FUJITSU Storage ETERNUS CS8000 in IBM® z/OS® environments

White Paper

Radically simplifying backup and archiving.

Content

Mainframe – reliable and powerful

For decades, mainframes have stood for maximum data availability. Furthermore, mainframes can handle large quantities of data and support numerous end users. Mainframe computers thus play an important role in hosting business-critical processes, for example in banking, insurance, government and for many other enterprises; they help to run complex and large programs and databases with thousands of users such as customer lists, payroll and accounting information.

The importance of the data managed by mainframes not only requires a reliable and powerful host system but also an equally reliable and powerful data protection solution. After all, backup is your last line of defense against data loss.

History of the Virtual Tape in the IBM z/OS environment

In 1996 IBM launched the first virtual tape system, the VTS. In 1998, StorageTek (today Oracle StorageTek) followed with its VSM. Both solutions were built to support only the IBM z/OS platform. Several other IBM z/OS ISV and hardware providers also built Virtual Tape Solutions for this platform, but were not able to gain a significant share of the market. In 1999 Fujitsu Siemens Computers (today FUJITSU) launched its CentricStor virtual tape solution which became the most open, flexible virtual tape library supporting a great range of existing mainframe and major Unix and Windows operating systems as well as major tape libraries. Today CentricStor is known under the name ETERNUS CS8000. It has been conceptually designed as a data protection appliance to be used with all types of tape management and backup software, servers, tape libraries and tape technology. It was initially released to support the BS2000/OSD, MVS mainframe platforms and ADIC tape libraries. However, it has evolved over the years into the most versatile data protection appliance which can be deployed in almost any environment and while protecting your previous investments in tape automation. Today, IBM mainframe customers use ETERNUS CS8000 on a global scale as their Virtual Tape Appliance, either just for z/platforms or in conjunction with open systems platforms (e.g. UNIX, Linux, Windows).

History of ETERNUS CS8000 in IBM z/OS environments

ETERNUS CS8000, the data protection appliance from FUJITSU, has had a record of success in the mainframe environment since 1999. The appliance is used around the world by the largest data centers in very data-intensive segments, such as financial services, insurance, telecommunications, public administration, industry and IT service provisioning. Its ongoing development has continued for many years in close collaboration with a well-established user group. This all translates into optimal support and a keen awareness of the demands arising from daily system use – all based on real-world best practices.

Why use ETERNUS CS8000?

True Tape Virtualization

FUJITSU Storage ETERNUS CS8000 makes the cross-media mix of disk and tape technology extremely efficient and thus benefits from the best of both worlds. For the mainframe host the appliance appears as a virtual tape library (VTL) – but that's not all: the unified ETERNUS CS8000 platform provides an intelligent management of cross-media mix – known as automated Information Lifecycle Management (ILM). The appliance combines the strengths of disk and tape with rule-based management, providing seamless and automated backup-to-disk-to tape (B2D2T) processes. ETERNUS CS8000 is not only the ideal target for mainframe backup but it also offers the highest degree of flexibility in the market. It supports mainframe and Open Systems backup and archiving as well as disk-only.Furthermore in the Open Systems Environment two other Interfaces can be used to store data.

The **ViNS (Virtual Network Storage)** subsystem provides a virtual very large file store that is accessed through NAS Interfaces, currently using the NFS and/or CIFS protocol. Client data is first stored on the internal RAID storage allowing very high throughput. The space available on the RAID is internally expanded to tape volumes by using a HSMS (Hierarchical Storage Management Service). For the purpose of providing virtually unlimited amount of space in a file store, the HSMS migrates data from RAID storage to tape volumes and keeps only a small amount of metadata online. When a host accesses migrated data the HSM will do a recall of the data from tape to the RAID system. For the host the recall is transparent regarding the access interface. It will only recognize an increased latency for data access. The ViNS subsystem also provides a function to replicate entire file systems to a second ETERNUS CS8000 system. The replica is intended to serve as a data backup in disaster cases.

The **Cloud Object Storage (COS)** subsystem provides a flat object storage which is accessible via TCP/IP connection to available external Ethernet interfaces using the COS protocol compatible to the part of Amazon S3 REST API. The S3 API became a standard interface for object oriented storage and is supported by commonly used host backup applications. The API defines a set of HTTP requests with described structure, authentication/ authorization mechanism and JSON/XML serialized response format to allow upload and retrieve user data as objects.

Highest levels of data availability

ETERNUS CS8000 provides the highest level of data protection possible thus ensuring the availability of business-critical data from the mainframe environment.

- **Highly available appliance ensures backup processes:**
  To terminate complex, time-consuming and error prone tape management, ETERNUS CS8000 handles the management of all target systems, providing a highly available virtualized tape robot. The redundant architecture enables reception of the backup data, even if a component should fail, e.g. if the physical tape drive fails, then the data is automatically directed to another tape drive or tape library in order to ensure that the data is safe.
- **Tape reorganization and self-healing:**
  The tape reorganization function effectively utilizes the capacity available. Furthermore, regular reorganization of tape media refreshes the magnetization. The appliance automatically makes quality checks of duplicate copies. If an error occurs, the self-healing functionality recovers the inaccessible information from the other copy in order to ensure the availability of data even over the very long-term. The self-healing also plays an important role if a copy is requested for a restore case but is not available for some reason. The recall request is automatically redirected to the second copy, the data is provided and the job for the backup software is done. The automated self-healing also recovers the failed copy and the level of redundancy is thus restored.

- **Flexible copy management:**
  ETERNUS CS8000 manages different levels of data availability. Data can be mirrored between two sites, replicated over very long distances and saved as multiple copies. This function is user-defined and policy-based. There is almost zero management effort after setup.
- **Automated continuation with cache mirror:**
  The core element of the most disaster resilient architecture is one logical ETERNUS CS8000 system which is deployed over two geographically separate sites, the so called "split-site" configuration with "cache mirror". The internal infrastructure is thereby extended to a second site. The host still sees one logical setup without being aware of the geographical location. The result is a system with no single point of failure which continues to run even after a complete site failure.

Investment protection

ETERNUS CS8000 is based on a modular architecture. Independent building blocks provide a genuine scale-out platform in both, capacity and performance. Tape libraries are decoupled from the backup software. A wide range of libraries and tape drives are supported. Even if the libraries and drives are different, they can be connected in parallel. This makes it very easy to introduce a new generation of tape libraries or tape drives. ETERNUS CS8000 handles the data migration, from the old library to the new one.

Consolidation of mainframe and open systems

ETERNUS CS8000 is a unified data protection appliance for all applications and the complete physical and virtual server environment, comprising mainframe and open systems. Flexible VTL and NAS support integrates backup, archiving, compliant archiving and second-tier file storage, while supporting the complete consolidation of heterogeneous environments - resources are leveraged and the costs are dramatically reduced.

Objective of this White Paper

The next section provides you with basic architecture information in order to show the differences between ETERNUS CS8000 and other VTL (Virtual Tape Library) appliances and technical IBM z/OS-related aspects.

The main part of this White Paper will focus on the IBM z/OS environment and how to get ETERNUS CS8000

- Installed
- Customized
- Operated
- Optimized
- Performance-tuned

A general overview with more details about principles, architecture and the advantages of ETERNUS CS8000 belong to the White Paper: "Technical Concepts of ETERNUS CS8000".

ETERNUS CS8000 - Short System Overview

From a hardware viewpoint the ETERNUS CS8000 appliance operates as a modular system, built up with appliance processor nodes (front-end and backend) and internal disk storage which can consist of a number of RAID systems. The internal disk storage can act as cache storage for data or as the target disk store. l. The front-end processor nodes (ICP – integrated channel processors) act as an interface to the hosts.

From an outside-in viewpoint, ETERNUS CS8000 is seen as a huge backup repository leveraging the advantages of a tape infrastructure while eliminating the disadvantages via an embedded virtualization layer. The backend processor nodes (IDP – integrated device processor) operate the HSM (Hierarchical Storage Management) services with interfaces to the attached target storage systems with a tape interface, i.e. tape drives and tape libraries, WORM tape or disk libraries. A disk based backend target can also be another ETERNUS CS8000.

