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IBM DS8870 Easy Tier Heat Map Transfer

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IBM DS8870 Easy Tier Heat Map Transfer

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Contents

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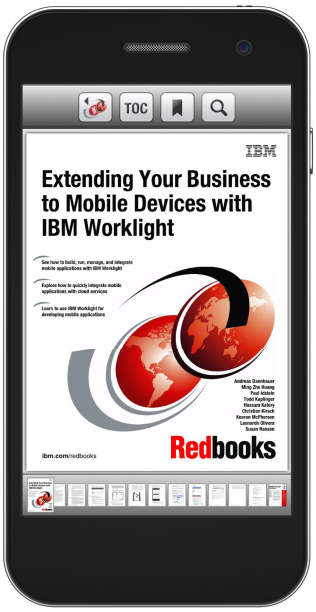

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Preface

This IBM® Redpaper™ publication describes the concepts, functions, and practical usage of IBM Easy Tier® Heat Map Transfer (HMT).

IBM System Storage® DS8000® Easy Tier is designed to automate data placement throughout the storage system disks pool. Easy Tier generates a heat map. It is a workload activity metric for each extent in a logical volume.

With Easy Tier HMT, it is possible to transfer the heat map from a mirrored primary site and reapply it periodically at secondary and tertiary sites by using the Easy Tier Heat Map Transfer Utility (HMTU). This capability helps maintain storage performance after a failover to a remote site. With DS8870 Release 7.5, the heat map transfer supports Metro Global Mirror (MGM) replication topology in addition to Metro Mirror/Global Copy/Global Mirror (MM/GC/GM) functions.

This paper is for those professionals who want to understand the Easy Tier HMT concept and its underlying design. It also provides guidance and practical illustrations about the operation of the HMTU.

For more information about the general concept of Easy Tier, see *IBM DS8000 Easy Tier*, REDP-4667.

For more information about Easy Tier Server and Easy Tier Application, see the following publications:

- *IBM System Storage DS8000 Easy Tier Server*, REDP-5013
- *DS8870 Easy Tier Application*, REDP-5014

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Overview

This chapter introduces the IBM Easy Tier Heat Map Transfer (HMT) and the IBM Easy Tier Easy Tier Heat Map Utility (HMTU). It describes the concepts and provides basic information for Easy Tier and Copy Services.

This chapter includes the following topics:

- Introduction
- Copy Services and Easy Tier basics
- Easy Tier evolution
- Basic Easy Tier concepts
- The Easy Tier Heat Map Transfer and Utility

1.1 Introduction

By using the HMTU, you can export the data placement statistics that are used at a Metro Mirror/Global Copy/Global Mirror (MM/GC/GM) primary site to reapply them at the secondary site. In addition, with the DS8870 R7.5 code, HMTU now supports three-site cascaded Metro Global Mirror (MGM) topologies and can transfer the Easy Tier Heat Map to the secondary and third site. Also, the IBM Geographically Dispersed Parallel Sysplex™ (IBM GDPS®) supports DS8870 multitarget heat map transfer capabilities for three-site and four-site MGM environment, and Metro Mirror/Extended Remote Copy/Global Mirror (MM/XRC/GM) copy services relationships.

The ability to reapply the data placement at the secondary or remote site with a similar physical configuration to what is at the primary site allows for consistency of the performance characteristics following a failover. This capability is an important feature for large environments that are performance-critical and require high availability (HA) or disaster recovery (DR) capability.

The latest HMT function is part of the Easy Tier feature that is available for DS8870 with License Machine Code (LMC) Version 7.7.50.xx.xx or higher.

1.2 Copy Services and Easy Tier basics

To better explain the Easy Tier HMT function, first review the basic concepts of IBM DS8000 Copy Services and Easy Tier in this section.

1.2.1 DS8000 Copy Services

DS8000 Copy Services are a collection of functions that provide DR, data migration, and data duplication. By using Copy Services functions, you can back up data with little or no disruption at the application level. The Copy Services functions run on all DS8000 models, which includes the DS8870 storage unit. It also supports Open Systems and IBM z™ Systems environments.

Many design characteristics of the DS8000, such as data copy, mirror capabilities, and other advanced features, contribute to the full-time protection of your data.

The DS8000 Copy Services functions are defined on the volume level and replicate data from the primary to the secondary site. The Easy Tier extent placement operates independently on both sites.

The HMTU works with Metro Mirror, Global Copy, Global Mirror, and Metro Global Mirror DS8870 Copy Services Functions and Easy Tier to optimize and synchronize the extents placement.

1.2.2 Easy Tier

In the DS8870, Easy Tier is a built-in dynamic data relocation feature that allows the host-transparent movement of data among the storage system resources. This feature improves configuration flexibility and performance tuning and planning.

Easy Tier is an optional and no-charge feature of the DS8870 storage system that offers enhanced capabilities through automated hot spot management and data relocation, auto-rebalancing, manual volume rebalancing and volume migration, rank depopulation, merging of extent pools, and thin-provisioning support. Easy Tier determines the appropriate tier of storage based on data access requirements. After this determination is made, it automatically moves data nondisruptively to the appropriate tier within the DS8870 at the volume level.

The basic IBM Easy Tier features can be summarized into two operating modes: automatic and manual. Easy Tier Automatic Mode and Manual Mode are not exclusive, which means that you can use Manual Mode capabilities even if Automatic Mode is active

Easy Tier automatic mode

In Automatic Mode, Easy Tier dynamically manages the capacity in single-tier (homogeneous) and multitier (hybrid) extent pools by auto-rebalancing extents to achieve better performance.

Note: Multitier extent pools can consist of up to five drive types that are managed in up to three different tiers (flash cards and solid-state drives (SSDs) as tier 0, Serial Attached SCSI (SAS) 15-K and 10-K rpm drives as tier 1, and nearline drives as tier 2).

Easy Tier Automatic Mode manages the data relocation across different tiers (inter-tier or cross-tier management) and within the same tier (intra-tier management) without any disruption to host operations.

Easy Tier Automatic Mode manages any combination of the three drive technology tiers:

- Flash: Flash cards (in the High Performance Flash Enclosures) and SSDs
- Enterprise: 15-K and 10-K rpm 2.5-inch hard disk drives (HDDs)
- Nearline: 7.2-K rpm 3.5-inch HDD

Easy Tier provides the following functions:

- Promote and Swap: For moving hot data to higher performing tiers.
- Warm Demote: Prevents performance overload of a tier by demoting warm extents to the lower tier. It is triggered when bandwidth or IOPS thresholds are exceeded.
- Cold Demote on lower tiers: Where coldest data is identified and moved to the nearline tier
- Expanded Cold Demote for HDD tiers: To demote part of the sequential workload to use the bandwidth in the nearline tier better.
- Auto-Rebalance: Redistributes the extents within a tier to balance usage across all ranks of the same tier for maximum performance.

Easy Tier Manual Mode

Easy Tier Manual Mode enables a set of manually started actions to manage data among the storage system resources in a dynamic fashion (without any disruption of the host operations).

Manual Mode includes the following capabilities:

- Dynamic volume relocation: Allows a DS8870 to migrate a volume to another extent pool
- Dynamic volume redistribution: Allows a DS8870 to redistribute volume capacity within the pool over the arrays

- Dynamic extent pool merge: Allows an extent pool to be merged with another extent pool
- Rank depopulation: Allows the removal of an allocated rank from an extent pool and relocates the allocated extents to the other ranks in the pool

Combining these capabilities greatly improves the configuration flexibility of the DS8870 and provides ease of use.

Easy Tier control

Users can suspend Easy Tier learning to avoid including unexpected workloads. You can, for example, suspend Easy Tier to avoid including a temporary batch workload at the end of every month and quarter that is different from the regular workload. After the batch activity completes, the Easy Tier learning process and migration for the impacted pools can be resumed.

1.3 Easy Tier evolution

The evolution of Easy Tier advanced functions throughout its last generations is summarized in Figure 1-1.

Easy Tier / DS8000 Model	Microcode Release	Tier Support	Auto Mode (Sub Volume)	Manual Mode (Full Volume)
Easy Tier 1 DS8700	R5.1	Two tier SSD + ENT SSD + NL	• Promote • Demote • Swap	• Dynamic extent pool merge • Dynamic volume relocation
Easy Tier 2 DS8700 DS8800	 R6.1 R6.1	Any two tiers SSD + ENT SSD + NL ENT + NL	• Promote • Demote • Swap • Auto Rebalance (Hybrid pool only)	• Rank depopulation • Manual volume rebalance
Easy Tier 3 DS8700 DS8800	 R6.2 R6.2	Any three tiers SSD + ENT + NL	• Auto Rebalance (Homogeneous Pool) • ESE Volume support	
Easy Tier 4 DS8700 DS8800 DS8870	 R6.3 R6.3 R7.0	Full support for FDE (encryption) drives	• Automatic data relocation capabilities for all FDE disk environments	• Support for all manual mode command for FDE environments
Easy Tier 5 DS8870	R7.1	Easy Tier Application Easy Tier Heat Map Transfer Easy Tier Server	• Storage administrators can control data placement via CLI • Provides directive data placement API to enable software integration • Learning data capture and apply for heat map transfer for remote copy environments • Unified storage caching and tiering capability for AIX servers	
Easy Tier 6 DS8870	R7.3	Tier 0 support for High Performance Flash Enclosures Easy Tier Server support for Flash Adapter 90 on POWER 940+ servers	• Intra-tier rebalance for heterogeneous Flash storage pools (HPFE and SSD)	
Easy Tier 7 DS8870	R7.4	Easy Tier Application API for System z Easy Tier Control	• Allow applications from zOS to give hints of data placement at dataset level • Allow customer to control learning and migration behaviour at pool and volume level to adapt to different workload requirement	
Easy Tier 8 DS8870	R7.5	Easy Tier Heat Map Transfer enhancements	• Support for Easy Tier Heat Map Transfer in three and four site Metro Global Mirror environments.	

Figure 1-1 All generations of IBM Easy Tier

The *first generation* introduced automated storage performance management by efficiently boosting enterprise-class performance with SSDs and automating storage tiering from enterprise-class drives to SSDs, therefore optimizing flash deployments with minimal costs. It also introduced dynamic volume relocation and dynamic extent pool merge.

The *second generation* added automated storage economics management by combining enterprise-class drives with nearline drives with the objective of maintaining enterprise-tier performance while shrinking the footprint and reducing costs with large capacity nearline drives. The second generation also introduced intra-tier performance management (*auto-rebalance*) for hybrid pools and manual volume rebalance and rank depopulation, along with warm and cold demote.

The *third generation* introduced further enhancements to provide automated storage performance and storage economics management across all three drive tiers (flash, enterprise, and nearline storage tiers), which allows you to consolidate and efficiently manage more workloads on a single DS8000 system. It also introduced support for auto-rebalance in homogeneous pools and support for thin-provisioned extent space-efficient (ESE) volumes.

The *fourth generation* enhanced the support of Full Disk Encryption (FDE) drives. IBM Easy Tier can perform volume migration, auto performance rebalancing in homogeneous and hybrid pools, hotspot management, rank depopulation, and thin provisioning (ESE volumes only) on encrypted drives and non-encrypted drives.

The *fifth generation* introduced the following advanced features:

- Easy Tier Server: Allows caching of the hottest data onto IBM AIX server-attached flash drives while maintaining DS8870 advanced functions. Easy Tier Server is described in *IBM System Storage DS8000 Easy Tier Server*, REDP-5013.
- Easy Tier Application: Enables administrators to affect directly the placement of logical volumes on specific tiers of a DS8870 based on application and business requirements. Easy Tier Application is described in *DS8870 Easy Tier Application*, REDP-5014.
- Easy Tier Heat Map Transfer: Maintains application-level performance at the secondary site of a DS8870 by transferring the Easy Tier information to the secondary site.

The *sixth generation* introduced the following advanced features:

- Support for the flash cards: The flash cards can be installed in the high-performance flash enclosure (HPFE) only. The use of flash cards in the DS8870 provides up to three and a half times the performance of flash drives.
- Support for the IBM Flash Adapter 90 attached to an IBM Power Systems server, in addition to the EXP30 Ultra SSD that DS8870 already supported.

The *seventh generation* adds the following advanced and innovative features:

- Easy Tier Application control: Easy Tier Application controls provide a more granular and flexible control of workload learning and data migration, and provide a volume-level tier restriction where a volume can be excluded from the nearline tier. A user can manage and control Easy Tier at the pool or volume level.
- Easy Tier Application for IBM z Systems™: Easy Tier Application for z Systems provides comprehensive data-placement management policy support between an application and storage. With this feature, you must program the policy only once to enforce it automatically. With hints about data usage and performance expectations, storage is optimized automatically toward higher performance and efficiency. Concurrently, the hint semantics relieve the application from the burden of storage resource management.

The *eight generation* supports Easy Tier HMT in three- and four-site Metro Global Mirror (MGM) environments.

For more information about the other Easy Tier features, see the following publications:

- *IBM System Storage DS8000 Easy Tier Server*, REDP-5013
- *DS8870 Easy Tier Application*, REDP-5014

1.4 Basic Easy Tier concepts

The data placement that is performed by Easy Tier is based on a generated *heat map* that is periodically rebuilt, as shown in Figure 1-2.

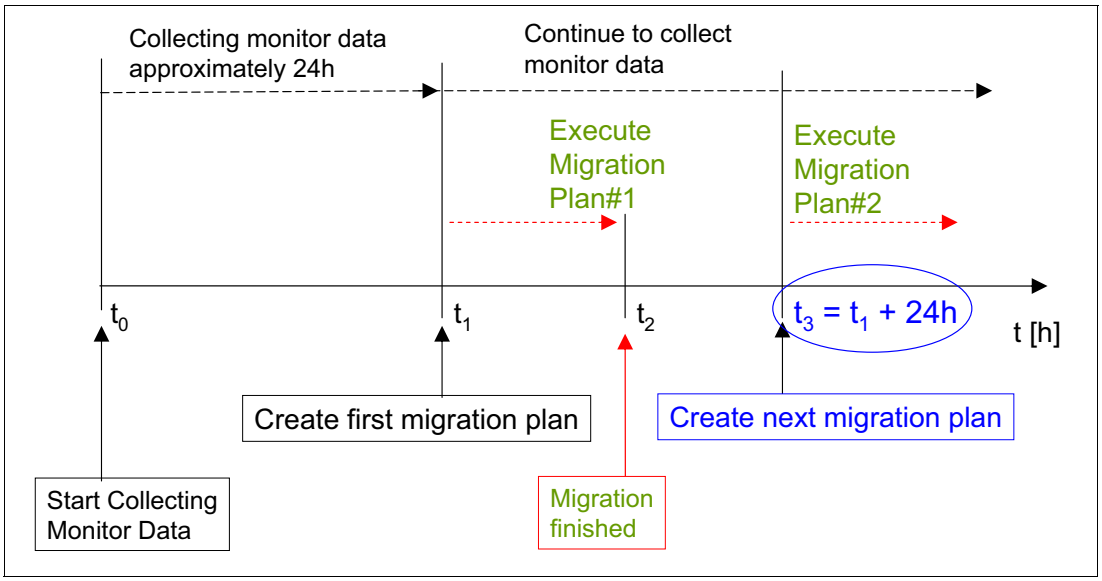

Figure 1-2 Easy Tier lifecycle schema

A heat map is a workload activity metric that is calculated for each extent in a logical volume. The workload activity is expressed as a temperature gradient ranging from hot (high I/O activity), warm, to cold (low I/O activity).

