Redpaper

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IBM System Storage DS8000: z/OS Distributed Data Backup

Many IBM® customers have shown interest in a solution that allows them to use the powerful backup and restore facilities on their IBM System z® host to back up and restore LUNs created for open system hosts using a Fixed Block Architecture (FBA) format.

In cooperation with our partner company INNOVATION Data Processing, IBM has designed a solution that covers such a need.

This IBM Redpapers™ publication provides an overview of the solution. It describes:

- The background and motivation for this solution
- The steps to execute to use z/OS® Distributed Data Backup and FDRSOS
- Our experiences when evaluating t he solution
- Further considerations, such as IBM FlashCopy® integration and file level backup and restore

Background and motivation

The solution described in this paper offers yet another alternative to the numerous backup and restore solutions that IBM already offers. It is motivated by our customers wish to use their powerful System z host facilities to back up and restore open systems data. In addition, other customers do not want a different solution for System z and open systems.

This new solution basically consists of two components:

- An enhancement to the DS8700 microcode, referred to as *z/OS Distributed Data Backup*. This is a no charge feature.
- A software product from our partner company INNOVATION Data Processing that is called *FDRSOS*.

Combining these two components with the IBM System Storage® TS7680 ProtecTIER® Deduplication Gateway for System z can also greatly reduce the amount of backup data being stored. Furthermore, the TS7680 can use IBM Global Mirror on a IBM System Storage DS8000® system to automatically replicate data to a remote site for a more effective disaster recovery and business continuity solution.

z/OS Distributed Data Backup

By default, z/OS, or, to be more precise, the I/O subsystem, communicates with the controller of its attached devices by sending out Channel Command Words (CCWs).

The devices are set up in Count Key Data (CKD) or Extended Count Key Data (ECKD™) format. For a description of the CKD and ECKD formats, refer to the following address:

http://publib.boulder.ibm.com/infocenter/dsichelp/ds8000ic/index.jsp?topic=/com.ibm.storage.ssic.help.doc/f2c_count_key_data_32odui.html

Windows® and UNIX® operating systems are typically attached to Fixed Block Architecture (FBA) disks. For more information about the FBA format, refer to the following address:

http://publib.boulder.ibm.com/infocenter/dsichelp/ds8000ic/index.jsp?topic=/com.ibm.storage.ssic.help.doc/f2c_fixedblock_32oduw.html

It appears to be contradictory that a System z host exchanges data with a device that had originally been setup in FBA format. Indeed, the System z host would send out CKD CCWs that the controller of the FBA devices would be unable to understand.

A possible solution is to make the FBA part of the controller able to understand FBA CCWs. This is exactly the approach that IBM has implemented with z/OS Distributed Data Backup (zDDB). zDDB is an optional licensed feature on the DS8000 Model 941 that allows hosts, attached through a FICON® or ESCON® interface, to access data on fixed block (FB) volumes through a device address on FICON or ESCON interfaces.

If the zDDB LIC feature key is installed and enabled and a volume group type specifies either FICON or ESCON interfaces, this volume group has implicit access to all FB logical volumes that are configured in addition to all CKD volumes specified in the volume group. Then, with the appropriate software, a z/OS host can perform backup and restore functions for FB logical volumes configured on a storage facility image for open systems hosts.

If you have not installed or enabled the zDDB LIC feature key, during a DS8000 power on sequence, the logical volumes and the LSSs that are associated with this licensed feature are

offline to any FICON or ESCON hardware interfaces. If a zDDB LIC feature key is disabled when it was previously enabled, the logical volumes and the LSSs that are associated with the licensed features remain online to any FICON or ESCON interfaces until the next power off sequence, but any I/O issued to these logical volumes is rejected.

The key data in a zDDB LIC feature key contains an allowed capacity value. This value refers to the total amount of physical capacity configured into any FB real rank on the storage facility image. The allowed capacity must be set to either 0 or to the maximum value, when the LIC feature is on or off.

To validate a zDDB feature key, the new LIC key must meet the following criteria:

- The specified storage type must be FB storage only.
- The specified capacity is either zero or the maximum capacity value.

