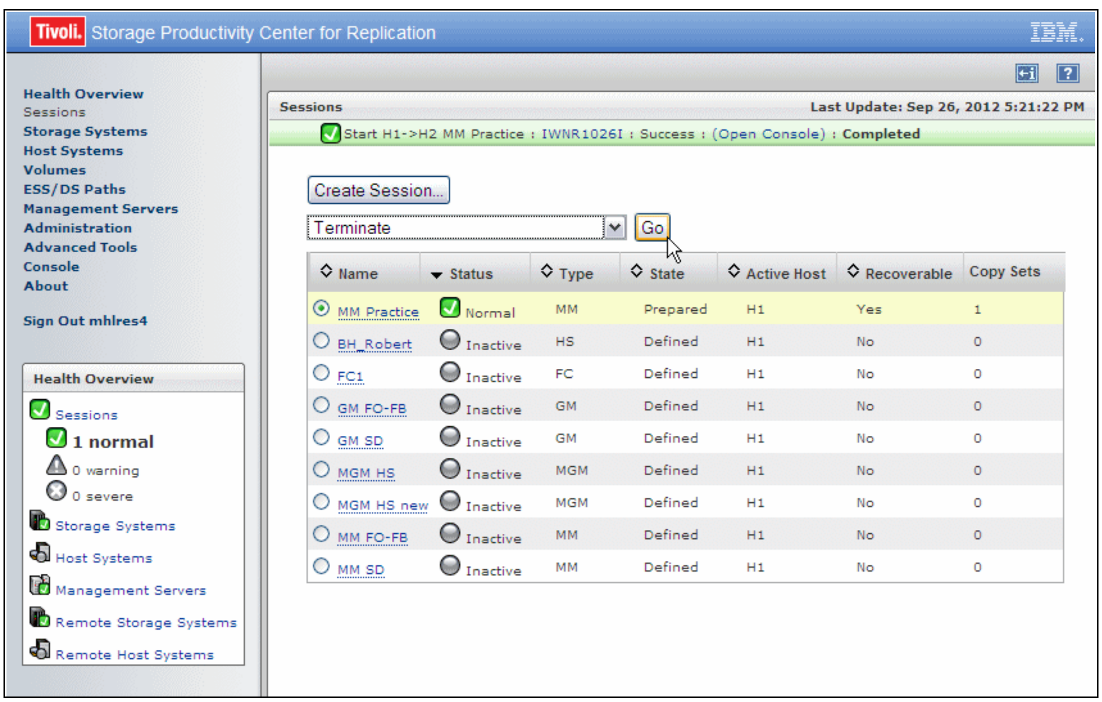

Figure 7-200 Metro Mirror session - Terminate action

2. The next message shown in Figure 7-201 is a warning that you are about to terminate a Metro Mirror relationship between H1 to H2 volumes. Note that if you require to start the very same Metro Mirror session again, a full copy from H1 to H2 volumes will be required. Click **Yes** to continue.

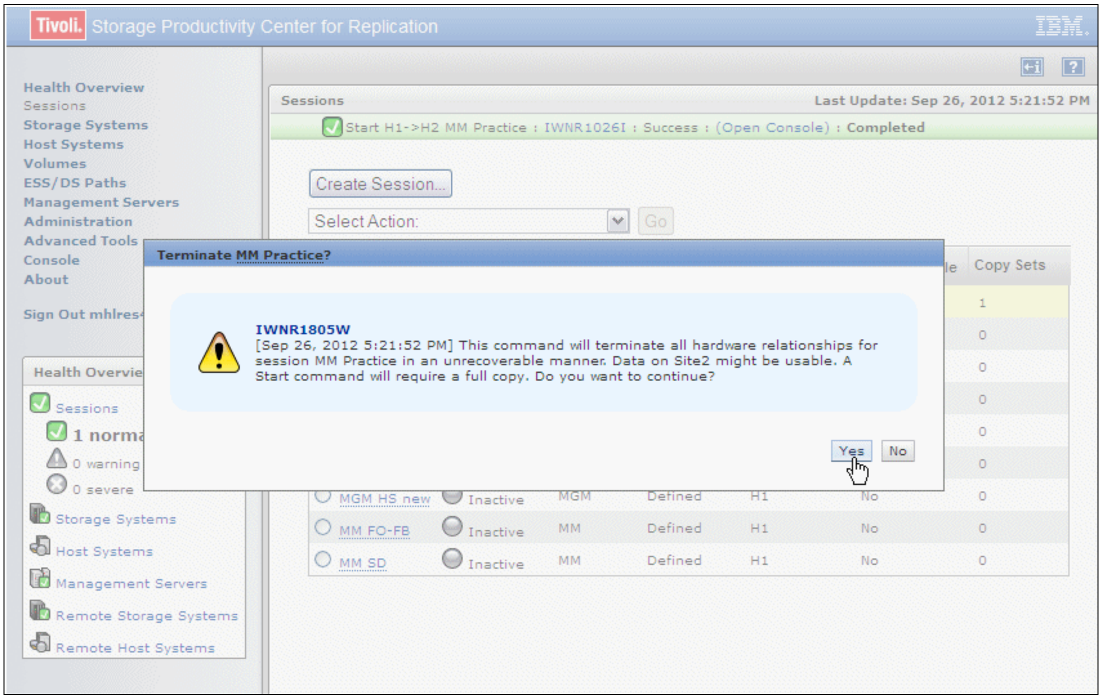

Figure 7-201 Terminate Metro Mirror session

3. There is a message at the top of the panel in Figure 7-202 indicating that a **Terminate** action has been successfully completed. The status of our Metro Mirror session is now *Inactive* and the state is *Defined*.

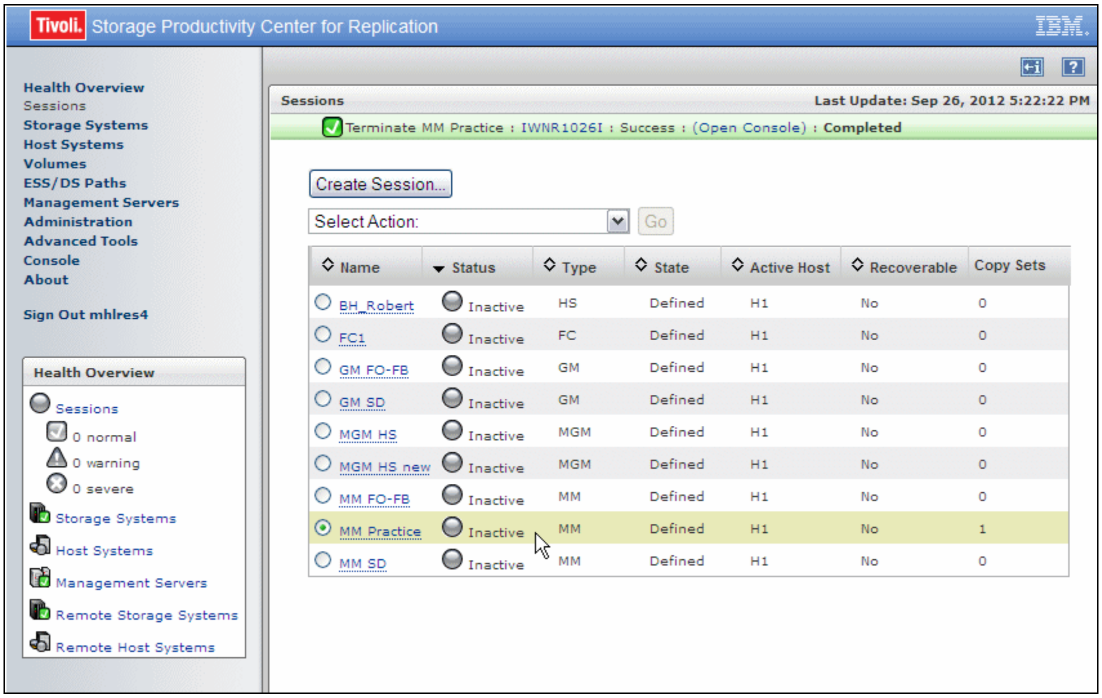

Figure 7-202 Terminate Metro Mirror session - Completed

After the Metro Mirror session is terminated, the following options are available:

Start H1 → H2 Starts copying from H1 to I2 volumes in Metro Mirror mode.

StartGC H1 → H2 Starts copying from H1 to I2 volumes in Global Copy mode.

7.7 Global Mirror Failover/Failback session using the GUI

You may create a session at any time after the server code is installed and up and running. Again, a session is only a token with a name and certain attributes assigned to this session. This is always the same approach independent on the session type. At this point you need to have storage subsystems defined to the Tivoli Storage Productivity Center for Replication server as described in “Adding IBM ESS or DS Storage Server to Tivoli Storage Productivity Center for Replication server” on page 137.

7.7.1 Creating a Global Mirror Failover/Failback session

Follow these steps to create a session:

1. Figure 7-203 shows that you always start from the *Navigation tree area* and click the hyperlink `Sessions`. This provides you with an overview of all defined sessions. At this point, there are no defined sessions. Click **Create Session** to continue.

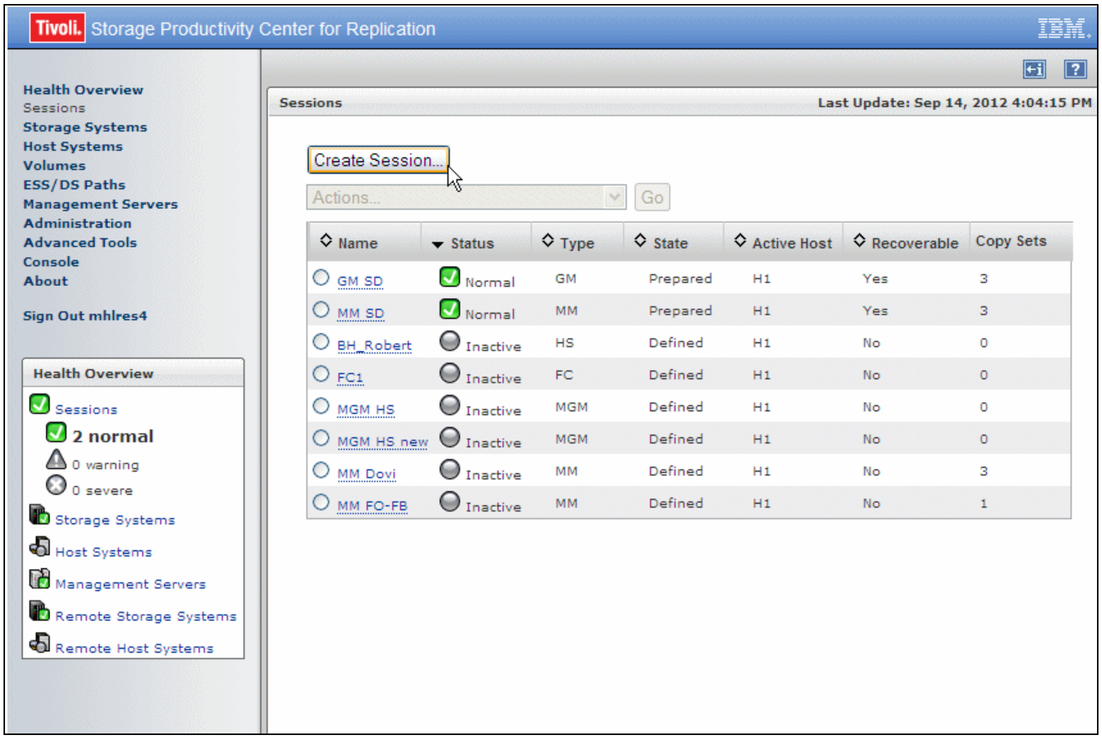

Figure 7-203 Creating a new session

2. Select the Hardware Type for the storage subsystems from the *Choose Hardware Type* pull-down menu. Select the **Global Mirror Failover/Failback** session from the Choose Session Type pull-down menu as shown in Figure 7-204 on page 403. On the right side, a pictograph symbolizes the involved sites and their volume types. H1 represents Site 1 volumes, H2 represents Site 2 volumes and J2 represent journal volumes used to restore data to the last consistency point. When you define Copy Sets, this pictograph helps you to orient and understand the replication direction. Click **Next** to continue.

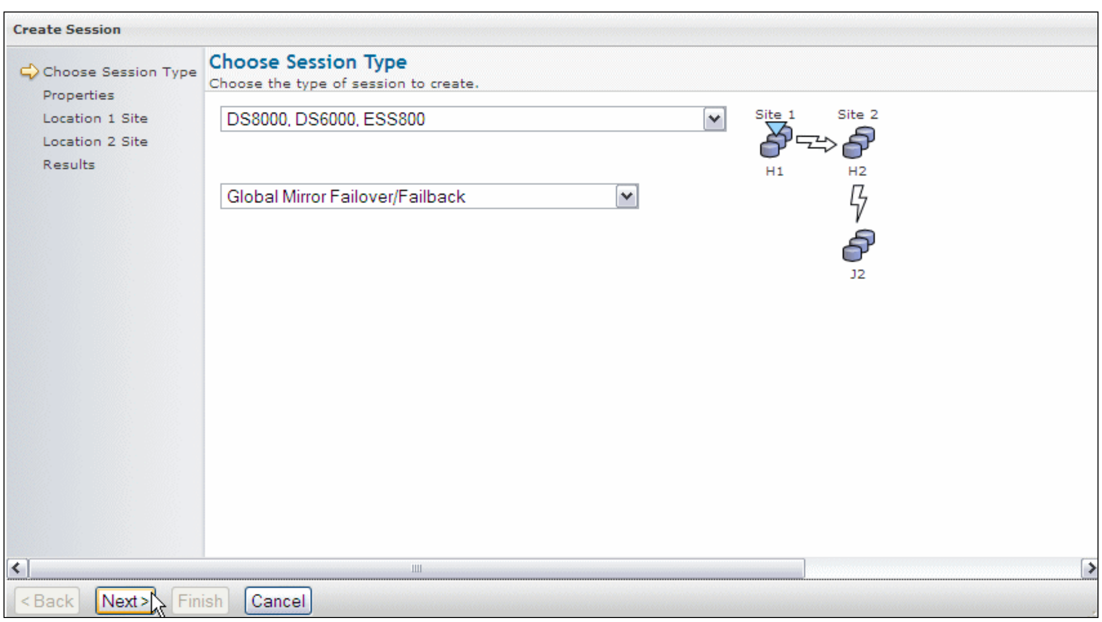

Figure 7-204 Define the Global Mirror FO/FB session

This leads us to the session Properties panel as Figure 7-205 shows.

The *Properties* panel is also important because it requires that you specify at least a name for the session which is about to be created. We choose the name GM FO-FB for our session. An optional *description* is desirable to understand the purpose of the session because the session name may not reveal what this session is intended for. Figure 7-205 on page 405 comments on the storage subsystems involved in this session. You may add a location of each storage server and a date when the session is created or changed.

The Properties panel allows you to specify some parameters to monitor and control the Global Mirror session. These parameters are described in the following paragraphs:

- Consistency Group interval time (sec):

  This value specifies how long to wait between the formation of the next Consistency Groups. This is specified in seconds, and the default is zero (0) seconds. Zero seconds means that Consistency Group formation happens constantly. As soon as a Consistency Group is successfully created, the process to create a new Consistency Group starts again immediately.

- Recovery Point Objective Alert:

  Specifies the length of time that you want to set for the recovery point objective (RPO) thresholds. The values determine whether a Warning or Severe alert is generated when the RPO threshold is exceeded for a role pair. The RPO represents the length of time in seconds of data exposure that is acceptable in the event of a disaster. The thresholds are specified in the following way:

  – *Warning level threshold (seconds):* when the RPO is greater than this value, you want an alert to be generated.

  – *Severe level threshold (seconds):* when RPO is greater than this value, an alert is also generated, and the session status changes to Severe.

- Fail MM/GC if the target is online (CKD only):

  This option ensures that all target (secondary) volumes in a Global Mirror session are offline and not visible to any host, otherwise the create session task will fail. This applies to CKD volumes only. Use this option since target (secondary) volumes in a Global Mirror session should be offline to all hosts.

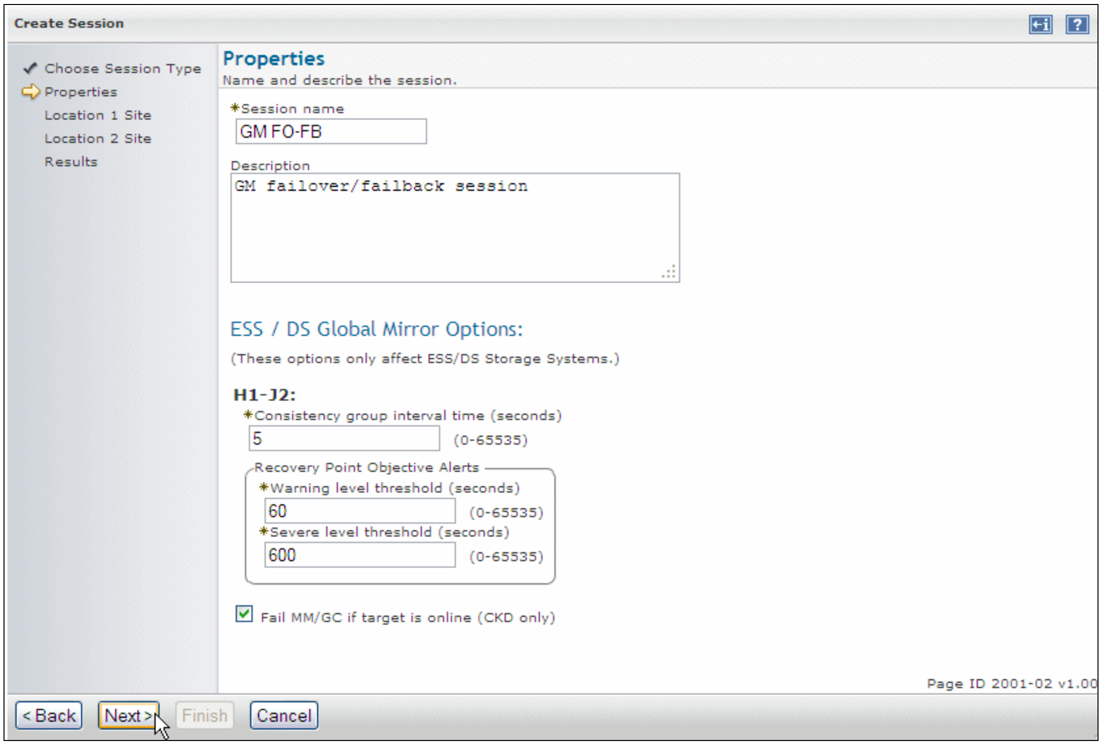

Figure 7-205 Define Global Mirror session Properties

3. From the pull-down **Site 1 Location** menu (see Figure 7-206), select the location of your H1 storage subsystem and click **Next** to continue.

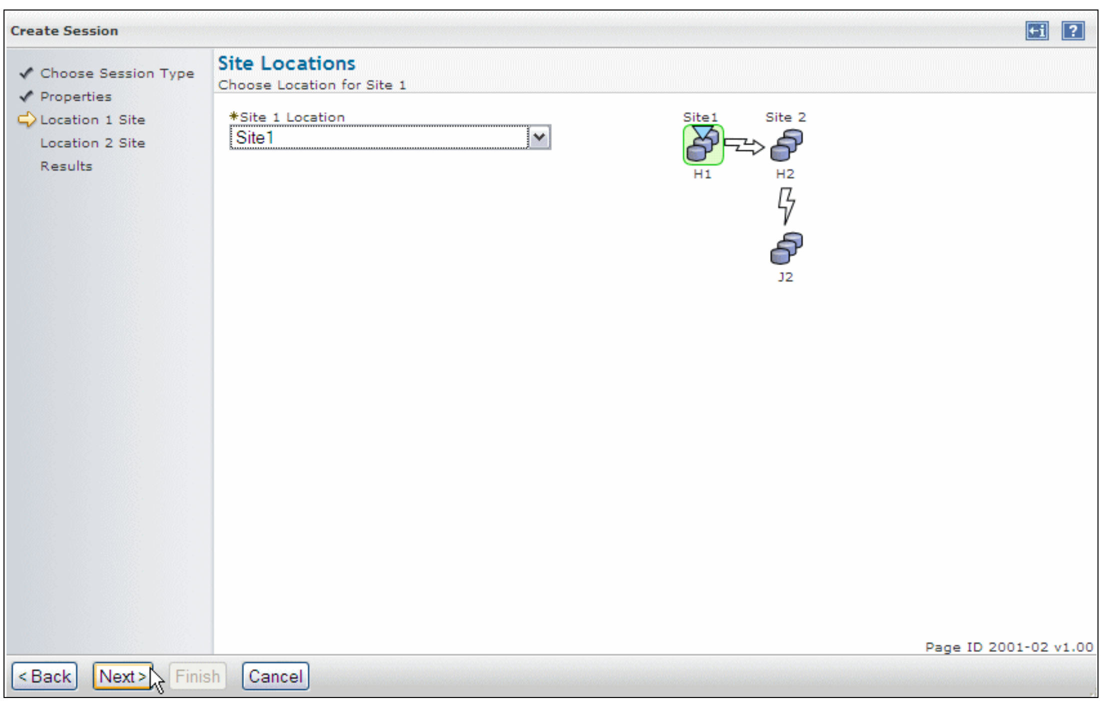

Figure 7-206 Define Global Mirror session Site 1 Location

4. From the pull-down **Site 2 Location** menu (see Figure 7-207), select the location of your H2 storage subsystem and click **Next** to continue.

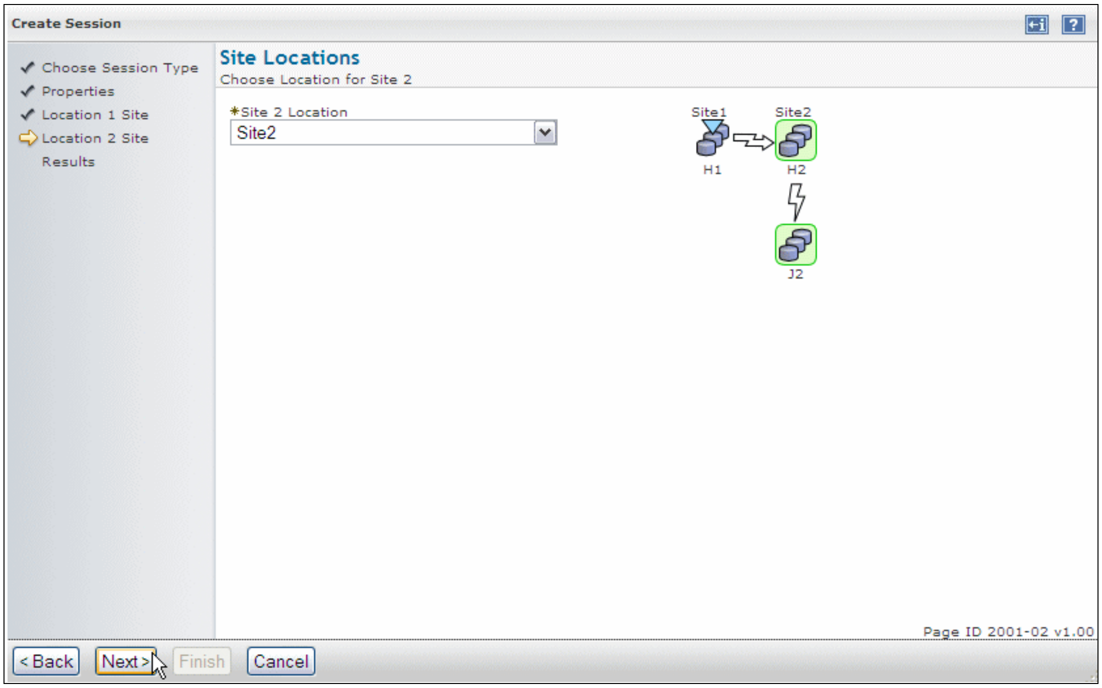

Figure 7-207 Define Global Mirror session Site 2 Location

5. Figure 7-208 displays the message that the GM FO-FB session was successfully created. Click **Finish** to exit the *Create Session* wizard. Alternatively, you have an option to add Copy Sets and click **Launch Add Copy Sets Wizard** and follow the instructions described in 7.7.2, "Adding Copy Sets to a Global Mirror Failover/Failback session" on page 407.

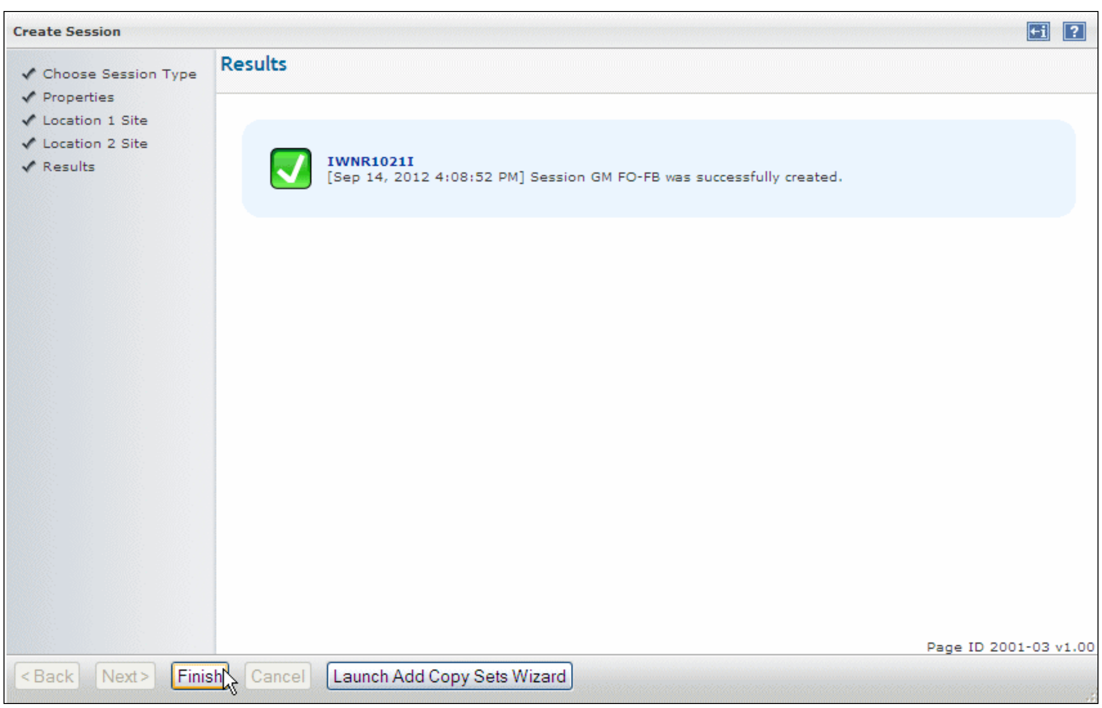

Figure 7-208 Define Global Mirror session - Results

7.7.2 Adding Copy Sets to a Global Mirror Failover/Failback session

After we have defined the Global Mirror Failover/Failback session GM FO-FB, we can populate this session in the next step with Copy Sets. Global Mirror Copy Set consists of one H1, one H2, and one J2 Global Mirror volume.

Figure 7-209 shows the session overview panel with the GM FO-FB session that we defined previously. The next logical action that you perform on GM FO-FB session is to add Copy Sets to it. Follow these steps:

1. Select your Global Mirror session name radio button (GM FO-FB in our example) and choose **Add Copy Sets** from the **Select Action** pull-down menu. Click **Go** to invoke the *Add Copy Sets* wizard.

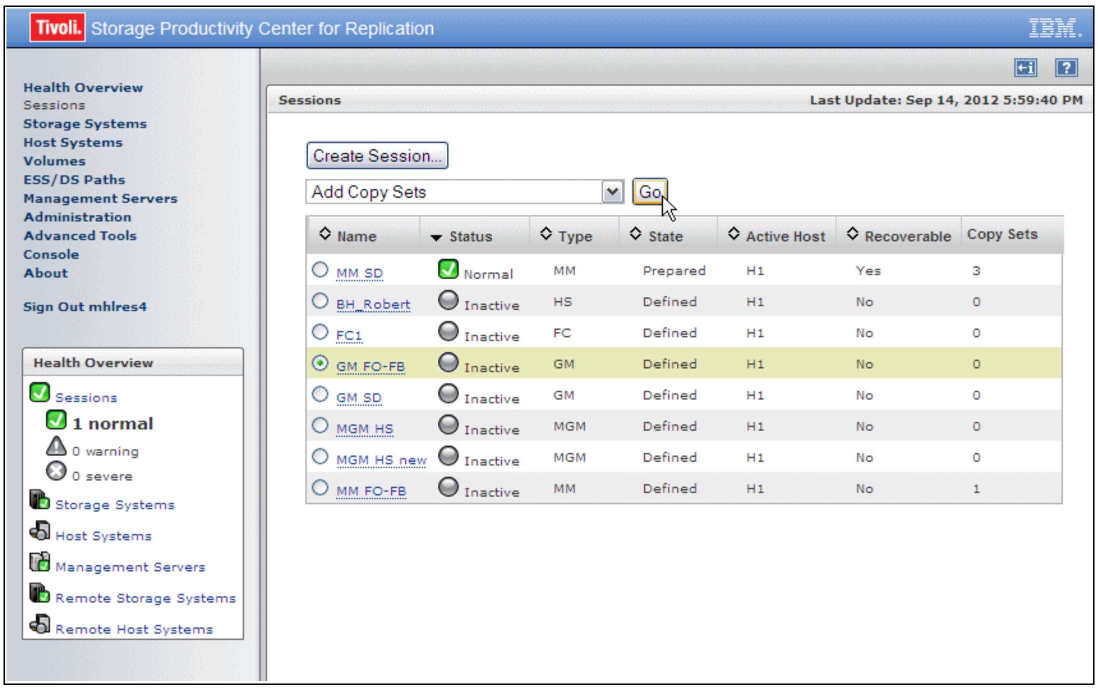

Figure 7-209 Add Copy Sets to Global Mirror FO/FB session

Note that over time, various terminology is introduced for the same thing. Peer-to-Peer Remote Copy or PPRC (today known as Metro Mirror and Global Mirror) started out with primary volumes and secondary volumes. This terminology was fine for a 2-site solution. With the arrival of switching sites from an application viewpoint as well as for the storage subsystem used, Tivoli Storage Productivity Center for Replication introduced a different terminology for these PPRC volumes and their association to a certain site.

Host 1 or Site 1 refers to the primary volumes as a starting point. This may also be the local site or application site. It may always be considered as the customer primary site. But it has the potential to change. A customer may want to switch application sites from Host 1 to Host 2 in Site 2 and also switch at the same time the Copy Services role of the associated storage subsystems. This led to Host 1, Site 1 volumes and Host 2, Site 2 volumes terminology being used in Tivoli Storage Productivity Center for Replication. In Global Mirror session there are journal volumes J2 used to restore data to the last consistency point and they are located at Site 2.

2. Figure 7-210 displays the panel which provides details on the primary volumes or local volumes which are called Host 1 volumes relating to the fact that these volumes reside in the Site 1 or application site or local site. These are all synonyms and refer to the same environment. Select the desired **Host 1 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Host 1 logical storage subsystem** list. Select the LSS where your H1 volumes resides. After the LSS has been selected, choose the appropriate volume from the **Host 1 volume** pull-down list or select **All Volumes**.
3. The alternative way to add a large number of volumes to this session is to create CSV file as explained in "Using CSV files for importing and exporting sessions" on page 194. In case you have a CSV file ready, select **Use a CSV file to import copy sets** check box and provide a path to your CSV file. Click **Next** to continue.

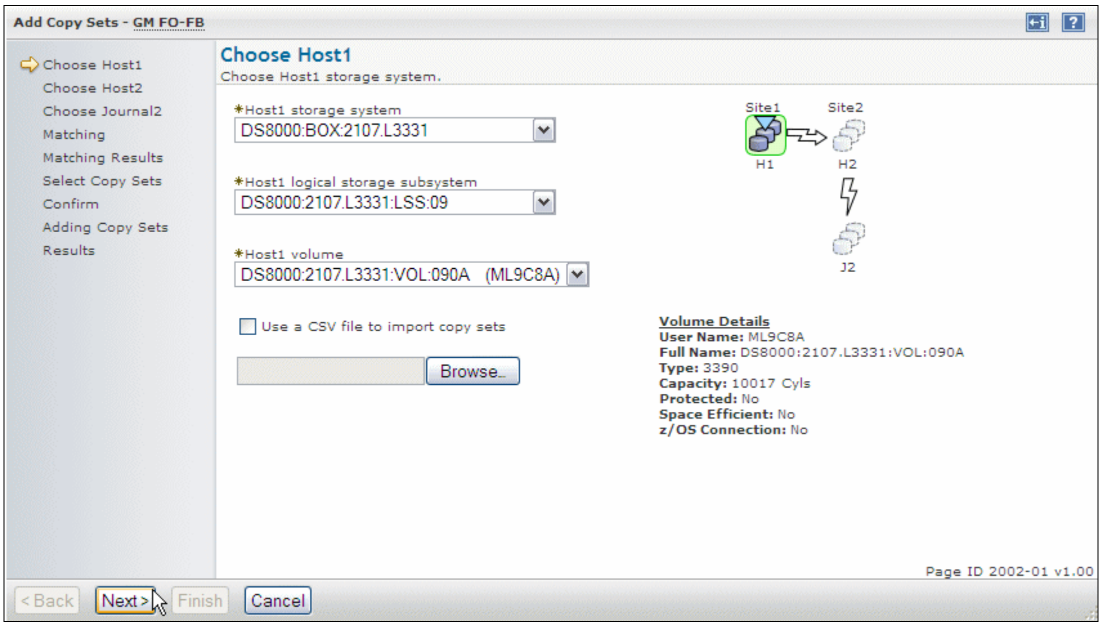

Figure 7-210 Add Copy Sets to Global Mirror FO/FB session - Choose Host 1

4. The next step is to define Site 2 storage subsystems and volumes as shown in Figure 7-211. Select the desired **Host 2 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Host 2 logical storage subsystem** list. Select the LSS where your H2 volume resides. If you selected **All volumes** for a given LSS in the previous step while defining Host 1 volumes, you do not have an option to select any volume from **Host 2 volume** list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 1 storage subsystem with all volumes from selected LSS in Host 2 storage subsystem. Click **Next** to continue.

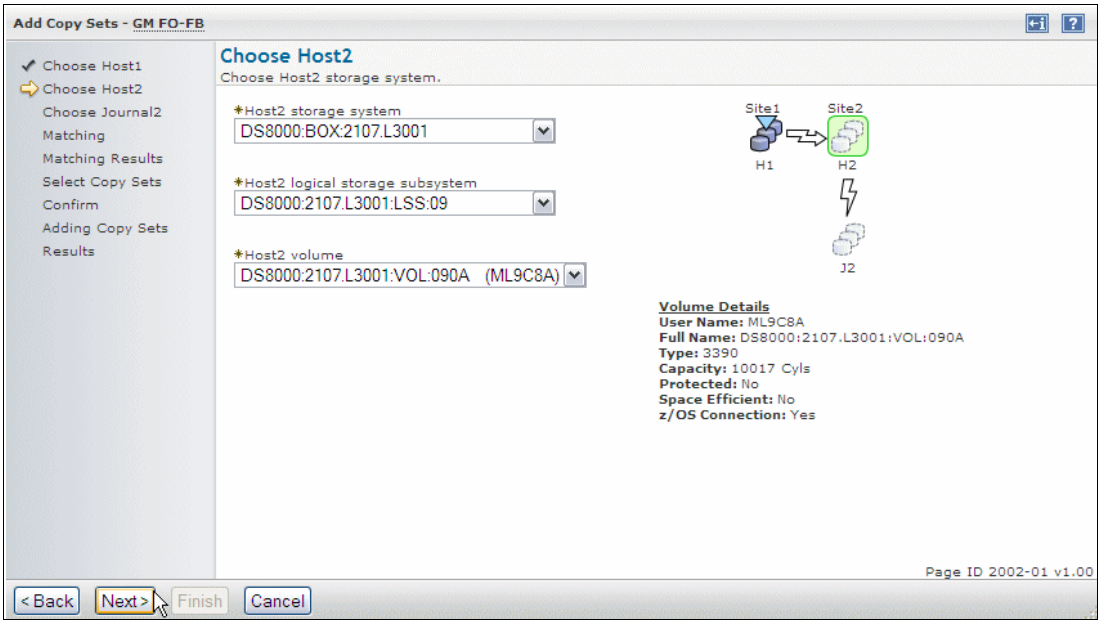

Figure 7-211 Add Copy Sets to Global Mirror FO/FB session - Choose Host 2 volumes

5. In order to complete Global Mirror Copy Set definition, we need to define J2 journal volume as shown in Figure 7-212 on page 409. Select the desired **Journal 2 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Journal 2 logical storage subsystem** list. Select the LSS where your J2 volume resides. If you selected **All volumes** for a given LSS in the previous step while defining Host 1 and Host 2 volumes, you do not have an option to select any volume from **Journal 2 volume** list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 2 storage subsystem with all volumes from selected LSS in Journal 2 storage subsystem. Click **Next** to continue.

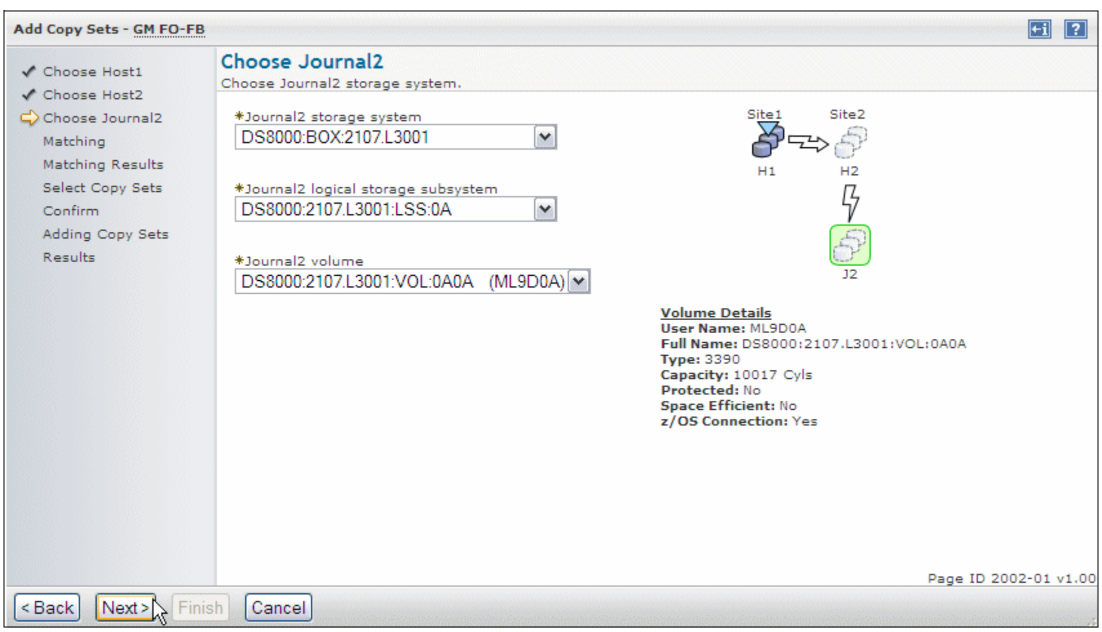

Figure 7-212 Add Copy Sets to Global Mirror FO/FB session - Choose Journal 2 volumes

6. The next panel in Figure 7-213 shows the Copy Set that you are about to add. If you need to add more Copy Sets to this session, just click **Add More**. After you have chosen all Copy Sets that you need, click **Next**.

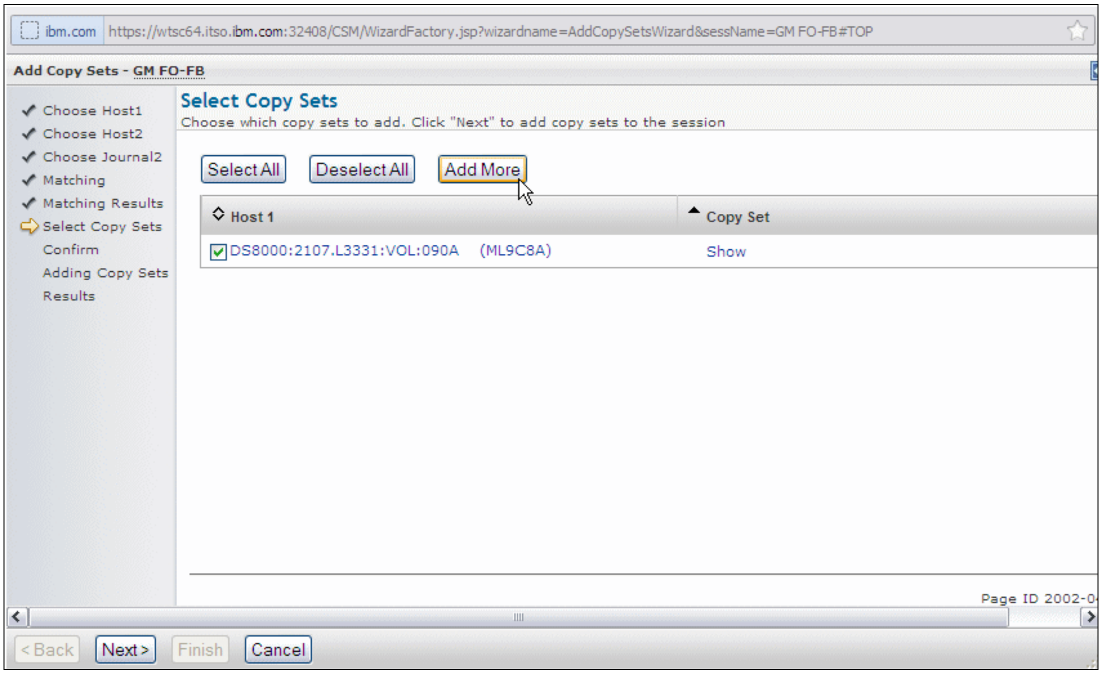

Figure 7-213 Add More Copy Sets

7. The next panel displays the number of Copy Sets that are going to be created. Click **Next** to continue.

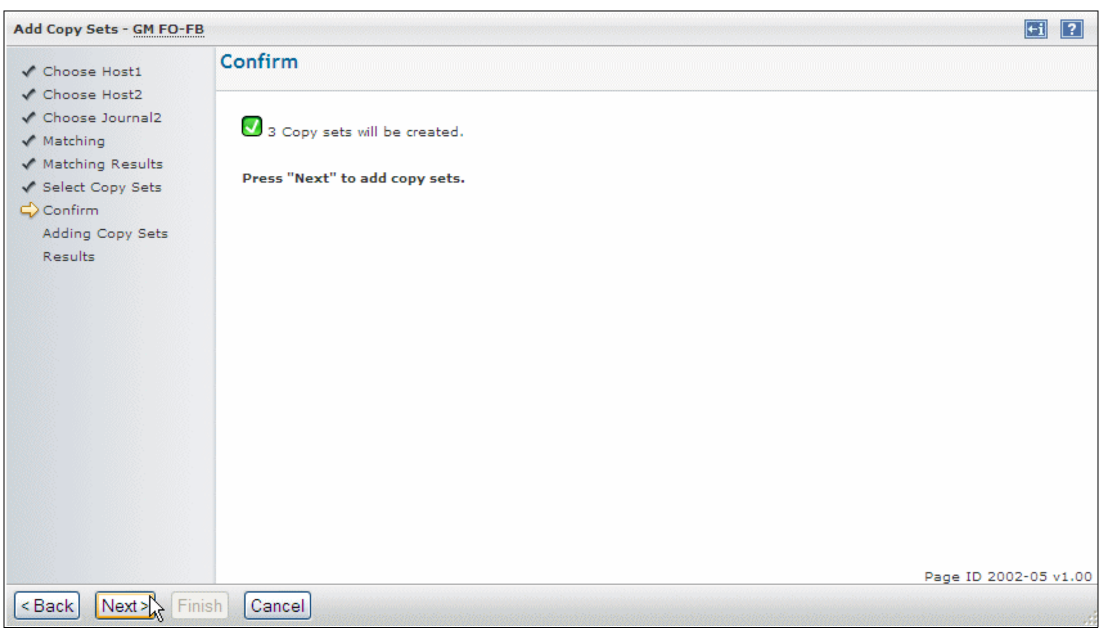

Figure 7-214 Add Copy Sets to Global Mirror FO/FB session - Confirm

8. Tivoli Storage Productivity Center for Replication internally adds Copy Sets to its database. Note that this does not start a Global Mirror relationship between H1, H2, and J2 volumes. It is just a Tivoli Storage Productivity Center for Replication internal process to add these Copy Sets to the Tivoli Storage Productivity Center for Replication inventory database.
9. After a few seconds, Tivoli Storage Productivity Center for Replication shows the Results panel, as shown in Figure 7-215. Click **Finish** to exit the *Add Copy Sets* wizard.

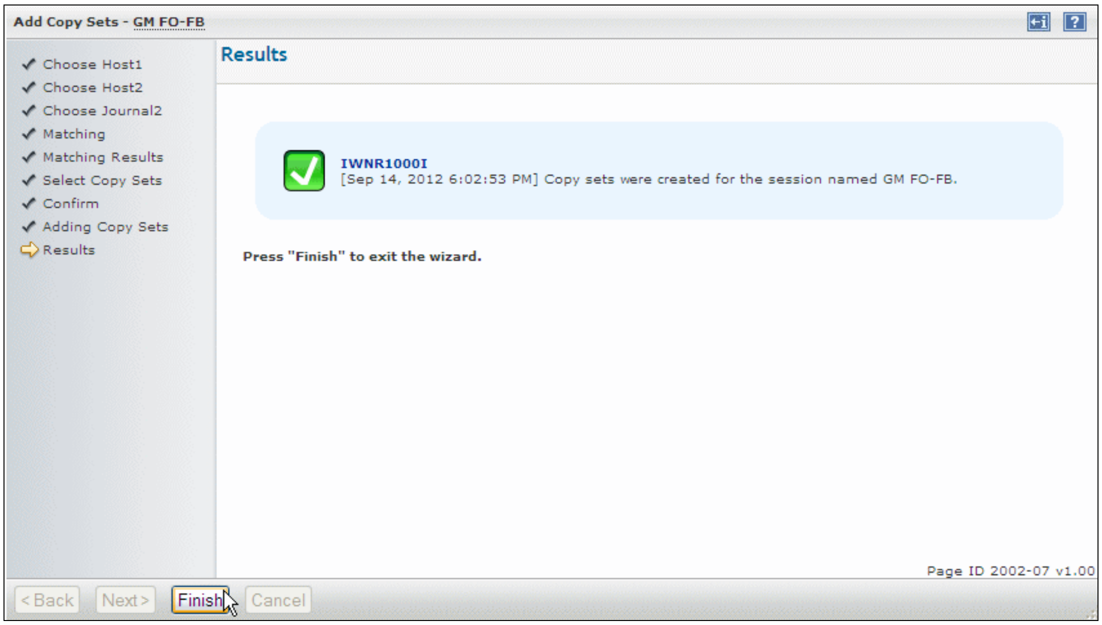

Figure 7-215 All Copy Sets are successfully added to the Tivoli Storage Productivity Center database

This concludes the steps through the GUI when you add Copy Sets to a Global Mirror session.

7.7.3 Starting a Global Mirror session

After we have defined a Global Mirror session and populated the session with Copy Sets, we can start the Global Mirror session by selecting either one of the following options:

Start H1 → H2 This starts the Global Mirror session.
StartGC H1 → H2 This starts only Global Copy replication between H1 and H2 volumes.

You can choose the **StartGC H1 → H2** action if you plan to start the replication between H1 and H2 volumes while a lot of write activity is going on the H1 volumes (the batch window, for example), and you have limited network connectivity between your storage boxes in Site1 and Site2. After the copying between H1 and volumes reaches 100%, you can perform the **Start H1 → H2** action, in order for your session to begin forming consistency groups. Follow these steps:

1. Figure 7-216 displays the GM FO-FB session as we defined it previously. From the **Select Action** pull-down menu, select **Start H1** → **H2** and click **Go**.

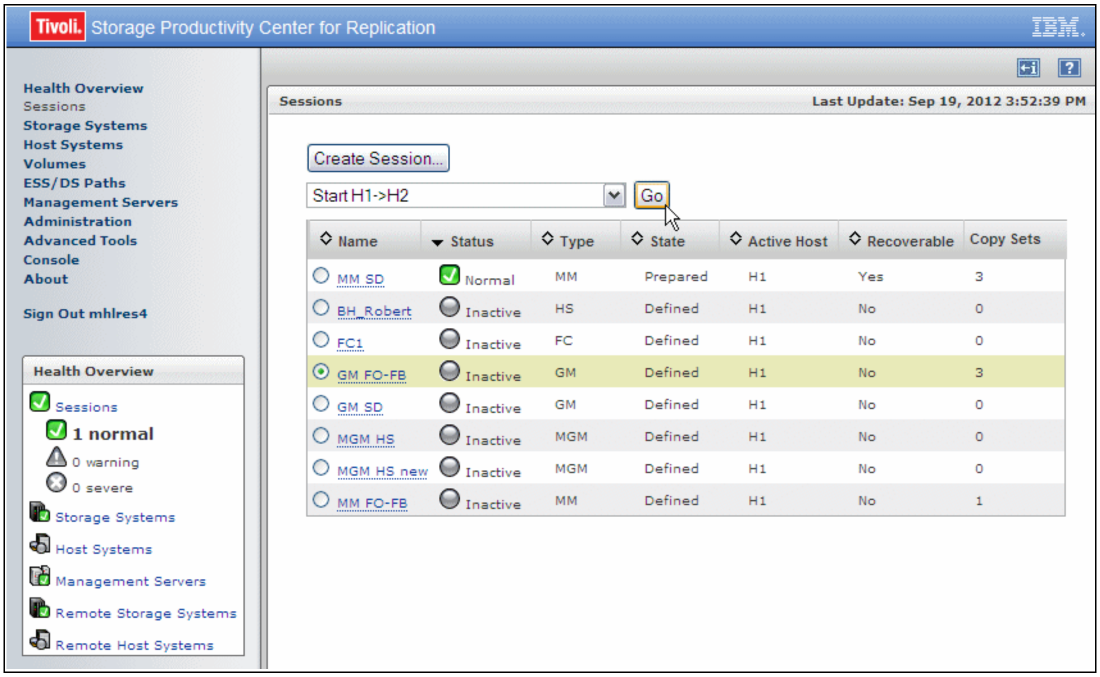

Figure 7-216 Global Mirror session - Start Action

2. The next message shown in Figure 7-217 is a warning that you are about to initiate a Global Mirror session. It will start copying of data from Host 1 to Host 2 volume defined previously by adding data set, thus overwriting any data on Host 2 volume. Furthermore, it will initiate a FlashCopy to J2 journal volume. Click **Yes** to continue.

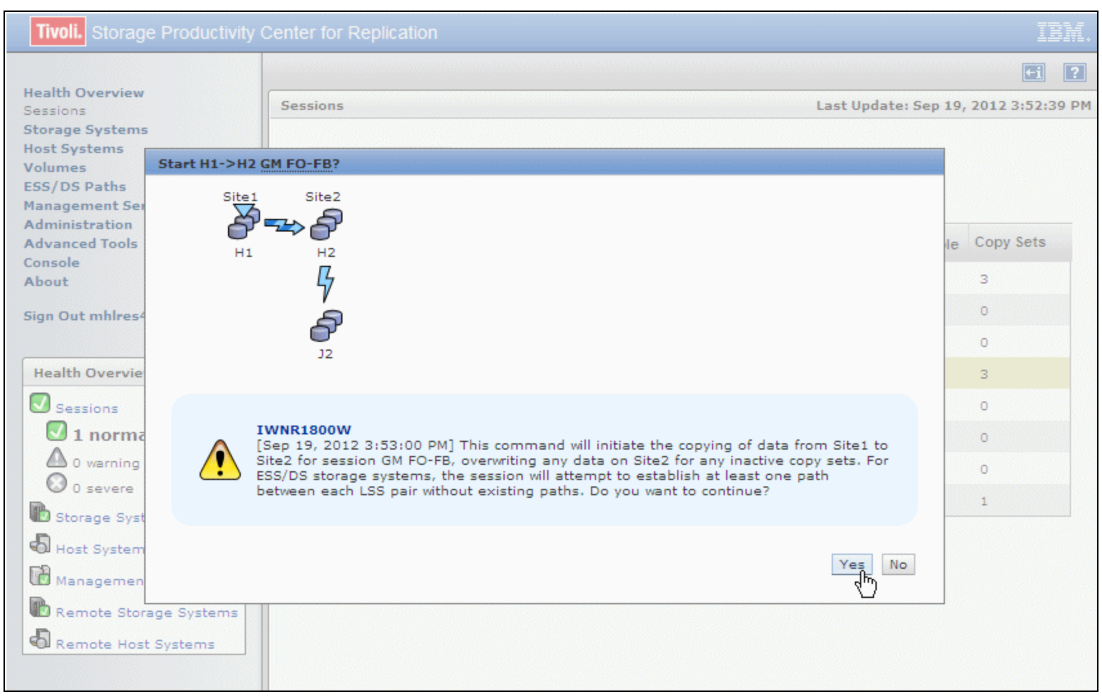

Figure 7-217 Start Global Mirror FO/FB session

3. The message at the top of the panel in Figure 7-218 confirms that Global Mirror session is started. The session is in *Preparing* state and *Warning* status. Click the session name hyperlink (*GM FO-FB* in our example) to find more details on this session.

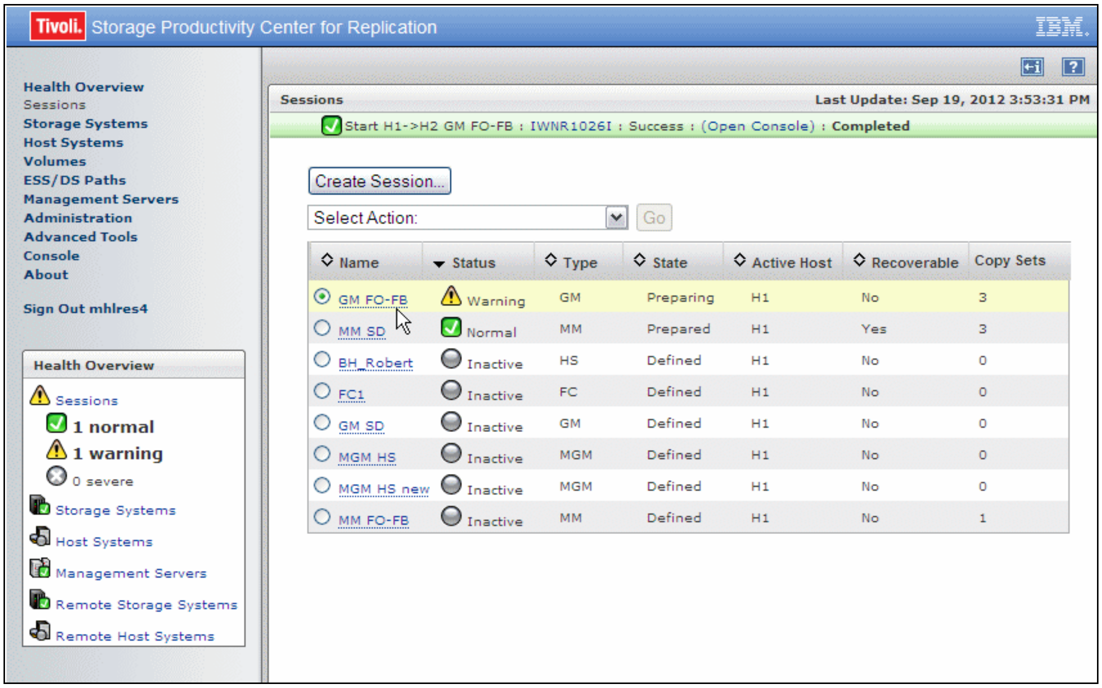

Figure 7-218 Start Global Mirror session is reported as Completed

4. As shown in Figure 7-219, the Global Mirror session has a *Warning* status. The session is still in *Preparing* state since the copying data between H1 and H2 volumes is still in progress.

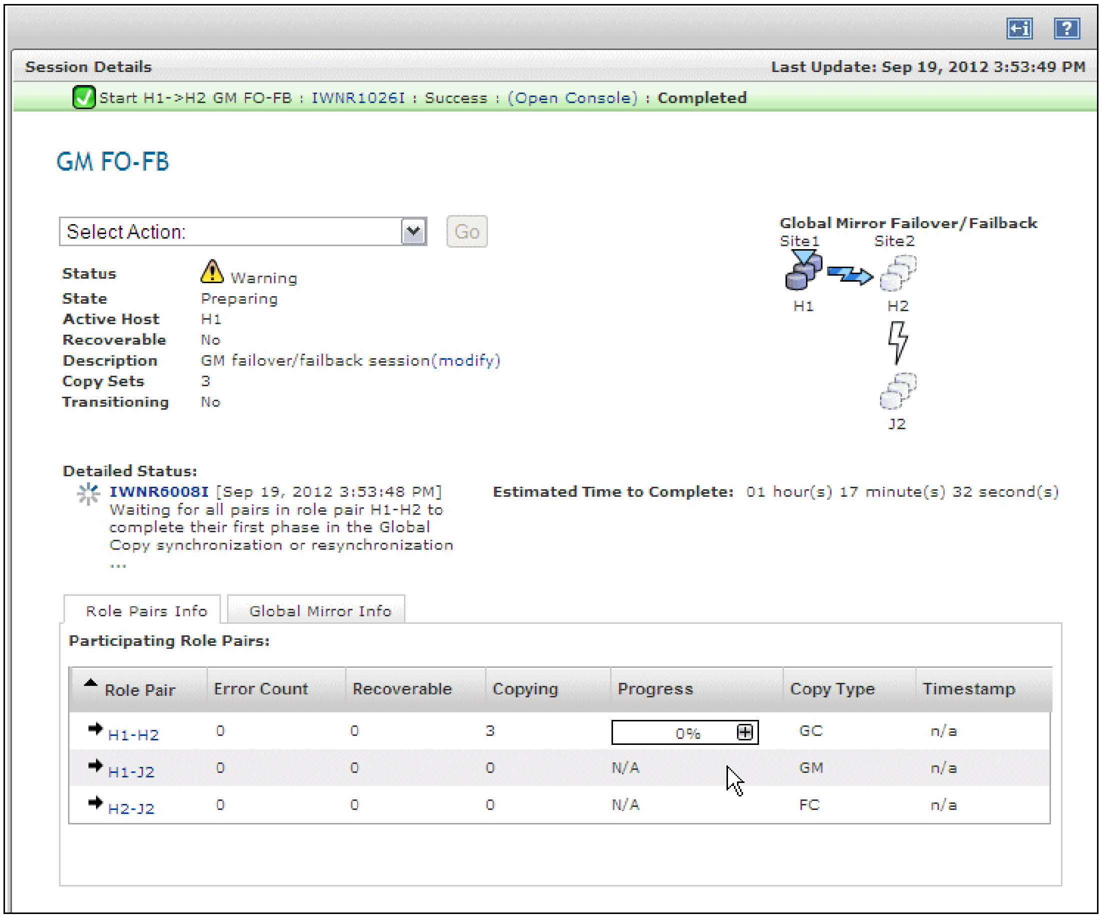

Figure 7-219 Global Mirror session details

5. Wait until the session changes to *Normal* status as shown in Figure 7-220. It means that the initial copy has finished and the first consistency group has been created.

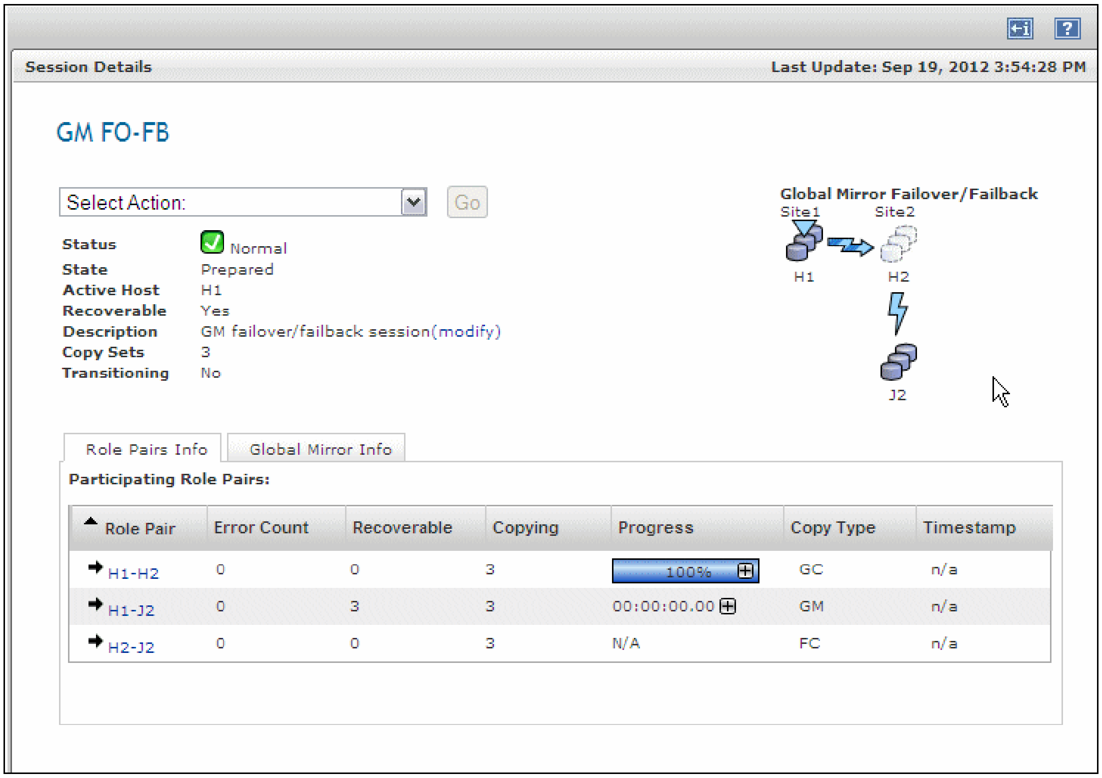

Figure 7-220 Global Mirror session is now forming consistency groups

After the Global Mirror Failover/Failback session is started and it has *Normal* status and is in *Prepared* state, the following options are available:

Start H1 → H2 Restarts Global Mirror session.

Suspend Suspends replication between H1 and H2 volumes.

Terminate Terminates the session (under *Cleanup* submenu).

7.7.4 Suspending a Global Mirror session

Now that the volumes of the Copy Set are in Global Mirror session and *Prepared* state and *Normal* status, we can initiate different actions against the Global Mirror session. One of them is **Suspend**. Follow these steps:

1. From the **Sessions** panel, select your Global Mirror session radio button, select **Suspend** from the **Action** pull-down list, and click **Go** as shown in Figure 7-221.

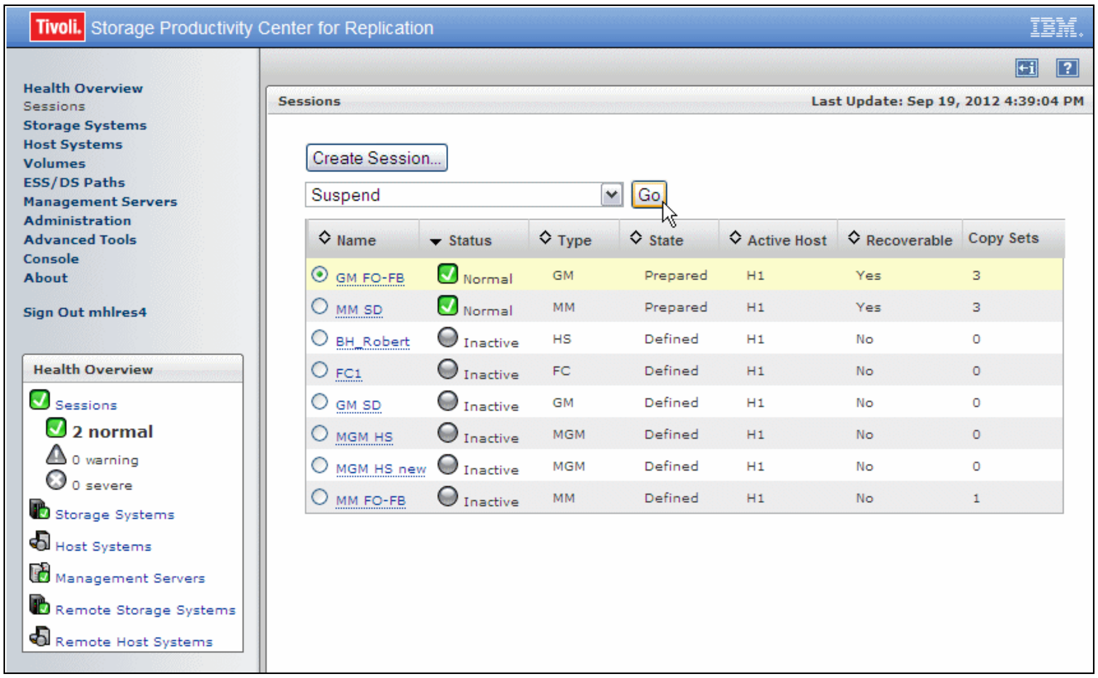

Figure 7-221 Global Mirror session - Suspend Action

2. The next message shown in Figure 7-222 is a warning that you are about to Suspend Global Mirror session. Click **Yes** to continue.

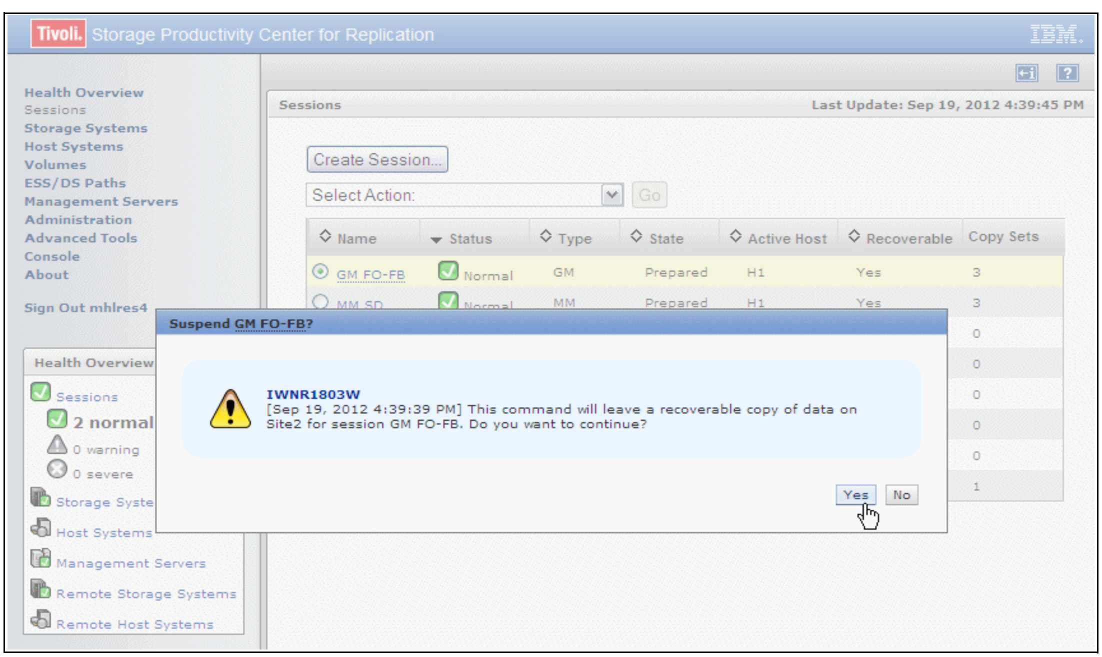

Figure 7-222 Suspend Global Mirror session

3. The status of our Global Mirror session has changed from *Normal* to *Severe* status indicating that data is not replicated anymore between Host 1 and Host 2 volumes. The state of the session is *Suspended* as indicated in Figure 7-223.

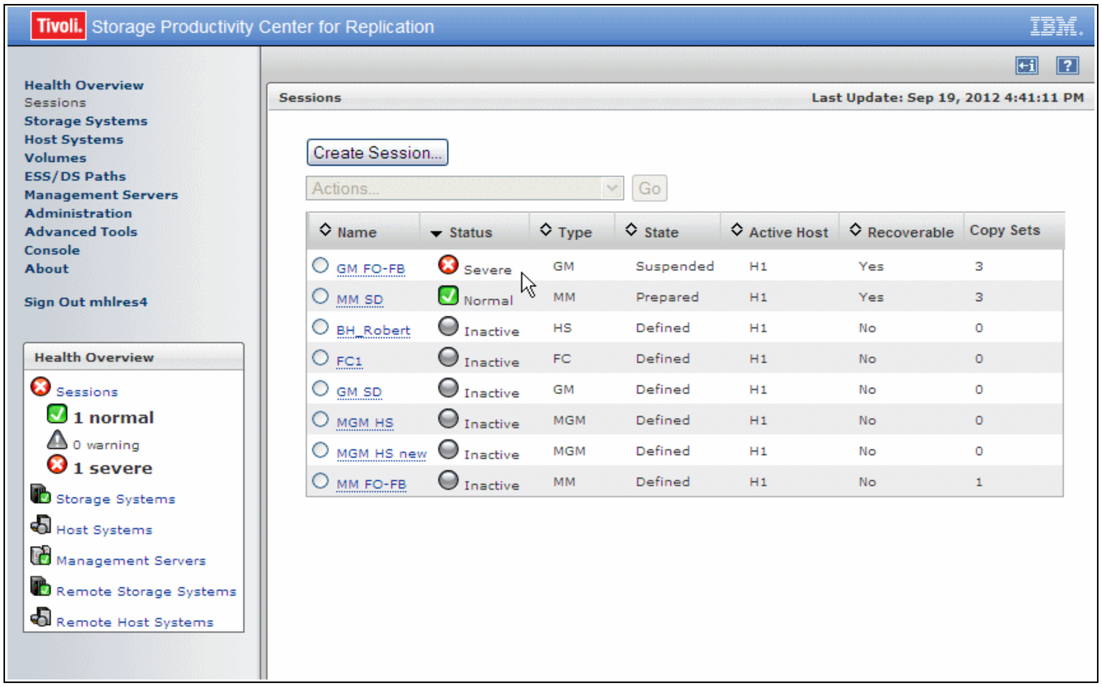

Figure 7-223 Suspend Global Mirror session is reported as Completed

Start H1 → H2 Restarts the session.

StartGC H1 → H2 Starts Global Copy between H1 and H2 volumes.

Recover Makes H2 volumes available for host access.

Terminate Terminates the session (under *Cleanup* submenu).

7.7.5 Recovering a Global Mirror session

After the Global Mirror session and its associated Copy Sets have been suspended, we can initiate a **Recover** action. Follow these steps:

1. Select the Global Mirror session radio button (GM FO-FB in our example shown in Figure 7-224) and a **Recove**r action from the **Select Action** pull-down menu. Click **Go** to continue.

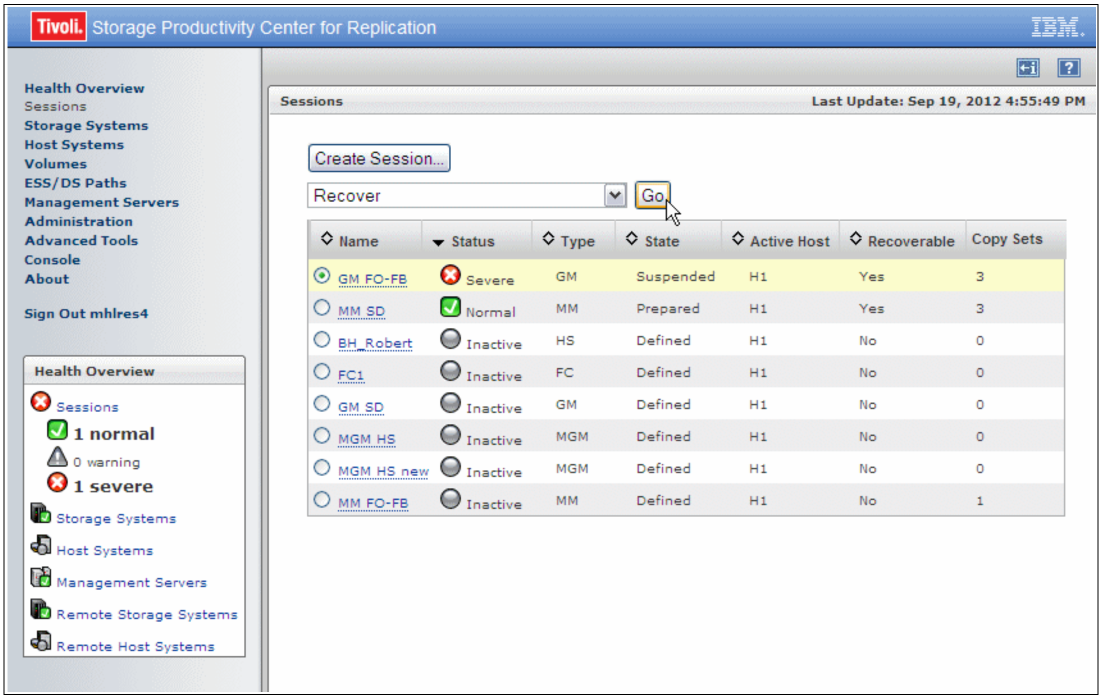

Figure 7-224 Global Mirror session - Recover action

2. The next message shown in Figure 7-225 is a warning that you will allow H2 volumes to be available to your host. Click **Yes** to continue.

> **Note:** Before executing the **Recover** action, H1 volumes must be offline for your application systems.

