

MirrorView and SAN Copy Foundations

Upon completion of this module, you will be able to:

- Describe the functional concepts of Remote Replication on the CLARiiON Storage Platform
- Describe the benefits of Remote Replication on the CLARiiON Storage Platform
- Identify the differences of the various EMC CLARiiON Remote Replication Solutions

These are the learning objectives for this training. Please take a moment to read them.

MirrorView Foundations

CLARIION MIRRORVIEW OVERVIEW

This section will present an overview of CLARiiON MirrorView.

MirrorView Foundations

Upon completion of this section, you will be able to:

- Identify and articulate the components that make up the CLARiiON MirrorView tool
- Identify and articulate CLARiiON MirrorView management options
- Identify and articulate CLARiiON MirrorView integration with CLARiiON SnapView tool

These are the objectives for this section. Please take a moment to review them.

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EMC MirrorView – What is it?

Synchronous Remote Mirroring Between Two CLARiiON Systems

- Independent of server, operating system, network, applications, and database
- Centralized, simplified management via EMC Navisphere
- Concurrent information access when used with SnapView

The diagram illustrates the MirrorView architecture. At the top, a network diagram labeled 'Metro East' shows a central switch connected to several servers. Below this, a large yellow arrow points from 'Production A' (represented by a red cylinder) to 'Mirror A' (represented by a red cylinder). A second yellow arrow points from 'Mirror B' (represented by a red cylinder) to 'Production B' (represented by a red cylinder). The text 'MirrorView' is written between the two arrows, indicating the mirroring process. To the right of the network diagram, the text 'Local or Remote bi-directional mirroring' is displayed.

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MirrorView (known as MirrorView/S, because of its synchronous nature) is a storage-based application that resides on the CLARiiON. It provides an online, host independent, mirrored data storage and protection solution that duplicates production site data (primary) to one or two secondary sites (secondary/secondaries) in a campus environment.

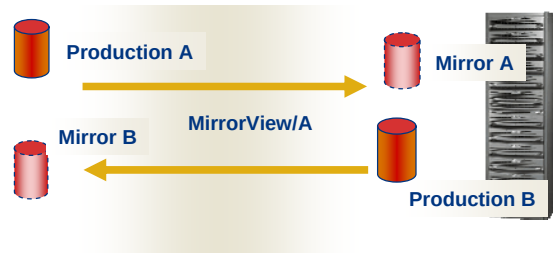
The mirroring is synchronous, meaning that every time a host writes to the primary array, the secondary array mirrors the write before an acknowledgement is returned to the host. MirrorView ensures that there is an exact byte-for-byte copy at both the local CLARiiON and the remote CLARiiON. Since MirrorView is storage-based software, no host CPU cycles are used. This allows MirrorView to operate in the background, transparent to any hosts or applications, and to be able to provide the same information protection services to all server platforms and operating system that connect to the CLARiiON.

MirrorView is fully integrated with EMC SnapView, the CLARiiON host-based software that creates consistent point-in-time copies for remote location snapshots. For simplified management and staff training, both MirrorView and SnapView are managed from within CLARiiON's Navisphere Management software. That means that the same user-friendly Windows-like interface is common among all the CLARiiON software products, which minimizes learning curves and reduces training costs.

EMC MirrorView/A

Incremental Remote Mirroring Between Two CLARiiON Systems

- Independent of server, operating system, network, applications, and database
- Centralized, simplified management via EMC Navisphere
- Concurrent information access when used with SnapView



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MirrorView/A, like MirrorView/S, is a storage-based application that resides on the CLARiiON. Unlike MirrorView/S, the mirroring is not synchronous. It provides a host independent protection solution that duplicates changes in production site data (primary) to a secondary site (secondary) at regular intervals (after an initial full synchronization). Because MirrorView/A does not use a synchronous mechanism, it is distance-independent, and allows replication over IP networks at extended distances.

MirrorView/A ensures that there is a restartable, point-in-time copy of the data at the remote CLARiiON. Since MirrorView/A is storage-based software, no host CPU cycles are used, and since it is not synchronous, host applications are unaffected by the latency of the network that connects the primary to the secondary. This allows MirrorView/A to operate in the background, transparent to any hosts or applications, and to be able to provide the same information protection services to all server platforms and operating systems that connect to the CLARiiON.

MirrorView/A is fully integrated with EMC SnapView, EMC SAN Copy, and EMC MirrorView, and uses features from all 3 of the layered applications mentioned. Part of the MirrorView/A replication process involves taking snapshots of the primary and secondary LUNs, and this implies that space must be pre-allocated in the Reserved LUN Pool on both CLARiiONs.