After 24 hours of monitoring, the first migrations start to take place and complete the relocation from DS8000 perspective.

Besides the host transparent data relocation capability, Easy Tier also provides monitoring capabilities that allow back-end workload data collection.

Note: To use the Easy Tier monitoring capabilities, the Easy Tier LIC feature must be enabled on the DS8000.

For more information about these concepts, usage, and the benefits of using Easy Tier and how to implement and analyze the effect to implement different tiers in your environment by using the Storage Tier Advisor Tool (STAT) for your environment, see *IBM DS8000 Easy Tier*, REDP-4667.

1.5 The Easy Tier Heat Map Transfer and Utility

This section examines possible usage scenarios for HMT, and then focuses on the HMTU.

1.5.1 Scenario for HMT and HMTU usage

The HMTU imports the heat map data from the primary storage system, and analyzes this data to accomplish the following goals:

- Identify those volumes that have a peer-to-peer remote client (PPRC) relationship.
- Determine the type of PPRC relationship that exists. The relationship can be Metro Mirror, Global Copy, Global Mirror, or Metro Global Mirror.

Given a three-site environment that uses DS8870 Copy Services for data replication (as shown in 1.3, “Easy Tier evolution” on page 4), the data placement optimization that is done by Easy Tier on the primary site by default is not replicated to the secondary site. Because there are different I/O characteristics for the primary (read and write) and the secondary or tertiary (write) sites for volumes in a Copy Services relationship, the data extents most likely are not on the same tiers.

After the secondary or tertiary site is promoted to the production site, a performance degradation is to be expected for a certain period until Easy Tier optimizes the extent distribution according to the I/O profile on the new production site.

HMTU tackles these limitations. In an environment that implemented HMTU, not only is data replicated to the secondary or third remote site by the Copy Services, but the Easy Tier persistent data placement optimization also is performed.

The HMT requires that the Easy Tier monitoring function is enabled at the primary and secondary/tertiary storage systems that are involved with the heat map transfer.

The HMTU, periodically or on-demand, transfers the Easy Tier heat map information from the primary to the secondary and tertiary storage system.

The secondary storage system generates migration plans that are based on the heat map data and its current physical configuration. In this way, the performance characteristics of the secondary storage become consistently updated to reflect the performance characteristics of the primary storage. The tertiary storage system generates migration plans that are based on the heat map data and its current physical configuration. In this way, the performance characteristics of the remote tertiary storage become consistently updated to reflect the performance characteristics of the secondary storage.

Multiple secondary storage systems also are supported in this context. You also can have multiple primary storage systems that are associated with a single secondary storage system.

If a workload failover occurs, the secondary or tertiary storage system performs the following tasks:

- Uses the heat map data that is transferred from the primary or secondary storage system.
- Maintains performance levels equivalent to the primary or secondary storage system while the primary storage system stays unavailable.

Important: It is preferable for the secondary and tertiary storage system to have the same physical configuration as the primary system to maintain the same performance levels.

Another benefit of the ET HMT function is to provide a significant reduction in the loss of Easy Tier Learning statistics inside the DS8870 servers. The heat map information that is produced from DS8870 server 0 is transferred to the DS8870 server 1 (called ET persistent data), which creates mechanisms to preserve these statistics and helps ET on the following system state transitions:

- DS8000 machine cold start processes
- DS8870 server failover/failback
- Unexpected Easy Tier restart

1.5.2 HMT functions

The HMT has the following major functions:

- Keep the paired internal DS8870 servers synchronized with the heat maps and copy and apply the ET persistent data on both DS8870 internal storage servers. This is a DS8870 internal aspect.
- Transfer the heat map by an external HMTU interface (which is installed in a management computer) from the primary DS8870 system to the secondary and tertiary.

These basic operations are shown in 1.3, “Easy Tier evolution” on page 4, which highlights the transfer of the heat map data that occurs through the out-of-band IP connection by using the HMTU and the process of saving the heat map on the DS8870 internal servers.

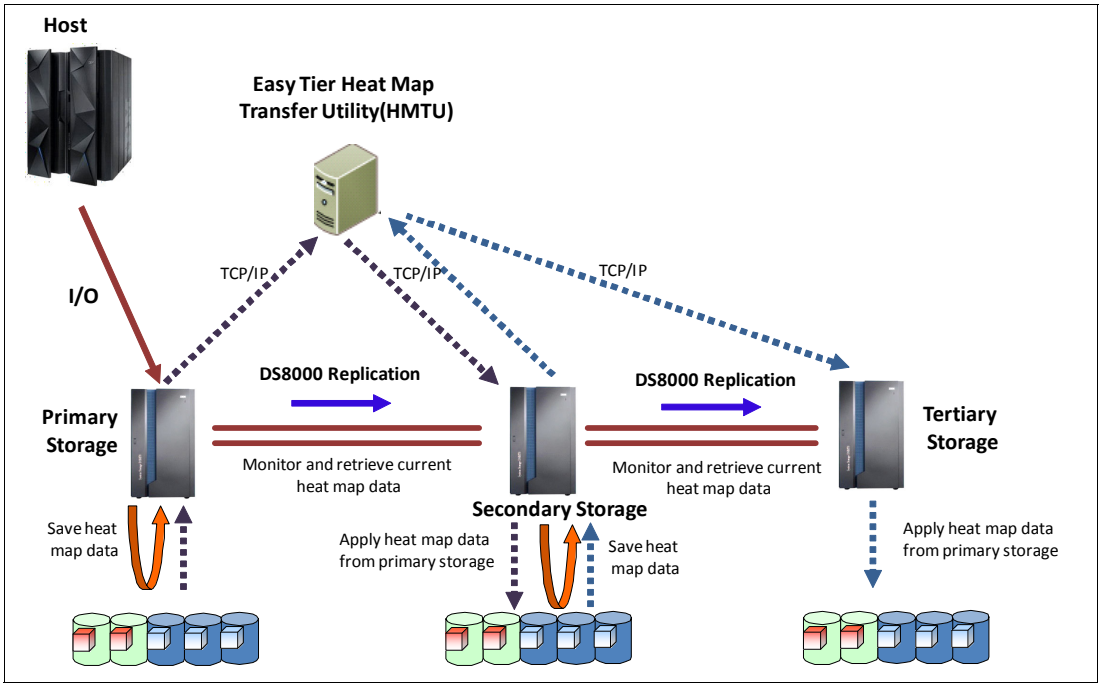

Figure 1-3 Flow of heat map data

The HMTU is installed on a separate management server and can work in the following ways:

- As a stand-alone server (Windows or Linux)
- Integrated with IBM Tivoli Storage Productivity Center for Replication

The part of HMTU that is running on a management computer collects the Easy Tier heat map for volumes in a Copy Services relationship from the primary storage and transfers it every 12 hours to the secondary storage.

Note: Currently, the HMTU does not support replicating the tier assignment instructions of the Easy Tier Application from primary to secondary or tertiary storage systems. To reflect the same tier assignment on remote storage systems, issue the same tier assignment commands on the secondary or tertiary storage system.

Having these statistics loaded on the secondary or tertiary site, Easy Tier creates and implements a migration plan on the extent level to provide the similar extent placement.

Tip: HMT is part of Easy Tier feature starting with LMC 7.7.50.xx.xx. Easy Tier is a no-charge feature of the IBM System Storage DS8870. However, as with any other DS8000 licensed function, the Easy Tier licensed function first must be ordered from IBM. The necessary Easy Tier activation codes then can be obtained from the following IBM Disk Storage Feature Activation (DSFA) website:

http://www.ibm.com/storage/dsfa

These codes are then applied by using the respective DS command-line interface or GUI command. For more information about how to obtain and activate DS8000 license keys, see Chapter 10, “IBM System Storage DS8000 features and license keys”, in *IBM DS8870 Architecture and Implementation*, SG24-8085.

2

IBM Easy Tier Heat Map Transfer architecture and design

This chapter provides more information about Easy Tier Heat Map Transfer (HMT) and the Easy Tier Heat Map Transfer Utility (HMTU).

This chapter includes the following topics:

- Architecture and design
- Considerations for HMTU implementation

2.1 Architecture and design

The Easy Tier HMT capability consists of the following functional components:

- The first component is integrated with Easy Tier and runs on the DS8870 internal servers where Easy Tier saves its persistent data, including a heat map. The data is kept in a repository on the DS8870 internal CPC servers. The saved data and heat map can be retrieved by Easy Tier in cases such as cold starts and Easy Tier restarts. This component is the HMT function.
- The second component is the HMTU, which installs on a separate management computer and interacts with the HMT function to collect and transfer heat map data to the secondary DS8870 site as part of the Copy Services relationship.

The HMTU component consists of two applications: the HMTU daemon and the HMTU interface.

The Easy Tier HMTU now supports cascading Peer-to-Peer Remote Copy (PPRC) configurations, as shown in Figure 2-1. This figure shows the HMT functions and its components.

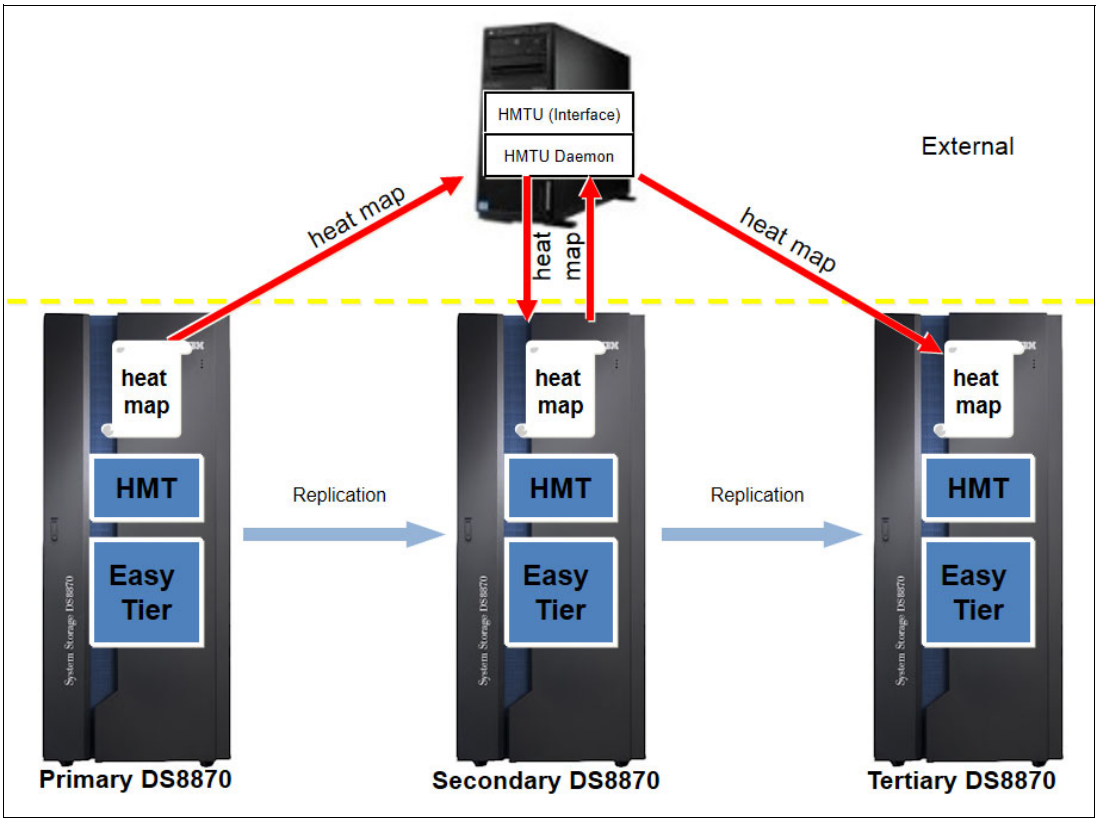

Figure 2-1 HMTU Internal and external layers

2.1.1 HMT function subcomponents

The HMT function is implemented in the DS8870 microcode and consists of the following subcomponents:

- Data persistency on the DS8870 server

  Easy Tier can take a snapshot of all of its in-memory data (including a heat map) and save it into a local repository. Therefore, Easy Tier can load the data back to memory from the previously mentioned structure during recovery thus reestablishing the status at snapshot time.

- Data persistency across the DS8870 servers

  After a snapshot is taken, it is replicated asynchronously across the DS8870 internal servers by using the HMT interface.

- Data transfer to the remote site in the DS8870 Copy Services relationship

  The snapshot (heat map) is transported to all remote systems in a Copy Services relationship by using the HMT proprietary interface.

- The Easy Tier Event Manager handles the recovery actions for all Easy Tier internal functions during a system state change

  The event manager listens for DS8870 system events to detect any system state change (such as failover or failback) and starts the mechanisms to save the Easy Tier persistent data (heat map). It then recovers on the failed back DS8870 server. The same process applies to Easy Tier restarts.

In Figure 2-2 you can see the logical subcomponents and their interactions. They are responsible for running many internal tasks that create, load, and apply the heat map. They also provide the access interface to the HMTU that is installed on external server that collects and transfers the heat map to the secondary DS8870.

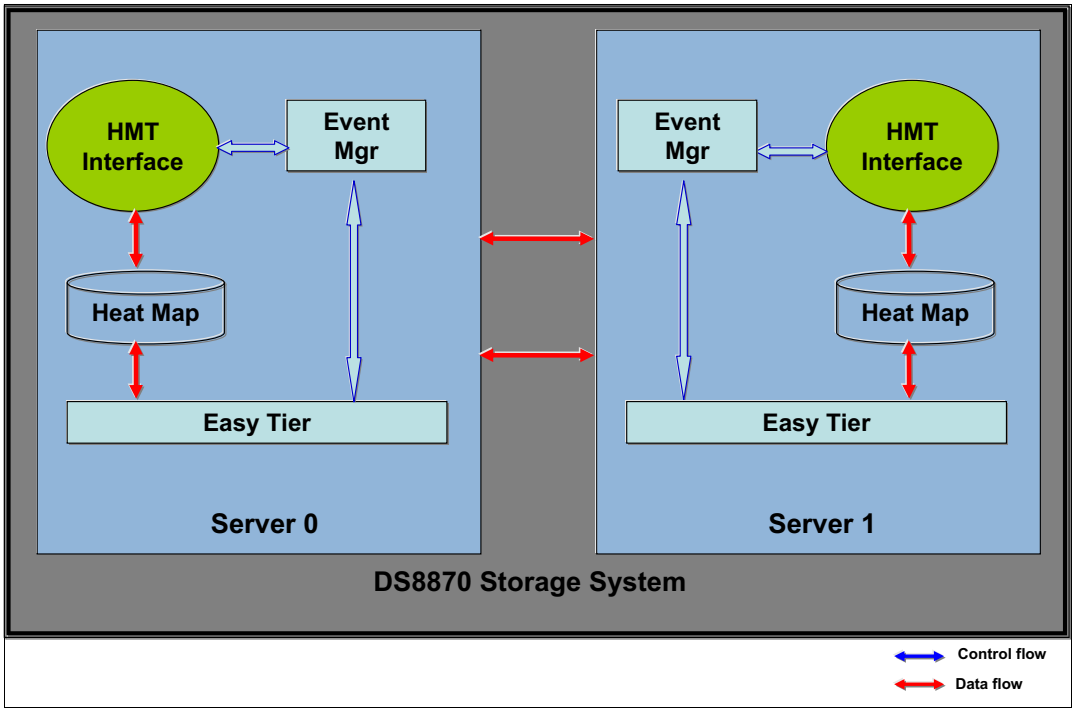

Figure 2-2 Easy Tier functions and relationships

Easy Tier and HMT operational considerations

The following considerations apply to the Easy Tier and HMT operations:

- Saving snapshots of Easy Tier persistent data (heat maps) can take some time because the save operation is I/O intensive and depends on the data size.
- If a DS8870 internal server failure occurs while a heat map snapshot is saved to the local disk, the snapshot data is lost and the data is recoverable based only on the most recent successfully completed snapshot. During the restart, the incomplete snapshot (heat map) is discarded.
- If a DS8870 server failure happens during the snapshot data transfer to the peer server, the data is lost at the peer server and it is recoverable only from the local server. On the peer server, the data is restorable only from the previous snapshot, if taken.