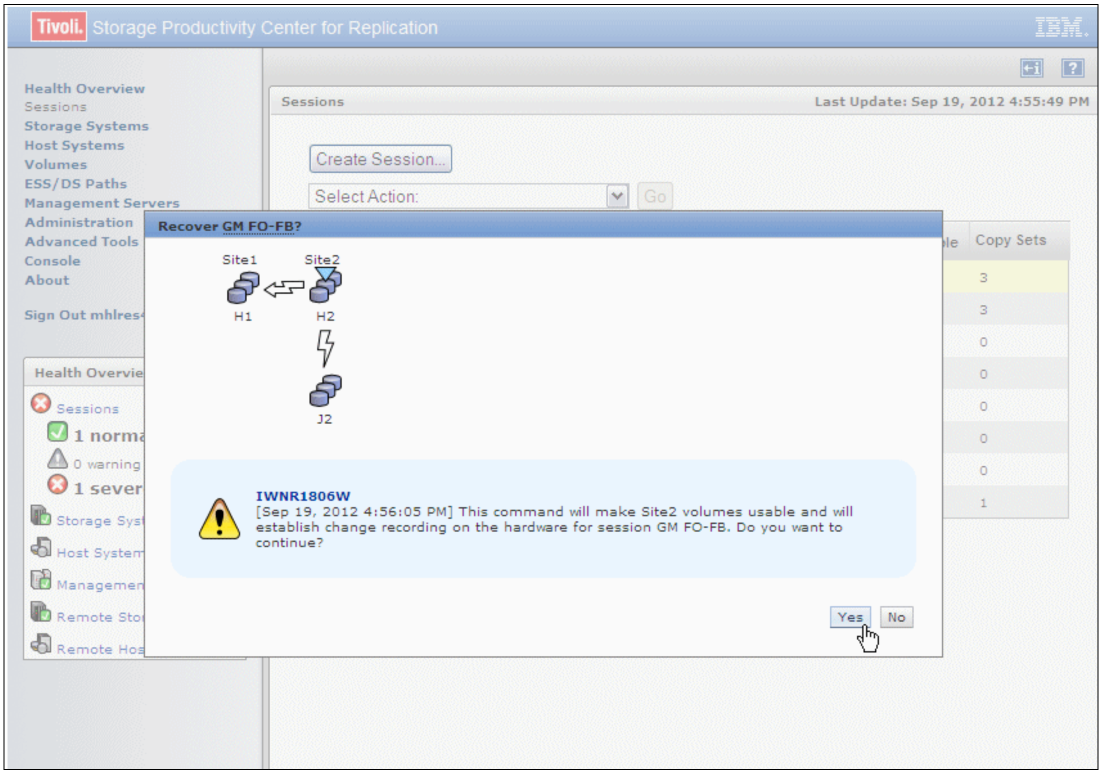

Figure 7-225 Recover Global Mirror session

3. There is a message at the top of the panel in Figure 7-226 indicating that a **Recover** action has been successfully completed. The status of our Global Mirror session is *Normal* and the State is *Target Available*, indicating that H2 volume is available to your systems.

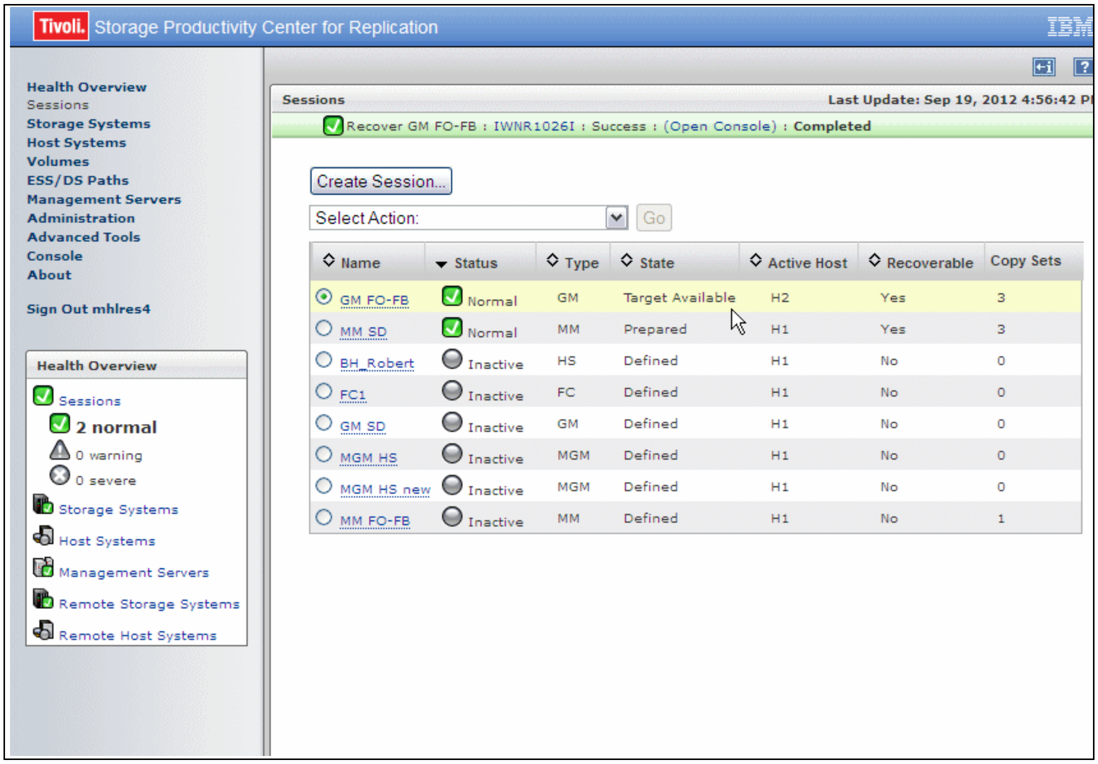

Figure 7-226 Global Mirror session - H2 storage subsystem volume available to systems

After the Global Mirror session is recovered in *Target Available* state, the following options are available:

Start H1 → H2 Restarts the Global Mirror session.

StartGC H1 → H2 Starts Global Copy between H1 and H2 volumes.

Enable Copy to Site 1 Before reversing the direction of copying in a failover and failback session, you must run this command, and confirm that you want to reverse the direction of replication. It enables **Start H2 → H1** command.

Terminate Terminates the session (under *Cleanup* submenu).

7.7.6 Enabling Copy to Site 1

After a **Recover** action, Host 2 volumes are active (assuming H1 to H2 replication direction). As the Host 2 site is now the active site you can reverse direction of copying in a Global Mirror Failover/Failback session. Follow these steps:

1. Before you can initiate copying from Host 2 to Host 1 volumes, you need to start the **Enable Copy to Site 1** command. To achieve this, from the **Select Action** pull-down menu, select **Enable Copy to Site 1**, and click **Go** as shown in Figure 7-227.

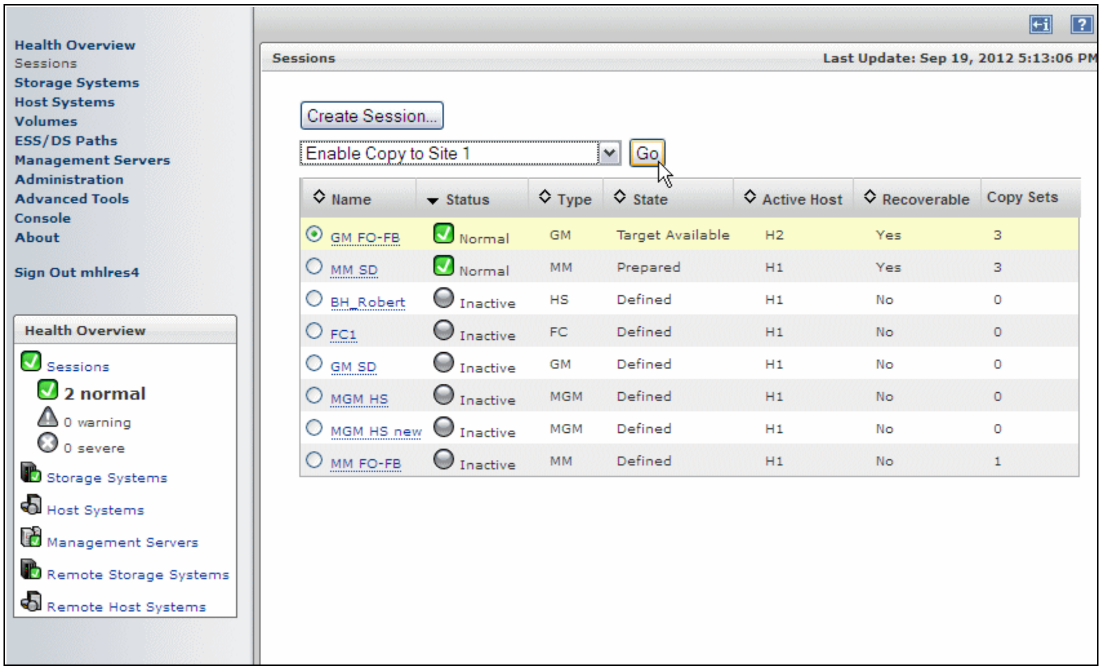

Figure 7-227 Global Mirror session - Enable Copy to Site 1

2. The next message shown in Figure 7-228 is a warning that you are about to enable the command that initiates copying data from H2 to H1 volumes. This command is disabled to protect against accidentally copying over production data. Ensure that all of the volumes in this session located at Site 1 are not being used by any application prior to enabling the command that allows copying data to Site 1. Click **Yes** to continue.

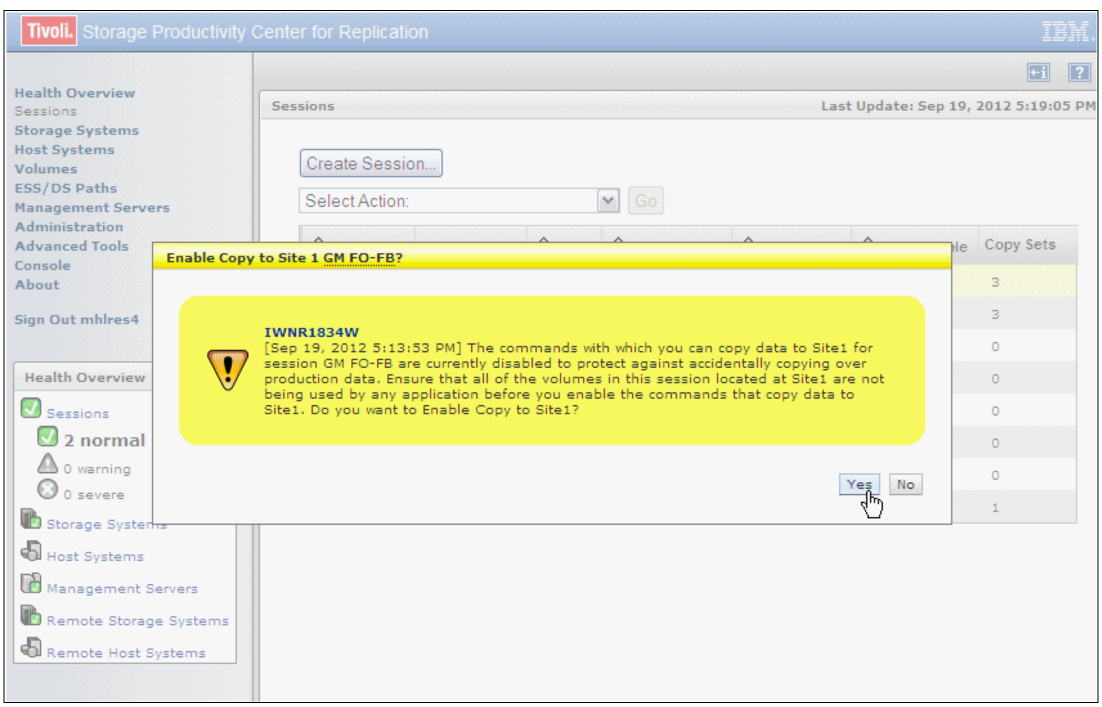

Figure 7-228 Enable Copy to Site 1

3. The message at the top of the panel in Figure 7-229 confirms that the Enable Copy to Site 1 command is completed. The status of our Global Mirror session is the same as it was after **Recover** command, *Normal* status and *Target Available* state, indicating that H2 volume is available to your host.

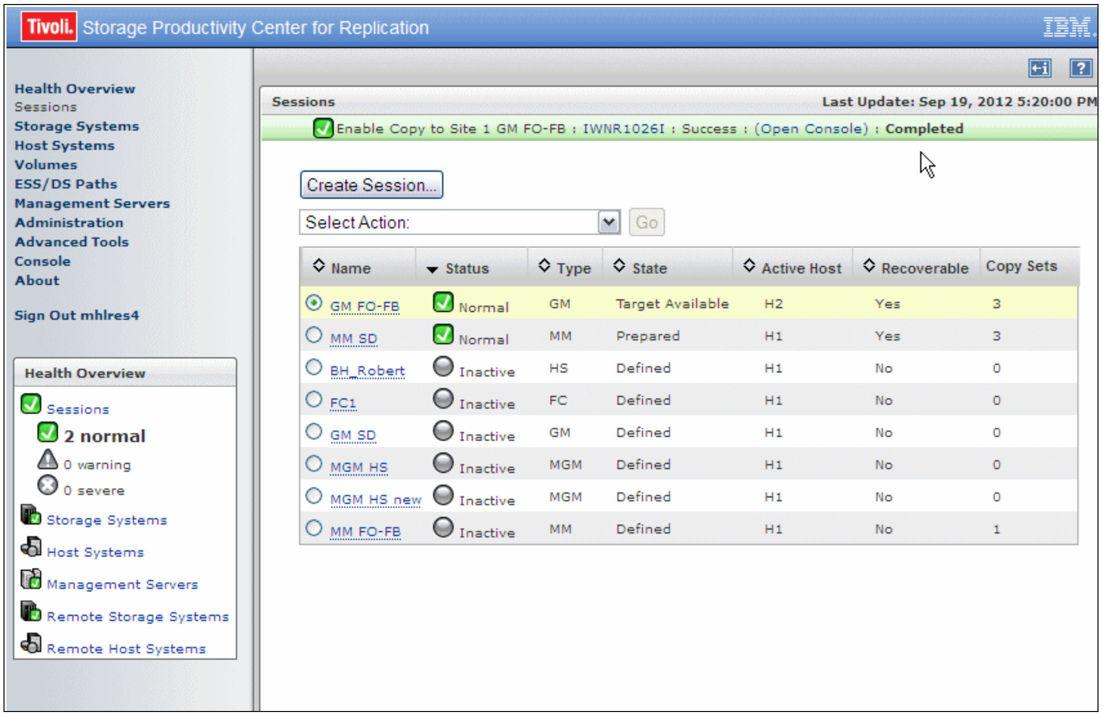

Figure 7-229 Enable Copy to Site 1 is reported as Completed

The following options are available at this stage:

Start H2 → H1	Starts replication from H2 to H1 volumes.
Re-enable Copy to Site 2	Re-enables replication from H1 to H2 volumes.
Terminate	Terminates the session (under *Cleanup* submenu).

7.7.7 Starting H2 → H1

After a **Recover** action and **Enable Copy to Site 1** command, Host 2 volumes are active. Follow these steps:

1. As Host 2 volumes are now the active site, you can initiate copying from Host 2 to Host 1 volumes. To achieve this, from the **Select Action** pull-down menu, select **Start H2 → H1** and click **Go** as shown in Figure 7-230.

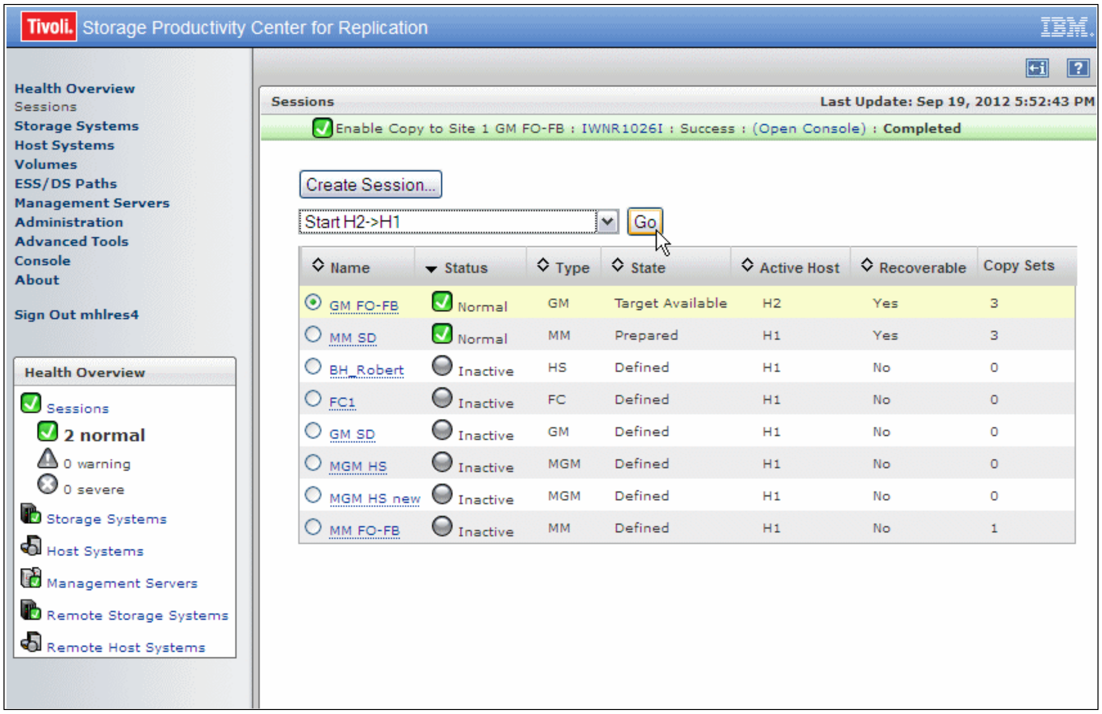

Figure 7-230 Global Mirror session - Start H2 → H1 Action

2. The next message shown in Figure 7-231 is a warning that you are about to initiate starting of Global Mirror session. It will start copying of data from Host 2 to Host 1 volumes, thus overwriting any data on Host 1 volumes. Click **Yes** to continue.

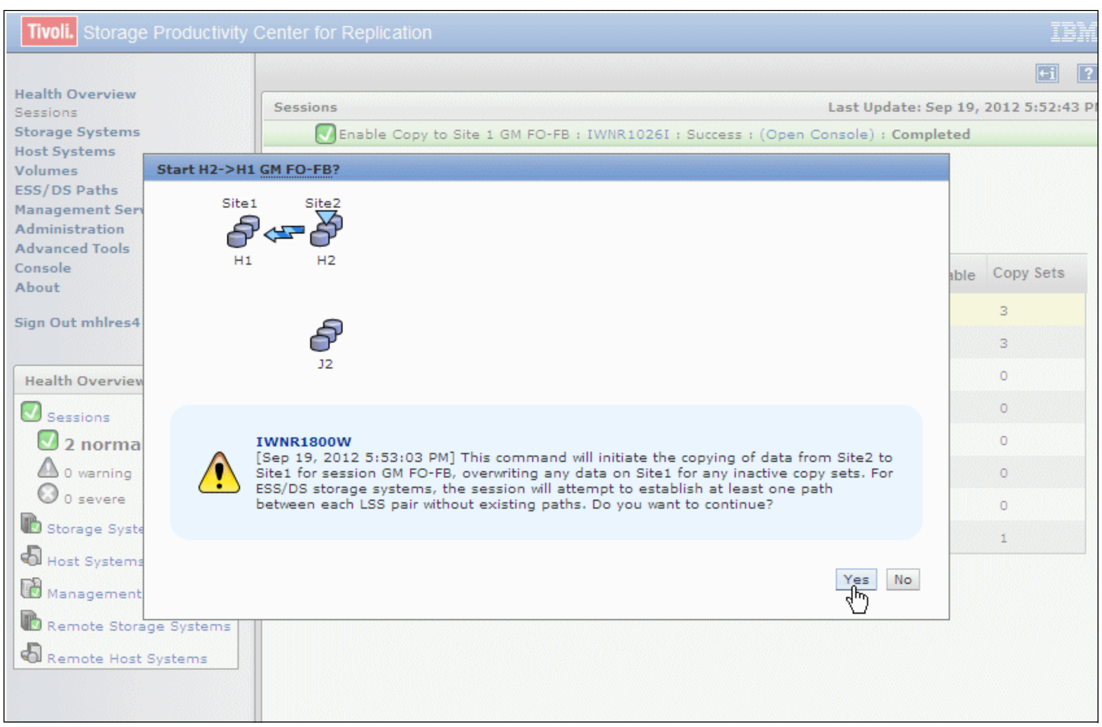

Figure 7-231 Start H2 → H1 Global Mirror FO/FB session

3. The message at the top of the panel in Figure 7-232 confirms that start of the Global Mirror session is completed. The session is in *Preparing* state and *Warning* status. Click the session name hyperlink (`GM FO-FB` in our example) to find more details about this session.

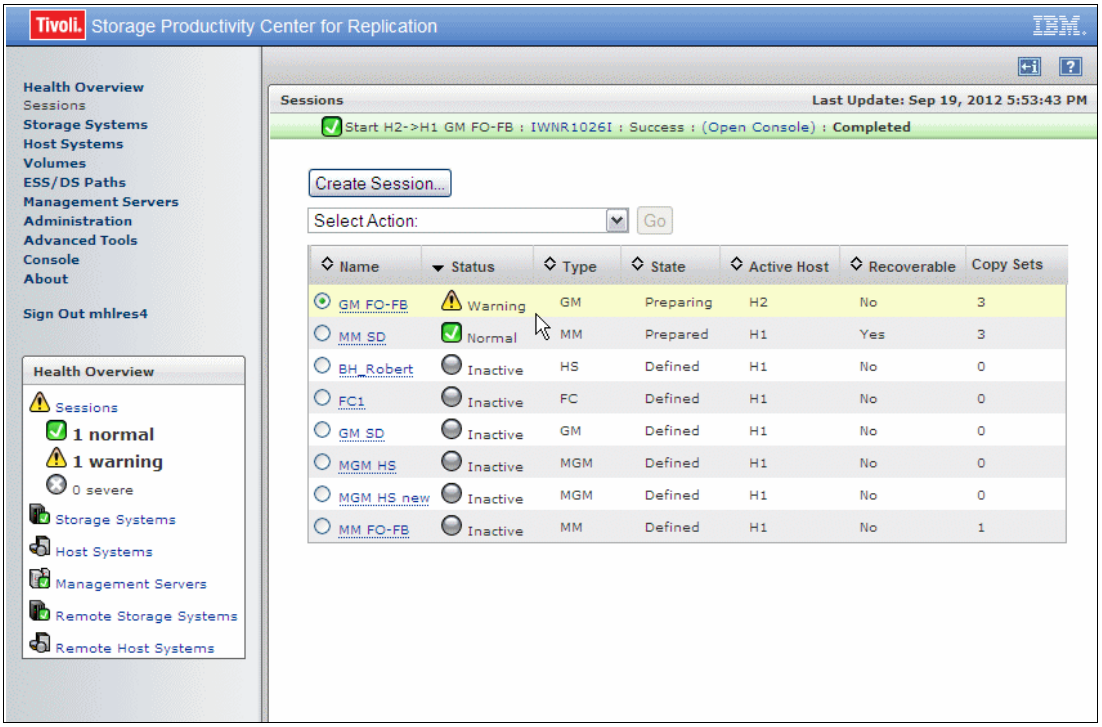

Figure 7-232 Start of H2 to H1 replication reported as Completed

> **Note:** After starting the session from H2 → H1, the session will forever stay in *preparing* state. The reason for this is that there is no journal volume at Site 1 where consistent copy could be formed. If you want to switch back to H1 site, you need to stop I/O on H2 volumes and suspend the session. This will cause all data that is not yet copied from H2 to H1 volumes to be copied. After a session is suspended, you can recover it back to H1 volumes.

After start of the session in direction H2 → H1 is completed, the following options are available:

Suspend Suspends replication from H2 to H1 volumes.

Start H2 → H1 Restarts replication from H2 to H1 volumes.

Terminate Terminates the session (under *Cleanup* submenu).

7.7.8 Suspending H2 to H1 replication

After you have started the replication from H2 to H1 volumes, you can suspend it. This is required to reactivate the H1 volumes. Follow these steps:

1. From the **Sessions** panel, select your Global Mirror session radio button, select **Suspend** from the **Action** pull-down list, and click **Go** as shown in Figure 7-233.

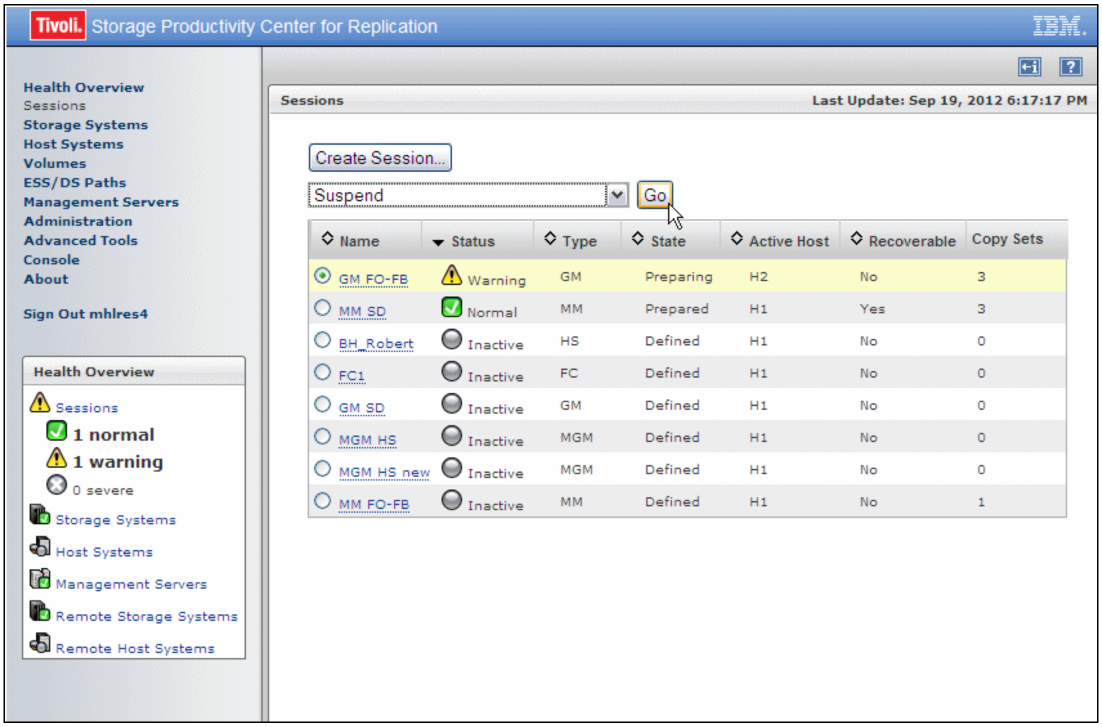

Figure 7-233 Suspend H2 to H1 replication

2. The next message shown in Figure 7-234 is a warning that you are about to suspend the replication between H2 and H1 volumes. Click **Yes** to continue.

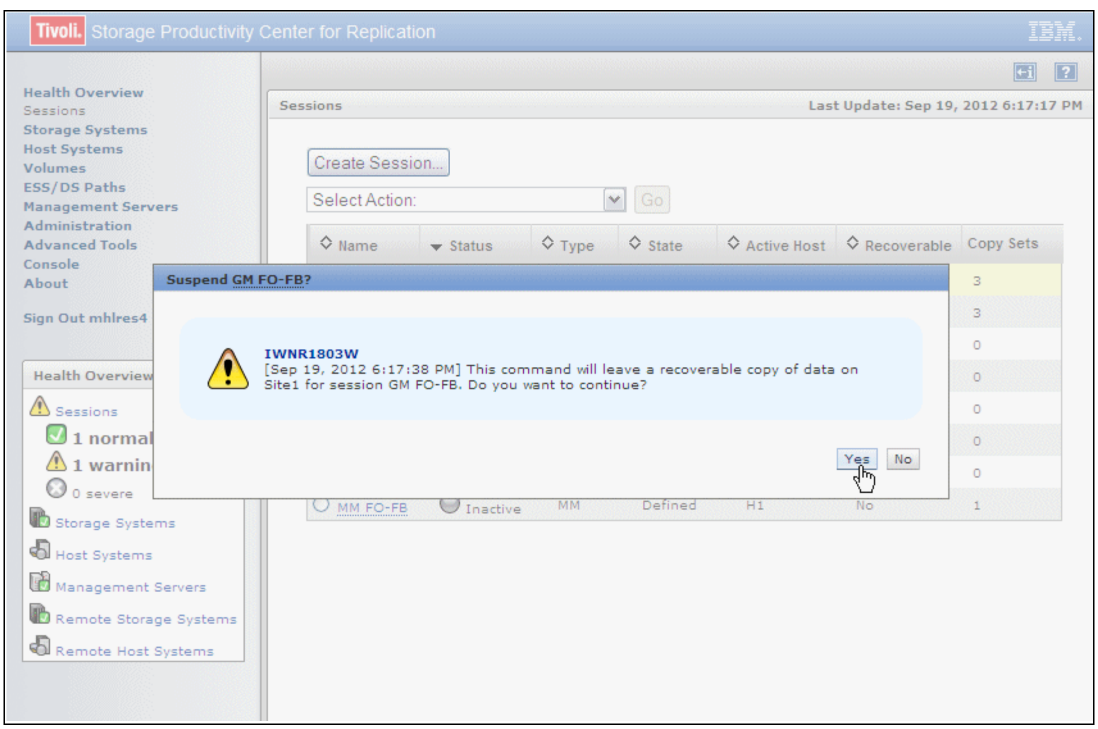

Figure 7-234 Suspend H2 to H1 replication warning

3. The status of our Global Mirror session has changed to *Severe* status, indicating that data is no longer replicated between Host 2 and Host 1 volumes. The state of the session is *Suspended* as indicated in Figure 7-235.

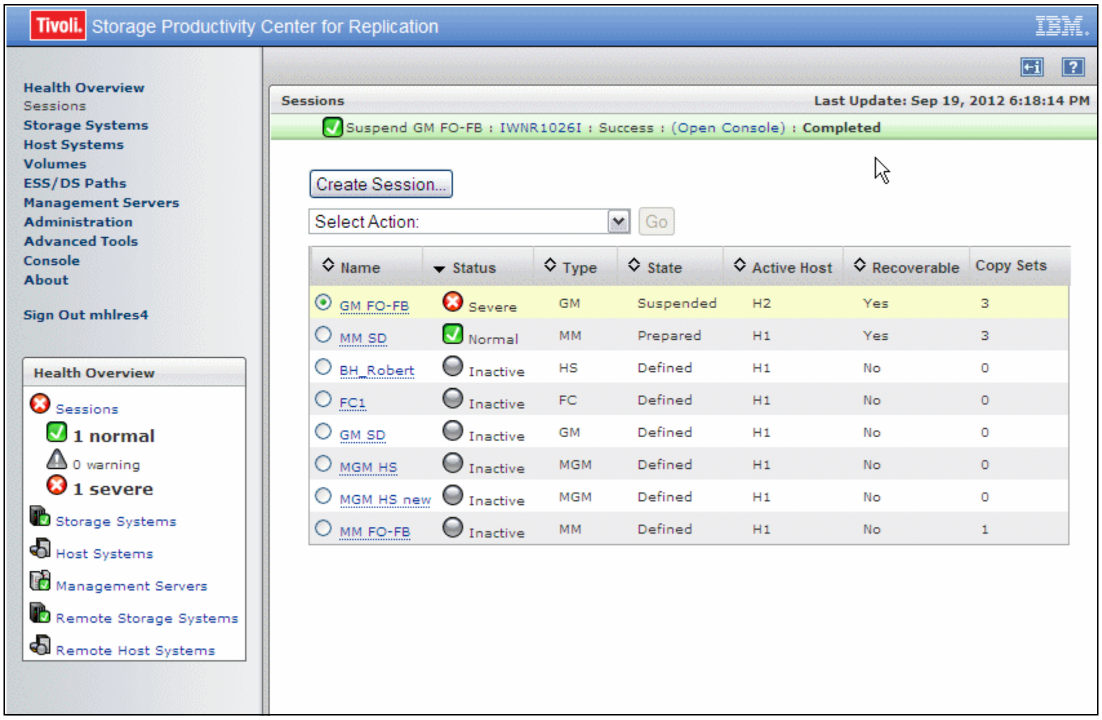

Figure 7-235 Suspend H2 to H1 replication Completed

After the Global Mirror session is suspended, the following actions are available:

Recover Makes H2 volumes available for host access.

Start H2 → H1 Restarts copying from H2 to H1 volumes.

Terminate Terminates the session (under *Cleanup* submenu).

7.7.9 Recovering a Global Mirror session (after Start H2 → H1)

After suspending a session in direction H2 to H1, you need to execute Recover to activate H1 volumes for host usage. After the Global Mirror session and its associated Copy Sets have been suspended, we can initiate a **Recover** action:

1. Select the Global Mirror session radio button (GM FO-FB in our example shown in Figure 7-236) and select a **Recover** action from the **Select Action** pull-down menu. Click **Go** to continue.

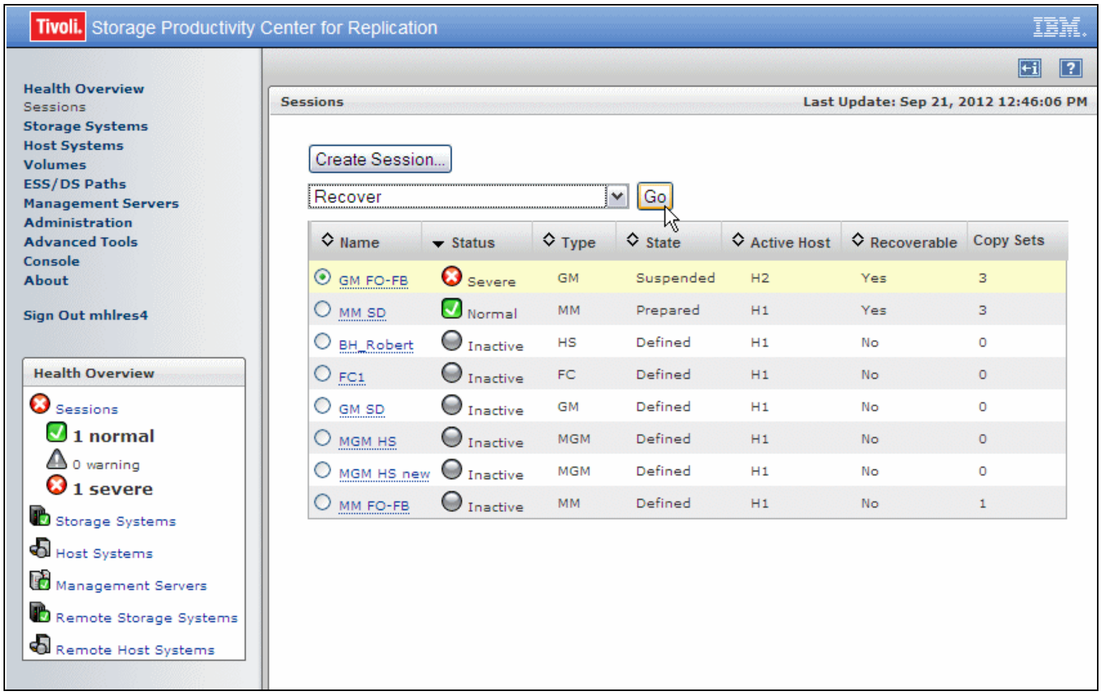

Figure 7-236 Global Mirror session - Recover H1 action

2. The next message shown in Example 7-237 is a warning that you will allow H1 volumes available to your host. Click **Yes** to continue.

> **Note:** Before executing a **Recover** action, H2 volumes must be offline for your application systems.

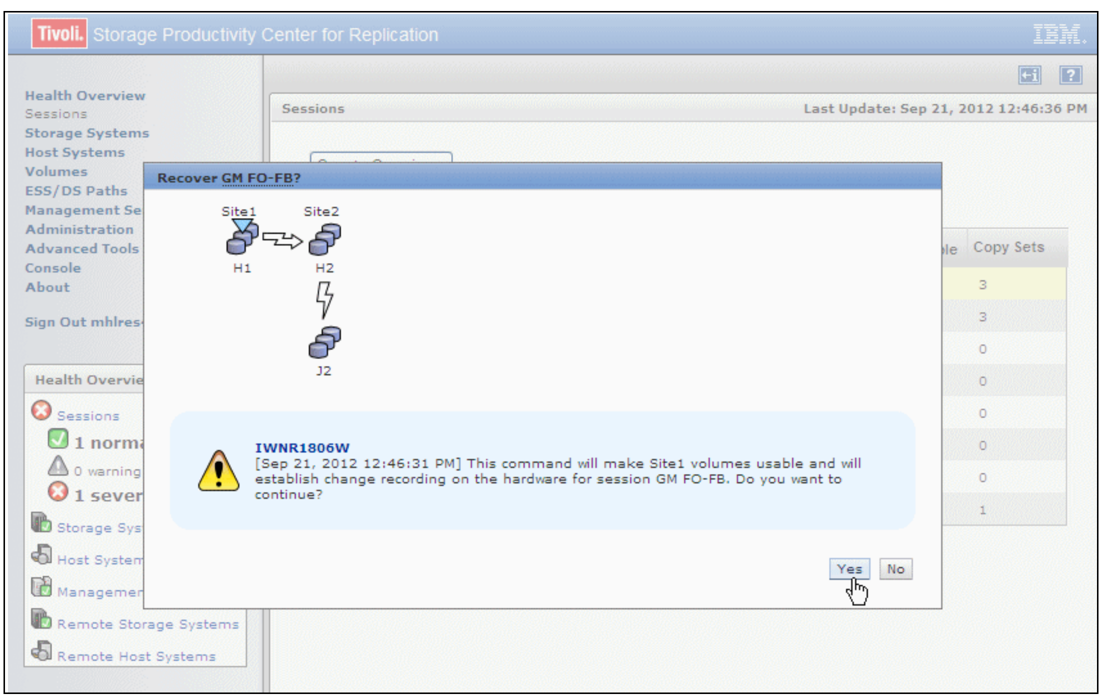

Figure 7-237 Recover Global Mirror Session - warning

3. There is a message at the top of the panel in Figure 7-238 indicating that a **Recover** action has been successfully completed. The status of our Global Mirror session is *Normal* and the State is *Target Available*, indicating that H1 volumes are available to your host.

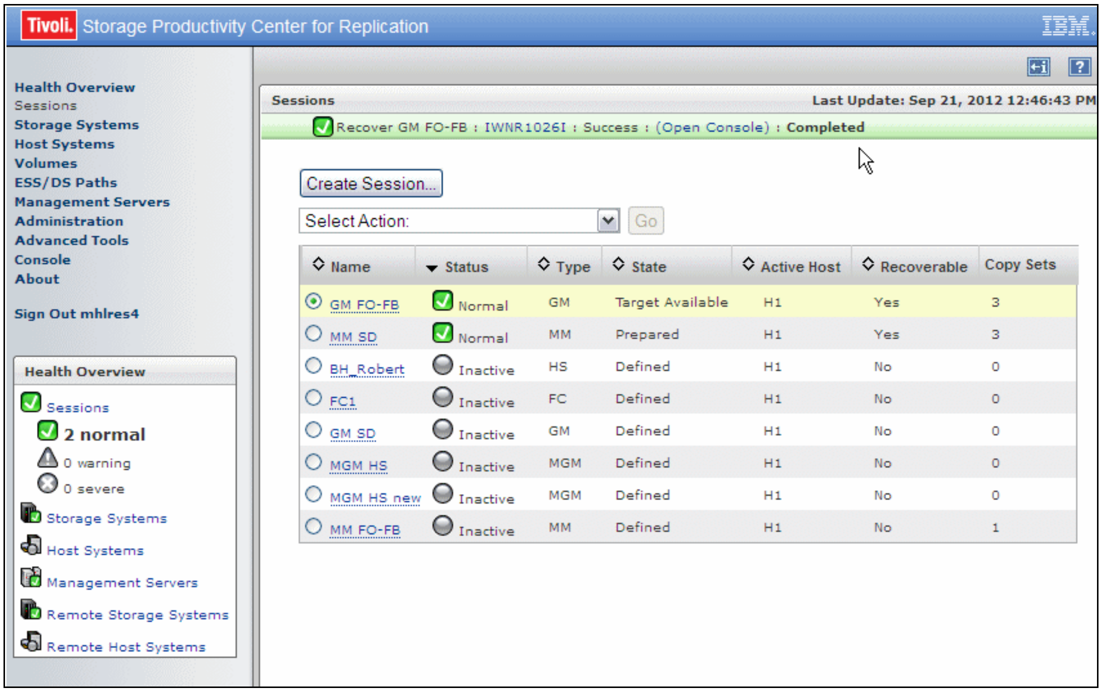

Figure 7-238 Global Mirror session - H1 storage subsystem volume available to host

After the Global Mirror session is recovered in *Target Available* state, the following options are available:

Start H2 → H1 Restarts Global Copy replication from H2 to H1 volumes.

Enable Copy to Site 2 Before reversing the direction of copying in a failover and failback session, you must run this command, and confirm that you want to reverse the direction of replication. This command will enable **Start H1 → H2** command.

Terminate Terminates the session.

7.7.10 Enabling Copy to Site 2

If we assume that the current copy direction is from Site 2 to Site 1 and you want to reverse the copy direction back from Site 1 to Site 2, you need to issue a **Suspend** command as we described in 7.7.8, “Suspending H2 to H1 replication” on page 424 and then a **Recover** command (see 7.7.9, “Recovering a Global Mirror session (after Start H2 ® H1)” on page 426). But this time, the **Recover** command will make H1 volumes available to applications since the data copying direction is from H2 to H1 volumes. After the **Recover** command is completed, the Host 1 site is now the active site and you can reverse direction of copying in a Global Mirror Failover/Failback session. Follow these steps:

1. Before you can initiate copying from Host 1 to Host 2 volumes, you need to start the **Enable Copy to Site 2** command. To achieve this, from the **Select Action** pull-down menu, select **Enable Copy to Site 2** and click **Go** as shown in Figure 7-239.

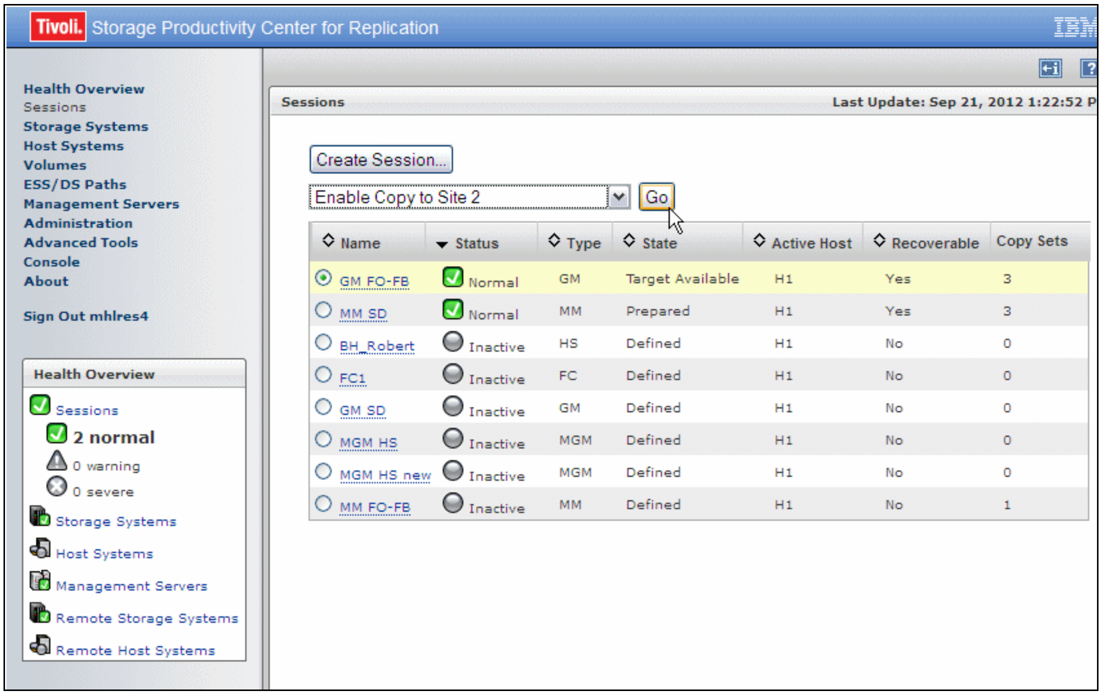

Figure 7-239 Global Mirror session - Enable Copy to Site 2

2. The next message shown in Figure 7-240 is a warning that you are about to enable copy from Site 1 to Site 2 since the command which initiates copying data from H1 to H2 volumes is disabled to protect against accidentally copying over production data. Ensure that all of the volumes in this session located at Site 2 are not being used by any application prior to enabling the command that allows copying data to Site 2. Click **Yes** to continue.

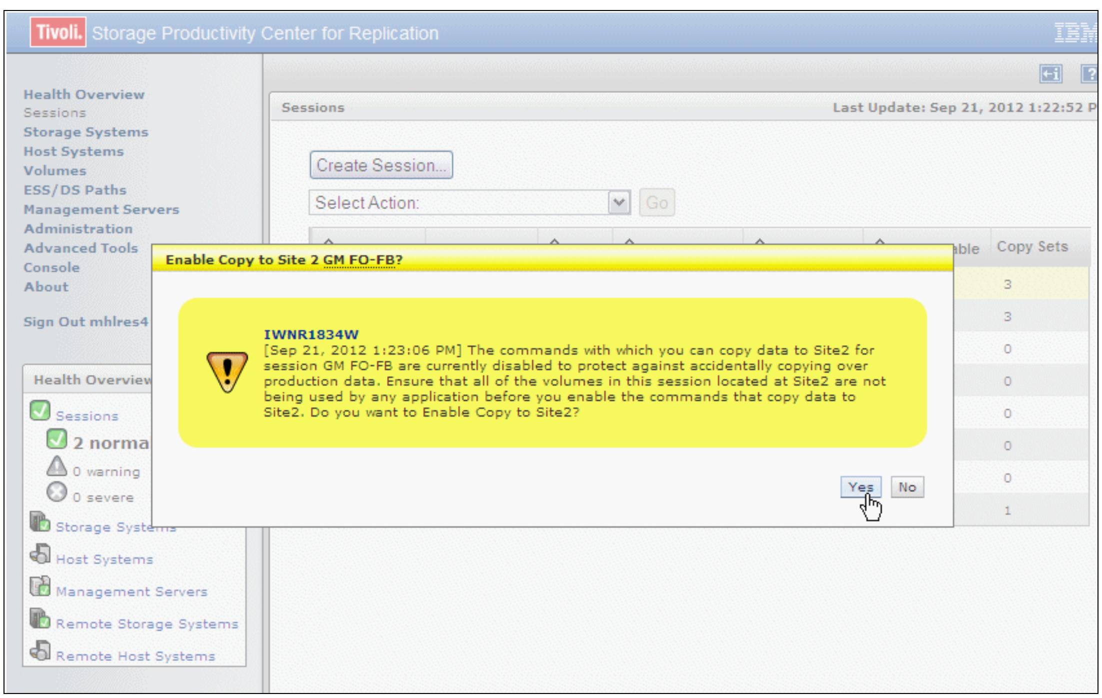

Figure 7-240 Enable Copy to Site 2

3. The message at the top of the panel in Figure 7-241 confirms that the Enable Copy to Site 2 command is completed. The status of our Global Mirror session is the same as it was after the `Recover` command, *Normal*, and the state is *Target Available*, indicating that the H1 volume is available to your host.

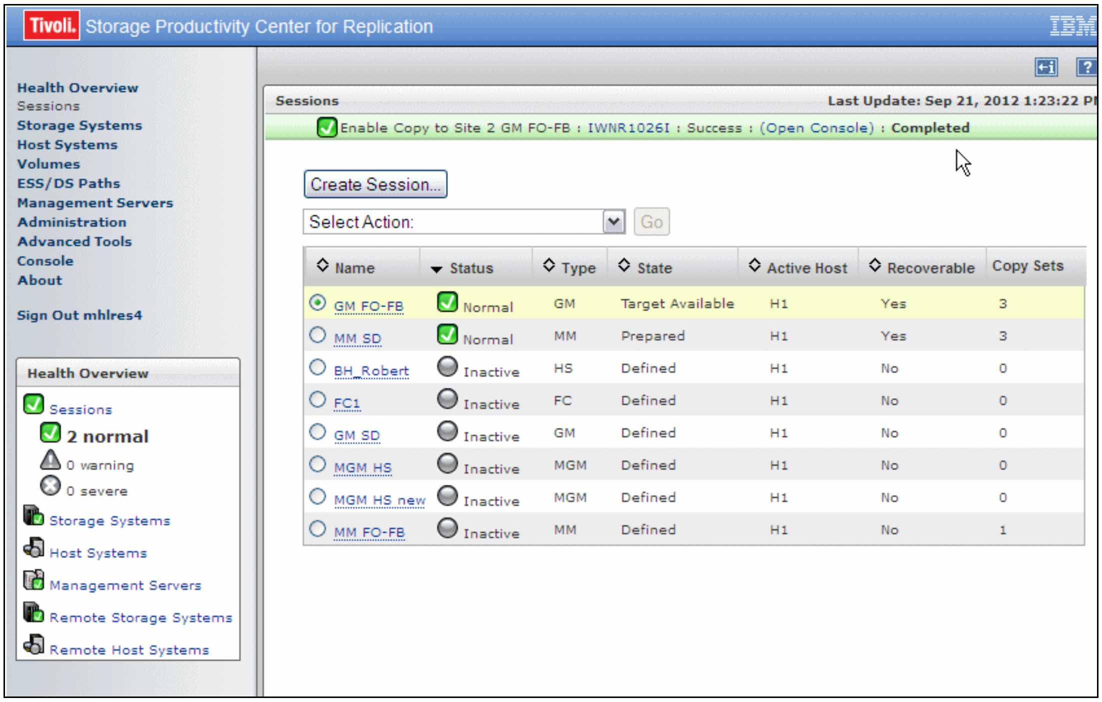

Figure 7-241 Enable Copy to Site 2 is reported as Completed

The following options are available at this stage:

Start H1 → H2 Restarts the Global Mirror session, with replication from H1 to H2 volumes.

StartGC H1 → H2 Starts Global Copy replication from H1 to H2 volumes.

Re-enable Copy to Site 1 Re-enables H2 to H1 replication.

Terminate Terminates the session (under *Cleanup* submenu).

7.7.11 Terminating a Global Mirror session

The **Terminate** action breaks the Global Mirror relationship between H1, H2, and J2 volumes, thus terminating data replication. Follow these steps:

1. Select the Global Mirror session radio button (GM FO-FB in our example shown in Figure 7-242) and the **Terminate** action from the **Select Action** pull-down menu. Click **Go** to continue.

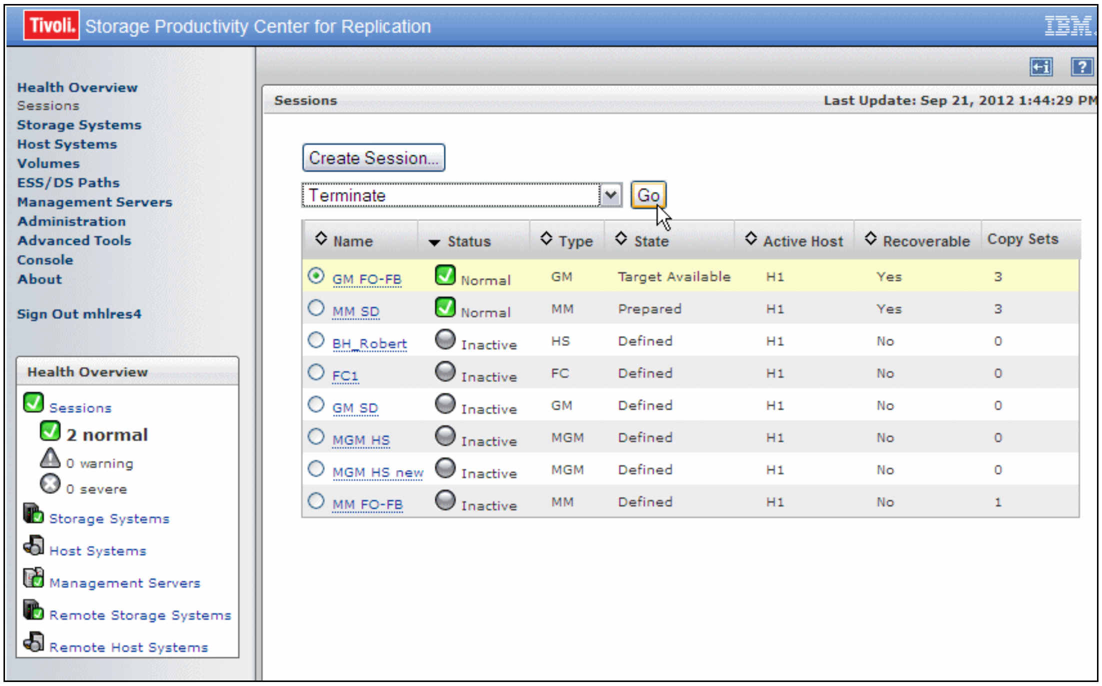

Figure 7-242 Global Mirror session - Terminate action

2. The next message shown in Figure 7-243 is a warning that you are about to terminate a Global Mirror relationship between H1, H2, and J2 volumes. Note that if you require to start the very same Global Mirror session again a full copy from H1 to H2 volumes will be required. Click **Yes** to continue.

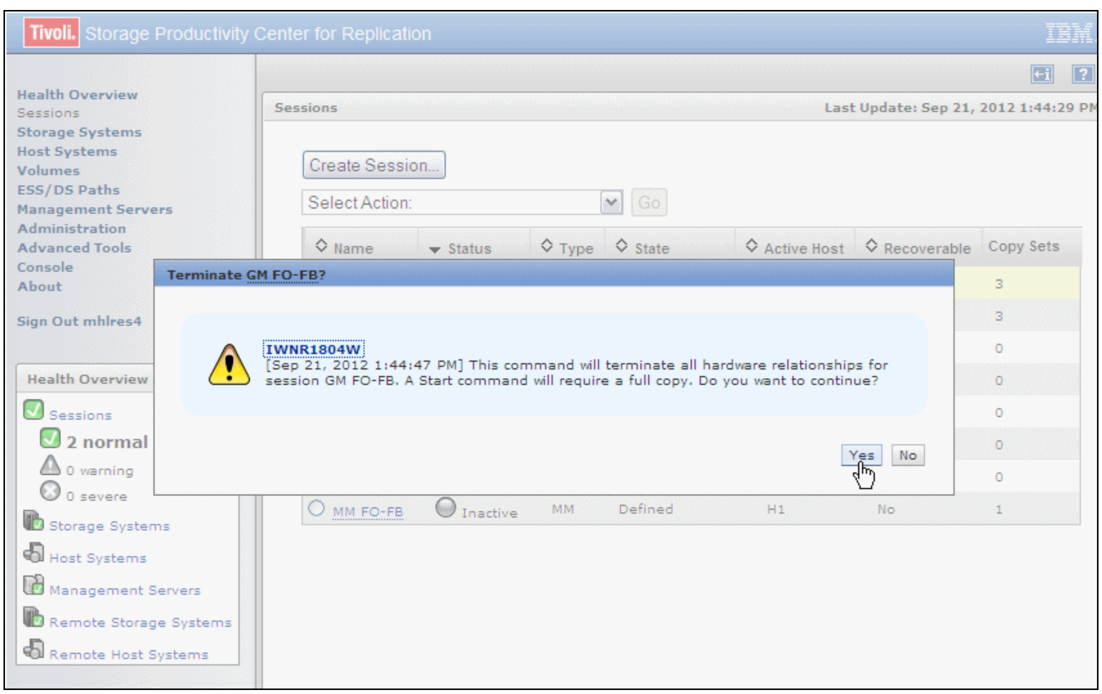

Figure 7-243 Terminate Global Mirror FO/FB session - warning

3. There is a message at the top of the panel in Figure 7-244 indicating that a **Terminate** action has been successfully completed. The status of our Global Mirror session is now *Inactive* and the state is *Defined*.

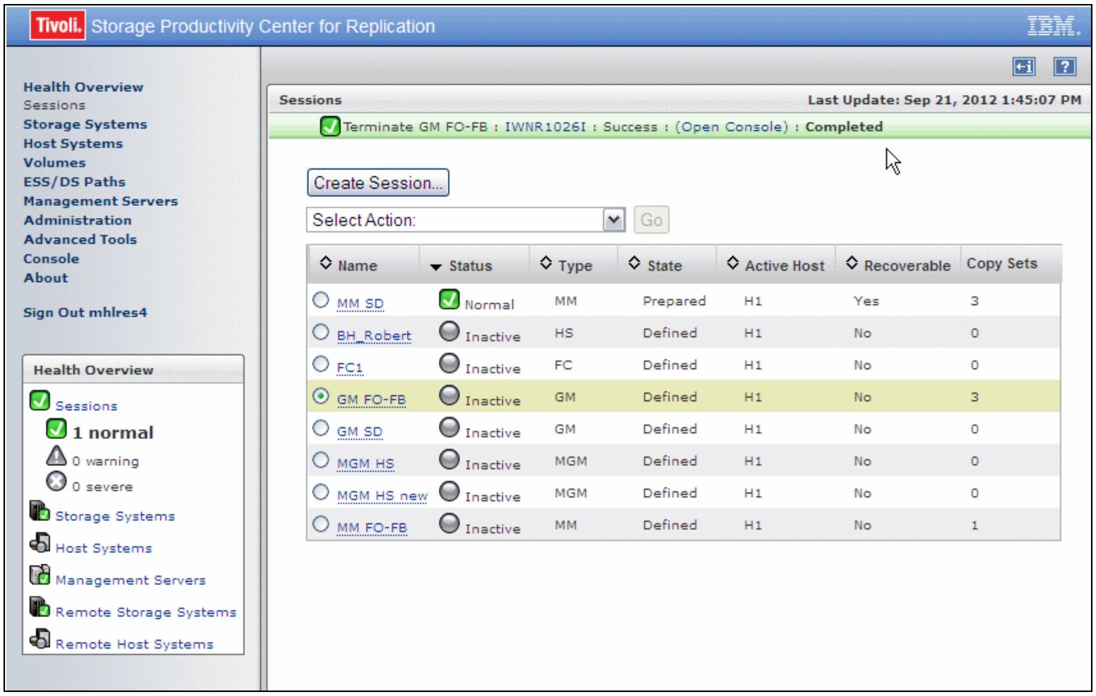

Figure 7-244 Terminate Global Mirror FO/FB session - Completed

After the Global Mirror Failover/Failback session is terminated, the following options are available:

Start H1 → H2 Restarts the Global Mirror session.

StartGC H1 → H2 Starts Global Copy from H1 to H2 volumes.

7.8 Global Mirror Failover/Failback with Practice session

A Global Mirror Failover/Failback with Practice session combines Global Mirror and FlashCopy to provide a point in time copy of the data on a remote site at a distance over 300 km away from your first site. You can use this to practice what you might do if a disaster occurred.

7.8.1 Creating Global Mirror Single Failover/Failback with Practice session

Figure 7-245 shows the Sessions panel. This provides you with an overview of all defined sessions. Follow these steps:

1. Click **Create Session** to create another session.

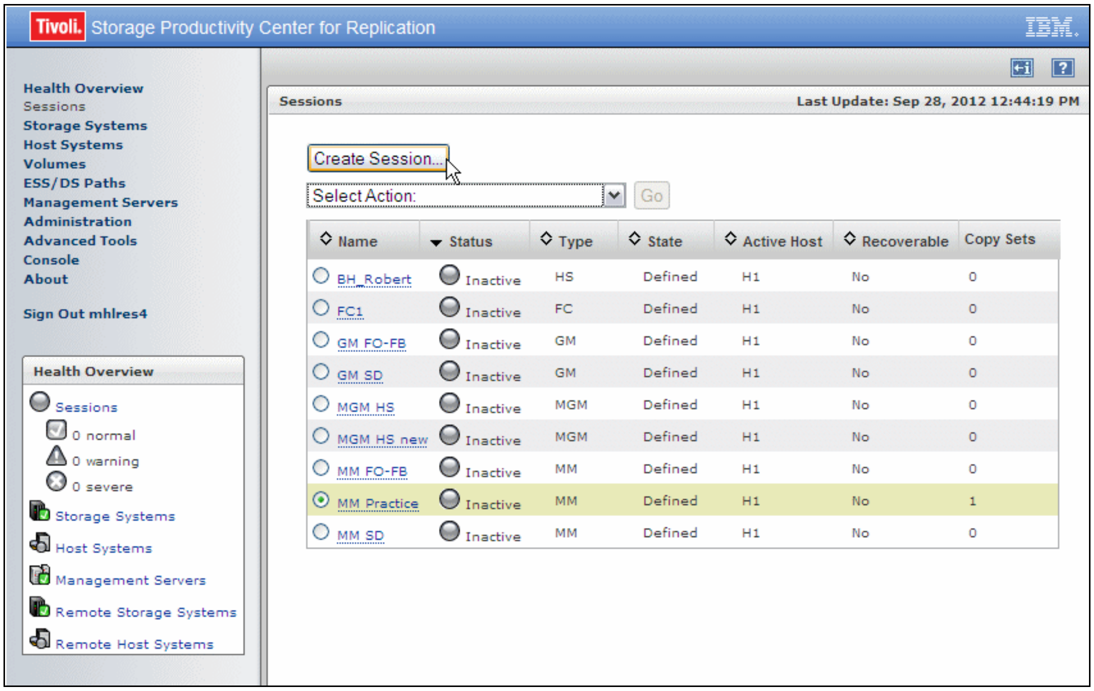

Figure 7-245 Create a new session

2. Select the Hardware Type of the storage subsystems from the Choose Hardware Type pull-down menu. Select the **Global Mirror Failover/Failback** session from the Choose Session Type pull-down menu as shown in Figure 7-246.
3. On the right side, a pictograph symbolizes the involved sites and their volume types. H1 represents Site 1 volumes, H2 represents Site 2 volumes, I2 represents Site 2 Intermediate volumes which are actually used as copy target, and J2 represent journal volumes used to restore data to the last consistency point. When you define Copy Sets, this pictograph helps you to orient and understand replication direction. Click **Next** to continue.

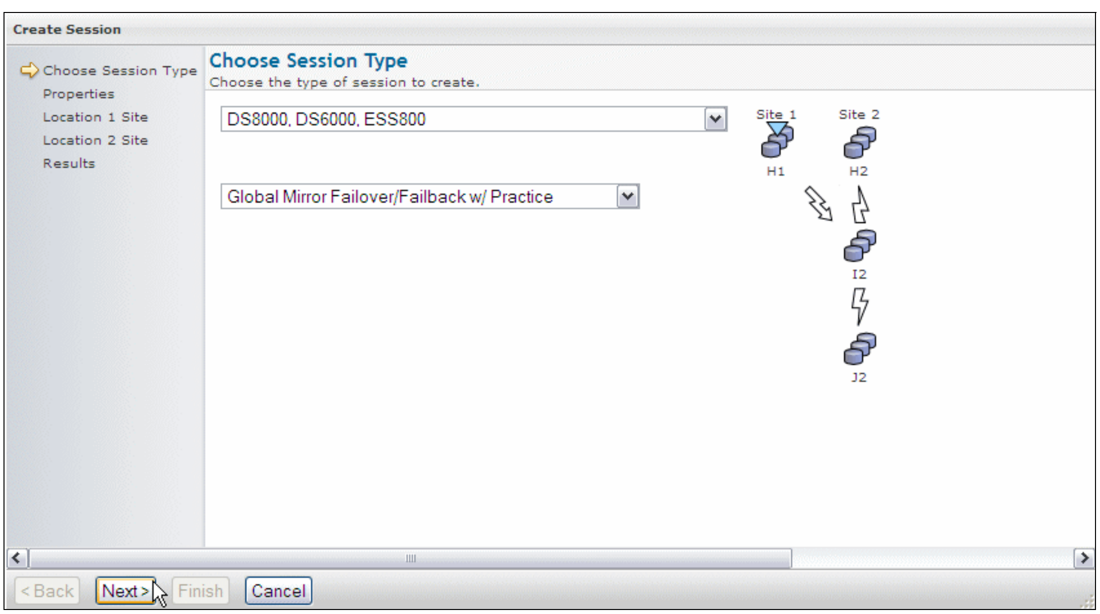

Figure 7-246 Define the Global Mirror FO/FB w/ Practice session

This leads us to the session Properties panel as Figure 7-247 shows.

The *Properties* panel is also important because it requires that you specify at least a name for the session which is about to be created. An optional description is desirable to understand the purpose of the session because the session name may not reveal what this session is intended for.

The Properties panel allows you to specify some parameters to monitor and control the Global Mirror session. These parameters are described in the following paragraphs:

- Consistency Group interval time (sec):

  This value specifies how long to wait between the formation of the next Consistency Groups. This is specified in seconds, and the default is zero (0) seconds. Zero seconds means that Consistency Group formation happens constantly. As soon as a Consistency Group is successfully created, the process to create a new Consistency Group starts again immediately.

- Recovery Point Objective Alert:

  Specifies the length of time that you want to set for the recovery point objective (RPO) thresholds. The values determine whether a Warning or Severe alert is generated when the RPO threshold is exceeded for a role pair. The RPO represents the length of time in seconds of data exposure that is acceptable in the event of a disaster. The thresholds are specified in the following way:

  – Warning level threshold (seconds):

    When the RPO is greater than this value, you want an alert to be generated.

  – Severe level threshold (seconds):

    When RPO is greater than this value, an alert is also generated, and the session status changes to *Severe*.

- Fail MM/GC if the target is online (CKD only):

  This option ensures that all target (secondary) volumes in a Global Mirror session are offline and not visible to any host, otherwise the create session task will fail. This applies to CKD volumes only. Use this option since target (secondary) volumes in a Global Mirror session should be offline to all hosts.

- DS FlashCopy Options for Role pair H2-I2:

  The following options are available only for DS8000 version 4.2 or later.

  – *Persistent*

    Select this option to keep FlashCopy pairs persistent on the hardware.

  – *No Copy*

    Select this option if you do not want the hardware to write the background copy until the source track is written to. Data is not copied to the H2 volume until the blocks or tracks of the I2 volume are modified. The point in time volume image is composed of the unmodified data on the I2 volume and the data that was copied to the H2 volume.

    If you want a complete point in time copy of the I2 volume to be created on the H2 volume, do not use the No Copy option. This option causes the data to be asynchronously copied from the I2 volume to the H2 volume.

- DS FlashCopy Options for Role pair I2-J2:

  This option is available only for System Storage DS8000 version 4.2 or later.

  – *Reflash After Recover*

Select this option if you want to create a FlashCopy replication between the I2 and J2 volumes after the recovery of a Global Mirror session. If you do not select this option, a FlashCopy replication is created only between the I2 and H2 volumes.

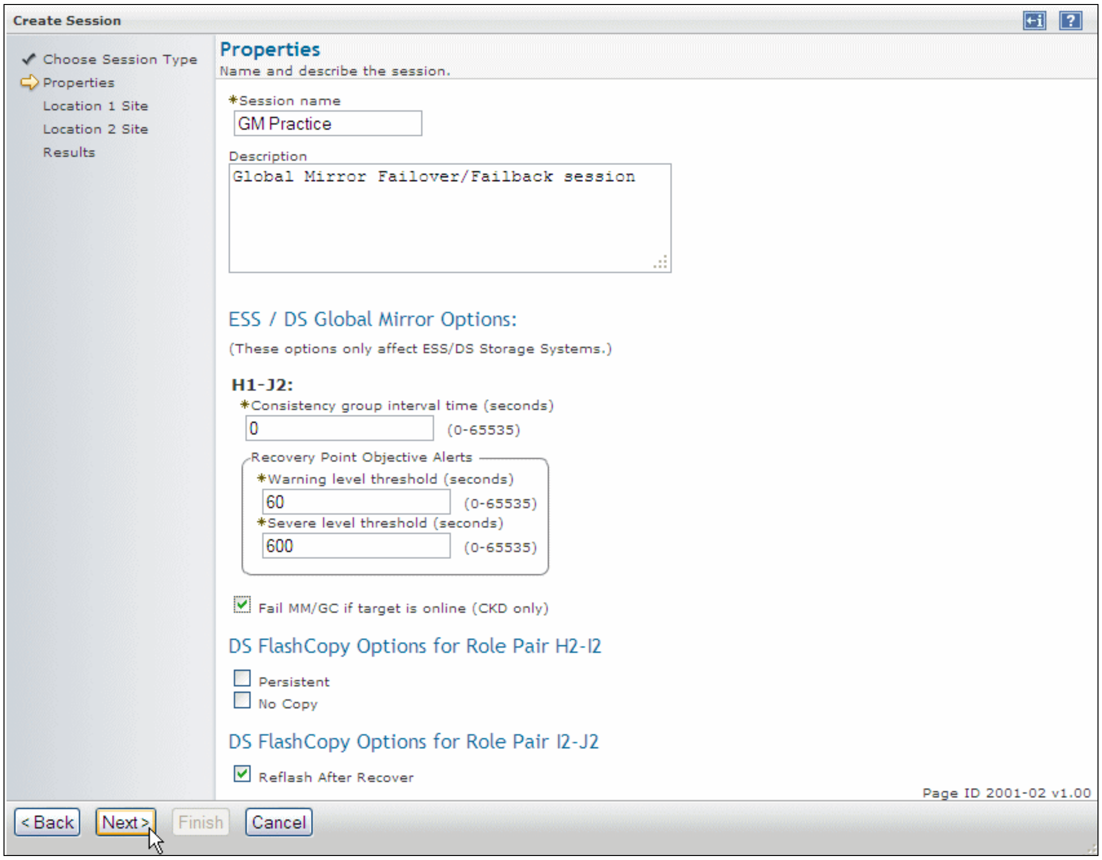

Figure 7-247 Define Global Mirror FO/FB w/ Practice session Properties

4. From the pull-down *Site 1 Location* menu (see Figure 7-248), select the location of your H1 storage subsystem previously defined and click **Next** to continue.

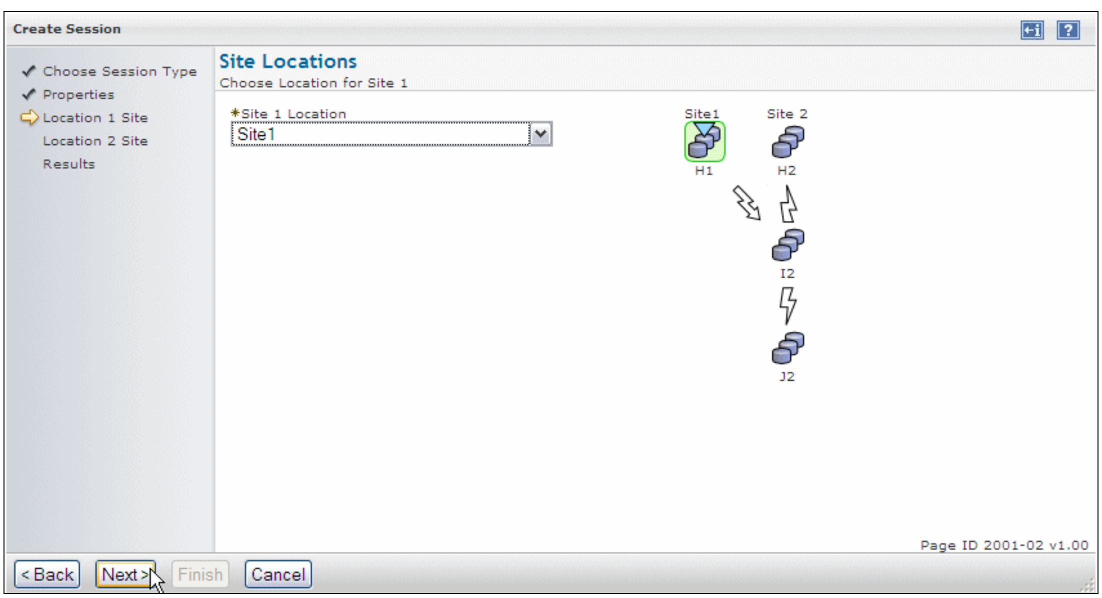

Figure 7-248 Define Global Mirror FO/FB w/ Practice session Site 1 Location

5. From the pull-down *Site 2 Location* menu (see Figure 7-249), select the location of your H2 storage subsystem previously defined and click **Next** to continue.

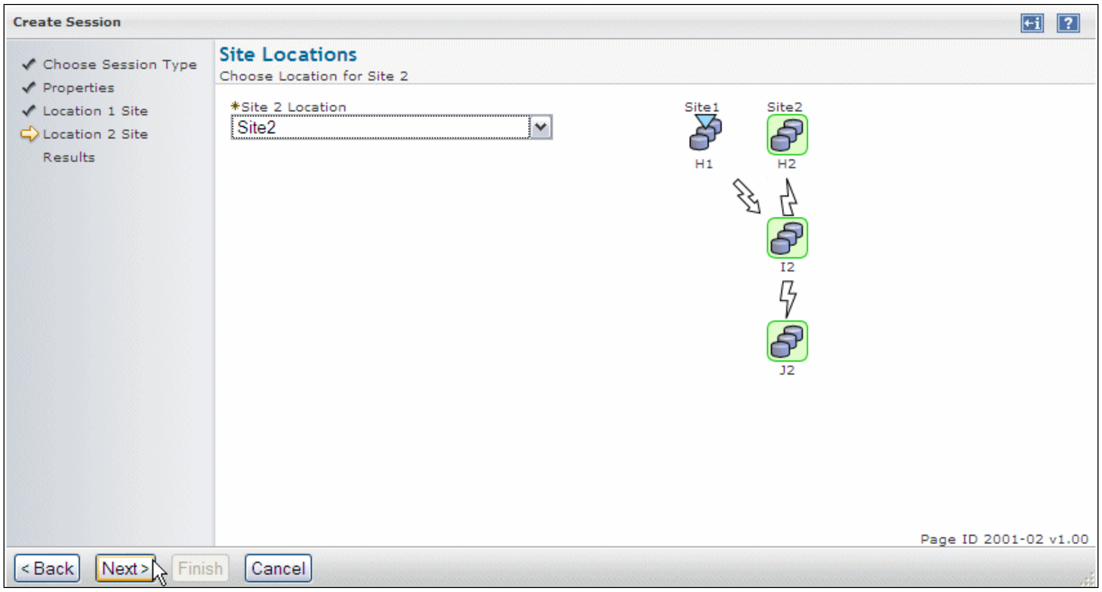

Figure 7-249 Define Global Mirror FO/FB w/ Practice session Site 2 Location

Figure 7-250 displays the message that the GM Practice session was successfully created. Click **Finish** to exit the *Create Session* wizard. Alternatively, you have an option to add Copy Sets and click **Launch Add Copy Sets Wizard** and follow the instructions described in "Adding Copy Sets to a Global Mirror session" on page 437.