The third type of processor node, the Virtual Library Processor (VLP), performs the appliance management services. Some of the services are used for configuring, operating and monitoring the appliance. Other services are specific for the subsystems. For the VTL subsystem the VLP also performs the inventory services for logical volumes, physical volumes and the tape volume cache (TVC) management. The VLP also provides TCP/IP-based control services for the virtual library emulation at the front-end and the physical tape libraries at the backend. The possible number of processor nodes with front-end/backend operation is currently a maximum of 20. The possible number of RAID systems is a maximum of 16 that provide a usable capacity of up to 350 PB. The scale-out cluster architecture allows seamless future extensions beyond the current limits.

Models of the ETERNUS CS8000 Series

The standard building blocks enable that each system can be configured and seamless scaled up according to individual needs. Each configured system is manufactured in Fujitsu's own factories and has to pass strongest quality assurance processes before delivery. The components are installed in Fujitsu standard racks. All racks are 42HUs height and 1100mm deep with an asymmetric construction for optimized cable management and enhanced service access.

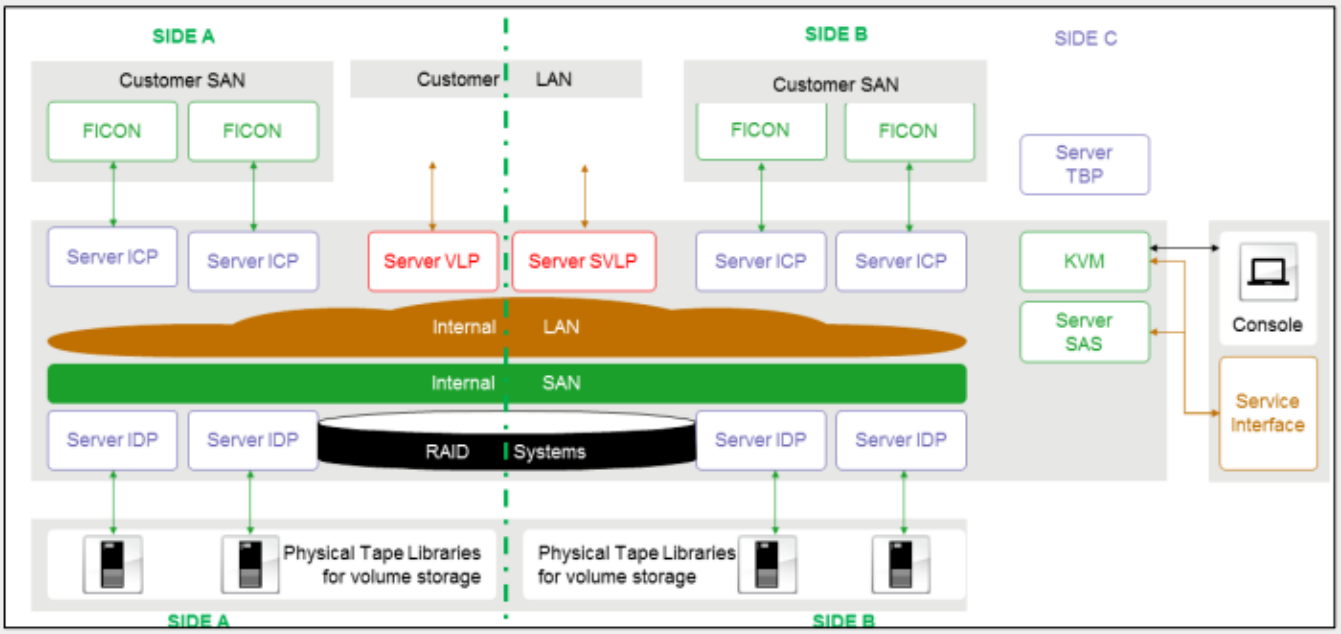
Each model configuration can be tailored to almost any individual needs with the possibility for further specific extensions. The storage subsystems ETERNUS CS8000 VTL and ETERNUS CS8000 NAS can coexist within a single appliance, but depending on the specific customer requirements, some functions may be limited or excluded. Tailored configurations differ basically in the degree of component redundancies and data throughput. Extensive throughput requirements are possible with a flexible scalability regarding number of interfaces and RAID storage capacity. The basic functions of the embedded appliance operating software can easily expanded with optional functions by activating respective license keys.

Dual-site / Split-site Configuration

IBM z/OS mainframes are designed to support the most critical applications of a business, such as banking, assurance, automotive and reservation systems etc. They have to support high volumes of transactions and very fast response times, as well as be up and running all the time with a minimum of outage. These mission-critical applications also require the highest degree of security, availability and systems management. ETERNUS CS8000 models for these highest availability demands are built with redundant processor nodes, redundant RAID systems and internal network redundancies and its failover control and management software. Such redundancies make it possible to distribute an ETERNUS CS8000 system configuration physically over two geographically distributed locations A

and B whereas the appliance cluster framework still operates as one single logical entity. The internal communication and data transfer infrastructure of the appliance is extended in such a way that maintains the logical structure of the internal SAN and LAN. The distance between the two locations greatly relies on the long distance network infrastructure which has to be provided in order to extend the internal SAN. This architecture concept helps to implement synchronous cache mirroring between locations A and B in an easy manner. Even if the cluster is split into two parts, the clustered nodes on each site are able to work with the cluster file system (CAFS) which resides at their site.

Figure 1: Architecture of synchronous cache mirror



Please note the third location **Site C** and the Tiebreaker Processor (**TBP**).

The Tie-Breaker Processor (TBP) works as an arbitration entity in case the SAN and LAN connection between the locations A and B breaks down and the CAFS cluster is split into two parts. The TBP helps to decide which side of the ETERNUS CS8000 system is to continue working with the IBM z/OS and which side is to be deactivated. The definition of such quorums is essential to ensure that a functioning and consistent file system remains available and that no split-brain situation occurs when a location fails or when connections between locations are interrupted. The Tie-Breaker should ideally reside on a third location with a separate power supply line. If there is no third location, the Tie-Breaker can be installed either at location A or location B based on the requirements of the DR set-up.

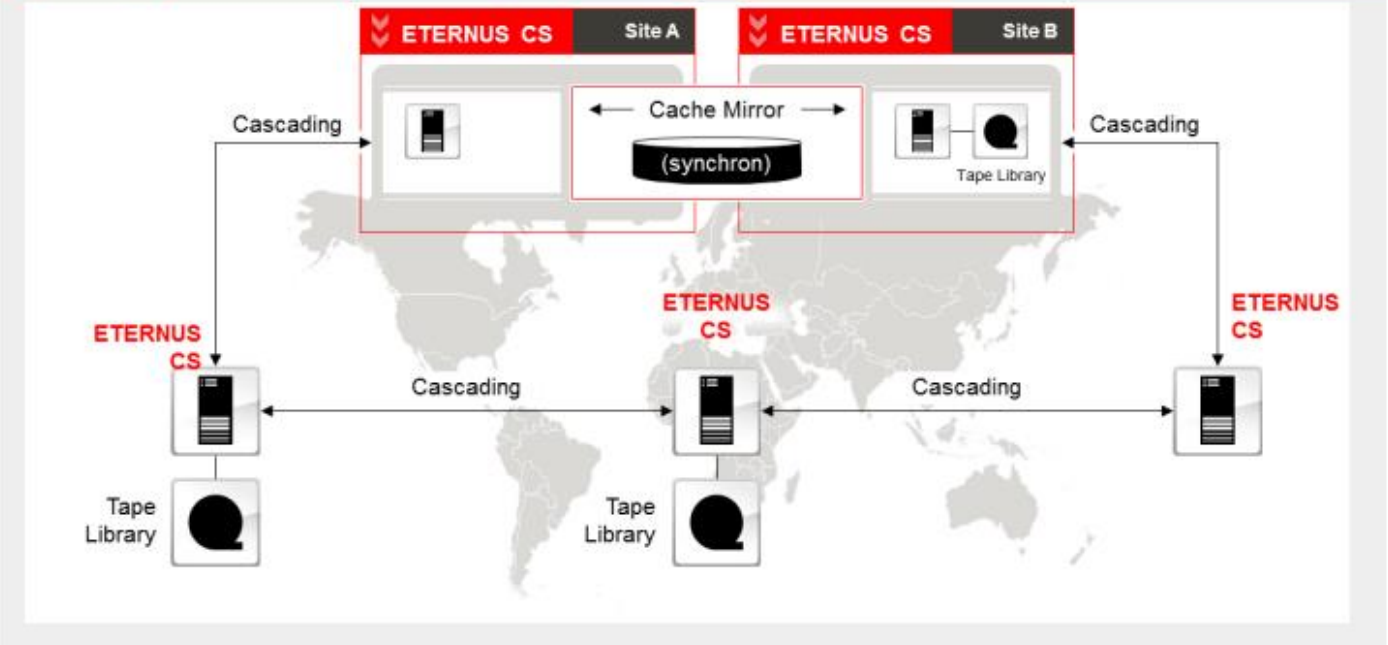
For more detailed information about the split-site configuration please read sections 3.4 and 4.4 in the White Paper: "Technical Concepts of ETERNUS CS8000".

