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An Oracle White Paper
May 2014

Implementing StorageTek Enterprise Library Software Client/Server Capability

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Introduction

Oracle's StorageTek Enterprise Library Software (ELS) is a software solution that enables and manages Oracle's StorageTek modular library systems and Oracle's StorageTek Virtual Storage Manager (VSM) system. The ELS solution offers a client/server capability that allows storage administrators to execute the ELS Storage Management Component (SMC) and the ELS Host Software Component (HSC) on different MVS hosts, or LPARs. The StorageTek ELS client/server capability uses software executing entirely on the IBM z/OS platform. The ELS client/server capability is also available on the Fujitsu MSP platform.

There are numerous benefits associated with running the ELS client/server capability instead of executing HSC on each host. This white paper provides instructions for storage administrators who want to implement this functionality and increase the efficiency of storage operations.

Benefits of Using ELS Client/Server

Why should customers change from executing HSC on each host to running the ELS client/server capability? There are several benefits:

- Reduce global tape outages. When HSC is recycled on one host, SMC automatically switches communication to an alternate HSC system running on another host. There is no limit to the number of alternate HSC servers that can be defined.

- Reduce host-to-host communication (COMMPATH) bottlenecks. When the number of active HSC hosts in a TapePlex is reduced to two, or possibly three, the COMMPATH message traffic between HSC hosts is correspondingly reduced.

- Reduce Control Data Set (CDS) contention. Sharing the CDS between fewer HSC hosts reduces the time spent waiting for the CDS reserve.

- Reduce library contention. Reducing the number of HSC hosts sharing long library strings of Oracle's StorageTek SL8500 modular library system significantly improves library performance and also reduces load on the library for Library Management Unit (LMU) COMMPATH traffic.

For StorageTek VSM users, running the ELS client/server capability provides additional benefits:

- Since the Virtual Tape Control Software (VTCS) feature of ELS is a major generator of host-to-host communication messages (COMMPATH traffic), reducing the number of HSC/VTCS hosts is especially beneficial in a VSM environment. Although the VTCS facility that allows putting VTCS locks in the z/OS coupling facility may alleviate this issue for some customers, it cannot be used when different LPARs in the same TapePlex are in different sysplexes.

- In a VSM environment, VTCS does most of the CDS updates. By reducing CDS contention between hosts, CDS performance (and thus VSM performance) may improve dramatically.

- Directing all VTCS requests to a single host, with a second VTCS system acting only as a backup server, allows VTCS to optimize its internal resource management, especially for migrates and recalls.

- Internal scratch cache consistency is maintained automatically, improving scratch selection performance.

- Management of real tape drives (RTDs) and multi-volume cartridges (MVCs) is more efficient if done by a single VTCS host.

StorageTek ELS Client/Server and VTCS Cross-TapePlex Replication

The VTCS Cross-TapePlex Replication function uses SMC services to send virtual tape volume (VTV) metadata to a TapePlex receiving VTV data.

If you decide to use the Cross-TapePlex Replication function, you must define the TapePlex(es) to which VTV data is to be replicated in the SMC configuration. The ability to send VTV data to another TapePlex is dependent on TCP/IP communication between the sending and receiving TapePlexes.

StorageTek Client System Component for MVS and StorageTek LibraryStation

Communication between Oracle's StorageTek Client System Component for MVS (MVS/CSC) and Oracle's StorageTek LibraryStation is no longer supported. MVS/CSC is still supported for customers who use Oracle's StorageTek Automated Cartridge System Library Software (ACSLS) for library management software, and StorageTek LibraryStation is still supported for non-mainframe clients that use HSC for library control. However, for customers who use only z/OS clients and servers, the only supported option is the ELS client/server capability.

Getting Started with ELS Client/Server Capability

The following steps should be performed before attempting to implement an ELS client/server environment.

- Read Oracle StorageTek ELS publication *Configuring and Managing SMC*, Chapter 3.