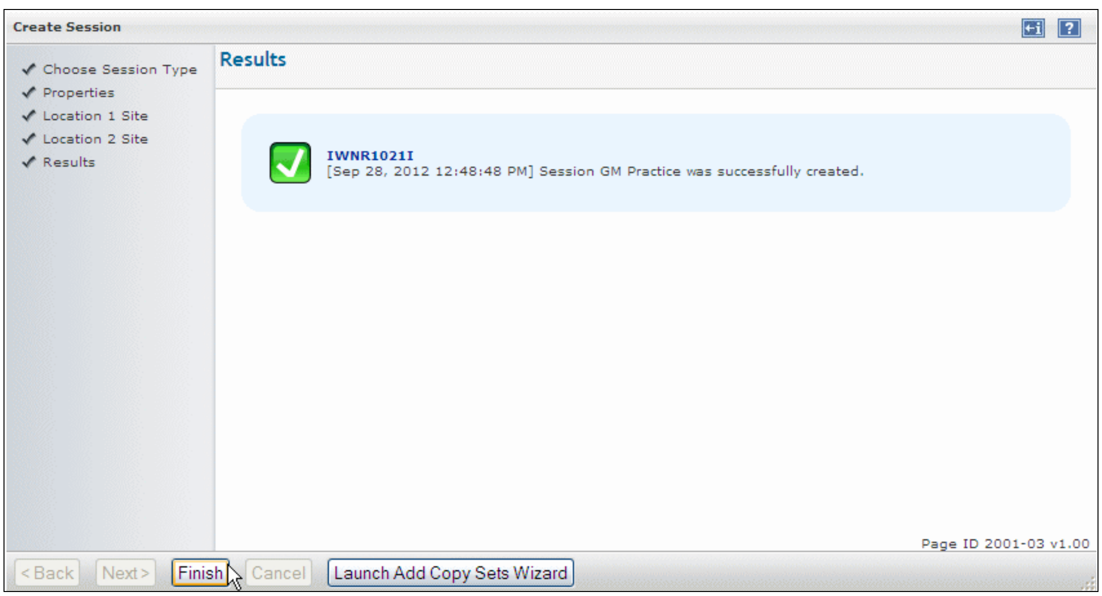

Figure 7-250 Define Global Mirror FO/FB w/ Practice session - Results

7.8.2 Adding Copy Sets to a Global Mirror session

After we have defined the Global Mirror session GMP Practice, we can populate this session in the next step with Copy Sets. A Global Mirror Copy Set consists of one H1, one H2, one I2, and one J2 Global Mirror volume.

Figure 7-251 shows the session overview panel with the GM Practice session that we defined previously. The next logical action that you perform on the GM Practice session is to add Copy Sets to it. Follow these steps:

1. Select your Global Mirror session name radio button (GM Practice in our example) and choose **Add Copy Sets** from the **Select Action** pull-down menu. Click **Go** to invoke the *Add Copy Sets* wizard.

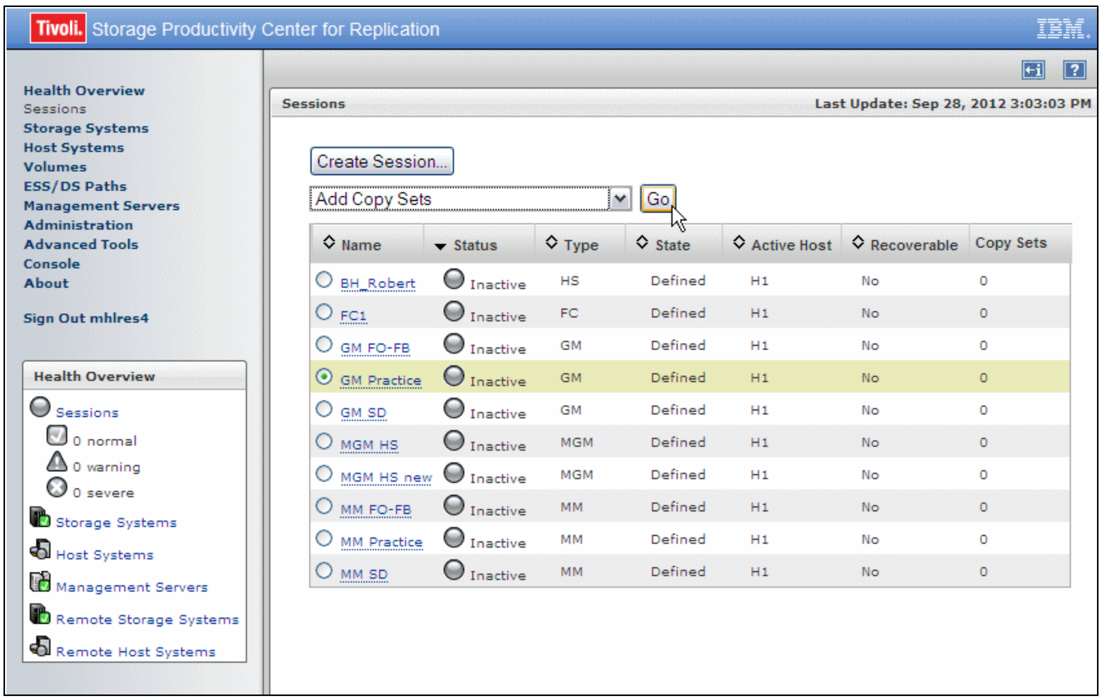

Figure 7-251 Add Copy Sets to Global Mirror FO/FB w/ Practice session

Note that over time, various terminology is introduced for the same thing. Peer-to-Peer Remote Copy or PPRC (today known as Metro Mirror and Global Mirror) started out with primary volumes and secondary volumes. This terminology was fine for a 2-site solution. With the arrival of switching sites from an application viewpoint as well as for the storage subsystem used, Tivoli Storage Productivity Center for Replication introduced a different terminology for these PPRC volumes and their association to a certain site.

Host 1 or Site 1 refers to the primary volumes as a starting point. This may also be the local site or application site. It may always be considered as the primary site. But it has the potential to change.You may want to switch application sites from Host 1 in Site 1 to Host 2 in Site 2 and also switch at the same time the Copy Services role of the associated storage subsystems. This led to Host 1, Site 1 volumes and Host 2, Site 2 volumes terminology being used in Tivoli Storage Productivity Center for Replication. In Global Mirror Failover/Failback w/ Practice session there are Journal volumes J2 used to restore data to the last consistency point and they are located at site 2. In case of the session with practice we are introducing Intermediate volumed as Site 2. In this type of session replication is established from H1 to I2 volumes.

2. Figure 7-252 displays the panel which provides details on the primary volumes or local volumes which are called Host 1 volumes relating to the fact that these volumes reside in the Site 1 (also referred to as the application site or local site). These are all synonyms and refer to the same environment. Select the desired **Host 1 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Host 1 logical storage subsystem** list. Select the LSS where your H1 volumes resides. After the LSS has been selected, choose the appropriate volume from the **Host 1 volume** pull-down list or select **All Volumes**.
3. The alternative way to add a large number of volumes to this session is to create CSV file as explained in “Using CSV files for importing and exporting sessions” on page 194. If you have a CSV file ready select **Use a CSV file to import copy sets** check box and provide a path to your CSV file. Click **Next** to continue.

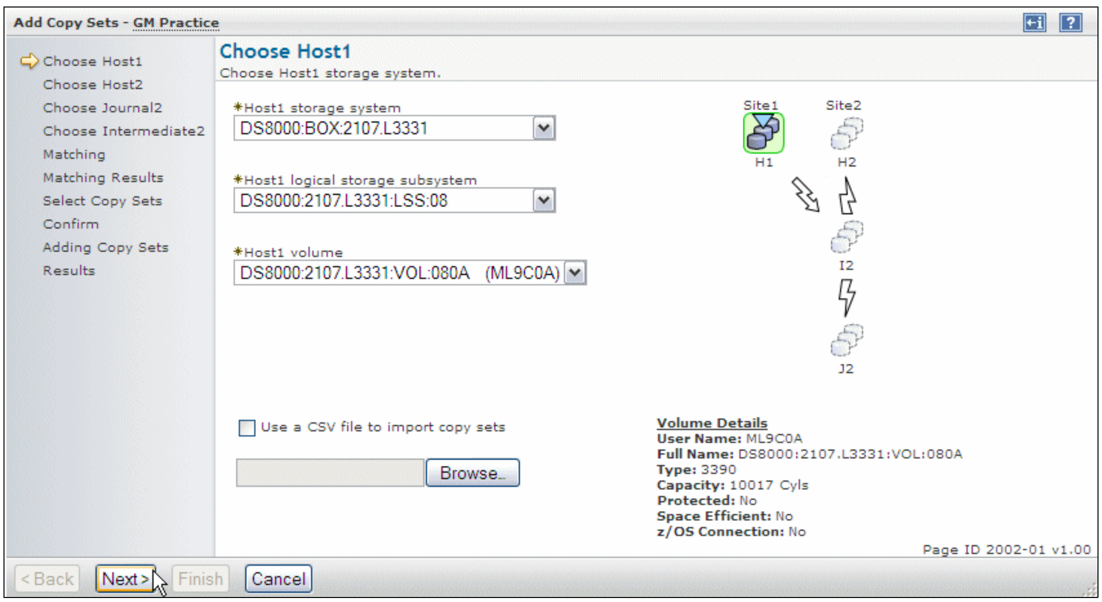

Figure 7-252 Add Copy Sets to Global Mirror FO/FB w/ Practice session - Choose Host 1

4. The next step is to define Site 2 storage subsystems and volumes as shown in Figure 7-253. Select the desired **Host 2 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Host 2 logical storage subsystem** list. Select the LSS where your H2 volume resides.If you selected **All volumes** for a given LSS in the previous step while defining Host 1 volumes, you do not have an option to select any volume from **Host 2 volume** list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 1 storage subsystem with all volumes from selected LSS in Host 2 storage subsystem. In our example we selected **All volumes** in *Choose Host1* step. Click **Next** to continue.

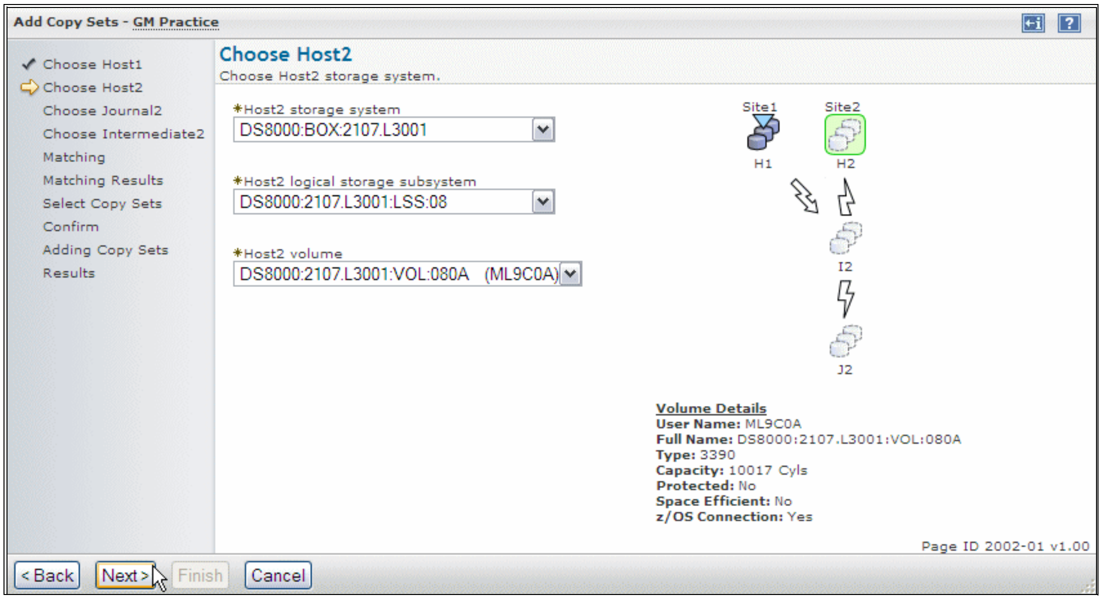

Figure 7-253 Add Copy Sets to Global Mirror FO/FB w/ Practice session - Choose Host 2 volumes

5. The next step is to define Site 2 storage subsystem and Journal volumes as shown in Figure 7-254. Select the desired **Journal 2 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Journal 2 logical storage subsystem** list. Select the LSS where your J2 volume resides. If you selected **All volumes** for a given LSS in the previous step while defining Host 1 and Host 2 volumes, you do not have an option to select any volume from **Journal 2 volume** list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 2 storage subsystem with all volumes from selected LSS in Journal 2 storage subsystem. Click **Next** to continue.

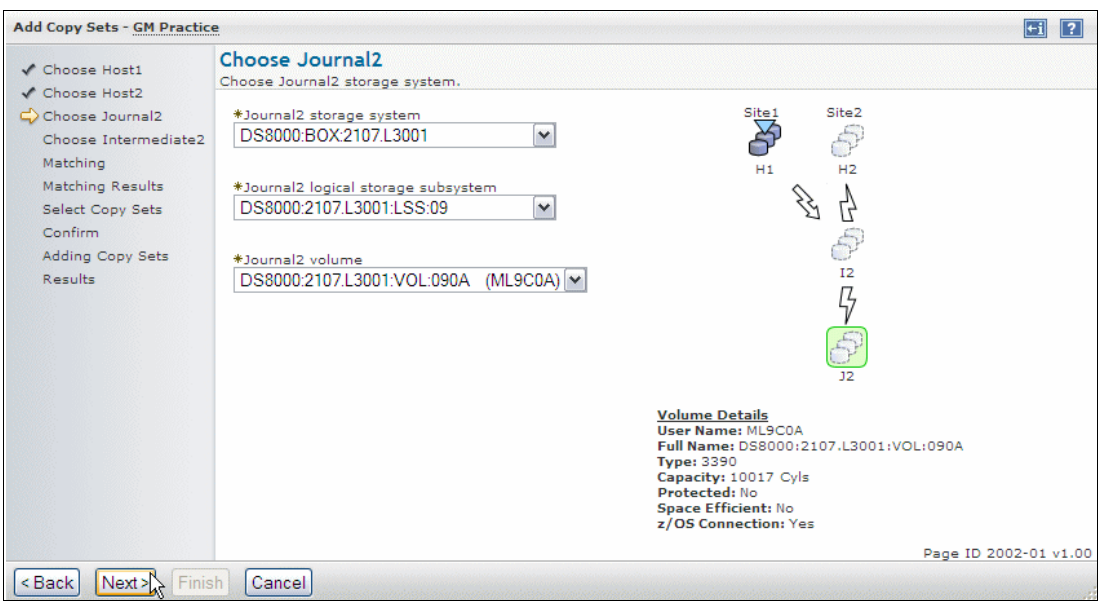

Figure 7-254 Add Copy Sets to Global Mirror FO/FB w/ Practice session - Choose Journal 2 volumes

6. The next step is to define Site 2 storage subsystems and Intermediate volumes as shown in Figure 7-255. Select the desired **Intermediate 2 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Intermediate 2 logical storage subsystem** list. Select the LSS where your I2 volumes resides. If All volumes for a given LSS were selected in the step while defining Host 1 volumes, you do not have an option to select any volume from Intermediate 2 volumes list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 1 storage subsystem with all volumes from selected LSS in Intermediate 2 storage subsystem. Click **Next** to continue.

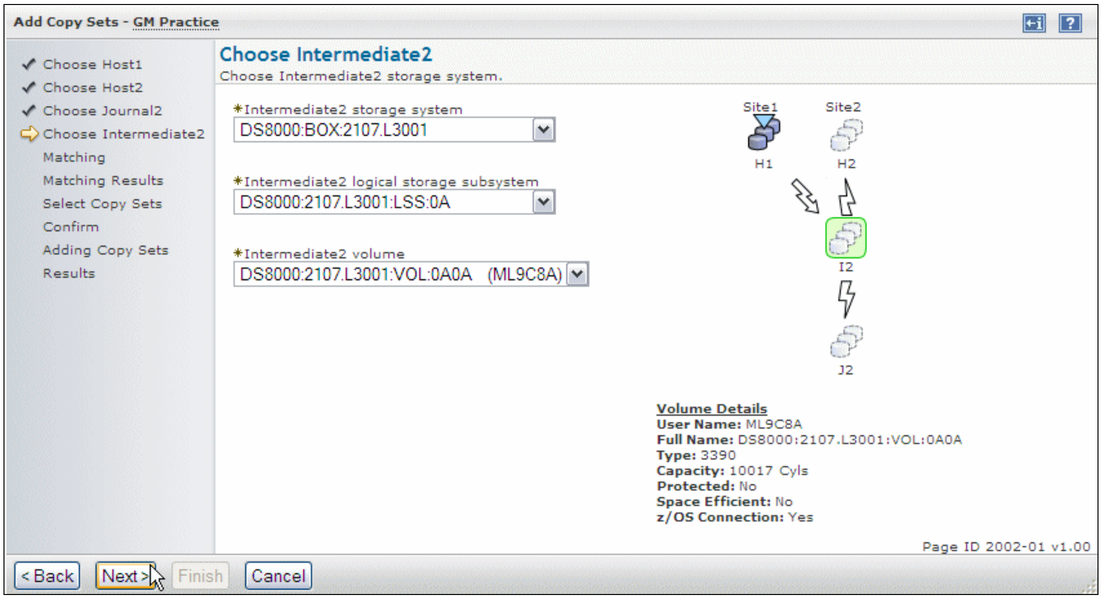

Figure 7-255 Add Copy Sets to Global Mirror FO/FB w/ Practice session - Choose I2 volumes

7. The next panel in Figure 7-256 displays the Select Copy Sets panel, where you have the chance to Deselect, Select, or Add More Copy Sets.

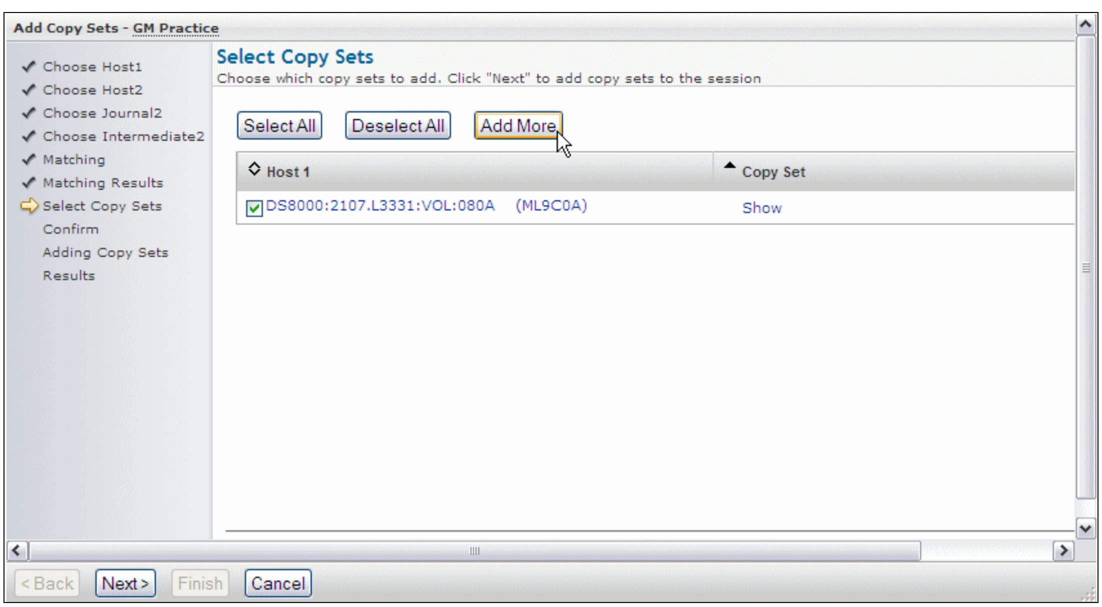

Figure 7-256 Add Copy Sets to Global Mirror FO/FB w/ Practice session - Select Copy Sets

8. After you have added all the Copy Sets that you need, click **Next** to continue, as shown in Figure 7-257.

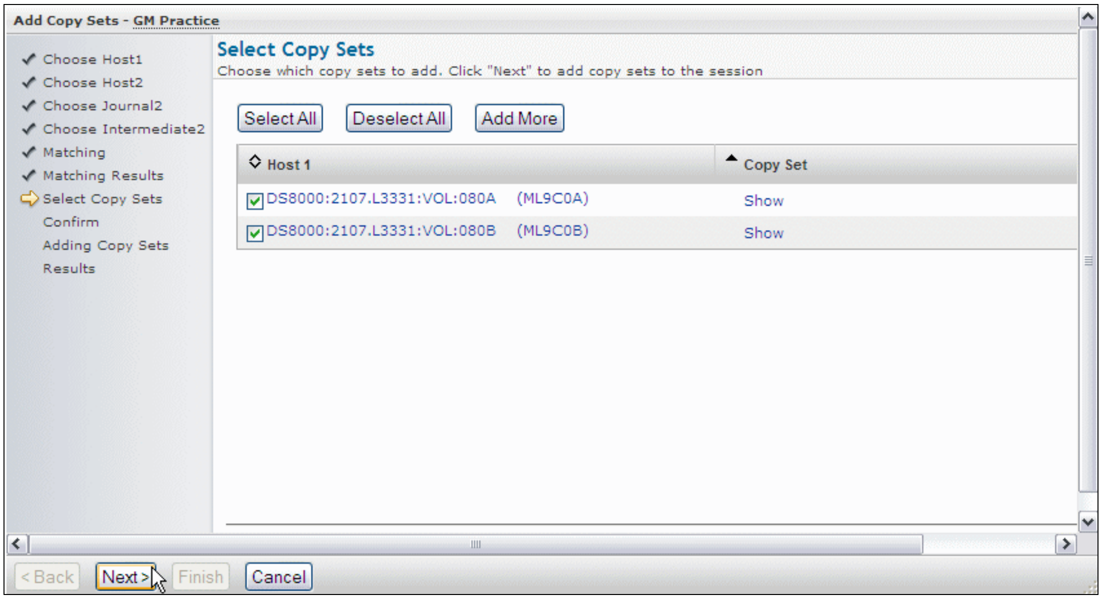

Figure 7-257 Add Copy Sets to Global Mirror FO/FB w/ Practice session - Copy Sets

9. The next panel displays the number of Copy Sets that are going to be created, as shown in Figure 7-258. Click **Next** to continue.

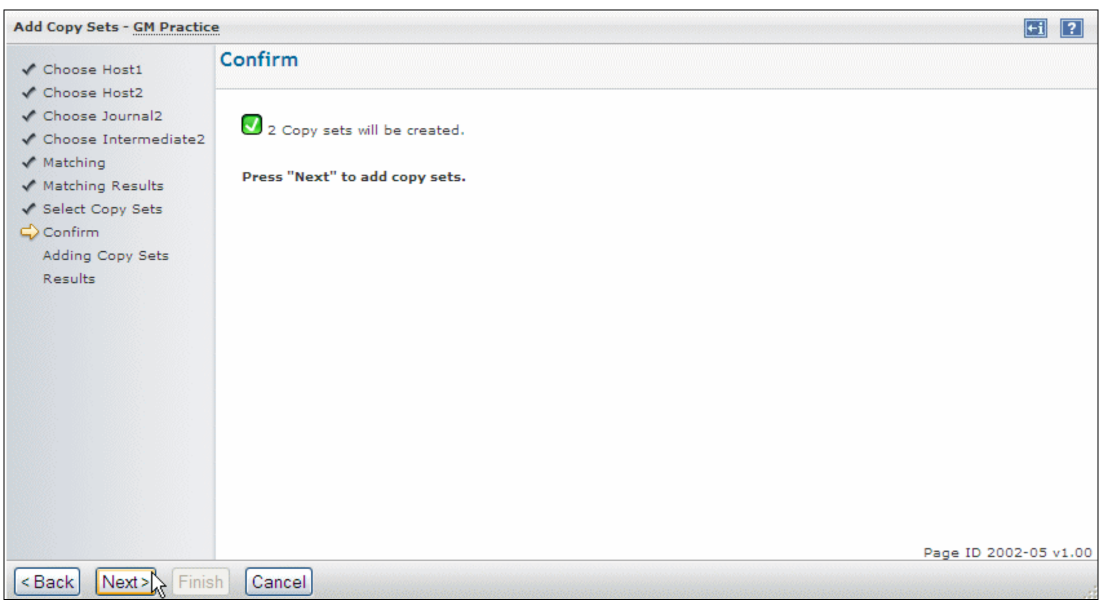

Figure 7-258 Add Copy Sets to Global Mirror FO/FB w/ Practice session - Confirm

10. After a few seconds, Tivoli Storage Productivity Center for Replication displays the Results of the Add Copy Sets operation, as shown in Figure 7-259. Click **Finish** to exit the *Add Copy Sets* wizard.

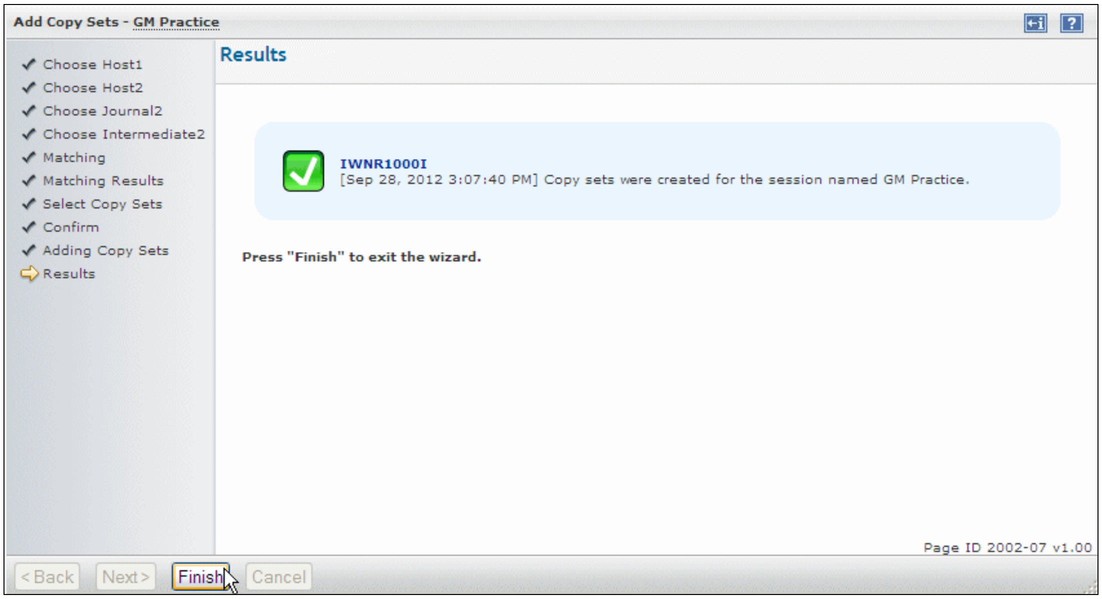

Figure 7-259 All Copy Sets are successfully added to the Tivoli Storage Productivity Center database

11. Figure 7-260 confirms that all Copy Sets are successfully added to the GM Practice session and the database is successfully updated. The session status is still *Inactive* and in *Defined* state.

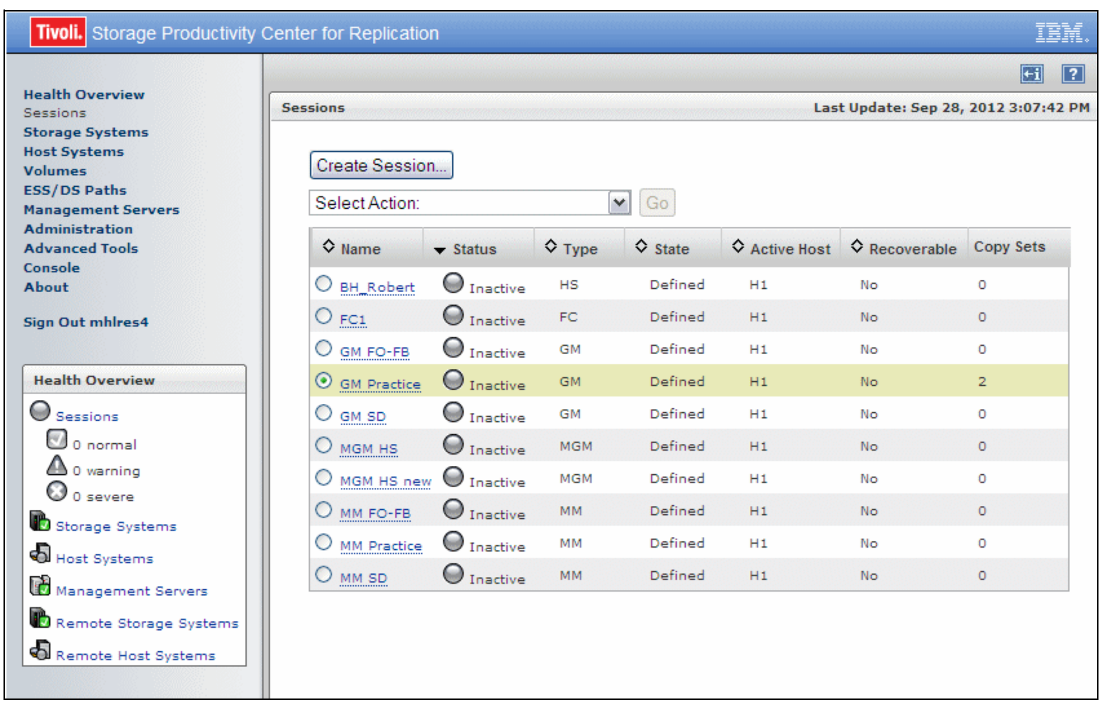

Figure 7-260 Add Copy Sets is completed

This concludes the steps through the GUI when you add Copy Sets to a Global Mirror session.

7.8.3 Starting an H1 → H2 Global Mirror session

After we have defined a Global Mirror session and populated the session with Copy Sets, we can start the Global Mirror session by selecting either one of the following options:

Start H1 → H2 This starts the Global Mirror session.

StartGC H1 → H2 This starts only Global Copy replication between H1 and I2 volumes.

You can choose the StartGC H1 → H2 action if you plan to start the replication between H1 and I2 volumes while a lot of write activity is going on the H1 volumes (the batch window, for example), and you have limited network connectivity between your storage boxes in Site 1 and Site 2. After the copying between H1 and volumes reaches 100%, you can perform the Start H1 → H2 action, in order for your session to begin forming consistency groups. Follow these steps:

1. Figure 7-261 displays the GM Practice session as we defined it previously. We defined only one Copy Set in our example. From the **Select Action** pull-down menu, select **Start H1 → H2** and click **Go**.

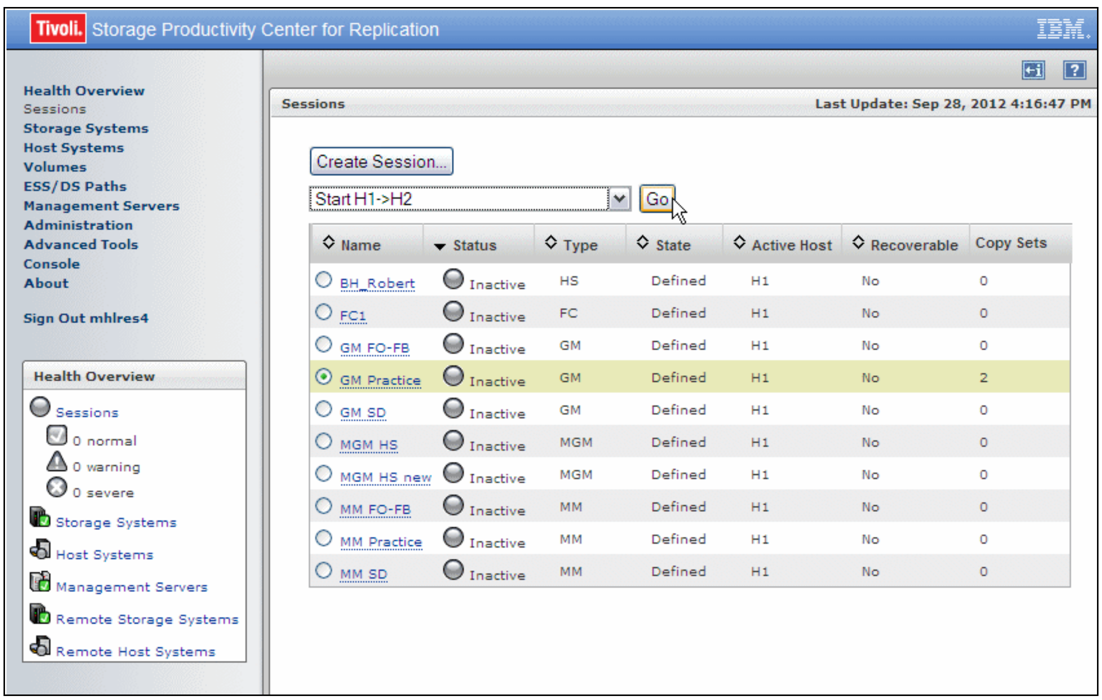

Figure 7-261 Global Mirror session - Start Action

2. The next message shown in Figure 7-262 is a warning that you are about to initiate a Global Mirror session. It will start copying data from Host 1 to Intermediate 2 volumes defined previously by adding the copy set, thus overwriting any data on Intermediate 2 volumes. Furthermore, it will initiate a FlashCopy to J2 journal volumes. At this stage, data on Host 2 volumes is not yet overwritten. Click **Yes** to continue.

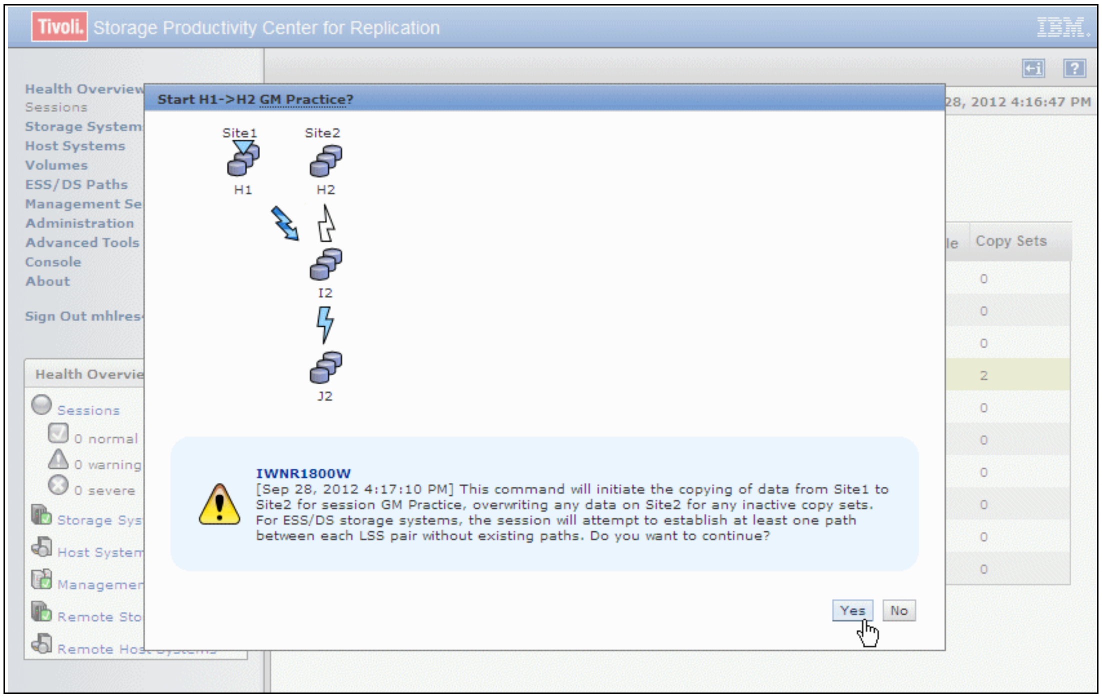

Figure 7-262 Start Global Mirror FO/FB w/ Practice session

3. The message at the top of the panel in Figure 7-263 confirms that Global Mirror session is started. The session is in *Preparing* state and *Warning* status. Click the session name hyperlink (*GM Practice* in our example) to find more details on this session.

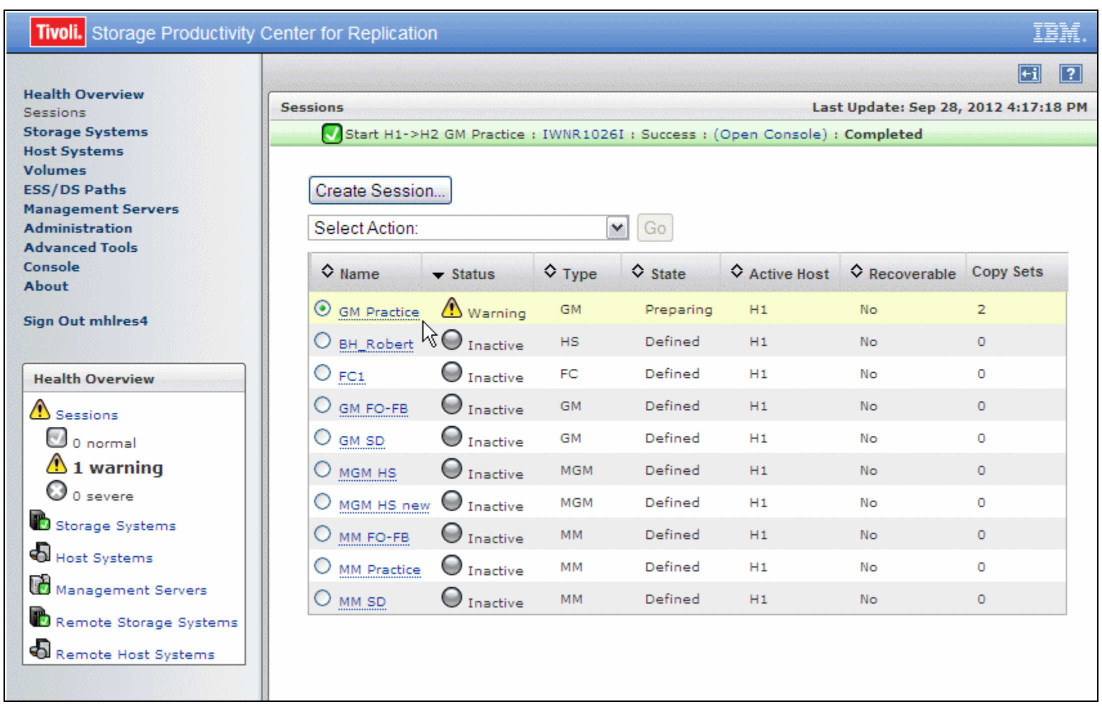

Figure 7-263 Start Global Mirror session is reported as Completed

4. As shown in Figure 7-264, the Global Mirror session is in Warning status. The session is still in *Preparing* state since the copying data between H1 and H2 volumes is still in progress.

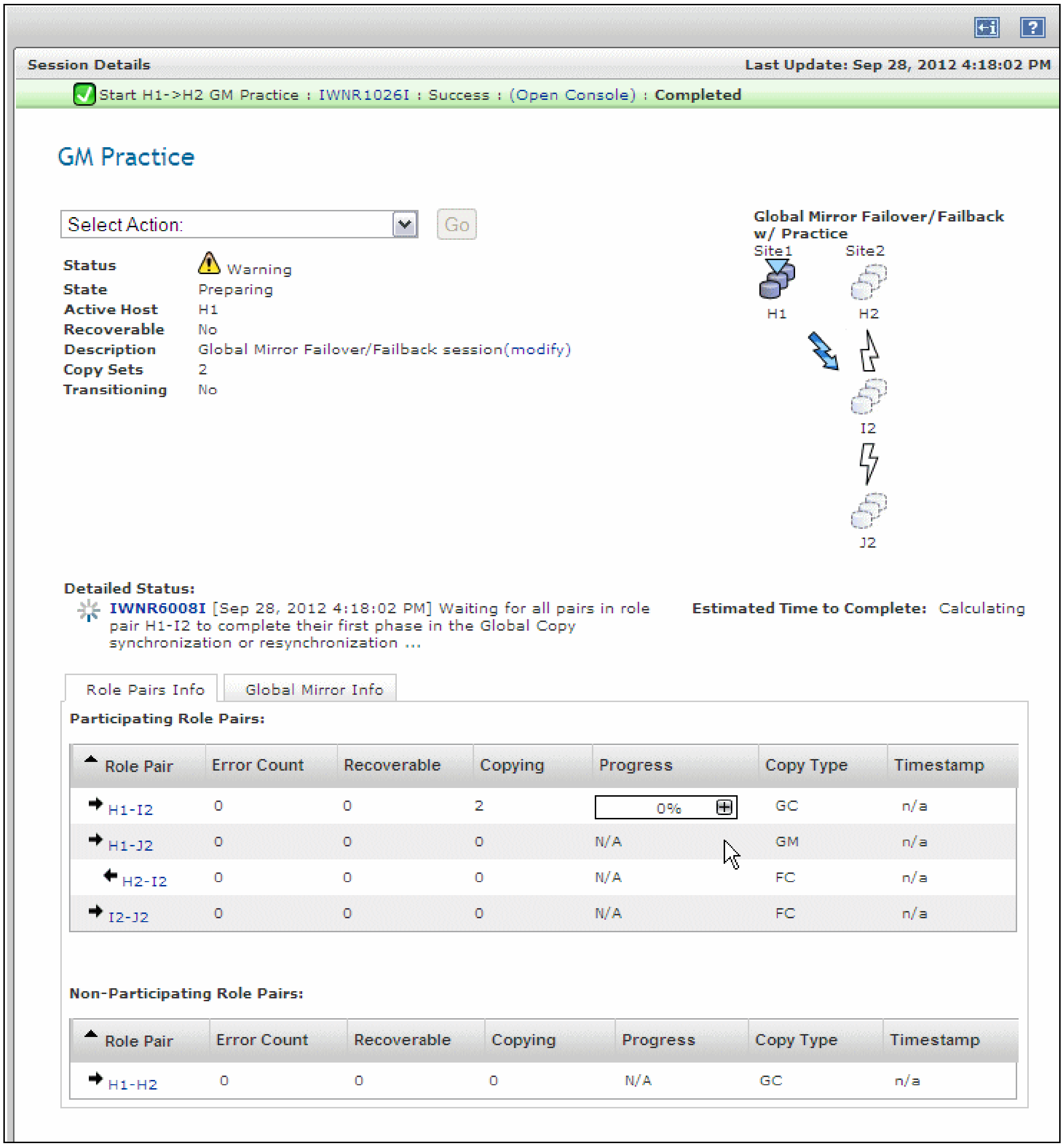

Figure 7-264 Global Mirror session details

5. Wait until session changes to *Normal* status as shown in Figure 7-265. It means that the initial copy has finished and the first consistency group has been created.

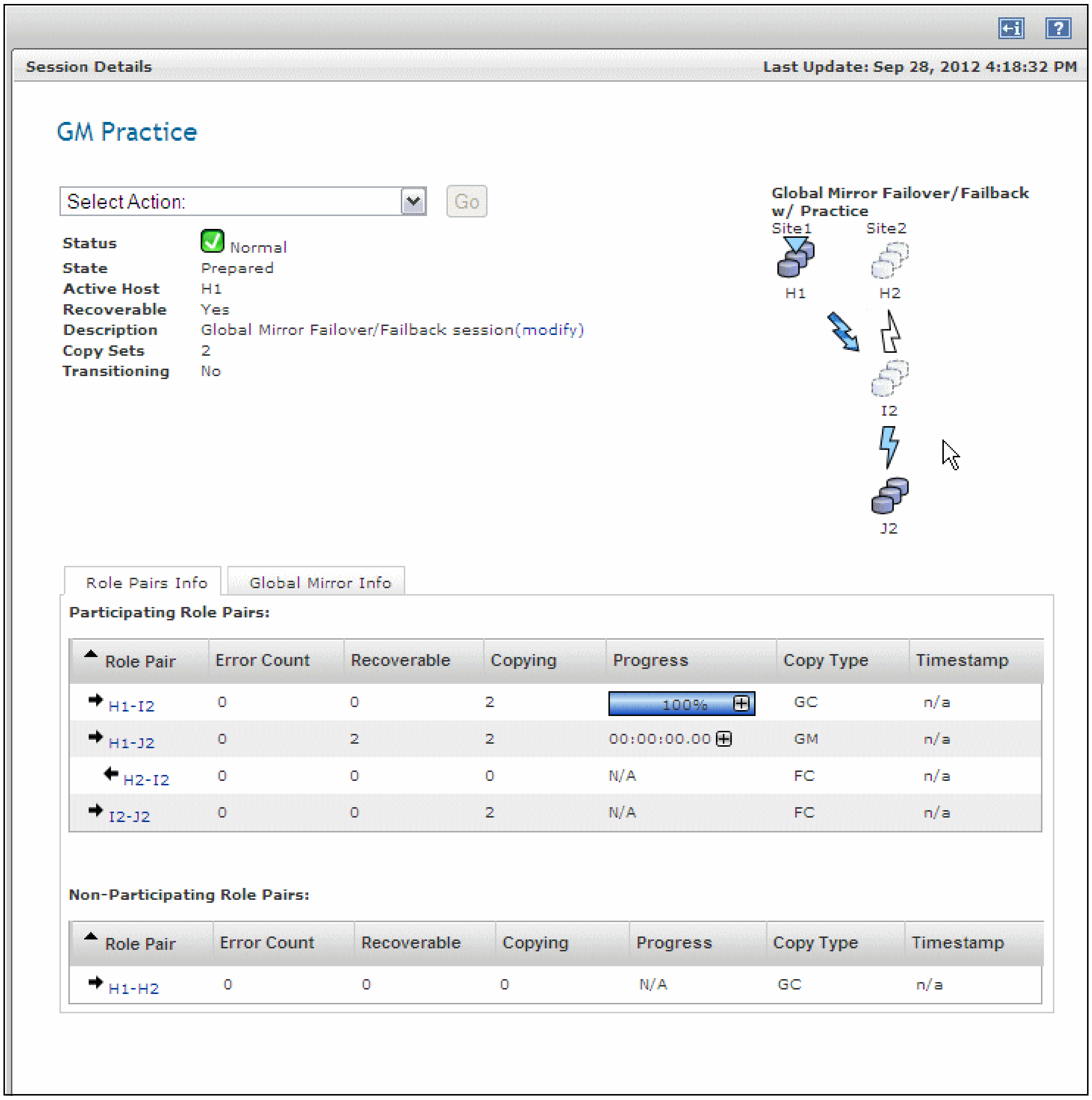

Figure 7-265 GM Failover/Failback w/ Practice session in Prepared State

After the Global Mirror session is started and it has *Normal* status and is in *Prepared* State, the following options are available:

Flash Flashes data from I2 volumes to H2 volumes.

Initiate Background Copy Copies all tracks from I2 volumes to H2 volumes.

Start H1 → H2 Restarts the session.

Suspend Stops copying with consistent I2 volumes.

Terminate Terminates the session (under *Cleanup* submenu).

7.8.4 Flashing a Global Mirror session

Now that the session in prepared state, we can initiate different actions against the Global Mirror session. One of them is **Flash**. With the **Flash** action, you create a consistent copy of I2 volumes on H2 volumes. With this action, you will overwrite data on Host 2 volumes.

> **Attention:** If Host 2 volumes are active on the server, the **Flash** action will fail.

Follow these steps:

1. From the **Sessions** panel, select your Global Mirror session radio button, select **Flash** from the **Select Action** pull-down list, and click **Go** as shown in Figure 7-266.

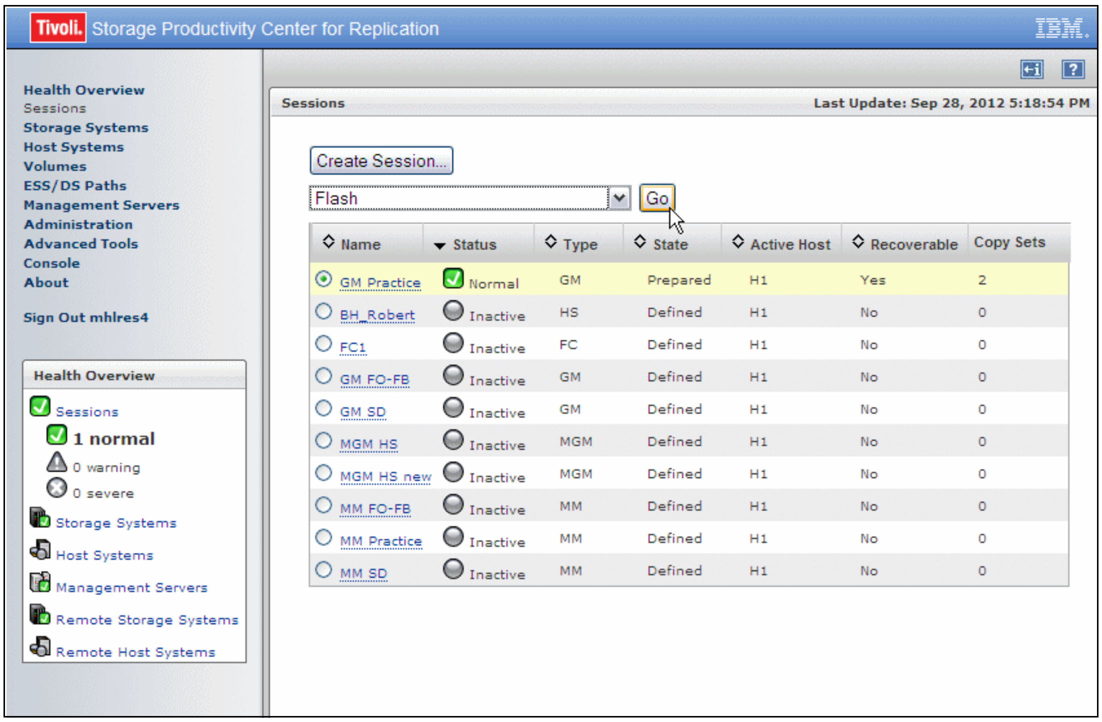

Figure 7-266 Global Mirror session - Flash Action

2. The next message shown in Figure 7-267 is a warning that you are about to Flash a Global Mirror session. Click **Yes** to continue.

Note: Flash copy for H2 volumes is taken from last consistency copy of J2 volumes.

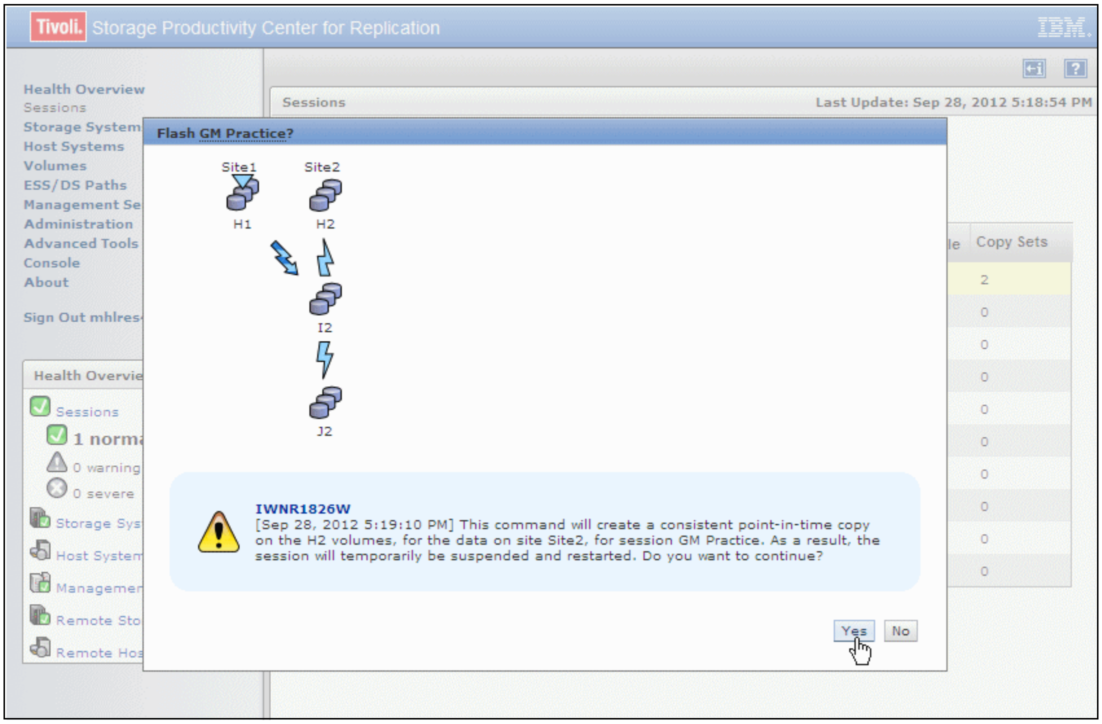

Figure 7-267 Flash Global Mirror session - warning

3. The status of our Global Mirror session briefly changed to *Flashing* status while initial point in time copy was established. After copy is established, session status is returned to *Normal*. In Figure 7-268, you can see the session details after executing the **Flash** action.

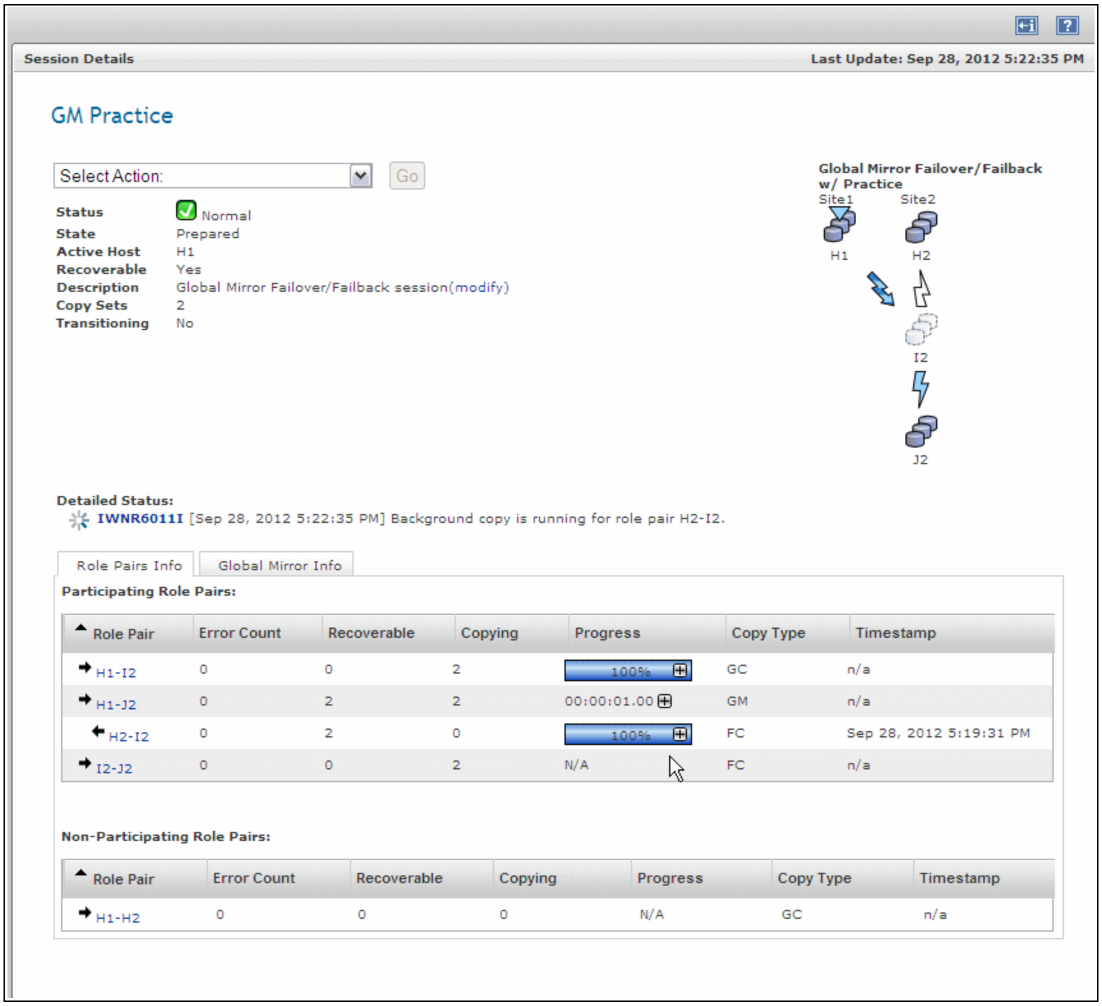

Figure 7-268 Flash Global Mirror session details

In the line of the H2-I2 pair, you can see the timestamp when point in time copy was created. This can be used as a reference.

After **Flash** action completed, you can start using the Host 2 volumes. The point in time copy is created with background copy option. This means it will be copied completely after creation. After it is copied it will not affect the performance of the source volumes.

You can use **Flash** action anytime in the life span of the session.

7.8.5 Initiating Background Copy

You can perform the Initiate Background Copy action in order to get a point in time copy of the I2 volumes in the H2 volumes, if you had specified the *No Copy* option in **DS FlashCopy Options for Role pair H2-I2** in the Properties for the session. Follow these steps:

1. From the Sessions panel, select the session you are working on, then choose **Initiate Background Copy** from the **Selection Action** pull-down menu, as shown in Figure 7-269.

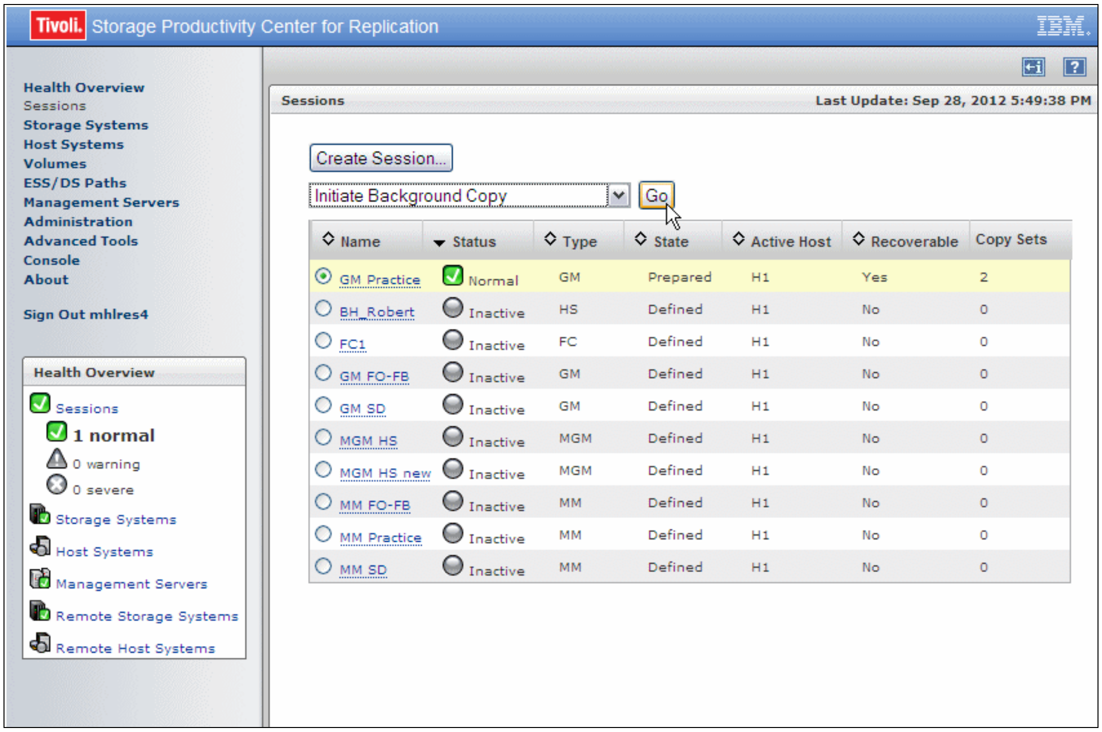

Figure 7-269 Initiate Background Copy

2. Tivoli Storage Productivity Center for Replication shows you a warning that it is about to initiate background copy of data that was flashed with No Copy option as shown in Figure 7-270. Click **Yes** to initiate the background copy.

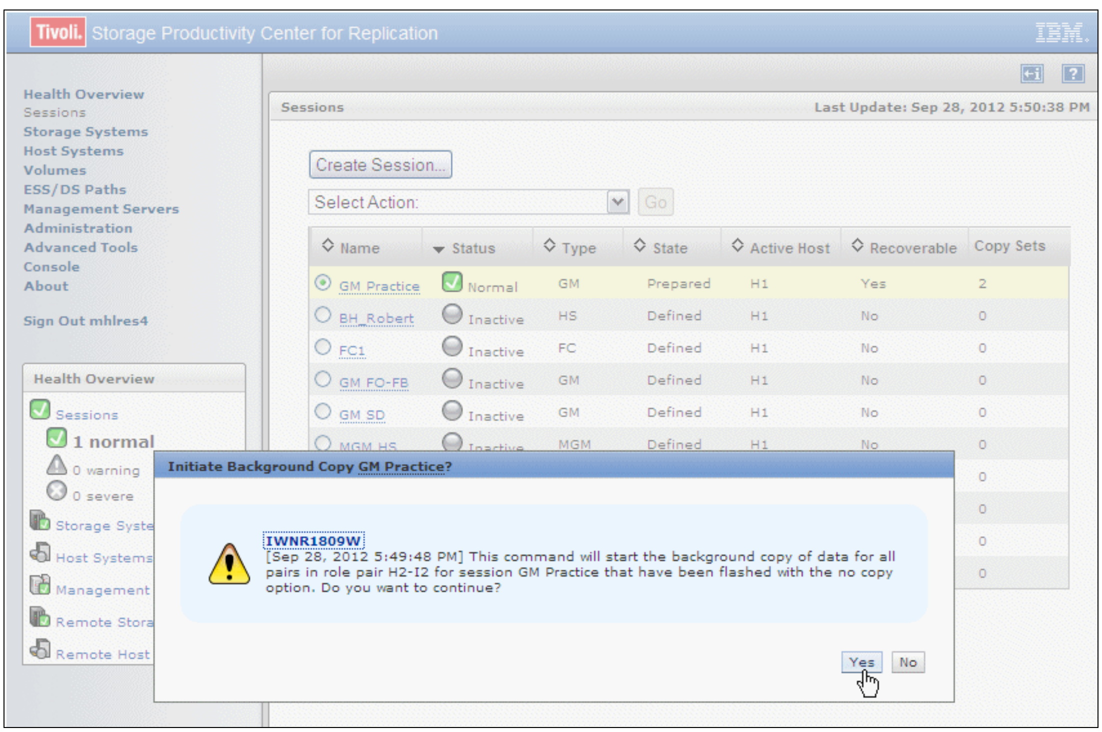

Figure 7-270 Initiate background copy warning

3. Tivoli Storage Productivity Center for Replication shows you a message while the background copy is going on, as seen in Figure 7-271.

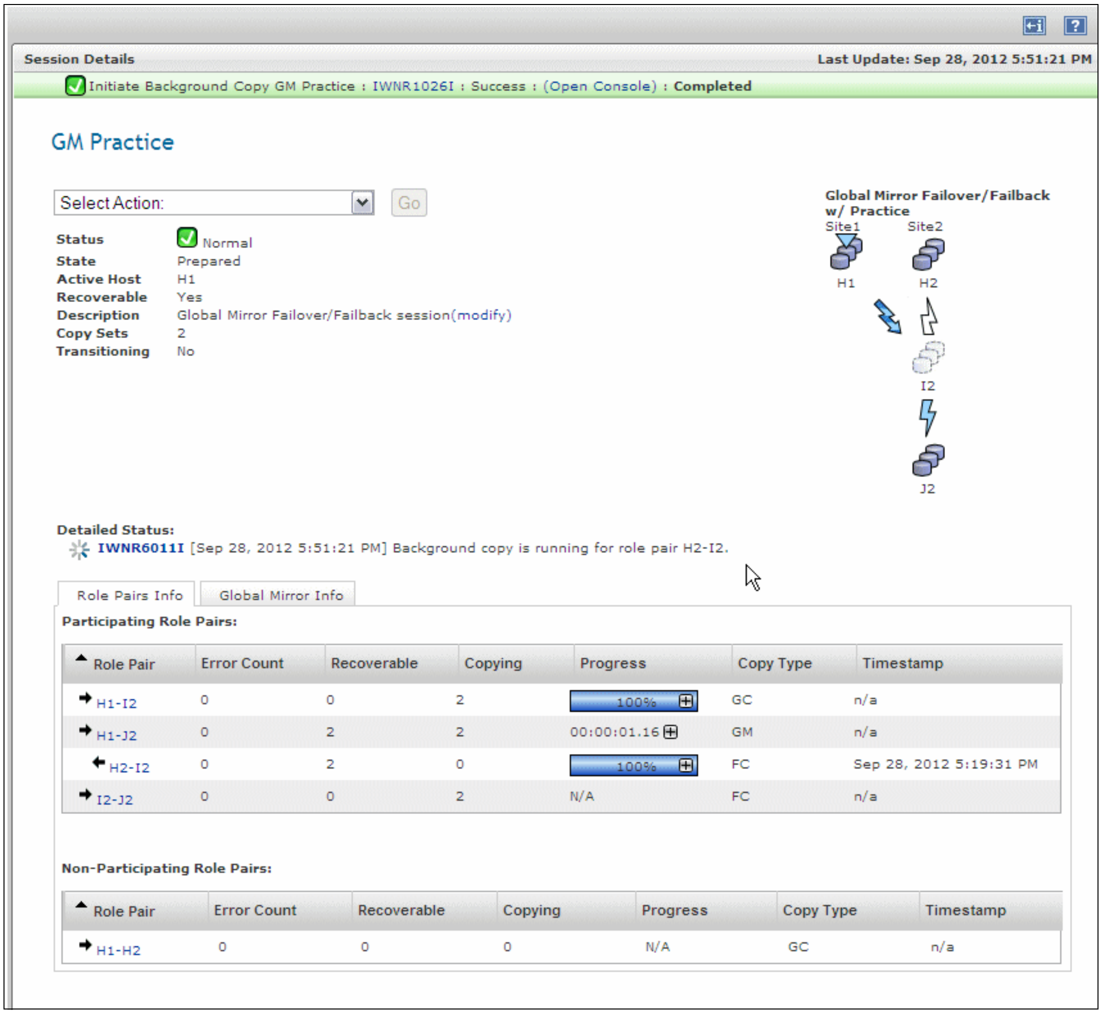

Figure 7-271 Background copy running

The FlashCopy relationship between I2 and H2 volumes ends as soon as all tracks are copied from I2 to H2 volumes.

7.8.6 Suspending a Global Mirror session

Now that the volumes of the Copy Set are in Global Mirror session and *Prepared* state and *Normal* status, we can initiate different actions against the Global Mirror session. One of them is **Suspend**. Follow these steps:

1. From the **Sessions** panel, select your Global Mirror session radio button, select **Suspend** from the **Action** pull-down list, and click **Go** as shown in Figure 7-272.

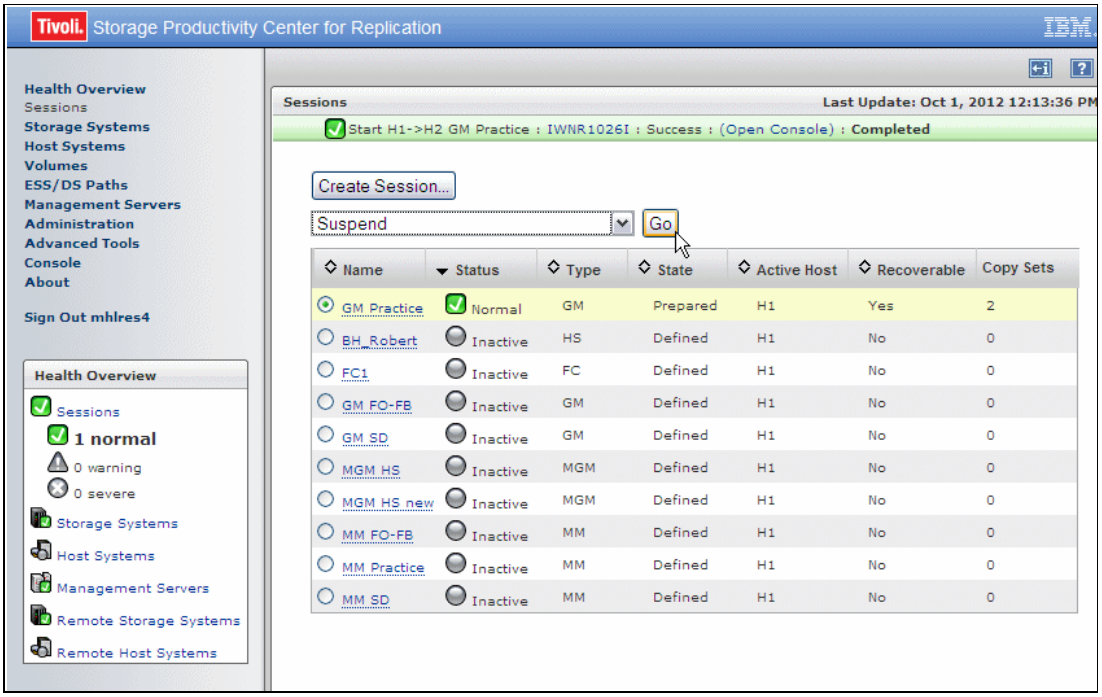

Figure 7-272 Global Mirror session - Suspend Action

2. The next message shown in Figure 7-273 is a warning that you are about to **Suspend** Global Mirror session. Click **Yes** to continue.

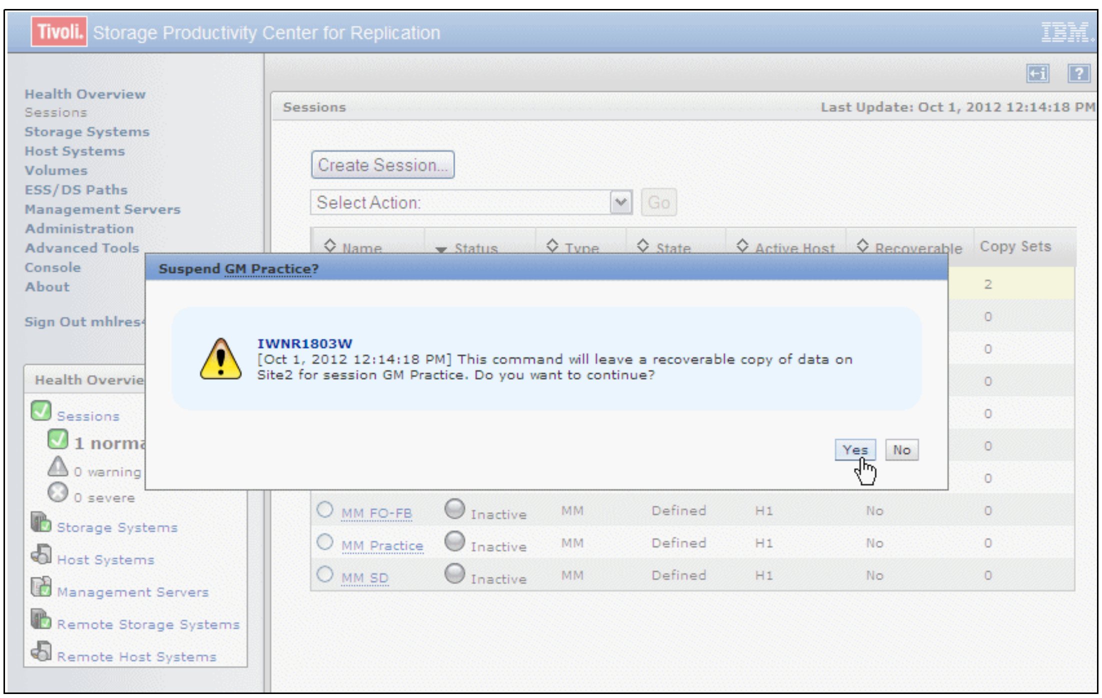

Figure 7-273 Suspend Global Mirror session

3. The status of our Global Mirror session has changed from *Normal* to *Severe* status, indicating that data is no longer being replicated between Host 1 and Intermediate 2 volumes. The state of the session is *Suspended* as indicated in Figure 7-274.

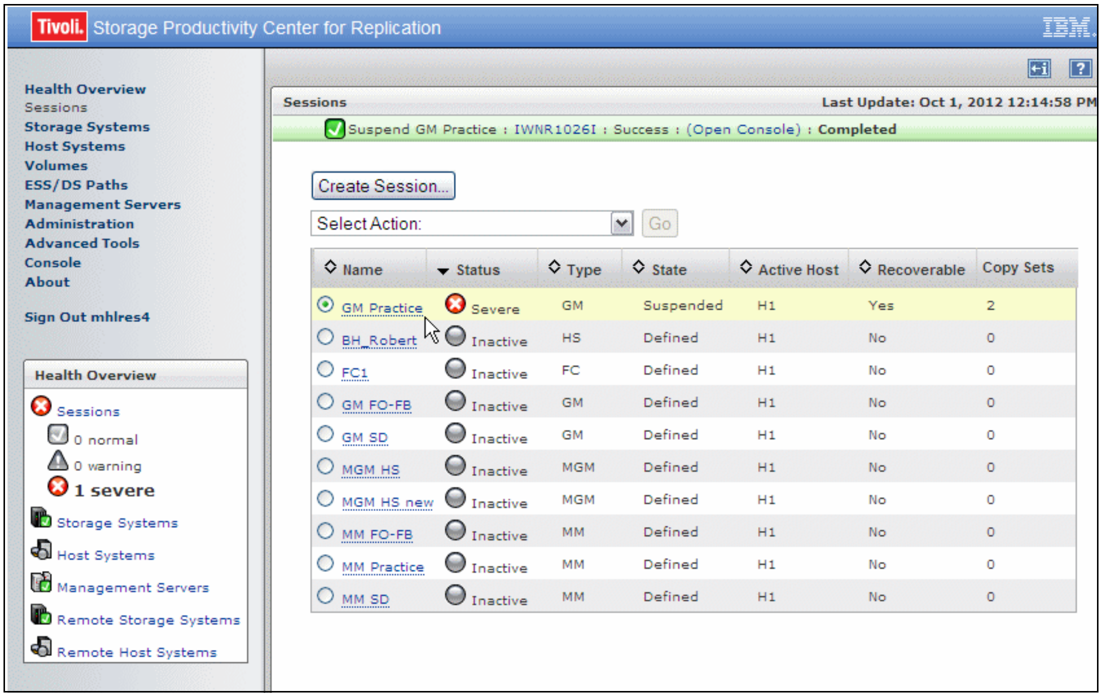

Figure 7-274 Suspend Global Mirror session is reported as Completed

In Figure 7-275, you can see the session details after executing a **Suspend** action.

