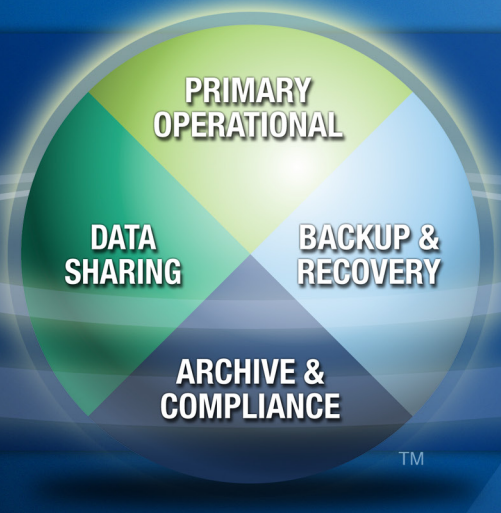
CHANNEL GATEWAY™



System Overview

LUMINEX™
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Channel Gateway System Overview
version 2.35

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March 2011

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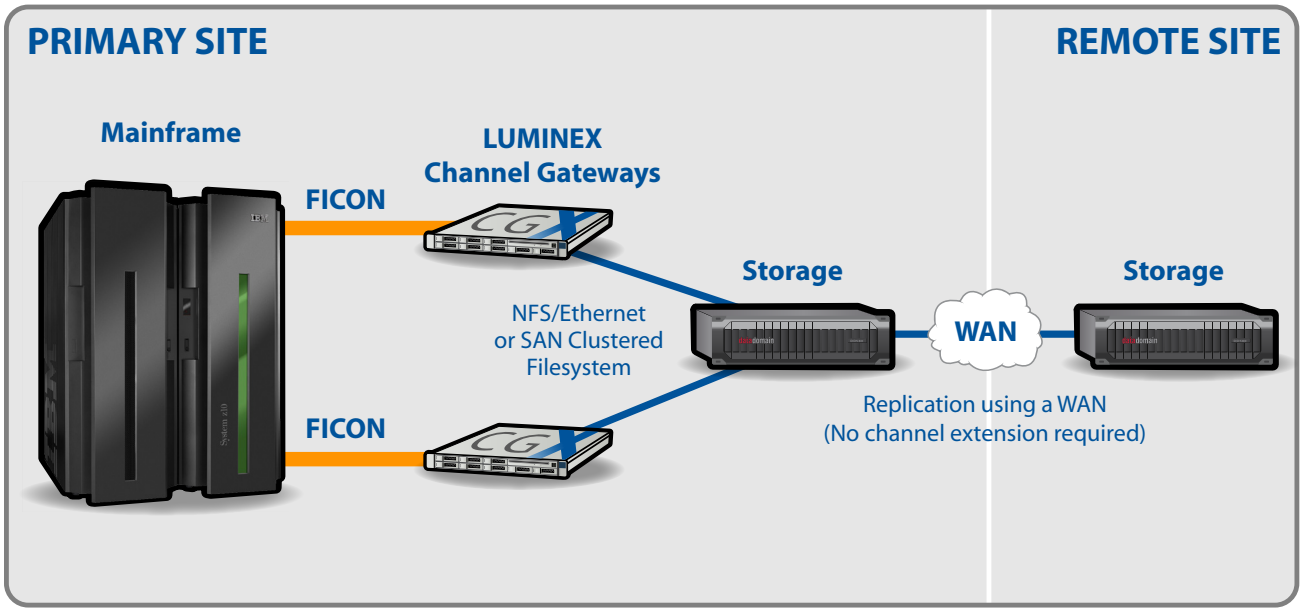
1. Product Overview

LUMINEX's Channel Gateway is a gateway product that enables Open Systems disk and libraries to be deployed as mainframe ESCON or FICON attached 3490 and 3590 tape drives. The Channel Gateway maps the ESCON/FICON protocol to the FC, SCSI or file system I/O protocol. With the use of disk storage, the handling of tapes is eliminated, RAID protection of data is provided, and no robotics are involved. All gateway activity is transparent to the mainframe and the FC/SCSI tape drives are presented as true mainframe attached tape drives.