2.1.2 The HMTU design and functions

The HMTU architecture works in the following three layer structure:

- Easy Tier with HMT to manage the placement and statistics gathering for all client data inside the DS8870.
- Copy Services to transport and keep the client data that is replicated on both sites.
- The HMTU to synchronize primary and secondary sites. This process includes the following major steps:

  a. Load storage system configuration information

     The storage system configuration can be acquired by loading it from a profile, which defines the connection information that is monitored by the HMTU, or by calling the appropriate HMTU interface at run time.

  b. Pull learning data from the source storage system

     For each Copy Services relationship, the HMTU daemon generates the volume list within the relationship on the source storage system according to the relationship configuration.

  c. Apply source learning data on target storage system

     For each Copy Services relationship, the HMTU generates the source-target volume mapping list based on these relationships according to the relationship configuration after learning data was pulled from the source storage system. It then sends this file to the target storage system, and Easy Tier applies it on the target.

  d. Record the learning data transfer results

     When one learning data transfer completes successfully or not, the result is recorded in the memory and (persistently) into a file. The outside application can then track the learning data transfer result.

2.1.3 Topology

The HMTU provides the flexibility to support the following types of Copy Services relationships:

- Two sites with multiple relationship at the same source and target DS8870.
- Two sites with multiple relationship starting with one source for multiple target DS8870.
- Multiple sources and target DS8870 combinations.

The HMTU application on the server consists of the following modules:

- The HMTU daemon, which is responsible for interacting directly with the DS8870 and ET.
- The HMTU interface, which is responsible for providing a common way to configure the information of DS8870 systems and presenting the Copy Services relationships and the transfer status.

HMTU daemon

The HTMU daemon is a built-in component of Tivoli Storage Productivity Center for Replication and GDPS. It also can be installed on a dedicated Windows or Linux host.

At the time of data transfer, the HMT daemon automatically detects the recent status of the Copy Services relationship. If the status is “suspend” (for example, because of failover), it ignores the data transfer for this relationship. If the status changes to duplex or copy pending (for example, because of failback), it restarts the transfer for this relationship.

From the server, the HTMU daemon accesses the primary, secondary, and if present, the tertiary storage sites by using an out-of-band IP connection. The IBM Enterprise Storage Server® Network Interface server (ESSNI) is responsible for providing access for and interaction with the HMTU and Easy Tier on DS8870 systems. The HMTU daemon collects the heat map data from the primary DS8870 and then transfers this data to secondary DS8870. Figure 2-3 shows how the HMTU daemon collects and transfers information over the Copy Services relationships.

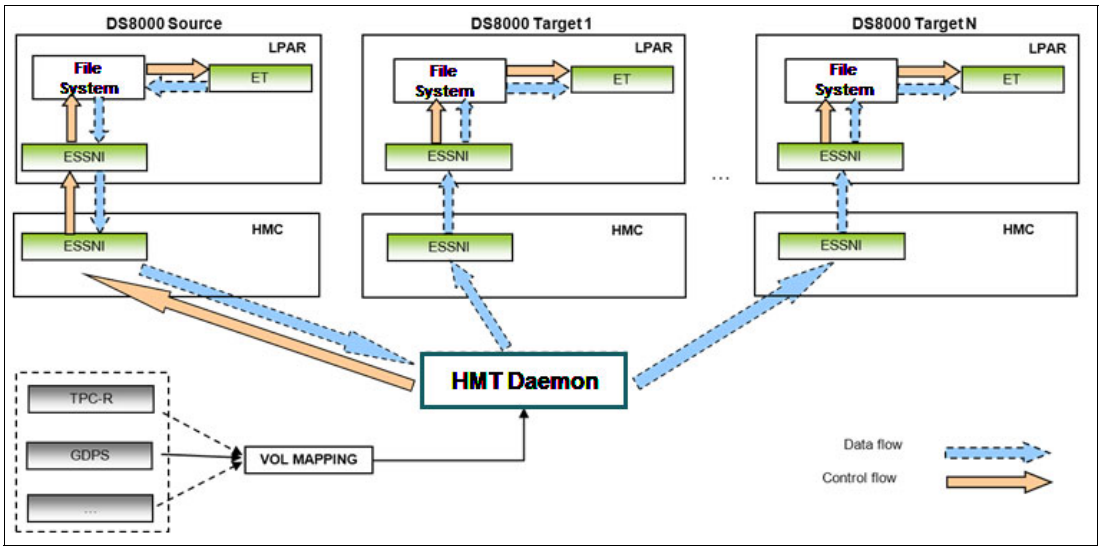

Figure 2-3 Topology flowchart

To manage the learning data transfers in Copy Services environments, the HMT daemon uses the following information:

- Storage system connection configuration, which includes the IP address of primary HMC (and secondary in a dual HMC environment), user name (the user must have the access authority of Copy Services Operator group at least), and the password to log in to the HMC.
- Copy Services relationship and volume mapping configuration. For each Copy Services relationship, this information includes the storage facility ID (which uniquely identifies one storage system) of the primary and the secondary/remote storage system. With these primary and secondary/remote DS8870 systems configured, the HMTU collects the volume mapping information.

Note: Easy Tier HMT supports Metro Mirror, Global Copy, Global Mirror, or Metro Global Mirror.

Heat Map Transfer Utility

The HMTU interface provides the access functions to configure the information about the DS8870 storage system connection, collects the Copy Services relationship, starts and stops the HMT daemon, and queries the data transfer results of each Copy Services relationship while it is monitored by the HMT daemon.

Deployment possibilities

Currently, HMTU is available in the following formats:

- Stand-alone application

  As a stand-alone application, HMTU can be installed in a Windows or Linux operating system. The application is composed of two parts: the HMTU daemon and the HMTU interface. The HMT daemon runs as a background service and it detects the Copy Services relationships automatically through the ESSNI. The HMTU interface is used by the storage administrator to configure the storage system connection information, start and stop the HMTU daemon, and query the data transfer result.

- Integrated with Tivoli Storage Productivity Center for Replication V5.2.x or higher, as shown in Figure 2-4.

  The HMTU daemon is installed as part of the Tivoli Storage Productivity Center software and runs as a background thread. It is configured and controlled through the Tivoli Storage Productivity Center for Replication user interface. It provides the following functions:

  – Storage system connection configuration
  – Controls to start and stop the HMT daemon
  – Possibility to query the HMT daemon data transfer results

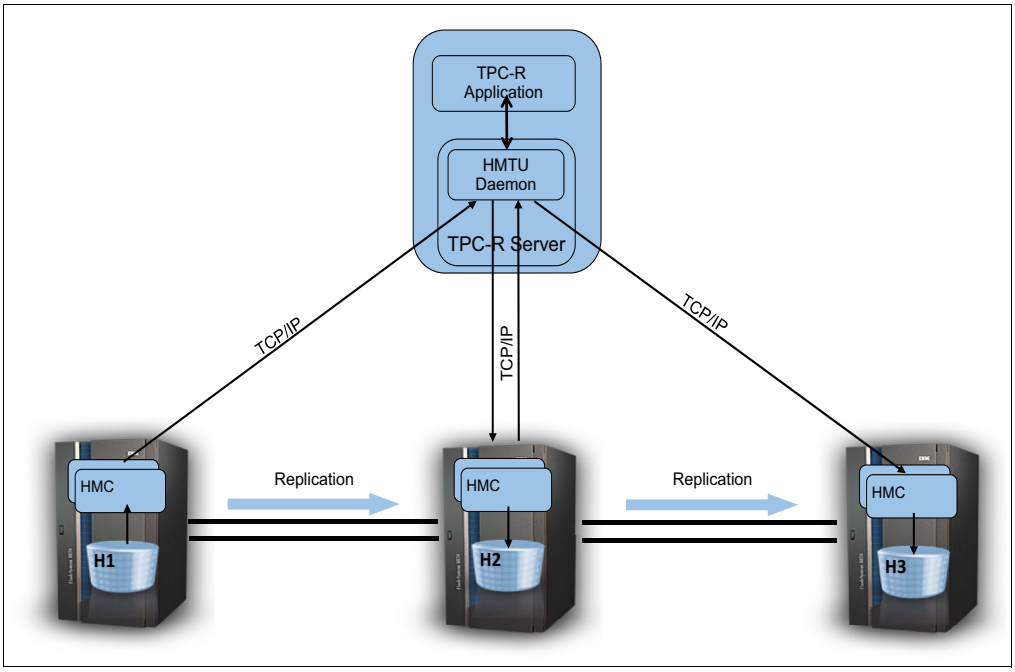

Figure 2-4 HMTU and Tivoli Storage Productivity Center for Replication integration

Each HMTU daemon manages the learning data transfer for one Copy Services pair. All of these HMTU daemon instances are identified by the specific working directory, which contains the configuration files.

This working directory can be established through the script or command mode of the stand-alone HMTU. Figure 2-5 shows how to implement the HMTU by using separate HMTU daemons to work across different Copy Services relationships.

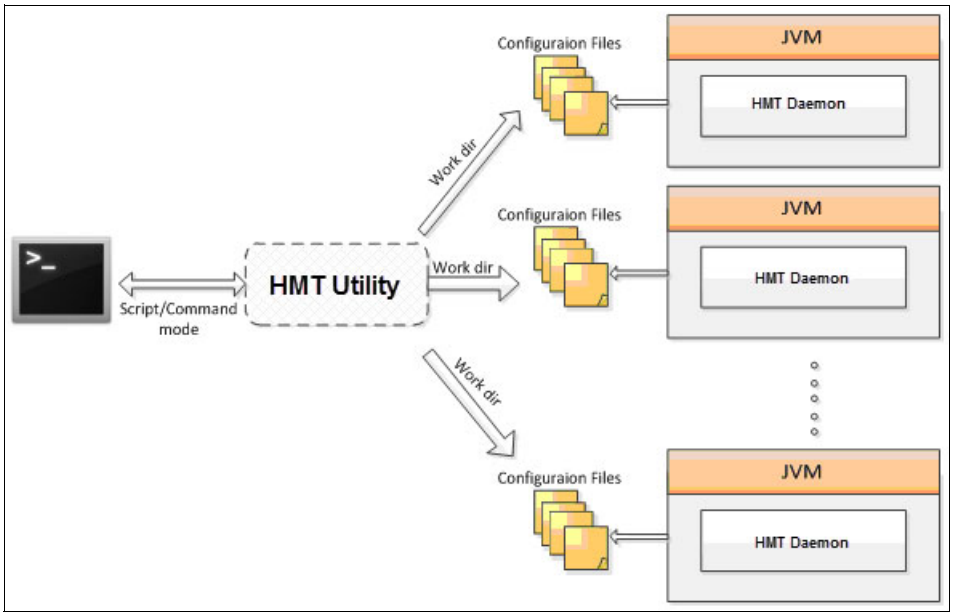

Figure 2-5 HMT daemon segregation

2.2 Considerations for HMTU implementation

To optimize the usage of the HMTU, the following aspects need special attention:

- DS8870 hardware configuration

  The goal of the HMT is to raise the secondary and tertiary DS8870 systems to the same system performance level that is observed at the primary site. Therefore, it is preferable that the secondary and tertiary storage systems have the same physical configuration as the primary one. If so, Easy Tier can use the same placement for volume extents in the respective corresponding site.

  Without the same physical configuration, a secondary and tertiary storage site can replicate the heat map data, but it is unlikely to able to replicate the performance characteristics of the primary storage system.

  Therefore, in cases where the DS8870 primary and remote systems are not using the same hardware configuration, the HMTU feature might deliver less advantage.

- Copy Services Features

  The HMTU supports Metro Mirror, Global Copy, Global Mirror, or Metro Global Mirror.

- Transfer time interval

  By default, the automatic heat map data transfer is processed every 12 hours. Because of the out-band transfer impact and bandwidth limitation, the frequency for heat map transfer over Copy Services is low.

The easy Tier cycle runs every 24 hours, which implies that the heat map that is generated observes the same period. The HMT uses 12 hours as a default interval, thus ensuring that the same map is transferred twice within in a day to the secondary/remote site.

Important: The HMTU transfers the heat map that is associated with each configured DS8870 relationship sequentially.

- The following general implementation rules apply:
  - In interactive mode, the HMTU accepts to start only one HMT daemon instance.
  - The stand-alone HMTU that uses the interactive mode does not allow the user to specify the work directory for different Copy Services relationships. The default work directory that is used is the HMTU directory that is established during the installation process.
  - The maximum of interconnected primary and secondary storage systems with copy services relationships under the same HMT Daemon management is 30.
  - On more complex Copy Services deployments that involve bidirectional relationships and volume mappings, any single HMTU can manage a maximum of eight DS8870s.
  - The HMTU management computer must have a network connection with all the DS8870 storage systems under HMTU daemon management.
  - It is not preferable the use of different HMT daemons to manage the same DS8870 storage system. For example, it is not a preferred practice to use the stand-alone HMTU management computer implementation and another integration with a potential Tivoli Storage Productivity Center for Replication HMTU to manage the same DS8870 system relationship.
  - The primary and remote DS8870 storage systems must have the ET and the HMT parameters enabled to collect statistics. The ET activation code also must be installed.

3

IBM Easy Tier Heat Map Transfer Utility installation and usage

This chapter describes the installation and usage of the Heat Map Transfer Utility (HMTU) and includes the following topics:

- Installation and requirements
- HMTU configuration process
- Command reference

3.1 Installation and requirements

This section describes the hardware, software, and networking requirements and installation process for the HMTU.

3.1.1 Pre-installation requirements

The following basic requirements must be met to prepare the environment for HMTU:

- The primary and secondary/remote DS8870 systems must be at LMC 7.7.50.xx.xx or higher.
- Easy Tier feature activation code is installed on all DS8870 systems.
- The hardware configuration for remote sites is similar to the primary site to achieve the optimal results.