In the line of the H1-J2 pair, you can see the timestamp when the session was suspended. This can be used as a reference.

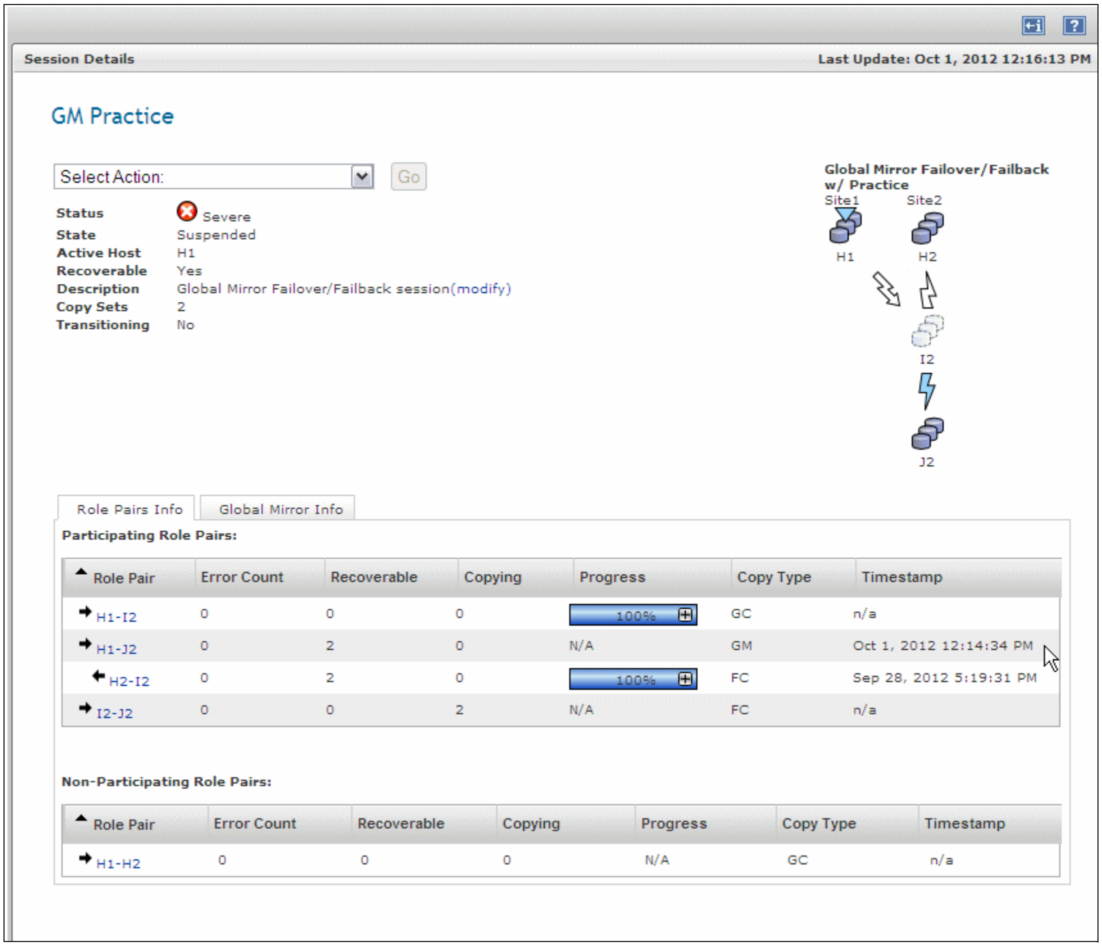

Figure 7-275 Suspend Global Mirror session details

After the Global Mirror session is suspended, the following options are available:

Initiate Background Copy Copies all tracks from I2 volumes to H2 volumes.

Recover Makes target (secondary) volumes available for host access.

Start H1 → H2 Restarts the Global Mirror session.

StartGC H1 → H2 Restarts replication between H1 and I2 volumes in Global Copy mode.

Terminate Terminates the session (under *Cleanup* submenu).

7.8.7 Recovering a Global Mirror session

After the Global Mirror session and its associated Copy Sets have been suspended, we can initiate a **Recover** action. Follow these steps:

1. Select the Global Mirror session radio button (GM Practice in our example, as shown in Figure 7-276), and the **Recove**r action from the **Select Action** pull-down menu. Click **Go** to continue.

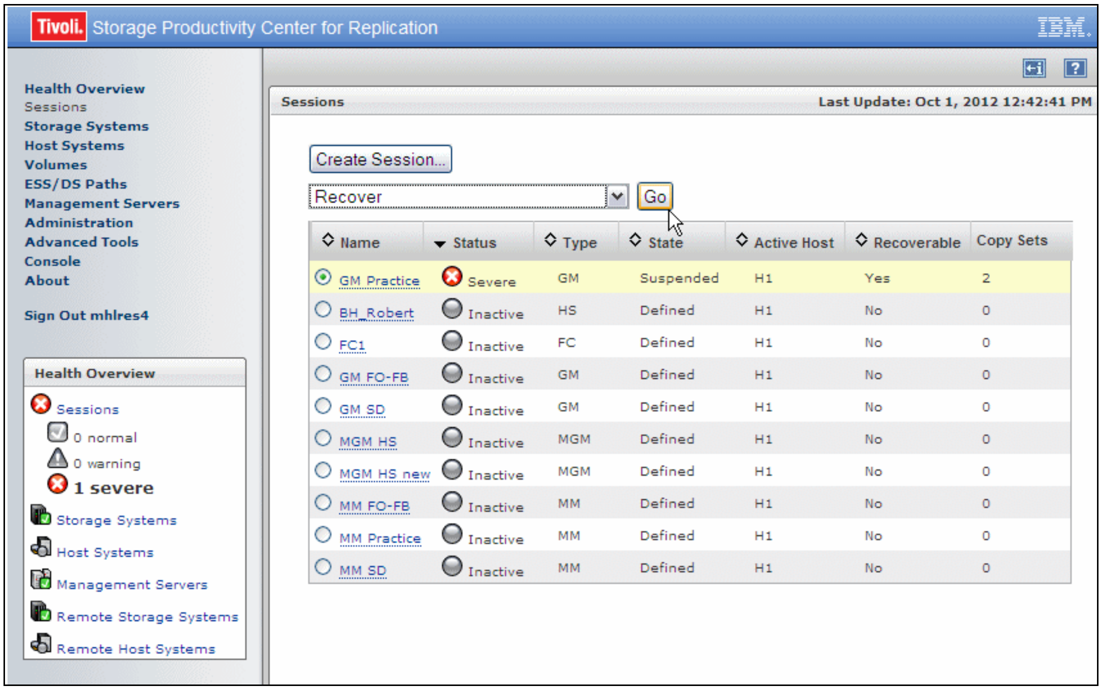

Figure 7-276 Global Mirror session - Recover action

2. The next message shown in Figure 7-277 is a warning that you will allow H2 volumes available to your host. Click **Yes** to continue.

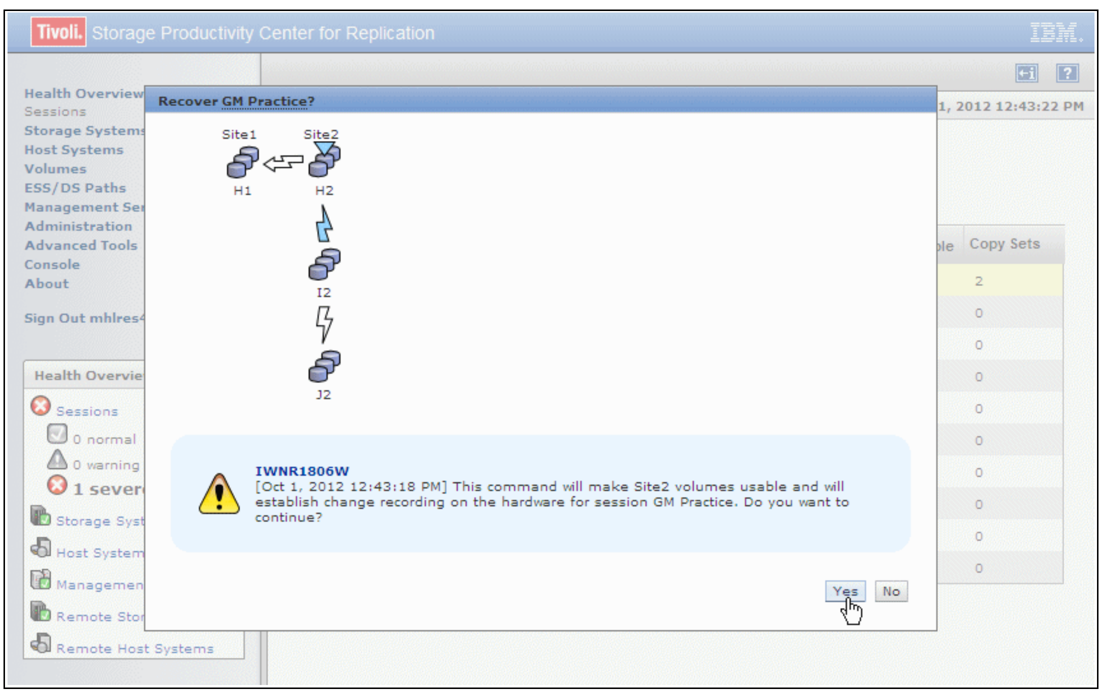

Figure 7-277 Recover Global Mirror Session

3. There is a message at the top of the panel in Figure 7-278 indicating that a **Recover** action has been successfully completed. The status of our Global Mirror session is *Normal* and the State is *Target Available*, indicating that H2 volumes are available to your host.

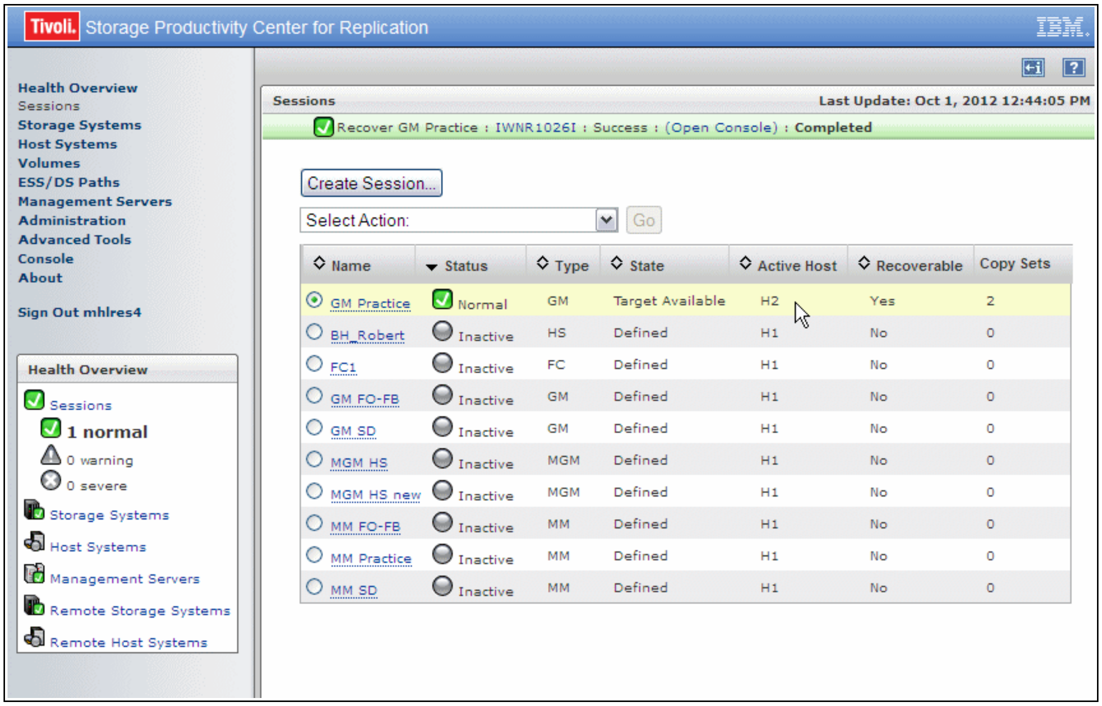

Figure 7-278 Global Mirror session - H2 storage subsystem volume available to host

After the Global Mirror session is recovered in *Target Available* state, the following options are available:

Flash
: Creates consistent point in time copy on H2 volumes.

Initiate Background Copy
: Copies all tracks from I2 volumes to H2 volumes.

Start H1 → H2
: Restarts the Global Mirror session.

StartGC H1 → H2
: Restarts the replication between H1 and I2 volumes in Global Copy mode.

Enable Copy to Site 1
: Before reversing the direction of copying in a failover and failback session, you must run this command, and confirm that you want to reverse the direction of replication. It enables **Start H2 → H1** command.

Terminate
: Terminates the session (under *Cleanup* submenu).

7.8.8 Enabling Copy to Site 1

After a **Recover** action, Host 2 volumes are active. As Site 2 is now the active site, you can reverse the direction of copying in a Global Mirror Failover/Failback session. Follow these steps:

1. Before you can initiate copying from Host 2 to Host 1 volumes, you need start the **Enable Copy to Site 1** command. To achieve this, from the **Select Action** pull-down menu, select **Enable Copy to Site 1** and click **Go** as shown in Figure 7-279.

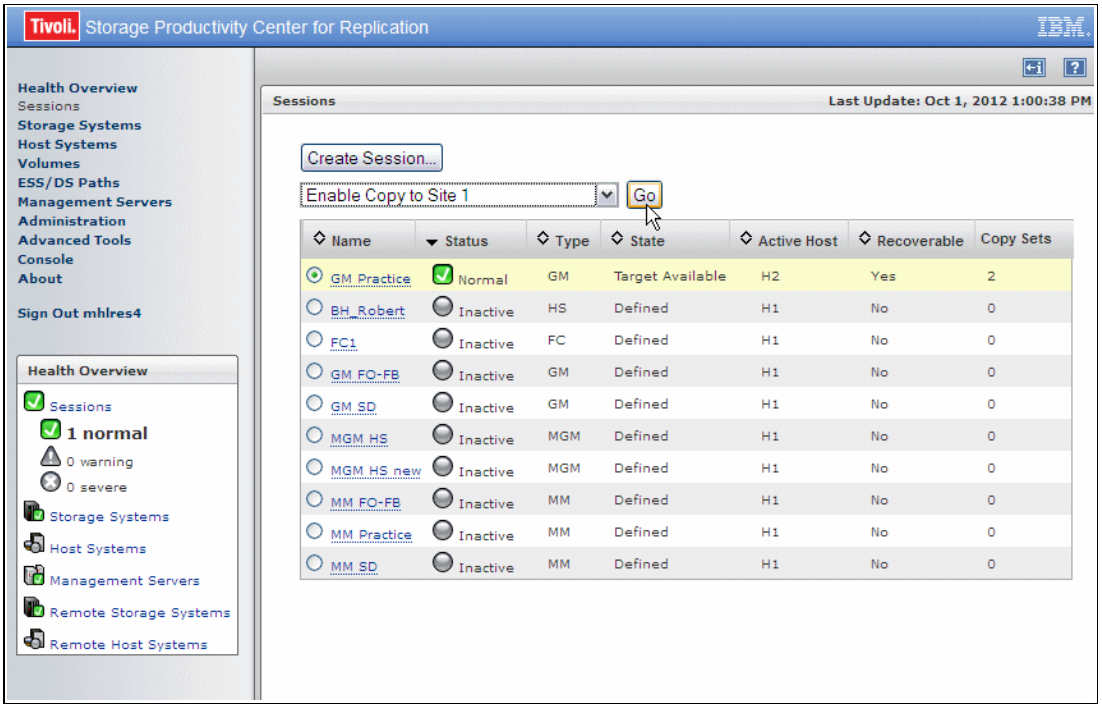

Figure 7-279 Global Mirror session - Enable Copy to Site 1

2. The next message shown in Figure 7-280 is a warning that you are about to enable the command that initiates copying data from H2 to H1 volumes. This command is disabled to protect against accidentally copying over production data. Ensure that all of the volumes in this session located at Site 1 are not being used by any application prior to enabling the command that allows copying data to Site 1. Click **Yes** to continue.

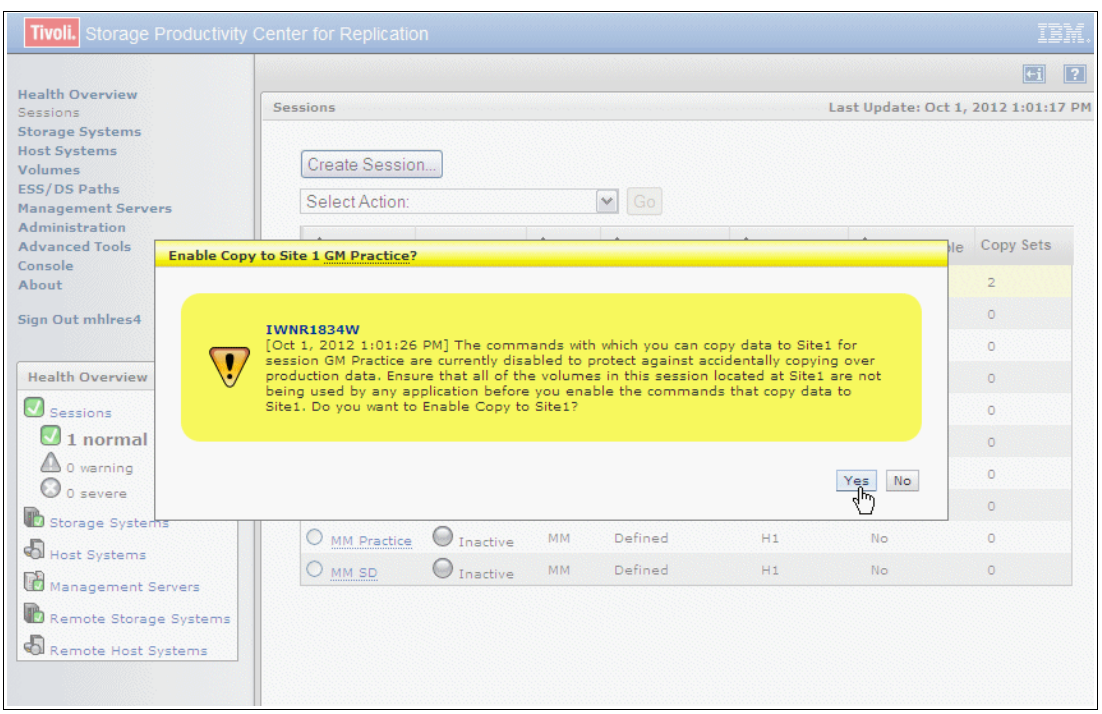

Figure 7-280 Enable Copy to Site 1

3. The message at the top of the panel in Figure 7-281 confirms that the Enable Copy to Site 1 command is completed. The status of our Global Mirror session is the same as it was after the **Recover** command: *Normal* status and *Target Available* state, indicating that the H2 volume is available to your host.

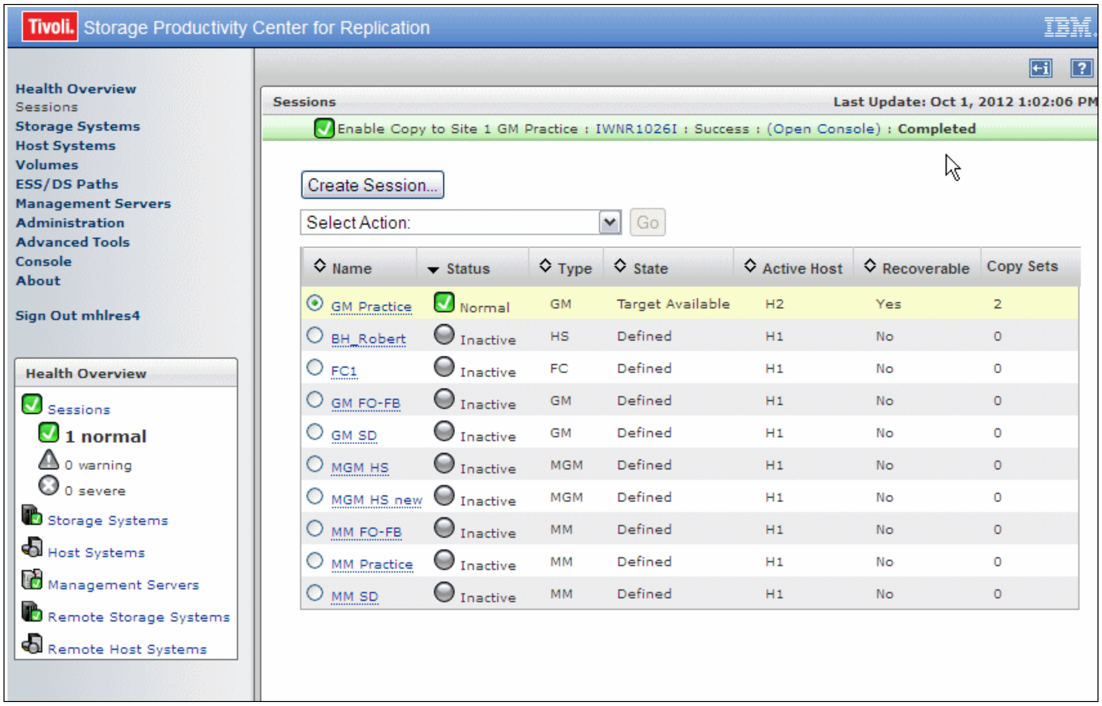

Figure 7-281 Enable Copy to Site 1 is reported as Completed

The following options are available at this stage:

Flash Creates a consistent point in time copy on H2 volumes.

Initiate Background Copy Copies all tracks from I2 volumes to H2 volumes.

Start H2 → H1 Restarts copying from H2 to H1 volumes.

Re-enable Copy to Site 2 Re-enables replication from Site 1 to Site 2.

Terminate Terminates the session (under *Cleanup* submenu).

7.8.9 Starting H2 → H1

After a **Recover** action, and the **Enable Copy to Site 1** command, Host 2 volumes are active. Follow these steps:

1. As Host 2 site is now the active site, you can initiate copying from Host 2 to Host 1 volumes. To achieve this, from the **Select Action** pull-down menu, select **Start H2 → H1** and click **Go** as shown in Figure 7-282.

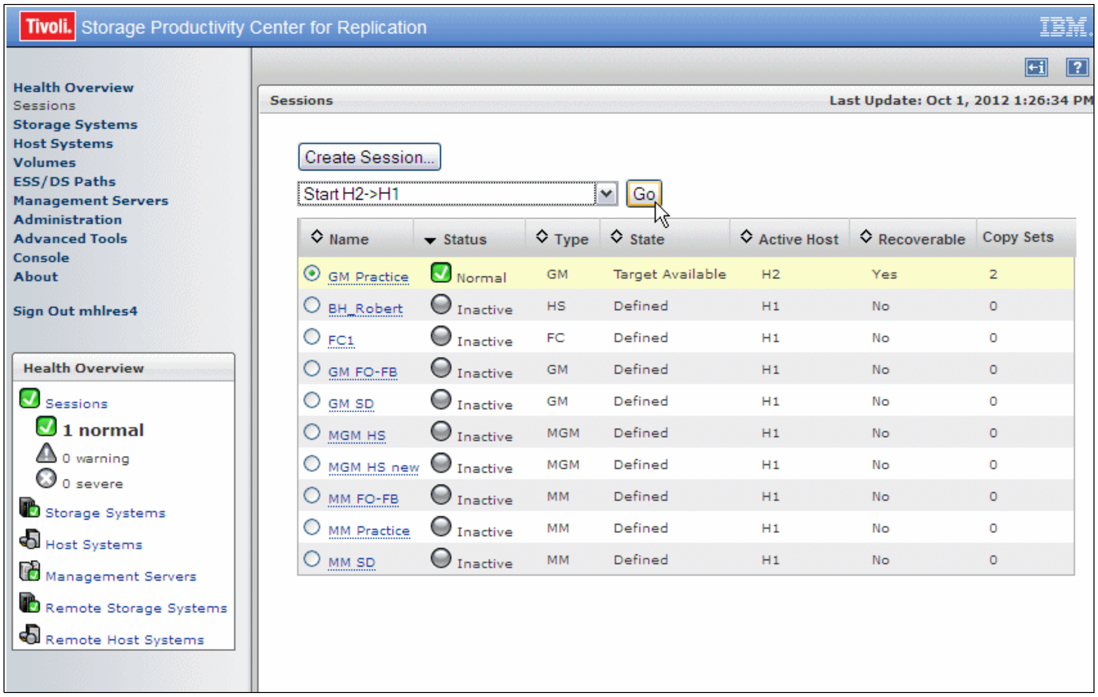

Figure 7-282 Global Mirror session - Start H2 → H1 Action

2. The next message shown in Figure 7-283 is a warning that you are about to initiate the start of the Global Mirror session. It will start copying of data from Host 2 to Host 1 volumes, thus overwriting any data on Host 1 volumes. At this stage, data on Intermediate 2 volumes is not changed. Click **Yes** to continue.

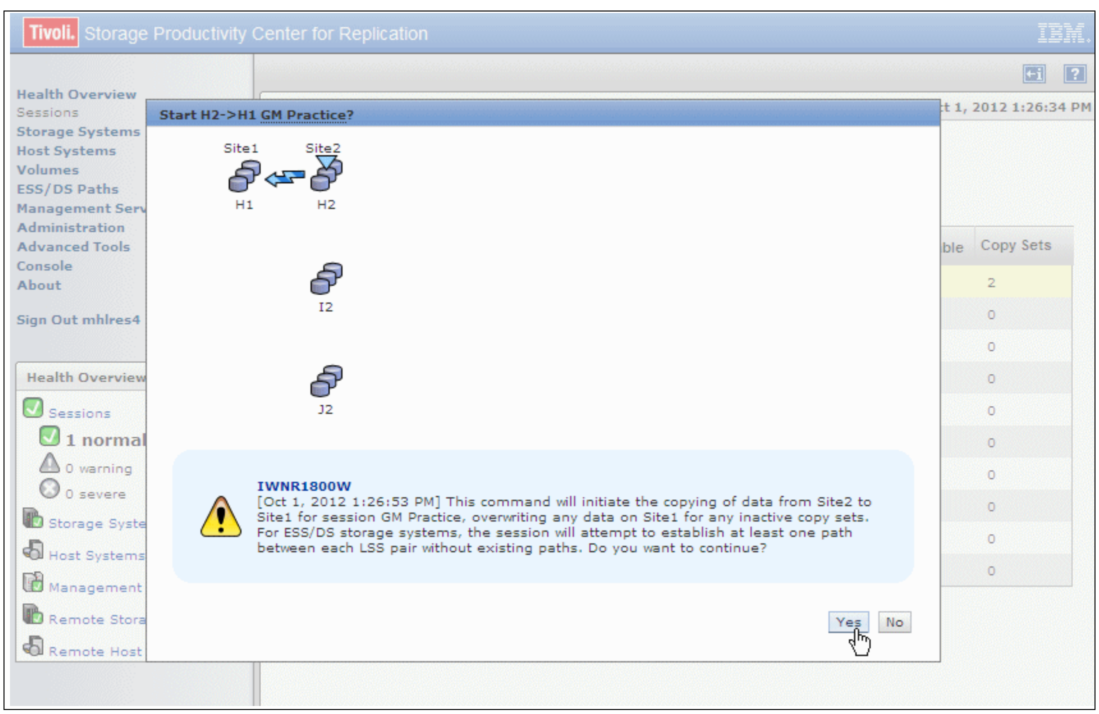

Figure 7-283 Start H2 → H1 Global Mirror FO/FB w/ Practice session

3. The message at the top of the panel in Figure 7-284 confirms that start of the Global Mirror session is completed. The session is in *Preparing* state and *Warning* status. Click the session name hyperlink (*GM Practice* in our example) for more details on this session.

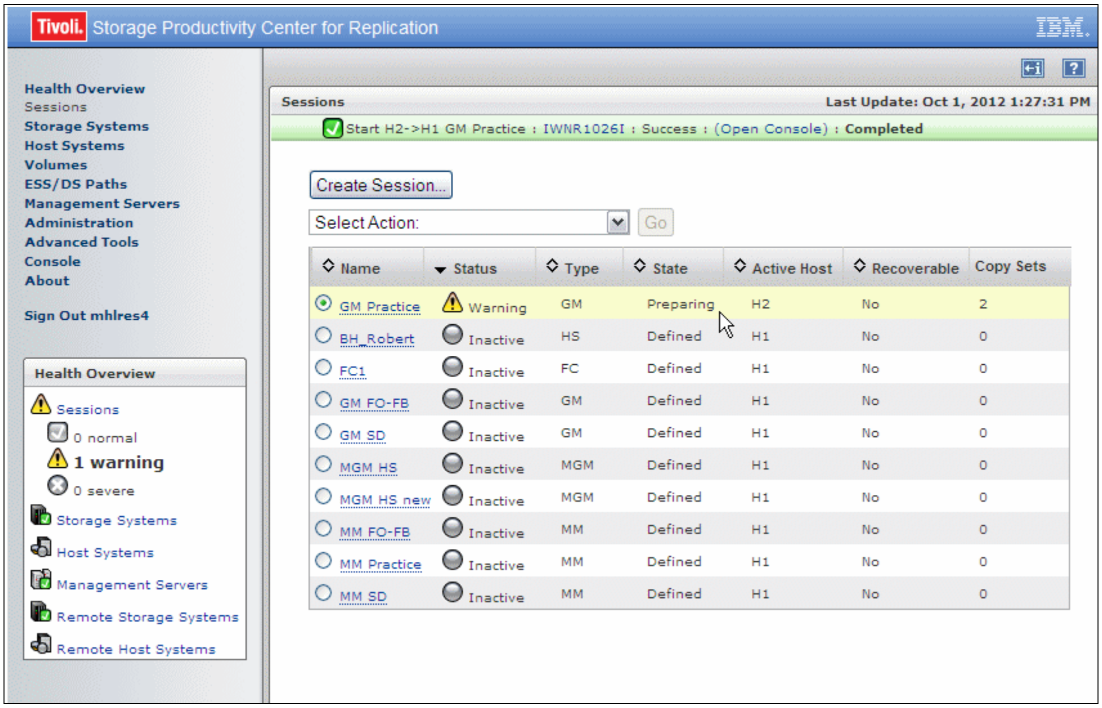

Figure 7-284 Start of H2 to H1 replication reported as Completed

Note: After starting the session from H2 → H1, the session will forever stay in *Preparing* state. The reason for this is that there is no journal volume at Site 1 where consistent copy could be formed. If you want to switch back to the H1 site, you need to stop I/O on the H2 volumes and suspend the session. This will cause that all data which is not yet copied from H2 to H1 volumes to be copied. After the session is suspended, you can recover it back to H1 volumes.

After start of the session in direction H2 → H1 is completed, the following options are available:

Initiate Background Copy	Copies all tracks from I2 volumes to H2 volumes.
Start H2 → H1	Restarts copying from H2 to H1 volumes.
Suspend	Stops copying with consistent H1 volumes.
Terminate	Terminates the session (under *Cleanup* submenu).

7.8.10 Suspending a Global Mirror session (after Start H2 → H1)

After you have started the session from H2 to H1, you can suspend it. This is required to activate H1 volumes and reverse data replication from H1 to H2 volumes. Follow these steps:

1. Before suspending the replication from H2 to H1 volumes, you must stop your application systems. After stopping the application systems, you should allow some time for all the updated tracks in H2 volumes to be replicated to H1 volumes.

2. From the *Sessions* panel, select your Global Mirror session radio button, select **Suspend** from the **Action** pull-down list, and click **Go** as shown in Figure 7-285.

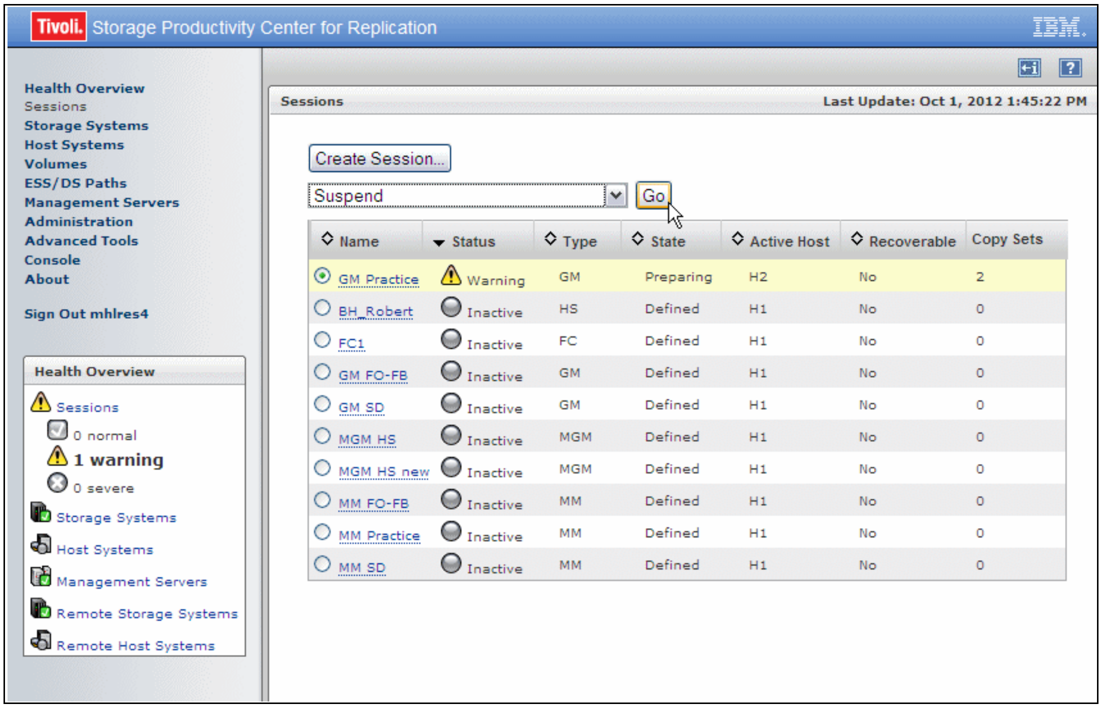

Figure 7-285 Global Mirror session - Suspend Action

3. The next message shown in Figure 7-286 is a warning that you are about to Suspend Global Mirror session. Click **Yes** to continue.

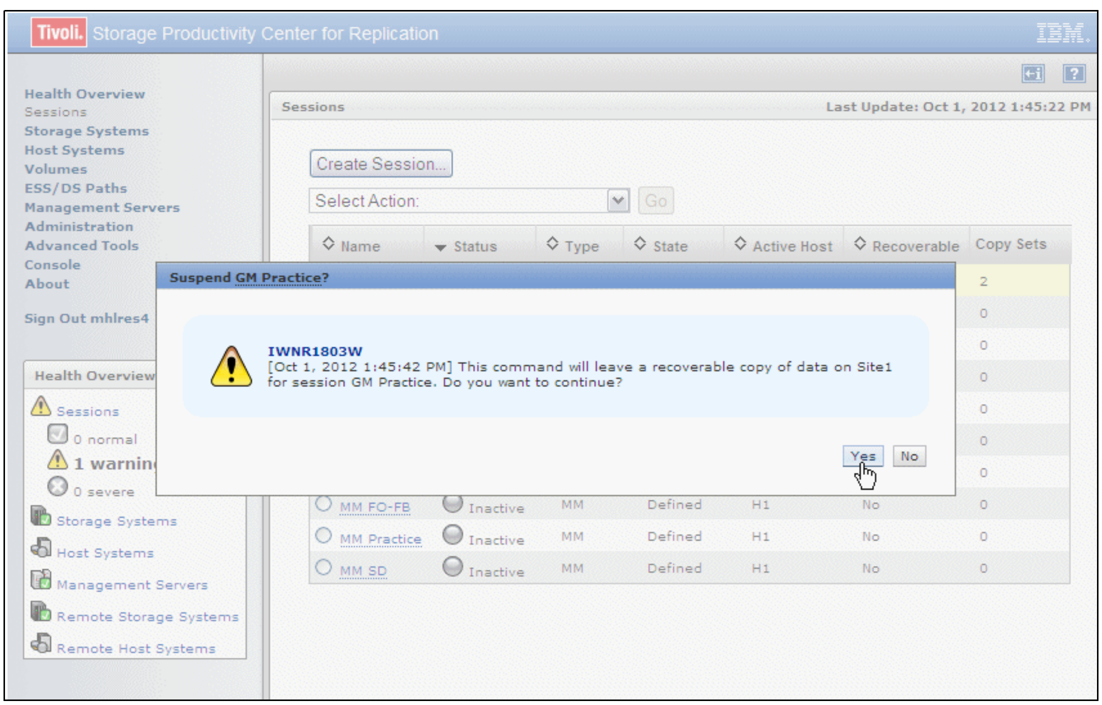

Figure 7-286 Suspend Global Mirror session

4. The status of our Global Mirror session has changed from *Normal* to *Severe* status, indicating that data is not replicated anymore between Host 2 and Host 1volumes. Before getting to suspended status, all H2 and H1 volumes were synchronized. The state of the session is *Suspended* as indicated in Figure 7-287.

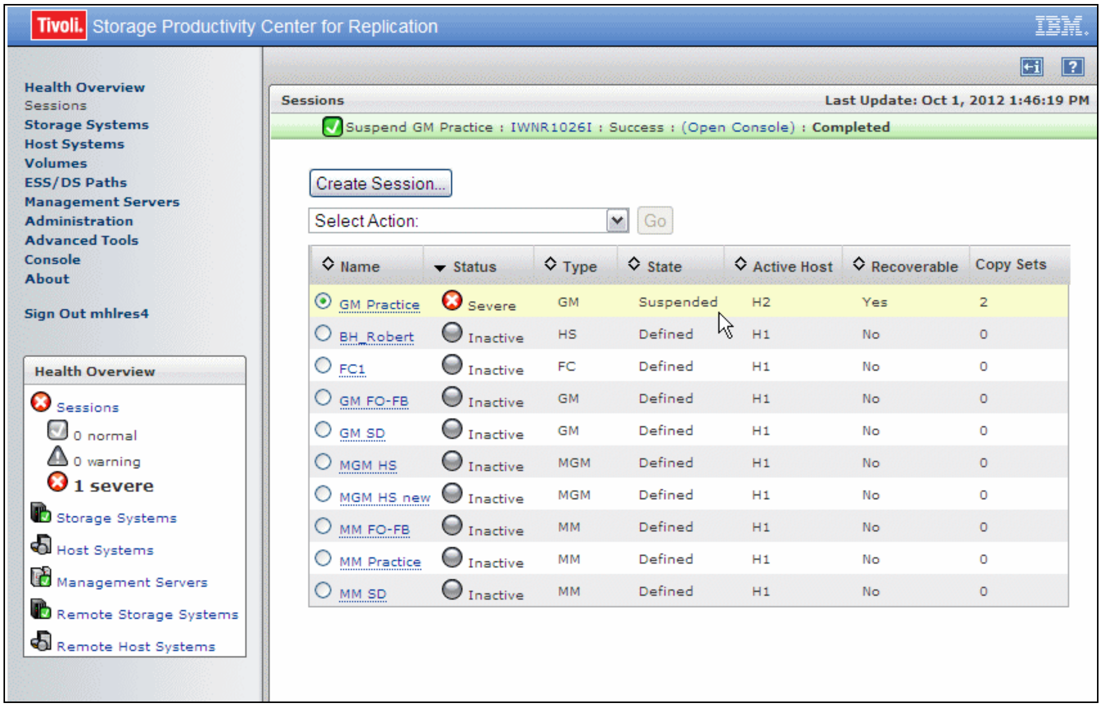

Figure 7-287 Suspend Global Mirror session is reported as Completed

In Figure 7-288, you can see the session details after executing the **Suspend** action.

In the line of the H1-H2 pair, you can see the timestamp when the session was suspended. This can be used as a reference.

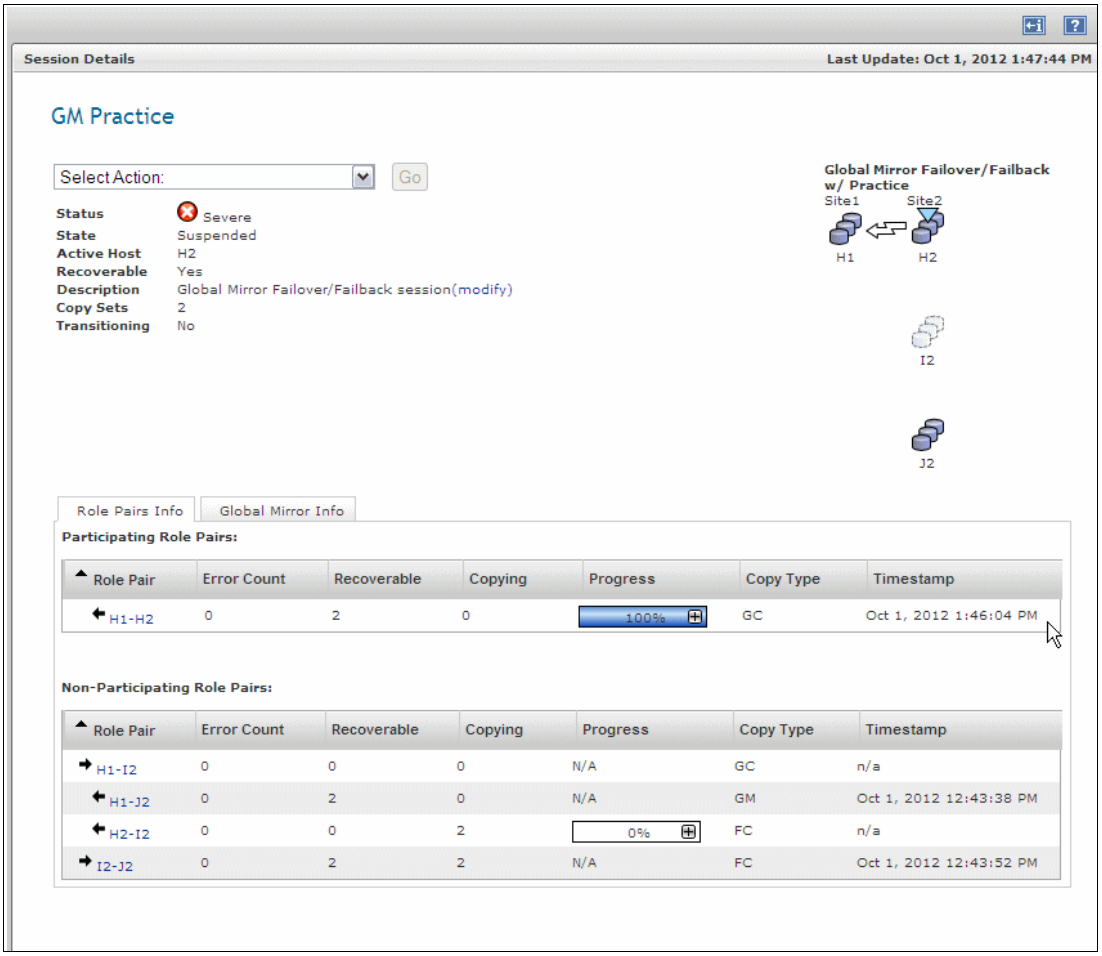

Figure 7-288 Suspend Global Mirror session details

After the Global Mirror session is suspended, the following options are available:

Initiate Background Copy Copies all tracks from I2 volumes to H2 volumes.

Start H2 → H1 Restarts copying from H2 to H1 volumes.

Terminate Terminates the session.

Recover Makes H1 volumes available for application systems.

7.8.11 Recovering a Global Mirror session (after Start H2 → H1)

After suspending session in direction H2 to H1, you need to execute Recover to activate H1 volumes in order for them to be available to your application systems. After the Global Mirror session and its associated Copy Sets have been suspended, you can initiate a **Recover** action. Follow these steps:

1. Select the Global Mirror session radio button (GM Practice in our example shown in Figure 7-289) and the **Recover** action from the **Select Action** pull-down menu. Click **Go** to continue.

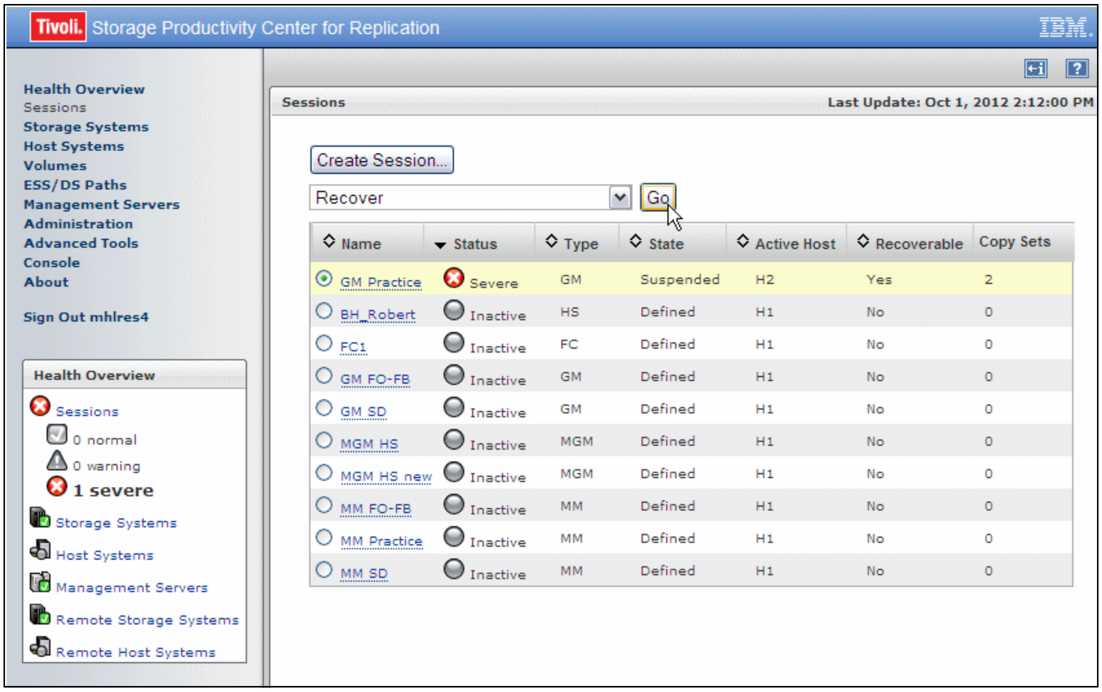

Figure 7-289   Global Mirror session - Recover action

2. The next message shown in Figure 7-290 is a warning that you will allow H1 volumes available to your host. Click **Yes** to continue.

> **Note:** Before executing a **Recover** action, the H2 volumes must be offline to your application systems.

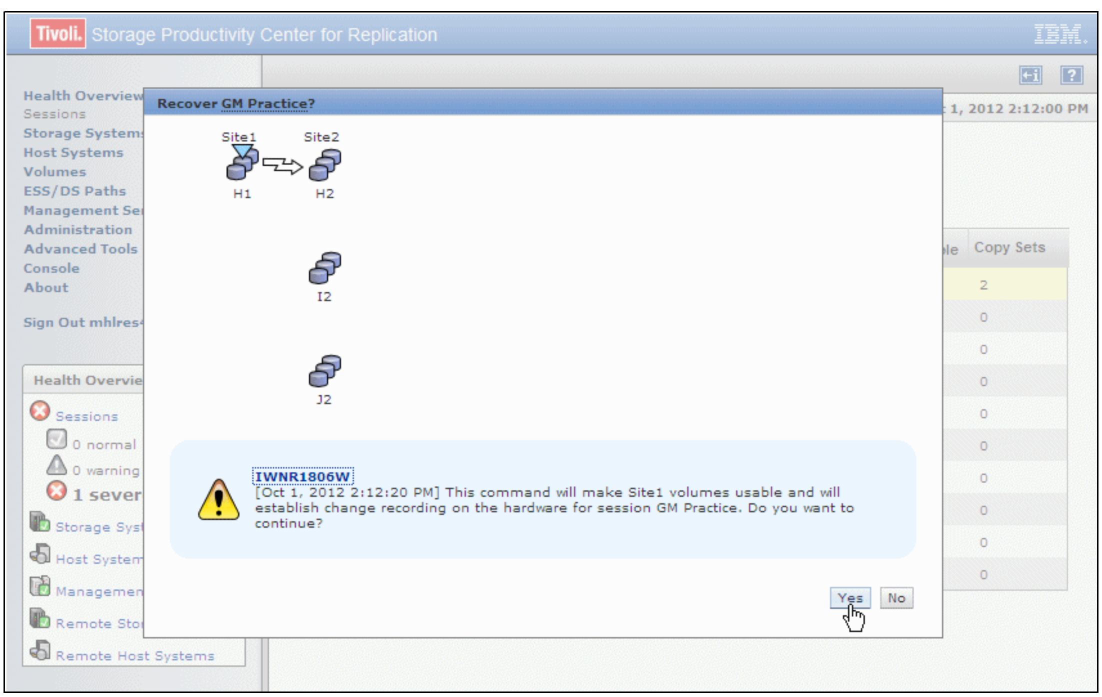

Figure 7-290   Recover Global Mirror Session

3. There is a message at the top of the panel in Figure 7-291 indicating that a **Recover** action has been successfully completed. The status of our Global Mirror session is *Normal* and the State is *Target Available*, indicating that H1 volumes are available to your host.

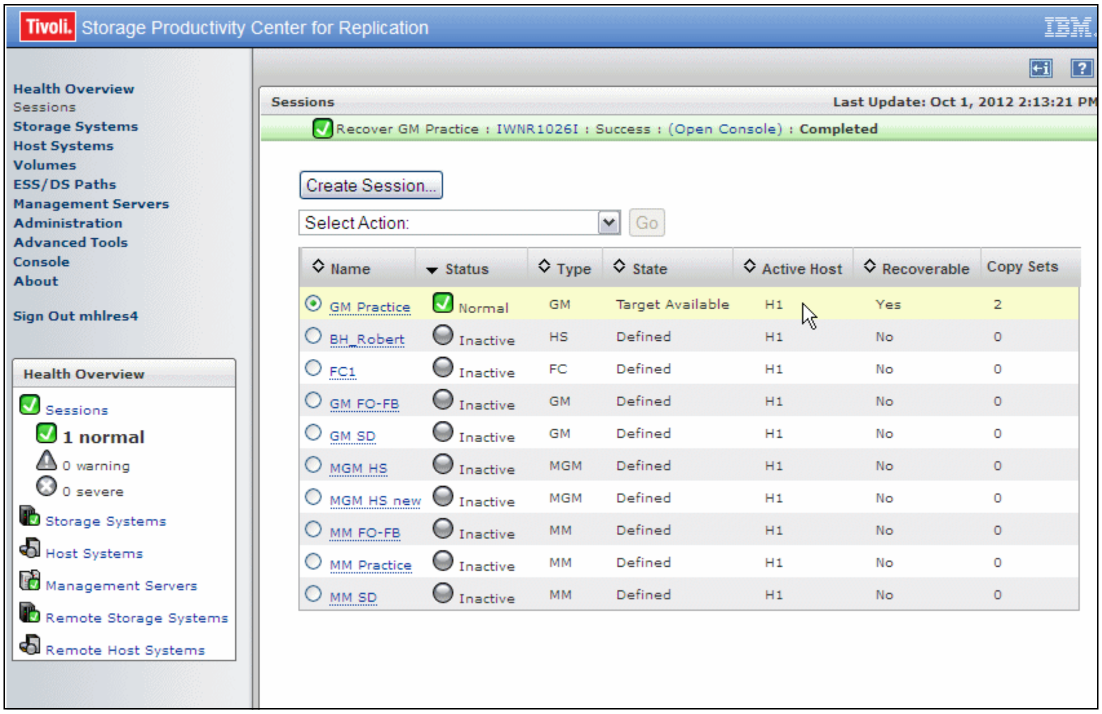

Figure 7-291 Global Mirror session - H1 volumes available to host

After the Global Mirror session is recovered in *Target Available* state, the following options are available:

Initiate Background Copy Copies all tracks from I2 volumes to H2 volumes.

Start H2 → H1 Restarts copying from H2 to H1 volumes.

Enable Copy to Site 2 Before reversing the direction of copying in a failover and failback session, you must run this command, and confirm that you want to reverse the direction of replication. It enables replication to Site 2.

Terminate Terminates the session (under Cleanup submenu).

7.8.12 Enabling Copy to Site 2

When the current copy direction is from Site 2 to Site 1, and you want to reverse the copy direction back from Site 1 to Site 2 you need to issue the **Suspend** command as described in 7.8.10, “Suspending a Global Mirror session (after Start H2 ® H1)” on page 460 and then issue the **Recover** command (see 7.8.11, “Recovering a Global Mirror session (after Start H2 ® H1)” on page 463). But this time, the **Recover** command will make H1 volumes available to applications since the data copying direction was from H2 to H1 volumes. After the **Recover** command is complete, the Host 1 site is now the active site and you can reverse direction of copying in a Global Mirror Failover/Failback session. Follow these steps:

1. Before you can initiate copying from Host 1 to Host 2 volumes, you need to start the **Enable Copy to Site 2** command. To achieve this, from the **Select Action** pull-down menu, select **Enable Copy to Site 2** and click **Go** as shown in Figure 7-292.

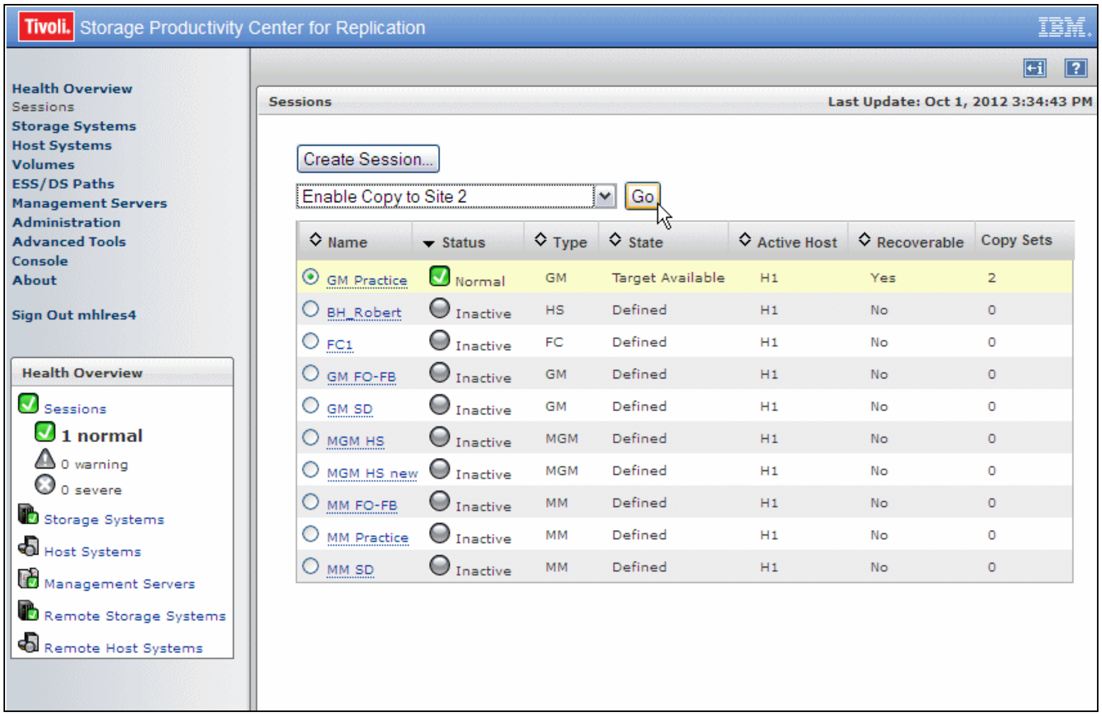

Figure 7-292 Global Mirror session - Enable Copy to Site 2

2. The next message shown in Figure 7-292 is a warning that you are about to enable the command that initiates copying data from H1 to H2 volumes. This command is disabled to protect against accidentally copying over production data. Ensure that all of the volumes in this session located at Site 2 are not being used by any application prior to enabling the command that allows copying data to Site 2. Click **Yes** to continue.

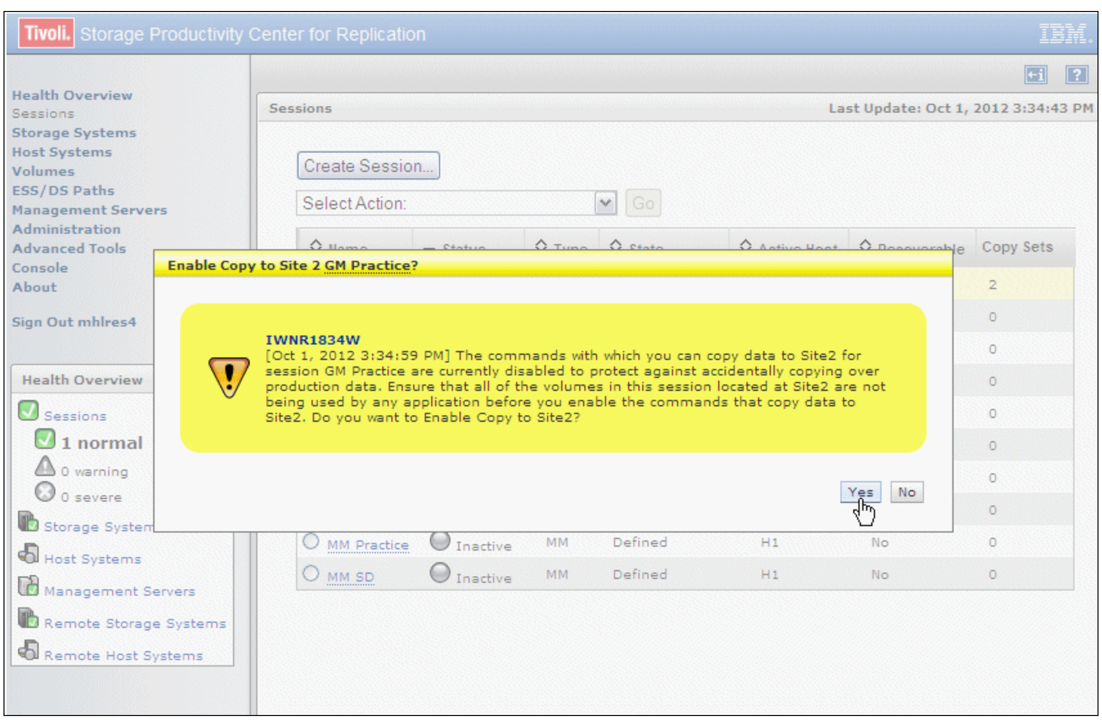

Figure 7-293 Enable Copy to Site 2

3. The message at the top of the panel in Figure 7-293 confirms that the Enable Copy to Site 2 command is completed. The status of our Metro Mirror session is the same as it was after the **Recover** command, *Normal* status and *Target Available* state, indicating that an H1 volume is available to your host.

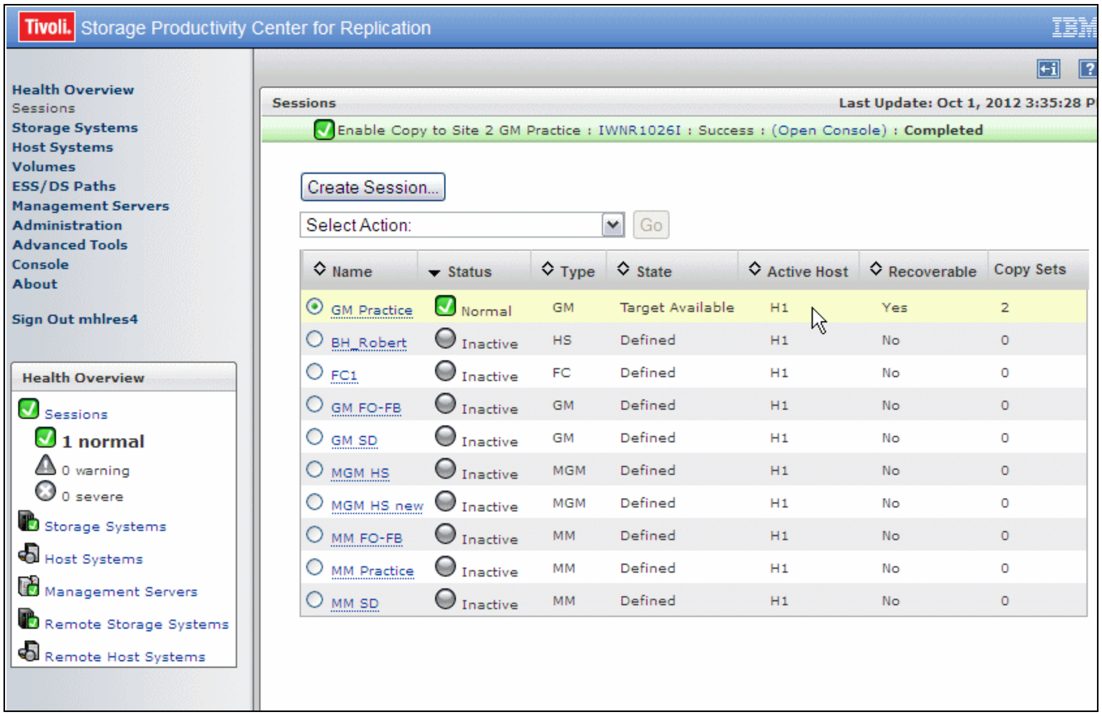

Figure 7-294 Enable Copy to Site 2 is reported as Completed

The following options are available at this stage:

Initiate Background Copy	Copies all tracks from I2 volumes to H2 volumes.
Start H1 → H2	Restarts the Global Mirror session.
StartGC H1 → H2	Restarts the replication between H1 and I2 volumes in Global Copy mode.
Re-enable Copy to Site 1	Re-enables **Start H2 → H1** command.
Terminate	Terminates the session (under *Cleanup* submenu).

7.8.13 Terminating a Global Mirror session

The **Terminate** action breaks the Global Mirror relationship between H1, H2, I2, and J2 volumes, thus terminating data replication. Follow these steps:

1. Select the Global Mirror session radio button (GM Practice in our example shown in Figure 7-295) and the **Stop** action from the **Select Action** pull-down menu. Click **Go** to continue.

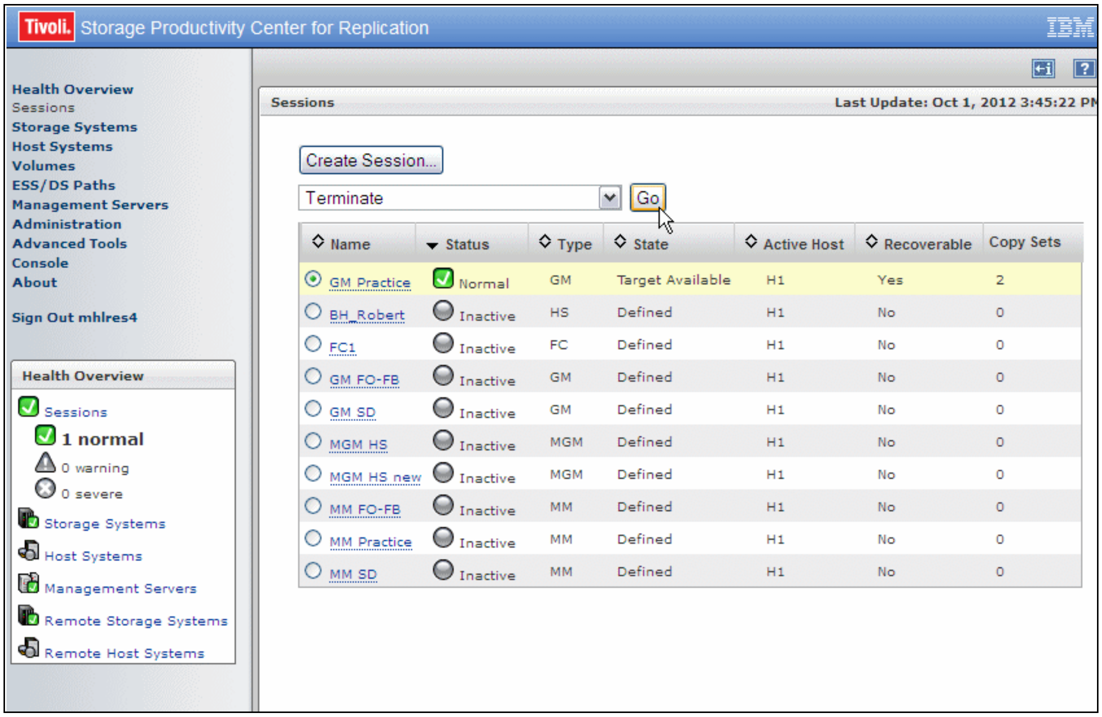

Figure 7-295   Global Mirror session - Terminate action

2. The next message shown in Figure 7-296 is a warning that you are about to terminate the Global Mirror relationship between H1, H2, I2, and J2 volumes. Note that if you need to start the very same Global Mirror session again, a full copy from H1 to H2 volumes will be required. Click **Yes** to continue.

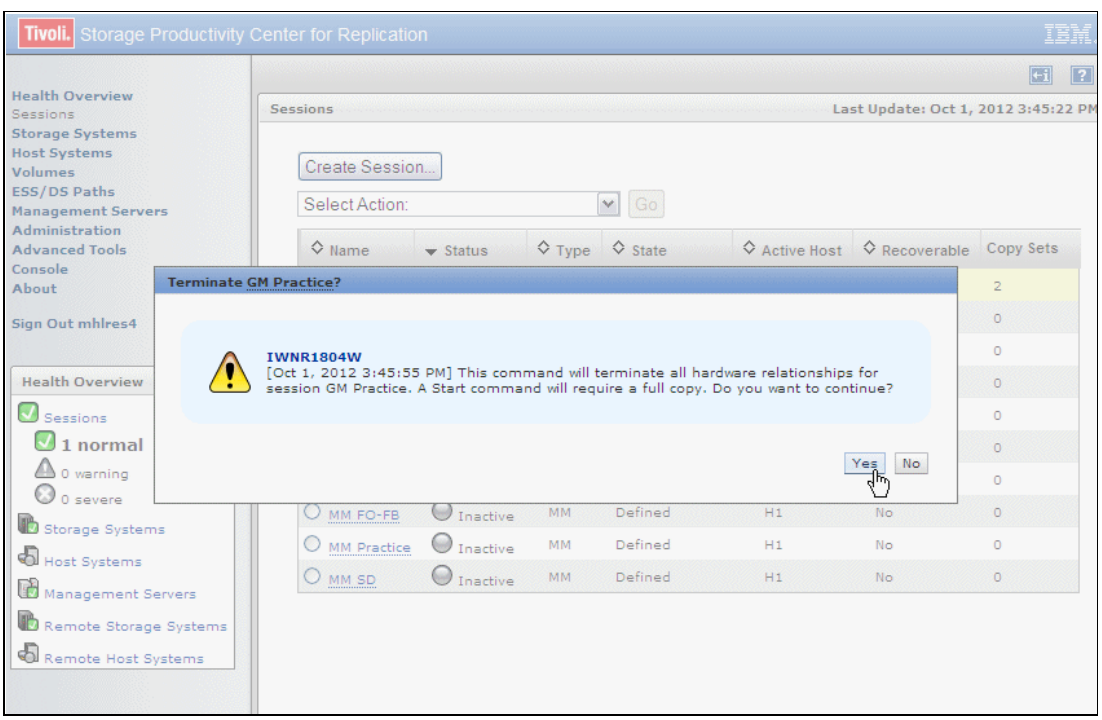

Figure 7-296   Terminate Global Mirror session

3. There is a message at the top of the panel in Figure 7-297 indicating that a **Terminate** action has been successfully completed. The status of our Global Mirror session is now *Inactive* and the state is *Defined*.

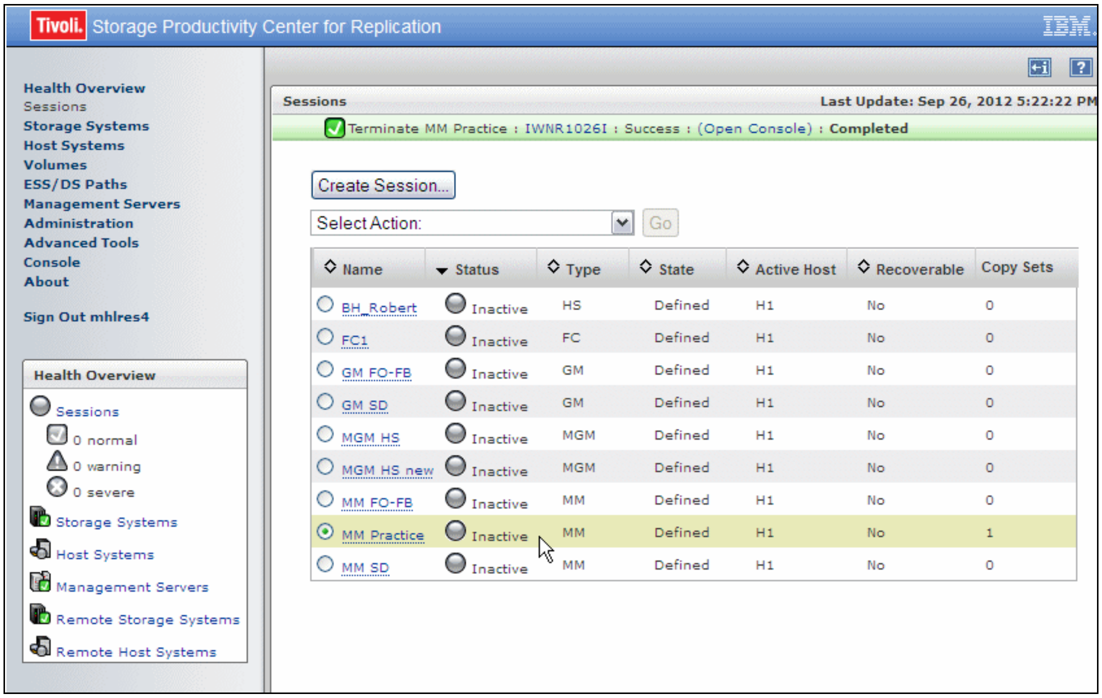

Figure 7-297 Terminate Global Mirror session - Completed

After the Global Mirror session is terminated, the following options are available:

Start H1 → H2 Restarts the Global Mirror session.

StartGC H1 → H2 Restarts the replication between H1 and I2 volumes in Global Copy mode.

7.9 Metro Global Mirror using the GUI

You may create a session at any time after the server code is installed and up and running. Again, a session is only a token with a name and certain attributes assigned to this session. This is always the same approach independent on the session type. At this point, you need to have storage subsystems defined to the Tivoli Storage Productivity Center for Replication server as described in 4.2, “Adding IBM ESS or DS Storage Server to Tivoli Storage Productivity Center for Replication server” on page 137.

7.9.1 Creating a Metro Global Mirror session

Figure 7-298 shows that you always start from *My Work* and click the hyperlink `Sessions`. This provides you with an overview of all defined sessions. Follow these steps:

1. At this point there are no defined sessions. Click **Create Session** to continue.

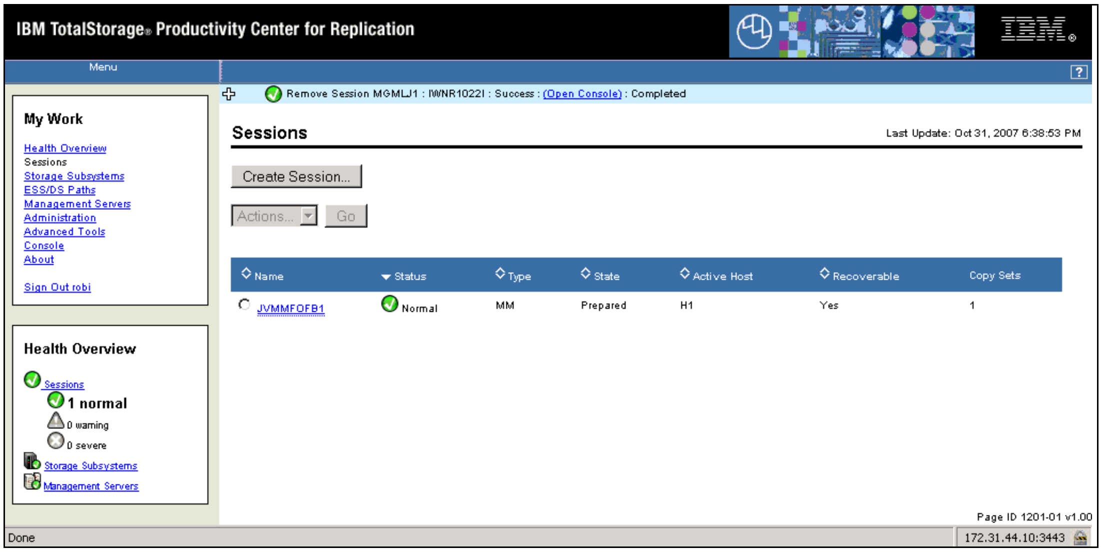

Figure 7-298 Query session through the Session hyperlink in My Work

2. Select the **Metro Global Mirror** session from the pull-down menu as shown in Figure 7-299. On the right side, a pictograph symbolizes the involved sites and their volume types. H1 represents Site 1 volumes, H2 represents Site 2 volumes, H3 represents Site 3, and J3 represents journal volumes in a Global Mirror session used to restore data to the last consistency point. When you define Copy Sets, this pictograph helps you to orient and understand replication direction. Click **Next** to continue.