When a zDDB LIC feature key is installed and the LIC feature key has a capacity greater than 0 bytes, then the DS8000 enables the zDDB function and notifies any attached hosts through the appropriate interface. If a zDDB LIC feature key that is disabled is installed while the zDDB facility is enabled, the LIC feature key is accepted, but the zDDB facility is concurrently disabled. While the feature is disabled, logical volumes that are associated with this feature are either offline to FICON or ESCON hosts or I/O issued to logical volumes associated with the feature are rejected on FICON or ESCON interfaces.

Use either of the optional z/OS Distributed Data Backup feature codes listed in Figure 1 to enable data backup of open systems from distributed server platforms through a System z host.

License function	Hardware machine type 239x indicator feature	Hardware machine type 242x indicator feature
z/OS Distributed Data Backup Indicator	7094 and 0714	Model LFA 7094

Figure 1 Feature codes for z/OS Distributed Data Backup

A major advantage of using z/OS Distributed Data Backup is that you reduce the Ethernet traffic because all distributed data backup/restore I/Os are driven through the channel subsystem.

FDRSOS

When the zDDB LIC feature key is installed and enabled and a volume group type specifies either FICON or ESCON interfaces, this volume group has implicit access to all FB logical volumes that are configured in addition to all CKD volumes specified in the volume group. Then, using the appropriate software, a z/OS host can perform backup and restore functions for FB logical volumes configured on a storage facility image for open systems hosts.

Our partner company (INNOVATION Data Processing) sells a product called FDRSOS. You can refer to the following addresses for details about FDRSOS:

- Home Page: http://www.fdr.com/index.cfm
- FDRSOS for IBM Storage: http://www.fdr.com/products/fdrsos_ibm/

The concept of FDRSOS fits seamlessly into the options z/OS Distributed Data Backup offers. Using FDRSOS and z/OS Distributed Data Backup, it is possible to fully back up and restore a FBA device that has been defined on a DS8700. FDRSOS can only run on z/OS.

Figure 2 shows a setup without z/OS Distributed Data Backup and FDRSOS, while Figure 3 shows a setup with z/OS Distributed Data Backup and FDRSOS.

The figures are taken from an INNOVATION Data Processing document that can be found at the following address:

http://www.fdr.com/products/fdrsos/pdf/10147_FDRSOSbro.pdf

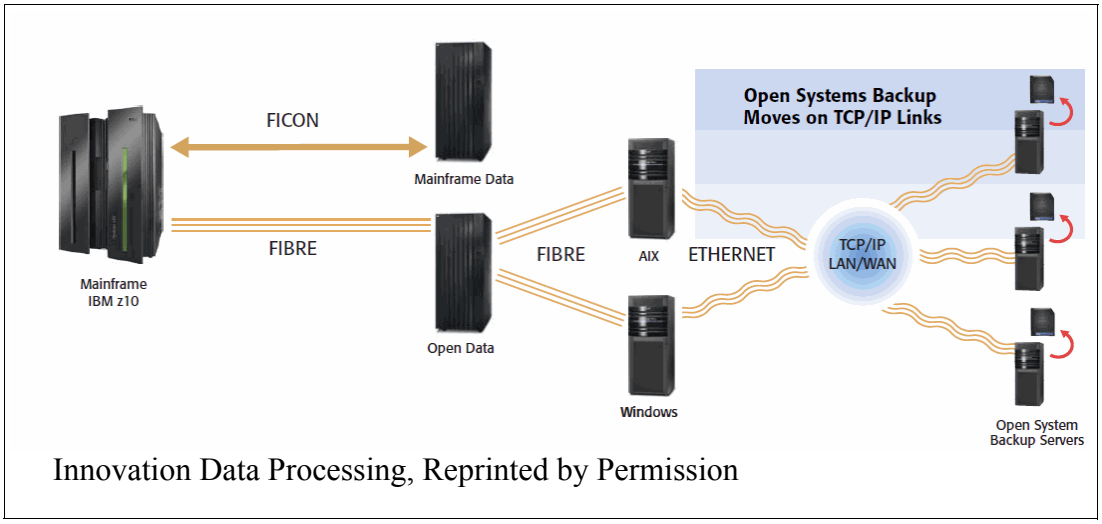

Figure 2 Before using z/OS Distributed Data Backup and FDRSOS

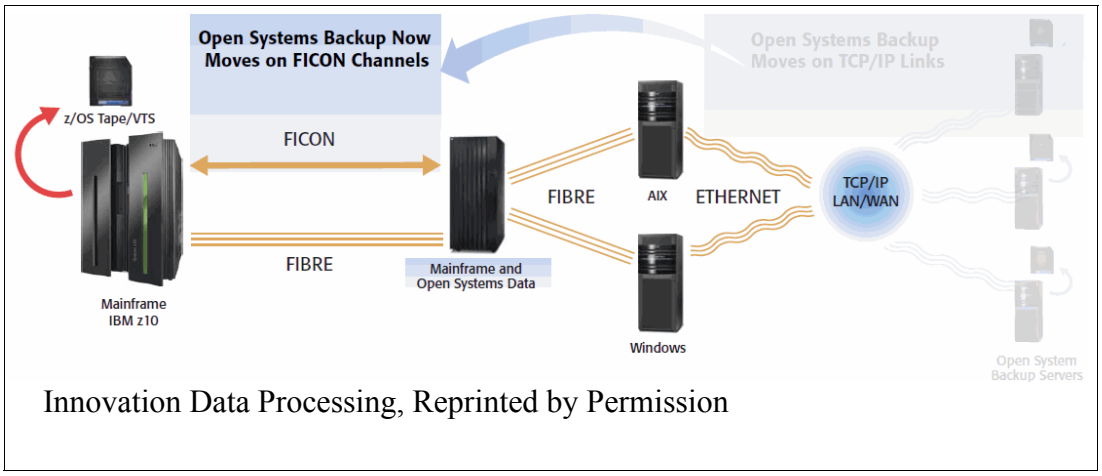

Figure 3 Using z/OS Distributed Data Backup and FDRSOS

You can see that the biggest portion of the data traffic (backup data) going over the Ethernet is now offloaded to the I/O channels.

Backing up a DS8700 LUN in FBA format using FDRSOS

Perform the following steps to back up a DS8000 FBA volume using FDRSOS:

1. Confirm that z/OS Distributed Data Backup feature was installed. For more information about this topic, refer to the following address:

   http://www.ibm.com/common/ssi/rep_ca/6/877/ENUSZG10-0246/ENUSZG10-0246.PDF

2. Make sure that the FDRSOS software is installed on the System z host. The FDRSOS User Documentation (Level V5.4 L74 and higher) mentions three ways to complete the installation:
   - Electronic installation: The installation package is downloaded from the INNOVATION Data Processing FTP site or received in an email.
   - CD installation: The installation package is downloaded from a CD.
   - Tape installation: The installation package is provided on a physical tape.

   None of these methods require SMP/E support.
3. Make sure that your LUNs are connected to both the open system and the System z hosts (there must be a fiber and a FICON connection).
4. Introduce the FBA volume to the System z host:
   a. Configure it in Hardware Configuration Definition (HCD).
   b. Optionally, confirm that the z/OS Distributed Data Backup LUNs are accessible.
   c. Assign a z/OS volume serial to the volume.
   d. Optionally, confirm the existence of the volume serial.
   e. Pseudo-vary online the volume to be backed up or restored, respectively.
   f. Run the backup and restore.

The examples in the following sections are taken from an INNOVATION Data Processing presentation that can be found at the following address:

http://www.fdr.com/press/10150_SHAREBostonTom_V7_for_print.pdf

Configuring a FBA volume in HCD

In order for z/OS to be able to access any data residing on a peripheral device, that device must be introduced to z/OS using the HCD. Therefore, z/OS Distributed Data Backup LUNs need to be defined in the same manner:

- A z/OS Distributed Data Backup volume is defined as 3390 in HCD.
- A z/OS Distributed Data Backup volume needs to stay offline at Initial Program Load (IPL) time (Figure 4).

```
Device number  . . : 01E0          Device type  . . . : 3390
Parameter/  Value    Req.  Description
 Feature
 OFFLINE     Yes            Device considered online or offline at IPL
 DYNAMIC     Yes            Device supports dynamic configuration
 LOCANY      Yes            UCB can reside in 31 bit storage
 ALTCTRL     No             Separate physical control unit path
 SHARED      Yes            Device shared with other systems
```

Figure 4 HCD definitions

z/OS Distributed Data Backup LUNs viewed from z/OS and an open system

Figure 5 shows the z/OS view of the z/OS Distributed Data Backup LUNs.