Cascaded Configuration / Long Distance Replication

ETERNUS CS8000 can also be configured and used as a typical "GRID" Environment. As shown in the configuration below, a split-site system can copy the data asynchronously into another split-site system or a single-site system, such as a Global Mirror Environment and vice versa.

A split-site ETERNUS CS8000 configuration operating as a source system already maintains two volume copies (like Dual Save). A second ETERNUS CS8000 system at the remote site is connected via a long-distance network. This target system can also be a split-site system or just a single-site system. The target system receives the third volume copy via Triple Save as defined by the source system. The second ETERNUS CS8000 VTL target system which can be very far away from the split-site source locations is suitable for disaster recovery. In the event of a major disaster that affects the two locations covered by the split-site configuration, the target system can take over the work from the source location.

Figure 2: Long distance volume replication with split-site source sytem



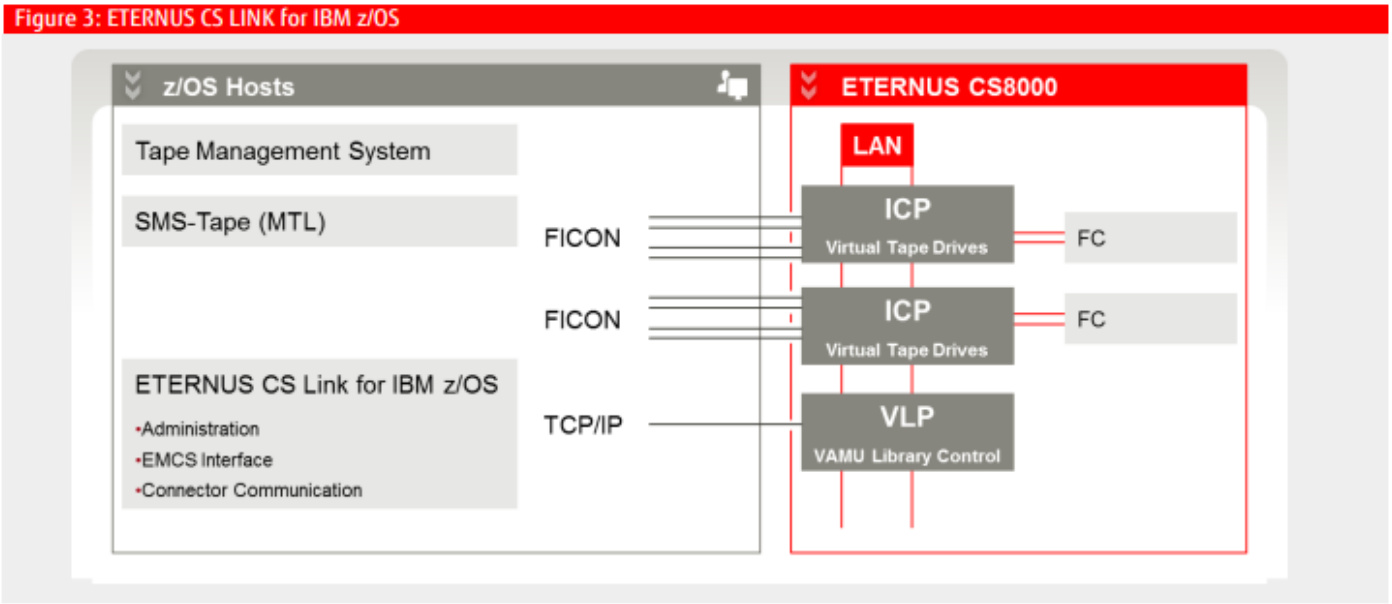
ETERNUS CS8000 in IBM z/OS environments

An ETERNUS CS8000 data protection appliance behaves towards IBM z/OS systems like physical IBM-3490E 36 track and/or IBM-3590 128 track tape technology and can communicate with more than one LPAR or SYSLEX in parallel. The virtual tape drives (devices) offered by ETERNUS CS8000 are configured like physically connected devices within the IBM z/OS HCD Dialog. The physical connection between ETERNUS CS8000 and the IBM host is implemented with FICON or over the FICON director channels. From an implementation viewpoint the connection is established by the host software for an ATL (Automatic Tape Library) which runs as a subsystem in IBM z/OS.

The Library Communication from the Mainframe Started Task is via a TCP/IP connection The Virtual Library Service (library emulation) is set to VAMU in the ETERNUS CS8000 installation and customizing dialog; the type of physical library attached to the backend of the ETERNUS CS8000 is not visible to the host.

Depending on the system type and the number of FICON ports in the front-end processor nodes the ETERNUS CS8000 can provide a respective number of virtual drives towards the host.

Figure 3: ETERNUS CS LINK for IBM z/OS



Configuration of Logical Drives

From the host viewpoint each virtual tape drive is connected like a physical tape drive. The ETERNUS CS8000 can be controlled in several ways (additional information about the control software is in the appendix). This White Paper focuses on ETERNUS CS LINK for IBM z/OS Library Management Software to integrate ETERNUS CS8000 as a MTL (Manual Tape Library which was established with the Release IBM z/OS 1.5) into an IBM z/OS environment. The MTL definitions are performed via the 'Define Device Parameters / Features' panel of HCD. An MTL resident device is defined by specifying YES for MTL and valid values for the LIBRARY-ID and LIBPORT-ID fields. The LIBRARY-ID identifies a library within a SYSPLEX. A LIBPORT-ID corresponds to a control unit within a defined library. The values for the LIBRARY-ID and LIBPORT-ID are arbitrary because MTL libraries are purely logical entities.

One ICP (Integrated Channel Processer = front-end node of an ETERNUS CS8000) can be licensed with 16, 32, 64, or 128 virtual tape drives. As a maximum of 10 ICPs is offered, the overall number of virtual tape drives can be up to 1280. Each ICP can be attached with a maximum of 4 physical FICON Channels.

Please note:

For a heterogeneous environment the ICPs can be shared between mainframe and open systems. In such a situation, the front-end processor is equipped with a FICON and a Fibre Channel Card, each with 2 ports. The configuration for the drives can be symmetric, e.g. 64 + 64 as well asymmetric 32 + 96 depending on the expected system load. The granularity of drive definitions should not be less than 8.

The following HCD examples describe a configuration level for 64 tape drives.

For IBM z/OS, an ICP represents up to 8 x 3490E Control Units (CU). A single 3490E controller supports 16 devices. On FICON channels four logical control units are defined to represent all 64 drive addresses. The IOCP sub parameter CUADD within the UNITADD statement is used to define the logical control units (0-7). In a configuration of 64 logical drives per ICP, only CUADD=0, CUADD=1, CUADD=2, CUADD=3 are required. The total amount of 1280 drives per ETERNUS CS8000 cannot be exceeded. Every ICP is equipped with at least two FICON ports which should be used for redundancy. Two FICON cards can be implemented in the ICP so that a maximum of 4 physical FICON channels can be used for each ICP, Long Wave and Short Wave FICON Mode are supported. Both, a direct connection and a switched configuration via a FICON director (switch), are possible.