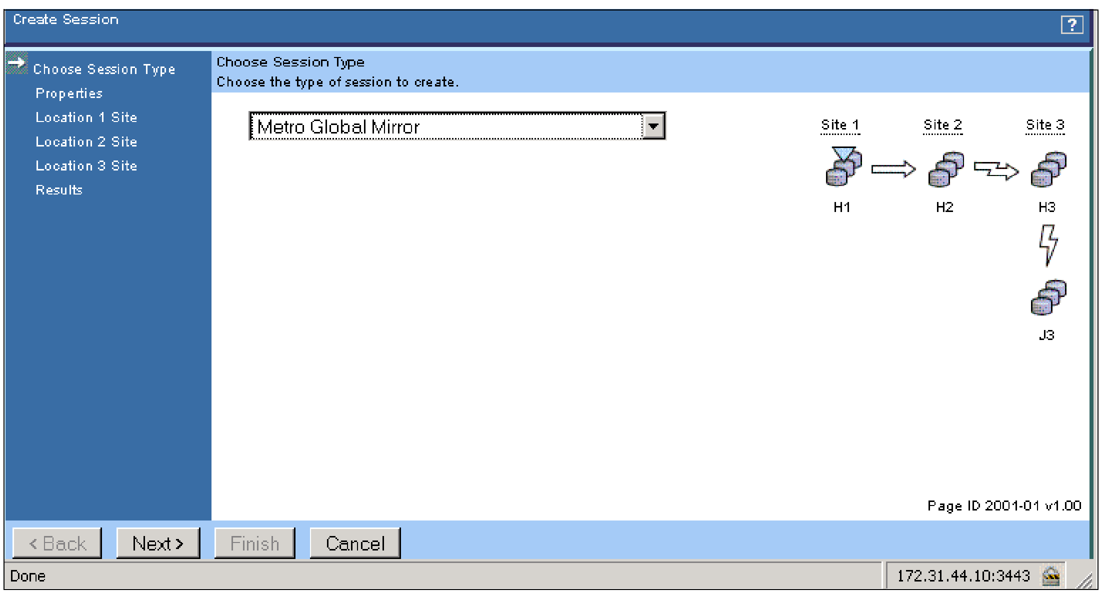

Figure 7-299 Define the Metro Global Mirror session

This leads us to the session Properties panel as Figure 7-299 shows.

The *Properties* panel is also important because it requires that you specify a name for the session which is about to be created. An optional *description* is desirable to understand the purpose of the session because the session name may not reveal what this session is intended for. In Figure 7-300 we are showing our session definition. You may add a location of each storage server and a date when the session is created or changed.

Metro Global Mirror is a method of three-site continuous data replication and it combines Metro Mirror synchronous copy and Global Mirror asynchronous copy into one session. In this combined session, the Metro Mirror target is the Global Mirror source. Furthermore, if there is a storage failure (or disaster) at Site 2, or even simply a loss of connectivity between Site 1 and Site 2, data can no longer be cascaded to the remote Site 3. However we could still copy data from Site 1 to Site 3 in a Global Mirror session. Therefore we need to set up *Consistency Group interval time (sec)* for Site 2 to Site 3 Global Mirror session (H2-J3) and for Site 1 to Site 3 Global Mirror session (H1-J3) as shown in Figure 7-300.

Consistency Group interval time (sec) value specifies how long to wait between the formation of the next Consistency Groups. This is specified in seconds, and the default is zero (0) seconds. Zero seconds means that Consistency Group formation happens constantly. As soon as a Consistency Group is successfully created, the process to create a new Consistency Group starts again immediately. The maximum value for *Consistency Group interval time* is 18 hours.

Fail MM/GC if the target is online (CKD only) option ensures that all target (secondary) volumes in a Metro Mirror session are offline and not visible to any host, otherwise the create session task will fail. This applies to CKD volumes only. Use this option since target (secondary) volumes in a Metro Mirror session should be offline to all hosts.

Tivoli Storage Productivity Center for Replication issues Freeze command in a Metro Mirror session as soon as the Copy Set volumes are suspended due to an error (for example, disk or link failure). Tivoli Storage Productivity Center for Replication always does a Freeze to create a consistent set of H2 volumes. The action that Tivoli Storage Productivity Center for Replication takes subsequent to the Freeze is specified by the **Metro Mirror Suspend Policy**. You basically have two options available:

1. Hold I/O after Suspend, known as Freeze and Stop policy:

   After a freeze, new writes are not allowed to the H1 volumes thus stopping your production systems.

2. Release I/O after Suspend, known as Freeze and Go policy:

   After a freeze, you can make new writes to the H1 volumes, but no replication will occur to the secondary volumes. This is the default setting for all new sessions.

Which option you select is really a business, rather than an IT, decision. If your Recovery Point Objective - RPO is zero (that is, you cannot tolerate any data loss in case of production site disaster), you must select **Hold I/O after Suspend**. This option will hold I/O at production site on all volumes defined in the session. Because all systems that can update the production site volumes are on hold before the Extended Long Busy for CKD volumes or SCSI queue full timer for FB volumes ends (default is 120 seconds), you are sure that no updates are made to the production volumes that are not mirrored to the volumes at the DR site. You need to take some action against this session within 120 seconds, otherwise I/O will be released to the production volumes.

However, if the event that caused Tivoli Storage Productivity Center for Replication to take **Hold I/O after Suspend** action was a transient event (for example, temporary link lost between sites) rather than a real disaster, you will have brought all production systems down unnecessarily.

If your RPO is higher than zero, you may decide to let the production systems continue operation after the H2 volumes have been protected. This is known as Freeze and Go policy and you need to select **Release I/O after Suspend** option. In this case, if the trigger was only a transient event, you have avoided an unnecessary outage. However, if the trigger was the first sign of an actual disaster, you could continue operating for some amount of time before all systems actually fail (so called 'Rolling disaster'). Any updates made to the primary volumes during this time will not have been remote copied, and therefore are lost.

In our example, we use **Release I/O after Suspend** option as shown in Figure 7-300.

1. Click **Next** to define location sites.

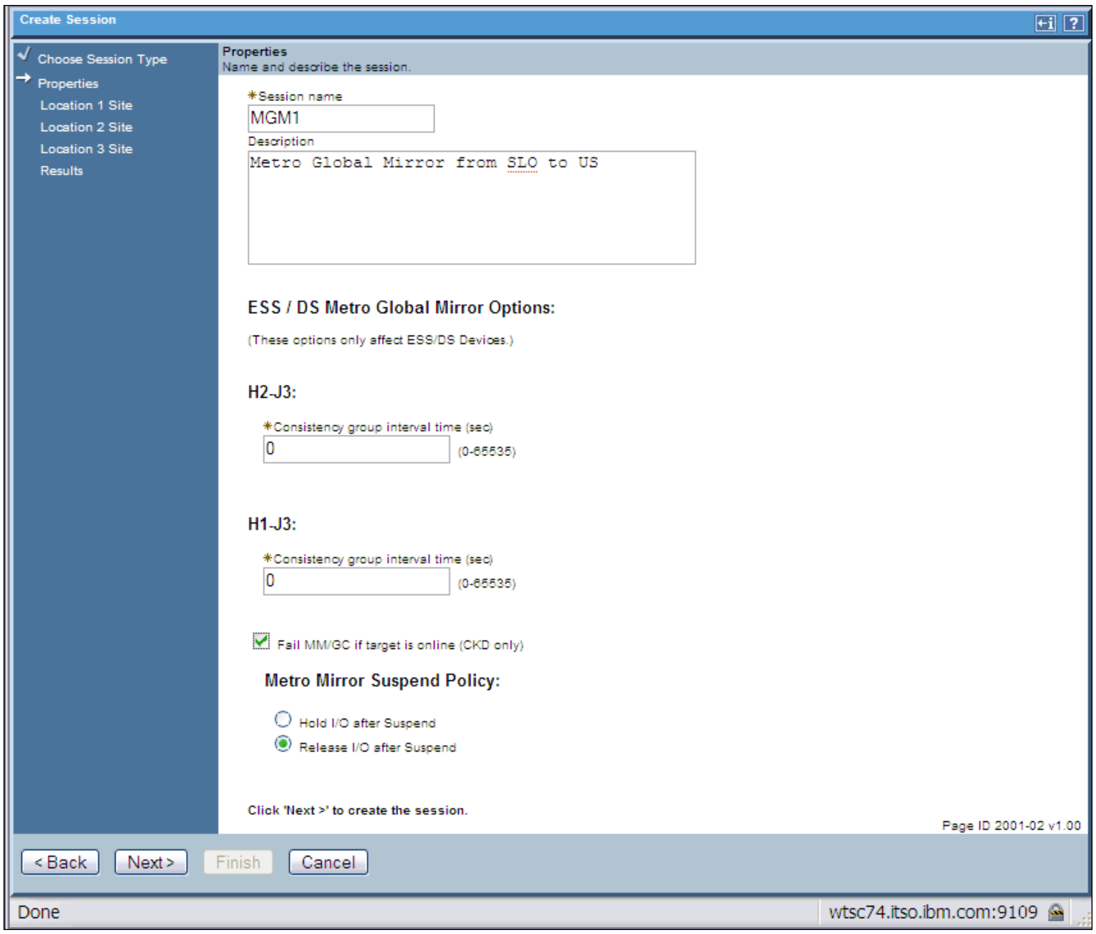

Figure 7-300 Define Metro Global Mirror - Properties

2. From the pull-down **Site 1 Location** menu (see Figure 7-301), select the location of your H1 storage subsystem previously defined and click **Next** to continue.

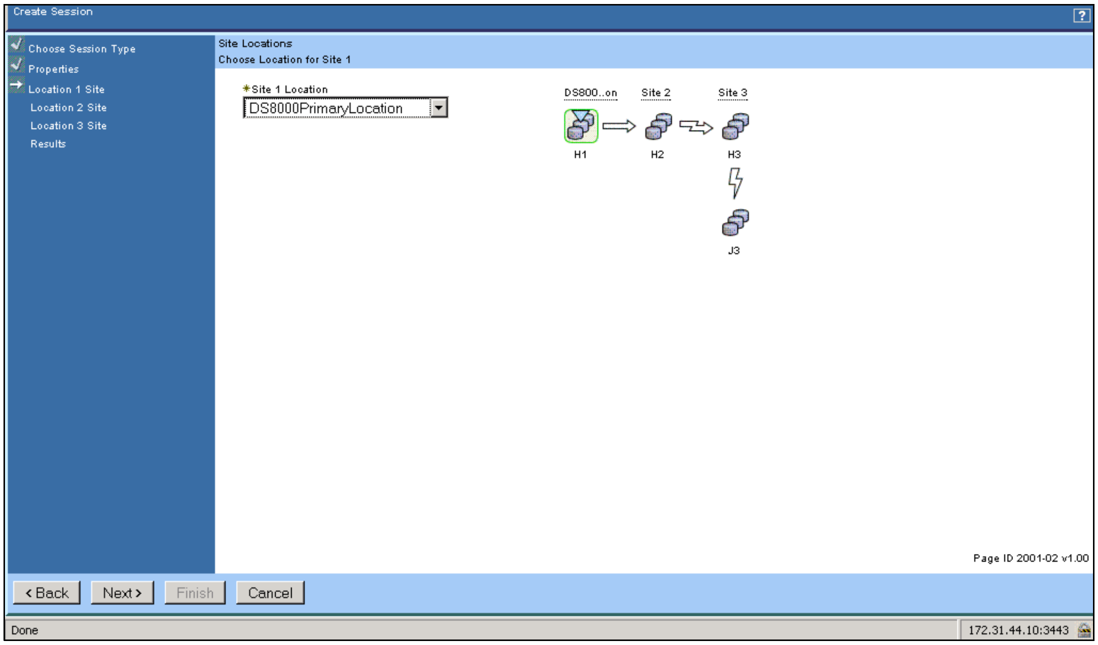

Figure 7-301 Define Metro Global Mirror session Site 1 Location

3. From the pull-down **Site 2 Location** menu (see Figure 7-302), select the location of your H2 storage subsystem previously defined and click **Next** to continue.

Note: In our scenario we are going to create a Metro Mirror session inside one DS8000 storage system. That is the reason why the Site 1 and Site 2 location logical names are the same.

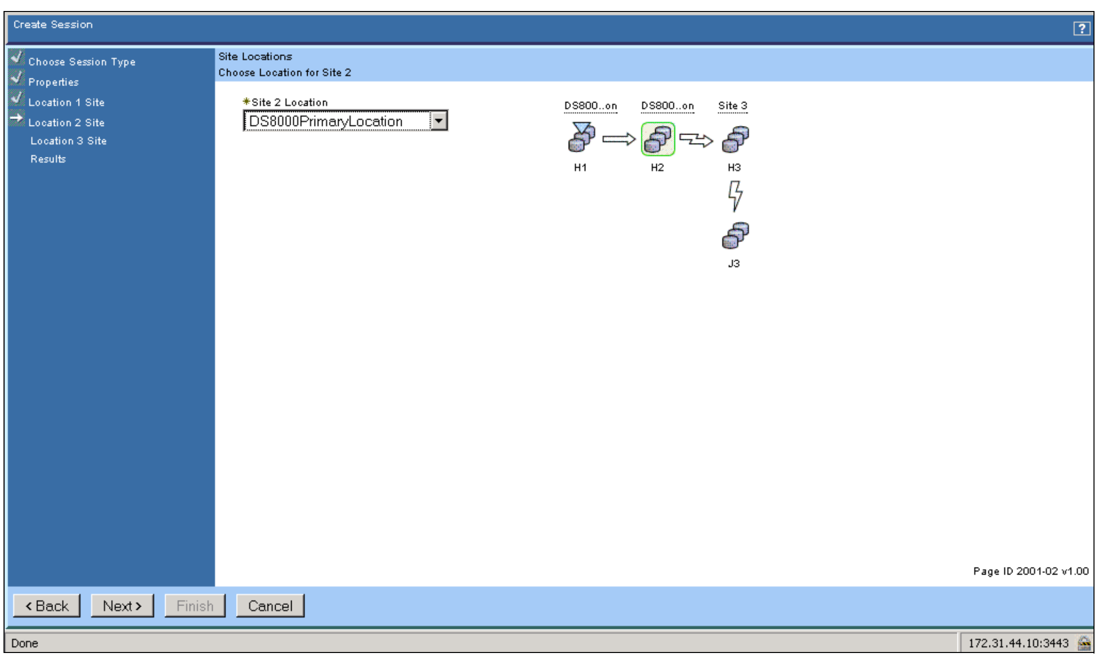

Figure 7-302 Define Metro Global Mirror session Site 2 Location

4. From the pull-down **Site 3 Location** menu (see Figure 7-303), select the location of your H3 storage subsystem previously defined and click **Next** to continue.

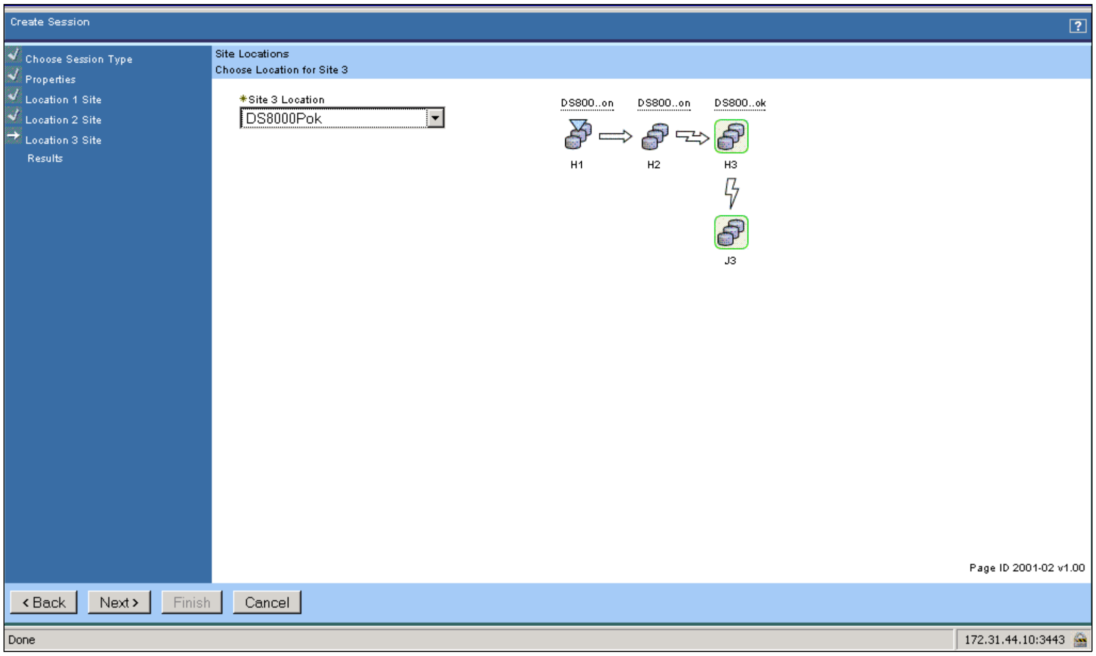

Figure 7-303 Define Metro Global Mirror session Site 3 Location

5. Figure 7-304 displays the message that the MGM1 session was successfully created. Click **Finish** to exit the *Create Session* wizard. Alternatively, you have an option to add Copy Sets and click **Launch Add Copy Sets Wizard** and follow the instructions described in 7.9.2, “Adding Copy Sets to a Metro Global Mirror session” on page 475.

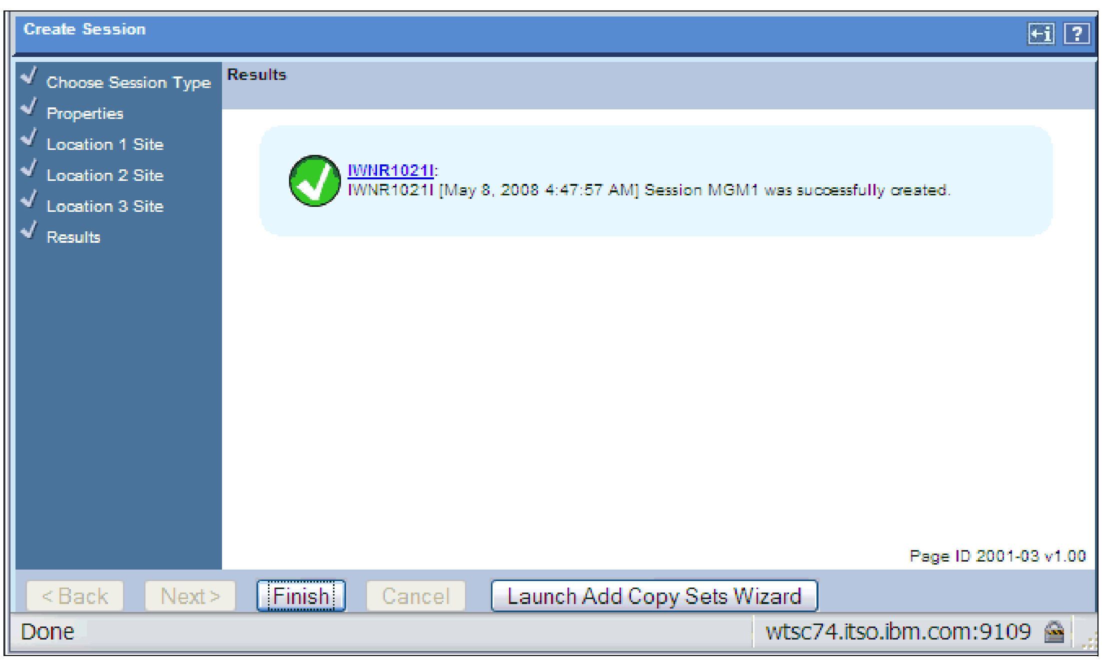

Figure 7-304 Define Metro Global Mirror session - Results

6. Go back to the Tivoli Storage Productivity Center for Replication home page and select the `Sessions` hyperlink to check on recently created FlashCopy sessions. Figure 7-305 now displays the Metro Global Mirror session that we successfully created.

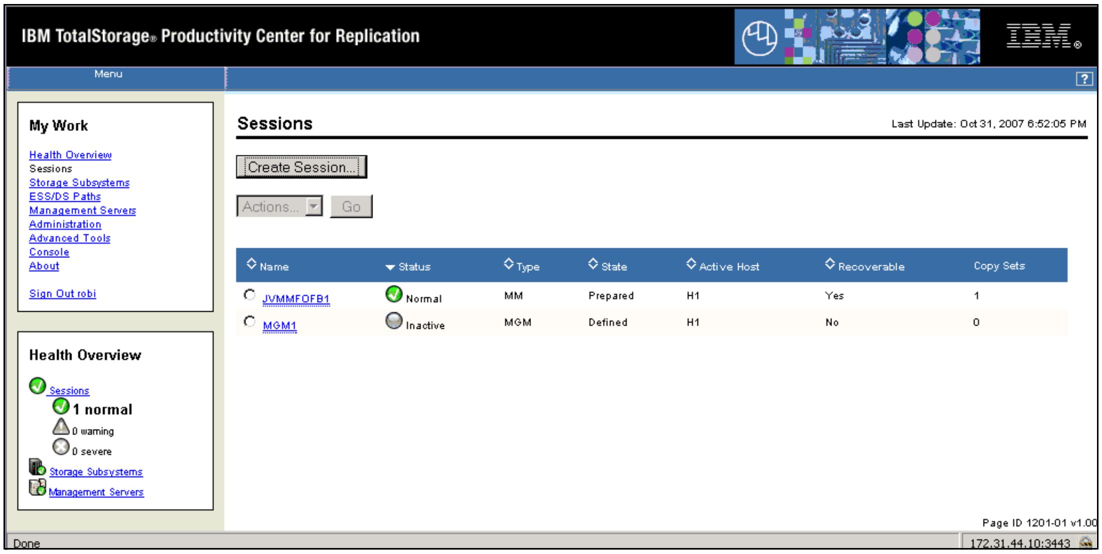

Figure 7-305 Metro Global Mirror session defined

Again, note that this session with its name is just a token and represents a Metro Global Mirror Copy Services type. At this stage, there is no storage server nor any volumes associated with this MGM1 session.

7.9.2 Adding Copy Sets to a Metro Global Mirror session

After we have defined the Metro Global Mirror session MGM1, we populate this session in the next step with Copy Sets. Copy Sets are Copy Services volumes. In a Metro Global Mirror session, a Copy Set consists of one H1, one H2, one H3, and one J3 volume.

Figure 7-306 shows the session overview panel with the MGM1 session that we defined previously. The next logical action that you perform on an MGM1 session is to add volumes or Copy Sets to it. Follow these steps:

1. Select your Metro Global Mirror session name radio button (MGM1 in our example) and choose **Add Copy Sets** from the **Select Action** pull-down menu. Click **Go** to invoke the *Add Copy Sets* wizard.

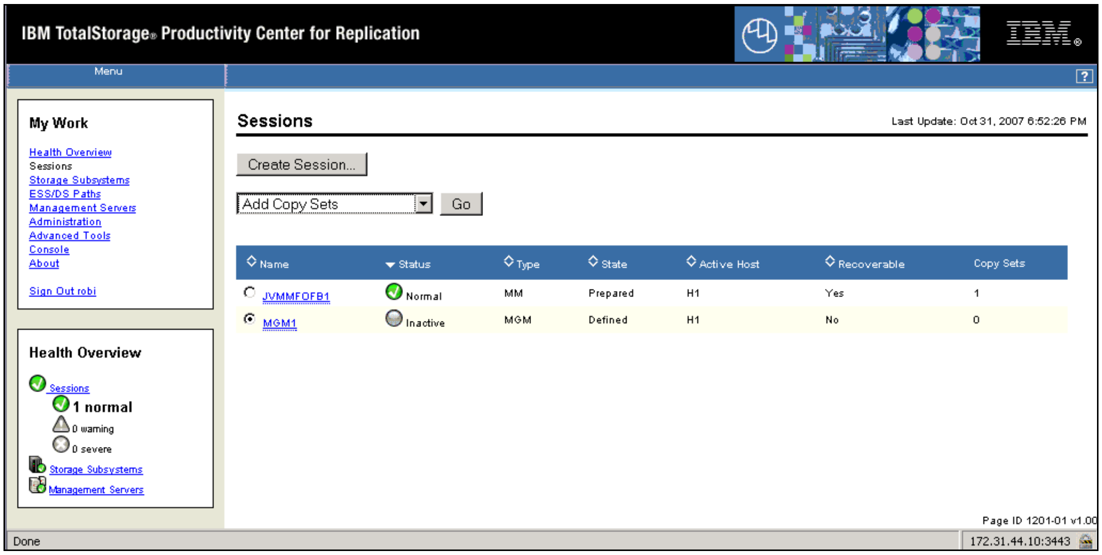

Figure 7-306   Add Copy Sets to Metro Global Mirror session

Note that over time various terminology is introduced for the same thing. Peer-to-Peer Remote Copy or PPRC (known today as Metro or Global Mirror) started out with primary volumes and secondary volumes. This terminology was fine for a 2-site solution. With the arrival of switching sites from an application viewpoint as well as for the storage subsystem used, Tivoli Storage Productivity Center for Replication introduced a different terminology for these PPRC volumes and their association to a certain site.

Host 1 or Site 1 refers to the primary volumes as a starting point. This may also be the local site or application site. It may always be considered as the primary site. But it has the potential to change. You may want to switch application sites from Host 1 in Site 1 to Host 2 in Site 2 and also switch at the same time the Copy Services role of the associated storage subsystems. This led to Host 1, Site 1 volumes and Host 2, Site 2 volumes terminology being used in Tivoli Storage Productivity Center for Replication. In a Metro Global Mirror three-site configuration, the primary site is referred as Site 1, intermediate site as Site 2 and remote site as Site 3.

2. Figure 7-307 displays the panel which provides details on the primary volumes or local volumes which are called Host 1 volumes relating to the fact that these volumes reside in the Site 1 or application site or local site. These are all synonyms and refer to the same environment. Select the desired **Host 1 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Host 1 logical storage subsystem** list. Select the LSS where your H1 volume resides. After the LSS has been selected, choose the appropriate volume from the **Host 1 volume** pull-down list.

3. The alternative way to add a large number of volumes to this session is to create CSV file as explained in “Using CSV files for importing and exporting sessions” on page 194. In case you have a CSV file ready, select **Use a CSV file to import copy sets** check box and provide a path to your CSV file.

4. In our example, we selected the DS8000 disk subsystem and appropriate volume as shown in Figure 7-307. Click **Next** to continue.

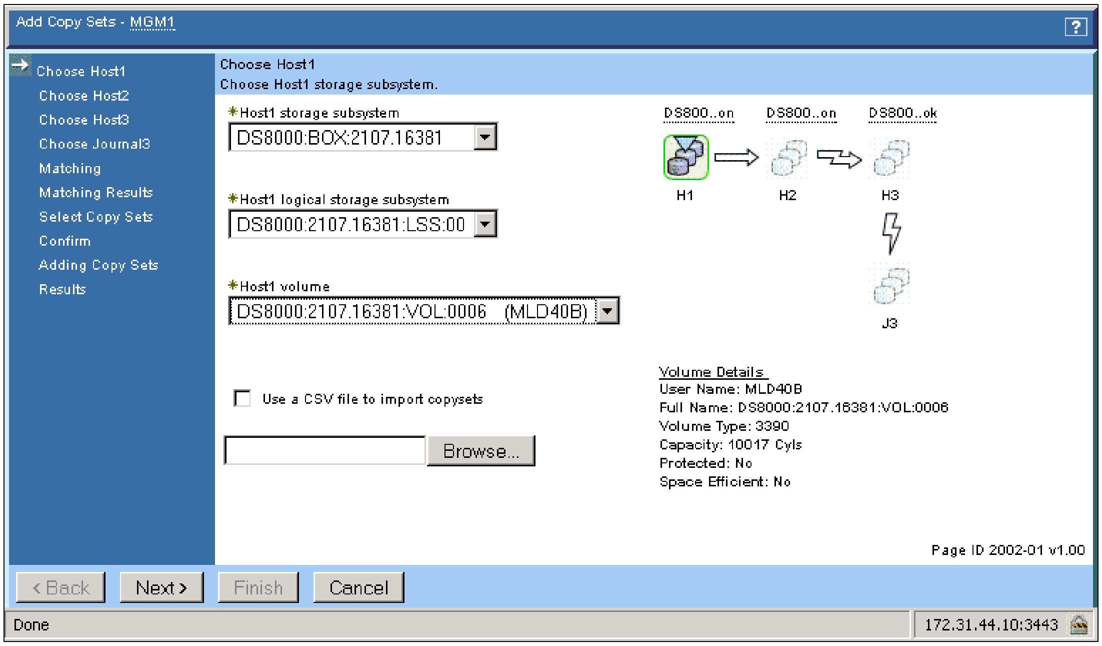

Figure 7-307 Add Copy Sets to Metro Global Mirror session- Choose Host 1

5. In case you want to define all volumes within a certain LSS for this session, there is an option to select **All Volumes** from the **Host1 volume** list as shown in Figure 7-308. Click **Next** to continue.

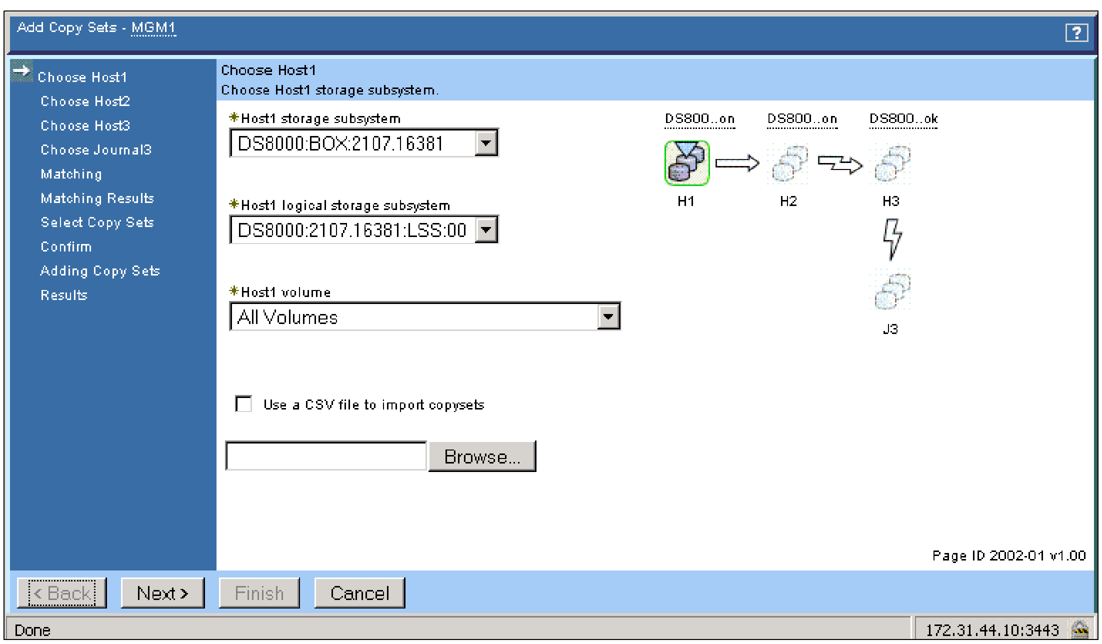

Figure 7-308 Add Copy Sets to Metro Global Mirror session - Choose Host 1 and All Volumes option

6. The next step is to define Site 2 storage subsystems and volumes as shown in Figure 7-309. Select the desired **Host 2 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Host 2 logical storage subsystem** list. Select the LSS where your H2 volumes resides.If **All volumes** for a given LSS were selected in the previous step while defining Host 1 volumes, you do not have an option to select any volume from **Host 2 volumes** list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 1 storage subsystem with all volumes from selected LSS in Host 2 storage subsystem. In our example we selected **All Volumes** in **Choose Host1** step. Click **Next** to continue.

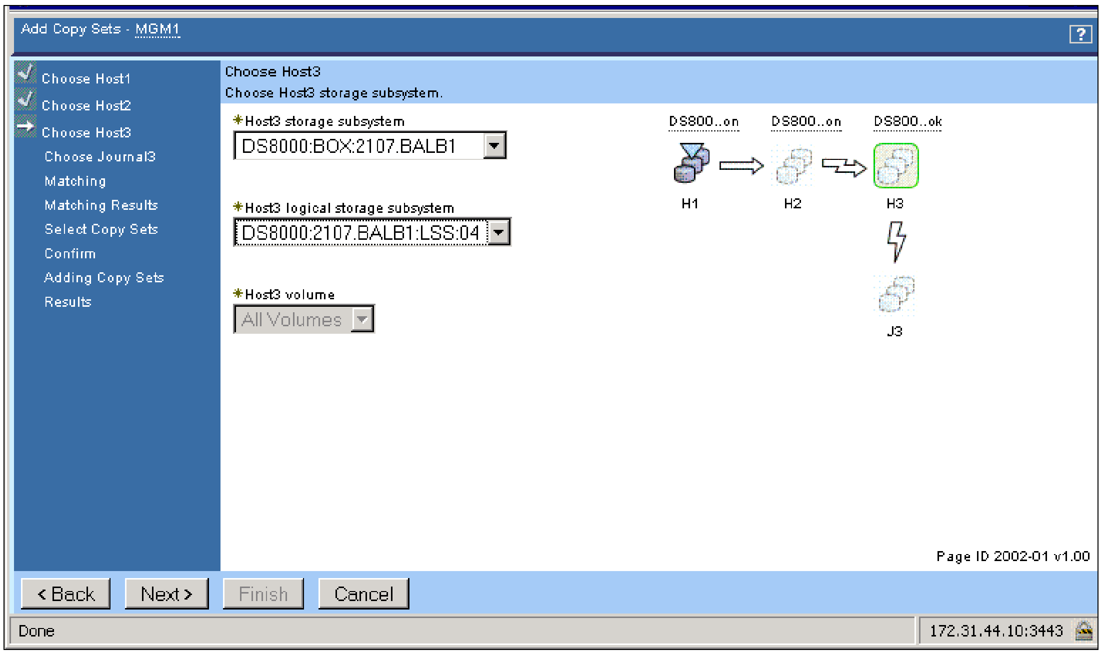

Figure 7-309 Add Copy Sets to Metro Global Mirror session - Choose Host 2 and All Volumes option

7. The next step is to define Site 3 storage subsystems and volumes as shown in Figure 7-310. Select the desired **Host 3 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Host 3 logical storage subsystem** list. Select the LSS where your H3 volumes resides. If **All volumes** for a given LSS were selected in the previous steps while defining Host 1 and Host 2 volumes, you do not have an option to select any volume from **Host 3 volumes** list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 1 and Host 2 storage subsystems with all volumes from selected LSS in Host 3 storage subsystem. In our example we selected **All Volumes** in previous steps. Click **Next** to continue.

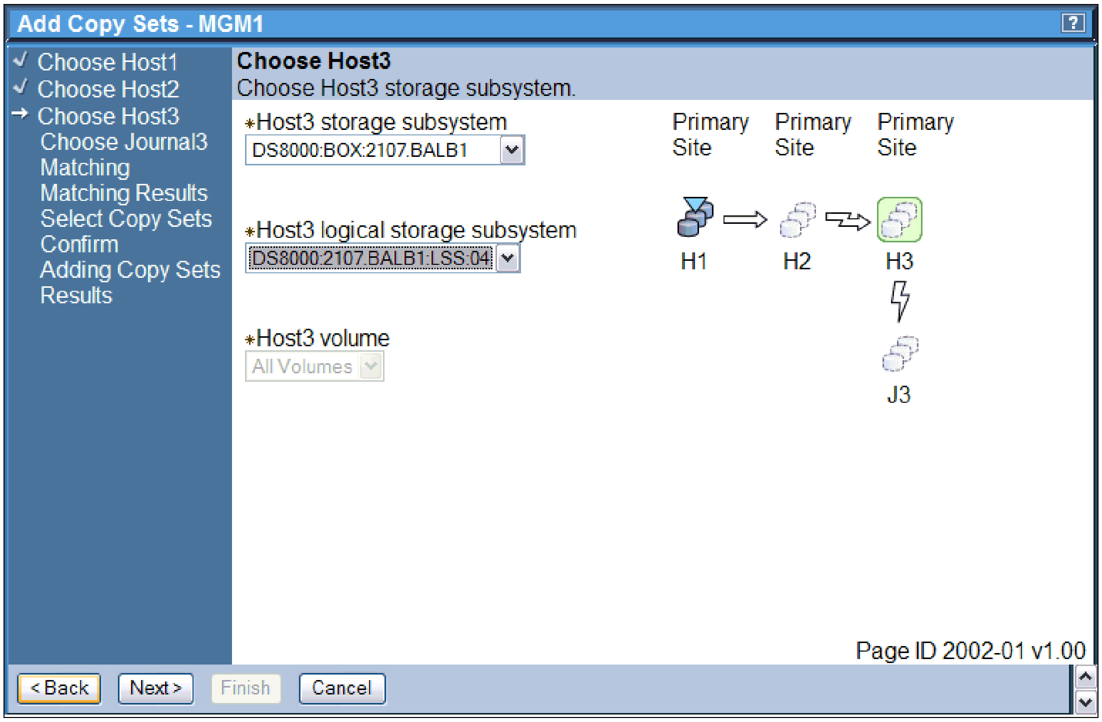

Figure 7-310 Add Copy Sets to Metro Global Mirror session - Choose Host 3 and All Volumes option

8. The Journal 3 is the last volume required for Metro Global Mirror Copy Set definition. Select the desired **Journal 3 storage subsystem** from the pull-down menu and wait for a few seconds to get the **Journal 3 logical storage subsystem** list as shown in Figure 7-311. Select the LSS where your J3 volumes resides.If **All volumes** for a given LSS were selected in the previous steps while defining Host 1, Host 2 and Host 3 volumes, you do not have an option to select any volume from **Journal 3 volume** list. Tivoli Storage Productivity Center for Replication will automatically match all volumes from selected LSS in Host 1, Host 2 and Host 3 storage subsystems with all volumes from selected LSS in Journal 3 storage subsystem. In our scenario we selected **All Volumes** in previous steps. Click **Next** to continue.

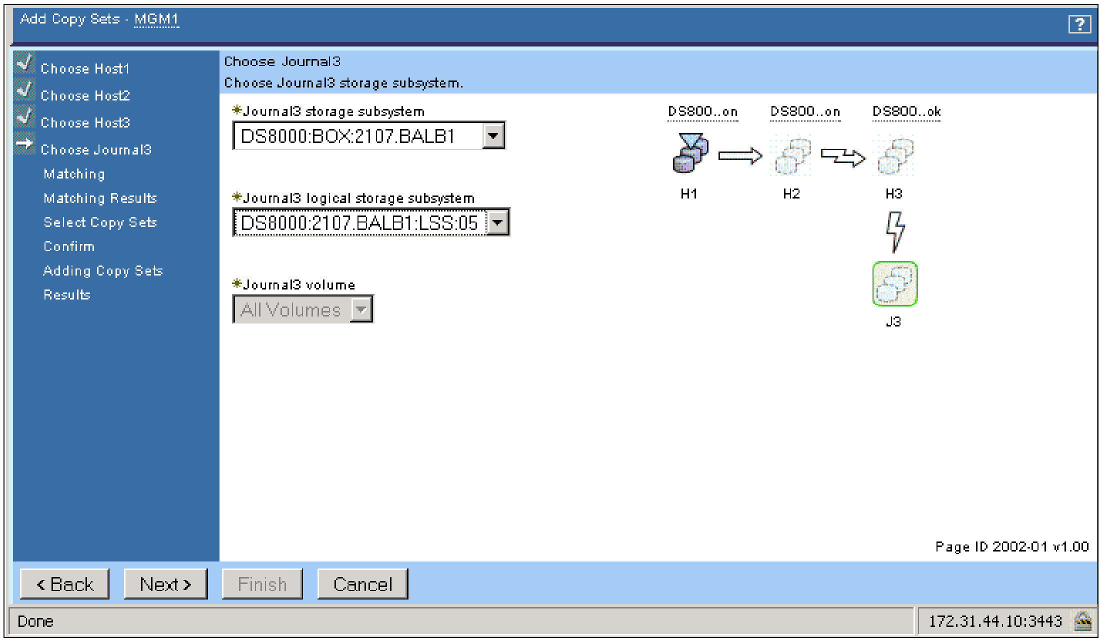

Figure 7-311 Add Copy Sets to Metro Global Mirror session - Choose Journal 3 and All Volumes option

9. The next panel in Figure 7-312 displays a message with regard to the matching results. In our example we have a warning message due to one of the following reasons:

   – The number of volumes at Host 1, Host 2, Host 3, and Journal 3 storage subsystem LSS is not the same.

   – Volumes at Host 2 and H3 storage subsystem LSS are smaller than Host 1 storage subsystem LSS volumes.

   – The Host 1, Host 2, Host 3 or Journal 3 volumes are already defined in some other copy services session.

   However, this warning message does not mean the failure of Copy Sets creation. Click **Next** to see the list of available Copy Sets.

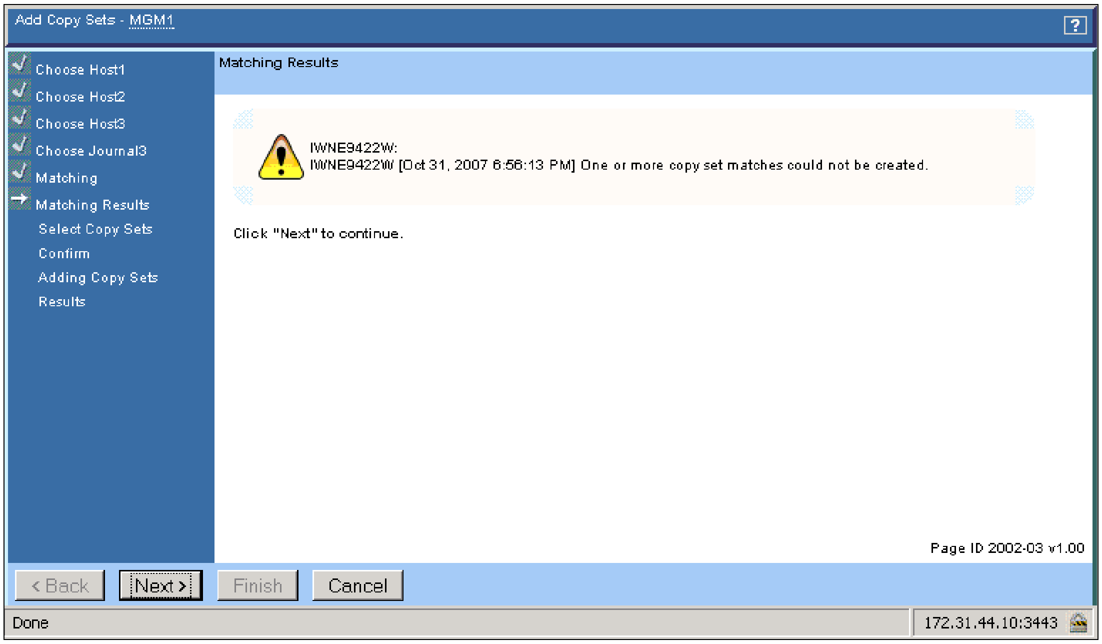

Figure 7-312 Add Copy Sets to Metro Global Mirror session - Matching Results

10. In our example there are Copy Sets in error and if you click the *Error* hyperlink next to it, the message description appears as shown in Figure 7-313. We are not able to create a Copy Set for each H1 volume due to the fact that the capacity of volumes at Host 1 storage subsystem LSS and at Host 2/Host 3/Journal 3 storage subsystem LSS are not the same. As a consequence a few Copy Sets cannot be selected. The rest of the volumes met the matching criteria and are automatically selected. You still have a chance to modify the current selection and deselect any of the Copy Set included in the list. The *Show* hyperlink next to each Copy Set provides additional information. We selected one Copy Set. Click **Next** to continue.

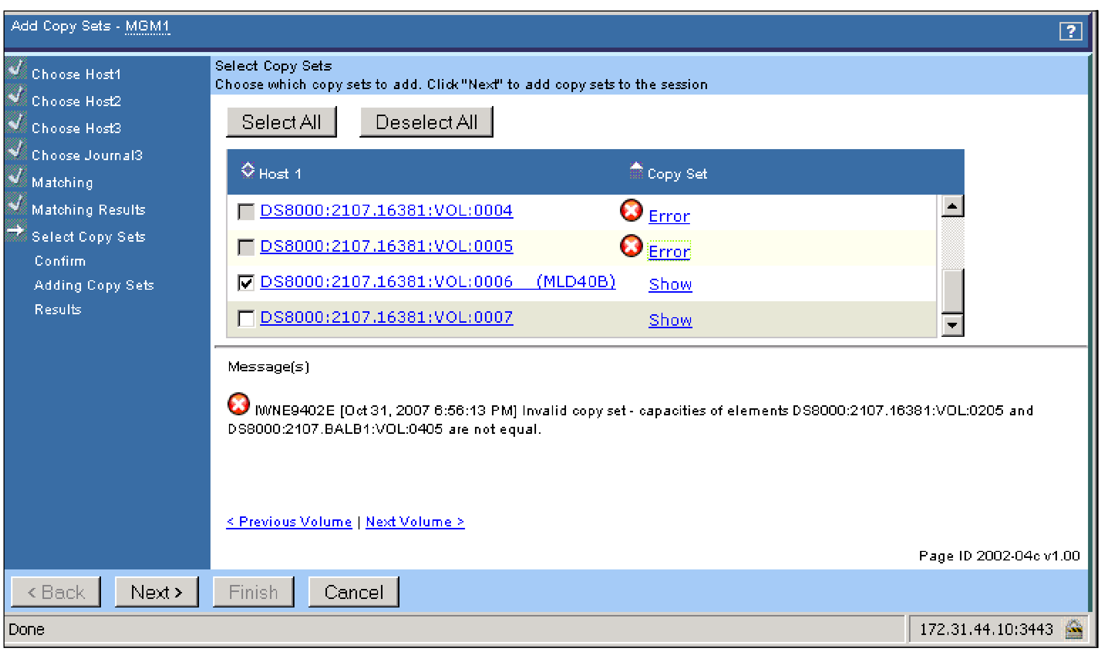

Figure 7-313 Add Copy Sets to Metro Global Mirror session - Select Copy Sets

11. The next panel displays the number of Copy Sets that are going to be created, as well as the number of unresolved matches (or not selected) as shown in Figure 7-314. Click **Next** to continue.

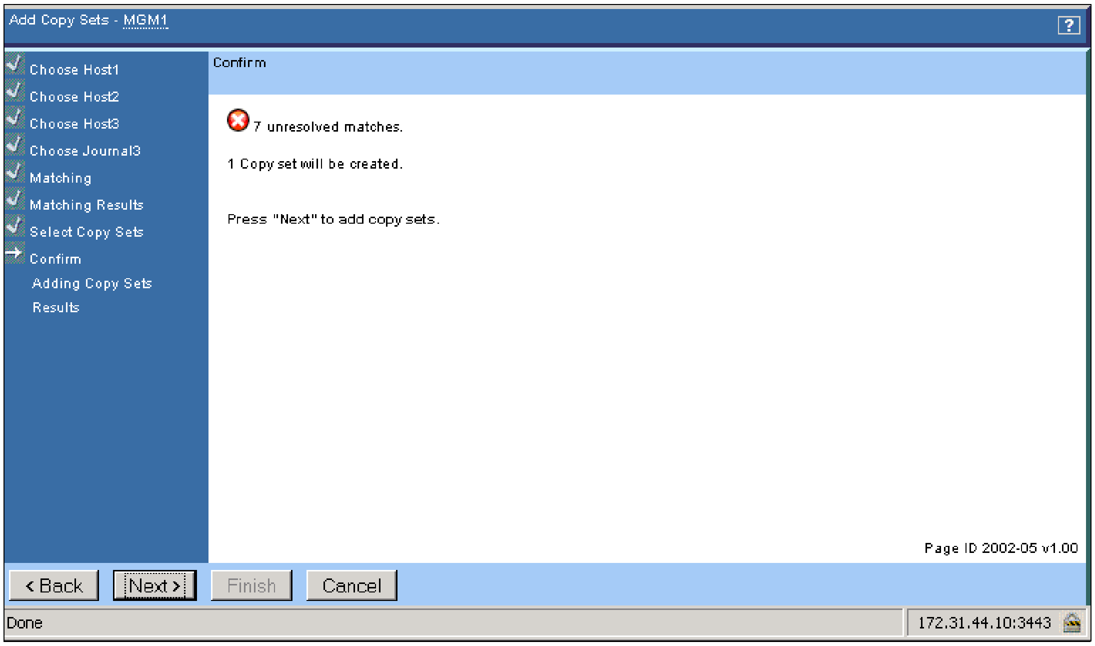

Figure 7-314 Add Copy Sets to Metro Global Mirror session - Confirm

12. Tivoli Storage Productivity Center for Replication internally adds that Copy Set to its database and you can monitor it through the progress panel which reports the number of Copy Sets added to the Tivoli Storage Productivity Center for Replication inventory database. Note this does not establish Metro Global Mirror copy pairs. It is just an Tivoli Storage Productivity Center for Replication internal process to add this Copy Set to the Tivoli Storage Productivity Center for Replication inventory database.

13. After a few seconds, the progress panel reaches 100% and leaves the *Adding Copy Sets* panel and progress to the next panel shown in Figure 7-315. Click **Finish** to exit the *Add Copy Sets* wizard.

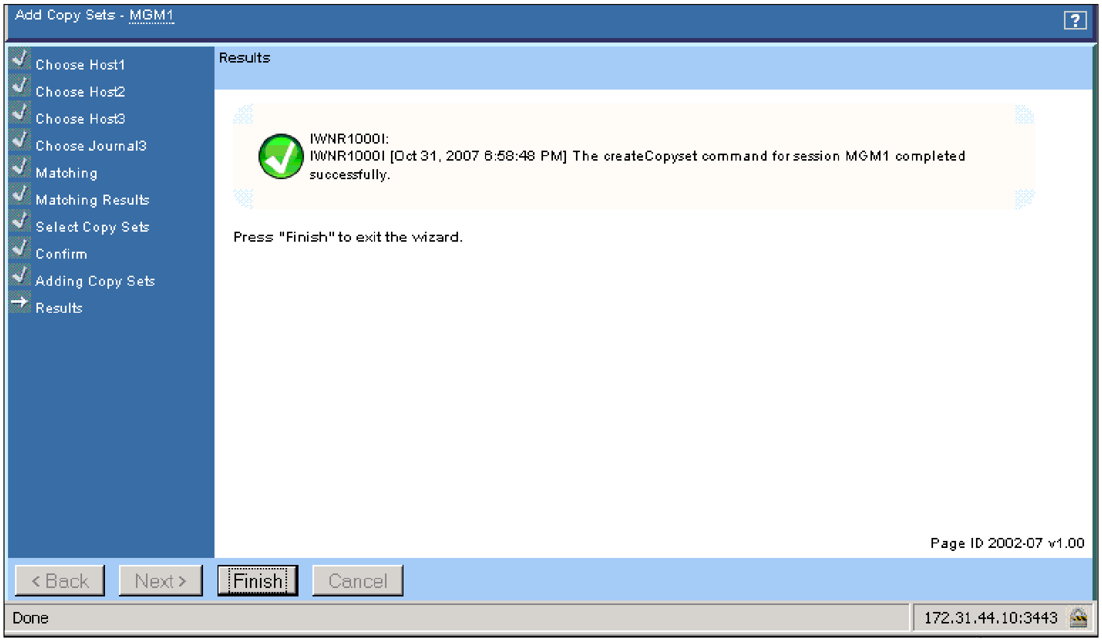

Figure 7-315 All Copy Sets are successfully added to the Tivoli Storage Productivity Center database

14. Figure 7-316 confirms that all Copy Sets are successfully added to the MGM1 session and the database is successfully updated. The session status is still *Inactive* but in *Defined* state.

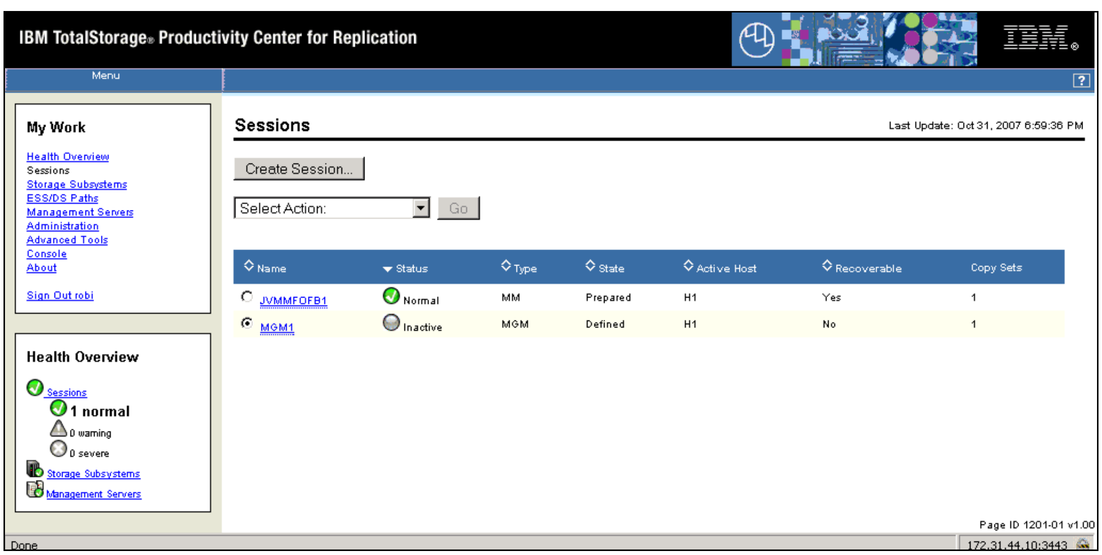

Figure 7-316 Metro Global Mirror session status

This concludes the steps through the GUI when you add Copy Sets to a Metro Global Mirror session.

7.9.3 Starting an H1 → H2 → H3 Metro Global Mirror session

After we have defined a Metro Global Mirror session and populated the session with Copy Sets, we can start the Metro Global Mirror session. Follow these steps:

1. Figure 7-317 displays the MGM1 session as we defined it previously. We defined one Copy Set in our example. Both Host 1 and Host 2 storage subsystems LSS pairs reside in a single DS8000 storage subsystem defined in *DS8000PrimaryLocation* location and Host 3 and Journal 3 volumes are defined in another DS8000 located in *DS8000Pok* location. As this is a three-site type of session it can be started in different directions as we are going to explain further in this section. Initially session can only be started in direction from Host 1 to Host 2 and to Host 3. To start it, from the **Select Action** pull-down menu select **Start H1** → **H2** → **H3** and click **Go**.

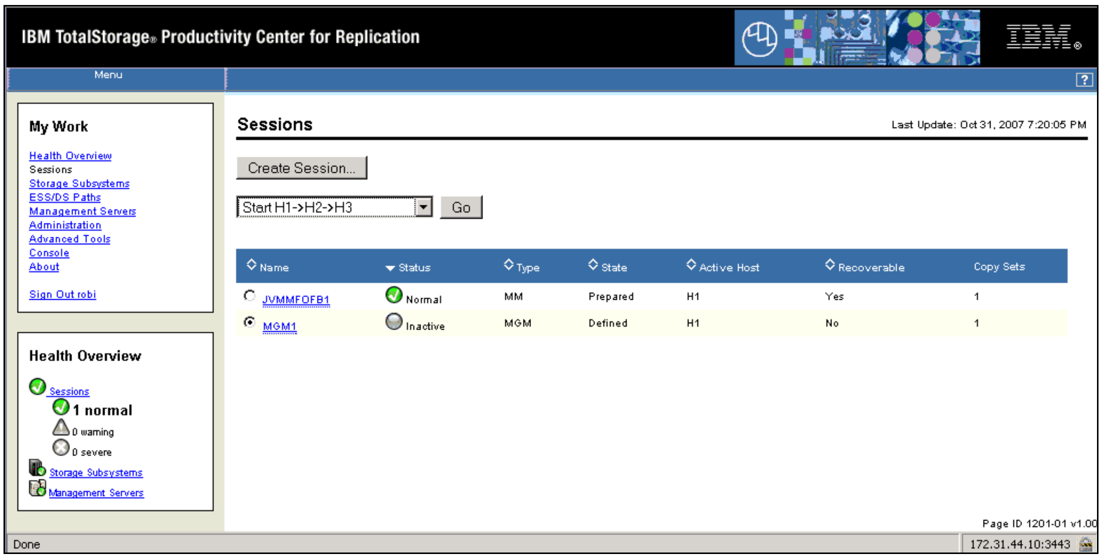

Figure 7-317 Metro Global Mirror session - Start H1 → H2 → H3 Action

2. The next message shown in Figure 7-318 is a warning that you are about to initiate a Metro Global Mirror session. This action creates Metro Mirror relationships between H1 and H2, and Global Mirror relationships between H2 and H3 volumes. In addition, it creates FlashCopy relationship between H3 and J3 journal volume as part of a Global Mirror configuration. After all relationships are established, copying of data from Site 1 to Site 2 and Site 3 will overwrite all data on H2, H3 and J3 volumes. Click **Yes** to continue.

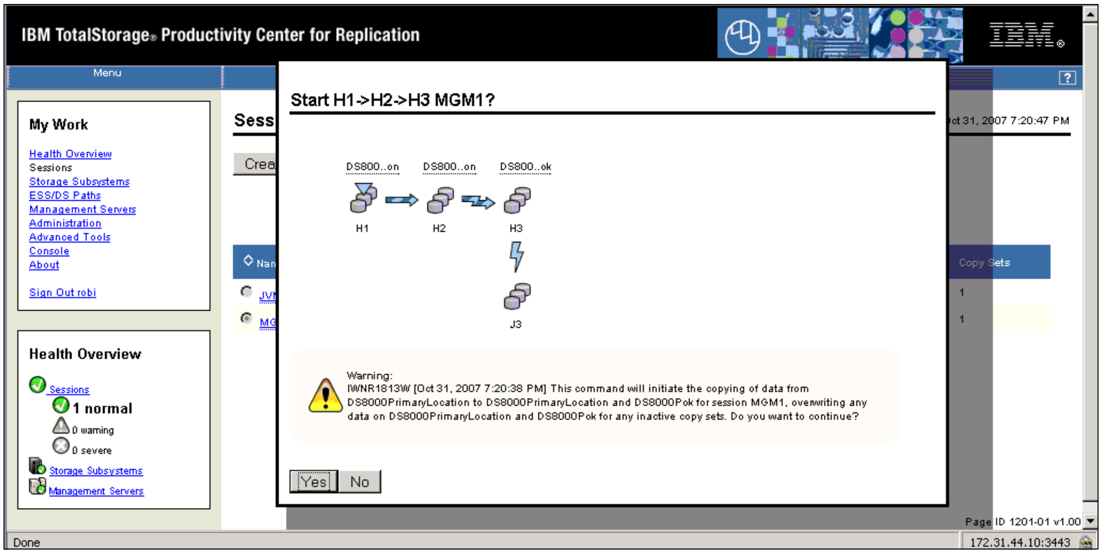

Figure 7-318 Start H1 → H2- → H3 Metro Global Mirror session

3. The message at the top of the panel in Figure 7-319 confirms that start of the Metro Mirror session is completed. The session is in *Preparing* state and *Warning* status. Click the session name hyperlink (**MGM1** in our scenario) for more details on this session.

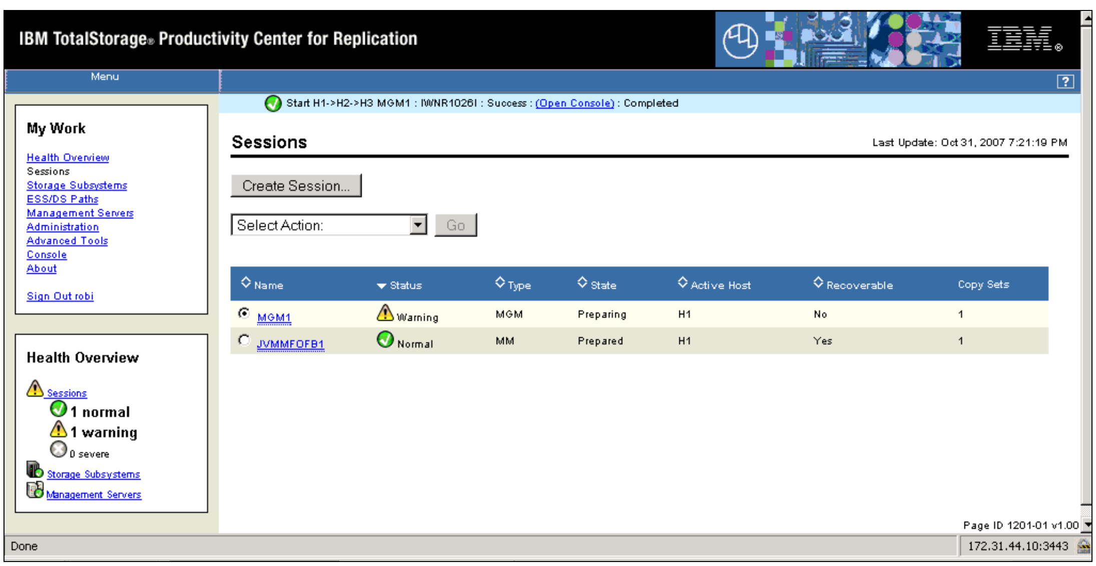

Figure 7-319 Start of Metro Global Mirror session is reported as Completed

4. As shown in Figure 7-320, the Metro Mirror session has *Warning* status and there are no errors. The copy progress between H1 and H2 volumes has reached 100% but there is still data copying in progress between H2 and H3 volumes and consistency group has not been formed yet. Therefore the session is still in *Preparing* state.

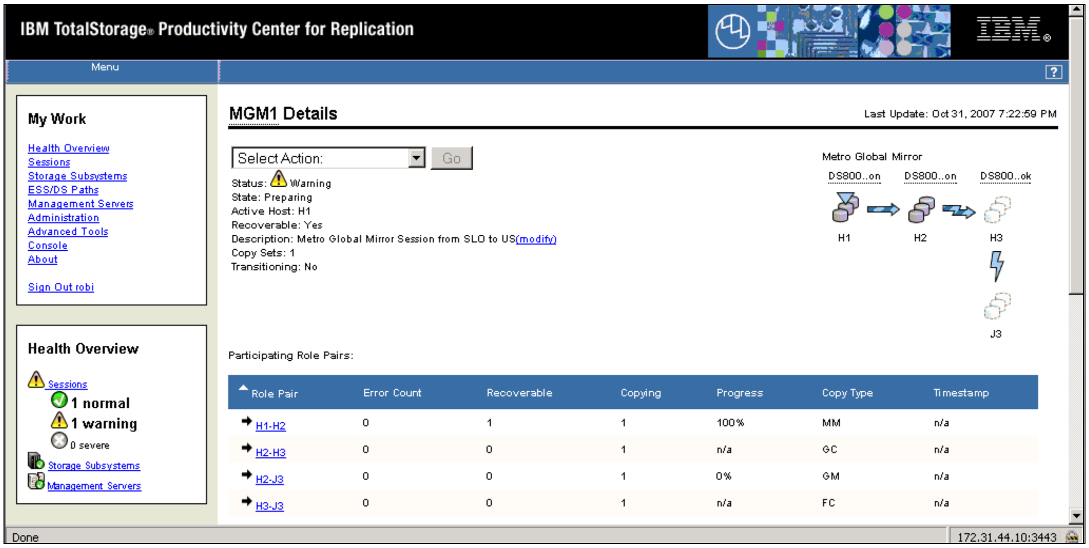

Figure 7-320 Metro Global Mirror session details

5. After the data has been copied from H2 to H3 volumes and the first consistency group has been created on J3 volumes, the session state changes to *Prepared* state and *Normal* status as shown Figure 7-321. Click the **Sessions** hyperlink in the *Health Overview* section at the bottom left side of the panel to go back to the main panel.

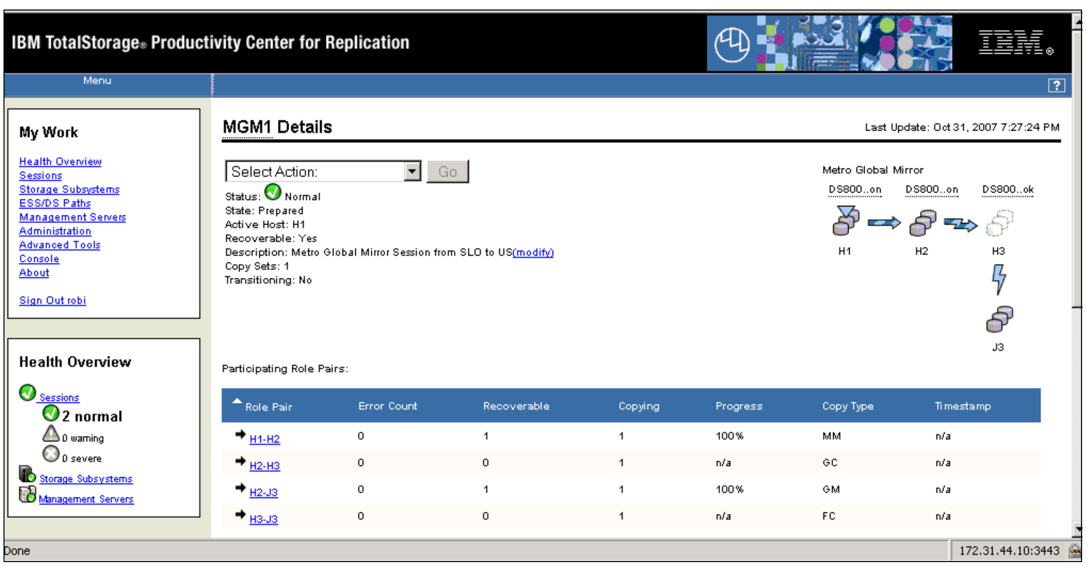

Figure 7-321 Metro Global Mirror session - Normal status

After the Metro Global Mirror session is started and it has *Normal* status and is in *Prepared* State, the following options are available:

Start H1 → H2 → H3 Restarts copying from H1 to H2 volumes in a Metro Mirror session and from H2 to H3 volumes in a Global Mirror session.

Start H1 → H3 Starts a Global Mirror session between H1 and H3 volumes.

Suspend Suspends a Metro Mirror session between H1 and H2 volumes and stops copying with consistent H2 volumes.

SuspendH2H3 Suspends a Global Mirror session between H2 and H3 volumes (it causes Global Mirror to stop forming consistency groups).

Terminate Terminates the session (under *Cleanup* submenu).

7.9.4 SuspendH2H3 in a Metro Global Mirror session

The **SuspendH2H3** action causes Global Mirror session between H2 and H3 volumes to stop forming consistency groups. Follow these steps:

1. From the **Sessions** panel, select your Metro Global Mirror session radio button, select **SuspendH2H3** from the **Select Action** pull-down list, and click **Go** as shown in Figure 7-322.

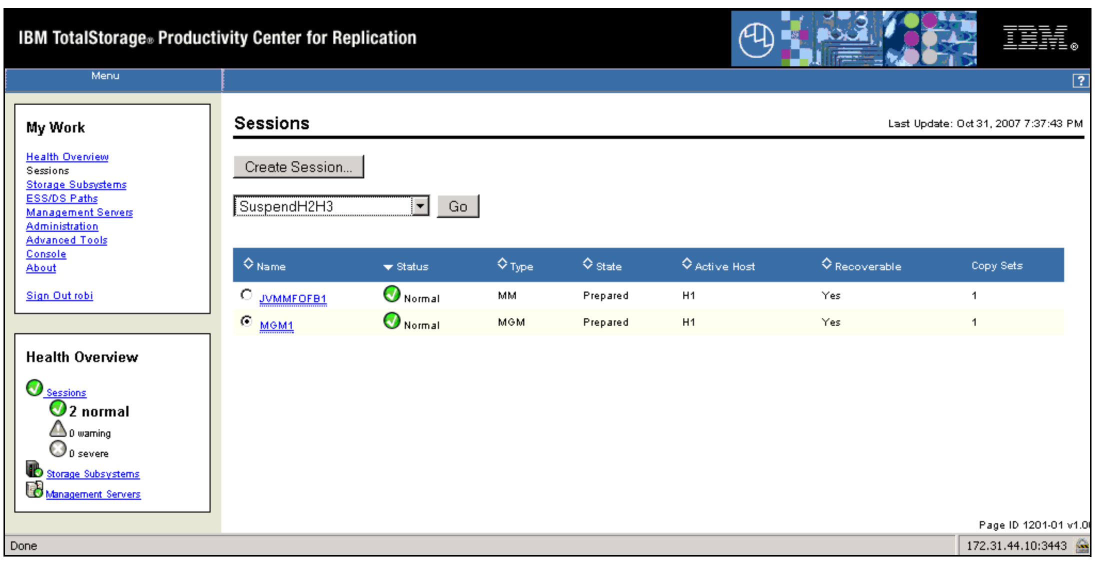

Figure 7-322 Metro Global Mirror session - SuspendH2H3 Action

2. The next message shown in Figure 7-323 is a warning that you are about to Suspend Global Mirror leg in a Metro Global Mirror session. It will stop the copying of data between H2 and H3 volumes but will not affect the copying of data from H1 to H2 volumes in Metro Mirror session. Click **Yes** to continue.

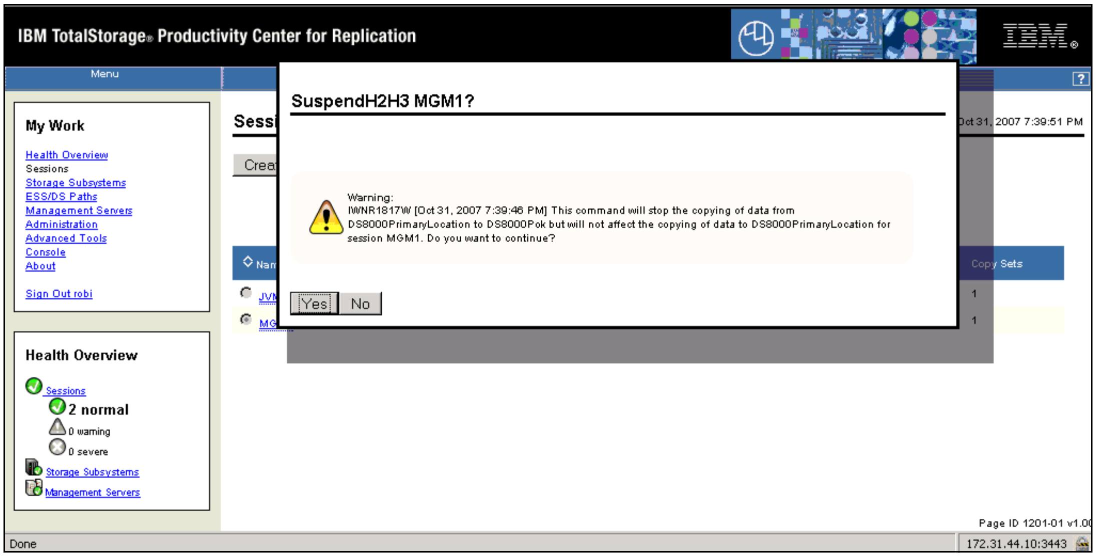

Figure 7-323 Suspend Metro Global Mirror session

3. The status of our Metro Global Mirror session has changed from *Normal* to *Severe* status indicating that data is not replicated anymore between Host 2 and Host 3 volumes. The State of the session is *SuspendedH2H3* as indicated in Figure 7-324.

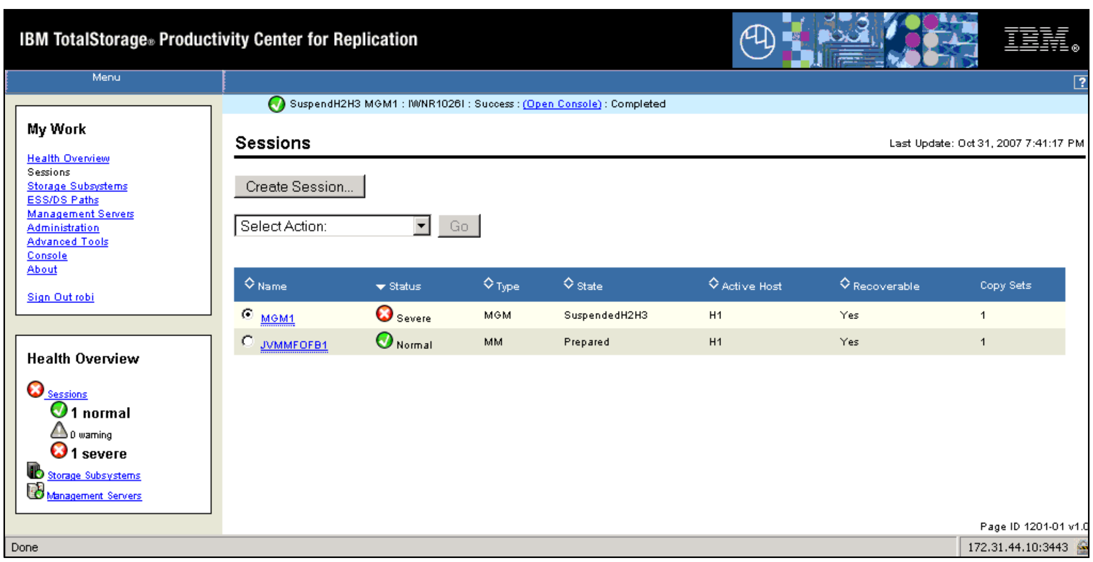

Figure 7-324 Suspend Metro Global Mirror session is reported as Completed

4. Click the session name hyperlink (**MGM1** in our example) to find more details about this session as shown in Figure 7-325. There is a timestamp for H2-J3 pair indicating when the session was suspended. It can be used as a reference.