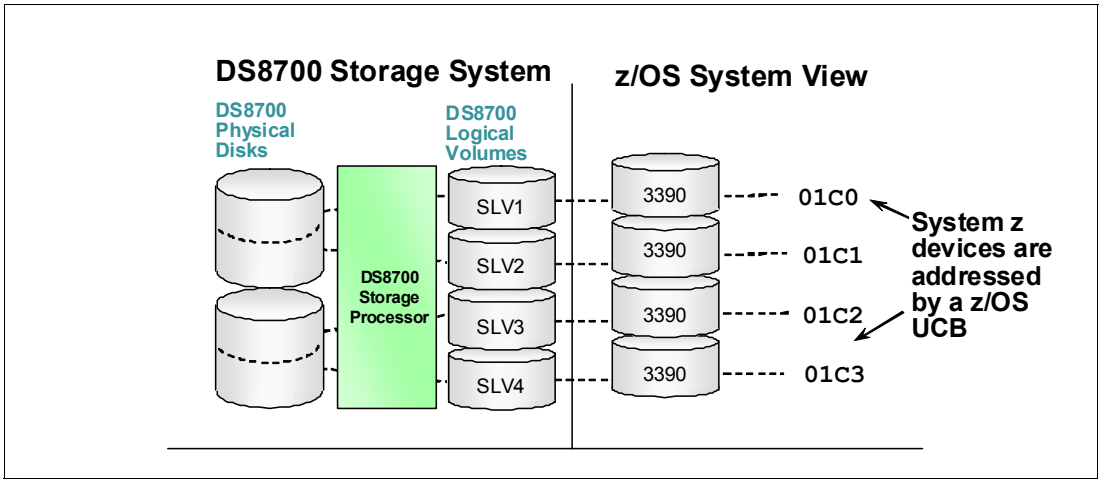

Figure 5 z/OS Distributed Data Backup LUNs as seen by z/OS

Figure 6 shows the open system view of the z/OS Distributed Data Backup LUNs.

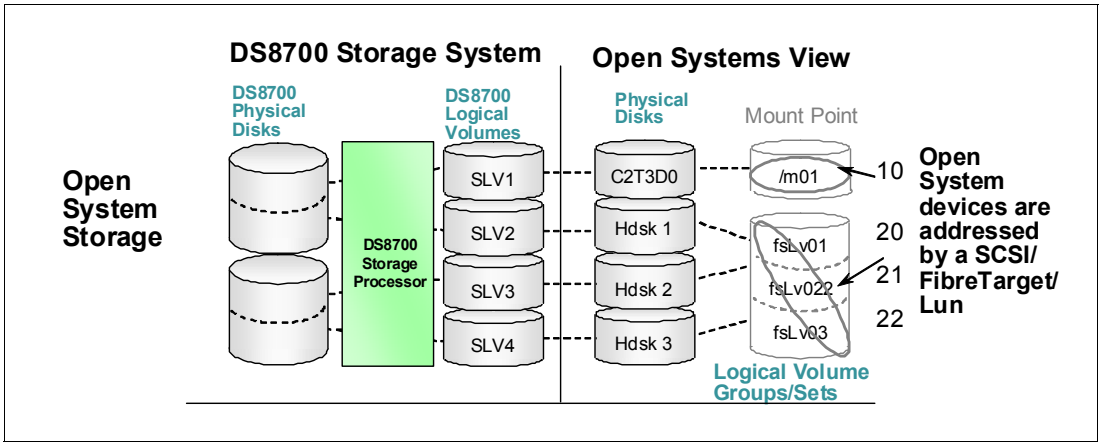

Figure 6 z/OS Distributed Data Backup LUNs as seen by the Open System

Figure 7 shows both the z/OS and open system views of the z/OS Distributed Data Backup LUNs.