2. Typical Configuration

Below is a diagram of a typical configuration with a storage device that includes offsite replication features.



3. Special Channel Gateway Features

3.1 No Database

There is no database needed with the Channel Gateway. Therefore there is no potential loss of data access due to a database crash.

3.2 No Tape Data on Server

In most configurations, the data storage is not on the Channel Gateway server. Therefore, a fatal error of the Channel Gateway server will not result in the loss of tape data.

3.3 Standard File Format of Virtual Tapes

All data written by the Channel Gateway are in standard Unix file formats. Data is not converted in the files (i.e. EBCDIC to ASCII). Other applications that can access standard files may also backup or restore these files (i.e. Tivoli or NetBackup).

3.4 Minimal Overhead

There is very little additional data written to the Virtual Tape files. The overhead is less than 1% of the data written.

3.5 Accessibility to Tape Data

Once the tape data has been written it is immediately available to any Channel Gateway that has access to this same storage. So, in a multiple Channel Gateway server environment, data written by one server is immediately accessible by others.

Many storage devices support some means of replication to a Disaster Recovery site. Channel Gateways at this DR site will immediately have access to that data if attached to the replicated storage. No actions are required to make this happen.

In some implementations using open-systems backup programs (Tivoli or NetBackup for example), data may be offloaded to tapes and removed from the primary storage. Later, if the data is needed, the backup program can be used to restore the data to the original location and the tape data accessed.

3.6 Virtual tape file size is configurable

When the virtual tape capacity is reached, the mainframe will present an “end of tape” status.

3.7 No operator console required

The system runs unattended.

3.8 Storage is not reserved for tapes

There is no storage wasted, as there is in physical tape, if the tape is not filled.

3.9 Reclaiming Storage

The Channel Gateway will never delete data without the appropriate commands from the mainframe. Options exist to reclaim the space when scratched or only when the scratched volume is rewritten.

3.10 Flexible Storage Media

The Channel Gateway can use a variety of disk storage devices. This storage can be network (NFS), iSCSI, SCSI, and Fiber-Channel. The Channel Gateway can utilize any of the specific features of the storage such as RAID, compression, deduplication, etc.

3.11 Multiple Virtual Tape Libraries (VTLs) and Storage Devices

The Channel Gateway supports multiple libraries and storage devices. A storage device can be an NFS mount point, a RAID LUN, or a directory on any supported storage. In a multiple storage device environment, by default, tape data can exist on any one of the available storage devices in the VTL. The method in which the device is selected is configurable. These are described below.

3.11.1 Storage by Capacity Method

When a request for a tape mount occurs, the Channel Gateway first determines if the data already exists on one of the devices in the VTL. If so, it will use that storage device. If the tape has never been used, the Channel Gateway will determine which storage devices in the VTL have the most capacity and will use it. This method allows you to balance capacity across multiple storage devices.