Figure 4: HCD Definition: Control Unit and IO Device Definition with Path Relation

```
CNTLUNIT CUNUMBR=7000,PATH=((CSS(0),30,32)),                    *
      UNITADD=((00,016)),LINK=((CSS(0),26,26)),CUADD=0,         *
      UNIT=3490
IODEVICE ADDRESS=(7000,016),CUNUMBR=(7000),STADET=Y,UNIT=3490
CNTLUNIT CUNUMBR=7010,PATH=((CSS(0),30,32)),                    *
      UNITADD=((00,016)),LINK=((CSS(0),26,26)),CUADD=1,         *
      UNIT=3490
IODEVICE ADDRESS=(7010,016),UNITADD=00,CUNUMBR=(7010),          *
      STADET=Y,UNIT=3490
CNTLUNIT CUNUMBR=7020,PATH=((CSS(0),30,32)),                    *
      UNITADD=((00,016)),LINK=((CSS(0),26,26)),CUADD=2,         *
      UNIT=3490
IODEVICE ADDRESS=(7020,016),UNITADD=00,CUNUMBR=(7020),          *
      STADET=Y,UNIT=3490
CNTLUNIT CUNUMBR=7030,PATH=((CSS(0),30,32)),                    *
      UNITADD=((00,016)),LINK=((CSS(0),26,26)),CUADD=3,         *
      UNIT=3490
IODEVICE ADDRESS=(7030,016),UNITADD=00,CUNUMBR=(7030),          *
      STADET=Y,UNIT=3490
```

Figure 5: HCD Drive Definition

```
--      OPERATING SYSTEM CONFIGURATION ID: PROD01
-       --- DEVICE ---       DEVICE
         NUMBER,RANGE      TYPE - MODEL SS PARAMETER           A                          FEATURE
-------------------------------------------------------------------------------------------------------
          7000,16         3490             OFFLINE=YES,DYNAMIC=Y,LOCANY=YES
                                           LIBRARY=NO,AUTOSWITCH=NO,LIBRARY-ID=10000,
                                           LIBPORT-ID=40,MTL=YES                    SHARABLE,COMPACT
```

Please note:

The values for LIBRARY-ID, LIBPORT-ID, and the MTL=YES definition are relevant and required for the MTL LIB configuration and for the installation and usage of the ETERNUS CS LINK for IBM z/OS communication and control software. The LIBRARY ID will be referenced (and is mandatory) in the SMS environment and must be specified again in the ISMF Library Definition Dialog. The LIBRARY-ID can be specified arbitrary (but non-zero); the 5-digit hexadecimal value must be unique within the SYSPLEX in order to identify this library among all the MTLs and ATLs within the SYSPLEX. The LIBPORT-ID can be specified arbitrary (but non-zero); 2-digit hexadecimal value. Although the value is arbitrary, it is recommended that the values begin with x"01" and increase accordingly. All devices physically attached to the same control unit and defined within the same MTL must have the same

LIBPORT-ID value. The number of devices with the same LIBPORT-ID value in the same library cannot exceed 16.

Figure 6: HCD 3490 MTL Tape Drives Device Parameter

```
---------------- View Device Parameter / Feature Definition ---------------
                                                                  Row 1 of 10
Command ===> ____________________________________________ Scroll ===> PAGE

Configuration ID . : ZOSLPA1        ZOSLPA1
Device number  . . : 7000           Device type  . . . : 3490
Generic / VM device type  . . . . : 3490

ENTER to continue.

Parameter/
Feature    Value             Description
OFFLINE    NO                Device considered online or offline at IPL
DYNAMIC    YES               Device supports dynamic configuration
LOCANY     YES               UCB can reside in 31 bit storage
LIBRARY    NO                Device supports auto tape library
AUTOSWITCH NO                Device is automatically switchable
LIBRARY-ID 10000             5 digit library serial number
LIBPORT-ID 01                2 digit library string ID (port number)
MTL        YES               Manual Tape Library (NOTE: PORTID LIMIT=32)
SHARABLE   YES               Device is Sharable between systems
COMPACT    NO                Compaction
------------------------------------------------------------------------------
```

ETERNUS CS LINK for IBM z/OS Concept and Description

Concept

ETERNUS CS LINK for IBM z/OS is the Library Management Software to integrate ETERNUS CS8000 into an IBM z/OS environment. The concept is:

the use of standard IBM z/OS mechanism for tape allocation and mount influence

coexistence with all other available software for this purpose (e.g. NCS, ELS)

support of tape management systems (CA1, TLMS and DFSMSrmm)

support of None Tape Management System Environments
Note: Other tape management systems may be supported on a case-by-case base.

ETERNUS CS LINK for IBM z/OS provides the following main features in IBM z/OS:

Allocation via standard IBM DFSMS functions

Mount interpretation via EMCS console and scratch selection

TCP/IP connection to ETERNUS CS8000 connected via LAN

utilities to meet DFSMS and TMS requirements

The basic goal for this control software was to reduce the manual operator intervention and replace it by automatic functions for all requirements. All tape-related activities for mount/dismount and error handling are processed by integrated recovery functions. ETERNUS CS LINK for IBM z/OS also uses the IBM z/OS and tape management recovery function. The major basis is IBM z/OS Extended Management Console Service and SMS-MTL for selecting and allocating drives.

Description

Allocation:

The device allocation is via the IBM z/OS DFSMS MTL function. Allocations that result in unspecific (scratch) mounts are interpreted via DFSMS ACS routines and by choosing the related storage group when the corresponding logical volume group of ETERNUS CS8000 is assigned. Allocations resulting in specific mounts are monitored by IBM z/OS and are directed to the library that is recorded in the volume entry of the TCDB. Workload balancing is achieved by standard IBM z/OS algorithms.

Mount interpretation via EMCS console and scratch selection:

The interpretation of all tape-related messages is via an EMCS console task. The EMCS console task uses a message table that is customized according to the installed tape management system. All actions are pre-filtered from the global message traffic and stored within a WTO table. The message queue analyzer then builds up the action queue for the VAMU communicator. For unspecific mounts the pool name is extracted from the mount message. For DFSMSrmm tape management the available API is used to search for a suitable scratch volume. For all other tape management systems the catalog search interface (CSI) is used to select scratch tapes from the TCDB (VOLCAT), which is always kept in sync with the tape management database, if OAM address space is active. Multiple volume pools based on TMS functions can be used to organize tape data processing. The EMCS task uses the esoteric name that is generated for the ETERNUS CS logical drives to select the unit addresses that it manages.

VAMU Configuration and TCP/IP:

ETERNUS CS LINK for IBM z/OS communicates with ETERNUS CS8000 via the VAMU interface feature, which emulates a tape library. ETERNUS

CS8000 can run multiple VAMU instances which use dedicated pairs of TCP/IP ports.

Each LPAR can operate a separate ETERNUS CS LINK for IBM z/OS task (LPAR-Mode).

In SYSPLEX environments only one ELINKZ instance is needed to run in global (PLEX-Mode) mode which handle the total SYSPLEX.

The usage of a single active ELINKZ task within a SYSPLEX is strongly recommended as it reduces the overhead of synchronization between the tasks on separate LPARS. You may use multiple standby tasks to handle outages. This Standby support (Dynamic Failover by failing Primary Task) is controlled by a Heartbeat Function between the Primary and Secondary (not active) ELINKZ Started Task. The parameter SCOPE=SPEC means it is possible to support more than one CS-ELINKZ task in a SYSPLEX (SPEC-Mode).

A maximum of 4 CS-ELINKZ tasks is supported in one SYSPLEX, each managing 1 to maximal 8 LPARs.

Up to 99 independent IBM z/OS systems or LPARs can be connected with ETERNUS CS8000 appliance.

The definition of an IP4-based Internet address and one port number (default value 9055) is needed for the connection to the ETERNUS CS8000 appliance. This port number must correspond to the defined ports of the ETERNUS CS8000 VAMU definition. ETERNUS CS LINK for IBM z/OS calls the Internet address and the defined port to establish the connection. When using different TCP/IP names the TCP name used can be specified in the ELINKZ PARMLIB. The default name is TCPIP.

The VAMU started task user needs the assignment of the OMVS segment.

Installation and Customizing Process

Note: The entire installation process is described in the ETERNUS CS LINK for IBM z/OS User Guide.