To enable HTMU, the HMT control switch on the storage system must be enabled (**-ethmtmode enabled**). This is the default mode.

Use the DS CLI command **chsi** to enable or disable heat map transfer control, as shown in Example 3-1.

chsi -ethmtmode enable | disable <Storage ID>

Example 3-1 Enable the HMT on a DS8870 system

```
dscli> showsi
Name             Oscar
desc             -
ID               IBM.2107-75xxxx1
Storage Unit     IBM.2107-75xxxx0
Model            961
WWNN             50050763XXXXXXXX
Signature        be5b-265b-xxxx-xxxx
State            Online
ESSNet           Enabled
Volume Group     V0
os400Serial      5CA
NVS Memory       16.0 GB
Cache Memory     480.5 GB
Processor Memory 509.6 GB
MTS              IBM.2421-75xxxx0
numegsupported   1
ETAutoMode       none
ETMonitor        none
IOPMmode         Disabled
ETCCMode         Enabled
ETHMTMode        Disabled
dscli> chsi -ethmtmode enable IBM.2107-75xxxx1
CMUC00042I chsi: Storage image IBM.2107-75xxxx1 successfully modified.
dscli> showsi
Name             Oscar
desc             -
ID               IBM.2107-75xxxx1
Storage Unit     IBM.2107-75xxxx0
Model            961
WWNN             50050763XXXXXXXX
Signature        be5b-265b-xxxx-xxxx
```

```
State            Online
ESSNet           Enabled
Volume Group     V0
os400Serial      5CA
NVS Memory       16.0 GB
Cache Memory     480.5 GB
Processor Memory 509.6 GB
MTS              IBM.2421-75xxxx0
numegsupported   1
ETAutoMode       none
ETMonitor        none
IOPMmode         Disabled
ETCCMode         Enabled
ETHMTMode        Enabled
```

The scope of Easy Tier HMT is determined by the following Easy Tier automatic mode settings:

- To automatically transfer the heat map data and manage data placement for logical volumes in multi-tiered pools, use the Easy Tier control default settings (**-etmonitor automode, -etautomode tiered**).
- To automatically transfer the heat map data and manage data placement for logical volumes in all pools, use the Easy Tier control settings (**-etmonitor all, -etautomode all**), as shown in Example 3-2.

Example 3-2 Change and verify ET mode example

```
dscli> chsi -etmonitor all -etautomode all IBM.2107-75xxxx1
CMUC00042I chsi: Storage image IBM.2107-75xxxx1 successfully modified.
dscli> showsi
Name             Oscar
desc             -
ID               IBM.2107-75xxxx1
Storage Unit     IBM.2107-75xxxx0
Model            961
WWNN             50050763XXXXXXXX
Signature        be5b-265b-xxxx-xxxx
State            Online
ESSNet           Enabled
Volume Group     V0
os400Serial      5CA
NVS Memory       16.0 GB
Cache Memory     480.5 GB
Processor Memory 509.6 GB
MTS              IBM.2421-75xxxx0
numegsupported   1
ETAutoMode       all
ETMonitor        all
IOPMmode         Disabled
ETCCMode         Enabled
ETHMTMode        Enabled
```

Important: If you currently do not have Easy Tier activated and want to run an Easy Tier evaluation on the primary and remote storage systems, you can set the Easy Tier control on the primary and remote storage systems to monitor only (**-etmonitor all**). The HMTU then automatically transfers the heat map data and uses this data to generate an Easy Tier report without changing the data layout on either of the storage systems.

3.1.2 Hardware and software support

This section describes the hardware, software, and network requirements for HMTU.

Supported hardware

The Easy Tier HMTU can be installed on the X86 or X86_64 platforms and does not require many hardware resources (processors and memory). HMTU can be also installed on virtual machines.

Supported operating systems

The HMTU can be installed on the following operating systems:

- Windows Platforms:
  - Microsoft Windows XP (X86)
  - Microsoft Windows 7 (X86, X86_64)
  - Microsoft Windows Server 2003 (X86_64)
  - Microsoft Windows Server 2008 (X86_64)
- Linux Platforms
  - Red Hat Enterprise Linux (RHEL) AS release 4 (X86, X86_64) or higher
  - SUSE Enterprise Linux 11 (X86) or higher

Important: For integration with Tivoli Productivity Center for Replication software, use the most recent version of supported operating systems and the Tivoli Productivity Center for Replication software.

Networking requirement

The host for the HMTU must have an IP network connection to every DS8870 storage system that is to be monitored by the HMTU.

3.1.3 HMTU package and internal structure

The HMTU can be delivered as a stand-alone software package or integrated with Tivoli Productive Center for Replication V5.2.x or higher.

The HMT application is also integrated with the Tivoli Storage Productivity Center for Replication as built-in package. HMTU is installed together with Tivoli Storage Productivity Center for Replication.

The HMTU package can be downloaded from the IBM Support Fix Central website, found at:

`http://www.ibm.com/support/fixcentral/`

When you are at the website, use the product selection list that is shown in Figure 3-1 on page 23 to find the HTMU package.

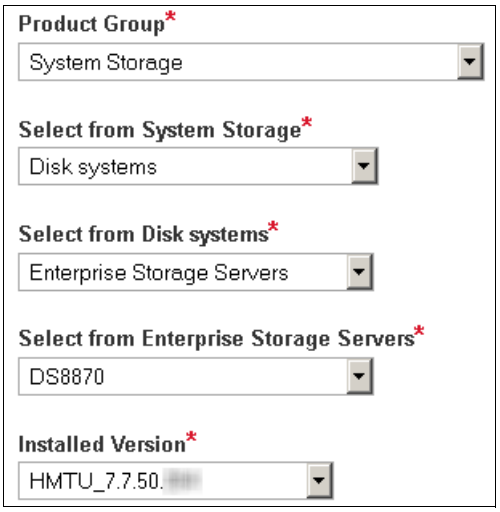

Figure 3-1 HMTU Fix Central path

The HMTU installation package includes the following information:

- Readme files for each supported platform
- The installation binary files
- IBM JRE binary installation binary files
- Readme file for installation
- License files

The installers for the supported host systems are in the following directories:

- Linux (RedHat, SUSE):

  `IMAGES/HeatMapTransferUtility/Disk1/InstData/Linux/VM/install.bin`

- Windows:

  `IMAGES\HeatMapTransferUtility\Disk1\InstData\Windows\VM\install.exe`

The installation process creates the following structures to accommodate the application:

- Windows HMTU binary files, as shown in Example 3-3.

Example 3-3 HMTU Windows binary folder content

```
C:\Program Files (x86)\IBM\hmtu>dir
Directory of C:\Program Files (x86)\IBM\hmtu
05/05/2015  08:39 AM    <DIR>          .
05/05/2015  08:39 AM    <DIR>          ..
04/29/2015  03:59 PM           773,870 EasyTier_HeatMapTransfer.pdf
04/29/2015  03:59 PM           111,503 hmtdaemon.jar
04/29/2015  03:59 PM               214 hmtu.bat
04/29/2015  03:59 PM             8,192 hmtu.exe
04/29/2015  03:59 PM            98,265 hmtutility.jar
05/05/2015  08:39 AM            11,578 IBM_Easy_Tier_Heat_Map_Transfer_Utility_InstallLog.log
05/05/2015  08:39 AM    <DIR>          jre
05/05/2015  08:39 AM    <DIR>          lib
05/05/2015  08:39 AM    <DIR>          license
04/29/2015  03:59 PM             7,755 README_WINDOWS.txt
05/05/2015  08:39 AM    <DIR>          Uninstall_hmtu
```

- Linux HMTU binary files, as shown in Example 3-4.

Example 3-4 HMTU Linux binary folder

```
[root@hmtuserver /opt/IBM/hmtu]$ ls -l
-rwxrwxr-x. 1 root root 773870 Apr 29 15:59 EasyTier_HeatMapTransfer.pdf
-rwxrwxr-x. 1 root root 111503 Apr 29 15:59 hmtdaemon.jar
-rwxrwxr-x. 1 root root    254 Apr 29 15:59 hmtu.sh
-rwxrwxr-x. 1 root root  98265 Apr 29 15:59 hmtutility.jar
-rw-rw-r--. 1 root root   6544 May  4 23:05 IBM_Easy_Tier_Heat_Map_Transfer_Utility_InstallLog.log
drwxr-xr-x. 5 1000 1000   4096 Mar 21  2012 jre
drwxrwxr-x. 2 root root   4096 May  4 23:05 lib
drwxrwxr-x. 2 root root   4096 May  4 23:05 license
-rwxrwxr-x. 1 root root   7785 Apr 29 15:59 README_LINUX.txt
drwxrwxr-x. 2 root root   4096 May  4 23:05 Uninstall_hmtu
```

3.1.4 Installation process and modes

The Easy Tier HMTU can be installed through the graphical, console, or unattended (silent) mode.

From the command-line interface, use the **-i** flag to specify a user interface mode for the installation, as shown in the following example:

```
-i [graphical | console | silent]
```

The default installation mode is graphical. The mode does not need to be specified unless a different mode than default mode is required.

Graphical mode

To install HMTU by using the graphical mode, start the setup file for your operating system that is in the ISO file that you downloaded. You can find the platform directory that contains the setup file for your operating system in the `IMAGES\HeatMapTransferUtility\Disk1\InstData` directory. The graphical mode uses the following process:

1. Select the setup file for your operating system: **install.exe** for Windows or **install.bin** for Linux and start it by double-clicking the Windows server or running by a shell on the Linux operating system.
2. Start the wizard, read the license statement, accept the IBM license terms to have this application installed on your server and click **Next**.
3. Choose the installation type **Typical** to include all components for HMTU (which is a default option) (Figure 3-2 on page 25). You can select **Minimal** for the essential binary files or **Customized** to select which part (product or documentation) of the package to install. Click **Next**.

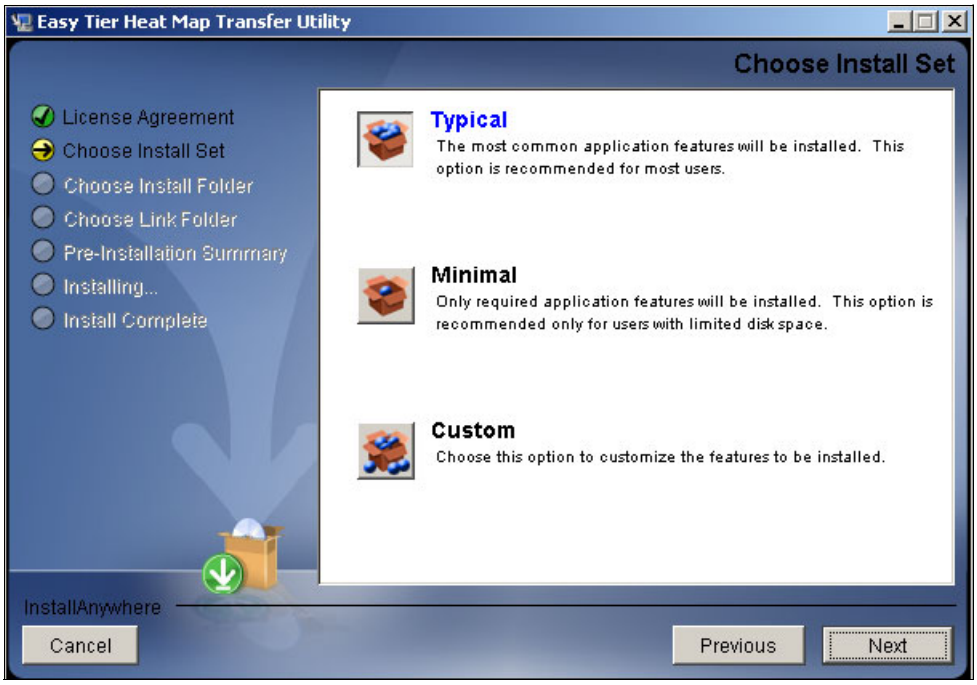

Figure 3-2 HMTU installation - Installation type

4. Set the installation folder to install the application and click **Next**.

   The following default values are used:

   – For Windows platforms, use `C:\Program File (x86)\IBM\hmtu` (Figure 3-3).

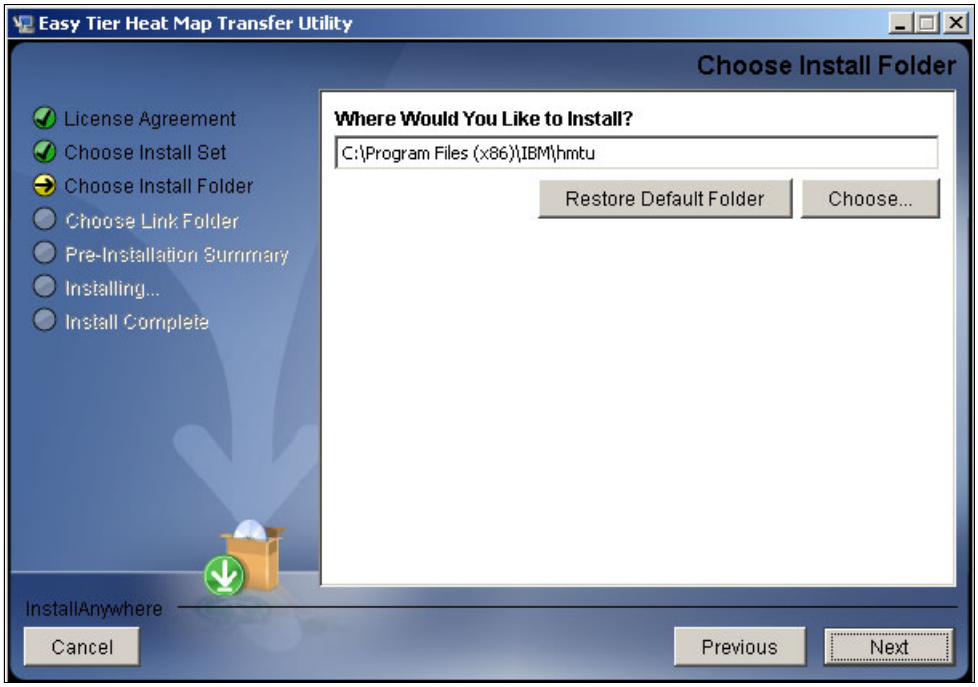

Figure 3-3 HMTU installation - Windows installation folder

– For Linux platforms, use `/opt/IBM/hmtu` (Figure 3-4).