MirrorView/A is managed from within CLARiiON's Navisphere Management software. That means that the same user-friendly Windows-like interface is common among all the CLARiiON software products, which minimizes learning curves and reduces training costs.

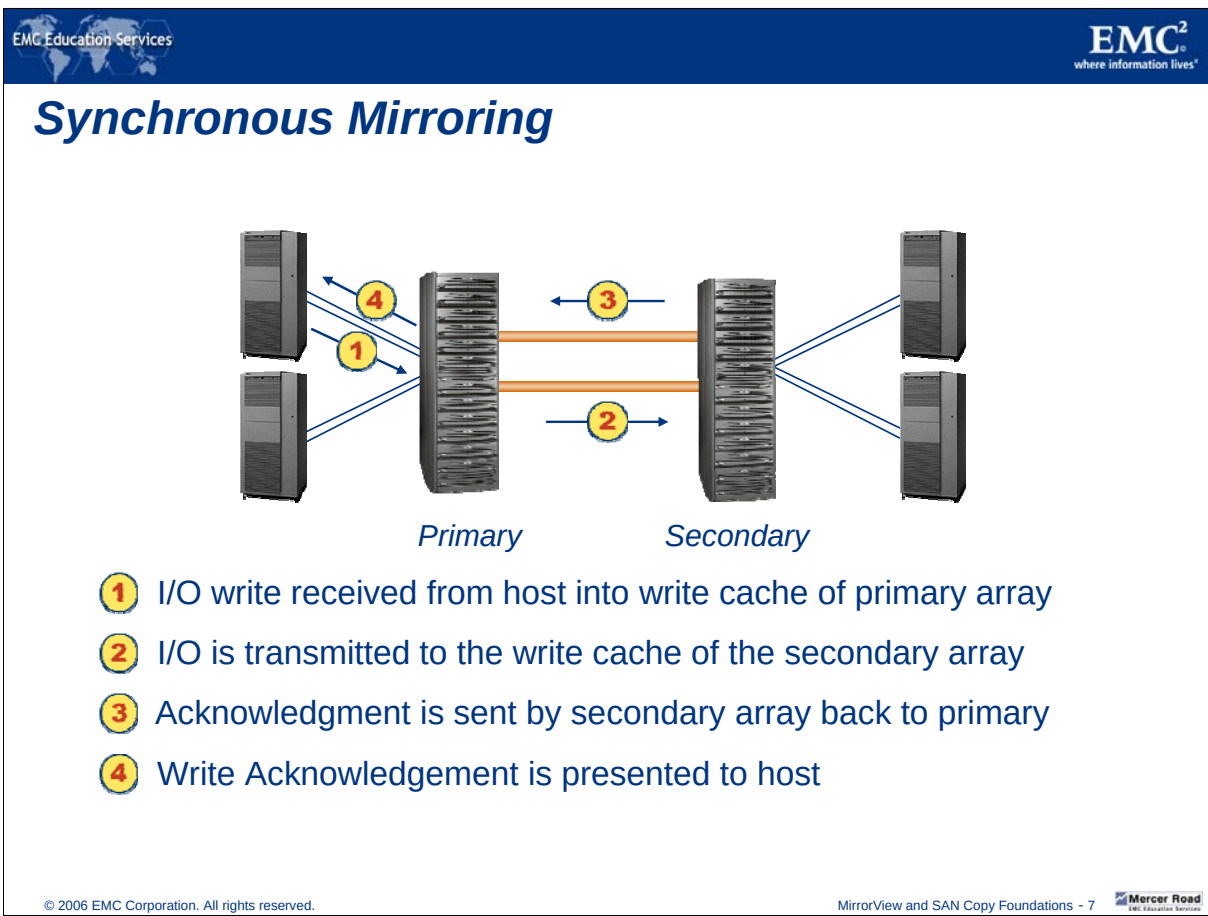
MirrorView Configuration

- MirrorView software must be loaded on both Primary and Secondary arrays
- Secondary LUN must be the same size as Primary LUN
- Secondary LUN need not be the same RAID type as Primary
- Secondary LUN not accessible to host(s)
 - Mirror must be removed or Secondary promoted to Primary for host to have access
- Bi-directional mirroring fully supported

The MirrorView software must be loaded on both arrays, regardless of whether the customer wants to implement bi-directional mirroring or not. If only synchronous mirroring is required, then only MirrorView will need to be active on the local and remote CLARiiON(s). If MirrorView/A is also required, then it will need to be activated separately, on both the local and remote CLARiiON.