The installation and version/SP/patch update process is straightforward without needing the SMP/E environment.

The installation package includes the following materials:

The installation file on a CD-ROM contains all ELINKZ software functions and sample jobs. All IBM z/OS related files are delivered in IBM z/OS XMIT format.

The media includes the following files:

Load library with all executable modules

Sample library with all JCL to install ETERNUS CS LINK for IBM z/OS

Sample parmlib with ETERNUS CS8000 VAMU configuration for 256 drives

Documentation as PDF file

IBM z/OS RECEIVE JOB in text format with allocation for XMIT files

An installation CD-ROM is delivered with each new service pack or version. Only the LOADLIB has to be replaced with the new one. New parameters or changes in the PARMLIB member, are documented in the enhancement news.

DFSFMS Considerations

The ETERNUS CS LINK for IBM z/OS/DFSMS interface invokes the Storage Management Subsystem automatic class selection routines (referred as DFSMS ACS routines) and uses the returned constructs as follows:

to alter the UNIT parameter for static or dynamic allocation requests for new data sets

to influence ETERNUS CS LINK for IBM z/OS allocation and ETERNUS CS8000 selection

The DFSMS interface has to be involved in the following phases of request processing:

During JCL interpretation or dynamic allocation, the interface is used to perform unit name substitution for the requested UNIT parameter value.

During ETERNUS CS LINK for IBM z/OS common allocation, the interface provides the means for ELINKZ device separation and directed allocation to modify the eligible device list (EDL), which ensures that a device is allocated matching the characteristics of the requested data set. At this time ELINKZ may perform scratch subpool specification, etc. The interface also ensures that the appropriate media type (logical size) is selected to satisfy the request.

Unit name substitution uses the DFSMS storage group name returned by the DFSMS storage group ACS routine to override the unit name for both static (JCL DD statements) and dynamic (SVC 99) allocation requests before IBM z/OS builds the eligible device list (EDL) for the request.

Media type and recording technique requirements for a request can be specified in the DFSMS data class instead of using a different tape technique (virtual, real) with a different capacity.

Storage groups, storage classes, and data classes can be defined and are used by the ELINKZ in the following ways:

ELINKZ uses the storage group name to perform unit name substitution as described above.

ELINKZ does not use the DFSMS storage class construct, but the ACS routines require a storage class to perform SMS allocation and to eventually assign a storage group. A default storage class thus has to be defined.

ETERNUS CS LINK does not use the data class for the selection of volume subpools. A default data class may be specified when defining the library entry to avoid unnecessary warning messages during the startup of the OAM, or if there is a need to specify different recording techniques

Figure 7: The new ETERNUS CS8000 is specified as library in the active control data set

```
  Panel  Utilities  Help
                    TAPE LIBRARY APPLICATION SELECTION

To Perform Library operations, Specify:

  CDS Name  . . . . . . . 'RZ.ETC.SCDS'
                          (1 to 44 Character Data Set Name or 'Active')
  Library Name  . . . . . ETCS00          (For Tape Library list, fully or
                                          Partially Specified or * for all)

Select one of the following options  :
  3  1. List     - Generate a list of Libraries
     2. Display  - Display a Library
     3. Define   - Define a Library
     4. Alter    - Alter a Library

If List option is chosen,
   Enter "/" to select option    _  Respecify View Criteria
                                 _  Respecify Sort Criteria

Use ENTER to Perform Selection;
Command ===>
```

... press and use the following example to define the new ETERNUS CS8000 library

```
  Panel  Utilities  Scroll  Help
                             TAPE LIBRARY DEFINE                  Page 1 of 4

SCDS Name  . : RZ.ETC.SCDS
Library Name : ETCS00

To Define Library, Specify:

  Description ==> ETERNUS CS8000 Library
              ==>
  Library ID . . . . . . . . . . . 10000    (00001 to FFFFF)
  Console Name . . . . . . . . . .
  Entry Default Data Class . . . . DCETCS
  Entry Default Use Attribute  . . P         (P=PRIVATE or S=SCRATCH)
  Eject Default  . . . . . . . . . K         (P=PURGE or K=KEEP)

Use ENTER to Perform Verification; Use DOWN Command to View next Panel;
Command ===>
```

The library ID which has been defined in the HCD process needs to be specified.
The defined library needs a Default Entry Class.
Best practice is to use a name like ETCS
No further definitions are required on page 2 of the dialog

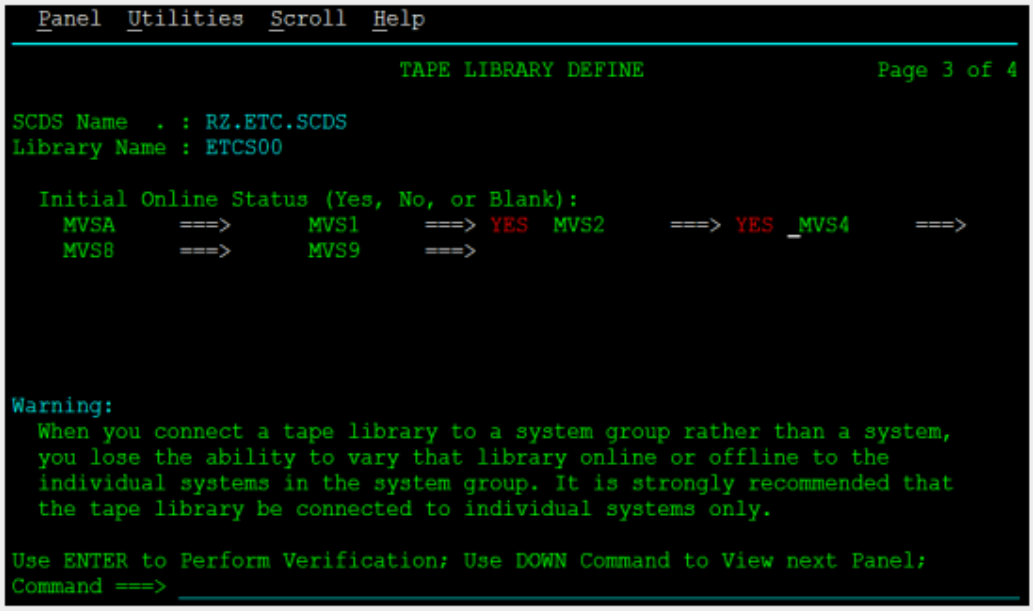
IFSFMS Considerations

ISMF Storage Administrator Mode is required to configure a new library.

Select Option 10 “Library management “in the ISMF PRIMARY OPTION MENU.

Select Option 3 “Tape Library” in the LIBRARY MANAGEMENT SELECTION MENU

Figure 8: The system is specified in which the newly created library should be ONLINE



The tape library is now defined.

The next steps are to define the

Default Data Class ISMF Dialog Option 4

Storage Groups representing the scratch subpools

Storage Class ISMF Dialog Option 5

Default Management Class ISMF Dialog Option 3

Details are provided in the following 4 figures

Figure 9: Definition of the Default Data Class (DCETCS) ISMF Dialog Option 4

Default Data Class (DCETCS) ISMF Dialog Option 4

```
 Panel  Utilities  Help
                    DATA CLASS APPLICATION SELECTION

To perform Data Class Operations, Specify:
  CDS Name . . . . . 'RZ.ETC.SCDS'
                              (1 to 44 character data set name or 'Active' )
  Data Class Name  . . DCETCS   (For Data Class List, fully or partially
                               specified or * for all)

Select one of the following options  :
  3  1. List     - Generate a list of Data Classes
     2. Display  - Display a Data Class
     3. Define   - Define a Data Class
     4. Alter    - Alter a Data Class

If List Option is chosen,
   Enter "/" to select option     _  Respecify View Criteria
                                  _  Respecify Sort Criteria


Use ENTER to Perform Selection;
Command ===>
```

For the next 6 panels the default values can be used.

Figure 9: Definition of the Storage Class Groups representing the scratch subpools

The Storage Groups representing the scratch subpools (if non-RMM TMS only one storage group is necessary).

Use the ISMF dialog again to start the definitions (Option 6).