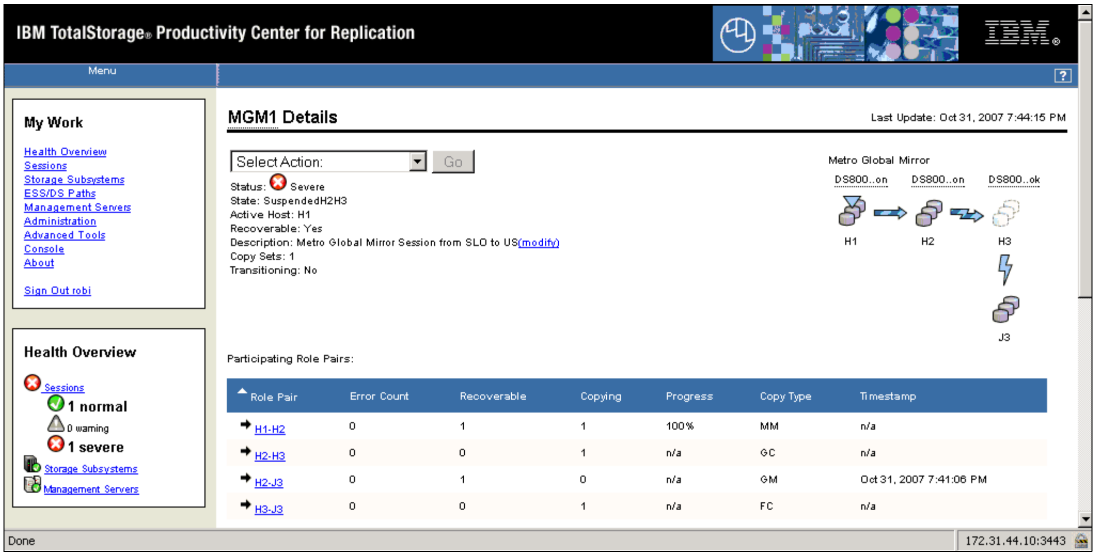

Figure 7-325 Suspend Metro Global Mirror session - Details

After the Metro Global Mirror session has *SuspendedH2H3* state, the following options are available:

RecoverH3 Makes H3 volumes available for host access.

Start H1 → H2 → H3 Restarts copying from H1 to H2 volumes in a Metro Mirror session and from H2 to H3 volumes in a Global Mirror session.

Suspend Suspends a Metro Mirror session between H1 and H2 volumes and stops copying with consistent H2 volumes.

Terminate Terminates the session (under *Cleanup* submenu).

7.9.5 RecoverH3 in a Metro Global Mirror session

After the Metro Global Mirror session and its associated Copy Sets have been suspended between H2 and H3 volumes, we can initiate **RecoverH3** action. Follow these steps:

1. Select the Metro Global Mirror session radio button (MGM1 in our example shown in Figure 7-326) and **RecoverH3** action from the **Select Action** pull-down menu. Click **Go** to continue.

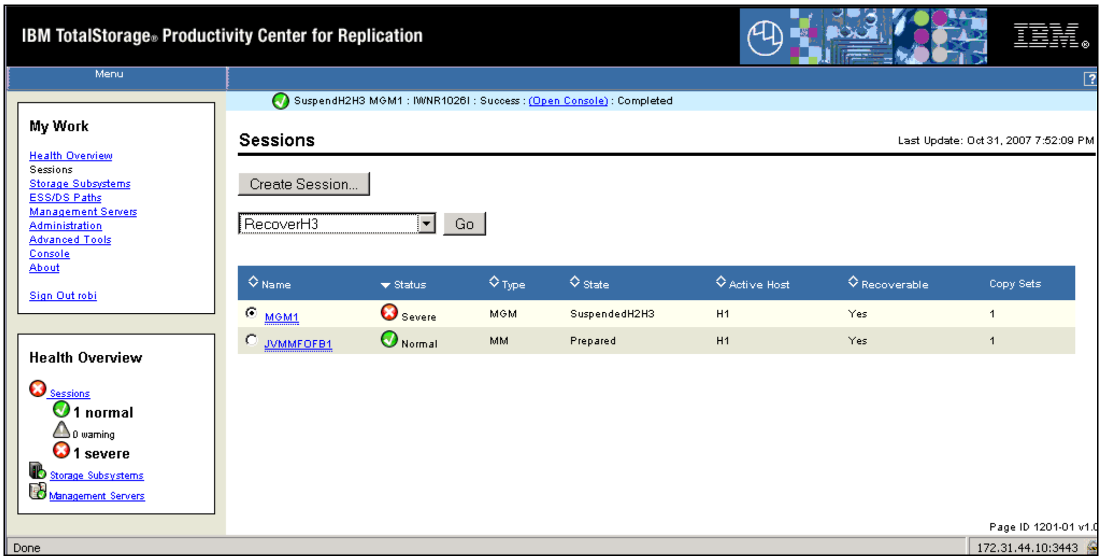

Figure 7-326 Metro Global Mirror session - RecoverH3 action

2. The next message shown in Figure 7-327 is a warning that you will allow H3 volumes available to your host. Click **Yes** to continue.

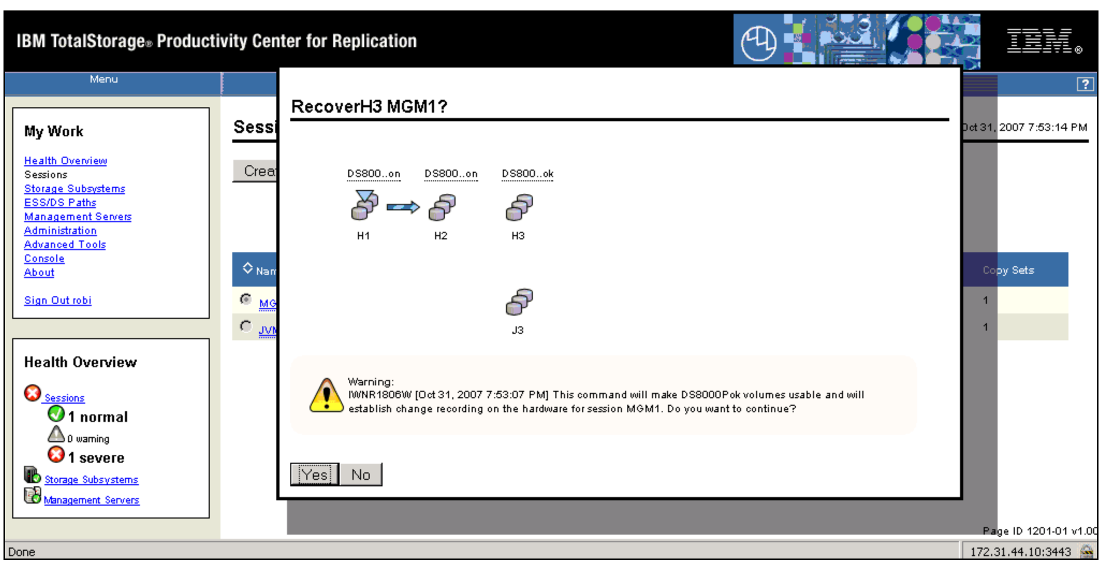

Figure 7-327 Metro Global Mirror session - RecoverH3 action

3. There is a message at the top of the panel in Figure 7-328 indicating that a **RecoverH3** action has been successfully completed. The status of our Metro Global Mirror session is *Normal* and the State is *Prepared*. H3 volume is now available to your host.

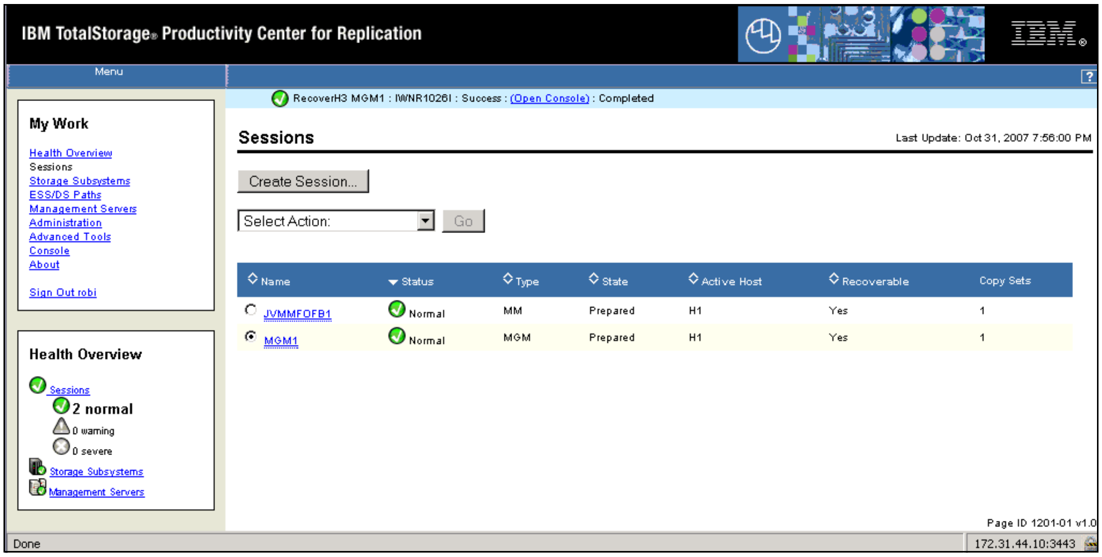

Figure 7-328 Metro Global Mirror session - H3 storage subsystem volume available to host

4. Click the session name hyperlink (**MGM1** in our example) to find more details about this session as shown in Figure 7-329. As you can see, there is only one volume pair set left in this Metro Global Mirror Copy Set since we recovered H3 volumes and thus stopped data copying from H2 to H3 volumes.

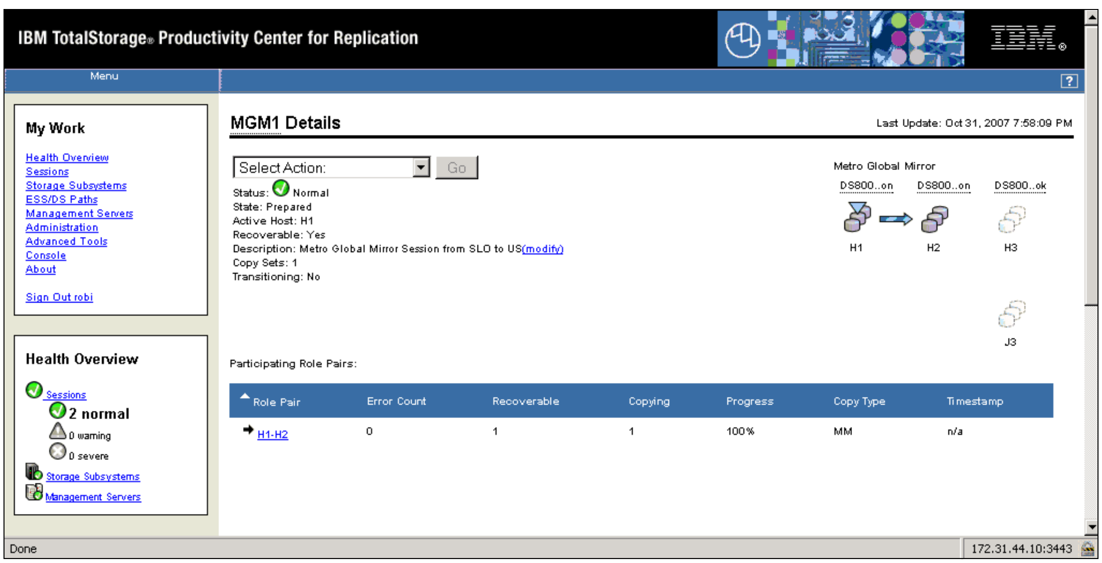

Figure 7-329 Metro Global Mirror session - details

After the *RecoverH3* action, the following options are available:

Start H1 → H2 Restarts copying from H1 to H2 volumes in a Metro Mirror session.

Start H1 → H2 → H3 Restarts copying from H1 to H2 volumes in a Metro Mirror session and from H2 to H3 volumes in a Global Mirror session.

Suspend Suspends a Metro Mirror session between H1 and H2 volumes and stops copying with consistent H2 volumes.

Terminate Terminates the session (under *Cleanup* submenu).

7.9.6 Suspending a Metro Global Mirror session

The **Suspend** action suspends Metro Mirror leg in a Metro Global Mirror session. It will stop the data copying between H1 and H2 volumes. In our example we issued **Suspend** command while the Metro Global Mirror session was in *Normal* status and *Prepared* state (H1 → H2 → H3 configuration). Follow these steps:

1. From the **Sessions** panel, select your Metro Global Mirror session radio button, select **Suspend** from the **Select Action** pull-down list, and click **Go** as shown in Figure 7-330.

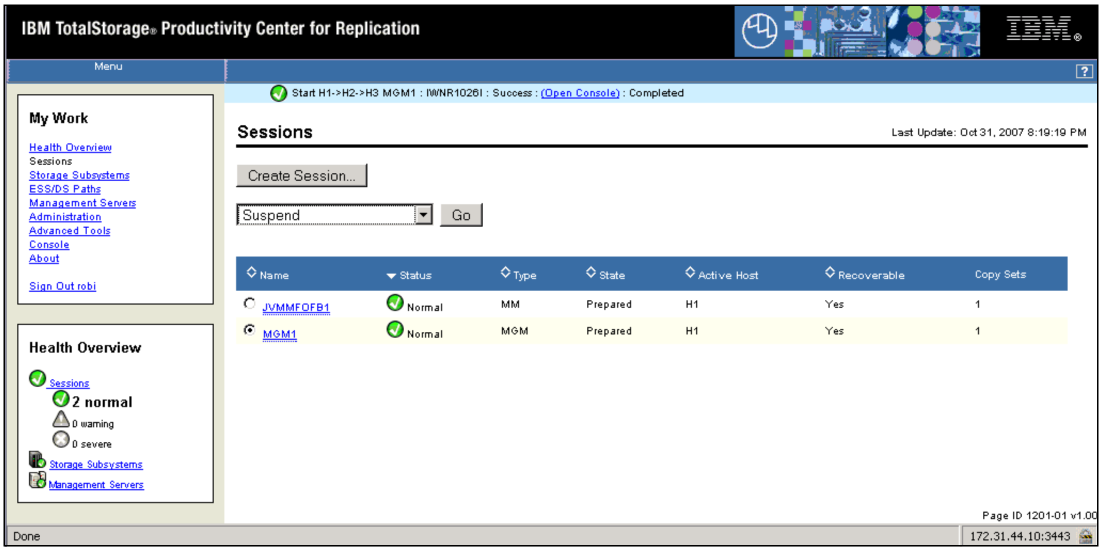

Figure 7-330 Metro Global Mirror session - Suspend Action

2. The next message shown in Figure 7-331 is a warning that you are about to Suspend Metro Mirror leg in a Metro Global Mirror session. Click **Yes** to continue.

> **Note:** After the Suspend is initiated, all host I/O is temporarily halted if **Release I/O after Suspend** has been selected during the Metro Mirror session creation step (see Figure 7-300 on page 472). In case **Hold I/O after Suspend** policy has been selected, then all systems that can update the H1 volumes are on hold before the Extended Long Busy for CKD volumes or SCSI Queue Full timer for FB volumes ends (default is 120 seconds).

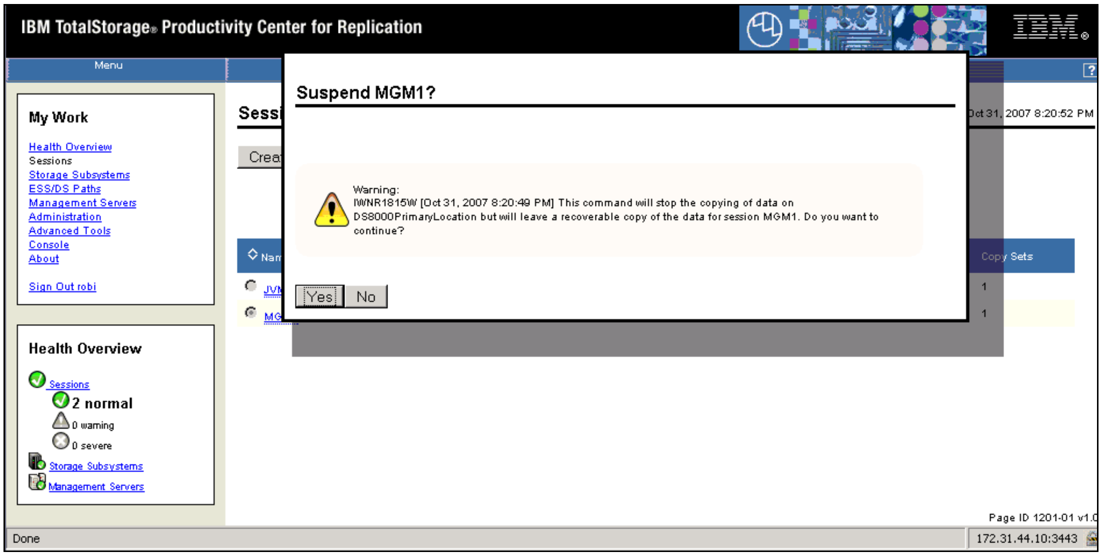

Figure 7-331 Suspend Metro Global Mirror session

3. There is a message indicating that suspend has been successful and the status of our Metro Global Mirror session has changed from *Normal* to *Severe* status since the data is not replicated anymore between Host 1and Host 2 volumes. The state of the session is *Suspended* as indicated in Figure 7-332.

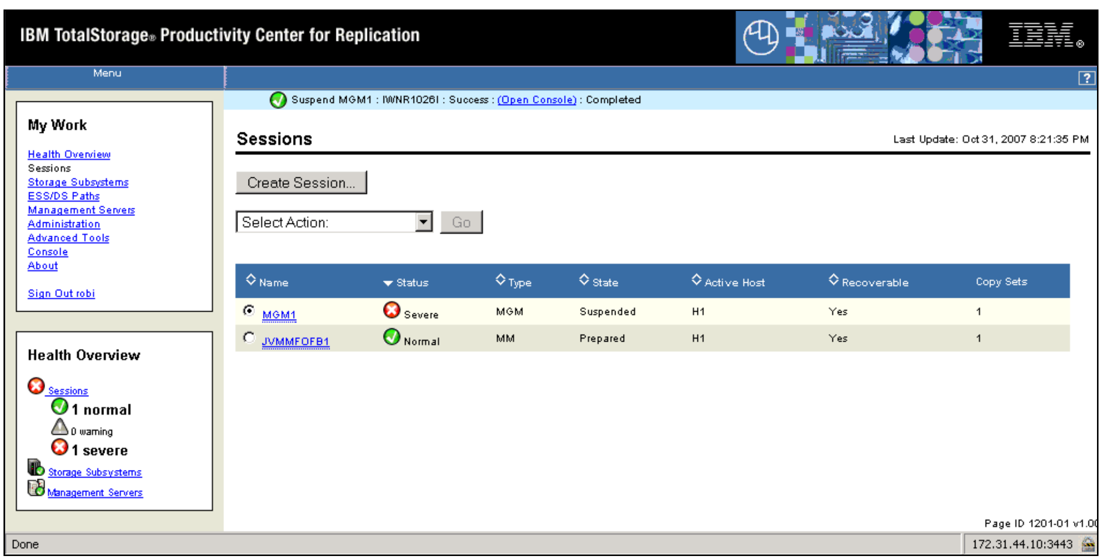

Figure 7-332 Suspend Metro Global Mirror session is reported as Completed

4. Click the session name hyperlink (**MGM1** in our example) to find more details about this session as shown in Figure 7-333. There is a timestamp for H1-H2 pair indicating when the Metro Mirror session was suspended. It can be used as a reference.

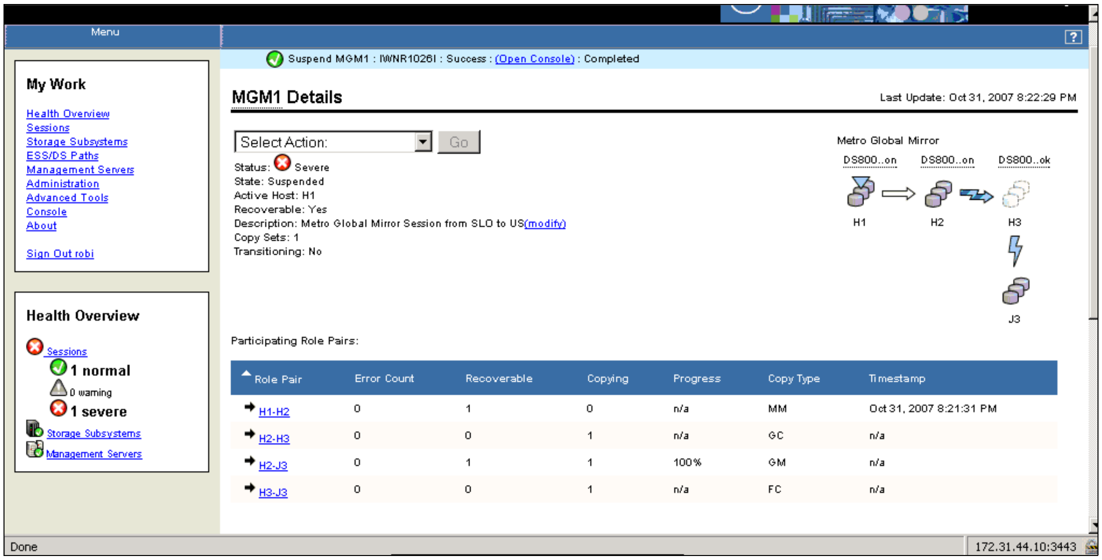

Figure 7-333 Metro Global Mirror session - Details

After the Metro Global Mirror session has *Suspended* state, the following options are available:

RecoverH2 Makes H2 volumes available for host access.

RecoverH3 Makes H3 volumes available for host access.

Release I/O Releases I/O to H1 volumes after Suspend event. This option is available only if the Metro Global Mirror session is created with **Hold I/O after Suspend** policy.

Start H1 → H2 → H3 Restarts copying from H1 to H2 volumes in a Metro Mirror session and from H2 to H3 volumes in a Global Mirror session.

Start H1 → H3 Restarts copying from H1 to H3 volumes in a Global Mirror session.

Terminate Terminates the session (under Cleanup submenu).

7.9.7 Releasing I/O in a Metro Global Mirror session

If you are going to suspend a Metro Mirror session that has been created with **Hold I/O after Suspend** policy (see 7.9.1, “Creating a Metro Global Mirror session” on page 469), then all systems that can update the H1 volumes are on hold before the Extended Long Busy for CKD volumes or SCSI Queue Full timer for FB volumes ends (default is 120 seconds). If you do not want to stop your production for 120 seconds, you have an option to release I/O immediately after the Metro Mirror session has been suspended. Follow these steps:

1. Select **Release I/O** from **Select Action** pull-down menu and click **Go** to continue (see Figure 7-334).

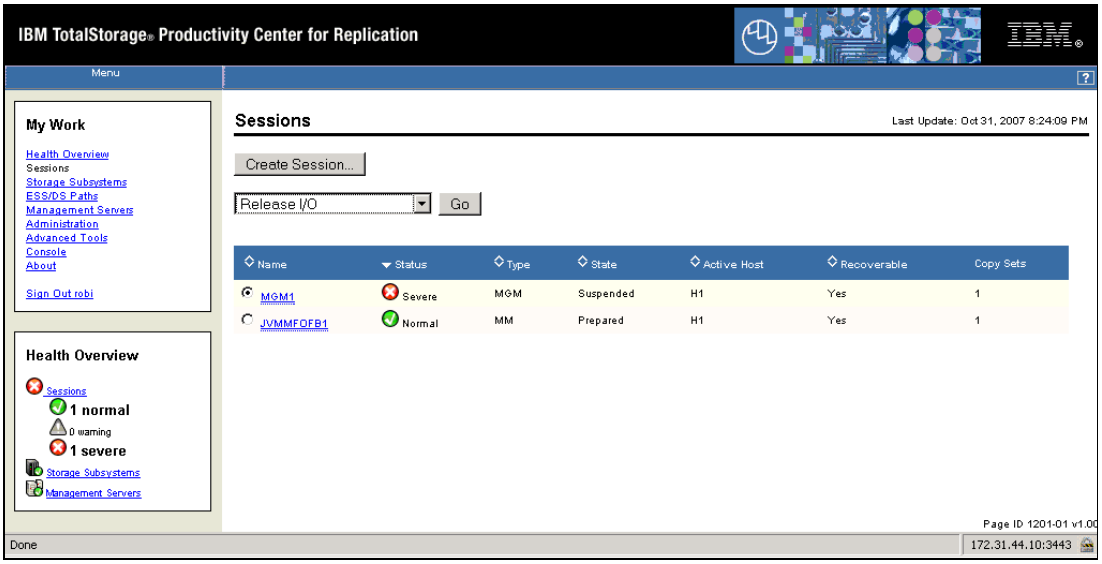

Figure 7-334 Metro Global Mirror session - Release I/O action

2. The next message shown in Figure 7-335 is a warning that you are about to allow writes to continue to H1 volumes. Click **Yes** to continue.

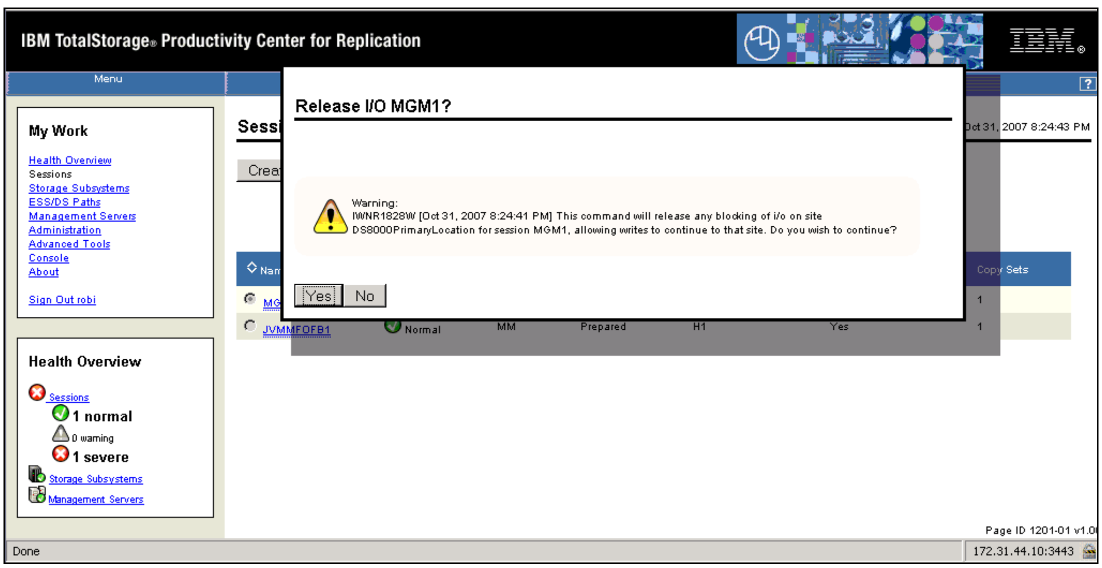

Figure 7-335 Metro Global Mirror session - Release I/O

3. There is a message at the top of the panel indicating that a **Release I/O** action has been successfully completed as shown in Figure 7-336.

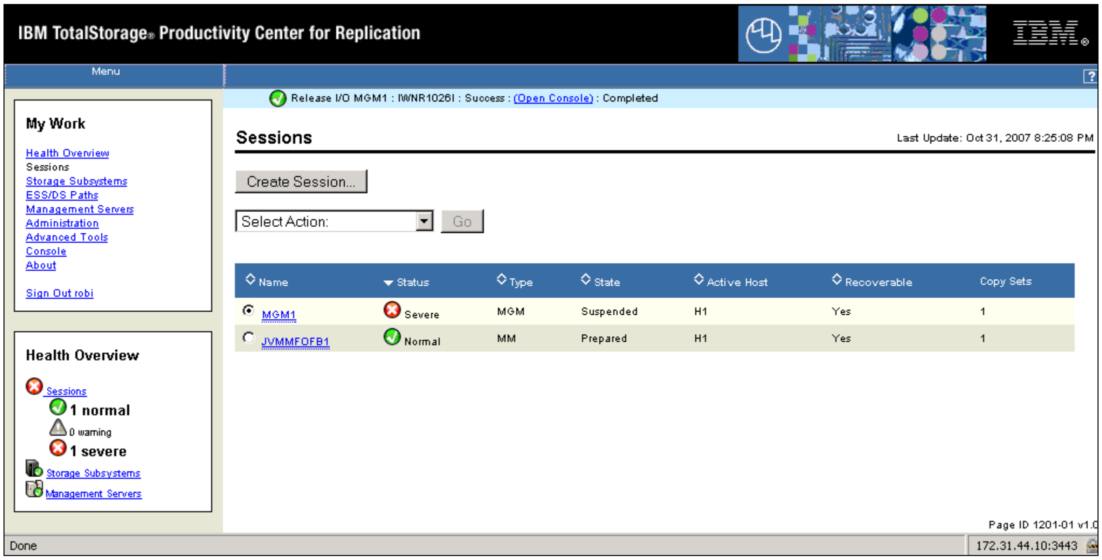

Figure 7-336 Metro Global Mirror session - Release I/O completed

The following options are available after *Release I/O* action:

RecoverH2 Makes H2 volumes available for host access.

RecoverH3 Makes H3 volumes available for host access.

Release I/O Releases I/O to H1 volumes after Suspend event. This option is available only if the Metro Global Mirror session is created with **Hold I/O after Suspend** policy.

Start H1 → H2 → H3 Restarts copying from H1 to H2 volumes in a Metro Mirror session and from H2 to H3 volumes in a Global Mirror session.

Start H1 → H3 Restarts copying from H1 to H3 volumes in a Global Mirror session.

Terminate Terminates the session (under Cleanup submenu).

7.9.8 RecoverH2 in a Metro Global Mirror session

After the Metro Global Mirror session and its associated Copy Sets have been suspended, we can initiate **RecoverH2** action. Follow these steps:

1. Select the Metro Mirror session radio button (MGM1 in our example shown in Figure 7-337) and the **Recover** action from the **Select Action** pull-down menu. Click **Go** to continue.

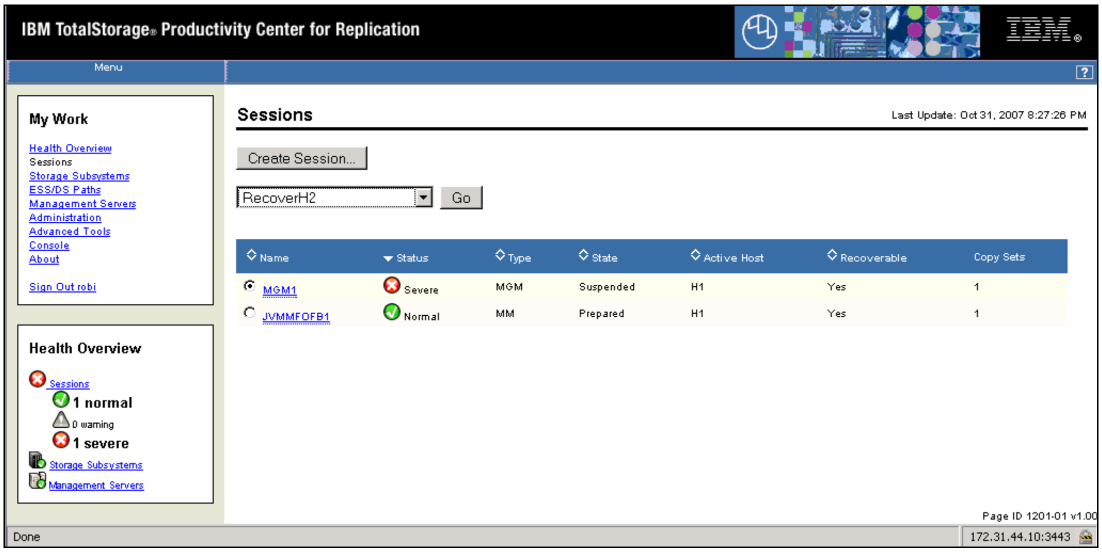

Figure 7-337 Metro Global Mirror session - RecoverH2 action

2. The next message shown in Figure 7-338 is a warning that you will allow H2 volumes available to your host. Click **Yes** to continue.

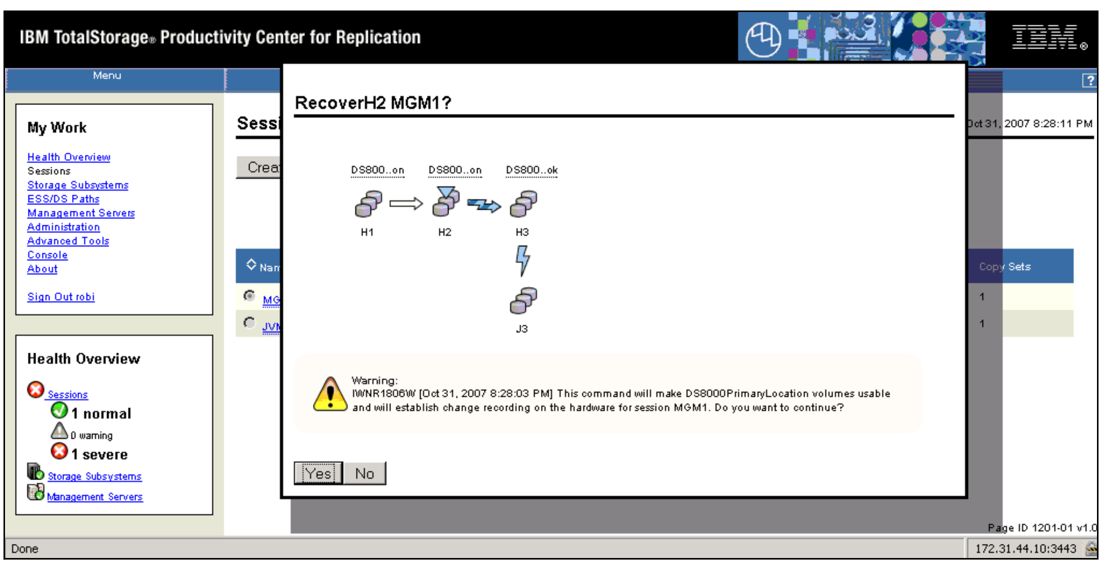

Figure 7-338 RecoverH2 - Metro Global Mirror Session

3. There is a message at the top of the panel in Figure 7-339 indicating that a **RecoverH2** action has been successfully completed. The status of our Metro Global Mirror session is *Normal* and the State is *Target Available* indicating that H2 volume is available to your host.

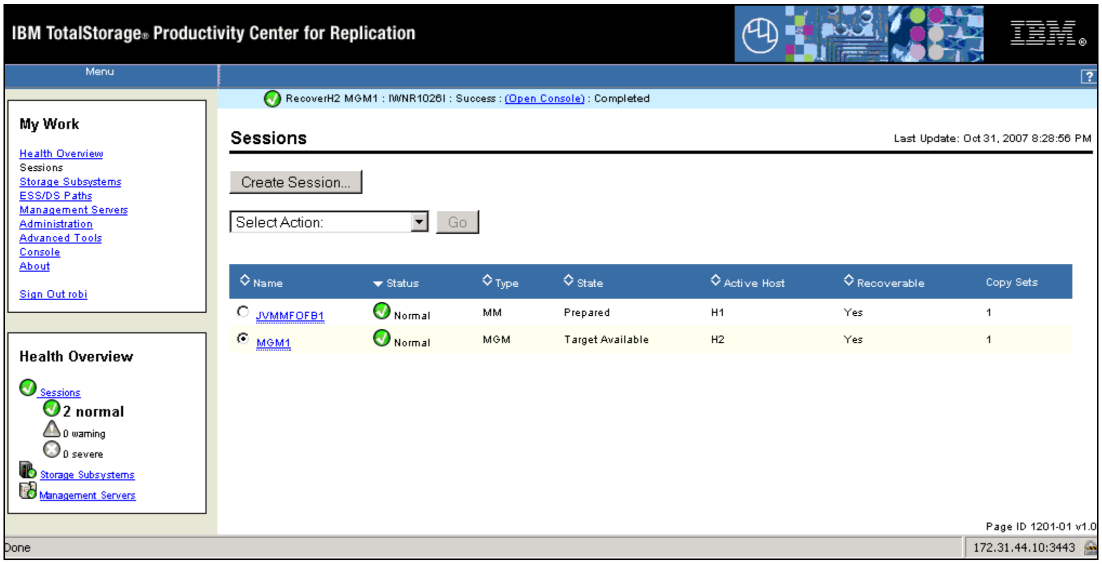

Figure 7-339 Metro Mirror session - H2 storage subsystem volume available to host

4. Click the Session name hyperlink (**MGM1** in our example) to find more details about this session as shown in Figure 7-340. There is a timestamp for H1-H2 pair indicating when the Metro Mirror session was suspended. It can be used as a reference.

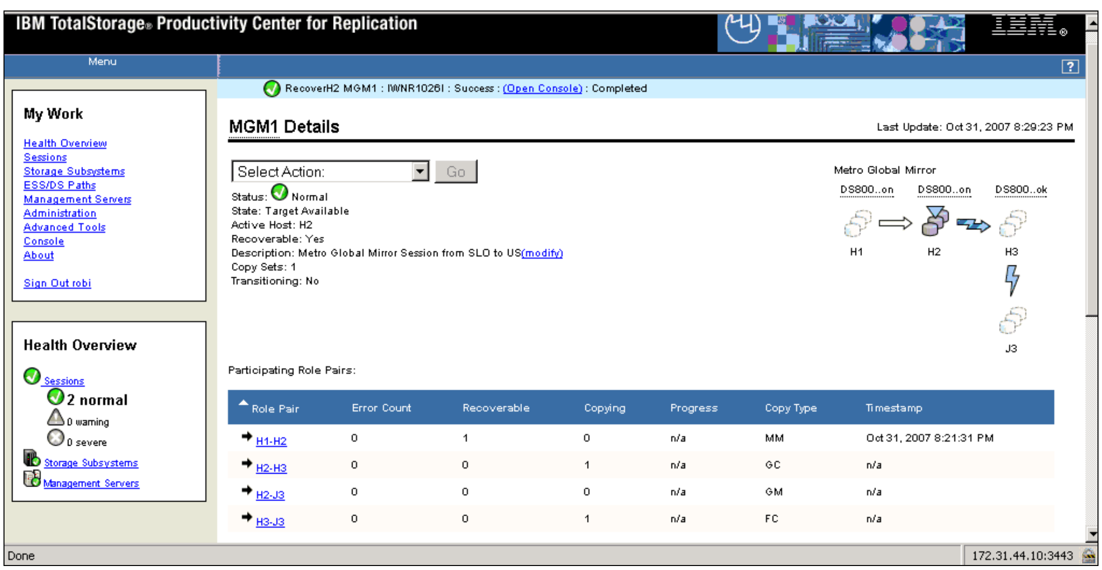

Figure 7-340 Metro Global Mirror session - Details

After the Metro Mirror session is recovered in *Target Available* state, the following options are available:

Release I/O Releases I/O to H1 volumes after Suspend event. This option is available only if the Metro Mirror session is created with **Hold I/O after Suspend** policy.

Start H1 → H2 → H3 Restarts copying from H1 to H2 volumes in a Metro Mirror session and from H2 to H3 volumes in a Global Mirror session.

Start H2 → H3 Restarts copying from H2 to H3 volumes in a Global Mirror session.

Enable Copy to Site 1 Before reversing the direction of copying in a failover and failback session, you must run this command, and confirm that you want to reverse the direction of replication. It will enable **Start H2 → H1 → H3** command.

Terminate Terminates the session (under Cleanup submenu).

7.9.9 Enable Copy to Site 1

After a **RecoverH2** action, Host 2 volumes are active and available to the host. As Host 2 site is now the active site, you can reverse direction of copying in a Metro Mirror session from H2 to H1 volumes. Follow these steps:

1. Before you can initiate copying from Host 2 to Host 1 volumes, you need to start the **Enable Copy to Site 1** command. To achieve this, from the **Select Action** pull-down menu, select **Enable Copy to Site 1** and click **Go** as shown in Figure 7-341.

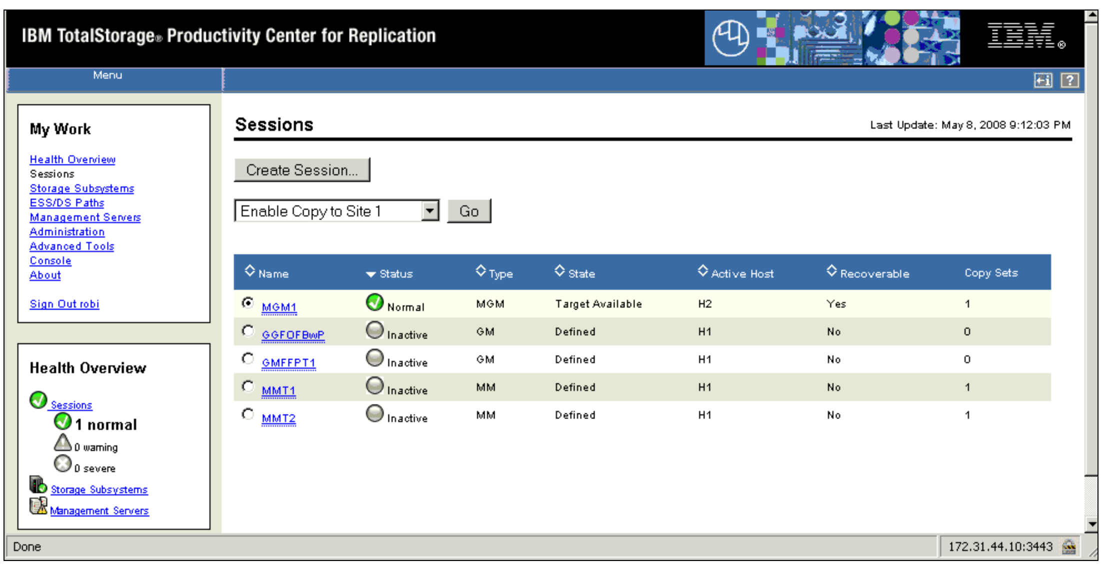

Figure 7-341 Metro Mirror session - Enable Copy to Site 1

2. The next message shown in Figure 7-342 is a warning that you are about to enable the command that initiates copying data from H2 to H1 volumes. This command is disabled to protect against accidentally copying over production data. Ensure that all of the volumes in this session located at Site 1 are not being used by any application prior to enabling the command that allows copying data to Site 1. Click **Yes** to continue.

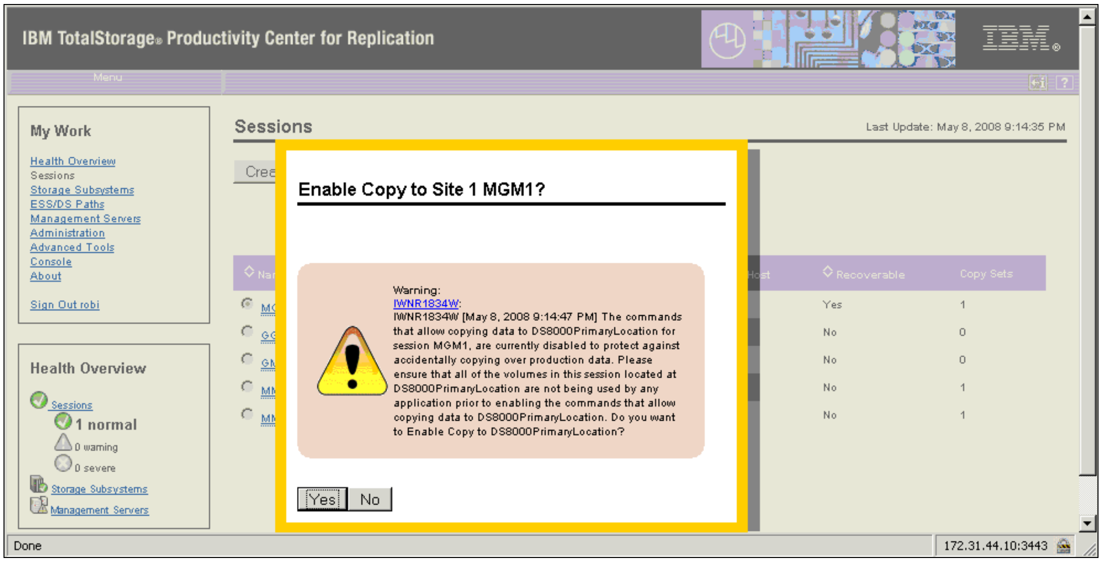

Figure 7-342 Enable Copy to Site 1

3. The message at the top of the panel in Figure 7-343 confirms that Enable Copy to Site 1 command is completed. The status of our Metro Global Mirror session is the same as it was after **RecoverH2** command: *Normal* status and *Target Available* state, indicating that H2 volume is available to your host.

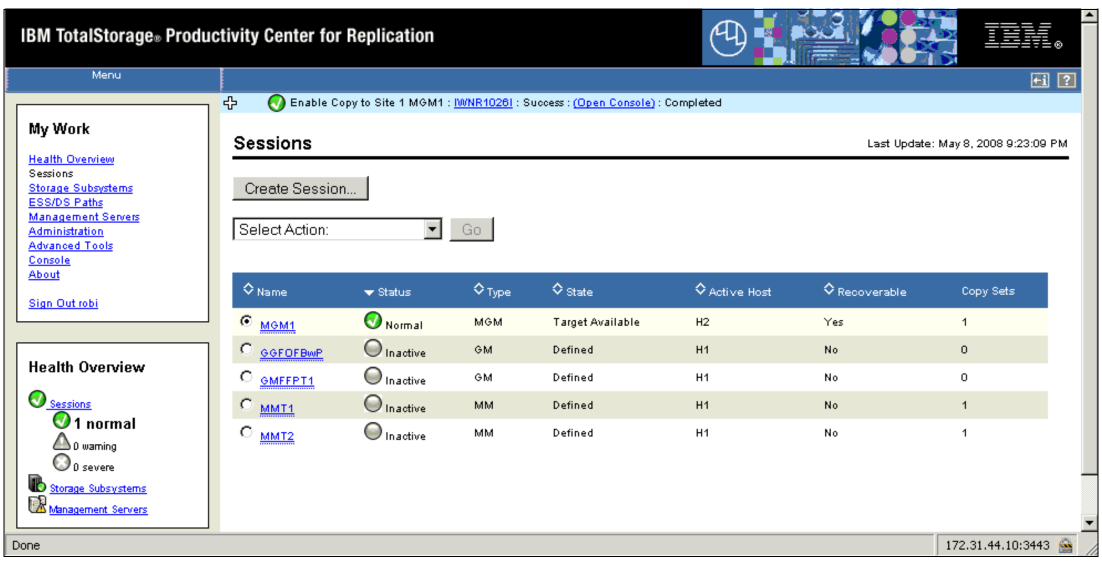

Figure 7-343 Enable Copy to Site 1 is reported as Completed

The following options are available at this stage:

Release I/O	Releases I/O to H1 volumes after Suspend event. This option is available only if the Metro Mirror session is created with **Hold I/O after Suspend** policy.
Start H2 → H1 → H3	Restarts copying from H2 to H1 volumes in a Metro Mirror session and H1 to H3 volumes in a Global Mirror session.
Start H2 → H3	Restarts copying from H2 to H3 volumes in a Global Mirror session.
Re-enable Copy to Site 2	Enables **Start H1 → H2 → H3** command.
Terminate	Terminates the session (under Cleanup submenu).

7.9.10 Starting H2 → H3 Metro Global Mirror session (after RecoverH2)

After a **RecoverH2** action has been executed (in order to start your application using Host 2 volumes), the Global Mirror session between H2 and H3 is suspended. Follow these steps:

1. At this stage, it is possible to re-establish Global Mirror from H2 to H3 volumes. To achieve this, from the **Select Action** pull-down menu, select **Start H2 → H3** and click **Go** as shown in Figure 7-344.

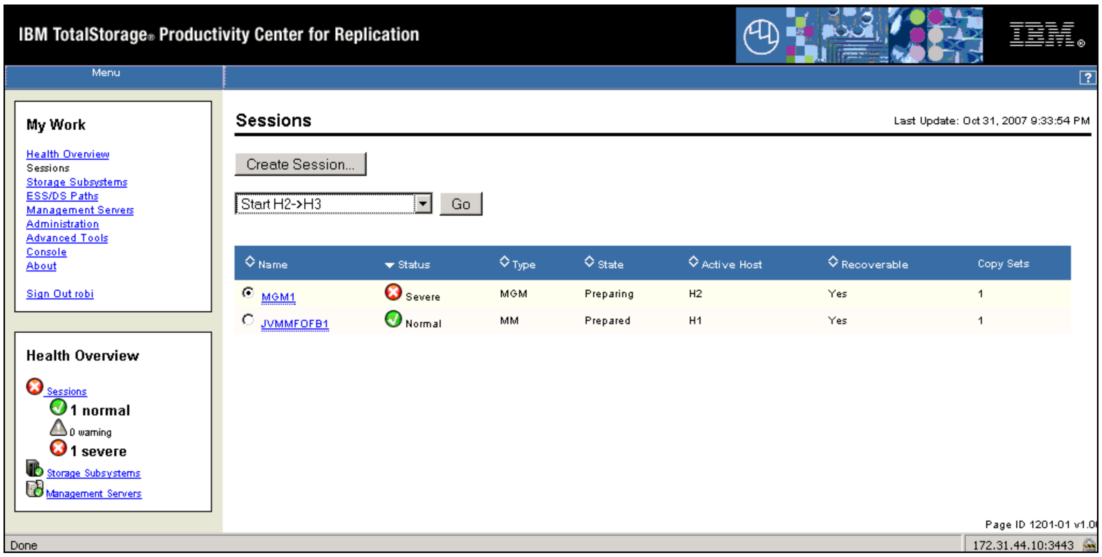

Figure 7-344 Metro Global Mirror session - Start H2 → H3 Action

2. The next message shown in Figure 7-345 is a warning that you are about to initiate Global Mirror between H2 and H3 volumes. Click **Yes** to continue.

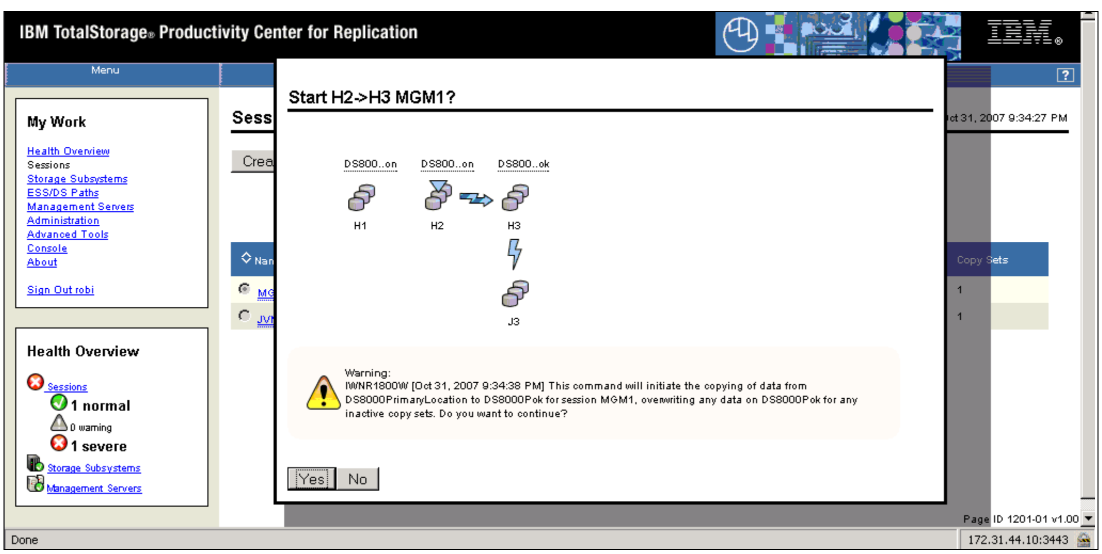

Figure 7-345 Metro Global Mirror session - Start H2 → H3 after RecoverH2

3. The message at the top of the panel in Figure 7-346 confirms that start of the Global Mirror between H2 and H3 is completed. The session is in *Prepared* state and *Normal* status. Click the Session name hyperlink (`MGM1` in our example) for details on this session.

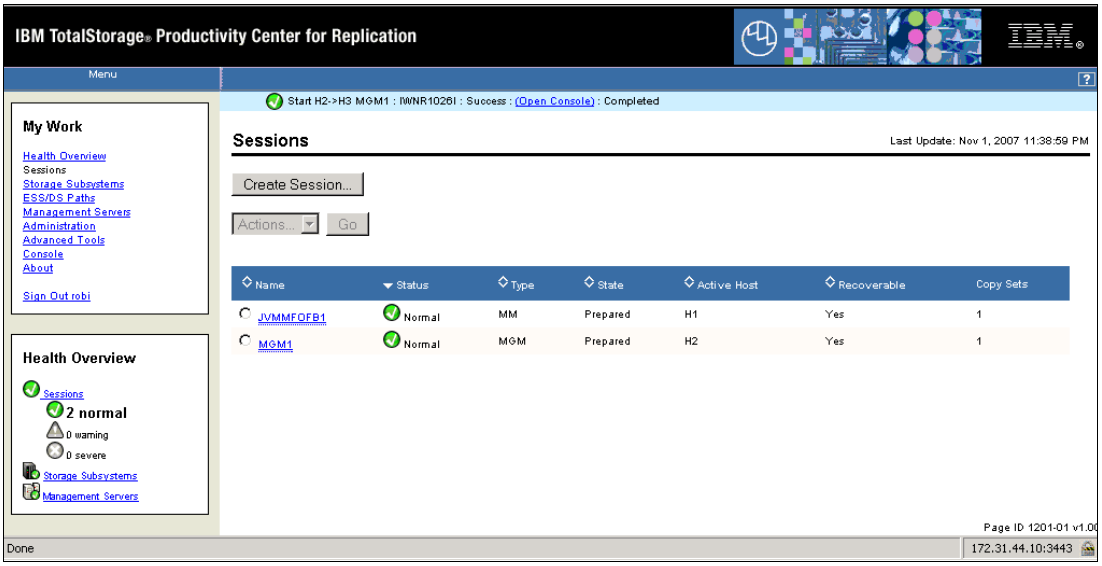

Figure 7-346 Metro Global Mirror session - Start H2 → H3 Completed

4. As shown in Figure 7-347, Global Mirror data copying progress reached 100%. Click the *Sessions* hyperlink in the *Health Overview* section at the bottom left side of the panel to go back to the Sessions panel.

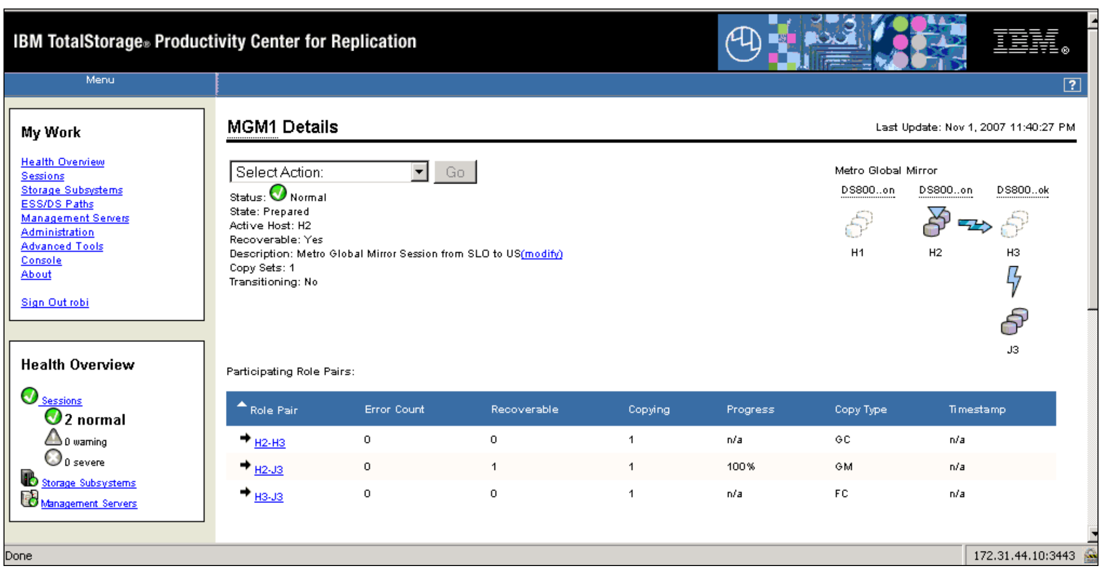

Figure 7-347 Metro Global Mirror session - details

At this stage, the following options are available:

Start H2 → H1 → H3 Creates a Metro Mirror session between H2 to H1 volumes and a Global Mirror session between H1 and H3 volumes.

Start H2 → H3 Restarts copying from H2 to H3 volumes in a Global Mirror session.

Suspend Stops copying with consistent H1 volumes.

Terminate Terminates the session (under Cleanup submenu).

7.9.11 Starting H2 → H1 → H3 Metro Global Mirror session (after RecoverH2)

After you have recovered volumes at Site 2 using the **RecoverH2** action, it is possible to change data replication direction after volumes at Site 1 are available again. Follow these steps:

1. To achieve this, from the **Select Action** pull-down menu, select **Start H2 → H1 → H3** and click **Go** as shown in Figure 7-348.

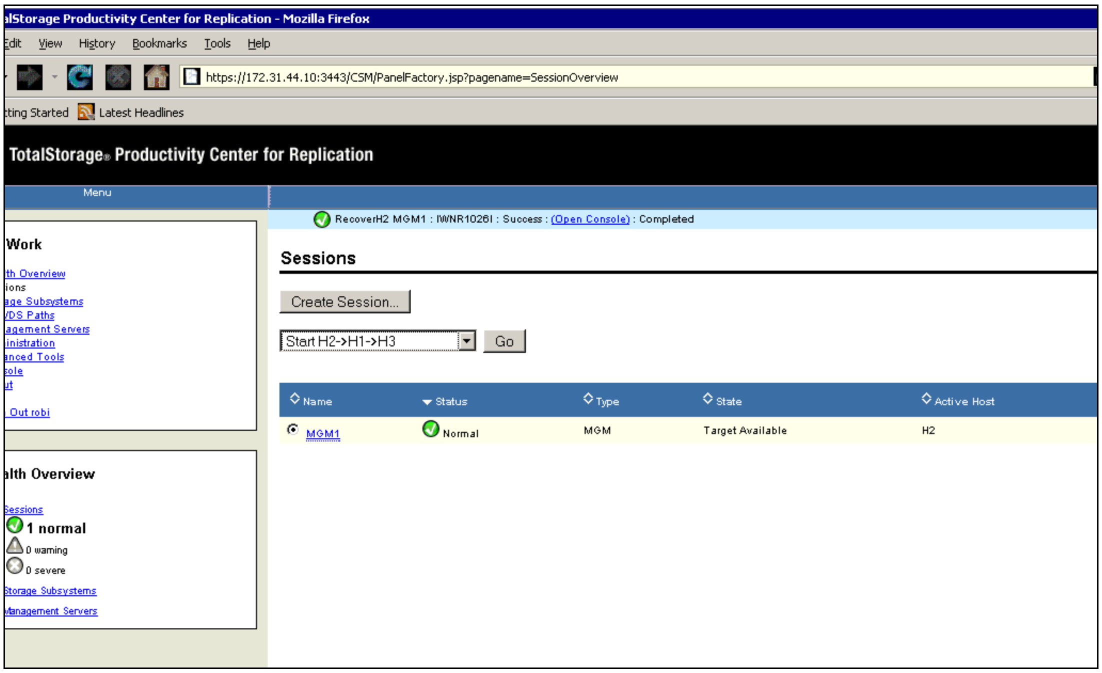

Figure 7-348 Metro Global Mirror session - Start H2 → H1 → H3 Action

2. The next message shown in Figure 7-349 is a warning that you are about to initiate Metro Mirror between H2 and H1 volumes as well as Global Mirror between H1 and H3 volumes. Click **Yes** to continue.

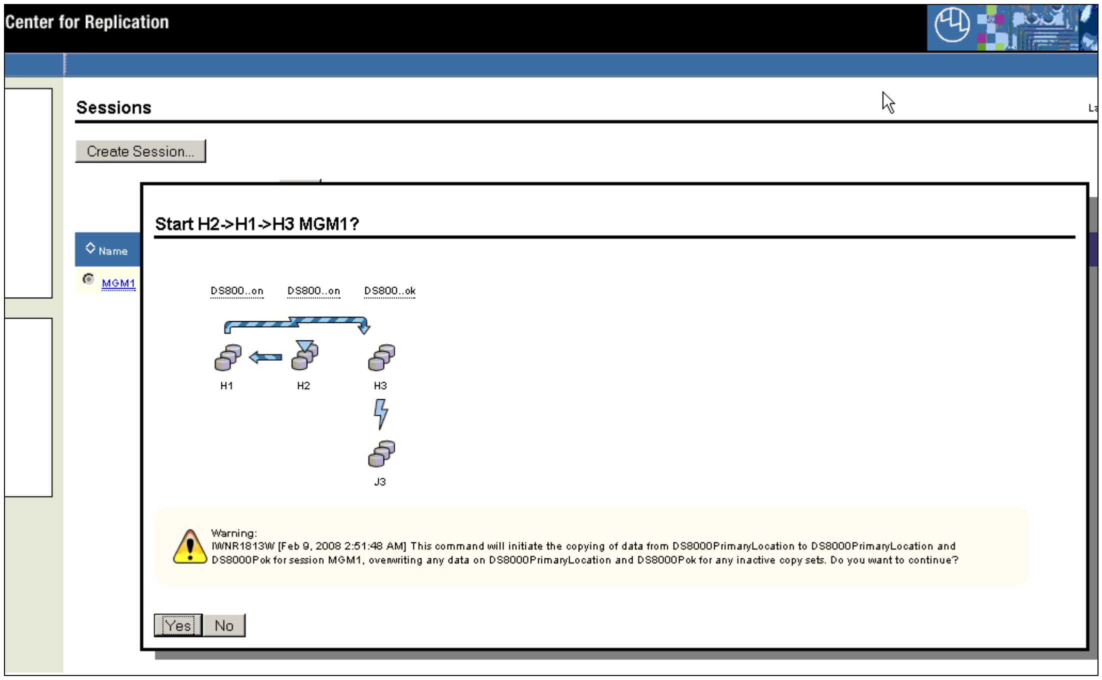

Figure 7-349 Metro Global Mirror session - Start H2 → H1 → H3 after RecoverH2

3. The message at the top of the panel in Figure 7-350 confirms that start of the Metro Global Mirror between H2, H1 and H3 is completed. The session is initially in *Preparing* state and *Warning* status since the data between H2 and H1 are not 100% synchronized. After the H1 and H2 volumes are fully synchronized and the first data consistency is created between H3 and J3 volumes the session goes to *Prepared* states and *Normal* status. Click the Session name hyperlink (**MGM1** in our example) for details on this session.

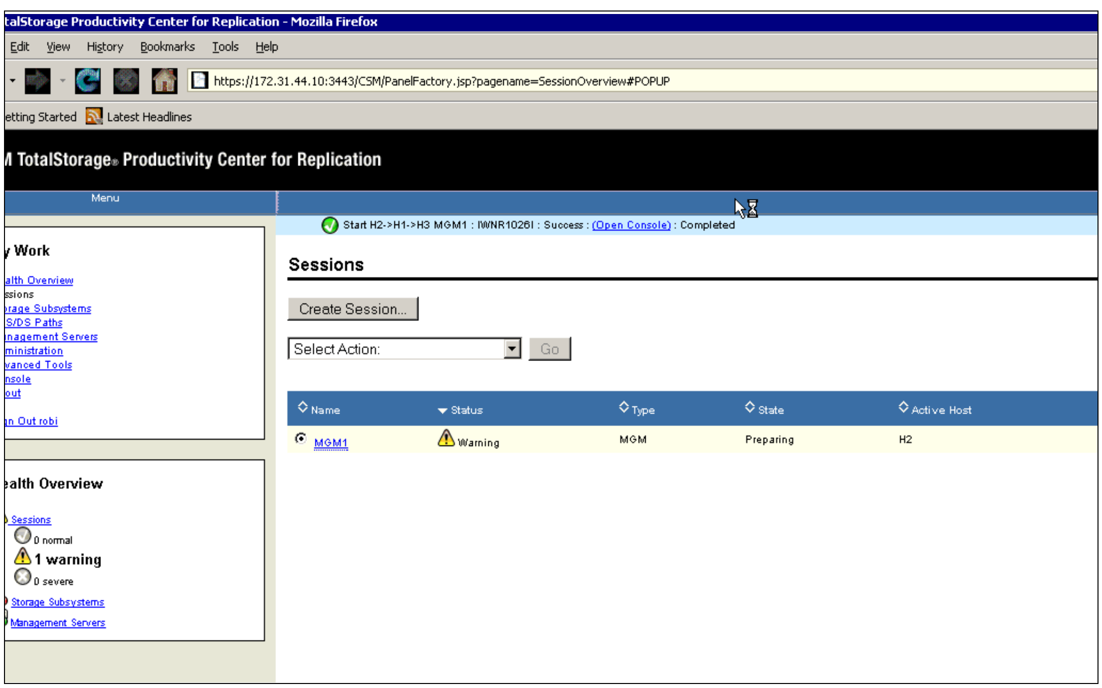

Figure 7-350 Metro Global Mirror session - Start H2 → H1 → H3 Completed

4. As shown in Figure 7-351, Metro Mirror data copying progress reached 100% and data consistency has been created on J3 volumes. Click the *Sessions* hyperlink in the *Health Overview* section at the bottom left side of the panel to go back to the Sessions panel.

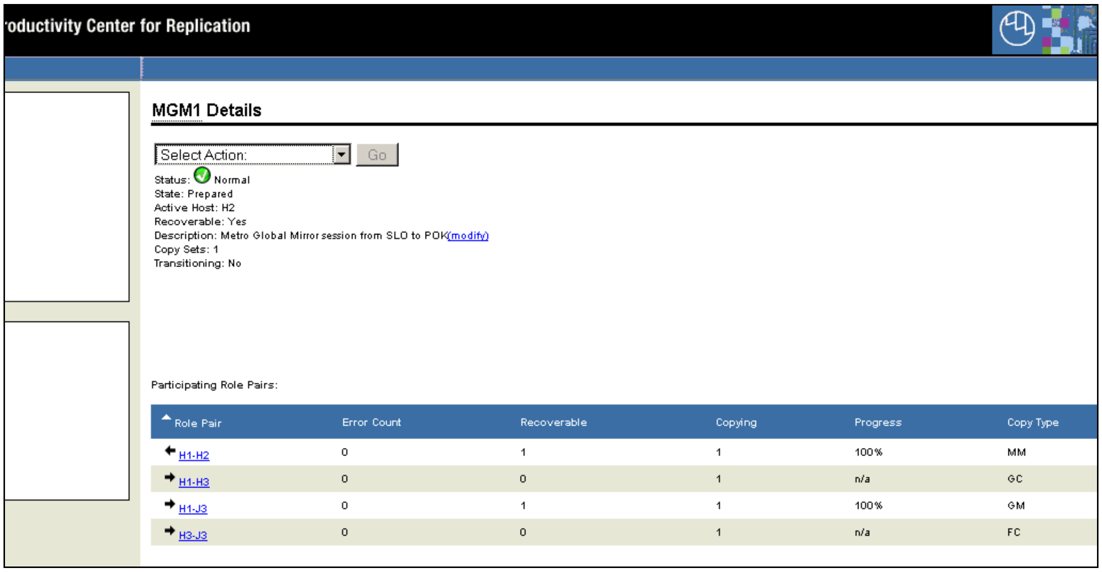

Figure 7-351 Metro Global Mirror session - details

At this stage, the following options are available:

Start H2 → H1 → H3 Creates a Metro Mirror session between H2 to H1 volumes and a Global Mirror session between H1 and H3 volumes.

Suspend Stops copying with consistent H1 volumes.

Suspend H1 → H3 Suspends a a Global Mirror session between H1 and H3 volumes (it causes Global Mirror to stop forming consistency groups).

Start H2 → H3 Restarts copying from H2 to H3 volumes in a Global Mirror session.

Terminate Terminates the session (under *Cleanup* submenu).

7.9.12 Suspending a Metro Global Mirror session (after Start H2 → H1 → H3)

A **Suspend** action after **Start H2-H1-H3** stops data replication between H2 and H1 volumes. Follow these steps:

1. From the **Sessions** panel, select your Metro Global Mirror session radio button, select **Suspend** from the **Select Action** pull-down list, and click **Go** as shown in Figure 7-352.

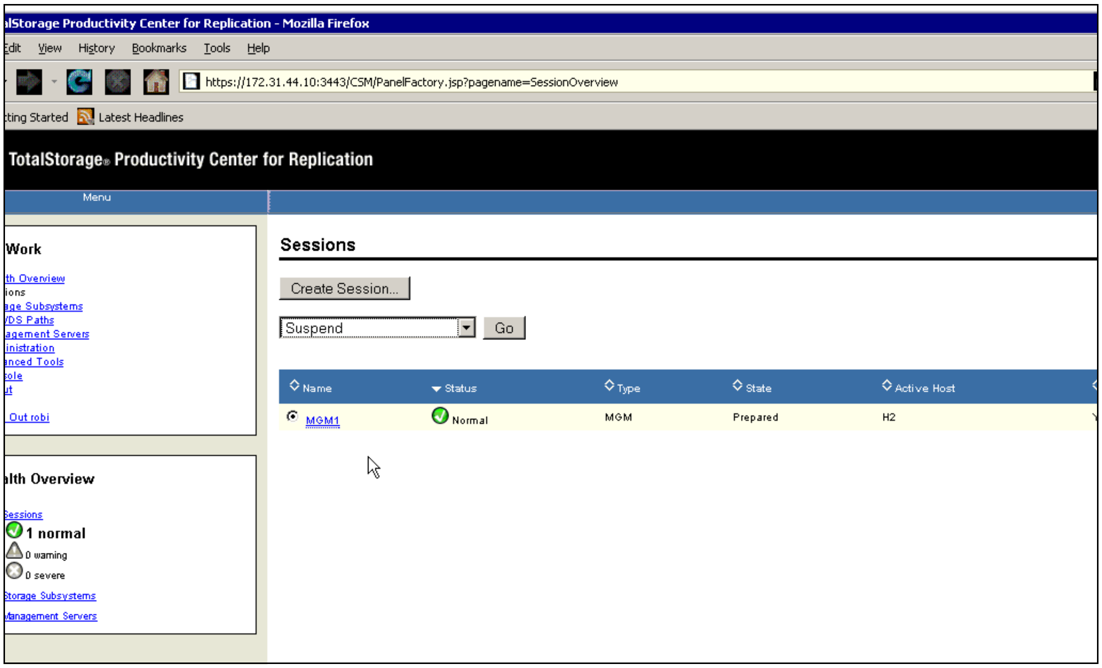

Figure 7-352 Metro Global Mirror session - Suspend Action

2. The next message shown in Figure 7-353 is a warning that you are about to suspend Metro Mirror between H2 and H1 volumes. Click **Yes** to continue.

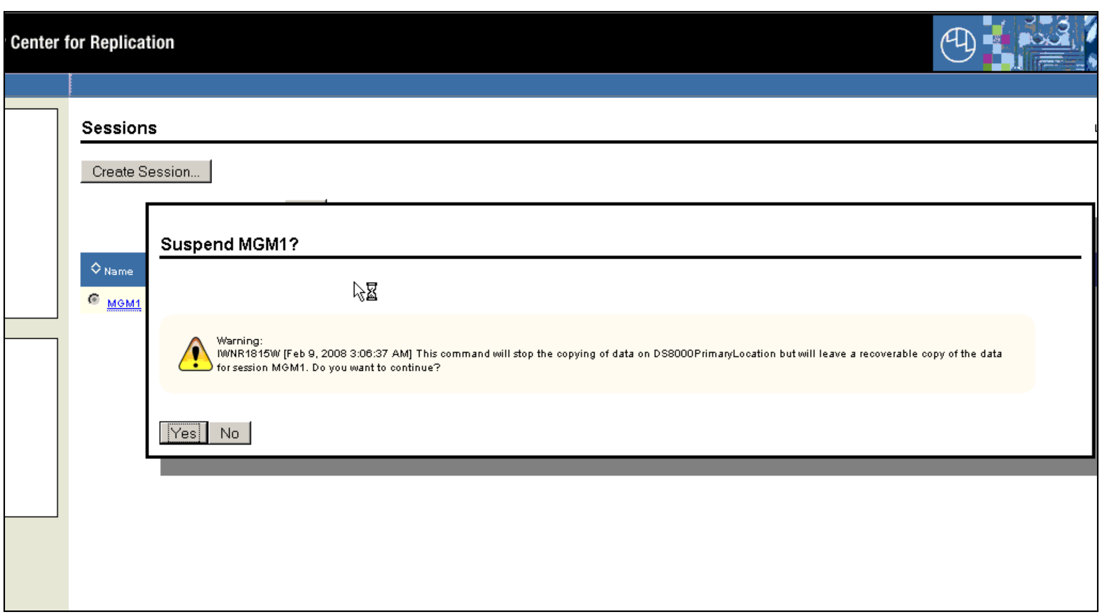

Figure 7-353 Suspend Metro Global Mirror session

3. The status of our Metro Global Mirror session has changed from *Normal* to *Severe* status indicating that data is not being replicated between Host 2 and Host 1 volumes. The state of the session is *Suspended* as indicated in Figure 7-354.

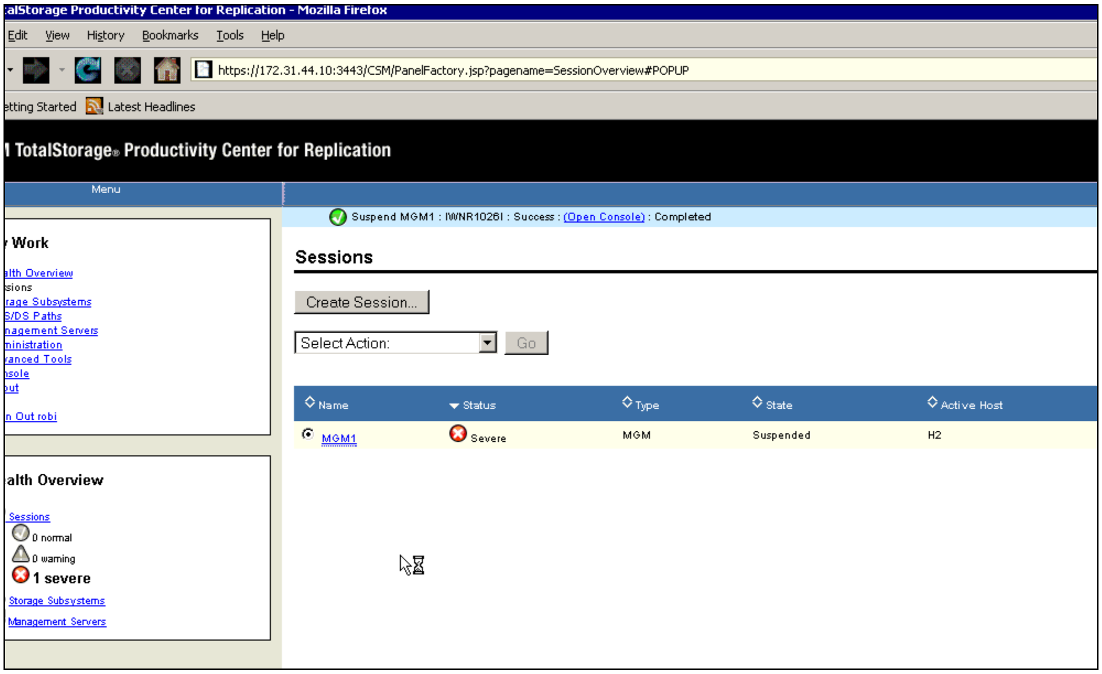

Figure 7-354 Suspend Metro Global Mirror session is reported as completed

4. Click the Session name hyperlink (**MGM1** in our example) to find more details about this session as shown in Figure 7-355. There is a timestamp for H1-H2 pair indicating when the Metro Mirror session was suspended. It can be used as a reference.