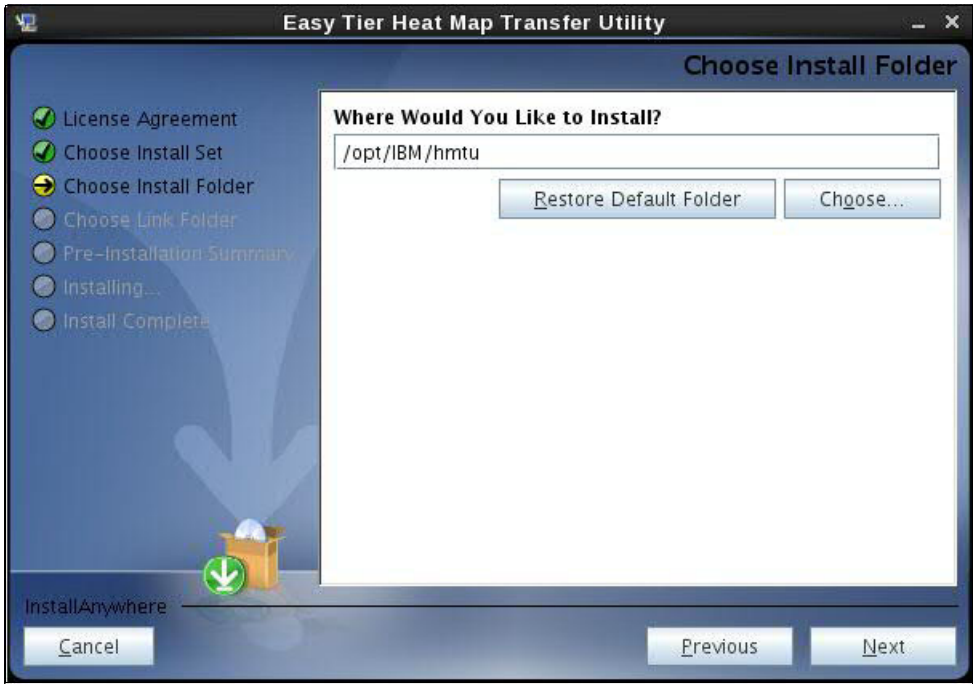

Figure 3-4 HMTU installation - Linux installation folder.png

5. Select the directory where the links, shortcuts, and icons are defined for the HMTU application and click **Next**.

   – For Windows platforms, use `hmtu` (Figure 3-5).

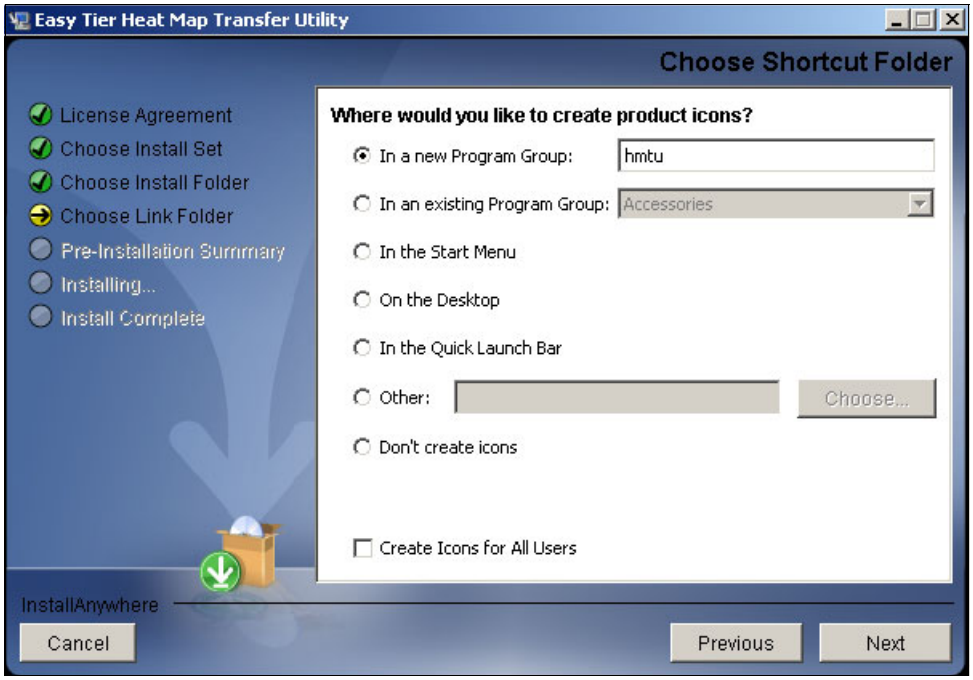

Figure 3-5 HMTU installation - Windows links and shortcut selection

– For Linux platforms, select **In your home folder** (Figure 3-6 on page 27).

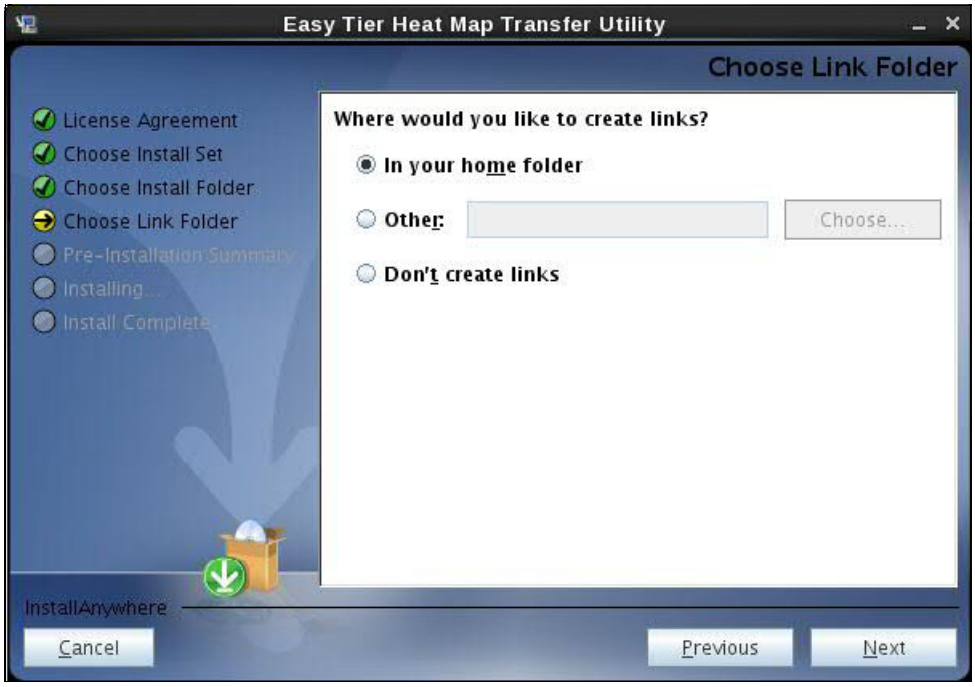

Figure 3-6 HMTU installation - Linux links and shortcut selection

6. Check the required selections and space that is available for installation and click **Install** to install all products.
   - For the Windows platforms summary, see Figure 3-7.

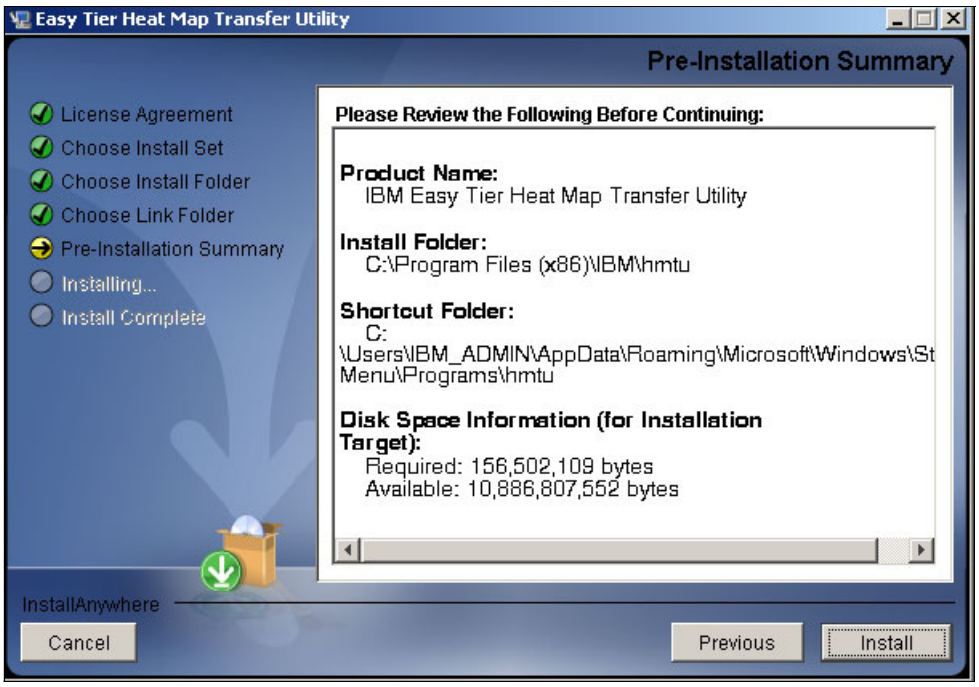

Figure 3-7 HMTU installation - Windows setup summary

– For the Linux platforms summary, see Figure 3-8.

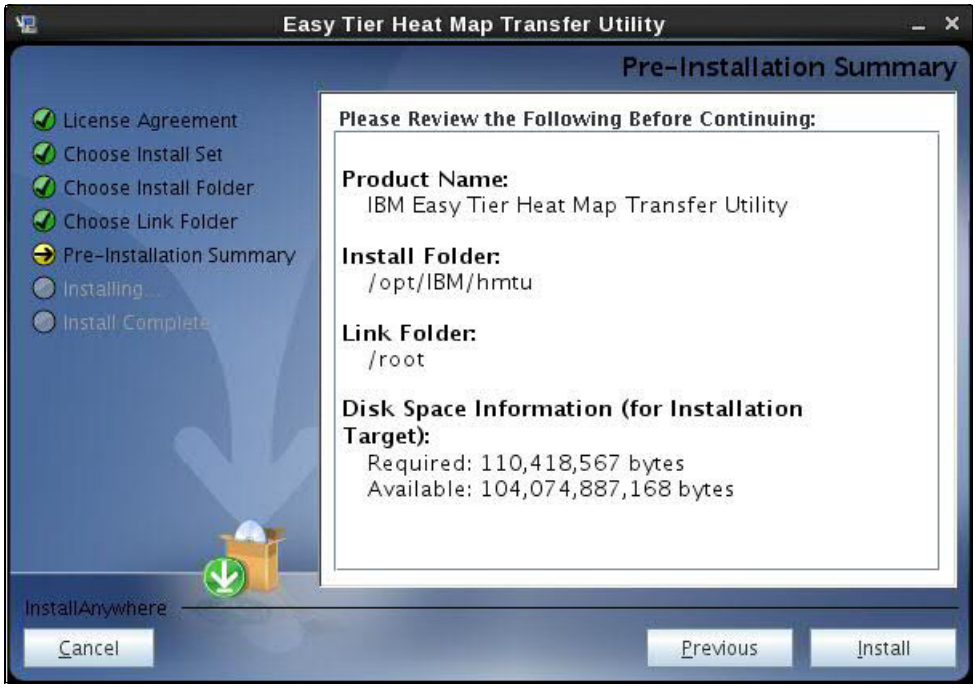

Figure 3-8 HMTU installation - Linux setup summary

Wait for the installation process to finish, and then click **Done** to close the window that opens at the end of the installation.

Console mode

The console mode most often is used for installations on the Linux operating system without a graphical display (X Window System). The same process can be used from a command prompt on a Windows system.

From the command line, use the **`-i console`** flag to specify a user interface mode for the command line, as shown in Example 3-5 (for Linux) and Example 3-6 on page 30 (for Windows). Complete the following steps (in bold characters) to install HMTU by using the console mode.

Example 3-5 Installation procedure in the console mode on Linux

```
[root@hmtuserver /]# cd /tmp/cd_image/IMAGES/HeatMapTransferUtility/Disk1/InstData/Linux/VM
[root@hmtuserver VM]# ./install.bin -i console
Preparing to install...
Extracting the JRE from the installer archive...
Unpacking the JRE...
Extracting the installation resources from the installer archive...
Configuring the installer for this system's environment...
Launching installer...

Graphical installers are not supported by the VM. The console mode will be used instead...
Preparing CONSOLE Mode Installation...
===============================================================================
IBM Easy Tier Heat Map Transfer Utility          (created with InstallAnywhere)
-------------------------------------------------------------------------------
===============================================================================
    International License Agreement for Non-Warranted Programs
```

```
    Part 1 - General Terms

    BY DOWNLOADING, INSTALLING, COPYING, ACCESSING, CLICKING ON AN
    "ACCEPT" BUTTON, OR OTHERWISE USING THE PROGRAM, LICENSEE AGREES TO
    THE TERMS OF THIS AGREEMENT. IF YOU ARE ACCEPTING THESE TERMS ON
    BEHALF OF LICENSEE, YOU REPRESENT AND WARRANT THAT YOU HAVE FULL
    AUTHORITY TO BIND LICENSEE TO THESE TERMS. IF YOU DO NOT AGREE TO
    THESE TERMS,

    * DO NOT DOWNLOAD, INSTALL, COPY, ACCESS, CLICK ON AN "ACCEPT" BUTTON,
    OR USE THE PROGRAM; AND

    * PROMPTLY RETURN THE UNUSED MEDIA AND DOCUMENTATION TO THE PARTY FROM
    WHOM IT WAS OBTAINED FOR A REFUND OF THE AMOUNT PAID. IF THE PROGRAM
    WAS DOWNLOADED, DESTROY ALL COPIES OF THE PROGRAM.

    1. Definitions

Press Enter to continue viewing the license agreement, or enter "1" to
   accept the agreement, "2" to decline it, "3" to print it, "4" to read
   non-IBM terms, or "99" to go back to the previous screen.: 1
===============================================================================
Choose Install Set
------------------
Please choose the Install Set to be installed by this installer.
  ->1- Typical
    2- Minimal
    3- Customize...
ENTER THE NUMBER FOR THE INSTALL SET, OR PRESS <ENTER> TO ACCEPT THE DEFAULT
   :1
===============================================================================
Choose Install Folder
---------------------
Where would you like to install?
  Default Install Folder: /opt/IBM/hmtu
ENTER AN ABSOLUTE PATH, OR PRESS <ENTER> TO ACCEPT THE DEFAULT
      :
===============================================================================
Choose Link Location
--------------------
Where would you like to create links?
  ->1- Default: /root
    2- In your home folder
    3- Choose another location...
    4- Don't create links
ENTER THE NUMBER OF AN OPTION ABOVE, OR PRESS <ENTER> TO ACCEPT THE DEFAULT
      :1
===============================================================================
Pre-Installation Summary
------------------------
Please Review the Following Before Continuing:
Product Name:
    IBM Easy Tier Heat Map Transfer Utility
Install Folder:
    /opt/IBM/hmtu
Link Folder:
    /root
Disk Space Information (for Installation Target):
    Required:  110,418,567 bytes
    Available: 105,142,673,408 bytes
```

```
PRESS <ENTER> TO CONTINUE:
===============================================================================
Ready To Install
----------------
InstallAnywhere is now ready to install IBM Easy Tier Heat Map Transfer Utility
onto your system at the following location:
   /opt/IBM/hmtu
PRESS <ENTER> TO INSTALL:
===============================================================================
Installing...
-------------
 [==================|==================|==================|==================]
 [------------------|------------------|------------------|------------------]
===============================================================================
Installation Complete
---------------------
Congratulations. IBM Easy Tier Heat Map Transfer Utility has been successfully
installed to:
   /opt/IBM/hmtu
PRESS <ENTER> TO EXIT THE INSTALLER:
```