This scratch subpool is mapped to an ETERNUS CS logical volume group (LVG). The Storage Group type is: TAPE.

```
 Panel  Utilities  Help
                    STORAGE GROUP APPLICATION SELECTION

To perform Storage Group Operations, Specify:
  CDS Name  . . . . . 'RZ.ETC.SCDS'
                        (1 to 44 character data set name or 'Active' )
  Storage Group Name    SGETCS00          (For Storage Group List, fully or
                                          partially specified or * for all)
  Storage Group Type    TAPE              (VIO, POOL, DUMMY, COPY POOL BACKUP,
                                          OBJECT, OBJECT BACKUP, or TAPE)
Select one of the following options  :
  3  1. List     - Generate a list of Storage Groups
     2. Display  - Display a Storage Group (POOL, OBJECT or TAPE only)
     3. Define   - Define a Storage Group
     4. Alter    - Alter a Storage Group
     5. Volume   - Display, Define, Alter or Delete Volume Information

If List Option is chosen,
   Enter "/" to select option     Respecify View Criteria
     _ Space Info in GB           Respecify Sort Criteria
Use ENTER to Perform Selection;
Command ===>
```

The description and the library name previously specified in the ISMF Library Dialog need to be entered in the next panel.
Remember that for non-RMM only one storage group is needed to represent the library.
The storage group is enabled by entering "Y" in the "DEFINE SMS Storage Group Status" field".

```
                        TAPE STORAGE GROUP DEFINE

SCDS Name . . . . . : RZ.ETC.SCDS
Storage Group Name  : SGETCS00

To DEFINE Storage Group, Specify:

  Description ==> ETERNUS CS 8000 Default Logical Volume Group
              ==>

  Library Names  (1 to 8 characters each):
    ===> ETCS00    ===>          ===>          ===>
    ===>           ===>          ===>          ===>



  DEFINE    SMS Storage Group Status . . Y  (Y or N)


Use ENTER to Perform Verification and Selection;
Command ===>
```

Figure 10: Definition of the Storage Class ISMF Dialog Option 5

Storage Class **ISMF Dialog Option 5**

```
 Panel  Utilities  Help
                    STORAGE CLASS APPLICATION SELECTION

To perform Storage Class Operations, Specify:
  CDS Name  . . . . . . . 'RZ.ETC.SCDS'
                          (1 to 44 character data set name or 'Active' )
  Storage Class Name  . . SCETCS00  (For Storage Class List, fully or
                                     partially specified or * for all)
Select one of the following options  :
  3  1. List          - Generate a list of Storage Classes
     2. Display       - Display a Storage Class
     3. Define        - Define a Storage Class
     4. Alter         - Alter a Storage Class
     5. Cache Display - Display Storage Classes/Cache Sets
     6. Lock Display  - Display Storage Classes/Lock Sets
If List Option is chosen,
   Enter "/" to select option    _  Respecify View Criteria
                                 _  Respecify Sort Criteria
If Cache Display is Chosen, Specify Cache Structure Name . . ________________
If Lock Display is Chosen, Specify Lock Structure Name . . . ________________
Use ENTER to Perform Selection;
Command ===> ____________________________________________________________
```

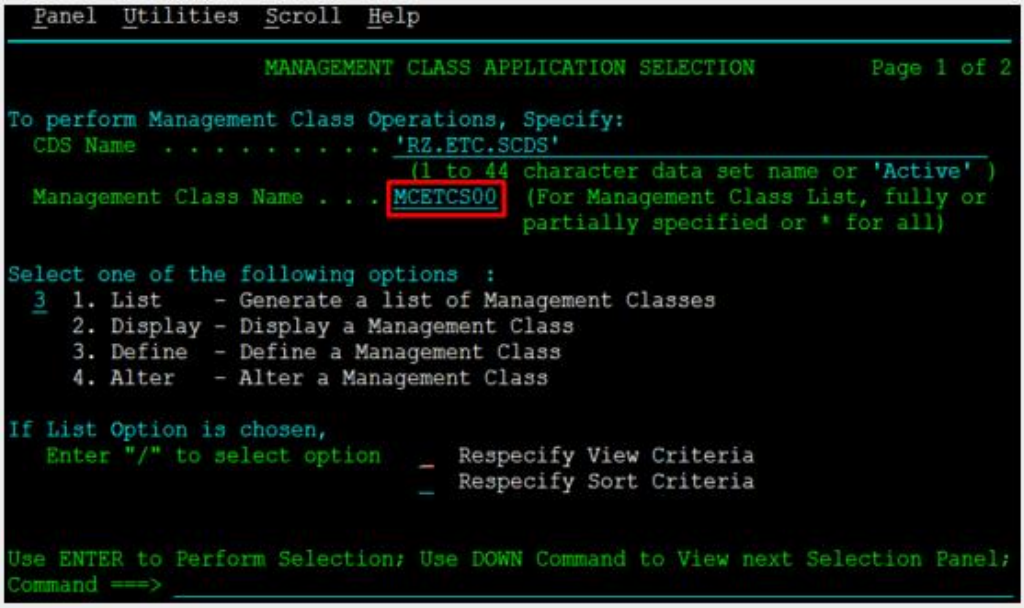
A storage class needs to be defined for SMS tape processing.
The storage class is only used for reference to ensure that the storage group can be assigned later.
All values can be kept with their default values.

```
 Panel  Utilities  Scroll  Help
                            STORAGE CLASS DEFINE              Page 1 of 2

SCDS Name . . . . . : RZ.ETC.SCDS
Storage Class Name  : SCETCS00
To DEFINE Storage Class, Specify:
  Description ==> ETERNUS CS 8000 Default Storage Class
              ==> ____________________________________________________________
  Performance Objectives
    Direct Millisecond Response . . . . ___        (1 to 999 or blank)
    Direct Bias . . . . . . . . . . . . _          (R, W or blank)
    Sequential Millisecond Response . . ___        (1 to 999 or blank)
    Sequential Bias . . . . . . . . . . _          (R, W or blank)
    Initial Access Response Seconds . . ____       (0 to 9999 or blank)
    Sustained Data Rate (MB/sec)  . . . ___        (0 to 999 or blank)
    OAM Sublevel  . . . . . . . . . . . _          (1, 2 or blank)
  Availability . . . . . . . . . . . . N           (C, P ,S or N)
  Accessibility  . . . . . . . . . . . N           (C, P ,S or N)
    Backup  . . . . . . . . . . . . . . _          (Y, N or Blank)
    Versioning  . . . . . . . . . . . . _          (Y, N or Blank)
Use ENTER to Perform Verification; Use DOWN Command to View next Page;
Command ===> ____________________________________________________________
```


Figure 11: Definition of the default Management Class ISMF Dialog Option 3

Default Management Class **ISMF Dialog Option 3**



The default values can be used for the next 6 panels within this dialog

Optimize your Backup / Restore Production Business

As described in the previous sections the ETERNUS CS8000 system in conjunction with the ETERNUS CS Link for IBM z/OS Software appears as a Manual Tape Library with up to 1280 tape drives for mainframe backup and archiving applications. For investment protection the existing tape environment may be used at the backend of ETERNUS CS8000.

Physical Tape Environment

When the existing tape environment is based on physical tapes drives, then quite often the backup jobs are consolidated to fill up the physical tapes to their maximum in order to reduce the amount of tapes required. This optimizes the physical tape usage but reduces the possibility of parallel work. The overall throughput is not optimized either. With a Virtual Tape Solution such as ETERNUS CS8000 more jobs can run in parallel until the maximum number of available Virtual Tape Drives is reached. Thanks to this parallel execution the required backup time is reduced, and backup windows can be better met. Due to the Logical Volume Group concept each application can be satisfied regarding its special requirements on logical volume size and grouping. Example: If full volume dumps of 3390-9 volumes with the DFSMSdss or Innovation FDR are to be created, it will be meaningful to use a logical volume size of 5 GB. With a compression factor of 3 each 3390-9 volume can be dumped to one logical tape volume. Space is not wasted, neither in the ETERNUS CS disk cache nor on the physical tape. Only the data which was written in compressed form is stored in the cache. The gap between the allocation of, for example, 3 GB to the max of 5 GB is not allocated and thus available for the next allocation. Smaller backups from the TSO Environment can be easily satisfied with a logical volume size group of 900 MB up to 2 GB. DB2 log files from large 'storage pools' or 3390 -54 can be grouped together into larger logical volumes like 20GB or 50GB LV Sizes. HSM backup and archiving data can be grouped together as well depending on respective business needs There are additional advantages resulting from introducing ETERNUS CS into a mainframe backup environment: The heavy start/stop operation in a plain physical tape environment is eliminated and the physical tape drives in the backend are operating in a healthy streaming mode. The allocation and re-allocation of drives requires applications to synchronize, i.e. not to block each other. With the high number of available virtual tape drives concurrent data streams can co-exist without mutual blocking.