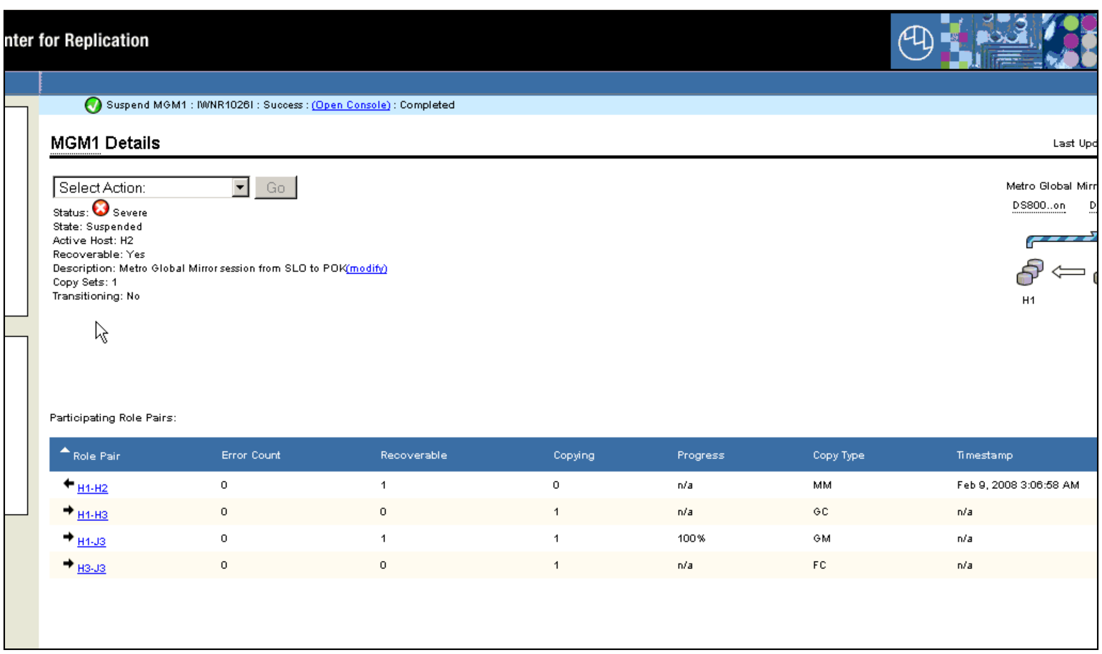

Figure 7-355 Suspend Metro Global Mirror session - Details

The following options are available at this stage:

Recover H1 Makes H1 volumes available for host access.

Recover H3 Makes H3 volumes available for host access.

Release I/O Releases I/O to H1 volumes after Suspend event. This option is available only if the Metro Mirror session is created with the **Hold I/O after Suspend** policy.

Start H2 → H1 → H3 Creates a Metro Mirror session between H2 to H1 volumes and a Global Mirror session between H1 and H3 volumes.

Start H2 → H3 Restarts copying from H2 to H3 volumes in a Global Mirror session.

Terminate Terminates the session (under *Cleanup* submenu).

7.9.13 Recovering H1 in a Metro Global Mirror session (after suspending H2 → H1 → H3 Metro Global Mirror session)

After the Metro Global Mirror session and its associated Copy Sets have been suspended in the H2 → H1 → H3 direction, we can initiate **RecoverH1** action. Follow these steps:

1. Select the Metro Global Mirror session radio button (MGM1 in our example shown in Figure 7-356) and the **Recover**H1 action from the **Select Action** pull-down menu. Click **Go** to continue.

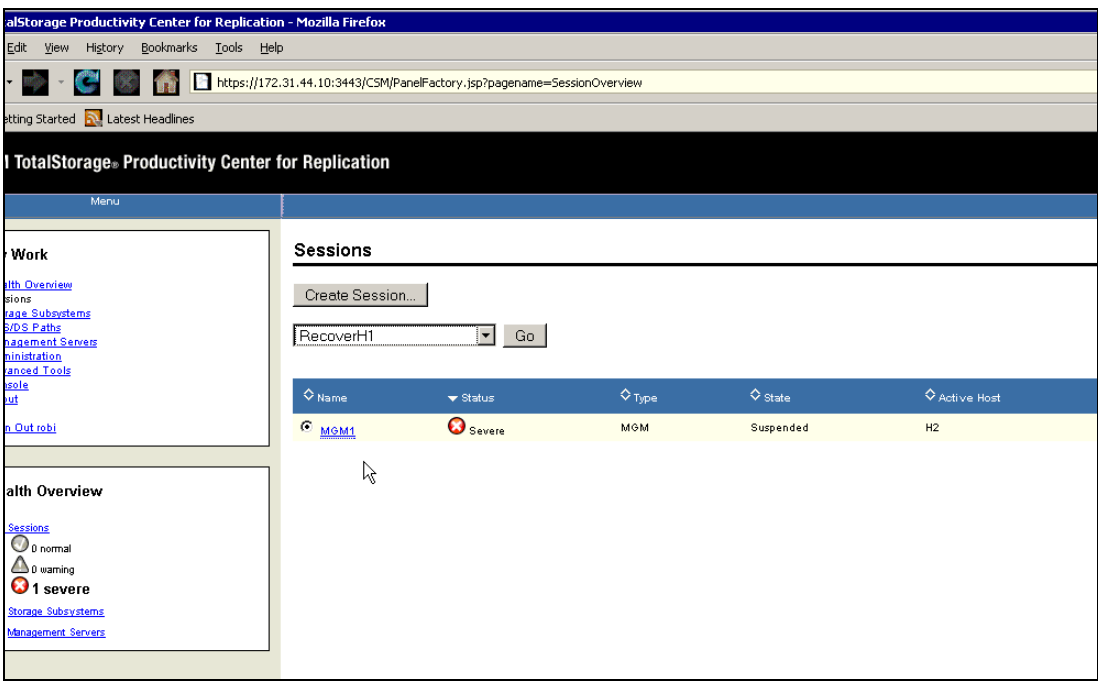

Figure 7-356 Metro Global Mirror session - RecoverH1 action

2. The next message shown in Figure 7-357 is a warning that you will allow H1 volumes available to your host. Click **Yes** to continue.

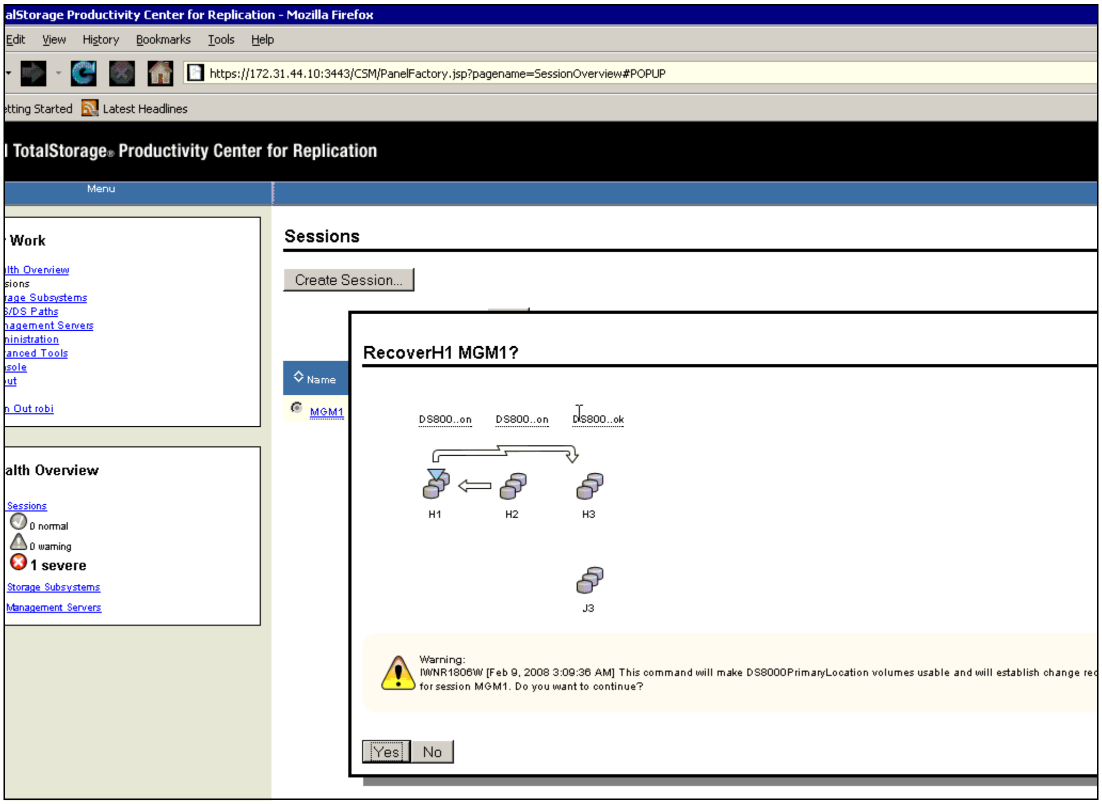

Figure 7-357 RecoverH1 - Metro Global Mirror Session

3. There is a message at the top of the panel in Figure 7-358 indicating that a **RecoverH1** action has been successfully completed. The status of our Metro Global Mirror session is *Normal* and the State is *Target Available* indicating that H1 volume is available to your host.

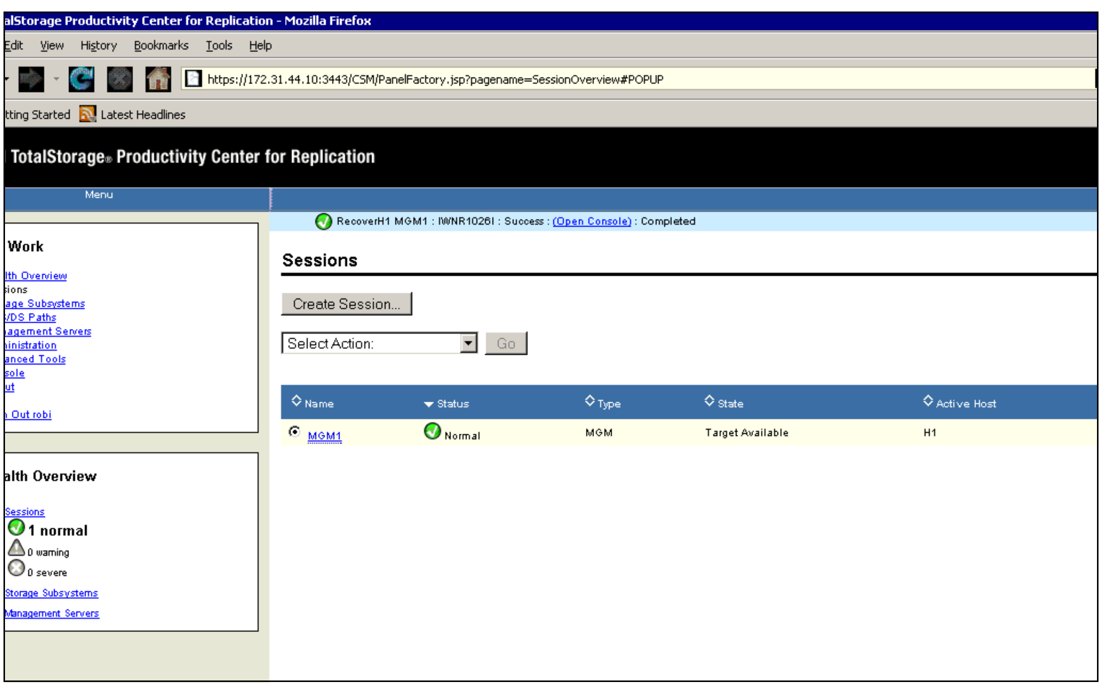

Figure 7-358 Metro Mirror session - H1 storage subsystem volume available to host

4. Click the Session name hyperlink (`MGM1` in our example) to find more details about this session as shown in Figure 7-359. There is a timestamp for the H1-H2 pair indicating when the Metro Mirror session was suspended. It can be used as a reference.

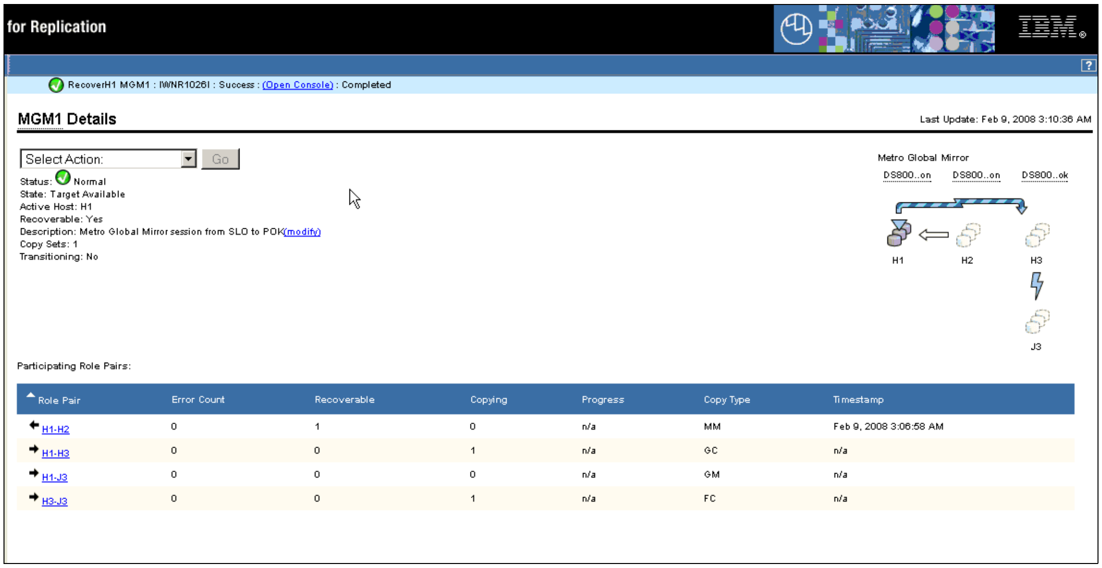

Figure 7-359 Metro Global Mirror session - Details

After the Metro Mirror session is recovered in *Target Available* state, the following options are available:

Start H1 → H3 Restarts copying from H1 to H3 volumes in a Global Mirror session.

Start H2 → H1 → H3 Restarts copying from H2 to H1 volumes in a Metro Mirror session and H1 to H3 volumes in a Global Mirror session.

Enable Copy to Site 2 Before reversing the direction of copying in a failover and failback session, you must run this command, and confirm that you want to reverse the direction of replication. It will enable **Start H1 → H2 → H3** command.

Terminate Terminates the session (under *Cleanup* submenu).

7.9.14 Enabling Copy to Site 2

If we assume that the current copy direction is from Site 2 to Site 1 and then to Site 3 and you want to reverse the copy direction back from Site 1 to Site 2 to Site 3 you need to issue **Suspend** command as we described in 7.9.12, “Suspending a Metro Global Mirror session (after Start H2 ® H1 ® H3)” on page 506 and then **Recover** command (see 7.9.13, “Recovering H1 in a Metro Global Mirror session (after suspending H2 ® H1 ® H3 Metro Global Mirror session)” on page 508). The **Recover** command will make H1 volumes available to applications since the data copying direction is from H2 to H1 volumes. After the **Recover** command is completed, Host 1 site is now active site and you can reverse direction of copying in a Metro Global Mirror session. Follow these steps:

1. Before you can initiate copying from Host 1 to Host 2 volumes, you need to start the **Enable Copy to Site 2** command. To achieve this, from the **Select Action** pull-down menu, select **Enable Copy to Site 2** and click **Go** as shown in Figure 7-360.

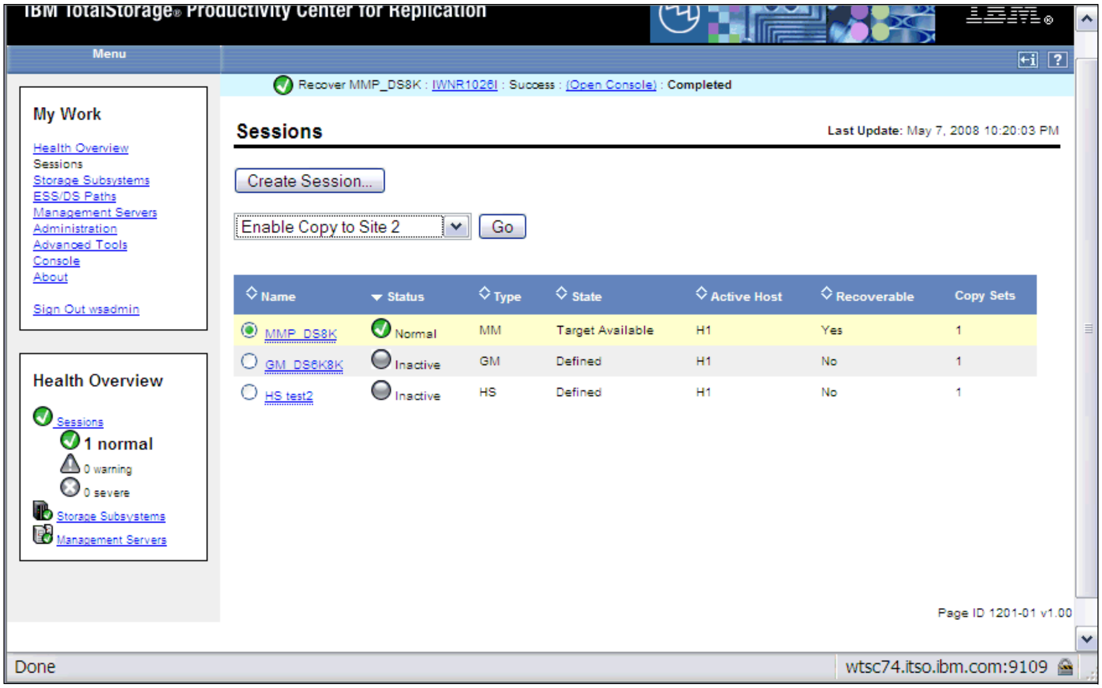

Figure 7-360 Metro Mirror session - Enable Copy to Site 2

2. The next message shown in Figure 7-361 is a warning that you are about to enable the command that initiates copying data from H1 to H2 volumes. This command is disabled to protect against accidentally copying over production data. Ensure that all of the volumes in this session located at Site 2 are not being used by any application prior to enabling the command that allows copying data to Site 2. Click **Yes** to continue.

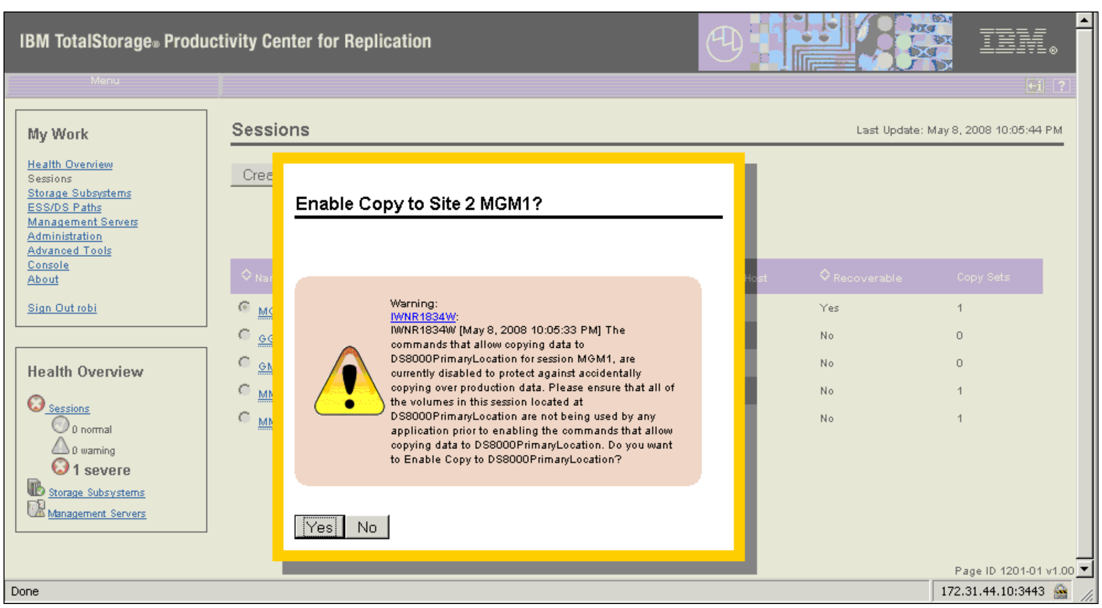

Figure 7-361 Enable Copy to Site 2

3. The message at the top of the panel in Figure 7-361 confirms that Enable Copy to Site 2 command is completed. The status of our Metro Mirror session is the same as it was after **Recover** command: *Normal* status and *Target Available* state, indicating that H1 volume is available to your host.

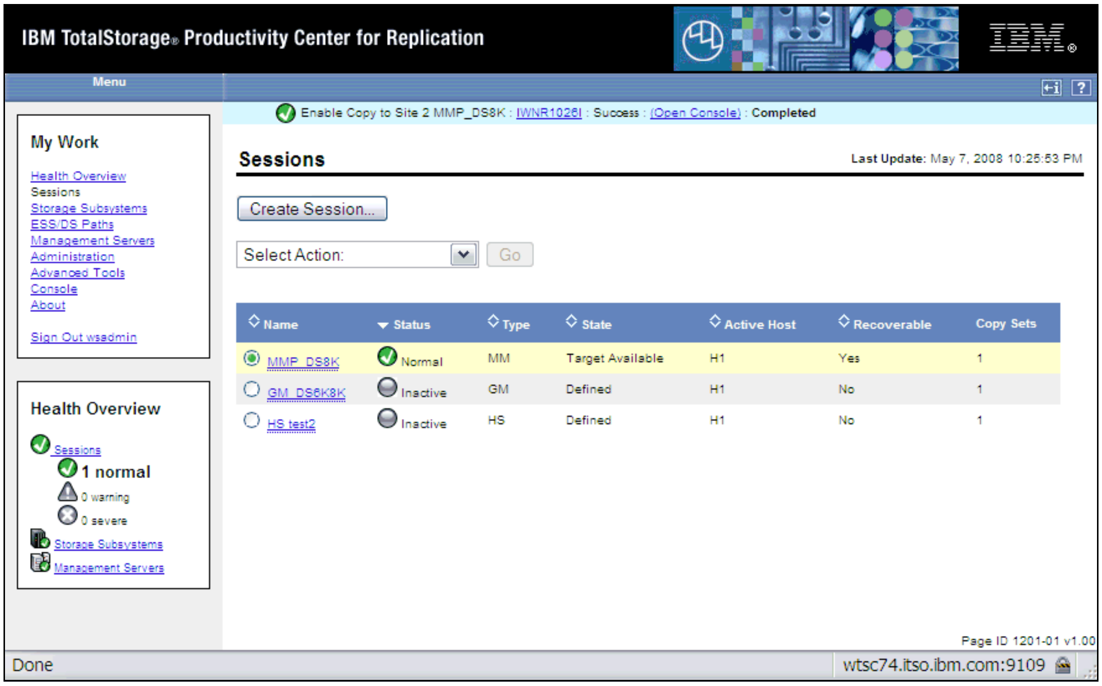

Figure 7-362 Enable Copy to Site 2 is reported as Completed

The following options are available at this stage:

Start H1 → H2 → H3 Restarts copying from H1 to H2 volumes in a Metro Mirror session and from H2 to H3 volumes in a Global Mirror session

Re-enable Copy to Site 1 Enables **Start H2 → H1 → H3** command

Terminate Terminates the session (under *Cleanup* submenu)

7.9.15 Starting H1 → H3 in a Metro Global Mirror session

The action **Start H1** → **H3** action can be issued at any time while the Metro Global Mirror session is operational as H1 → H2 → H3. **Start H1** → **H3** action changes H1 → H2 → H3 Metro Global Mirror session to a Global Mirror session between H1 and H3 volumes. It is used in a case of an H2 site failure. Follow these steps:

1. Select the Metro Mirror session radio button (MGM1 in our example shown in Figure 7-363) and **Start H1** → **H3** action from the **Select Action** pull-down menu. Click **Go** to continue.

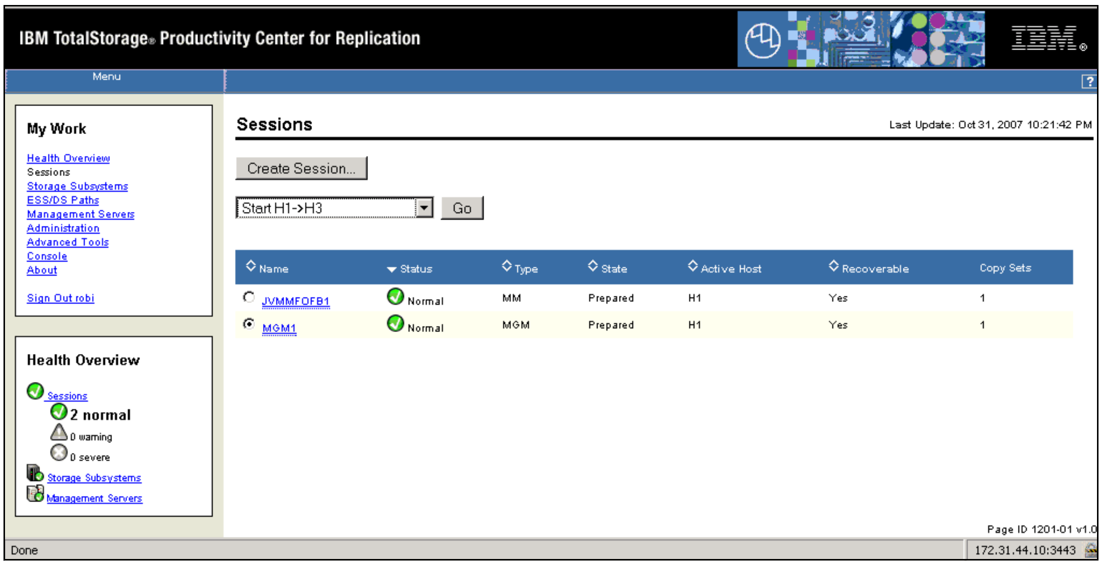

Figure 7-363 Metro Global Mirror session - Start H1 → H3 action

2. The next message shown in Figure 7-364 is a warning that you will stop data replication from H1 to H2 volumes and establish Global Mirror session between H1 and H3 volumes. Click **Yes** to continue.

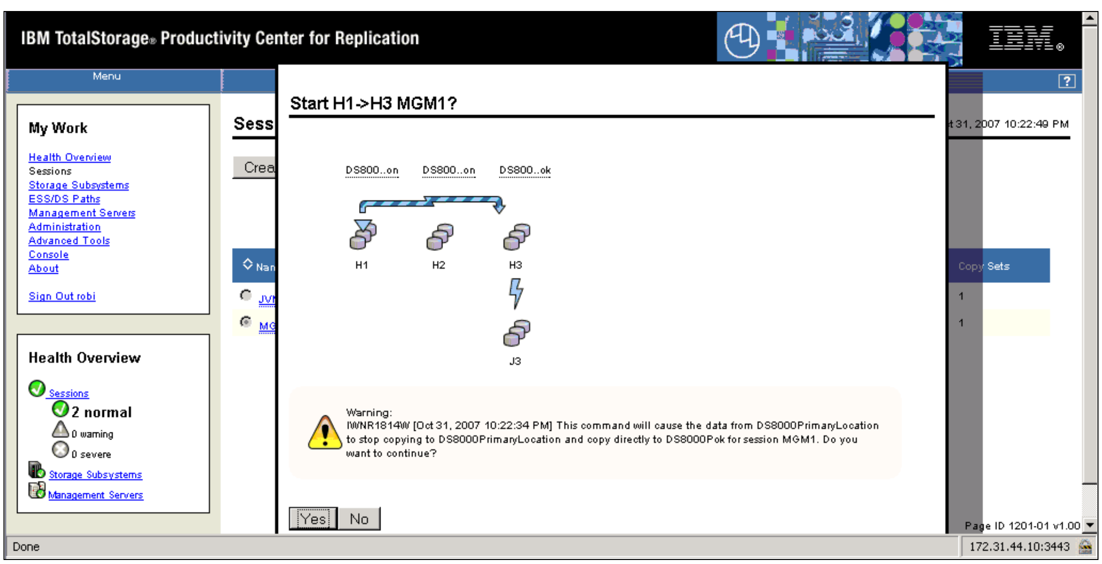

Figure 7-364 Metro Global Mirror session - Start H1 → H3 action

3. There is a message at the top of the panel in Figure 7-365 indicating that a **Start H1 → H3** action has been successfully completed. The status of our Metro Global Mirror session is *Normal* and the state is *Prepared*. Click the Session name hyperlink (**`MGM1`** in our scenario) for more details on this session.

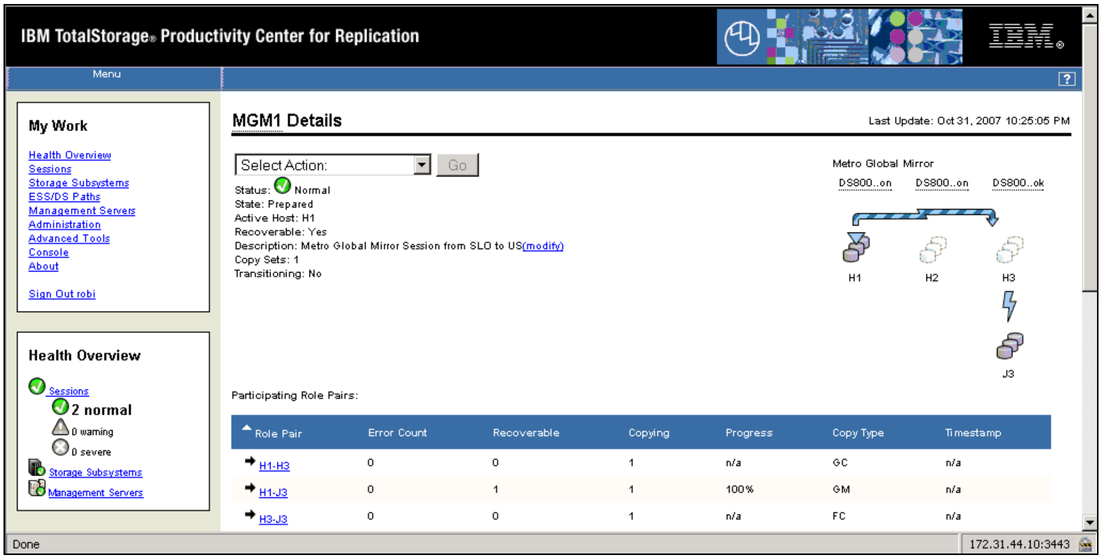

Figure 7-365 Metro Global Mirror session - Start H1 → H3 action - Details

The following options are available at this stage:

Start H1 → H2 → H3 Restarts copying from H1 to H2 volumes in a Metro Mirror session and from H2 to H3 volumes in a Global Mirror session.

Start H1 → H3 Starts Global Mirror session between H1 and H3 volumes.

Suspend Suspends a Metro Mirror session between H1 and H2 volumes and it will stop copying with consistent H2 volumes.

Terminate Terminates the session (under *Cleanup* submenu).

7.9.16 Suspending a Metro Global Mirror session (after Start H1 → H3)

A **Suspend** action after **Start H1-H3** causes a Global Mirror session between H1 and H3 volumes to stop forming consistency groups. Follow these steps:

1. From the **Sessions** panel, select your Metro Global Mirror session radio button, select **Suspend** from the **Select Action** pull-down list, and click **Go** as shown in Figure 7-366.

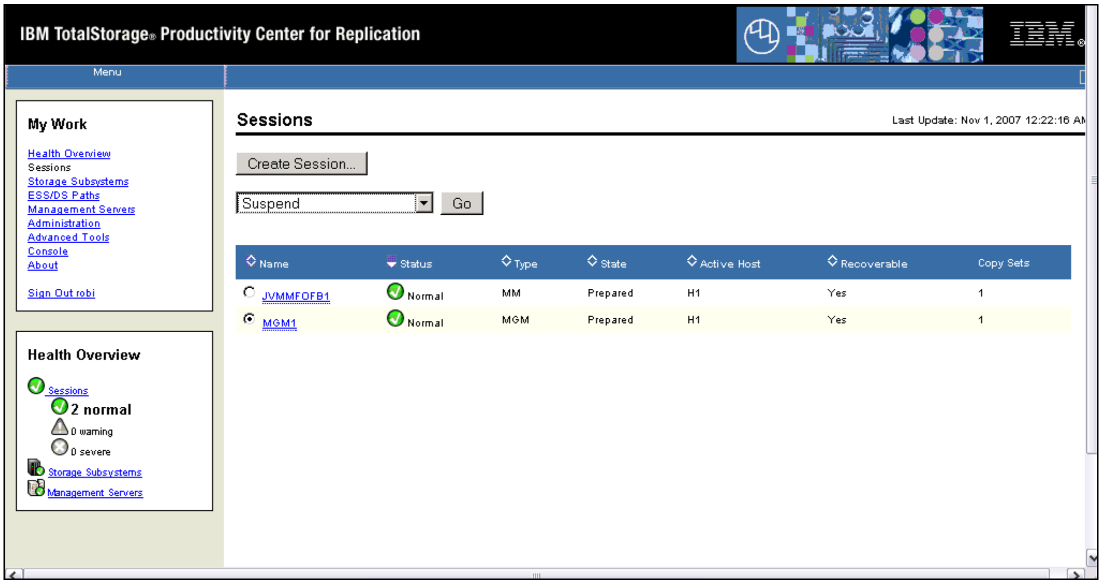

Figure 7-366 Metro Global Mirror session - Suspend Action

2. The next message shown in Figure 7-367 is a warning that you are about to suspend Global Mirror between H1 and H3 volumes. Click **Yes** to continue.

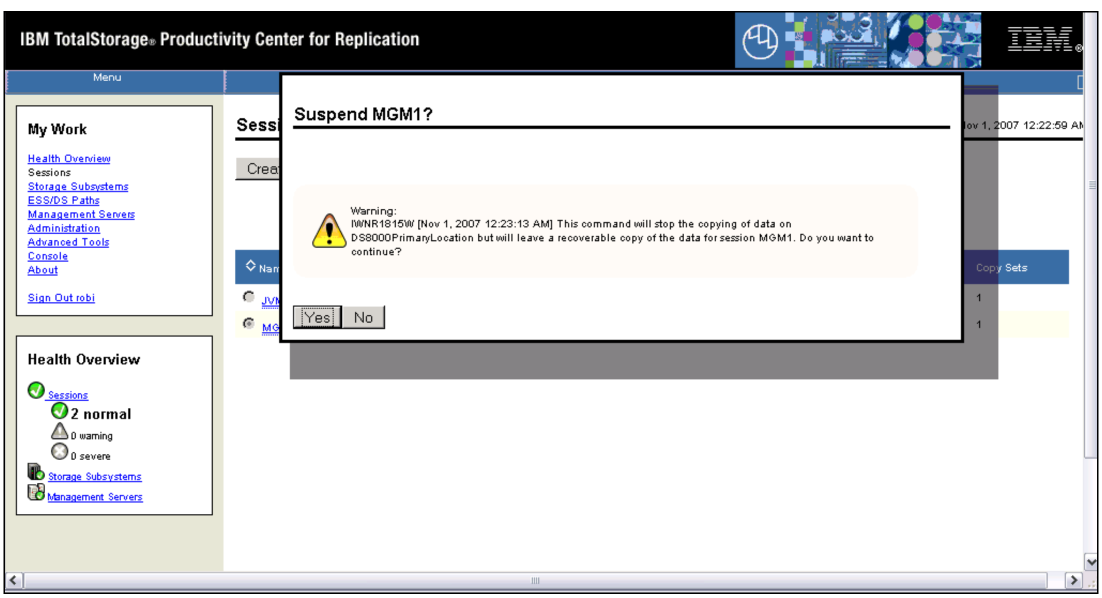

Figure 7-367 Suspend Metro Global Mirror session

3. The status of our Metro Global Mirror session has changed from *Normal* to *Severe* status, indicating that data is not replicated anymore between Host 1and Host 3 volumes. The state of the session is *Suspended* as indicated in Figure 7-368.

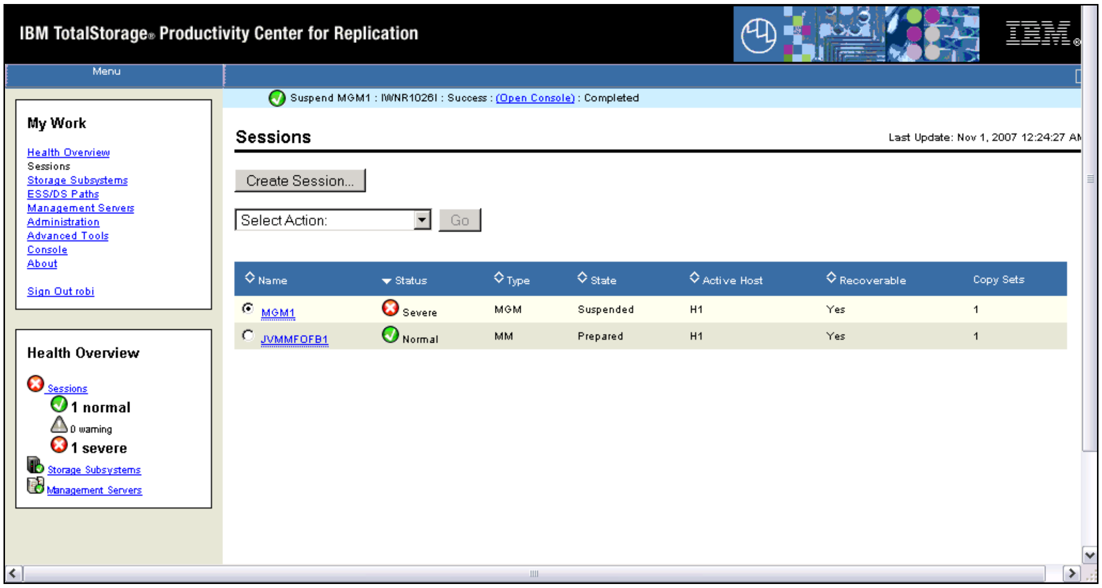

Figure 7-368 Suspend Metro Global Mirror session is reported as completed

4. Click the Session name hyperlink (**MGM1** in our example) for more details on this session as shown in Figure 7-369. There is a timestamp for H1-J3 pair indicating when the Metro Mirror session was suspended. It can be used as a reference.

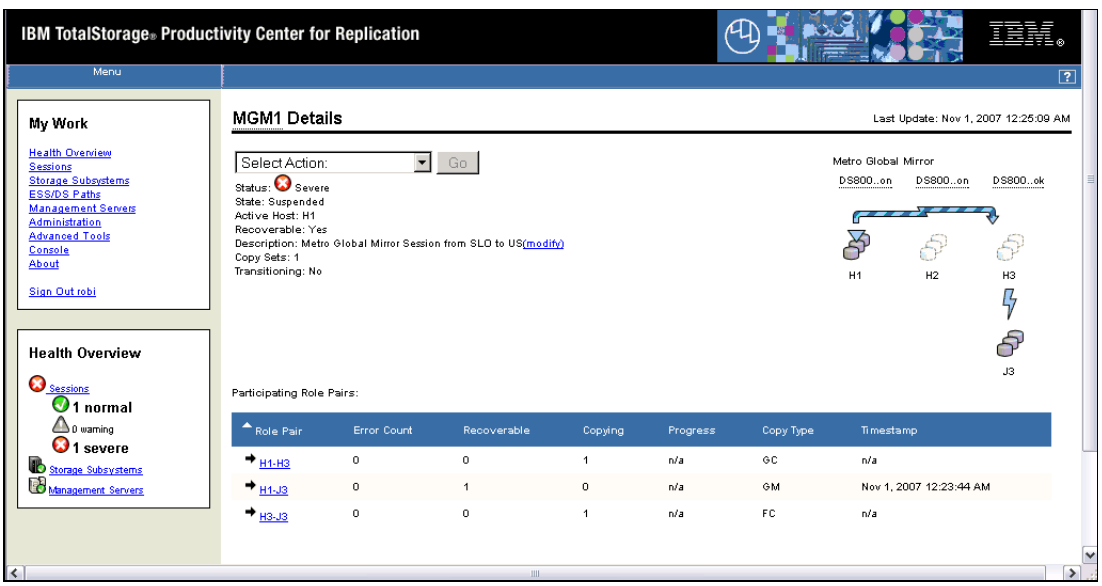

Figure 7-369 Suspend Metro Global Mirror session - Details

The following options are available at this stage:

Recover Makes target volumes available for host access.

Start H1 → H3 Starts Global Mirror session between H1 and H3 volumes.

Start H1 → H2 → H3 Restarts copying from H1 to H2 volumes in a Metro Mirror session and from H2 to H3 volumes in a Global Mirror session.

Terminate Terminates the session (under *Cleanup* submenu).

7.9.17 Recovering a Metro Global Mirror session (after suspending H1 → H3 Global Mirror session)

After the Metro Global Mirror session and its associated Copy Sets have been suspended between H1 and H3 volumes, we can initiate a **Recover** action. Follow these steps:

1. Select the Metro Global Mirror session radio button (MGM1 in our example shown in Figure 7-370) and the **Recover** action from the **Select Action** pull-down menu. It will make H3 volumes available to your host. Click **Go** to continue.

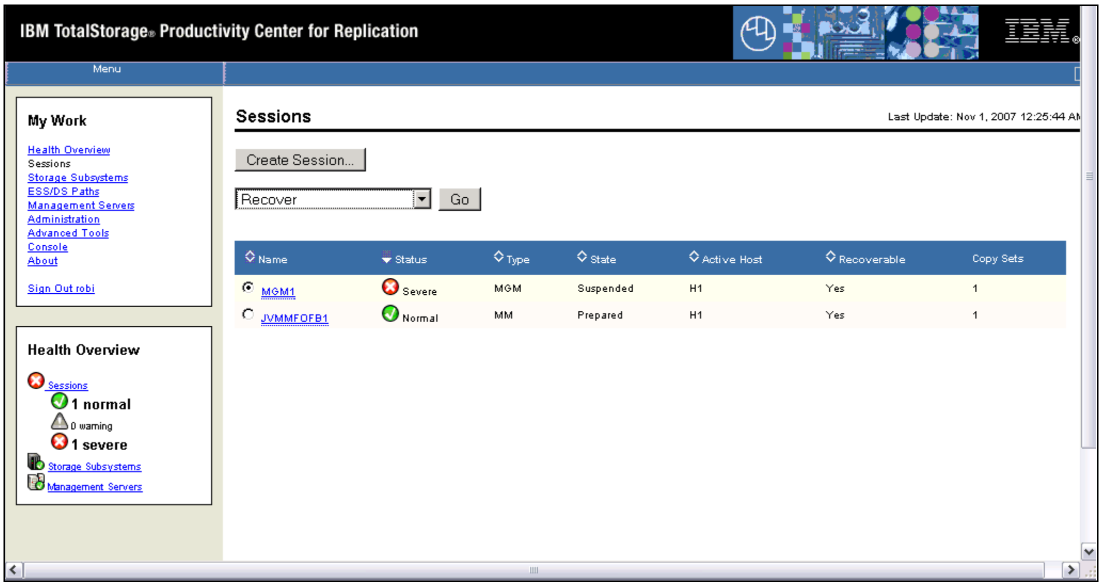

Figure 7-370 Metro Global Mirror session - Recover action

2. The next message shown in Figure 7-371 is a warning that you will allow H3 volumes available to your host. Click **Yes** to continue.

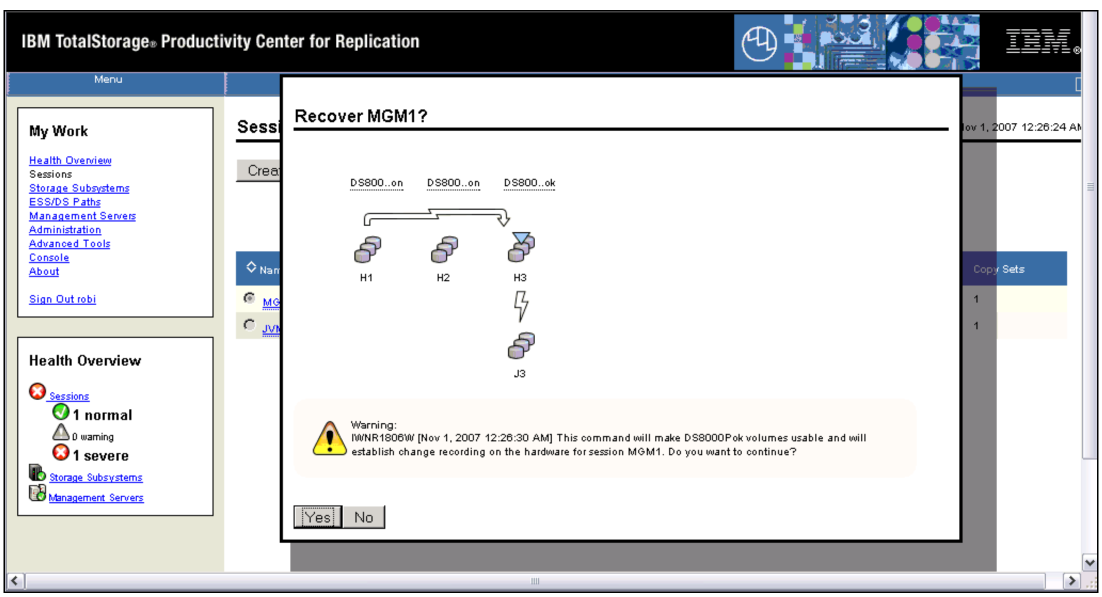

Figure 7-371 Metro Global Mirror session - Recover action

3. There is a message at the top of the panel in Figure 7-372 indicating that a **Recover** action has been successfully completed. The status of our Metro Global Mirror session is *Normal* and the State is *Target Available*. H3 volumes are now available to your host.

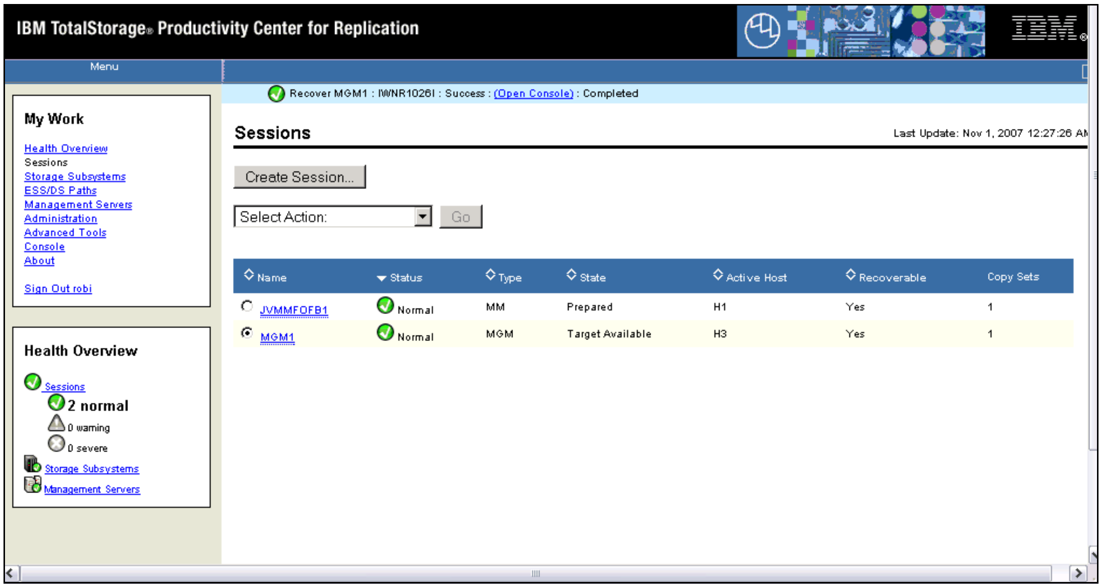

Figure 7-372 Metro Global Mirror session - Recover completed

4. Click the Session name hyperlink (`MGM1` in our example) for more details on this session as shown in Figure 7-373.

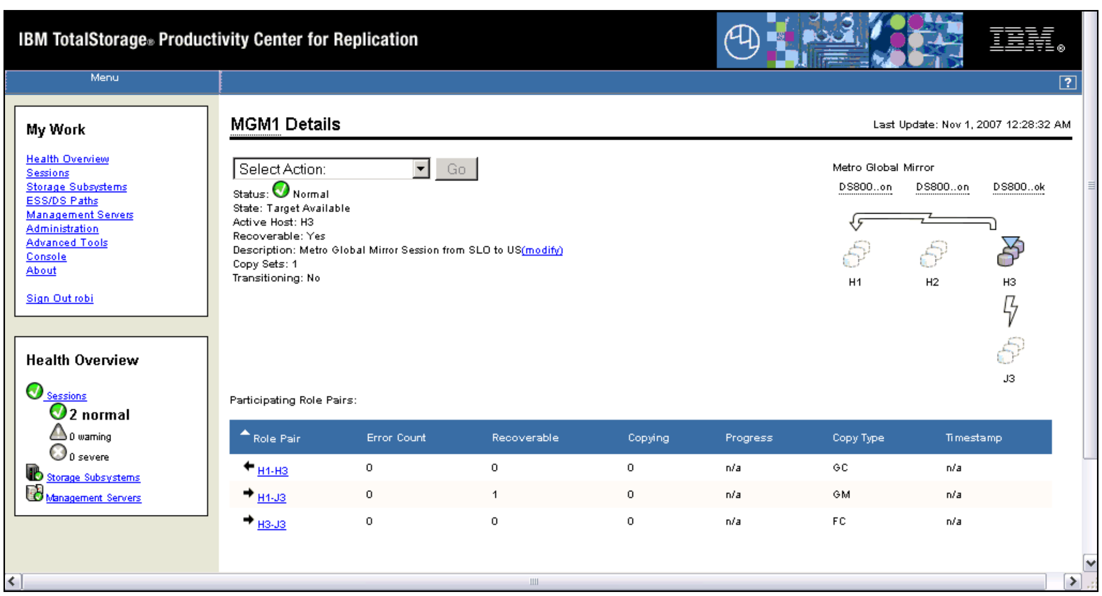

Figure 7-373 Metro Global Mirror session - details

The following actions are available at this stage:

Start H1 → H3 Starts a Global Mirror session between H1 and H3 volumes.

Enable Copy to Site 1 Before reversing the direction of copying in La failover and failback session, you must run this command, and confirm that you want to reverse the direction of replication. It will enable **Start H3 → H1 → H2** command.

Terminate Terminates the session.

7.9.18 Enabling Copy to Site 1 (after Recover H3)

After a **Recover** action, Host 3 volumes are active (assuming H1 to H3 replication direction). As the Host 3 site is now the active site, you can reverse direction of copying in a Global Mirror session. Follow these steps:

1. Before you can initiate copying from Host 3 to Host 1 volumes, you need to start the **Enable Copy to Site 1** command. To achieve this, from the **Select Action** pull-down menu, select **Enable Copy to Site 1** and click **Go** as shown in Figure 7-374.

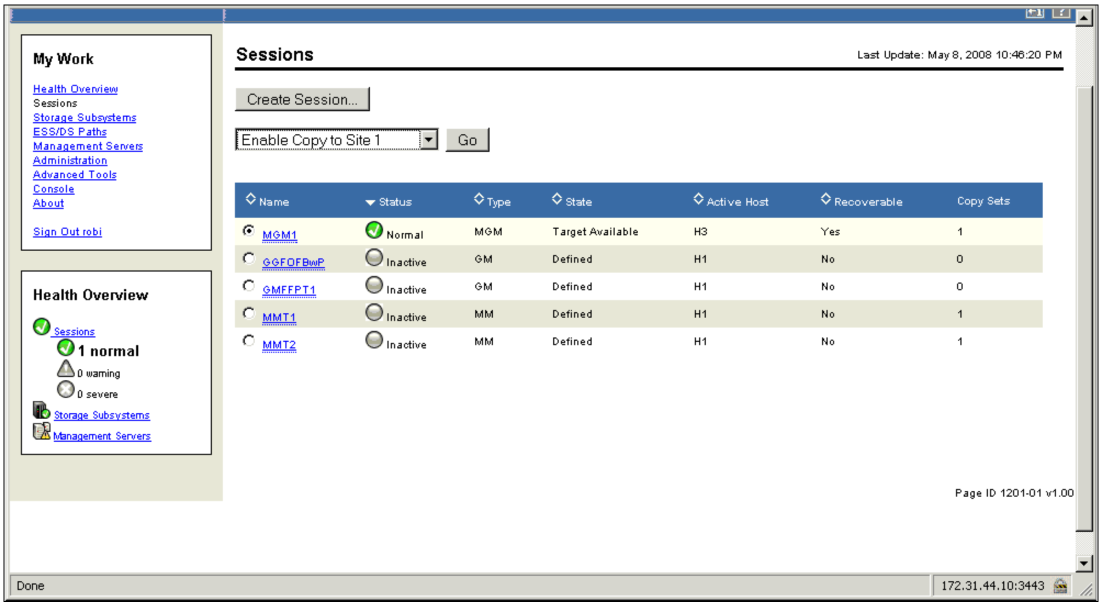

Figure 7-374 Metro Global Mirror session - Enable Copy to Site 1

2. The next message shown in Figure 7-375 is a warning that you are about to enable the command that initiates copying data from H3 to H1 volumes. This command is disabled to protect against accidentally copying over production data. Ensure that all of the volumes in this session located at Site 1 are not being used by any application prior to enabling the command that allows copying data to Site 1. Click **Yes** to continue.

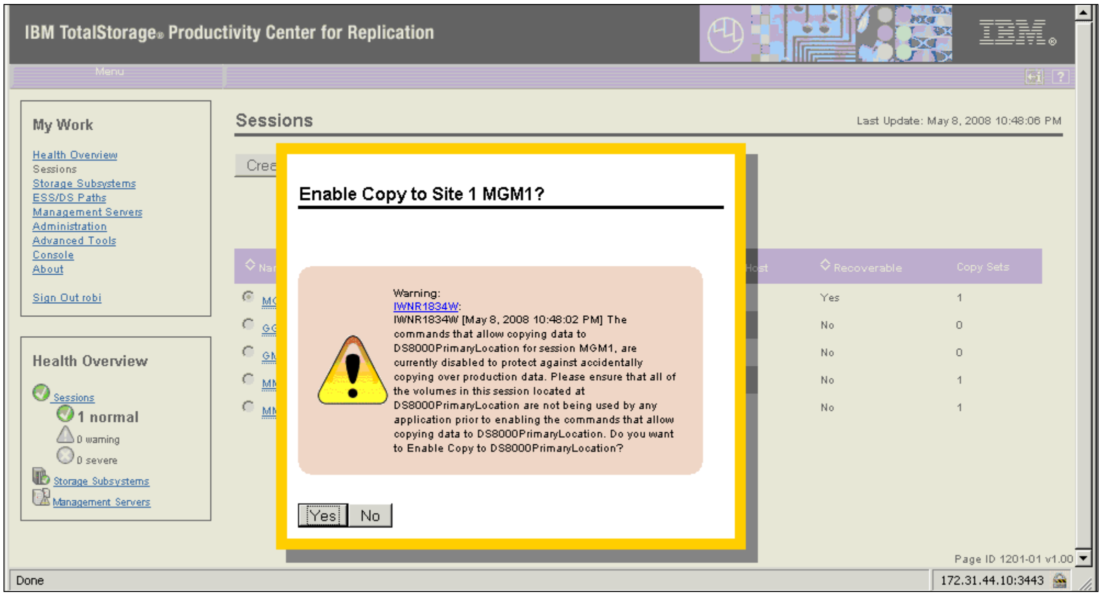

Figure 7-375 Enable Copy to Site 1

3. The message at the top of the panel in Figure 7-376 confirms that Enable Copy to Site 1 command is completed. The status of our Metro Global Mirror session is the same as it was after **Recover** command: *Normal* status and *Target Available* state, indicating that H3 volume is available to your host.

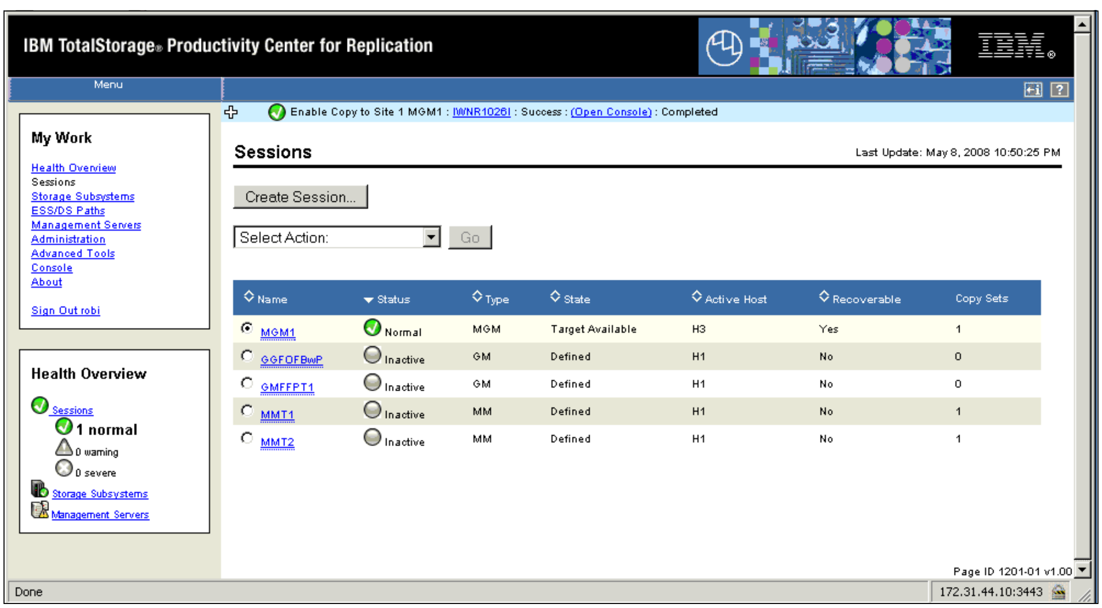

Figure 7-376 Enable Copy to Site 1 is reported as Completed

The following options are available at this stage:

Start H3 → H1 → H2 Restarts copying from H3 to H1 and then to H2 volumes but without data consistency due to a Global Copy relationship between H3 and H1 volumes.

Re-enable Copy to Site 3 Before reversing the direction of copying in a failover and failback session, you must run this command, and confirm that you want to reverse the direction of replication. It will enable **Start H1 → H3** command.

Terminate Terminates the session (under *Cleanup* submenu).

7.9.19 Starting H3 → H1 → H2 in a Metro Global Mirror session (after recovering H3 volumes in an H1 → H3 Global Mirror session)

After the **Recover** action against H3 volume in a Global Mirror session between H1 and H3 has been executed (see 7.9.17, “Recovering a Metro Global Mirror session (after suspending H1 ® H3 Global Mirror session)” on page 517) and **Enable Copy to Site 1**, it is possible to re-establish the data copying between H3 and H1 and then to H2 volumes. Note that the relationship between H3 and H1 is only Global copy and thus data consistency is not guaranteed during this process. Follow these steps:

1. To initiate this action, select **Start H3 → H1 → H2** from the **Select Action** pull-down menu and click **Go** as shown in Figure 7-377.

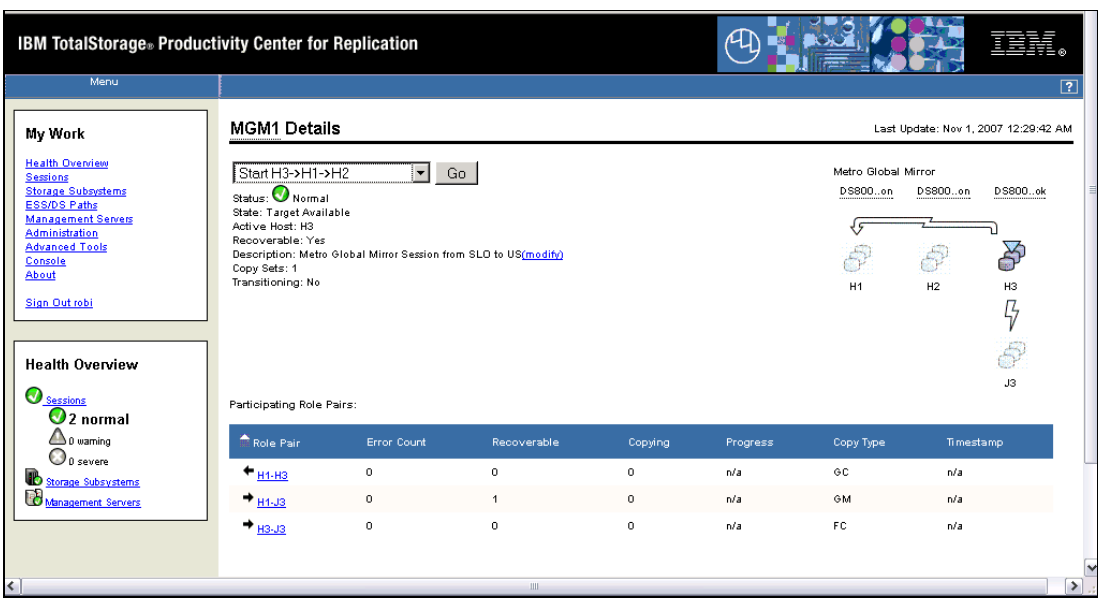

Figure 7-377 Metro Global Mirror session - Start H3 → H1 → H2 Action

2. The next message shown in Figure 7-378 is a warning that you are about to initiate data replication between H3 and H1 volumes in Global Copy mode (without data consistency) and between H1 and H2 volumes in a Metro Mirror session. Click **Yes** to continue.

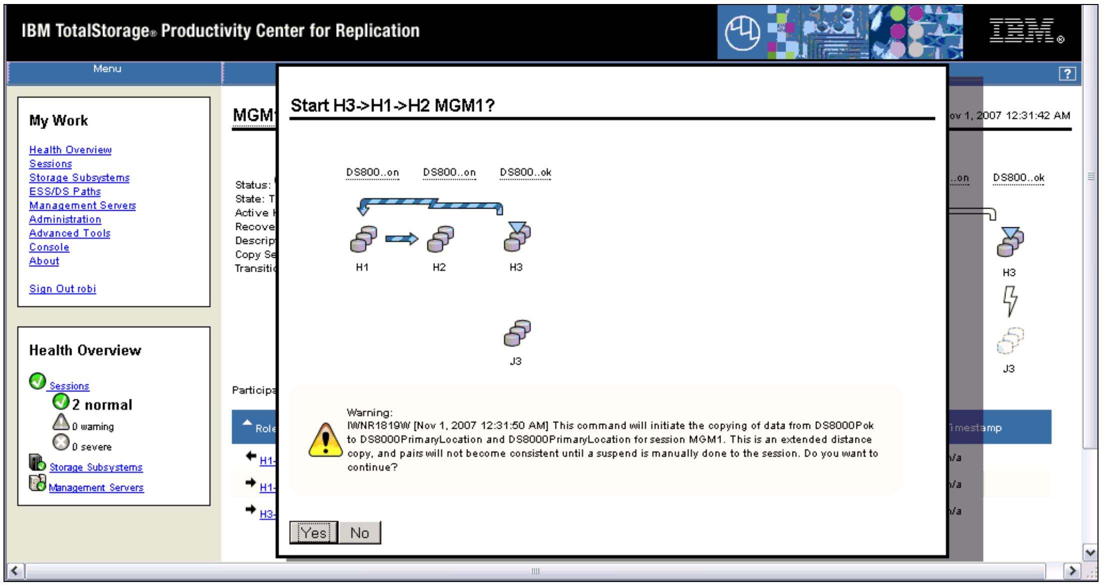

Figure 7-378 Metro Global Mirror session - Start H3 → H1 → H2

3. The message at the top of the panel in Figure 7-379 confirms that start of the H3 → H1_>H2 action is completed. The session is in *Preparing* state and *Warning* status since there is no data consistency between H3 and H1volumes. Click the Session name hyperlink (`MGM1` in our example) to find more details about this session.

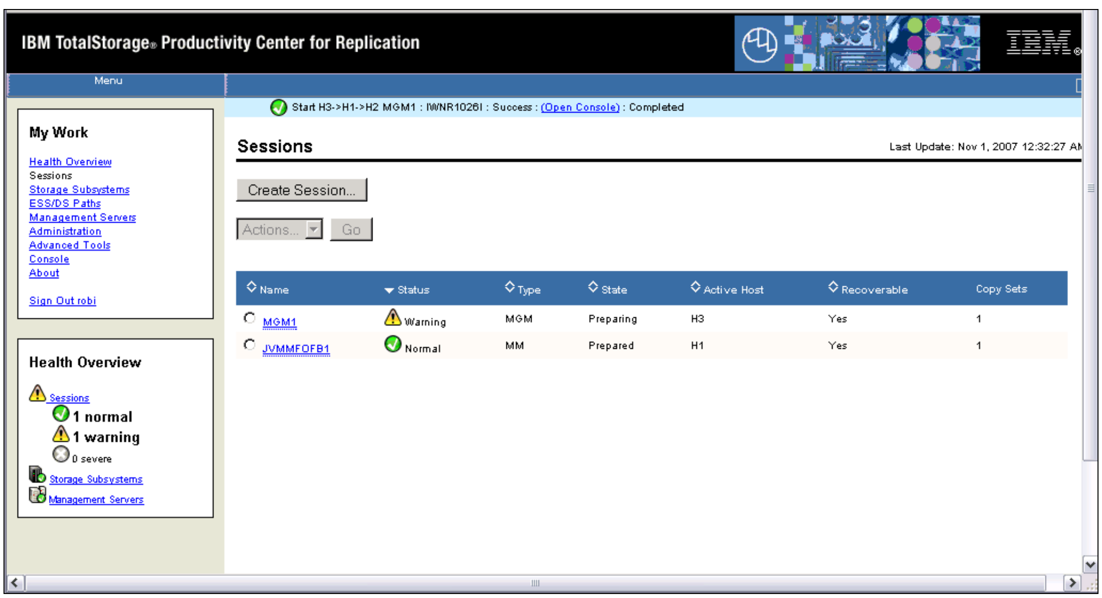

Figure 7-379 Metro Global Mirror session - Start H1 → H2 → H3 Completed

4. As shown in Figure 7-380, data copying is in progress between H3 and H1 and between H1 and H2. Click the *Sessions* hyperlink in the *Health Overview* section at the bottom left side of the panel to go back to the Sessions panel.

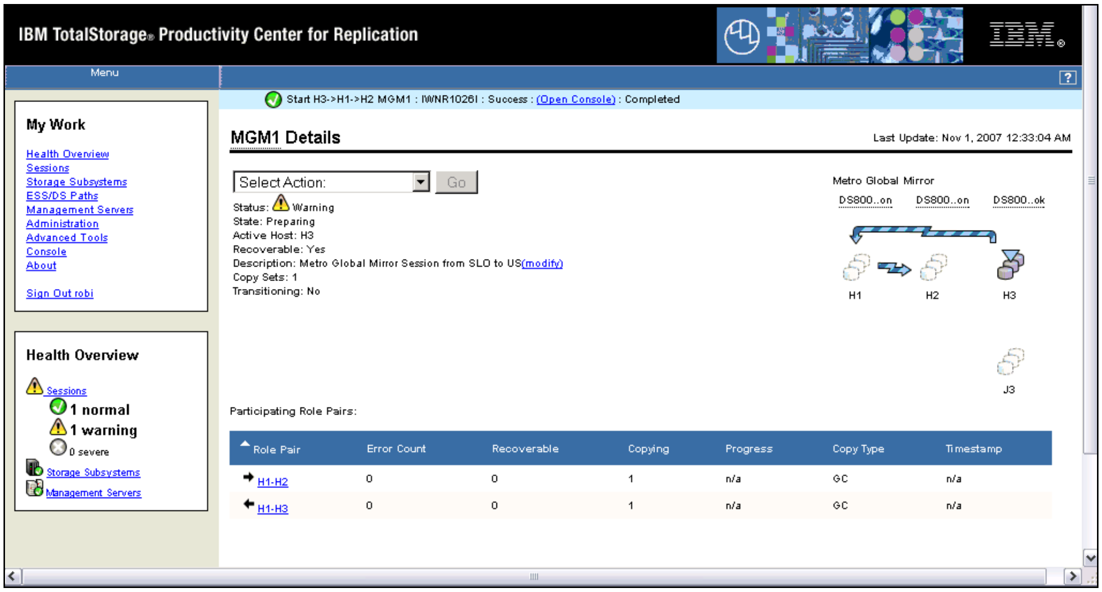

Figure 7-380 Metro Global Mirror session - details

Note: After starting the session from H3 → H1 → H2, the session will forever stay in *Preparing* state. The reason for this is that there is no journal volume at Site 1 where a consistent copy could be formed. If you want to switch back to the H1 site, you need to stop I/O on the H3 volumes and suspend the session. This will cause that all data which is not yet copied from H3 to H1 volumes to be copied. After the session is suspended, you can recover it back to H1 volumes.

At this stage, the following options are available:

Start H3 → H1 → H2 Restarts copying from H3 to H1 and then to H2 volumes but without data consistency due to a Global Copy relationship between H3 and H1 volumes.

Suspend Stops copying with consistent H1 volumes.

Terminate Terminates the session (under *Cleanup* submenu).

7.9.20 Suspending a Metro Mirror session (after Start H3 → H1 → H2)

A **Suspend** action after **Start H3 → H1 → H2** stops the copying of data from H3 to H1, but it leaves consistent and recoverable H1 volumes. Follow these steps:

1. From the **Sessions** panel, select your Metro Global Mirror session radio button, select **Suspend** from the **Select Action** pull-down list, and click **Go** as shown in Figure 7-381.

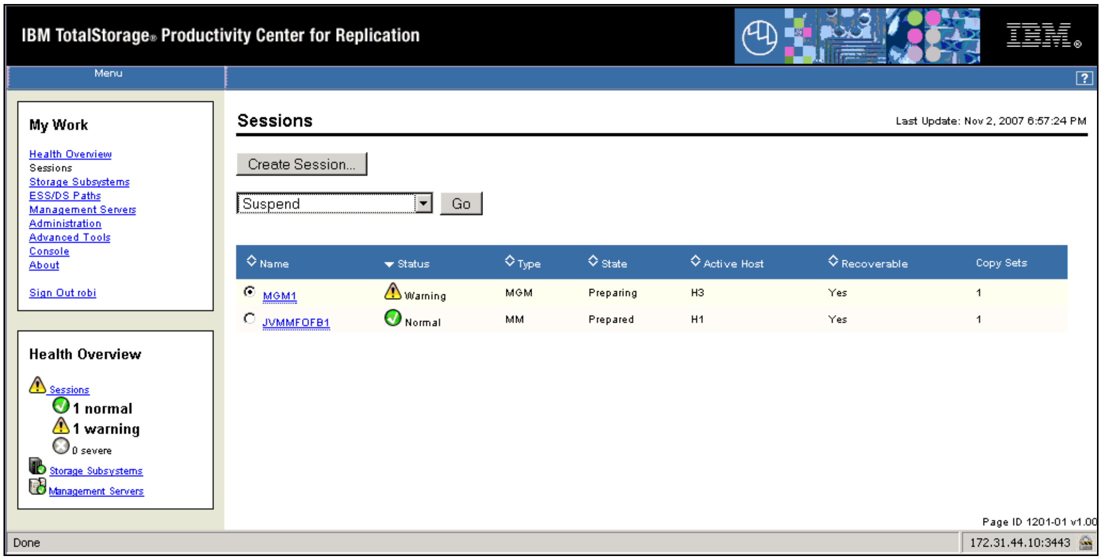

Figure 7-381 Metro Global Mirror session - Suspend Action

2. The next message shown in Figure 7-382 is a warning that you are about to stop data replication between H1 and H3 volumes. Click **Yes** to continue.

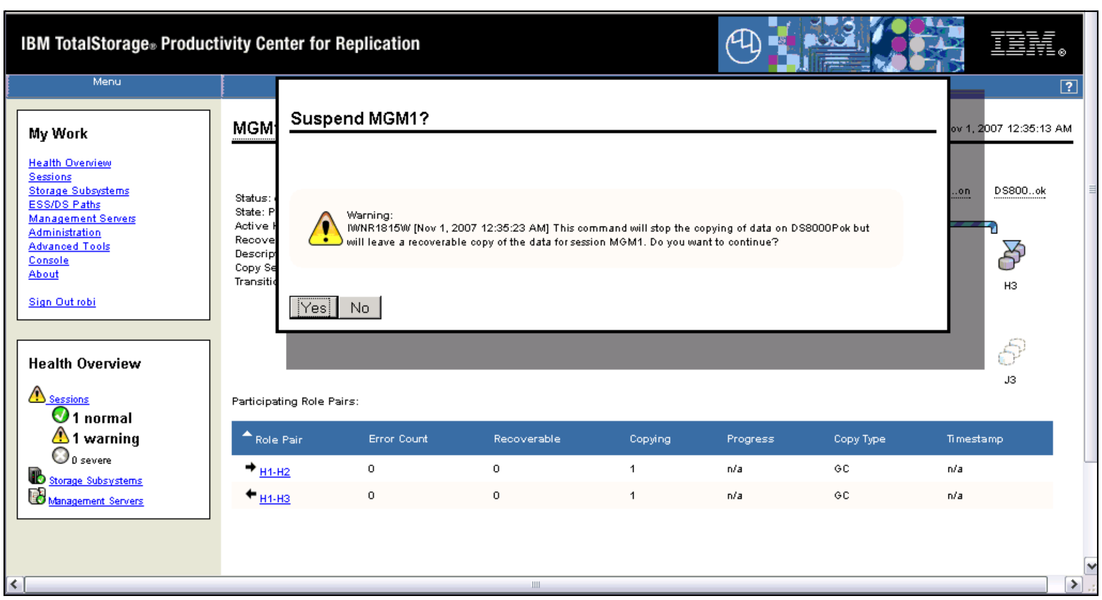

Figure 7-382 Suspend Metro Global Mirror session

3. The status of our Metro Global Mirror session has changed from *Warning* to *Severe* status indicating that data is not replicated anymore between H3 and Host 1 volumes. The state of the session is *Suspended* as indicated in Figure 7-383.