Example 3-6 Installation procedure in the console mode on Windows

```
C:\>
C:\>cd temp\cd_image\IMAGES\HeatMapTransferUtility\Disk1\InstData\Windows\VM
C:\VM> install.exe -i console
Preparing CONSOLE Mode Installation...
===============================================================================
IBM Easy Tier Heat Map Transfer Utility          (created with InstallAnywhere)
-------------------------------------------------------------------------------

===============================================================================
    International License Agreement for Non-Warranted Programs

    Part 1 - General Terms

    BY DOWNLOADING, INSTALLING, COPYING, ACCESSING, CLICKING ON AN
    "ACCEPT" BUTTON, OR OTHERWISE USING THE PROGRAM, LICENSEE AGREES TO
    THE TERMS OF THIS AGREEMENT. IF YOU ARE ACCEPTING THESE TERMS ON
    BEHALF OF LICENSEE, YOU REPRESENT AND WARRANT THAT YOU HAVE FULL
    AUTHORITY TO BIND LICENSEE TO THESE TERMS. IF YOU DO NOT AGREE TO
    THESE TERMS,

    * DO NOT DOWNLOAD, INSTALL, COPY, ACCESS, CLICK ON AN "ACCEPT" BUTTON,
    OR USE THE PROGRAM; AND

    * PROMPTLY RETURN THE UNUSED MEDIA AND DOCUMENTATION TO THE PARTY FROM
    WHOM IT WAS OBTAINED FOR A REFUND OF THE AMOUNT PAID. IF THE PROGRAM
    WAS DOWNLOADED, DESTROY ALL COPIES OF THE PROGRAM.

    1. Definitions

Press Enter to continue viewing the license agreement, or enter "1" to
   accept the agreement, "2" to decline it, "3" to print it, "4" to read
   non-IBM terms, or "99" to go back to the previous screen.: 1
===============================================================================
Choose Install Set
------------------
Please choose the Install Set to be installed by this installer.
  ->1- Typical
```

```
    2- Minimal
    3- Customize...
ENTER THE NUMBER FOR THE INSTALL SET, OR PRESS <ENTER> TO ACCEPT THE DEFAULT
   :1
===============================================================================
Choose Install Folder
---------------------
Where would you like to install?
  Default Install Folder: C:\Program Files (x86)\IBM\hmtu
ENTER AN ABSOLUTE PATH, OR PRESS <ENTER> TO ACCEPT THE DEFAULT
      :
===============================================================================
Choose Link Location
--------------------
Where would you like to create links?
  ->1- Default: C:\Users\IBM_ADMIN\AppData\Roaming\Microsoft\Windows\Start
Menu\Programs\hmtu
    2- In your home folder
    3- Choose another location...
    4- Don't create links
ENTER THE NUMBER OF AN OPTION ABOVE, OR PRESS <ENTER> TO ACCEPT THE DEFAULT
      :
===============================================================================
Pre-Installation Summary
------------------------
Please Review the Following Before Continuing:
Product Name:
    IBM Easy Tier Heat Map Transfer Utility
Install Folder:
    C:\Program Files (x86)\IBM\hmtu
Shortcut Folder:
    C:\Users\IBM_ADMIN\AppData\Roaming\Microsoft\Windows\Start Menu\Programs\hmtu
Disk Space Information (for Installation Target):
    Required:  156,502,109 bytes
    Available: 10,421,567,488 bytes
PRESS <ENTER> TO CONTINUE:
===============================================================================
Ready To Install
----------------
InstallAnywhere is now ready to install IBM Easy Tier Heat Map Transfer Utility
onto your system at the following location:
   C:\Program Files (x86)\IBM\hmtu
PRESS <ENTER> TO INSTALL:
===============================================================================
Installing...
-------------
 [==================|==================|==================|==================]
 [------------------|------------------|------------------|------------------]
===============================================================================
Installation Complete
---------------------
Congratulations. IBM Easy Tier Heat Map Transfer Utility has been successfully
installed to:
   C:\Program Files (x86)\IBM\hmtu
PRESS <ENTER> TO EXIT THE INSTALLER:
```

Silent mode

By using silent mode, you can install the application on Windows or Linux from the command line without prompts or feedback by using the predefined settings that are included in a created configuration file.

Important: Silent mode requires administration rights to ensure access to the installation folders.

Before starting a silent mode installation, you must define a properties file. Depending on the operating system (Linux or Windows), the file has different contents.

The sample `install.properties` file for Linux is shown in Example 3-7.

Example 3-7 Sample install.properties file for Linux

```
# The installation.properties file - for HMTU silent installation on Linux
# Indicate whether the license agreement been accepted
#-----------------------------------------------------
LICENSE_ACCEPTED=TRUE
#Choose Install Folder
#---------------------
USER_INSTALL_DIR=/opt/IBM/hmtu
#Choose Link Location
#--------------------
USER_SHORTCUTS=/root
```

The sample `install.properties` file for Windows is shown in Example 3-8.

Example 3-8 Sample install.properties file for Windows

```
# The installation.properties file - for HMTU silent installation on Windows
# Indicate whether the license agreement been accepted
#-----------------------------------------------------
LICENSE_ACCEPTED=TRUE
#Choose Install Folder
#---------------------
USER_INSTALL_DIR=C:\\Program Files (x86)\\IBM\\hmtu
#Choose Shortcut Folder
#----------------------
USER_SHORTCUTS= C:\\Users\\IBM_ADMIN\\AppData\\Roaming\\Microsoft\\Windows\\Start
Menu\\Programs\\hmtu
```

For Linux, use the installation process that is shown in Example 3-9.

Example 3-9 Installation process in silent mode for Linux

```
[root@hmtuserver /]# cd /tmp/cd_image/IMAGES/HeatMapTransferUtility/Disk1/InstData/Linux/VM
[root@hmtuserver VM]# ./install.bin -i silent -f /root/install.properties
Preparing to install...
Extracting the JRE from the installer archive...
Unpacking the JRE...
Extracting the installation resources from the installer archive...
Configuring the installer for this system's environment...
Launching installer...
Preparing SILENT Mode Installation...
===============================================================================
IBM Easy Tier Heat Map Transfer Utility          (created with InstallAnywhere)
-------------------------------------------------------------------------------
===============================================================================
```

```
Installing...
-------------
 [==================|==================|==================|==================]
 [------------------|------------------|------------------|------------------]
Installation Complete.
```

3.2 HMTU configuration process

This section describes two scenarios with procedures and information about how to configure the application to work correctly by using the CLI or Tivoli Storage Productivity Center for Replication interface.

3.2.1 Configuring the HMTU by using the CLI

This section describes the process that is used to configure the HMTU. Use this process as a guide for initial configuration and for help in understanding the HMTU commands.

To configure the HMTU by using the CLI, complete the following steps:

1. Open the HMTU console by using one of the following methods:
   - Click the HMTU shortcut that is in a graphical installation.
   - Run the `hmtu` file, as shown in Example 3-10.
     - For Windows, use **`C:\Program Files (x86)\IBM\hmtu\hmtu.exe`**.
     - For Linux, use **`/opt/IBM/hmtu/hmtu.sh`**.

Example 3-10 Start the HMTU command interface on the Linux operating system

```
[root@hmtuserver /]# cd /opt/IBM/hmtu
[root@hmtuserver hmtu]# ./hmtu.sh
hmtu>
```

2. Run **`manageserver`** to start the process (daemon) of managing your heat map data automatically, as shown in Example 3-11.

Example 3-11 Start the HMTU server daemon

```
hmtu>manageserver -action start
Date/Time: 2015-05-05 03:01:24 IBM HMTU Version: 7.7.50.267
GUSS00039I The Easy Tier heat map transfer server was started successfully.
GUSS00037W No devices are being monitored by Easy Tier heat map transfer.
Tip: Refer the command lsdev -checkconn to check the status of the storage systems. Issue
the lshmt command to check the data transfer results
```

3. Run **`adddev`** to make your primary and secondary/remote DS8870 systems known to the heat map transfer utility, as shown in Example 3-12.

Example 3-12 Add DS8870 systems to the HMTU

```
hmtu>adddev -dev IBM.2107-75XXX51 -hmc1 ds8870_B.ibm.com  -user admin -passwd ***
Date/Time: 2015-05-05 03:01:42 IBM HMTU Version: 7.7.50.267
GUSS00000I The device IBM.2107-75XXX51 was added successfully.
hmtu>adddev -dev IBM.2107-75XXX31 -hmc1 ds8870_A.ibm.com  -user admin -passwd ***
Date/Time: 2015-05-05 03:02:10 IBM HMTU Version: 7.7.50.267
GUSS00000I The device IBM.2107-75XXX31 was added successfully.
hmtu>adddev -dev IBM.2107-13XXX91 -hmc1 ds8870_C.ibm.com  -user admin -passwd ***
Date/Time: 2015-05-05 03:02:16 IBM HMTU Version: 7.7.50.267
GUSS00000I The device IBM.2107-13XXX91 was added successfully.
```

```
hmtu>lsdev
Date/Time: 2015-05-05 03:02:18 IBM HMTU Version: 7.7.50.267
DevId               HMC1                    HMC2         User             ConnStatus
=============================================================================================
IBM.2107-75XXX51    ds8870_B.ibm.com                     admin            -
IBM.2107-75XXX31    ds8870_A.ibm.com                     admin            -
IBM.2107-13XXX91    ds8870_C.ibm.com                     admin            -
```

Important: The password was intentionally omitted in the example.

4. Check the connection between the HMTU server and DS8870 Systems by running **lsdev -checkconn**, as shown in Example 3-13.

Example 3-13 Check the connection status between the HMTU server and the DS8870

```
hmtu>lsdev -checkconn
Date/Time: 2015-05-05 03:02:59 IBM HMTU Version: 7.7.50.267
evId                HMC1                    HMC2         User             ConnStatus
=============================================================================================
IBM.2107-75XXX51    ds8870_B.ibm.com                     admin            Running
IBM.2107-75XXX31    ds8870_A.ibm.com                     admin            Running
IBM.2107-13XXX91    ds8870_C.ibm.com                     admin            Running
```

5. Run **showserver** to display heat map data server status, as shown in Example 3-14.

Example 3-14 Check the HMTU server status and next transfer cycle

```
hmtu>showserver
Date/Time: 2015-05-05 03:21:57 IBM HMTU Version: 7.7.50.267
ServerStartTime              2015-05-05 03:01:22
ServerRunningStatus          Sleeping
XferInterval(min)            720
NextXferStartTime(Estimated) 2015-05-05 15:01:22
```

6. Run **mananeserver -action xfer** to start immediately a file transfer cycle, as shown in Example 3-15.

Example 3-15 Start a transfer cycle

```
hmtu>manageserver -action xfer
Date/Time: 2015-05-05 03:22:57 IBM HMTU Version: 7.7.50.267
GUSS00041I The heat map transfer was started successfully.
```

7. Check the status of the transfer by running **showserver** and **lshmt**, as shown in Example 3-16.

Example 3-16 Check heat map transfer status

```
hmtu>showserver
Date/Time: 2015-05-05 03:23:11 IBM HMTU Version: 7.7.50.267
ServerStartTime              2015-05-05 03:01:22
ServerRunningStatus          In Progress
XferInterval(min)            720
NextXferStartTime(Estimated) 2015-05-05 15:01:22

hmtu>lshmt
Date/Time: 2015-05-05 03:24:06 IBM HMTU Version: 7.7.50.267
PrimaryDev          SecondaryDev        TotalXferTimes SuccessfulXferTimes FailedXferTimes
LastResult           LastStartTime          lastDuration(sec)
=============================================================================================
```

```
IBM.2107-75XXX51    IBM.2107-13XXX91    -             -                   -
-                    -                      -
IBM.2107-75XXX31    IBM.2107-75XXX51    -             -                   -
-                    -                      -
```

8. When heat map transfer process finishes, the HMTU is set to work automatically so that a user can check the transfer status periodically, as shown in Example 3-17.

Example 3-17 Check heat map transfer status

```
hmtu>lshmt
Date/Time: 2015-05-05 03:39:06 IBM HMTU Version: 7.7.50.267
PrimaryDev          SecondaryDev        TotalXferTimes SuccessfulXferTimes FailedXferTimes
LastResult           LastStartTime          lastDuration(sec)
================================================================================================
=========================================================
IBM.2107-75XXX51    IBM.2107-13XXX91    1              1                   0
SUCCESS              2015-05-05 03:24:51    310
IBM.2107-75XXX31    IBM.2107-75XXX51    1              1                   0
SUCCESS              2015-05-05 03:30:01    304
```

Removing the DS8870 System configuration from the HMTU

To remove information from the DS8870 system that is already configured on HMTU, complete the following steps:

1. Run **lsdev** to list which DS8870 system must be removed. Run **showserver** to verify the status of the transfer process, as shown in Example 3-18.

Example 3-18 List the DS8870 HMT status

```
hmtu>showserver
Date/Time: 2015-05-06 03:40:11 IBM HMTU Version: 7.7.50.267
ServerStartTime              2015-05-05 03:01:22
ServerRunningStatus          Speeping
XferInterval(min)            720
NextXferStartTime(Estimated) 2015-05-06 15:11:51
```

2. When the transfer status is in sleeping or stopped mode, proceed with removal by running **rmdev**, as shown in Example 3-19.

Example 3-19 Remove devices and stop the HMTU server

```
hmtu>rmdev -dev IBM.2107-75XXX51
Date/Time: 2015-05-06 04:10:14 IBM HMTU Version: 7.7.50.267
GUSS00002I The device IBM.2107-75XXX51 was removed successfully.
hmtu>rmdev -dev IBM.2107-13XXX91
Date/Time: 2015-05-06 04:12:14 IBM HMTU Version: 7.7.50.267
GUSS00002I The device IBM.2107-13XXX91 was removed successfully.
hmtu>rmdev -dev IBM.2107-75XXX31
Date/Time: 2015-05-06 04:13:17 IBM HMTU Version: 7.7.50.267
GUSS00002I The device IBM.2107-75XXX31 was removed successfully.
hmtu>lsdev
Date/Time: 2015-05-06 04:15:17 IBM HMTU Version: 7.7.50.267
DevId               HMC1                 HMC2                User            ConnStatus
================================================================================================
hmtu>manageserver -action stop
Date/Time: 2015-05-06 04:20:06 IBM HMTU Version: 7.7.50.267
GUSS00040I The Easy Tier heat map transfer server was stopped successfully.
hmtu>showserver
Date/Time: 2015-05-06 04:21:00 IBM HMTU Version: 7.7.50.267
ServerStartTime              -
```

```
ServerRunningStatus          Inactive
XferInterval(min)            -
NextXferStartTime(Estimated) -
```

3.2.2 Configuring HMT in Tivoli Storage Productivity Center for Replication

The HMT daemon is installed as part of the Tivoli Storage Productivity Center for Replication software, and run as a background thread inside Tivoli Storage Productivity Center for Replication. It is configured and controlled through the Tivoli Storage Productivity Center for Replication user interface.

The HMT daemon detects the PPRC relationships automatically through ESSNI.