Virtual Tape Environment

Even a migration from an existing Virtual Tape System to ETERNUS CS8000 is easy. As described above, the main advantage is to have a platform independent Virtual Tape Solution which can be shared even with an Open System backup environment. This dramatically reduces the costs and ensures that the resources within ETERNUS CS8000 (e.g., cache, front-end processors) can be shared without impacting backup requirements.

Another advantage of ETERNUS CS8000 is the scalability of up to 1280 Virtual Tape Drives in a single system - even if that system is physically split across two sites. The data is secured via real-time cache mirroring after writing from the physical block on both cache sides. With long distance replication or the cascading function work in a grid environment is possible; i.e. in total with more than 2,000 available Virtual Tape Drives. The third copy function makes it possible to have three copies of data on tape or to create a quadruple plex. You can also choose which physical tape drives and robotics are used at the backend. Several customers use different hardware (disk, tape) to have a real media break at the backend.

Migration from a foreign Virtual Tape System

Migrating a Virtual Tape System to ETERNUS CS8000 is straightforward if several factors influencing the migration are considered:

- The different tape management systems
- Backup environments
- Storage management systems and their policies
- Different robotic control environments

Which migration software should be preferred and how can Fujitsu support in such a migration?

Dedicated migration software is recommended for a very heterogeneous tape environment where several tools, programs and applications are used. It is thus possible to copy all standard application files as well as many proprietary file types, such as DB2, DFSMSdss, DFSMShsm, CA-Disk (DMS), FDR, Mobius Infopac, SAR (CA=View), SAS. All this data can be copied without any changes in the catalog environment (for example, last used or last modification date, creation job name etc.). With a streamlined backup and tape environment (such as IBM DFHSM or CA-DISK only, or Innovation FDR) the on-board tools of the respective programs are recommended for migrating its own data from the old tape environment to ETERNUS CS8000. Lots of data may not have to be migrated based on the defined retention period (for instance 40 days). It is always recommended to run the old and the new Virtual Tape System environment in parallel at the beginning of a new production phase. The new backups are written to ETERNUS CS8000 and the old backup data may expire on the old Virtual Tape System. Long term backups and archives should be migrated as listed above.

Which Tape Management Systems are supported and which Automated Tape Library Interfaces or Virtual Tape Systems can be migrated?

IBM DFSMSrmm, CA-1, CA-TLMS, as Tape Management Systems as well Non-Tape Management Environments are supported – other Tape Management Systems may be supported on a case-by-case scenario. If the existing tape environment is stored on standard IBM z/OS mainframe technique tapes, there should be no hurdles or problems migrating this data to ETERNUS CS8000.

How long does a migration from a (Virtual) Tape System to ETERNUS CS8000 take?

In general, this depends on the number of logical tapes, the physical devices in the backend of the old VTS, the usage of the tapes, and the average mount time. The following rough estimation is possible: IBM VTS (4 x 3590 backend devices) 20,000 (800 MB) Tapes in 30 calendar days IBM VTS (8 x 3590 backend devices) 50,000 (800 MB) Tapes in 30 calendar days.

How does the migration software work?

The data on the old (virtual) tape library is copied on a block level base without altering the characteristics of the data sets. The input data set characteristics (BLKSIZE, RECFM, LRECL, creating job name, creation date, etc.) are copied to the output dataset without any change. This ensures that the output dataset is an exact replica of the input dataset.

The Volume Group Concept of ETERNUS CS8000

Prior to defining logical volumes in the ETERNUS CS8000, consider

- the total number of logical volumes required,
- the volume serial ranges to define, and the
- number of volumes within each range

The VOLSERs have to be unique throughout a SYSPLEX. The number of logical volumes required for handling the workload also needs to be determined. And consider:

- the size of logical volumes,
- the number of scratch volumes needed on a daily base,
- the time needed to return to scratch processing, and
- how often scratch processing is performed.

Size of logical volumes

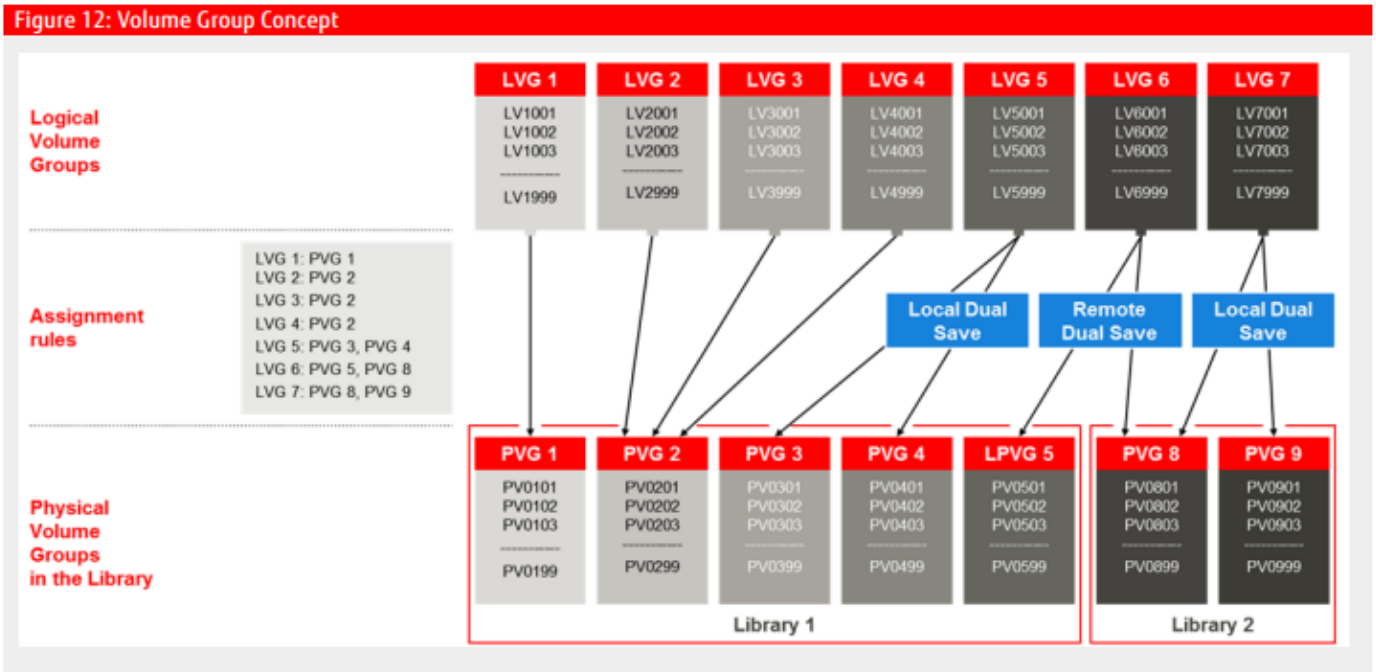
If a compression rate of 3:1 can be achieved, the effective maximum logical volume size for a 5 GB logical volume is 15 GB. ETERNUS CS8000 allows the formation of volume groups which are named entities. LVs (Logical Volumes) or PVs (Physical Volumes) with identical attributes can be grouped and their attributes can be managed by set operations, i.e. only one command is required for all elements of the group. As a high overall number of volumes can be typically found in many installations this grouping facilitates the management of LVs and PVs. It is worth grouping the HSM data with a logical volume size (900 MB – 2 GB or 4 GB) together with other small backup files. Large backup files with the same retention period should also be kept together.