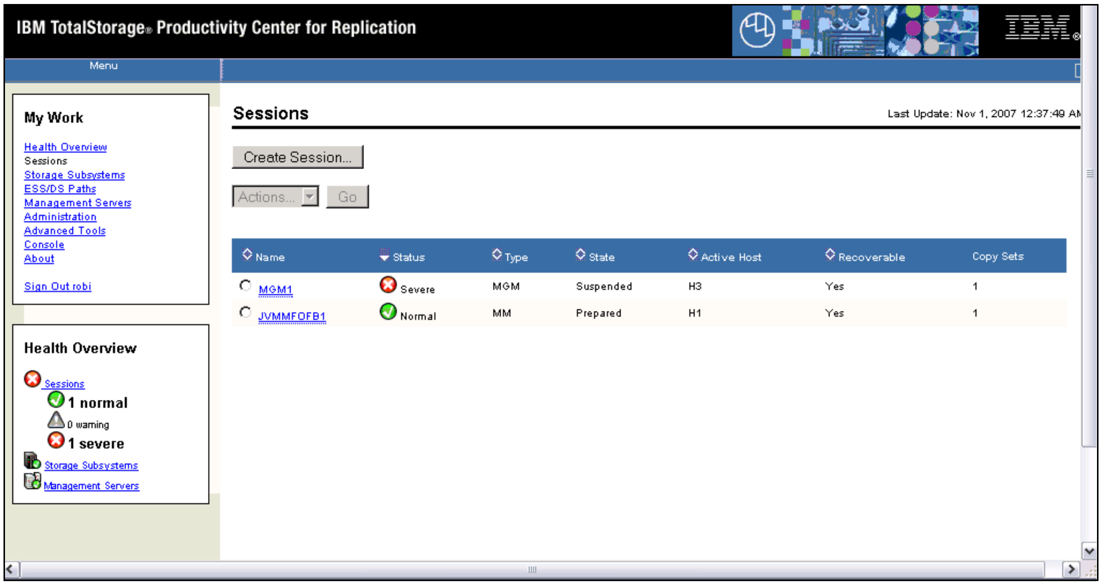

Figure 7-383 Suspend Metro Global Mirror session is reported as completed

4. Click the Session name hyperlink (**MGM1** in our example) for more details on this session as shown in Figure 7-384. There is a timestamp for H1-H3 pair indicating when the Metro Mirror session was suspended. It can be used as a reference.

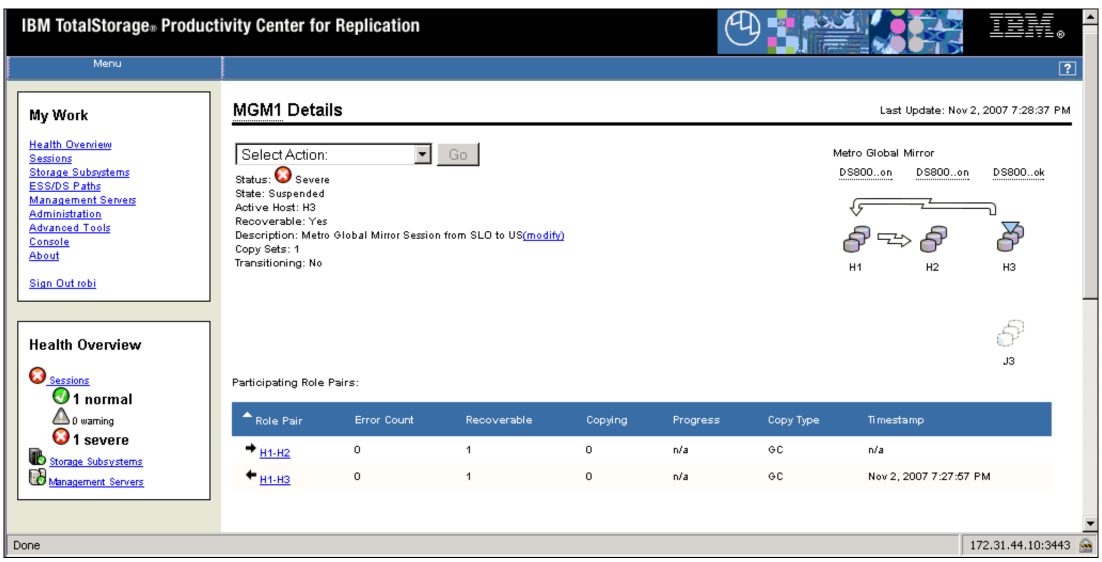

Figure 7-384 Suspend Metro Global Mirror session - Details

The following options are available at this stage:

Recover Makes target volumes available for host access.

Start H3 → H1 → H2 Restarts copying from H3 to H1 and then to H2 volumes but without data consistency due to a Global Copy relationship between H3 and H1 volumes.

Terminate Terminates the session (under *Cleanup* submenu).

7.9.21 Recovering Metro Global Mirror (after suspending H3 → H1 → H2 Metro Global Mirror session)

After the H3 → H1 → H2 Metro Global Mirror session and its associated Copy Sets have been suspended, we can initiate **Recover** action. Follow these steps:

1. Select the Metro Global Mirror session radio button (MGM1 in our example shown in Figure 7-385) and the **Recover** action from the **Select Action** pull-down menu. It will make an H1 volume available to your host. Click **Go** to continue.

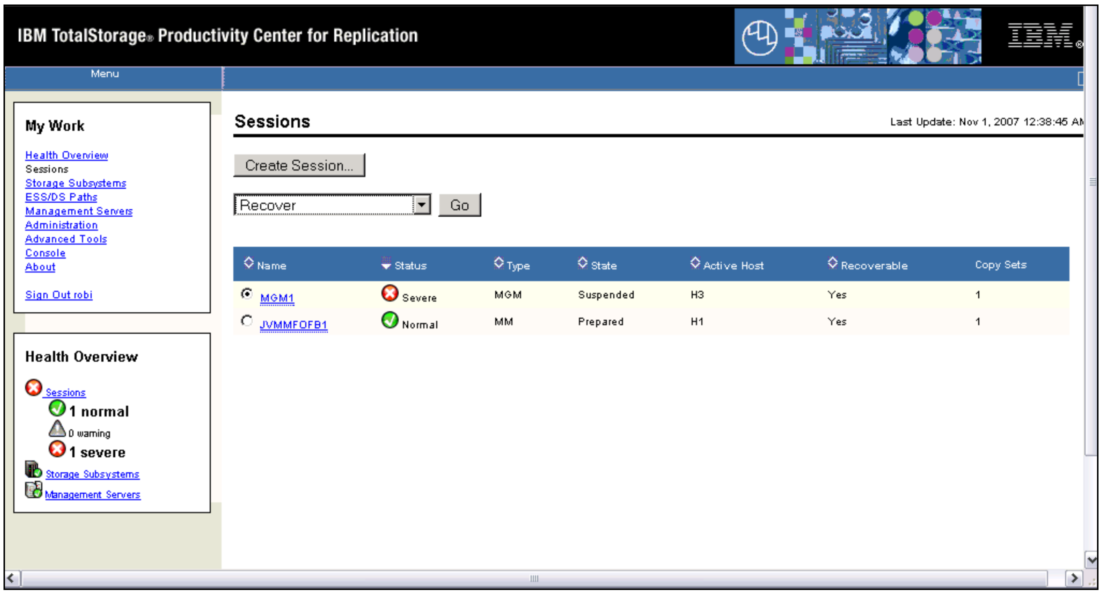

Figure 7-385 Metro Global Mirror session - Recover action

2. The next message shown in Figure 7-386 is a warning that you will allow H1 volumes available to your host. Click **Yes** to continue.

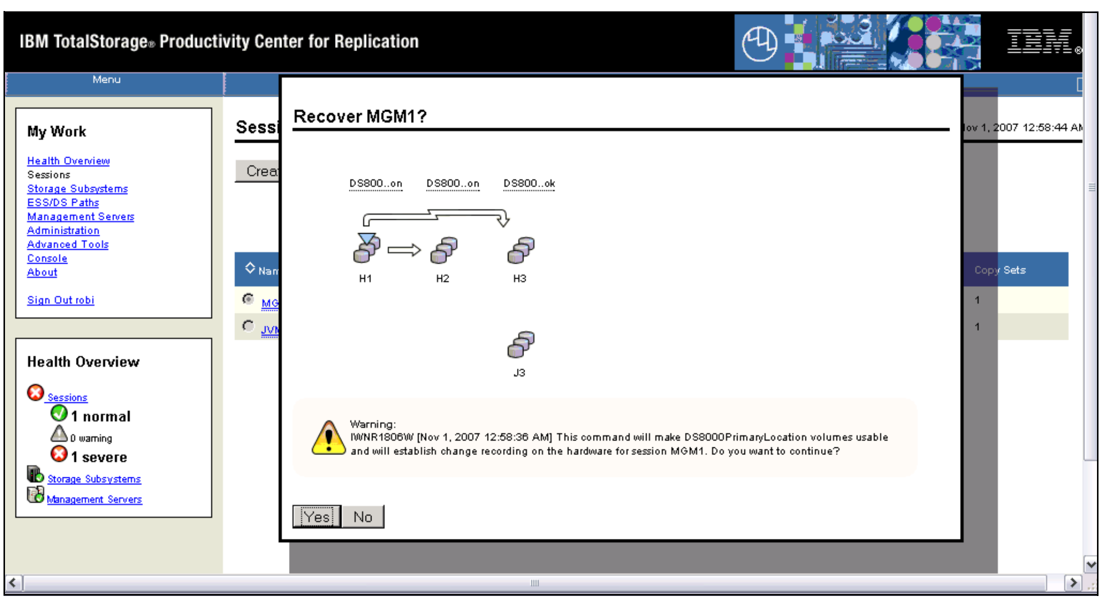

Figure 7-386 Metro Global Mirror session - Recover action

3. There is a message at the top of the panel in Figure 7-387 indicating that a **Recover** action has been successfully completed. The status of our Metro Global Mirror session is *Normal* and the State is *Target Available*. H1 volume is now available to your host.

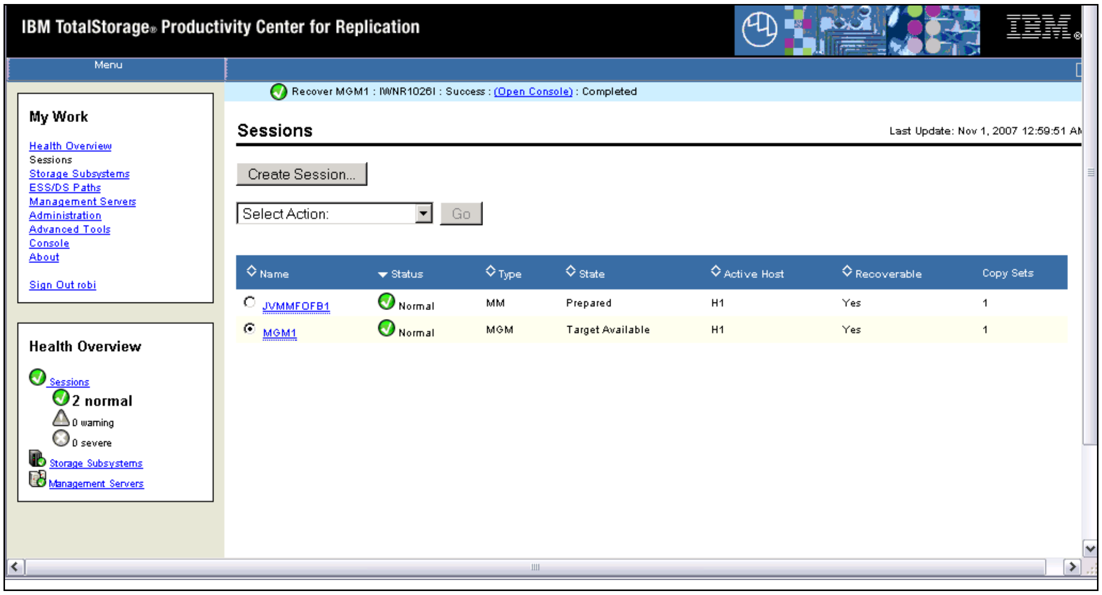

Figure 7-387 Metro Global Mirror session - H3 storage subsystem volume available to host

4. Click the Session name hyperlink (`MGM1` in our example) for more details on this session as shown in Figure 7-388.

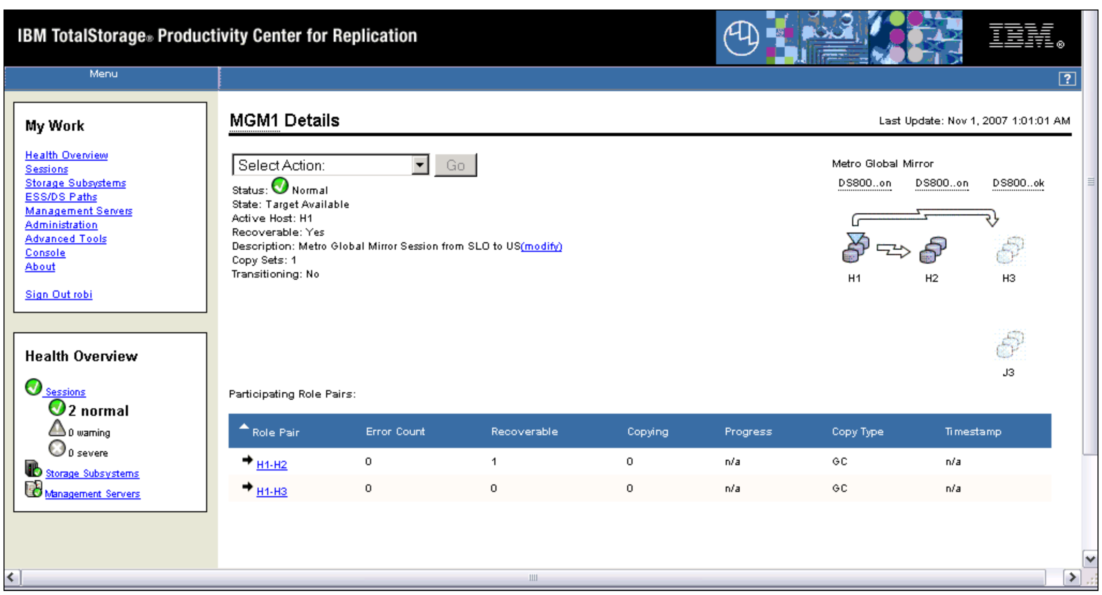

Figure 7-388 Metro Global Mirror session - details

After the *Recover* action, the following options are available:

Start H3 → H1 → H2 Restarts copying from H3 to H1 and then to H2 volumes but without data consistency due to a Global Copy relationship between H3 and H1 volumes.

Enable Copy to Site 2 Before reversing the direction of copying in a failover and failback session, you must run this command, and confirm that you want to reverse the direction of replication. It will enable **Start H1 → H2 → H3** command.

Terminate Terminates the session (under Cleanup submenu).

If you want to get back to the original Metro Global Mirror configuration (H1 → H2 → H3), you need to issue **Enable copy to Site 2** command. It will allow you to **Start H1 → H2 → H3** command.

7.9.22 Terminating a Metro Global Mirror session

The **Terminate** action removes all Metro Global Mirror relationships between H1 and H2 and H2 and H3 volumes thus terminating data replication. If you want H1, H2 or H3 volumes, depending on the copy direction, to be data consistent before removing their relationship, you must issue the **`Suspend`** command, then the **`Recover`** command, and then the **`Terminate`** command. In case you want to a Start Metro Global Mirror session after it has been terminated, full copy will take place from H1 to H2 and H3. Follow these steps:

1. Select the Metro Mirror session radio button (MGM1 in our example shown in Figure 7-389) and **Terminate** action from the **Select Action** pull-down menu. Click **Go** to continue. In our example, we terminated the session when the copy direction was from H1 to H2 and H3 volumes.

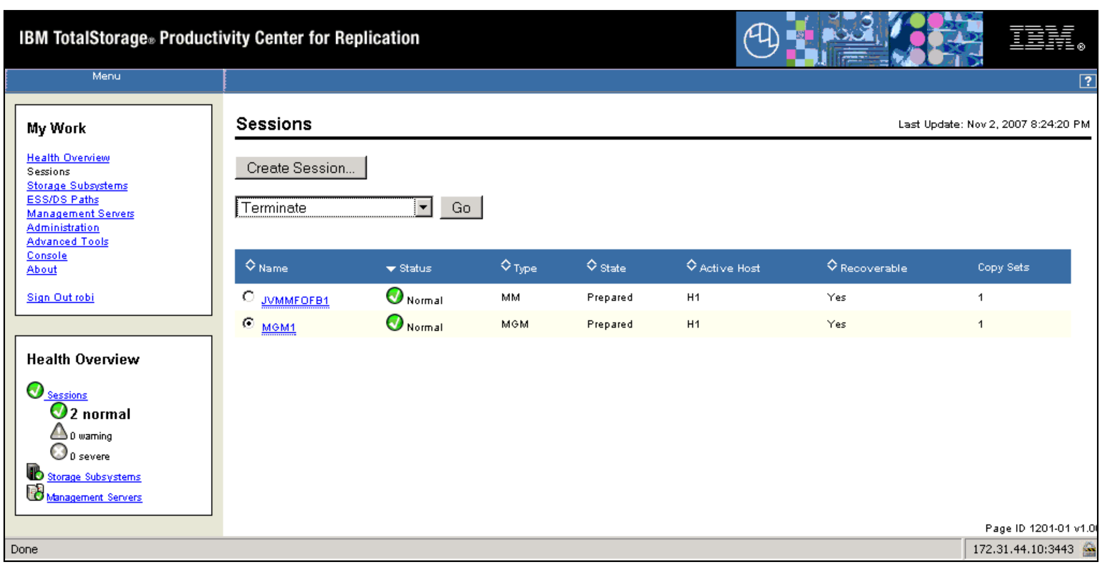

Figure 7-389 Metro Global Mirror session - Terminate action

2. The next message shown in Figure 7-390 is a warning that you are about to terminate Metro Global Mirror relationship between H1 to H2 and H3 volumes. Note that if you have to start the very same Metro Global Mirror session again, a full copy from H1 to H2 and H3 volumes will be required. Click **Yes** to continue.

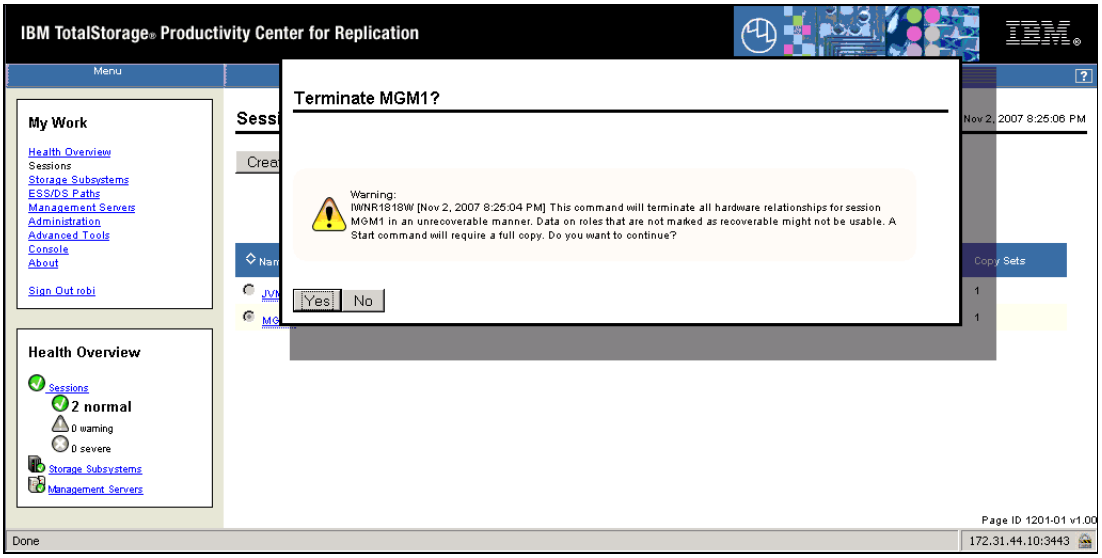

Figure 7-390 Terminate Metro Global Mirror session

3. There is a message at the top of the panel in Figure 7-391 indicating that a **Terminate** action has been successfully completed. The status of our Metro Global Mirror session is now *Inactive* and the state is *Defined*.

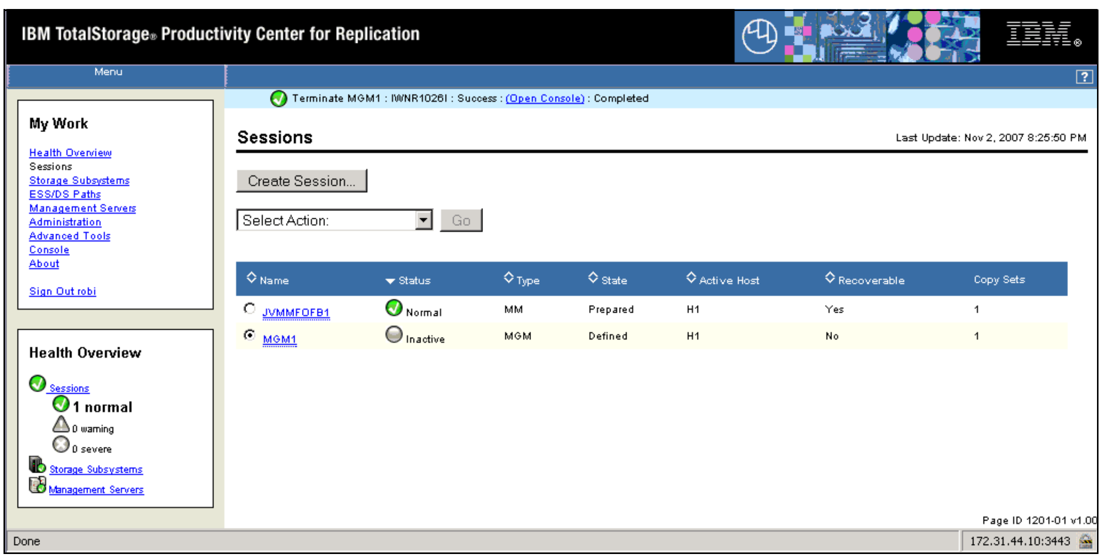

Figure 7-391 Terminate Metro Global Mirror session - Completed

4. Click the session name hyperlink (**MGM1** in our example) to find more details about this session. As shown in Figure 7-392 the Copy Set volume pairs are inactive, there is no data copying in progress, but the Metro Mirror and Global Mirror logical path between H1, H2 and H3 volumes are still there.

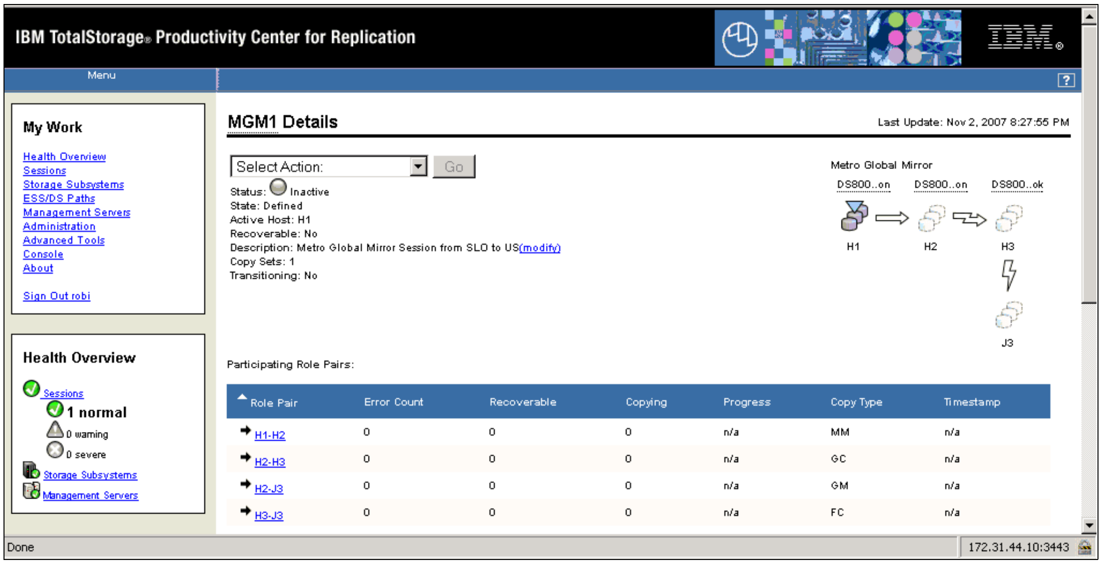

Figure 7-392 Terminate Metro Global Mirror session - Detail

After the Metro Mirror session is terminated, the following option is available:

Start H1 → H2 → H3 Restarts copying from H1 to H2 volumes in a Metro Mirror session and from H2 to H3 volumes in a Global Mirror session.

8

DS8000 recovery scenarios

In this chapter, we discuss various scenarios in case of planned and unplanned outages in the environment where we control replication using Tivoli Storage Productivity Center for Replication. We cover the following scenarios for DS8000 and SAN Volume Controller:

- Metro Mirror Single Direction planned outages
- Metro Mirror Single Direction unplanned outages
- Global Mirror Single Direction planned outages
- Global Mirror Single Direction unplanned outages
- Metro Mirror Failover/Failback planned outages
- Metro Mirror Failover/Failback unplanned outages
- Global Mirror Failover/Failback planned outages
- Global Mirror Failover/Failback unplanned outages
- Metro Mirror Failover/Failback with Practice session
- Metro Mirror Failover/Failback with Practice planned outages
- Metro Mirror Failover/Failback with Practice unplanned outages
- Global Mirror Failover/Failback with Practice session
- Global Mirror Failover/Failback with Practice planned outages
- Global Mirror Failover/Failback with Practice unplanned outages
- Metro Global Mirror planned outages
- Metro Global Mirror unplanned outages
- Metro Global Mirror practice scenarios at H3 site
- Basic HyperSwap planned outages
- Basic HyperSwap unplanned outages

8.1 Metro Mirror Single Direction planned outages

In this section, we discuss what steps are required in case of planned outages when you use the Metro Mirror Single Direction session. Planned outages can be used for storage or server maintenance.

8.1.1 Planned outage of H1 site

If you plan to perform planned actions on H1 site, you need to perform the following steps:

1. Verify that all sessions are in **Normal** state.
2. Stop I/O on servers accessing volumes on H1 site.
3. Execute the **Suspend** action as described in 7.3.6, “Suspending a Metro Mirror session” on page 304.
4. Execute the **Recover** action as described in 7.3.7, “Recovering a Metro Mirror session” on page 309.
5. Start I/O on the servers accessing volumes on H2 site.
6. Perform the actions on H1 site.

As this type of session is only single direction, you need to create a new session with the direction from H2 to H1 in order to move production back to H1 site. Steps for moving back would be the same as described before.

> **Note:** When returning back from H2 to H1 volumes, H1 volumes will be fully re-synchronized. This means the data will be overwritten. Create a copy of H1 volumes before performing this action. This can be achieved by creating a Flash Copy session where H1 volumes would be the source volumes. This would guarantee that you will have a consistent copy of data in case of failure in the H2 site while re-synchronizing back to H1 site.

8.1.2 Planned outage of H2 site

For a planned outage on H2 site, you need to perform the following steps:

1. Verify that all sessions are in **Normal** state.
2. Execute the **Suspend** action as described in 7.3.6, “Suspending a Metro Mirror session” on page 304.
3. Perform the actions on H2 site.
4. Execute the **Start** action in order to restart Metro Mirror session as described in 7.3.4, “Starting Metro Mirror session” on page 298.

> **Note:** The **Start** action after Suspend will only perform a copy of changes from H1 volumes to H2 volumes.

8.2 Metro Mirror Single Direction unplanned outages

In this section, we discuss what steps are required in case of unplanned outages when you use the Metro Mirror Single Direction session.

8.2.1 Unplanned outage of H1 site

In case of unplanned outages on H1 site, you need to perform the following steps to recover to H2 site:

1. Execute the **Recover** action as described in 7.3.7, “Recovering a Metro Mirror session” on page 309.
2. Start I/O on the servers accessing volumes on H2 site.

As this type of session is only single direction, you need to create a new session from H2 to H1 in order to move production back to the H1 site after it has been re-established. Steps for moving back would be the same as described in 8.1.1, “Planned outage of H1 site” on page 532.

8.2.2 Unplanned outage of H2 site

In case of an unplanned action on the H2 site, you need to perform the following step to resynchronize H2 site after it has been re-established:

Execute the **Start** action as described in 7.3.4, “Starting Metro Mirror session” on page 298.

> **Note:** The **Start** action after failure of the H2 site will perform a full copy from H1 volumes to H2 volumes.

8.3 Global Mirror Single Direction planned outages

In this section, we discuss what steps are required in case of planned outages when you use the Global Mirror Single Direction session. Planned outages can be used for storage or server maintenance.

8.3.1 Planned outage of H1 site

If you plan to perform planned action on H1 site, you need to perform the following steps:

1. Verify that all sessions are in **Normal** state.
2. Stop I/O on servers accessing volumes on H1 site.
3. Wait so that copy on H2 site will be synchronized.
4. Execute the **Suspend** action as described in 7.4.4, “Suspending a Global Mirror session” on page 328.
5. Execute the **Recover** action as described in 7.4.5, “Recovering a Global Mirror session” on page 329.
6. Start I/O on the servers accessing volumes on H2 site.
7. Perform the actions on H1 site.

As this type of session is only single direction, you need to create a new session with direction from H2 to H1 in order to move production back to H1 site. Steps for moving back would be the same as described before.

To move volumes back to site H1, you can also create the Metro Mirror Single Direction session.

Note: When returning back from H2 to H1 volumes, H1 volumes will be fully re synchronized. This means the data will be overwritten. Create a copy of H1 volumes before performing this action. This can be achieved by creating Flash Copy session where H1 volumes would be source volumes. This would guarantee that you would have consistent copy of data in case of failure in H2 site while re synchronizing back to H1 site.

8.3.2 Planned outage of H2 site

To perform a planned action on the H2 site, follow these steps:

1. Verify that all sessions are in **Normal** state.
2. Execute the **Suspend** action as described in 7.4.4, “Suspending a Global Mirror session” on page 328.
3. Perform the actions on H2 site.
4. Execute the **Start** action to restart Global Mirror session as described in 7.4.3, “Starting a Global Mirror session” on page 325.

Note: The **Start** action after Suspend will only perform a copy of changes from H1 volumes to H2 volumes.

8.4 Global Mirror Single Direction unplanned outages

In this section, we discuss what steps are required in case of unplanned outages when you use the Global Mirror Single Direction session.

8.4.1 Unplanned outage of H1 site

In case of unplanned outages on H1 site, you need to perform the following steps to recover to the H2 site:

1. Execute **Recover** action as described in 7.4.5, “Recovering a Global Mirror session” on page 329.
2. Start I/O on servers accessing volumes on the H2 site.

As this type of session is only single direction, you need to create a new session from H2 to H1 in order to move production back to H1 site after it has been re-established. Steps for moving back would be the same as described in 8.3.1, “Planned outage of H1 site” on page 533.

To move volumes back to the H1 site, you can also create the Global Mirror Single Direction session.

8.4.2 Unplanned outage of H2 site

In case of an unplanned action on the H2 site, you need to resynchronize the H2 site after it has been re-established. To complete this step, execute the **Start** action as described in 7.4.3, “Starting a Global Mirror session” on page 325.

Note: The **Start** action after failure of the H2 site will perform a full copy from H1 volumes to H2 volumes.

8.5 Metro Mirror Failover/Failback planned outages

In this section, we discuss what steps are required in case of planned outages when you use the Metro Mirror Failover/Failback session. Planned outages can be used for storage or server maintenance.

8.5.1 Planned outage of H1 site

To perform a planned action on the H1 site, follow these steps:

1. Verify that all sessions are in **Normal** state.
2. Stop I/O on servers accessing volumes on H1 site.
3. Execute the **Suspend** action as described in 7.3.6, "Suspending a Metro Mirror session" on page 304.
4. Execute the **Recover** action as described in 7.3.7, "Recovering a Metro Mirror session" on page 309.
5. Start I/O on the servers accessing volumes on H2 site.
6. Perform the actions on H1 site.

To return back to site H1, perform the following steps:

1. Execute **Start H2 → H1** action as described in 7.6.8, "Starting an H2 ® H1 Metro Mirror session" on page 394.

   Note: The **Start H2 → H1** action after will only perform a copy of changes from H2 volumes to H1 volumes. Create a copy of the H1 volumes before performing this action. This can be achieved by creating a Flash Copy session where H1 volumes will be source volumes. This will guarantee that you will have a consistent copy of data in case of failure in H2 site while re-synchronizing back to the H1 site.

2. Wait for volumes to synchronize. Verify that all sessions are in **Normal** state.
3. Stop I/O on servers accessing volumes on H2 site.
4. Execute the **Suspend** action as described in 7.3.6, "Suspending a Metro Mirror session" on page 304.
5. Execute the **Recover** action as described in 7.3.7, "Recovering a Metro Mirror session" on page 309.
6. Execute **Start H1 → H2** action as described in 7.3.4, "Starting Metro Mirror session" on page 298.
7. Start I/O on the servers accessing volumes on H1 site.

8.5.2 Planned outage of H2 site

To perform a planned action on the H2 site, follow these steps:

1. Verify that all sessions are in **Normal** state.

2. Execute the **Suspend** action as described in 7.3.6, “Suspending a Metro Mirror session” on page 304.
3. Perform the actions on the H2 site.
4. Execute the **Start H1 → H2** action in order to restart the Metro Mirror session as described in 7.3.4, “Starting Metro Mirror session” on page 298.

> **Note:** The **Start H1 → H2** action after suspend will only perform a copy of changes from H1 volumes to H2 volumes.

8.6 Metro Mirror Failover/Failback unplanned outages

In this section, we discuss what steps are required in case of unplanned outages when you use the Metro Mirror Failover/Failback session.

8.6.1 Unplanned outage of H1 site

In case of unplanned outages on H1 site, you need to perform the following steps to recover to the H2 site:

1. Execute the **Recover** action as described in 7.3.7, “Recovering a Metro Mirror session” on page 309.
2. Start I/O on the servers accessing volumes on H2 site.

In order to move production back to H1 site after it has been re-established, perform the following steps:

1. Execute **Start H2 → H1** action as described, 7.3.4, “Starting Metro Mirror session” on page 298.

> **Note:** The **Start** action after failure of H2 site will a perform a full copy from H2 volumes to H1 volumes.

2. Wait for volumes to synchronize. Verify that all sessions are in **Normal** state.
3. Stop I/O on servers accessing volumes on H2 site.
4. Execute the **Suspend** action as described in 7.3.6, “Suspending a Metro Mirror session” on page 304.
5. Execute the **Recover** action as described in 7.3.7, “Recovering a Metro Mirror session” on page 309.
6. Execute **Start H1 → H2** action as described in 7.3.4, “Starting Metro Mirror session” on page 298.
7. Start I/O on the servers accessing volumes on H1 site.

8.6.2 Unplanned outage of H2 site

In case of an unplanned action on H2 site, you need to re-synchronize the H2 site after it has been re-established. To complete this step, execute the **Start H1 → H2** action as described in 7.4.3, “Starting a Global Mirror session” on page 325.

Note: The **Start H1 → H2** action after failure of the H2 site will perform a full copy from H1 volumes to H2 volumes.

8.7 Global Mirror Failover/Failback planned outages

In this section, we discuss what steps are required in case of planned outages when you use the Global Mirror Failover/Failback session. Planned outages can be used for storage or server maintenance.

8.7.1 Planned outage of H1 site

To perform a planned action on the H1 site, follow these steps:

1. Verify that all sessions are in **Normal** state.
2. Stop I/O on servers accessing volumes on H1 site.
3. Wait until copy on H2 site will be synchronized.
4. Execute the **Suspend** action as described in 7.4.4, “Suspending a Global Mirror session” on page 328.
5. Execute the **Recover** action as described in 7.4.5, “Recovering a Global Mirror session” on page 329.
6. Start I/O on the servers accessing volumes on H2 site.
7. Perform the actions on H1 site.

To return back to site H1 perform the following steps:

1. Execute **Start H2 → H1** action as described in 7.4.3, “Starting a Global Mirror session” on page 325.

   Note: The **Start H2 → H1** action after will only perform a copy of changes from H2 volumes to H1 volumes. Create a copy of H1 volumes before performing this action. This can be achieved by creating a Flash Copy session where H1 volumes would be source volumes. This would guarantee that you would have a consistent copy of data in case of failure in the H2 site while re-synchronizing back to the H1 site.

2. Stop I/O on servers accessing volumes on H2 site.
3. Wait for volumes to synchronize. Verify that all sessions are in **Normal** state.
4. Execute the **Suspend** action as described in 7.4.4, “Suspending a Global Mirror session” on page 328.
5. Execute the **Recover** action as described in 7.4.5, “Recovering a Global Mirror session” on page 329.
6. Execute **Start H1->H2** action as described in 7.4.3, “Starting a Global Mirror session” on page 325.
7. Start I/O on the servers accessing volumes on the H1 site.

8.7.2 Planned outage of H2 site

To perform a planned action on the H2 site, follow these steps:

1. Verify that all sessions are in **Normal** state.
2. Execute the **Suspend** action as described in 7.4.4, “Suspending a Global Mirror session” on page 328.
3. Perform the actions on the H2 site.
4. Execute the **Start H1** → **H2** action in order to restart Global Mirror session as described in 7.4.3, “Starting a Global Mirror session” on page 325.

> **Note:** The **Start H1** → **H2** action after suspend will only perform a copy of changes from H1 volumes to H2 volumes.

8.8 Global Mirror Failover/Failback unplanned outages

In this section, we discuss what steps are required in case of unplanned outages when you use the Global Mirror Failover/Failback session.

8.8.1 Unplanned outage of H1 site

In case of unplanned outages on the H1 site, perform the following actions to recover to the H2 site:

1. Execute **Recover** action as described in 7.4.5, “Recovering a Global Mirror session” on page 329.
2. Start I/O on servers accessing volumes on H2 site.

In order to move production back to H1 site after it has been re-established, perform the following steps:

1. Execute **Start H2** → **H1** action as described, 7.8.9, “Starting H2 ® H1” on page 458.

   > **Note:** The **Start** action after failure of the H2 site will perform a full copy from H2 volumes to H1 volumes.

2. Stop I/O on servers accessing volumes on H2 site.
3. Wait for volumes to synchronize. Verify that all sessions are in **Normal** state.
4. Execute the **Suspend** action as described in 7.8.6, “Suspending a Global Mirror session” on page 451.
5. Execute the **Recover** action as described in 7.8.7, “Recovering a Global Mirror session” on page 454.
6. Execute **Start H1** → **H2** action as described in 7.4.3, “Starting a Global Mirror session” on page 325.
7. Start I/O on the servers accessing volumes on the H1 site.

8.8.2 Unplanned outage of H2 site

In case of an unplanned action on the H2 site, you need to re-synchronize the H2 site after it has been re-established. To complete this step, execute the **Start H1 → H2** action as described in 7.8.3, “Starting an H1 ® H2 Global Mirror session” on page 443.

Note: The **Start** action after failure of the H2 site will perform a full copy from H1 volumes to H2 volumes.

8.9 Metro Mirror Failover/Failback with Practice session

In this section, we discuss what steps are required if you want perform practice when you use the Metro Mirror Failover/Failback w/ Practice session. Practice can be used to perform tests of your recovery procedures.

8.9.1 Practice on H2 site

To perform practice on the H2 site, follow these steps:

1. Verify that all sessions are in **Normal** state.
2. Execute the **Suspend** action as described in 7.6, “Metro Mirror Failover/Failback with Practice” on page 375.
3. Execute the **Flash** action as described in 7.6.4, “Flashing a Metro Mirror session” on page 386.
4. Execute the **Start H1 → H2** action as described in 7.6.3, “Starting the session” on page 383.
5. Perform practice actions on H2 site.

8.10 Metro Mirror Failover/Failback with Practice planned outages

In this section, we discuss what steps are required in case of planned outages when you use the Metro Mirror Failover/Failback w/ Practice session. Planned outages can be used for storage or server maintenance.

8.10.1 Planned outage of H1 site

To perform planned actions on the H1 site, perform the following steps:

1. Verify that all sessions are in **Normal** state.
2. Stop I/O on servers accessing volumes on H1 site.
3. Execute the **Suspend** action as described in 7.6.5, “Suspending a Metro Mirror session” on page 388.
4. Execute the **Recover** action as described in 7.6.6, “Recovering a Metro Mirror session” on page 390.
5. Start I/O on the servers accessing volumes on H2 site.

6. Perform the actions on H1 site.

To return back to site H1, perform the following steps:

1. Execute **Start H2** → **H1** action as described in 7.6.8, “Starting an H2 ® H1 Metro Mirror session” on page 394.

   > **Note:** The **Start H2** → **H1** action after will only perform copy of changes from H2 volumes to H1 volumes. Create a copy of H1 volumes before performing this action. This can be achieved by creating a Flash Copy session where H1 volumes would be source volumes. This would guarantee that you would have a consistent copy of data in case of failure in H2 site while re-synchronizing back to the H1 site.

2. Wait for volumes to synchronize. Verify that all sessions are in **Normal** state.
3. Stop I/O on servers accessing volumes on the H2 site.
4. Execute the **Suspend** action as described in 7.6.5, “Suspending a Metro Mirror session” on page 388.
5. Execute the **Recover** action as described in 7.6.6, “Recovering a Metro Mirror session” on page 390.
6. Execute **Start H1** → **H2** action as described in 7.6.8, “Starting an H2 ® H1 Metro Mirror session” on page 394.
7. Start I/O on the servers accessing volumes on the H1 site.

8.10.2 Planned outage of H2 site

To perform a planned action on the H2 site, you need to perform the following steps:

1. Verify that all sessions are in **Normal** state.
2. Execute the **Suspend** action as described in 7.6.5, “Suspending a Metro Mirror session” on page 388.
3. Perform the actions on H2 site.
4. Execute the **Start H1->H2** action in order to restart Metro Mirror session as described in 7.6.3, “Starting the session” on page 383.

> **Note:** The **Start H1** → **H2** action after suspend will only perform a copy of changes from H1 volumes to H2 volumes.

8.11 Metro Mirror Failover/Failback with Practice unplanned outages

In this section, we discuss what steps are required in case of unplanned outages when you use the Metro Mirror Failover/Failback session.

8.11.1 Unplanned outage of H1 site

In case of unplanned outages on H1 site, you need to perform the following steps to recover to H2 site:

1. Execute the **Recover** action as described in 7.6.6, “Recovering a Metro Mirror session” on page 390.
2. Start I/O on the servers accessing volumes on H2 site.

In order to move production back to H1 site after it has been re-established, perform the following steps:

1. Execute **Start H2** → **H1** action as described, 7.6.8, “Starting an H2 ® H1 Metro Mirror session” on page 394.

   > **Note:** The **Start** action after failure of the H2 site will perform a full copy from H2 volumes to H1 volumes.

2. Wait for volumes to synchronize. Verify that all sessions are in **Normal** state.
3. Stop I/O on servers accessing volumes on H2 site.
4. Execute the **Suspend** action as described in 7.6.5, “Suspending a Metro Mirror session” on page 388.
5. Execute the **Recover** action as described in 7.6.6, “Recovering a Metro Mirror session” on page 390.
6. Execute **Start H1->H2** action as described in 7.6.3, “Starting the session” on page 383.
7. Start I/O on the servers accessing volumes on H1 site.

8.11.2 Unplanned outage of H2 site

In case of an unplanned action on the H2 site, you need to re-synchronize the H2 site after it has been re-established. To complete this step, execute the **Start H1** → **H2** action as described in 7.6.8, “Starting an H2 ® H1 Metro Mirror session” on page 394.

> **Note:** The **Start H1** → **H2** action after failure of the H2 site will perform a full copy from H1 volumes to H2 volumes.

8.12 Global Mirror Failover/Failback with Practice session

In this section, we discuss what steps are required if you want perform practice when you use the Global Mirror Failover/Failback w/ Practice session. Practice can be used to perform tests of recovery procedures.

8.12.1 Practice on H2 site

To perform practice on the H2 site, you need to follow these steps:

1. Verify that all sessions are in **Normal** state.
2. Execute the **Suspend** action as described in 7.8.6, “Suspending a Global Mirror session” on page 451.

3. Execute the **Flash** action as described in 7.8.4, “Flashing a Global Mirror session” on page 447.
4. Execute the **Start H1** → **H2** action as described in 7.8.3, “Starting an H1 ® H2 Global Mirror session” on page 443.
5. Perform practice actions on H2 site.

8.13 Global Mirror Failover/Failback with Practice planned outages

In this section, we discuss what steps are required in case of planned outages when you use the Global Mirror Failover/Failback session. Planned outages can be used for storage or server maintenance.

8.13.1 Planned outage of H1 site

To perform planned actions on the H1 site, follow these steps:

1. Verify that all sessions are in **Normal** state.
2. Stop I/O on servers accessing volumes on H1 site.
3. Wait so that copy on H2 site will be synchronized.
4. Execute the **Suspend** action as described in 7.8.6, “Suspending a Global Mirror session” on page 451.
5. Execute the **Recover** action as described in 7.8.7, “Recovering a Global Mirror session” on page 454.
6. Start I/O on the servers accessing volumes on H2 site.
7. Perform the actions on H1 site.

To return back to site H1, perform the following steps:

1. Execute **Start H2** → **H1** action as described in 7.8.9, “Starting H2 ® H1” on page 458.

> **Note:** The **Start H2** → **H1** action after will only perform copy of changes from H2 volumes to H1 volumes. Create a copy of H1 volumes before performing this action. This can be achieved by creating Flash Copy session where H1 volumes would be source volumes. This would guarantee that you would have a consistent copy of data in case of failure in H2 site while re-synchronizing back to the H1 site.

2. Stop I/O on servers accessing volumes on H2 site.
3. Wait for volumes to synchronize. Verify that all sessions are in **Normal** state.
4. Execute the **Suspend** action as described in 7.8.6, “Suspending a Global Mirror session” on page 451.
5. Execute the **Recover** action as described in 7.8.7, “Recovering a Global Mirror session” on page 454.
6. Execute **Start H1** → **H2** action as described in 7.8.3, “Starting an H1 ® H2 Global Mirror session” on page 443.
7. Start I/O on the servers accessing volumes on H1 site.

8.13.2 Planned outage of H2 site

To perform a planned action on the H2 site, follow these steps:

1. Verify that all sessions are in **Normal** state.
2. Execute the **Suspend** action as described in 7.8.6, “Suspending a Global Mirror session” on page 451.
3. Perform the actions on H2 site.
4. Execute the **Start H1** → **H2** action in order to restart Global Mirror session as described in 7.8.3, “Starting an H1 ® H2 Global Mirror session” on page 443.

> **Note:** The **Start H1** → **H2** action after suspend will only perform a copy of changes from H1 volumes to H2 volumes.

8.14 Global Mirror Failover/Failback with Practice unplanned outages

In this section, we discuss what steps are required in case of unplanned outages when you use the Global Mirror Failover/Failback session.

8.14.1 Unplanned outage of H1 site

In case of unplanned outages on the H1 site, you need to perform the following actions to recover to the H2 site:

1. Execute the **Recover** action as described in 7.8.7, “Recovering a Global Mirror session” on page 454.
2. Start I/O on servers accessing volumes on H2 site.

In order to move production back to H1 site after it has been re-established, perform the following steps:

1. Execute **Start H2** → **H1** action as described, 7.8.3, “Starting an H1 ® H2 Global Mirror session” on page 443.

   > **Note:** The **Start** action after failure of the H2 site will perform a full copy from H2 volumes to H1 volumes.

2. Stop I/O on servers accessing volumes on H2 site.
3. Wait for volumes to synchronize. Verify that all sessions are in **Normal** state.
4. Execute the **Suspend** action as described in 7.8.6, “Suspending a Global Mirror session” on page 451.
5. Execute the **Recover** action as described in 7.8.7, “Recovering a Global Mirror session” on page 454.
6. Execute **Start H1** → **H2** action as described in 7.8.3, “Starting an H1 ® H2 Global Mirror session” on page 443.
7. Start I/O on the servers accessing volumes on H1 site.

8.14.2 Unplanned outage of H2 site

In case of an unplanned action on the H2 site, you need to re-synchronize the H2 site after it has been re-established. To complete this step, execute the **Start H1 → H2** action as described in 7.8.3, “Starting an H1 ® H2 Global Mirror session” on page 443.

> **Note:** The **Start** action after failure of the H2 site will perform a full copy from H1 volumes to H2 volumes.

8.15 Metro Global Mirror planned outages

In this section, we discuss what steps are required in case of planned outages when you use the Metro Global Mirror session. Planned outages can be used for storage or server maintenance.

8.15.1 Planned outage of local H1 site, with a production move to intermediate H2 site and return

In this scenario, the goal is to take down the local H1 site, move production to the intermediate H2 site and return to the original configuration. Perform the following steps to accomplish that:

1. Execute **Start H1 → H2 → H3** action as described in 7.9.3, “Starting an H1 ® H2 ® H3 Metro Global Mirror session” on page 484. Issue this action to begin Metro Global Mirror on your system when the production I/O is running on H1 site. Wait for the session to go to the prepared state.

   > **Note:** Stop production I/O on H1 before continuing to the next step.

2. Execute **Suspend** action as described in 7.9.6, “Suspending a Metro Global Mirror session” on page 492. This command creates the planned outage by suspending the Metro Mirror relationship between H1 and H2. When this step is complete, the session state should be suspended and recoverable.
3. Execute **RecoverH2** action as described in 7.9.8, “RecoverH2 in a Metro Global Mirror session” on page 497. This command makes H2 target-available. When the session state is target-available at H2, run production I/O to H2.
4. Execute **Start H2 → H3** action as described in 7.9.10, “Starting H2 ® H3 Metro Global Mirror session (after RecoverH2)” on page 501. This command starts a Global Mirror session during the outage of H1. Production I/O can continue on H2. Wait for the session to go to the prepared state.

   > **Note:** A suspend is not necessary before going to the next step.

5. Execute **Start H2 → H1 → H3** action as described in 7.9.11, “Starting H2 ® H1 ® H3 Metro Global Mirror session (after RecoverH2)” on page 503. Issue this command when H1 is available and ready to be brought back into the configuration. This command starts a Metro Global Mirror session with H1 and H2 roles reversed from the original configuration. Production I/O can continue on H2. Wait for the session to go to the prepared state.

> **Note:** The following steps are optional to return to the original configuration.
>
> Stop production I/O on H2 before continuing to the next step and when ready to return back to H1 location.

6. Execute **Suspend** action as described in 7.9.6, “Suspending a Metro Global Mirror session” on page 492. This command suspends the Metro Mirror relationship between H2 and H1. When this step is complete, the session state should be suspended and recoverable.
7. Execute **RecoverH1** action as described in 7.9.13, “Recovering H1 in a Metro Global Mirror session (after suspending H2 ® H1 ® H3 Metro Global Mirror session)” on page 508. This command makes H1 target-available. When the session state is target-available at H1, run production I/O to H1.
8. Execute **Start H1 → H2 → H3** action as described in 7.9.3, “Starting an H1 ® H2 ® H3 Metro Global Mirror session” on page 484. This command restores the original configuration.

8.15.2 Planned outage of intermediate H2 site and return

In this scenario, we cover planned action at H2 site, and then bring it back up to its original configuration. Perform the following actions to accomplish that:

1. Execute **Start H1 → H2 → H3** action as described in 7.9.3, “Starting an H1 ® H2 ® H3 Metro Global Mirror session” on page 484. Issue this action to begin Metro Global Mirror on your system when the production I/O is running on H1 site. Wait for the session to go to the prepared state.

> **Note:** Continue running production I/O to H1 during the following steps.

2. Execute **Start H1 → H3** action as described in 7.9.15, “Starting H1 ® H3 in a Metro Global Mirror session” on page 513. This action starts a Global Mirror session during the outage of H2 site. Production I/O can continue on H1 site. Wait for the session to go to the prepared state.

> **Note:** When H2 site is available again, and in order to restore the original Metro Global Mirror configuration, a **Suspend** action is not necessary before going to the next step.

3. Execute **Start H1 → H2 → H3** action as described in 7.9.3, “Starting an H1 ® H2 ® H3 Metro Global Mirror session” on page 484. Issue this action when H2 is available and ready to be brought back into the configuration. This action restores the original configuration. Production I/O can continue on H1.

8.15.3 Planned outage of local H1 site and intermediate H2 site in normal configuration with production move to remote H3 site and return

In this scenario, we cover planned actions on the H1 site and the H2 site while in normal configuration, we move the production to the remote H3 site and then restore the original configuration. Perform the following actions to accomplish that:

1. Execute **Start H1 → H2 → H3** action as described in 7.9.3, “Starting an H1 ® H2 ® H3 Metro Global Mirror session” on page 484. Issue this action to begin Metro Global Mirror

on your system when the production I/O is running on H1. Wait for the session to go to the prepared state.

Note: Stop production I/O on H1 before continuing to the next step.

2. Execute **Suspend** action as described in 7.9.16, “Suspending a Metro Global Mirror session (after Start H1 ® H3)” on page 515. This action creates the planned outage by suspending the Metro Mirror relationship between H1 site and H2 site. When this step is complete, the session state should be suspended and recoverable.
3. Execute **RecoverH3** action as described in 7.9.17, “Recovering a Metro Global Mirror session (after suspending H1 ® H3 Global Mirror session)” on page 517. This action makes H3 target-available. When the session state is Target Available at H3, run test I/O to H3.

   This command makes H3 target-available. When the session state is target-available at H3, run production I/O to H3.

Note: Continue running production I/O on H3 before continuing to the next step.

4. Execute **Start H3** → **H1** → **H2** action as described in 7.9.19, “Starting H3 ® H1 ® H2 in a Metro Global Mirror session (after recovering H3 volumes in an H1 ® H3 Global Mirror session)” on page 521.

   Issue this action when H1 and H2 are available and ready to be brought back into the configuration. Changes from production at the remote H3 site flow from the local H1 site to the intermediate H2 site. The H3-H1 and H1-H2 pairs are Global Copy. The session stays in a preparing state.

Note: When ready to return back to the H1 site, stop production I/O on H3 before continuing to the next step.

5. Execute **Suspend** action as described in 7.9.20, “Suspending a Metro Mirror session (after Start H3 ® H1 ® H2)” on page 524. This action suspends Global Copy relationship between H3 → H1 and H1 → H2. When this step is complete, the session state should be suspended and recoverable.
6. Execute **RecoverH1** action as described in 7.9.13, “Recovering H1 in a Metro Global Mirror session (after suspending H2 ® H1 ® H3 Metro Global Mirror session)” on page 508. This action makes H1 target-available. When the session state is target-available at H1, run production I/O to H1.
7. Execute **Start H1** → **H2** → **H3** action as described in 7.9.3, “Starting an H1 ® H2 ® H3 Metro Global Mirror session” on page 484. Issue this action when H2 is available and ready to be brought back into the configuration. This action restores the original configuration.

8.15.4 Planned outage of remote H3 site and return

In this scenario, we cover planned actions on the H3 site, and then bring it back up to its original configuration. Perform the following actions to accomplish that:

1. Execute **Start H1** → **H2-** → **H3** action as described in 7.9.3, “Starting an H1 ® H2 ® H3 Metro Global Mirror session” on page 484. Issue this action to begin Metro Global Mirror on your system when the production I/O is running on H1. Wait for the session to go to the prepared state.

> **Note:** Continue running production I/O to H1 during the following steps.

2. Execute **SuspendH2H3** action as described in 7.9.4, “SuspendH2H3 in a Metro Global Mirror session” on page 487. Issue this action to suspend the Global Mirror portion of the session only. The Metro Mirror continues between H1 and H2. This causes the session state to be suspended.
3. After the H3 site is available again execute **Start H1 → H2 → H3** action as described in 7.9.3, “Starting an H1 ® H2 ® H3 Metro Global Mirror session” on page 484. This command restores the original configuration by starting the Global Mirror portion.

8.16 Metro Global Mirror unplanned outages

In this section, we discuss what steps are required in case of unplanned outages when you use the Metro Global Mirror session.

8.16.1 Unplanned outage of local H1 site, production move to intermediate H2 site and return

In this scenario, we describe actions in case of an unplanned outage of the local site (H1), move the production to the intermediate site (H2), and return to the original configuration.

> **Note:** Make sure that the heartbeat function is enabled.

1. Execute **Start H1 → H2 → H3** action as described in 7.9.3, “Starting an H1 ® H2 ® H3 Metro Global Mirror session” on page 484. Issue this command to begin Metro Global Mirror on your system when the production I/O is running on H1. Assume that the session state goes to prepared in this example.
2. An unplanned outage of H2 will cause the session to go suspended. The session is recoverable if it was in a prepared state when the outage occurred. If the session state was preparing, the session would not be recoverable. This will also cause your production I/O on H1 to crash.
3. Execute **Recover H2** action as described in 7.9.8, “RecoverH2 in a Metro Global Mirror session” on page 497. This command makes H2 target-available. When the session state is target-available at H2, run production I/O to H2.
4. Execute **Start H2 → H3** action as described in 7.9.10, “Starting H2 ® H3 Metro Global Mirror session (after RecoverH2)” on page 501. This command starts a Global Mirror session during the outage of H1. Production I/O can continue on H2. Wait for the session to go to the prepared state.

> **Note:** A **Suspend** action is not necessary before going to the next step.

5. Execute **Start H2 → H1 → H3** action as described in 7.9.11, “Starting H2 ® H1 ® H3 Metro Global Mirror session (after RecoverH2)” on page 503 Issue the RecoverH2 command when H1 is available and ready to be brought back into the configuration. This command starts an MGM session with H1 and H2 roles reversed from the original configuration. Production I/O can continue on H2. Wait for the session to go to the prepared state.

Note: The following steps are used to return to the original configuration after the H1 site is available. Stop production I/O on H2 before continuing to the next step.

6. Execute **Suspend** action as described in 7.9.16, “Suspending a Metro Global Mirror session (after Start H1 ® H3)” on page 515. This command suspends the Metro Mirror relationship between H2 and H1. When this step is complete, the session state should be suspended and recoverable.
7. Execute **RecoverH1** action as described in 7.9.17, “Recovering a Metro Global Mirror session (after suspending H1 ® H3 Global Mirror session)” on page 517 This command makes H1 target-available. When the session state is Target Available at H1, run production I/O to H1.
8. Execute **Start H1 → H2 → H3** action as described in 7.9.3, “Starting an H1 ® H2 ® H3 Metro Global Mirror session” on page 484. This command restores the original configuration.

8.16.2 Unplanned outage of intermediate H2 site and return

In this scenario, we cover actions in case of an unplanned outage of the H2 site and return to the original configuration. Perform the following actions after outage:

Note: Make sure that the heartbeat function is enabled.

1. An unplanned outage of H2 will cause the session to go suspended. The session is recoverable if it was in a prepared state when the outage occurred. If the session state was preparing, the session would not be recoverable.
2. Execute **Start H1 → H3** action as described in 7.9.5, “RecoverH3 in a Metro Global Mirror session” on page 490. This action starts a Global Mirror session during the outage of H2. Production I/O can continue on H1. Wait for the session to go to the prepared state.

   Note: In order to bring the H2 site back to configuration after site H2 has been re-established, a **Suspend** action is not necessary before going to the next step.

3. Execute **Start H1 → H2 → H3** action as described in 7.9.3, “Starting an H1 ® H2 ® H3 Metro Global Mirror session” on page 484. Issue this action when H2 is available and ready to be brought back into the configuration. This action restores the original configuration. Production I/O can continue on H1.

8.16.3 Unplanned outage of local H1 site and intermediate H2 site, with production move to remote H3 site and return

In this scenario, we cover actions in case of an unplanned outage of the H1 site and the H2 site, move production to the H3 site, and return to the original configuration. Perform the following actions after outage:

Note: Make sure that the heartbeat function is enabled.

1. Execute **RecoverH3** action as described in 7.9.17, “Recovering a Metro Global Mirror session (after suspending H1 ® H3 Global Mirror session)” on page 517. This action

makes H3 target-available. The session will be severe/target-available. When the session state is target-available at H3, run production I/O to H3.

Note: Continue running production I/O on H3 before continuing to the next step.

2. In order to move production back to H1 site after site H1 and site H2 have been restored, execute **Start H3 → H1 → H2** action as described in 7.9.19, "Starting H3 ® H1 ® H2 in a Metro Global Mirror session
(after recovering H3 volumes in an H1 ® H3 Global Mirror session)" on page 521. Issue this action when H1 and H2 are available and ready to be brought back into the configuration. Changes from production at the remote H3 site flow from the local H1 site to the intermediate H2 site. The H3-H1 and H1-H2 pairs are Global Copy. The session stays in the preparing state.

Note: Stop production I/O on H3 before continuing to the next step.

3. Execute **Suspend** action as described in 7.9.20, "Suspending a Metro Mirror session (after Start H3 ® H1 ® H2)" on page 524. This command suspends the Global Copy relationship between H3 → H1 and H1 → H2. When this step is complete, the session state should be suspended and recoverable.
4. Execute **Recover H1** action as described in 7.9.21, "Recovering Metro Global Mirror (after suspending H3 ® H1 ® H2 Metro Global Mirror session)" on page 526. This action makes H1 target-available. When the session state is target-available at H1, run production I/O to H1.
5. Execute **Start H1 → H2 → H3** action as described in 7.9.3, "Starting an H1 ® H2 ® H3 Metro Global Mirror session" on page 484. This action restores the original configuration.

8.16.4 Unplanned outage of remote H3 site and return

In this scenario, we cover actions in case of an unplanned outage of the H3 site and return to the original configuration. Perform the following actions after outage:

Note: Make sure that the heartbeat function is enabled.

A failure of the remote H3 site causes the session state to go from prepared to **SuspendedH2H3**, with an error message that the connection to the H3 site has been lost.

After the H3 site is repaired and ready to return to the configuration, the session remains **SuspendedH2H3** and recoverable until the following action is completed.

Execute **Start H1 → H2 → H3** action as described in 7.9.3, "Starting an H1 ® H2 ® H3 Metro Global Mirror session" on page 484. Issue this action only when the remote H3 site is repaired and ready to return to the configuration. With this command, your session returns to the original configuration by starting the Global Mirror portion back up.

8.17 Metro Global Mirror practice scenarios at H3 site

In this section, we describe how to practice on the remote H3 site while running a Metro Global Mirror session.

To practice on the remote site, you first need to suspend the back-end. For example, if running in an H1 → H2 → H3 configuration, issue a **SuspendH2H3** action to pause the Global Mirror portion of the session while leaving the Metro Mirror portion of the session active. When the session is in a suspended state (that is, H2H3 is suspended while in an H1 → H2 → H3 configuration), you have the option to issue a **RecoverH3** action.

The **RecoverH3** action acts differently than other recover actions. In this case, the action acts only to make the remote H3 site target-available and does not switch the application site to H3. The application site remains the original host site and the session acts as it does in a normal Metro Mirror Failover/Failback session.

While the session is in this mode, it remains capable of disaster recovery and will freeze all pairs to maintain consistency during an error. You can also suspend the session by action and recover to the intermediate site if necessary. However, if the intermediate site is H2, it will not be possible to restart a full three-site solution. To get three sites back up and running, you need to copy back to H1 using the **Start H2 → H1** action and then suspend and recover to H1. After H1 is the application host again, you can issue the **Start H1 → H2 → H3** action to restart three-site support. If this is done, all data written to H3 during the practice is overwritten with the data that is on H1.

In addition, you can restart the front-end after a normal recover to H3 while in an H1 → H2 → H3 configuration. For example, after issuing a **RecoverH3** action, you can issue a **Start H1 → H2** action to set up disaster recovery. The difference here is that the **RecoverH3** action in this scenario requires you to still issue the **Start H1 → H2** action to set up disaster recovery while practicing on H3.

8.17.1 Overview of Metro Global Mirror scenarios for practicing at H3 site

This section provides an overview of the Metro Global Mirror scenarios for practicing at H3 site.

> **Note:** For simplicity, the following scenarios are geared toward the configuration where the session is running H1 → H2 → H3. The same options apply when in the configuration is running H2 → H1 → H3.

There are two methods to set up a practice mode at the remote site, H3.

In the first method, you issue the following actions:

1. Execute **Start H1 → H2 → H3** action as described in 7.9.3, “Starting an H1 ® H2 ® H3 Metro Global Mirror session” on page 484.
2. Execute **SuspendH2H3** action as described in7.9.4, “SuspendH2H3 in a Metro Global Mirror session” on page 487.
3. Execute **RecoverH3** action as described in 7.9.5, “RecoverH3 in a Metro Global Mirror session” on page 490.

After you have issued the commands, keep running application on H1 site, and set up a practice environment on H3 site.

The previous steps put the session into a prepared state with only the H1 → H2 role pair considered as participating. There is no need to issue a **Start H1 → H2** action at this point because the session automatically transitions to that state.

In the second method of setting up a practice mode, issue the following commands:

1. Execute **Start H1 → H2 → H3** action as described in 7.9.3, "Starting an H1 ® H2 ® H3 Metro Global Mirror session" on page 484.
2. Execute **Suspend** action as described in 7.9.6, "Suspending a Metro Global Mirror session" on page 492.3.
3. Execute **RecoverH3** action as described in 7.9.5, "RecoverH3 in a Metro Global Mirror session" on page 490.
4. Execute **Start H1 → H2** action.

After you have executed the actions, keep running application on H1, and set up a practice environment on H3.

The difference between the second method and the first method is that a suspend is issued instead of a suspend H2H3. When the session is in suspended mode (versus suspended H2H3), the session does not automatically go into practice mode. The application site switches to H3 and you must issue a start H1 → H2 to enable the practice mode.

8.17.2 Practice scenario 1: While practicing, disaster occurs at H1 site, then recover to H2 site

This section describes an H3 site practice scenario, where a disaster occurs at H1 site, followed by a recovery to H2 site.

If a disaster occurs at H1 site, the session immediately suspends itself. You then need to complete the following steps:

1. Execute **RecoverH2** action as described in 7.9.8, "RecoverH2 in a Metro Global Mirror session" on page 497.
2. Move the application I/O to H2 site.
3. Execute **Start H2 → H1** action in order to make the session capable of disaster recovery again.

8.17.3 Practice scenario 2: While practicing, planned outage at H1 site, then recover to H2 site

This section describes an H3 site practice scenario, with a planned outage at H1 site, followed by a recovery to H2 site.

While practicing, if you want a planned outage with a switch to H2 site, do the following steps:

1. Execute **Suspend** action as described in 7.8.6, "Suspending a Global Mirror session" on page 451.
2. Execute **RecoverH2** action as described in 7.9.8, "RecoverH2 in a Metro Global Mirror session" on page 497.
3. Move the application I/O to H2 site.
4. Execute **Start H2 → H1** action as described in 7.8.9, "Starting H2 ® H1" on page 458, in order to make the session capable of disaster recovery again.

8.17.4 Practice scenario 3: While practicing with production at H2 site, move production back to H1 site

This section describes an H3 practice scenario, with production running at H2 site, followed by a move of production to H1 site.

While practicing, if you moved the production to H2 site, you need to move it back to H1 site before you can start three-site support. Assuming the session is running H2 → H1, do the following steps to move production back to H1 site:

1. Execute **Suspend** action as described in 7.9.6, “Suspending a Metro Global Mirror session” on page 492.
2. Issue **RecoverH1** action.
3. Move the application I/O to H1 site.
4. Execute **Start H1** → **H2** action to make the session capable of disaster recovery again and move the application I/O to H3 site.
5. Execute **Start H1** → **H2** → **H3** action as described in 7.9.3, “Starting an H1 ® H2 ® H3 Metro Global Mirror session” on page 484 when H3 site is ready to receive a copy of the data at H1 site. When this action completes, all writes that were done to H3 site are overwritten by the data on H1 site.

8.18 Basic HyperSwap planned outages

In this section, we discuss what steps are required in case of planned outages when you use the Basic HyperSwap session. Planned outages can be used for storage maintenance.

8.18.1 Planned outage of H1 site storage subsystem (H1 volumes)

If you plan to perform planned actions on H1 site storage subsystem, you need to perform the following steps:

1. Verify that the Basic HyperSwap session has *Normal* status and is in *Prepared* state.
2. Execute the **HyperSwap** action as described in 6.6.5, “Starting H1->H2 in a Basic HyperSwap session” on page 244.
3. Perform the actions on H1 site storage subsystem.

When the Site 1 storage subsystem is ready, perform the following steps to swap your application back to Site 1 storage subsystem:

1. Verify that Basic HyperSwap sessions have *Normal* status and are in *Target Available* state with H2 as Active Host.
2. Execute the **Start H2** → **H1** action as described in 6.6.7, “Starting H2->H1 in a Basic HyperSwap session” on page 250.
3. Execute the **HyperSwap** action as described in 6.6.8, “HyperSwap command (after Start H2->H1)” on page 252.

8.18.2 Planned outage of H2 site storage subsystem (H2 volumes)

If you plan to perform planned actions on H2 site storage subsystem, you need to perform the following steps:

1. Verify that the Basic HyperSwap session has *Normal* status and is in *Prepared* state.
2. Execute the **Stop** action as described in 6.6.9, “Stopping a Basic HyperSwap session” on page 255.

> **Note: Stop** action is completely transparent to the host I/O since *Freeze* (consistency group creation) is not issued against volumes. Therefore H2 volumes do not contain a consistent copy of your data. If possible, quiesce your application or stop I/O before you execute **Stop** command.

3. Perform the actions on H2 site storage subsystem.

When the Site 2 storage subsystem is ready, perform the following step to re-start data copying from H1 to H2 volumes:

1. Execute the **Start H1** → **H2** action as described in 6.6.5, “Starting H1->H2 in a Basic HyperSwap session” on page 244.

8.19 Basic HyperSwap unplanned outages

In this section, we discuss actions performed in case of unplanned outages when you use the Basic HyperSwap session.

8.19.1 Unplanned outage of H1 site storage subsystem (H1 volumes)

In case of unplanned outages on H1 site, Basic HyperSwap will automatically swap I/O from H1 volumes to H2 volumes residing at Site 2 storage subsystem. You can find all HyperSwap messages about unplanned HyperSwap in the MVS log as described in 6.6.2, “HyperSwap phases” on page 231.

8.19.2 Unplanned outage of H2 site storage subsystem (H2 volumes)

In case of unplanned outages on H2 site, all primary volumes in a Basic HyperSwap session will be suspended and all writes are on hold before the Extended Long Busy - ELB ends (default is 120 seconds). In order to release I/O writes to the primary volumes in a Basic HyperSwap session execute **Stop** command as described in 6.6.9, “Stopping a Basic HyperSwap session” on page 255.

Related publications

The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered in this book.

IBM Redbooks publications

The following IBM Redbooks publications provide additional information about the topic in this document. Note that some publications referenced in this list might be available in softcopy only.

- *Tivoli Storage Productivity Center V5.1 Technical Guide*, SG24-8053
- *Tivoli Storage Productivity Center V5.2 Release Guide*, SG24-8204
- *Configuring Secure Communication between HyperSwap and Tivoli Storage Productivity Center for Replication using TLS and AT-TLS*, REDP-5061

You can search for, view, download or order these documents and other Redbooks publications, Redpaper publications, Web Docs, draft and additional materials, at the following website:

ibm.com/redbooks

Other publications

These publications are also relevant as further information sources:

- *Tivoli Common Reporting User's Guide,* SC23-8737
- *Tivoli Storage Productivity Center User's Guide,* SC27-4048

Online resources

These websites are also relevant as further information sources:

- Tivoli Storage Productivity Center developerWorks site:

  http://www.ibm.com/developerworks/servicemanagement/sm/tpc/index.html
- Tivoli Storage Productivity Center Support Site:

  http://www-947.ibm.com/support/entry/portal/product/tivoli/tivoli_storage_productivity_center?productContext=1039251977

Help from IBM

IBM Support and downloads:

ibm.com/support

IBM Global Services:

ibm.com/services

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Redbooks

IBM Tivoli Storage Productivity Center for Replication for System z

(1.0” spine)
0.875”<->1.498”
460 <-> 788 pages

IBM Tivoli Storage Productivity Center for Replication for System z

Effectively use Tivoli Storage Productivity Center for Replication

Install and configure the software on System z

Manage replication services from one interface

IBM Tivoli Storage Productivity Center for Replication provides support for the advanced copy services capabilities on the DS8000 and DS6000, in addition to the support for SAN Volume Controller. This support focuses on automating administration and configuration of these services, operational control (starting, suspending, resuming) copy services tasks, and monitoring and managing the copy services sessions.

In addition to the support for FlashCopy and Metro Mirror, Tivoli Storage Productivity Center for Replication supports Global Mirror on the DS8000, and SAN Volume hardware platforms. Advanced disaster recovery functions are also supported with failover/failback (planned and unplanned) from a primary site to a disaster recovery site. A new product, IBM Tivoli Storage Productivity Center for Replication Basic Edition for System z enables Basic HyperSwap on z/OS, which allows the management of disk replication services using an intuitive GUI on z/OS systems.

Tivoli Storage Productivity Center for Replication also can monitor the performance of the copy services that provide a measurement of the amount of replication and the amount of time that is required to complete the replication operations.

This IBM Redbooks publication provides the information you need to install Tivoli Storage Productivity Center for Replication V5.1, and create and manage replication sessions on a z/OS platform. Scenarios are provided that document the work performed in our laboratory setting, using the GUI and CLI.

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