- Develop a plan for the final client/server configuration, including TapePlex names and server names; the LPARs on which HSC/VTCS will execute (two HSC/VTCS LPARs are recommended for redundancy); and client/server network port addresses. Since TCP/IP network connections between the client and server are not persistent (each transaction is its own connection), there is no limit to the number of clients that can connect to a single server. An extended simulation in the lab sustained a workload of approximately 300 virtual mounts per minute with one HSC system and one SMC HTTP server. Therefore, at this time Oracle does not recommend more than two servers per TapePlex, even if there are a large number of clients and a very high transaction volume. If you wish

to define additional servers for increased redundancy, a best practice is to limit the number of active HSC/VTCS servers in a TapePlex to two LPARs at any one time.

- Review the HSC LIBGEN to ensure that all library drives are defined for the hosts where HSC will run. If a library drive is not defined to HSC, it cannot be used by any SMC client. SMC client hosts do not need to be defined in the LIBGEN.

- If drives have different device addresses on different hosts, or if different hosts define the same device addresses for different physical devices, more information can be found below in the section SMC Drive Address Mapping.

- Define an OMVS segment in RACF for the user ID associated with SMC, in order to allow the SMC address space to use the communication facility. IBM documentation describes how to do this.

VTCS Considerations for ELS Client/Server

If VTCS is installed on the system, you must ensure that both the VTCS CONFIG and the MVS HCD define all virtual tape drives (VTVs) on the hosts where HSC will run. VTDs do not need to be online to the server host, but the server host must have a CHPID to all virtual tape storage subsystems (VTSSs) accessed by client systems, for sending ECAM messages to a VTSS.

If all VTDs are not currently defined to the server host, execute the VTCS CONFIG utility to update the server host VTD definitions. For example, assume HSC will run as a server on MVSA and the VTCS CONFIG has the following HOST statement:

```
HOST NAME=MVSA

     VTD LOW=9000 HIGH=901F
```

Add the following statement and execute the VTCS CONFIG utility:

```
     VTD LOW=9020 HIGH=903F NOVERIFY
```

ELS Client/Server in IBM's JES3 Environment

In general, ELS client/server in JES3 has the same requirements as in JES2. However, it is important to note that in JES3, the allocation will be performed by a JES3 GLOBAL host, while message processing may be done by the JES3 LOCAL host. The HSC designated as the server for *both* the GLOBAL and LOCAL hosts must have all device addresses defined in the LIBGEN and VTCS CONFIG, and all virtual device addresses must be defined in the HCD of the server host.

SMC Command Parameter Recommendations

The following section describes several SMC command parameters that may affect the ELS client/server environment.

MONITOR Command Parameters

By default, the SMC subsystem will start a communications monitor task. The primary functions of the communications monitor include the following:

- If there are currently no active server paths, attempt to communicate to each path in sequence to establish a path. If a path is successfully established, pending mounts are redriven.

- If SMC is currently active on a server path other than the first server defined ("primary" server), attempt to communicate with the first server in the list. If communication can be re-established, switch the current active path back to the primary server.

- The communications monitor task periodically checks for pending mounts that have been requested but not satisfied. Virtual mounts are automatically redriven.

MONITOR Command

By default, the communication monitor is enabled when SMC is initiated. You can disable the monitor by specifying the command MONitor INTerval(OFF). The default value is 60, meaning that the monitor functions are repeated every 60 seconds.

MONITOR PREFPRIMARY Parameter

By default, the communication monitor prefers the primary (first defined) server. You can alter this behavior (no automatic server switch as long as there is an active communication path) by specifying MONitor PREFprimary(OFF).

TAPEPLEX Command Parameters

Whether or not you are using the SMC client/server capability, at least one TapePlex must be defined to SMC. The SMC TAPEPLEX command has a number of optional parameters:

TAPEPLEX WTORDEST Parameter

The WTORDEST parameter provides the ability to relay HSC WTOR messages associated with mounts (such as scratch shortage, volume not in the library, etc.) to the SMC client console. Depending on the ELS operating environment and your automated message handling procedures, you may want to set the WTORDEST(CLIENT) option on the TapePlex to allow responses to be entered from the client console rather than the HSC server console. WTORDEST(CLIENT) is honored for both local and remove HSC servers.