3.11.2 Storage by Load Method

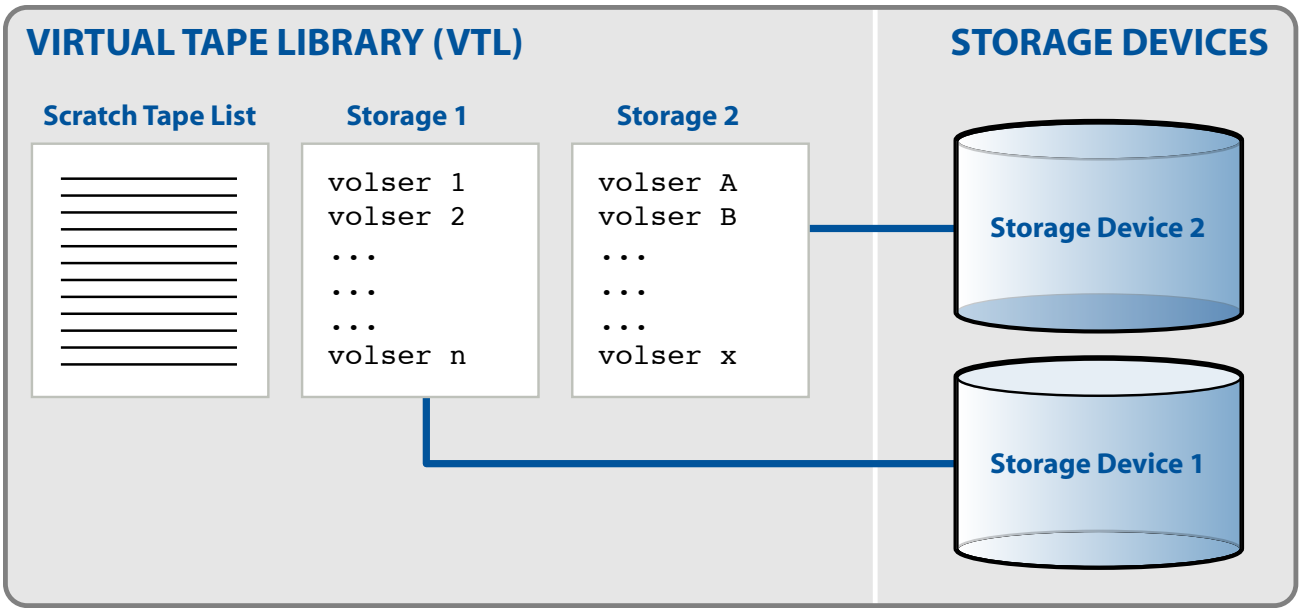
When a request occurs for a tape that has never been written, the Channel Gateway will determine which storage to use by selecting the device which has the least number of current users.

3.11.3 File Count Method

Similar to the Capacity Method, new tape mounts are placed in the storage device with the fewest files.

3.12 Configurability

The Channel Gateway is highly configurable down to the individual device. This allows users to setup different esoterics that have different functionality. For example, different devices can be configured to access different storage devices or VTLs. VTLs have different scratch pools and/or scratching methods. Different devices can have different maximum tape sizes or storage areas.



In the diagram above, Storage Device 1 or 2 can be one of the following:

- a file system,
- a LUN of a SAN, or
- a NFS export from a NAS appliance.

4. Mainframe Support

4.1 Supported OSs

The Channel Gateway supports all versions of MVS, Z/OS, and later versions of VM and VSE. For VM and VSE, additional software may be required on your mainframe to support automated mounting.

4.2 EPIC Support

With BIM-EPIC, LUMINEX has provided support for the EPIC software on VSE. The software provides support for scratch tape handling and automated mounts. Contact EPIC support for the update for these modules.

4.3 Tmount

Standard VSE does not support the mount requests to the device. LUMINEX has developed a mainframe utility that provides automated mount support. This program can be integrated with your processes. Contact LUMINEX regarding Tmount.

4.4 TapeLoad

The VM operating system does not support mount requests to the device. IBM's VMTape, if installed, will provide for the mount requests for automated mounts. If VMTape is not installed, LUMINEX can provide a utility, TapeLoad, which will provide for automated mounts. Contact LUMINEX regarding TapeLoad.

4.5 Admin+

Many times system programmers would like to perform specific operations on the Channel Gateway server. Some of these are: determining the amount of storage capacity, synchronize times, generating reports, etc. The Admin+ program provides a means by which these operations and responses can be made available to the system programmer. Due to the flexibility of Admin+ and the Channel Gateway, new features to the Admin+ utility can easily be created. Contact LUMINEX regarding Admin+.