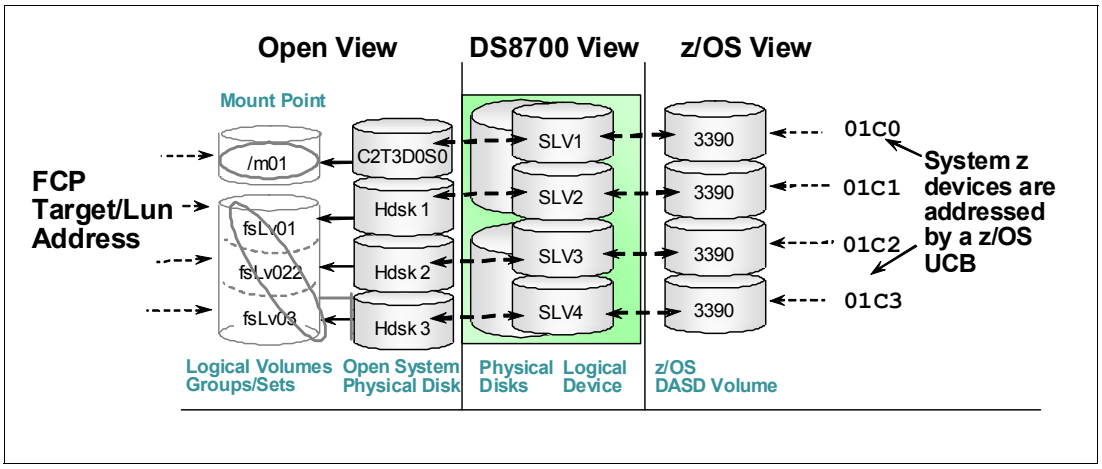

Figure 7 A consolidated view

Optional: Confirming that the z/OS DDB LUNs are accessible

This step is optional, but it is a best practice to verify that a z/OS Distributed Data Backup LUN can be accessed at all. Use the z/OS DEVSERV command to verify that the LUN is accessible (Figure 8).

```
DS P,21e0,16
IEE459I 09.33.39 DEVSERV PATHS 685
UNIT DTYPE  M CNT VOLSER  CHPID=PATH STATUS
     RTYPE  SSID CFW TC   DFW PIN DC-STATE CCA DDC
021E0,3390   ,F,000,E#21E0,18=X 17=X
021E1,3390   ,F,000,       ,18=X 17=X
021E2,3390   ,F,000,E#21E2,18=X 17=X
021E3,3390   ,F,000,E#21E3,18=X 17=X
021E4,3390   ,F,000,E#21E4,18=X 17=X
 ...
021EB,3390   ,F,000,E#21EB,18=X 17=X
021EC,3390   ,F,000,E#21EC,18=X 17=X
021ED,3390   ,F,000,E#21ED,18=X 17=X
021EE,3390   ,F,000,       ,18=X 17=X
021EF,3390   ,F,000,       ,18=X 17=X
************ SYMBOL DEFINITIONS ******************
  F = OFFLINE          X = INDETERMINATE FAILING UNIT
```

Figure 8 Confirming that the LUNs are accessible

In Figure 8, we see two different kinds of z/OS Distributed Data Backup LUNs:

- LUNS that are not carrying a VOLSER (see the text in the red circled area): These LUNs have not been assigned a VOLSER yet. However, they do have paths defined and can therefore be assumed to be I/O accessible.
- LUNS that are carrying a VOLSER: These LUNS have been already assigned a VOLSER (refer to “Assigning a volume serial to the z/OS Distributed Data Backup volume” on page 8).

Assigning a volume serial to the z/OS Distributed Data Backup volume

Any volume in z/OS (unless it is in an uninitialized state) carries a volume serial (VOLSER). A VOLSER must be assigned to any z/OS Distributed Data Backup volume. The VOLSER is written into Unit Control Blocks (UCBs) that represent the z/OS Distributed Data Backup LUNs. This is done by using the FDRSOS software (see Figure 9).

```
//LABEL     EXEC  PGM=FDRSOS,REGION=0M
//STEPLIB    DD   DISP=SHR,DSN=fdrsos.loadlib
//SYSPRINT   DD   SYSOUT=*
//SYSUDUMP   DD   SYSOUT=*
//SYSIN      DD   *
  LABEL    TYPE=SOS
  MOUNT    UNIT=01E0,SETVOL=41HD07
  MOUNT    UNIT=01E1,SETVOL=32HD10
  *    *      *      *      *      *      *
  MOUNT    UNIT=01EA,SETVOL=C2T3D0
```

Figure 9 Assigning a VOLSER to z/OS Distributed Data Backup LUNs

In this example (the job card statement is left out), there is a range of 11 LUNs (x'01E0 ... x'01EA) assigned a VOLSER.