TAPEPLEX LOCSUBsys Parameter

The LOCSUBsys parameter allows you to define the subsystem name of a HSC subsystem executing on the same LPAR where SMC executes. SMC always attempts to use the local path first if one is defined.

SERVER Command Parameters

SERVER WAIT Parameter

The WAIT parameter indicates the number of seconds SMC will wait for a response before it assumes that a communication or server problem exists. By default, SMC waits 300 seconds (5 minutes) for a response to a mount or dismount request. If the specified WAIT parameter is less than the mount default, it applies only to allocation volume lookup requests; if the specified WAIT parameter is greater than the mount default, it applies to all requests. The default WAIT value of 60 seconds is adequate in most installations. However, if your HSC CDS backup job duration exceeds the WAIT time, allocation volume lookup requests will time out and cause server switching to a different HSC system, which also will be unable to respond to the request during the backup window. Therefore, you should set the WAIT parameter to match the normal execution time of the CDS backup job.

SERVER RETRY Parameter

The RETRY parameter indicates the number of times SMC will retry sending a specific message to the server. The default value of 3 is usually sufficient, but you may want to increase this value depending on the network reliability. If an error occurs when the message is sent to the server, SMC waits one second and then retries, up to the maximum number of retries specified. If the error occurs in receiving the response, for nonmount requests SMC waits the specified server WAIT time, then retries the request up to the specified number of retries. For mount requests, SMC tracks the mount failure on the drive and redrives the mount once a successful request to the server is processed, if the mount is still outstanding.

ALLOCDEF Command Parameters

ALLOCDEF FAILNOINFO Parameter

The ALLOCDEF command FAILNOINFO parameter may be used to indicate how allocation should be managed when SMC is unable to determine volume information due to the inability to communicate with one or more TapePlexes. When SMC is unable to obtain volume information from the server, it is unable to exclude drives from allocation that are unsuitable, and may, for example, allow a virtual volume to be allocated to a real tape drive. By specifying the FAILNOINFO parameter, you can cause the job to fail at allocation rather than forcing the job to be cancelled when a volume cannot be mounted. FAILNOINFO values are ON, OFF, and SPECIFIC. If FAILNOINFO SPECIFIC is specified, and SMC communicates with a TapePlex that recognizes the specific volume, the unavailable TapePlex is ignored. If FAILNOINFO ON is specified, and SMC communicates with a TapePlex that recognizes the specific volume or has available scratch volumes based on the policy, the unavailable TapePlex is ignored.

UNITATTR Command Parameters

UNITATTR TAPEPLEX Parameter

The UNITATTR command TAPEPLEX parameter allows a TapePlex name to be specified for a device address or range of device addresses. This parameter can be used to define drives as belonging to a TapePlex before the HSC associated with the TapePlex is active, which in turn allows SMC to manage the redrive of mounts associated with the devices using defined policy information (such as

scratch subpool). The TAPEPLEX parameter also may be used to define which TapePlex SMC should consider the "owner" of a device address that is defined in more than one HSC TapePlex.

HTTP Command

The SMC HTTP server function should be started only on hosts where there is an active HSC subsystem. The format of the SMC HTTP command is:

```
HTTP START PORT(port_number)
```

Additional HTTP command parameters are described in the Oracle StorageTek ELS publication *ELS Command, Control Statement, and Utility Reference*.

Converting to an ELS Client/Server Environment

Assume the ELS administrator wants to convert from running HSC and SMC on a number of LPARs to a client/server environment. The following steps are an example of a plan to achieve the desired configuration:

1. Plan the final configuration before starting the conversion (see the earlier section, Getting Started with ELS Client/Server Capability.)