The secondary LUN must be the same size, though not necessarily the same RAID type, as the primary LUN.

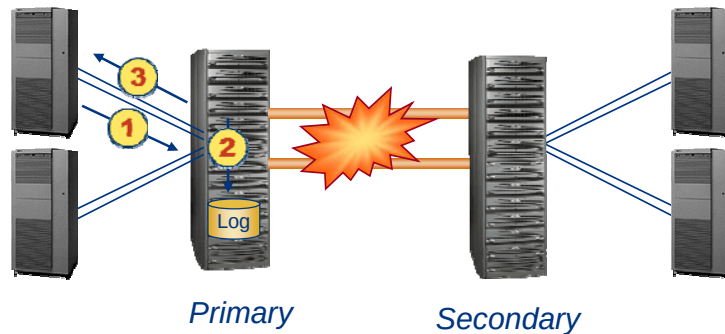
The Host cannot attach to an active secondary LUN as long as it is configured as a secondary mirror, unless you promote the secondary mirror to be the primary mirror (as seen in a disaster recovery scenario), or if you remove the secondary LUN as a secondary copy. Once this is done, a full resynchronization to the LUN would have to be performed.



CLARiiON Synchronous Mirroring occurs as follows:

- Data is sent from the production host to the source LUN (primary LUN) in the primary array. The data is loaded into cache or written to target disk if cache not enabled.
- A copy of the host's write data is sent to the Mirror LUN (Secondary LUN) in the secondary array and either loaded into cache or written to target disk, if cache is disabled.
- Acknowledgement of write completion is sent from secondary array to primary array.
- Acknowledgement of write completion is sent from primary array to production host.
- Connected SPs must be the same designation: SPA to SPA, SPB to SPB.
- A single connection is supported.
- SPs use the CMI protocol over the link when communicating.

Protection of Mirrored Data



- 1 I/O write received from host into write cache of primary array
- 2 If secondary array is not reachable, mirror marked as fractured
- 3 Acknowledgment is sent by primary array back to production host

CLARiiON Synchronous Mirroring During Fracture occurs as follows:

- Data is sent from the production host to the source LUN (primary LUN) in the primary array.
- The data is loaded into cache or written to target disk if cache is not enabled.
- If the secondary array cannot be reached, it is marked as fractured and the fracture log and, optionally, the write intent log, are updated with information about the changed data areas on the source LUN.
- Acknowledgement of write completion is sent from primary array to production host.



MirrorView Connectivity, Flexibility, and Distances

- Switch attach
 - FC/IP router >60km
 - DWDM 200km
 - Optical extender 40 km
 - Longwave GBIC 10 km
 - Shortwave GBIC 500 m
- Direct attach
 - CLARiiON to CLARiiON . . 300/500 m
 - Optical extender 10 km
- Check CLARiiON Best Practices Guide for Latest Connectivity Information

Failover Location



Production Location

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With MirrorView, you have the flexibility to architect and deploy business continuity solutions based on your business requirements, whether it is distance, performance, connectivity, and/or communication link costs. MirrorView can operate in a variety of configurations, from direct attach to using front-end switches, Dense Wave Division Multiplexors (DWDM), and even Fibre Channel over IP storage routers.

The most common attaches, for synchronous MirrorView involve using Fibre Channel switches to extend the fabric. With front-end switch support, you are able to add additional host connectivity by connecting the CLARiiON systems directly to the switches and mirroring through the switches. By adding distance extenders—either Optical extenders, DWDM devices, or Fibre Channel over IP storage routers—you can configure an environment that supports your specific business requirements, whether it is local, campus, or extended distance.

For configurations that require less host connectivity, you can deploy MirrorView in a direct attach configuration for distances up to 10 km when utilizing extender devices.

MirrorView Foundations

CLARIION MIRRORVIEW TERMINOLOGY

This section will review the terminology.

Remote Mirror Terms

- **Primary**
 - CLARiiON that serves mirrored primary data to a production host
- **Secondary**
 - CLARiiON that contains a mirrored secondary copy of primary data
- **Mirror Synchronization**
 - Mechanism to copy data from primary LUN to a secondary LUN
 - Mechanism may use fracture log/write intent log to avoid full data copy
- **Mirror Fracture**
 - Condition when a secondary is unreachable by the primary
 - Can be invoked by administrative command

In normal operation, data is committed to the secondary image as part of the I/O processing before the system acknowledges the write back to the host. However, if a secondary LUN is unreachable, then MirrorView marks the secondary image as “fractured” and records the write on the primary LUN in a fracture log.