Optional: Confirming the existence of VOLSER on the zDDB LUNs

This step is optional, but it is a best practice to verify that the z/OS Distributed Data Backup LUNs have been assigned a VOLSER. Use the z/OS DEVSERV command to verify the LUNS (Figure 10).

```
DS P,21e0,16
IEE459I 09.33.39 DEVSERV PATHS 685
UNIT DTYPE  M CNT VOLSER  CHPID=PATH STATUS
     RTYPE  SSID CFW TC   DFW PIN DC-STATE CCA DDC
021E0,3390   ,F,000,E#21E0,18=X 17=X
021E1,3390   ,F,000,      ,18=X 17=X
021E2,3390   ,F,000,E#21E2,18=X 17=X
021E3,3390   ,F,000,E#21E3,18=X 17=X
021E4,3390   ,F,000,E#21E4,18=X 17=X
 ...
021EB,3390   ,F,000,E#21EB,18=X 17=X
021EC,3390   ,F,000,E#21EC,18=X 17=X
021ED,3390   ,F,000,E#21ED,18=X 17=X
021EE,3390   ,F,000,      ,18=X 17=X
021EF,3390   ,F,000,      ,18=X 17=X
************ SYMBOL DEFINITIONS ******************
  F = OFFLINE          X = INDETERMINATE FAILING UNIT
```

Figure 10 Confirming that there is a VOLSER on the z/OS Distributed Data Backup LUNs

In Figure 10, we see two different kinds of z/OS Distributed Data Backup LUNs:

- LUNS that are carrying a VOLSER (see the text in the red circled area): These are LUNS that have been already assigned a VOLSER.

- LUNS that are not carrying a VOLSER: These LUNs have not been assigned a VOLSER. However, they do have paths defined and can therefore be assumed to be I/O accessible. Refer to “Optional: Confirming that the z/OS DDB LUNs are accessible” on page 7 for more information.

Varying a z/OS Distributed Data Backup LUN pseudo-online

After each IPL, the UCB of a z/OS Distributed Data Backup LUN vanishes, which makes the LUN inaccessible to FDRSOS. Therefore, you need to vary the z/OS Distributed Data Backup LUNs pseudo-online by using the FDRSOS software.

Example 1 shows an example (only the control statements are shown here, not the entire JCL). To refer generically to device addresses, use the asterisk as a wildcard character, as shown with address 21E*.

Example 1 Control statements to vary z/OS Distributed Data Backup LUNs online

```
VARYON TYPE=SOS
MOUNT UNIT=21E*
```

Rather than running a vary online job after each IPL, include the VARYON and MOUNT commands into a member that is executed upon IPL.

The SOS parameter within the VARYON command could be suffixed by “, PRINT=STATUS”. Such suffix makes FDRSOS try to identify and report the disk format (that is, Linux®), which is a function that allows you to verify that you have used the right open system volume that is mounted on the respective System z device address.

Running the backup and restore job

At this stage, you are ready to run the respective backup and restore jobs. Figure 11 shows an example of a backup job.

```
//DUMP     EXEC  PGM=FDRSOS,REGION=0M
//TAPEA     DD   DSN=BACKUP.SC2T3D0(+1),DISP=(,CATLG),UNIT=TAPE
//TAPEAA    DD   … will create a duplicate copy for vaulting
//SYSPRINA  DD   SYSOUT=* … for the status report
    DUMP     TYPE=FULL,PRINT=STATUS
    MOUNT    VOL=C2T3D0,TAPEDD=A
FDR216 UNIT=01EA IS A SUN SOLARIS VOLUME WITH VOL NAME OF NONAME
        WITH A LABEL OF IBM-DS8700-5063 cyl 8860 alt2
        WITH A MOUNT POINT OF /m01
FDR122 OPERATION STATISTICS FOR SOS VOLUME.......C2T3D0
                BYTES ON VOLUME..........4,355,850,240
                * * * * *
                BYTES ON BACKUP..........4,364,783,536
                * * * * *
                CPU TIME (SECONDS)..............11.942
                ELAPSED TIME (MINUTES).............4.7
                BACKUP TIME(EXCLUDING MOUNTS)......4.2
                BACKUP COPY 1 ON TAPE DSN=BACKUP.SC2T3D0.C1   VOL=900013
                BACKUP COPY 2 ON TAPE DSN=BACKUP.SC2T3D0.C2   VOL=900022
FDR002 FDR DUMP SUCCESSFULLY COMPLETED VOL=C2T3D0
```