2. Select one of the server hosts currently running HSC, and start the SMC HTTP server function on that host. For the purposes of this example, the TCP/IP host name for this server host is MVSA. For the SMC system executing on MVSA, add the following SMC command to the SMCCMDS dataset:

```
HTTP START PORT(8888)
```

3. Select a "pilot" client host, and define appropriate TAPEPLEX and SERVER statements. For the purposes of this example, the TCP/IP host name for this pilot client host is MVSB. Define HSC on the pilot host as the local subsystem for the TapePlex. For the SMC system executing on MVSB, add the following SMC commands to the SMCCMDS dataset:

```
TAPEPLEX NAME(HSCLIB) LOCSUB(HSC0)

SERVER NAME(SRV1) TAPEPLEX(HSCLIB) HOST(MVSA) PORT(8888)
```

4. Start the SMC subsystem as usual, then disable the local subsystem and attempt to communicate with the server:

```
TAPEPLEX NAME(LIB) LOCDIS
```

5. Verify that communications with the remote TapePlex are successful by issuing the TAPEPLEX STATUS command.

6. Once the client/server configuration is working for the pilot client host, start the SMC HTTP server function on a second HSC server host. For the purposes of this example, the TCP/IP host name for this second server host is MVSC.

7. Define the second server as an alternate for the first server for the pilot SMC client executing on MVSB:

```
SERVER NAME(SRV2) TAPEPLEX(HSCLIB) HOST(MVSB) PORT(8888)
```

8. On the pilot SMC client executing on MVSB, disable the first server; SMC will automatically attempt to communicate using the second server:

```
SERVER NAME(SRV1) DISABLE
```

9. Re-enable the first server and force a switch back to it:

```
SERVER NAME(SRV1) ENABLE

RESYNC
```

Alternatively, if you do not issue the RESYNC command, the SMC communication monitor will automatically switch back to SRV1 within the monitor interval (default 60 seconds).

Any local HSC system that was executing on MVSB is now replaced by the HSC servers on MVSA or MVSC. The local HSC system executing on MVSB now can be eliminated.

10. Continue to convert additional client hosts in a similar manner until the desired final configuration is attained. Ultimately in this example, SMC HTTP server tasks and HSC subsystems are operating on MVSA and MVSC and are sharing the same CDS and hardware configuration. The SMC client on MVSB has primary and secondary server paths defined to MVSA and MVSC. Additional SMC clients with TAPEPLEX and SERVER definitions identical to those defined for the SMC executing on MVSB can be added as required. Theoretically, an unlimited number of SMC clients can be added without adding any more SMC HTTP servers or LPARs running HSC/VTCS servers.

SMC Communication Error Messages

When SMC is unable to communicate with a TapePlex over any defined path (either a local subsystem or a SERVER path), a highlighted message is issued that remains highlighted until communication is established. The message text will define the type of error encountered.

In addition, if a particular communication request fails, SMC issues a message indicating that the communication is unsuccessful. In general, an unsuccessful communication request causes SMC to attempt to switch to another communication path.

Additional ELS Client/Server Considerations

The ELS client/server capability is designed to be completely compatible both upwards and downwards between releases. Therefore, when upgrading to a new ELS release, administrators can upgrade the client and server hosts in any order.

SMC Drive Address Mapping

This section addresses some special considerations for drive address mapping when an SMC client communicates with more than one HSC TapePlex (represented by separate HSC CDSes, one for each TapePlex.)