Grouping is effective for LVs by LVGs (Logical Volume Groups) as well as for PVs by PVGs (Physical Volume Groups). Each LVG is associated to at least one PVG. Each PVG is uniquely associated to a tape library. If a tape library has tape drives of different types, each PVG can only be associated to tape drives of one single type within the library. At least top PVGs are thus required in order to operate a tape library with two different tape technologies.

It is possible to configure:

- Up to 3 million LVs
- Up to 513 LVGs
- Up to 101 PVGs

Figure 12: Volume Group Concept



As hosts are not aware of the volume group concept and hosts address volumes preferably by "name" (depending on the backup software: Volser, VSN, Label), sets of LVs are most conveniently formed by grouping LVs by their name. Grouping cartridges by a PVG is also handled by the administrator in consideration of the LVGs assigned to the PVG. PVGs are one of several means for the administrator to influence ETERNUS CS8000 operations. Virtual tape libraries of different type and capacity can thus basically be provided for the hosts based on a single, centrally managed physical data storage.

For each LV, as seen and addressed by the host, the LVG determines uniformly for all its LVs:

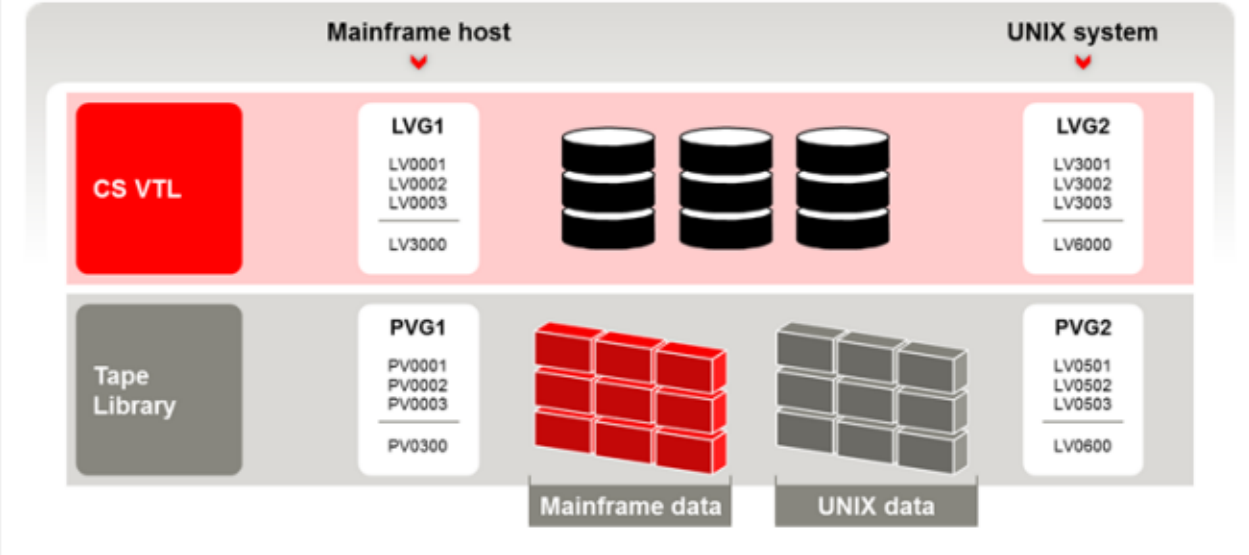
- The properties of the LVs, such as format, type of media and maximum size.
- The PV on which the data of LVs is permanently stored, by assigning the LVG to one or more PVGs. For example, with a LVG assigned to two/three PVGs, all the LVs of the LVG are saved redundantly on two/three PVGs (Dual Save/Triple Save).

The assignment of a LVG to a PVG is limited by the size and capacity of the LVs in this LVG and the capacity of cartridges in the PVG. A LV of maximum size must be stored as a whole on one single physical cartridge and cannot be split into parts and continued on a second physical cartridge.

Example for Mainframe and Open System LVG Definition

Two different systems (a mainframe host and a UNIX system) may use ETERNUS CS8000 in conjunction with a common type library system. By grouping volumes, mainframe data and UNIX data can be stored on different PVs. The LVs of the mainframe are assigned to the LVG1, while those of the UNIX system are assigned to the LVG2. These LVGs are assigned to different PVGs. As a result of these assignments, mainframe data is now stored on the PV PV0001 through PV0300, while UNIX data is stored on the PV PV0501 through PV0600.

Figure 13: Example for Mainframe and Open System LVG Definition



Before defining LVs within ETERNUS CS8000, the total number of LVs required must be considered, the volume serial ranges and the number of volumes within each range have to be defined. The VSN for LVs and PVs must be unique. The number of LVs that are required depends on the planned ETERNUS CS8000 workload. The numbers of PVs required depends on the workload and accommodated capacity at the backend of ETERNUS CS8000. The following needs to be considered:

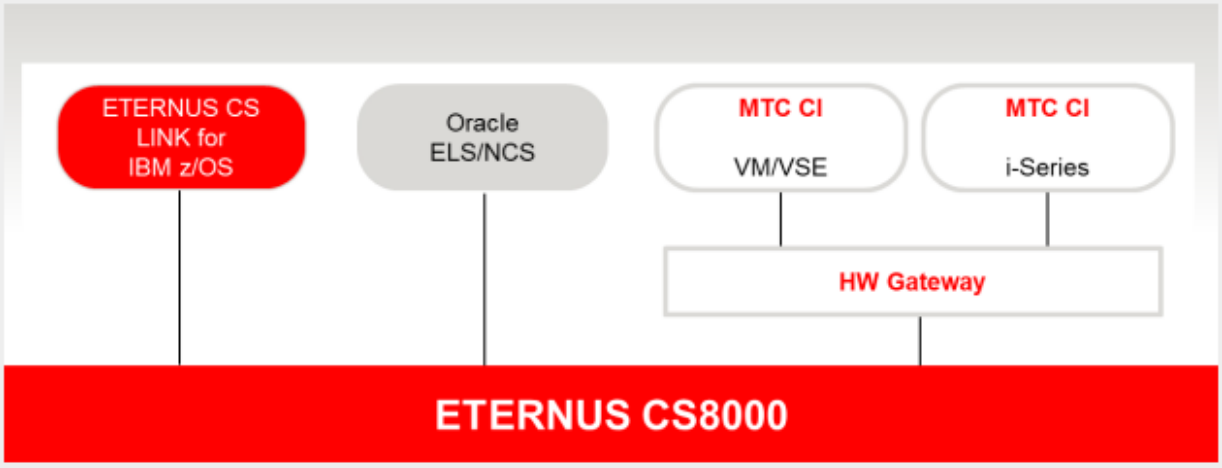
- The number of LVs/LVGs
- The average amount of data on a volume
- The average compression ratio achieved for the data
- Whether the Multiple Save function is to be used
- Whether the VAULT function is to be used
- The number of PVs/scratch PVs ν The number of PVGs

Appendix

The ETERNUS CS8000 client software family

The following shows the control software on the different mainframe operating system platforms which are offered to communicate with ETERNUS CS8000.

Figure 21: Overview - ETERNUS CS8000 client software family



The ETERNUS CS LINK for IBM z/OS is part of the ETERNUS CS8000 client software family

- ETERNUS CS LINK for IBM z/OS is the new base to integrate the ETERNUS CS8000 in large scale IBM z/OS environments. Key feature is the usage of standard IBM z/OS mechanism for tape device allocation and mount processing.
- Oracles ELS/NCS Software can be used and delivered to integrate the ETERNUS CS8000 into a heterogeneous or existing Virtual Tape Environment.
- MTC CI (for VM/VSE and i-Series) for integrating ETERNUS CS8000 into VM/VSE or i-Series environments. A hardware gateway (HW Gateway) is required and part of the offering

Please see the corresponding data sheet for more information:

- ETERNUS CS Link for IBM z/OS

For more information, please see the:

- Datasheet: ETERNUS CS8000
- Website: www.fujitsu.com/eternus-cs8000

FUJITSU Storage ETERNUS CS8000 in IBM® z/OS® environments

White Paper

For more information:

www.fujitsu.com/eternus-cs8000

Contact
Fujitsu
Fujitsu Technology Solutions
Mies-van-der-Rohe-Straße 8
80802 Munich
Germany