Figure 11 Running a FDRSOS backup job

The job in Figure 11 on page 9 writes the output to a Generation Data Group (GDG) on tape as well as a second one (//TAPEAA DD statement).

Experimenting with z/OS DDB and FDRSOS

This section describes scenarios we executed while evaluating z/OS Distributed Data Backup and FDRSOS. For our testing, we set up the environment shown in Figure 12.

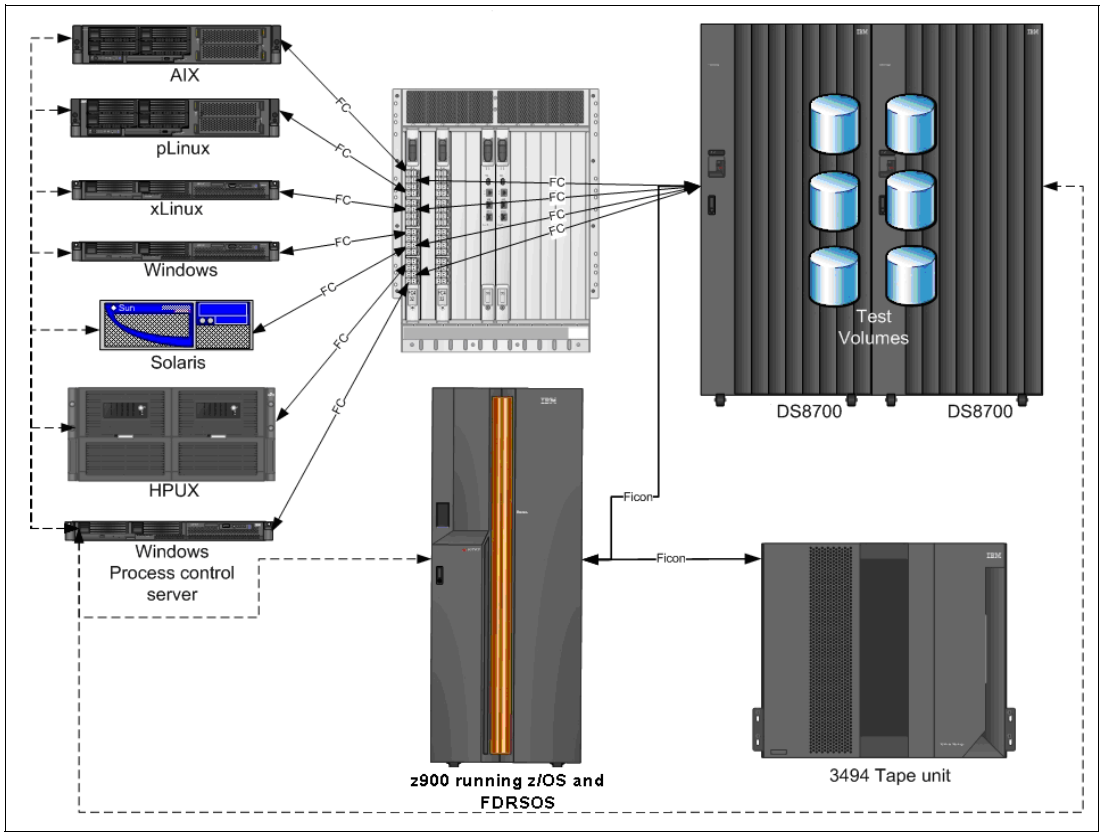

Figure 12 Testing setup

Figure 12 mentions a special server called the *Windows Process control server*. This server has overall process control and can access all Windows, UNIX, and z/OS systems via batch files. For more information, refer to “Submitting jobs into z/OS”.