The POLICY parameter associated with TAPEREQ can be used to specify a TapePlex name for drive allocation.
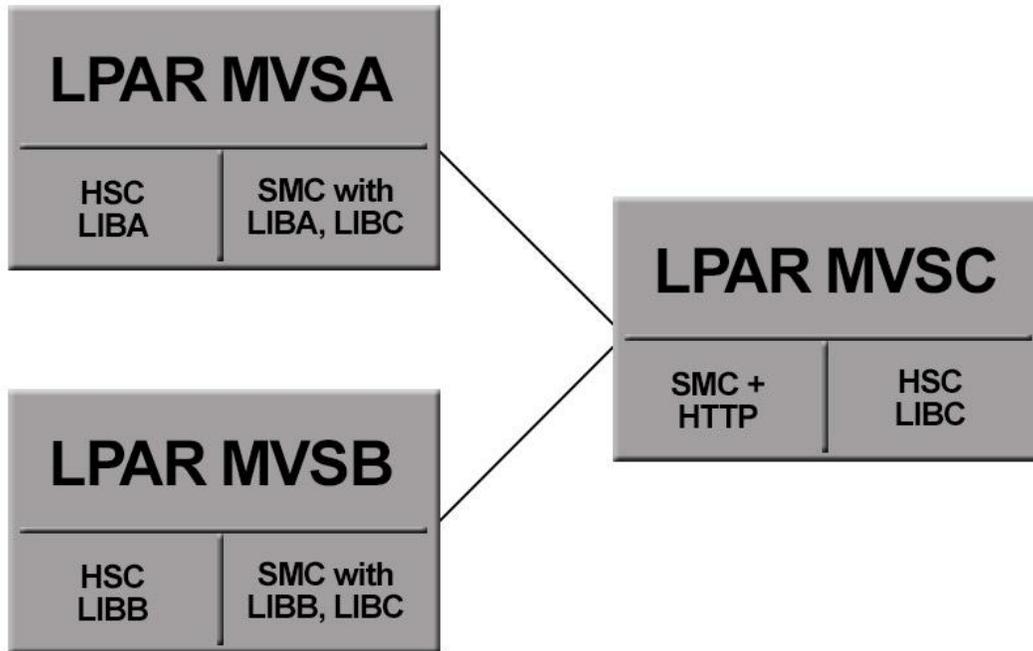

Figure 1. Drive mapping scenario 1 with HSC and SMC

Drive Mapping Scenario 1

SMC provides device address mapping capabilities to allow you to manage an environment where drive addresses are different on different hosts. The following example illustrates the use of the drive mapping feature in a complex multiple TapePlex environment.

In drive mapping scenario 1, the assumption is that each HSC (on MVSA, MVSB, and MVSC) is a different physical TapePlex configuration with a different CDS, and that each LPAR is executing SMC. On MVSA and MVSB, SMC accesses both the local TapePlex and the remote TapePlex on MVSC. Assume the following device address configuration:

On MVSA, tape UCBs exist for 0800-080F, 0900-090F, and 9000-903F. The drives 0800-080F are real drives defined in the HSC called LIBA, the drives 0900-090F are real drives defined in the HSC called LIBC, and the drives 9000-903F are virtual drives defined in the HSC called LIBC.

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On MVSB, tape UCBs exist for 0900-090F, 0A00-0A0F, and 9000-901F. The drives 0900-090F are real drives defined in the HSC called LIBB, the drives 0A00-0A0F are real drives defined in the HSC called LIBC, and the drives 9000-901F are virtual drives defined in the HSC called LIBC. (Note that the drives 0900-090F are physically different devices from the ones on MVSA defined in LIBC.)

On MVSC, tape UCBs exist for 0900-090F, 0A00-0A0F, and 9000-901F, and all are defined in the HSC called LIBC.

In SMC, if the same device address is reported by multiple TapePlexes, the TapePlex that SMC will consider as the drive owner is unpredictable. To ensure that the device UCB address on the client maps to the correct device address on the server, Oracle recommends that you use the HSC and SMC drive mapping features to avoid conflicts in the device addresses. For this example, follow these steps:

1. Execute the HSC SLUADMIN SET utility to create a new "dummy" drive host and establish it as the drive host name. The utility can be executed on any host, with HSC active or inactive; however, the change goes into effect only when HSC on a host is recycled. For example:

```
SET NEWHOST(DUMMYDRV) LIKEHOST(MVSB)

SET DRVHOST(DUMMYDRV)
```

This suggestion assumes that the HSC CDS does not already define the maximum of 16 allowable hosts. If there are no empty host "slots" in the CDS, one alternative is to plan the client/server conversion so that you first convert hosts that do not have overlapping device addresses in order to free up a host slot to use as the drive host. Another possibility is to define the host where HSC will run as the DRVHOST, and follow the remaining steps in this procedure. One disadvantage of using a "real" host as the dummy drive host is that HSC messages may show dummy device addresses instead of the real addresses.