5. Mainframe Configuration Considerations

5.1 IOGEN

The Channel Gateway is gen'd as a range of 3490 or 3590 tape drives. There is no difference between the 3490 and 3590 in the Channel Gateway. The 3490 specification is limited to 2^{22}-1 blocks and the 3590 specification is limited to 2^{32}-1 blocks. Below is a typical IOGEN report for configuring the Channel Gateway devices. This IOGEN supports 2 control units on 2 different Channel Gateway servers. Bold items are values that are typically imported to the Channel Gateways.

```
CNTLUNIT CUNUMBR=0880,PATH=((CSS(2),BA)),UNITADD=((00,016)),  *
      LINK=((CSS(2),48)),CUADD=0,UNIT=3490
IODEVICE ADDRESS=(880,016),UNITADD=00,CUNUMBR=(0880),STADET=Y,*
      UNIT=3490
CNTLUNIT CUNUMBR=0890,PATH=((CSS(2),BA)),UNITADD=((00,016)),  *
      LINK=((CSS(2),48)),CUADD=1,UNIT=3490
IODEVICE ADDRESS=(890,016),UNITADD=00,CUNUMBR=(0890),STADET=Y,*
      UNIT=3490

CNTLUNIT CUNUMBR=08A0,PATH=((CSS(2),AE)),UNITADD=((00,016)),  *
      LINK=((CSS(2),48)),CUADD=0,UNIT=3490
IODEVICE ADDRESS=(8A0,016),UNITADD=00,CUNUMBR=(08A0),STADET=Y,*
      UNIT=3490
CNTLUNIT CUNUMBR=08B0,PATH=((CSS(2),AE)),UNITADD=((00,016)),  *
      LINK=((CSS(2),48)),CUADD=1,UNIT=3490
IODEVICE ADDRESS=(8B0,016),UNITADD=00,CUNUMBR=(08B0),STADET=Y,*
      UNIT=3490
```

5.2 Multiple Control Unit Image Support

The Channel Gateway can support multiple Control Unit Images. Each image will be accessed by a different CUADD value in the IOGEN. Each Control Unit Image will consist of up to 256 devices. To support more than 256 devices, multiple Control Unit Images are required.

5.3 Multiple LPAR Support

The Channel Gateway supports access from multiple LPARs.

5.4 Device Allocation

Since the Channel Gateway looks like a typical 3490/3590 tape drive, care must be taken that the Channel Gateway devices not be in the same allocation pool as other 3490/3590 tape drives. Methods for how to do this vary with the Tape Management system in use. Some define the Channel Gateway devices as Manual Tape Libraries, others use esoterics.

5.5 Creation of Scratch Tapes

A new range of scratch tapes must be added to the Tape Management System. The Channel Gateway must also be configured to use these tapes. See Scratch Tape Management for more information.

6. Basic Operations of Tape Emulation

6.1 Channel Command Word Handling

To the mainframe, the Channel Gateway looks like an IBM 3490/3590 tape drive. It will respond to all Channel Command Words (CCWs) that are in supported in the 3490/3590 interface. The Channel Gateway application receives the CCWs, performs the appropriate action, and returns the proper status back to the mainframe. 3490/3590 sense data also provides details to various error conditions such as: Permanent Equipment Check, Read Data Check, Write Data Check, and others.

The Channel Gateway does not support the Data Security Erase and Erase Gap CCWs. When these CCWs are received, the Channel Gateway will accept them, perform no operation, and present good status back to the mainframe.

6.2 Multiple Physical Path Support

The Channel Gateway supports multiple physical paths (ESCON/FICON boards). In multiple ESCON/FICON systems, each path has access to all of the data. So if one of the ESCON/FICON boards, cables, or some other failure occurs, all of the data is still accessible from the working ESCON/FICON.

6.3 Multiple LPAR Support

The Channel Gateway supports multiple LPARs on the same path. The Channel Gateway is also compatible with path management programs such as MIM.

6.4 End of Tape Condition

When a real 3490/3590 tape reaches its storage capacity, the tape drive sends a status to the mainframe to alert it of this condition. The mainframe will quickly terminate the write, put a trailer label on the tape, and then request another tape.

- The Channel Gateway presents the same “end-of-tape” status under the following conditions:
- The configured maximum size of the virtual tape has been reached
- The disk storage has reached its capacity threshold

7. Scratch Tape Management

7.1 Creating Scratch Tapes

The Channel Gateway maintains its scratch tapes in a simple file. These tapes must also be defined in the Tape Management System as tapes available to the Channel Gateway. Any number of scratch tapes can be created but a typical number is between 10,000 and 100,000. Additional scratch tapes can easily be added by use of the Scratch Tape Synchronization method described in this document. Storage is not pre-allocated for scratch tapes.