Submitting jobs into z/OS

To make sure that the file systems of the UNIX operating systems can be backed up (and restored, respectively), we unmount them prior to the backup and restore operations. This action ensures that there will not be any I/O on these file systems while running the FDRSOS software. However, such an approach implies the need for synchronization between the activities on the UNIX systems (unmounting the file systems) and starting the backup and restore jobs on the System z host.

As we ran our testing using scripts, we decided to use the FTP option that is part of the z/OS TCP/IP implementation.

FTP is normally used to transfer data sets to and from a server by using the GET and PUT commands. In our scenario, an FTP connection is established from an UNIX client to a z/OS server (the DFSMSdfp environment).

Using the FTP site filetype=xxx option allows you to change the server environment to which the client is communicating. If xxx is set to JES (you must use lower case characters), GET and PUT communicate with JES rather than with DFSMSdfp, which allows you to send batch jobs from the UNIX system to the z/OS internal reader.

For this reason, we decide to run all activity on the open systems system. We create a script that:

- Unmounts all file systems
- Sends the jobs to z/OS's internal reader via FTP (labeling volumes and so on)
- Acquires the job output

This approach can be universally used.

INNOVATION Data Processing also offers (for an additional charge) a component named FDR/UPSTREAM/SOS that can exchange JCL and scripts between z/OS and an open system.

Further considerations regarding z/OS DDB and FDRSOS

At the time of the writing this paper, only z/OS Distributed Data Backup and FDRSOS have been tested and supported by IBM, which means that at this point in time only a full volume backup and restore is supported.

However INNOVATION Data Processing offers further software that might be subject to future testing:

- Integration with FlashCopy (SOSINSTANT)
- Backup and restore at the file level (UPSTREAM/SOS)

Integration with FlashCopy

In this scenario, IBM FlashCopy is used to generate a point-in-time copy, and then nondisruptive backups can be started by using FDRSOS to back up that copy.

INNOVATION Data Processing offers a solution named SOSINSTANT that allows integration with zDDB, FlashCopy, and FlashCopy Consistency Groups to enable backup operations and provide consistent FlashCopy disaster recovery protection even as fully functional business application systems continue using distributed data without interruption (refer to http://www.fdr.com/press/10150_SHAREBostonTom_V7_for_print.pdf for more information), as shown in Figure 13.

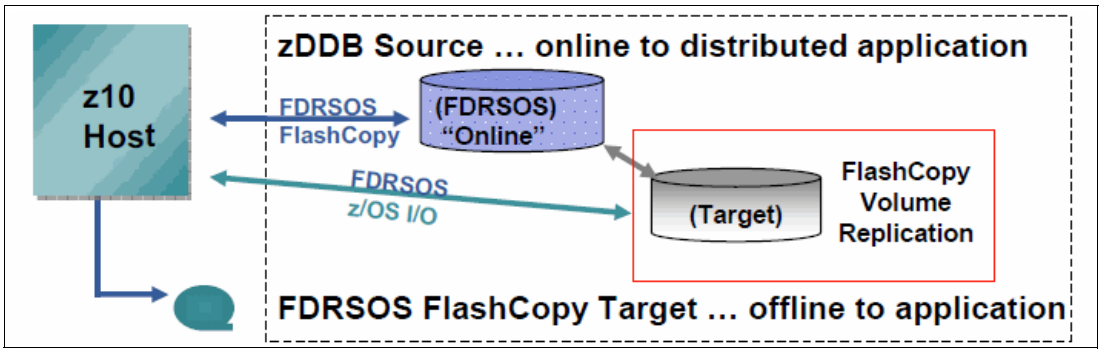

Figure 13 Integration with FlashCopy

Backup and restore at the file level

Up to now, we have assumed that full volume backups and restores, respectively, would be made. However, customers might appreciate being able to run backup and restore activities at the file level.

INNOVATION Data Processing offers a product named UPSTREAM/SOS that extends z/OS Cross Platform Distributed Data Protection to the file level (refer to http://www.fdr.com/press/10150_SHAREBostonTom_V7_for_print.pdf for more information).

The team who wrote this paper

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Thanks to the following people for their contributions to this project:

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This document REDP-4701-00 was created or updated on November 16, 2010.

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Trademarks