2. Select dummy device addresses to use to replace those that are duplicated. These addresses should not be defined in any system as a tape device, but they may be either disk device addresses or unused device addresses in the configuration. For the example, select 0E00-0E0F and 0F00-0F0F as the dummy addresses for the two versions of 0900-090F. Run the SET SLIDRIVS utility to assign the dummy addresses to the dummy drive host. The utility can be run on any host whether HSC is active or not; however, the change goes into effect only when HSC on a host is recycled.

```
SET SLIDRIVS(0E00-0E0F) FORLSMID(00:00) FORPANEL(0) +

FORHOST(DUMMYDRV)

SET SLIDRIVS(0F00-0F0F) FORLSMID(00:00) FORPANEL(0) +

FORHOST(DUMMYDRV)
```

3. For the virtual drives, execute the CONFIG utility to add the DUMMYDRV HOST. If you have defined a DRVHOST, the DUMMYDRV HOST must be defined for VTCS even though the drive addresses are the same and are not mapped to different addresses.

- Run the VTCS DECOM utility to create a current version of the VTCS configuration. The following example shows a portion of the VTCS DECOM output for a sample configuration:

```
NAME=VTSS1 LOW=70 HIGH=80 MAXMIG=3 RETAIN=5

HOST NAME=MVSC

      VTD LOW=9000 HIGH=901F

HOST NAME=DUMMYDRV
```

- Edit the DECOM CONFIG output to add the VTD addresses to the DUMMYDRV host. If the VTD addresses are different for different hosts, assign dummy addresses to the VTDs.

- Ensure that all VTDs accessible to any client are defined for all hosts that will execute as servers. The VTD statements for server hosts should include the NOVERIFY option for the devices that are not actually defined to the server host. (The NOVERIFY option is not required on the DUMMYDRV host, since HSC/VTCS will never be started on a host named DUMMYDRV.) The following is an example of the CONFIG input after modification:

```
NAME=VTSS1 LOW=70 HIGH=80 MAXMIG=3 RETAIN=5

HOST NAME=MVSC

      VTD LOW=9000 HIGH=901F

      VTD LOW=9020 HIGH=903F NOVERIFY

HOST NAME=DUMMYDRV

      VTD LOW=9000 HIGH=903F
```

- Alternatively, assume that the VTD device addresses are different on some hosts. In that case, define the VTD addresses for the DUMMYDRV host to be alias device numbers. For example:

```
NAME=VTSS1 LOW=70 HIGH=80 MAXMIG=3 RETAIN=5

HOST NAME=MVSC

      VTD LOW=9000 HIGH=901F

      VTD LOW=9020 HIGH=903F NOVERIFY

HOST NAME=DUMMYDRV

      VTD LOW=F000 HIGH=F03F
```

- Execute the CONFIG utility with the updated input.

4. Recycle HSC on all hosts. (The SET utility can be run with hosts active, but the change is not recognized until HSC is recycled.)

5. Issue the SMC DRIVEMAP command for each SMC, or update the SMCCMDS dataset and recycle the instances of SMC. The SMC DRIVEMAP command maps the HSC DRVHOST device addresses to the LPAR UCB addresses. For the SMC on MVSA and MVSC:

```
DRIVEMAP CLIENT(0900-090F) SERVER(0F00-0F0F)
```

For the SMC on MVSB:

```
DRIVEMAP CLIENT(0900-090F) SERVER(0E00-0E0F)
```

The SMC on host MVSC uses the DRVHOST device addresses even though its own host ID (MVSC) is defined in HSC CDS; therefore, it also requires a DRIVEMAP command to map the addresses.