Adding a DS8870 system to HMTU

To configure the HMTU to be used on the Tivoli Storage Productivity Center for Replication interface, complete the following steps:

1. In the initial Tivoli Storage Productivity Center for Replication window, click **Storage Systems**.
2. Add all DS8870 storage systems to Tivoli Storage Productivity Center for Replication, as shown in Figure 3-9, until all systems are added, as shown in Figure 3-10 on page 37.

Figure 3-9 Add DS8870 systems to Tivoli Storage Productivity Center for Replication

Figure 3-10 List of DS8870 systems in Tivoli Storage Productivity Center for Replication

3. Click the **Easy Tier Heat Map Transfer** tab to start the configuration, then click **Add Storage Systems**, as shown in Figure 3-11.

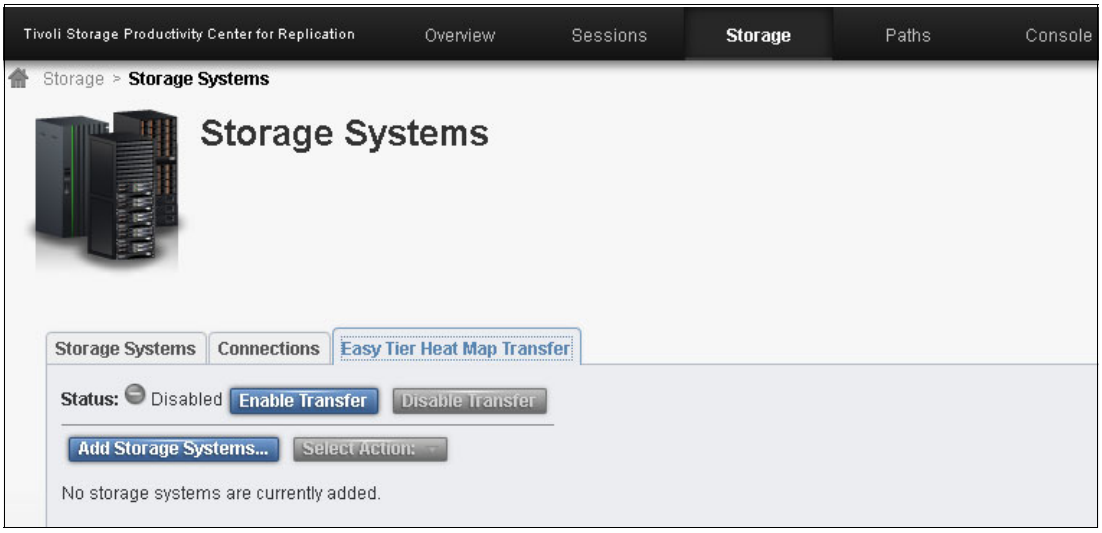

Figure 3-11 Add storage systems in the HMTU tab

Important: The Tivoli Storage Productivity Center for Replication for z Systems can manage the connection with the DS8870 system over the IBM FICON® inband connection or a Hardware Management Console (HMC). In this case, the DS8870 is not presented on the HMTU and cannot be added and managed by the HMT daemon. When you are using Tivoli Storage Productivity Center for Replication to manage IBM z/OS® over FICON, use a stand-alone server for HMT application.

4. Select the DS8870 systems to be included on the HMTU, as shown in Figure 3-12, and then click **Add Storage Systems**.

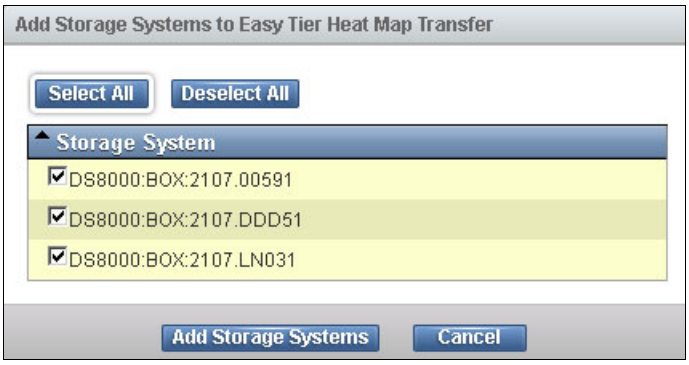

Figure 3-12 Storage systems selection for HMT

5. After the DS8870 systems are included in HMTU, all the systems have an inactive connection status. Next, enable the transfer by clicking **Enable Transfer** and confirm the operation, as shown in Figure 3-13.

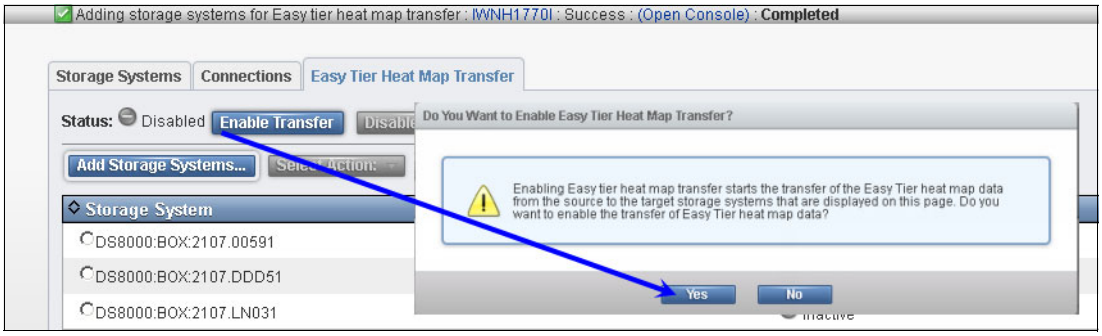

Figure 3-13 Tivoli Storage Productivity Center for Replication - enable the HMTU transfer process

All DS8870 systems automatically start the transfer process by using the HMT application.

Check the status of all the included relationships. If they are in the Connected status, the transfer is enabled and communicating as expected, as shown in Figure 3-14.

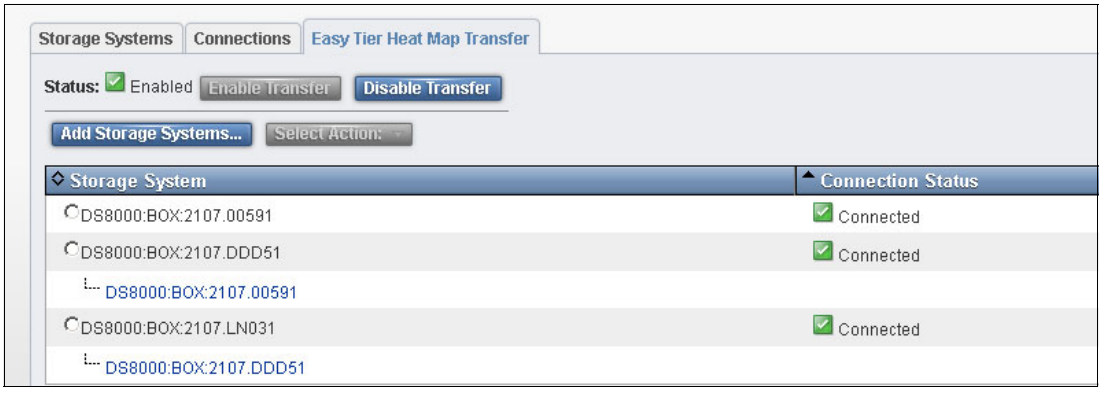

Figure 3-14 Tivoli Storage Productivity Center for Replication - HMTU transfer status

Checking the transfer status

To check the transfer status and validate when the latest transfer occurred, you can use one of the following methods:

- Click **Select Action** and then select **View Transfer Status**.
- Click the paired DS8870 systems, as shown in Figure 3-15.

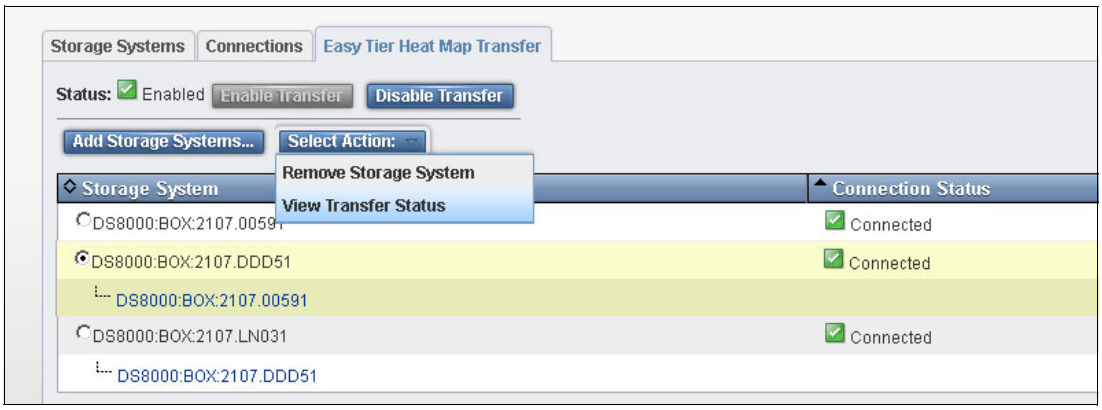

Figure 3-15 Tivoli Storage Productivity Center for Replication - view transfer status

You also can check the statistics and other information about the latest transfer, as shown in Figure 3-16.

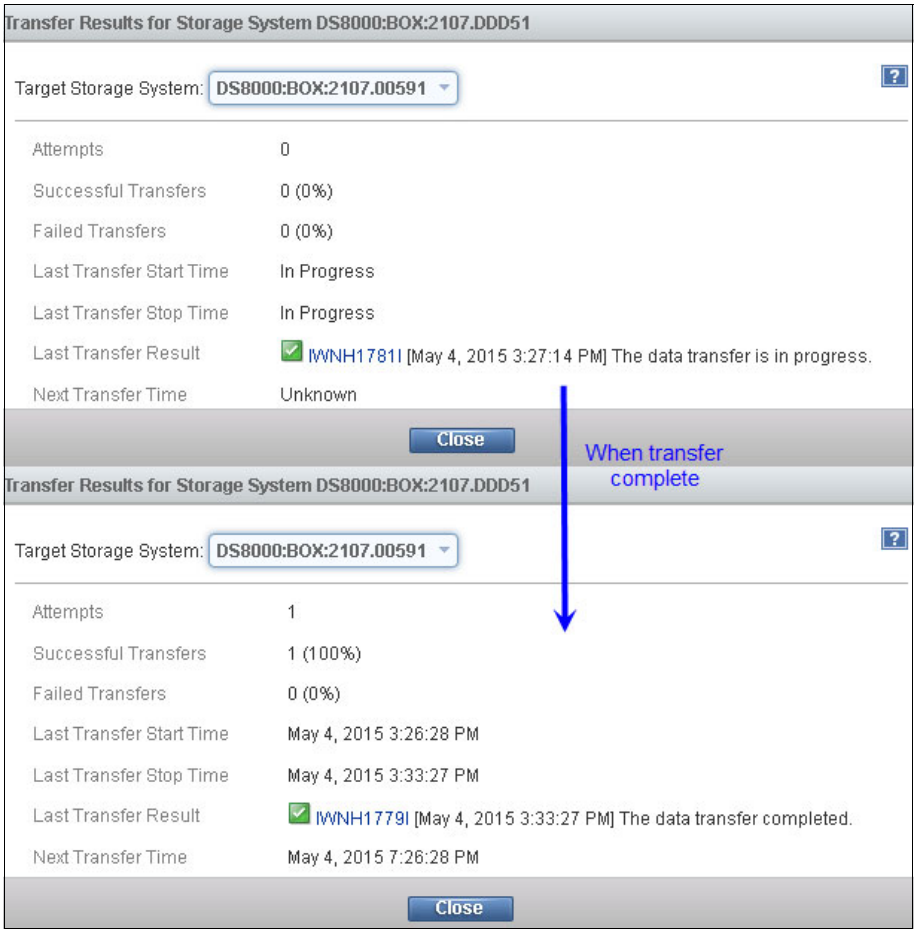

Figure 3-16 Tivoli Storage Productivity Center for Replication - transfer status and statistics

Removing the configuration from HMTU

To remove the DS8870 systems that are configured on HMTU, from Tivoli Storage Productivity Center for Replication, complete the following steps:

1. Click **Disable Transfer** to stop the transfer processes and confirm this decision, as shown in Figure 3-17.

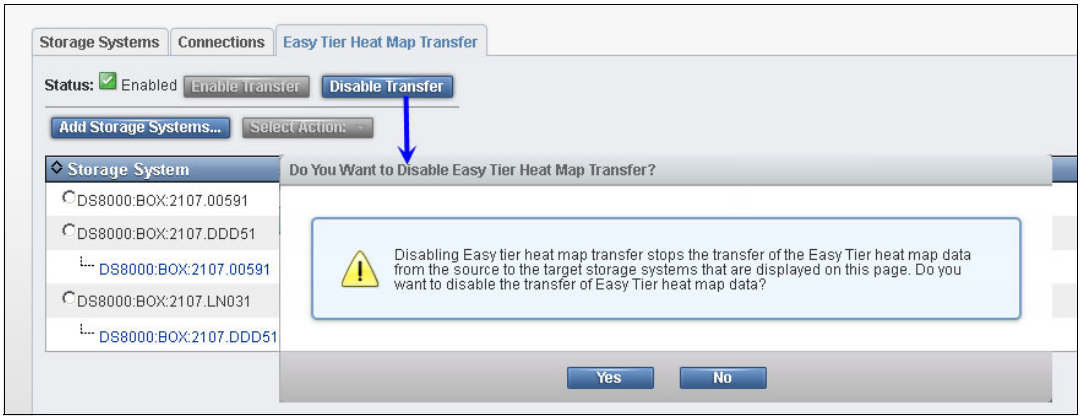

Figure 3-17 Tivoli Storage Productivity Center for Replication - disable heat map transfer

2. Select the DS8870 system to be removed, click **Select Action**, and then click the **Remove Storage System** option, as shown in Figure 3-18.