7.2 Multiple Scratch Pool Support

The Channel Gateway can support multiple scratch lists. Since each scratch list is tied to a specific VTL, different scratch lists can be selected by choosing a different VTL by CHPID, cuport, cuimage or unit address, or through requests for different scratch media type from the tape management system. For example, RMM may request MEDIA1 or MEDIA2 which each could be associated with a different VTL. These VTLs can use the same or different storage devices. There are different configurations that will support multiple scratch pools.

7.2.1 Scratch Pool per LPAR

The Channel Gateway can support multiple Control Unit Images per server. Each Control Unit may be configured to support a single LPAR, or multiple LPARs (see section Multiple LPAR Support). If the Channel Gateway is configured for specified LPAR support, a VTL can be assigned to a particular LPAR. For example, if a Control Unit consisting of devices 600-60F is configured for LPARs 02, 04, and 05, the following scratch pools can be used:

Device	LPAR	VTL
600-60F	02	vtl02
600-60F	04	vtl04
600-60F	05	vtl05

The VTLs can share the same storage devices. You can also have VTLs selected by CHPID, cuport, cuimage and unit address.

7.3 Mounting a Scratch Tape

When a request for a scratch tape occurs, the Channel Gateway accesses the scratch list to select a volser.

When the scratch tape is mounted, the mainframe will read the VOL1 header information. The tape management system will verify that this tape is actually scratched. If not, it will unload the tape and request another-

7.4 Scratch Tape Synchronization

Periodically the tapes are expired. The Channel Gateway system must be alerted of this expiration so it can put the tapes back into its scratch list. The Channel Gateway gets scratch

tape information through JCL which sends the formatted scratch report to the Channel Gateway system. The Channel Gateway system receives this scratch report through a special, configurable tape name. For example, SCRTAP is a common tape name. The JCL will send the report to this tape. Once received that Channel Gateway will parse the report and do the following actions for each tape in the report:

- Verify that this tape is not already in the Channel Gateway scratch list
- Verify that this scratch isn't currently mounted
- Verify that the scratch has been scratched for a configurable number of days
- Verify that the volser is within a configurable pattern
- Verify that the volser is not excluded based on a configurable pattern
- Add the scratched tape to the top of the list
- Delete or not delete the data based on configuration

The JCL should be run on a regular interval to keep the tape management system and the Channel Gateway in synchronization.

There are two types of scratch reports, a full report of all current scratch tapes, or a list of the most recent scratch tapes. The advantages and disadvantages of these are described below.

7.4.1 Full Report Synchronization

A full scratch report contains all the tapes that are in the scratch status. Generally this report is quite large. The Channel Gateway will parse this entire report and add those that are not currently in the scratch list. This process can take up to 20 minutes, depending on the size of the report. Under some conditions, noted above, a scratch tape may not be added to the list. The next time the full report is sent, those affected tapes will be added to the list.

This is the most reliable method of updating the scratch list but it is the most time consuming.

7.4.2 Recently Scratched Synchronization

A report of only those tapes that have been recently scratched can be sent to the Channel Gateway. Typically this report is relatively small. Parsing of this report generally occurs very quickly. But, there are possibilities that the Channel Gateway scratch list will not properly reflect the tape management system's scratch list. For example, there is a possibility that a tape is scratched while the report is being generated; this tape may or may not be in the next report. Due to the possibilities of the scratch list not being 100% synchronized with the tape management system, this mechanism is not recommend.

8. Remote Access

Most systems are configured to allow for remote access by LUMINEX personnel. This access is used for software upgrades, configuration changes, or problem analysis. The most common method of access is through the use of a VPN of the customer's choice. Typically the access needs to allow telnet or ssh and FTP or sFTP. The customer should plan on providing this access.

8.1 IP Addresses

Typically each server is configured with 2 IP addresses that are accessible remotely. One network is for the general management of the server and should be on the general customer network. The second port is for access to the Integrated Lights Out Manager. This port provides for low-level access to the server in the event of a significant system problem. Typically this port is not used but may be required for LUMINEX support.

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