6. If you are using VTCS and have used the DUMMYDRV host to set up dummy VTD addresses, you can issue SMC DRIVEMAP commands for all client hosts to map the client UCB drive addresses to the DUMMYDRV virtual drive addresses. In the example above, where the VTDs were assigned drive addresses F000-F03F in the DUMMYDRV host in the VTCS CONFIG, the following DRIVEMAP command is used on SMC on MVSA:

```
DRIVEMAP CLIENT(9000-903F) SERVER(F000-F03F)
```

On MVSB and MVSC:

DRIVEMAP CLIENT(9000-901F) SERVER(F000-F01F)

Drive Mapping Scenario 2

Another scenario that may require the use of drive mapping is a device address that may be switched between two TapePlexes. For example, assume that device address 0800 on host MVSA normally maps to a drive in HSCA; for example, ACS 00, LSM 00, panel 0, slot 0. Assume that under some circumstances cables are switched so that device address 0800 is physically controlled by HSCB, ACS 01, LSM 01, panel 0, slot 0. Again the drive mapping feature in HSC and SMC can be used to tell SMC which TapePlex controls device number 0800.

Similar to drive mapping scenario 1, the shared address should be mapped in both HSC systems to different unique device addresses using the DRVHOST facility. Assume the DRVHOST is set on HSCA so that the drive at ACS 00, LSM 00, panel 0, slot 0, is specified as 0900. Similarly, set the DRVHOST on HSCB so that the drive at ACS 01, LSM 01, panel 0, slot 0, is specified as 0A00. Use the SMC DRIVEMAP command to map the client drive address 0800 to the default drive.

```
DRIVEMAP CLIENT(0800) SERVER(0900)
```

This will cause SMC to direct mounts to 0800 to TapePlex HSCA, ACS 00, LSM 00, panel 0, slot 0. If the drive is physically switched, update the drive map by issuing the following commands to SMC:

```
DRIVEMAP OFF
```

```
DRIVEMAP CLIENT(0800) SERVER(0A00)
```

```
RESYNC
```

When these commands are issued, SMC will refresh its drive information and will now direct mounts to 0800 to TapePlex HSCB, ACS 01, LSM 01, panel 0, slot 0.

Drive Mapping Scenario 2: An Alternative Approach

Another alternative in this scenario is to use the SMC UNITATTR command to define the TapePlex that "owns" the drive that represents the device address on the SMC host. For example, assume that two TapePlexes, HSCA and HSCB, both have a VTD range from 9000-90FF, but these devices are in

two physically different VTSSs. A host MVSA has UCBs defined for the address range of 9000-90FF, and has TAPEPLEX statements pointing to both HSCA and HSCB. These UCBs are actually mapped to the VTSS defined in HSCB. The following SMC UNITATTR statement directs SMC to use the HSCB definition of these drives and not the HSCA version:

```
UNITATTR ADDR(9000-90FF) MODEL(VIRTUAL) TAPEPLEX(HSCB)
```

When SMC communicates with TapePlex HSCA, it ignores any references to addresses 9000-90FF. In addition, when SMC communicates with TapePlex HSCB, the drive model for these device addresses from HSC or VTCS overrides the MODEL parameter specified in the UNITATTR statement.

Conclusion

Oracle's StorageTek Enterprise Library Software solution offers a client/server capability that allows storage administrators to execute SMC and HSC on different MVS hosts, or LPARs. When organizations use StorageTek ELS client/server capability instead of executing HSC on each host, they can realize several benefits:

- Reduce global tape outages

- Reduce host-to-host communication bottlenecks

- Reduce CDS contention

- Reduce library contention

There are additional benefits for users of Oracle's StorageTek Virtual Storage Manager system, including a reduction in the number of VTCS hosts, performance improvements, and internal scratch cache consistency.

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May 2014

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