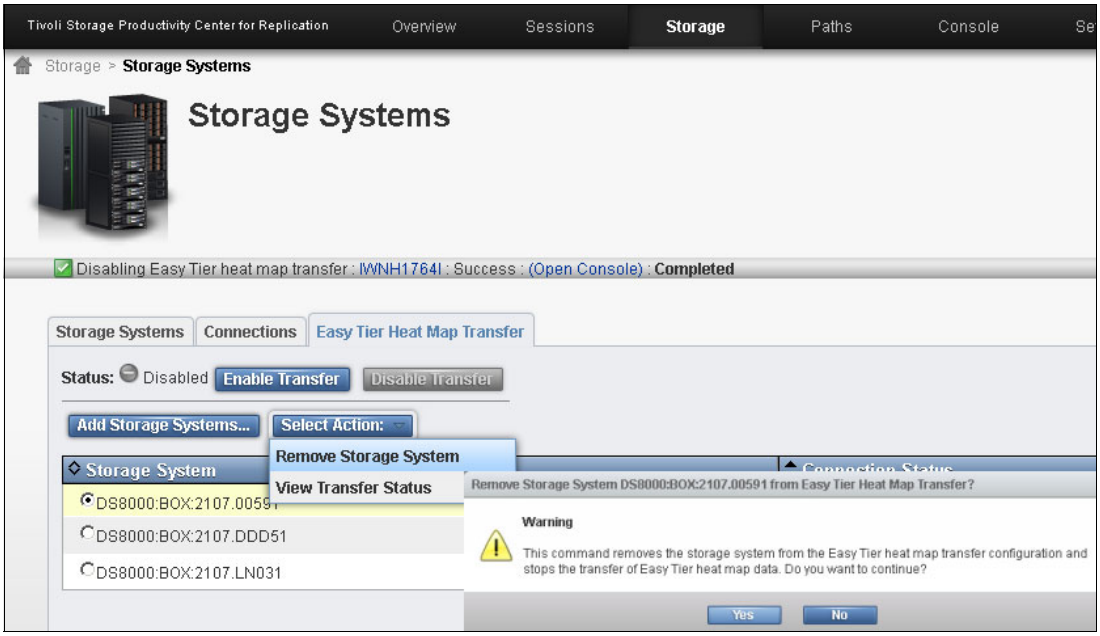

Figure 3-18 Tivoli Storage Productivity Center for Replication - remove a DS8870 from HMTU

3. Confirm the removal of the DS8870 system and verify that the process was finished correctly, as shown in Figure 3-19.

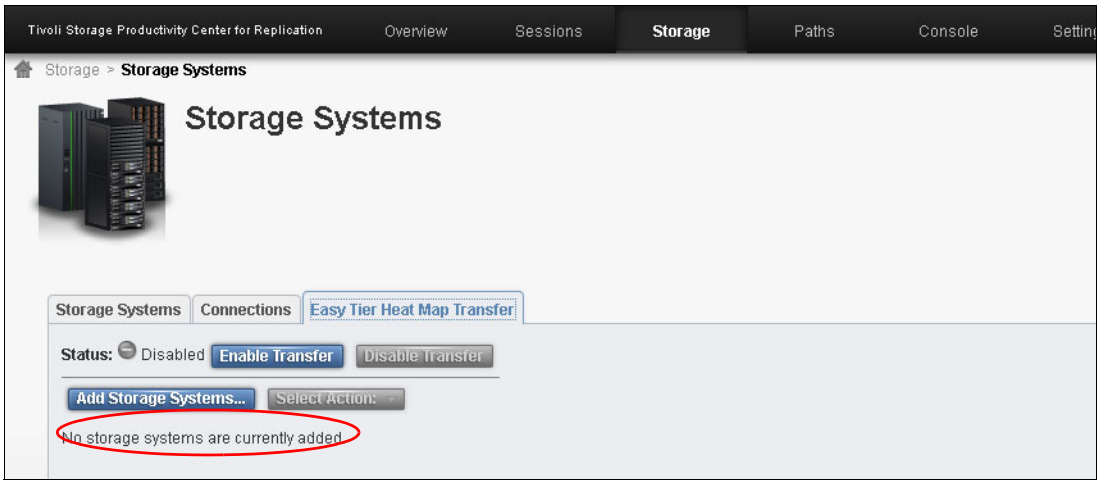

Figure 3-19 No more storage systems in the HMT tab

3.2.3 Verifying the allocation by using IBM Storage Tier Advisor Tool

You can use the HMTU to replicate the Easy Tier maps from primary to secondary site. You can verify the allocation status of extents at the secondary site by using the Storage Tier Advisor Tool (STAT).

Complete the following steps to verify the allocation by using STAT:

1. After verifying your code bundle (run the **`ver -l`** command on DSCLI to view the firmware level and LMC), download the correct software package (if required) directly from this website:

   `ftp://ftp.software.ibm.com/storage/ds8000/updates/DS8K_Customer_Download_Files/Storage_Tier_Advisor_Tool/`

   For more information about how to install and use the STAT, see Chapter 5 of *IBM DS8000 Easy Tier*, REDP-4667.
2. Collect the information from DS8870 by using the DS CLI or DS8870 GUI.
3. This process creates two files, including the extents allocation and other information.

   Import these files on STAT. By using your browser, open the `index.html` file that is generated by the tool.
4. Click **Volume Heat Distribution** and check the status for HMTU statistics.

The secondary DS8870 system presents the status of a volume, as shown in the “Based on Target field” in Figure 3-20.

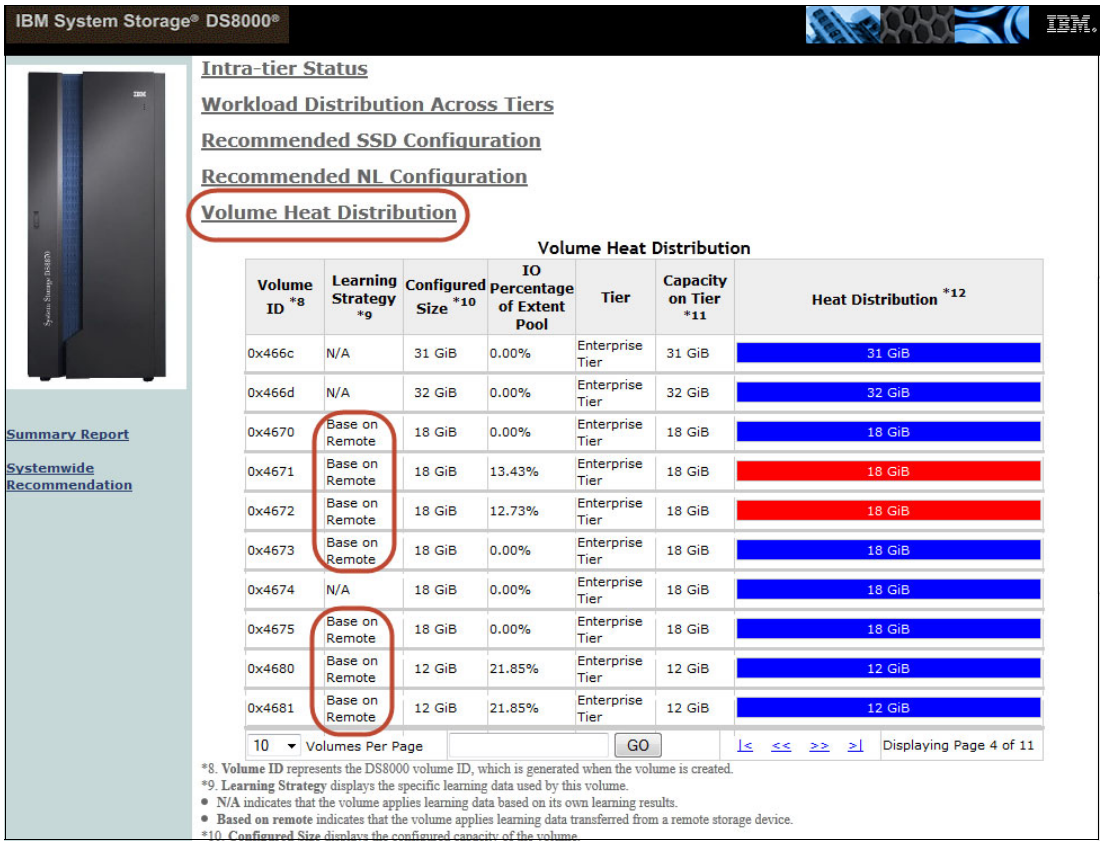

Figure 3-20 STAT output by using HMTU

3.2.4 Upgrading the HMTU

You can upgrade your system to use the HMTU by following the removal and installation procedures. All configured DS8870 system information is preserved and reinserted after a new version is installed.

After installing the new version, restart the server by using the `manageserver -action start` option.

Validate the information about the HMTU daemon and schedule time by using the **`showserver`** command. As a good practice, start a transfer immediately by using the **`manageserver -action xfer`** command.

3.2.5 Removing the HMTU

The HMTU can be removed by using the graphical, silent, or console mode as an interface.

For Windows, you can optionally use the Add/Remove Programs tool to remove the HMTU from your system, as shown in Figure 3-21 on page 43.

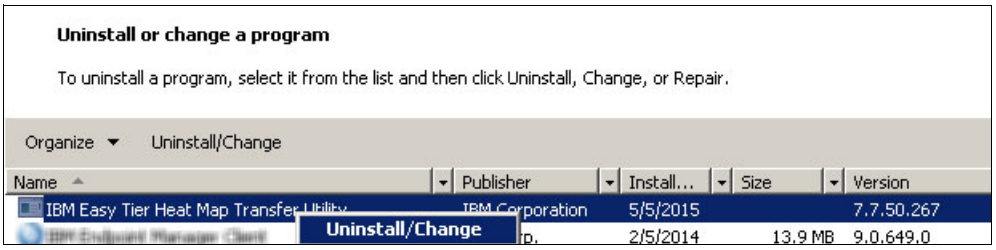

Figure 3-21 Example Windows 7 uninstall program

From the command line, enter the directory path and run **Uninstall_hmtu**, and optionally the parameter **-i** to specify the uninstall mode. If the **-i** parameter is not specified, the uninstall mode defaults to graphical mode.

Console mode

In console mode, enter `back` to return to the previous window, or `quit` to exit the uninstallation. Some operating systems require restarting after uninstallation is completed.

From the command line or terminal session enter the HMTU installed directory path, the **Uninstall_hmtu** command, and the parameter **-i console** to specify the command-line mode, as shown in Example 3-20.

Example 3-20 Uninstall by using the command line

```
[root@hmtuserver /]# /opt/IBM/hmtu/Uninstall_hmtu/Uninstall_hmtu -i console
Preparing CONSOLE Mode Installation...
===============================================================================
IBM Easy Tier Heat Map Transfer Utility          (created with InstallAnywhere)
-------------------------------------------------------------------------------
===============================================================================
Uninstall IBM Easy Tier Heat Map Transfer Utility
-------------------------------------------------
About to uninstall...
IBM Easy Tier Heat Map Transfer Utility
This will remove features installed by InstallAnywhere.  It will not remove
files and folders created after the installation.
PRESS <ENTER> TO CONTINUE:
===============================================================================
Uninstall Options
-----------------
ENTER THE NUMBER FOR YOUR CHOICE, OR PRESS <ENTER> TO ACCEPT THE DEFAULT:
->1- Completely remove all features and components.
    2- Choose specific features that were installed by InstallAnywhere.
Please choose one of the following options::
===============================================================================
Uninstalling...
---------------
********************(lines omitted)
Uninstall Complete
------------------
All items were successfully uninstalled.
```

Follow the process to confirm the options. Some operating systems might require a restart to complete the uninstallation.

Silent mode

From the command line or terminal session, enter the HMTU installed directory path, the **Uninstall_hmtu** command, and the parameter **-i silent** to specify the unattended mode, as shown in Example 3-21.

Example 3-21 Uninstall by using silent mode

```
[root@hmtuserver /]# /opt/IBM/hmtu/Uninstall_hmtu/Uninstall_hmtu -i silent
Preparing SILENT Mode Installation...
===============================================================================
IBM Easy Tier Heat Map Transfer Utility          (created with InstallAnywhere)
-------------------------------------------------------------------------------
===============================================================================
Uninstalling...
---------------
********************(lines omitted)
Installation Complete.
```

3.3 Command reference

The complete HMTU command list and messages are available on the DS8000 IBM Knowledge Center available at this website:

http://www-01.ibm.com/support/knowledgecenter/api/redirect/dsichelp/ds8000ic/index.jsp

The following commands for HMTU are most commonly used:

- **adddev**: Adds a storage system to the HMTU.
- **chdev**: Modifies the HMTU for a storage system.
- **exit | quit**: Ends the current HMTU session.
- **help**: Lists detailed usage information about the specified HMTU command.
- **lsdev**: Lists the configuration and status information of all the storage systems that are managed by the HMTU.
- **lshmt**: Queries and displays the data transfer results for the peer-to-peer remote client relationships (PPRC) that are defined for the storage system.
- **manageserver**: Issues an HMTU service start or stop or immediately starts a transfer operation.
- **rmdev**: Removes a storage system from HMTU management.
- **showserver**: Displays the status of the HMTU service.
- **chserver:** Sets a starting time for HMTU transfer operations to begin. To validate the new start time, the HMT daemon must be restarted by using the **manageserver -action start/stop** command.
- **ver**: Displays the version of the heat map transfer utility also.

Related publications

The publications that are listed in this section are considered suitable for a more detailed description of the topics that are covered in this paper.

IBM Redbooks

The following IBM Redbooks publications provide more information about the topics in this document. Some publications that are referenced in this list might be available in softcopy only:

- *DS8870 Easy Tier Application*, REDP-5014
- *IBM DS8870 Architecture and Implementation*, SG24-8085
- *IBM DS8000 Easy Tier*, REDP-4667
- *IBM System Storage DS8000 Easy Tier Server*, REDP-5013

You can search for, view, download, or order these documents and other Redbooks, Redpapers, Web Docs, draft, and other materials, at this website:

`http://www.ibm.com/redbooks`

Other publications

The following publications also are relevant as further information sources:

- *Driving Business Value on Power Systems with Solid-State Drives*, POW03025USEN
- *IBM DS8000 Storage Virtualization Overview Including Storage Pool Striping, Thin Provisioning, Easy Tier,* WP101550
- *IBM Easy Tier on DS8000, SVC and Storwize V7000 Deployment Considerations Guide January 2011*, WP101844
- *IBM System Storage DS8870 (Machine type 242x) delivers advanced Easy Tier capabilities, enhanced resiliency, and business continuity functions*, ENUS113-043
- *IBM System Storage DS8870 (Machine type 239x) Function Authorizations for advanced Easy Tier Server capabilities*, ENUS113-040
- *IBM System Storage DS8700 (Machine types 2421, 2422, 2423, and 2424) is designed to deliver new Easy Tier solid-state storage workload optimizer, advanced features supporting business continuity, and new drive options that can help to double the system's maximum capacity*, ZG10-0125
- *IBM System Storage DS8870 Introduction and Planning Guide,* GC27-4209-04
- *IBM System Storage DS8700 Performance with Easy Tier,* WP101675
- *IBM System Storage DS8700 and DS8800 (M/T 242x) delivers DS8000 I/O Priority Manager and advanced features to enhance data protection for multi-tenant copy services,* ZG11-0130
- *IBM System Storage DS8700 and DS8800 (M/T 242x) offers higher scalability with additional tiering capabilities and drive options to address price and performance requirements,* ZG11-0282

- *IBM System Storage DS8700 and DS8800 Performance with Easy Tier 2nd Generation*, WP101961
- *IBM System Storage DS8800 and DS8700 Performance with Easy Tier 3rd Generation*, WP102024
- *IBM System Storage DS Command-Line Interface User's Guide,* GC27-4212

Online resources

The following websites also are relevant as further information sources:

- Documentation for the DS8000 system:

  http://www.ibm.com/systems/storage/disk/ds8000/index.html
- IBM Almaden Research Center, Easy Tier:

  http://www.almaden.ibm.com/storagesystems/projects/easytier/
- IBM Disk Storage Feature Activation (DSFA):

  http://www.ibm.com/storage/dsfa
- IBM System Storage Interoperation Center (SSIC):

  http://www.ibm.com/systems/support/storage/config/ssic/index.jsp
- IBM Techdocs Library: The IBM Technical Sales Library:

  http://www.ibm.com/support/techdocs/atsmastr.nsf/Web/Techdocs

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