MirrorView/A relies on SnapView to track changes made to the primary image, and will update the secondary at intervals chosen by the user.

Remote Mirror State Terms

- **Mirror Availability States**
 - Inactive - admin control to stop mirror processing
 - state applies to the entire mirror
 - Active - I/O allowed (normal state)
 - Attention - admin action required
- **Mirror Data States**
 - Out of sync - full sync needed
 - In sync - primary LUN and secondary LUN contain identical data
 - Consistent - write intent log, or fracture log, may be needed
 - Synchronizing - mirror sync operation in progress
 - Rolling back - a secondary MirrorView/A image is rolling back
- **Heartbeat**
 - Messages used to determine when a secondary is reachable
 - Heartbeats only used after secondary determined unreachable

The three mirror states are inactive, active, and attention. These states vary in the ways that they respond to read and write requests from a host. Transitions between the states is either automatic or by administrative control.

While a mirror is in any state, normal administrative operations can occur, such as adding or deleting a secondary array.

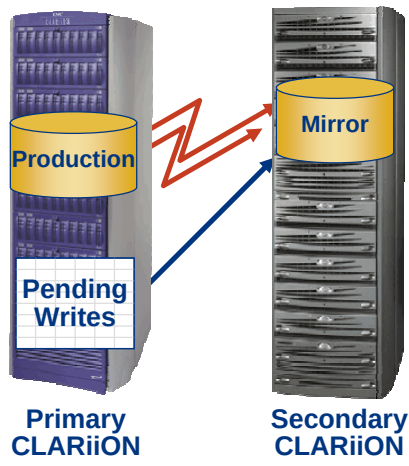
The image states are: out-of-sync, in-sync, consistent, rolling back, and synchronizing. These states represent the relationships between the primary image and a secondary image. Rolling back is a state associated only with MirrorView/A - if an update of the secondary is incomplete, and it is desired to promote the secondary (as would be the case in a disaster), then the secondary will first roll back to a consistent, previous point in time. This action makes use of the SnapView Session automatically started on a secondary image before updates are applied. The Session is automatically terminated once updates are successfully applied.



Synchronous MirrorView's Internal Protection

- Fracture Log
 - Captures pending writes to remote system when communications link is down
 - When link is restored, Fracture Log resynchronizes only pending writes since time of link failure
 - Partial re-synch greatly reduces time required to regain "synchronous" state with remote system
- Optional Write Intent Log
 - Minimizes recovery time in the event of failure of primary system or one of its components
 - Only pending writes are sent to remote site to regain "synchronous" state

Partial Re-synchronization



Primary CLARiiON Secondary CLARiiON

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Just like the CLARiiON storage system, MirrorView operates with the utmost in data protection and availability functionality. MirrorView uses two very important logs to help aid in the protection of data and timely re-synchronization in the event of fibre link failure, or if a primary or secondary system becomes unreachable.

The Fracture Log helps minimize the time to get back to a fully synchronous state with the secondary system, in the event that the secondary system becomes unreachable. This is because only the changes committed to the fracture log need to be passed to the secondary system. It also allows an administrator to temporarily fracture the mirror to perform maintenance on hosts attached to either system and, when finished, only the changes in the Fracture Log need to be written to the secondary system to get it back to a fully synchronous state.

The optional Write Intent Log gets written to each time a write request happens on a particular mirror. It helps minimize the time to get back to a fully synchronous state in the event that the primary system has a problem.

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MirrorView Remote Mirroring Consolidation

- One CLARiiON can be a target for up to four other systems
- Consolidate multiple business locations to one disaster recovery/business continuity site
- Centralized processing efficiencies
 - Backups
 - Decision support queries
 - Data warehouse refreshes

Location A Location B Location C Location D Remote Location

Source A Source B Source C Source D Target A Target B Target C Target D

4:1 Fan-in ratio

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MirrorView can also be used to consolidate, or “fan-in” information on one remote CLARiiON for purposes of consolidated backups, simplified failover, consolidated remote processing activities, and even remote bunkering. You can mirror up to four source systems to one target system. The source systems and target systems can be in any location you desire (synchronous distance limitations are listed later in the presentation); for example, you may have four local retail store fronts that perform transaction processing and you want to synchronously mirror those four locations back to one central disaster restart location where you have a failover copy as well as a copy to run backups, decision support queries, and warehouse refreshes without impacting production activities. This 4:1 ratio is also applicable to MirrorView/A.



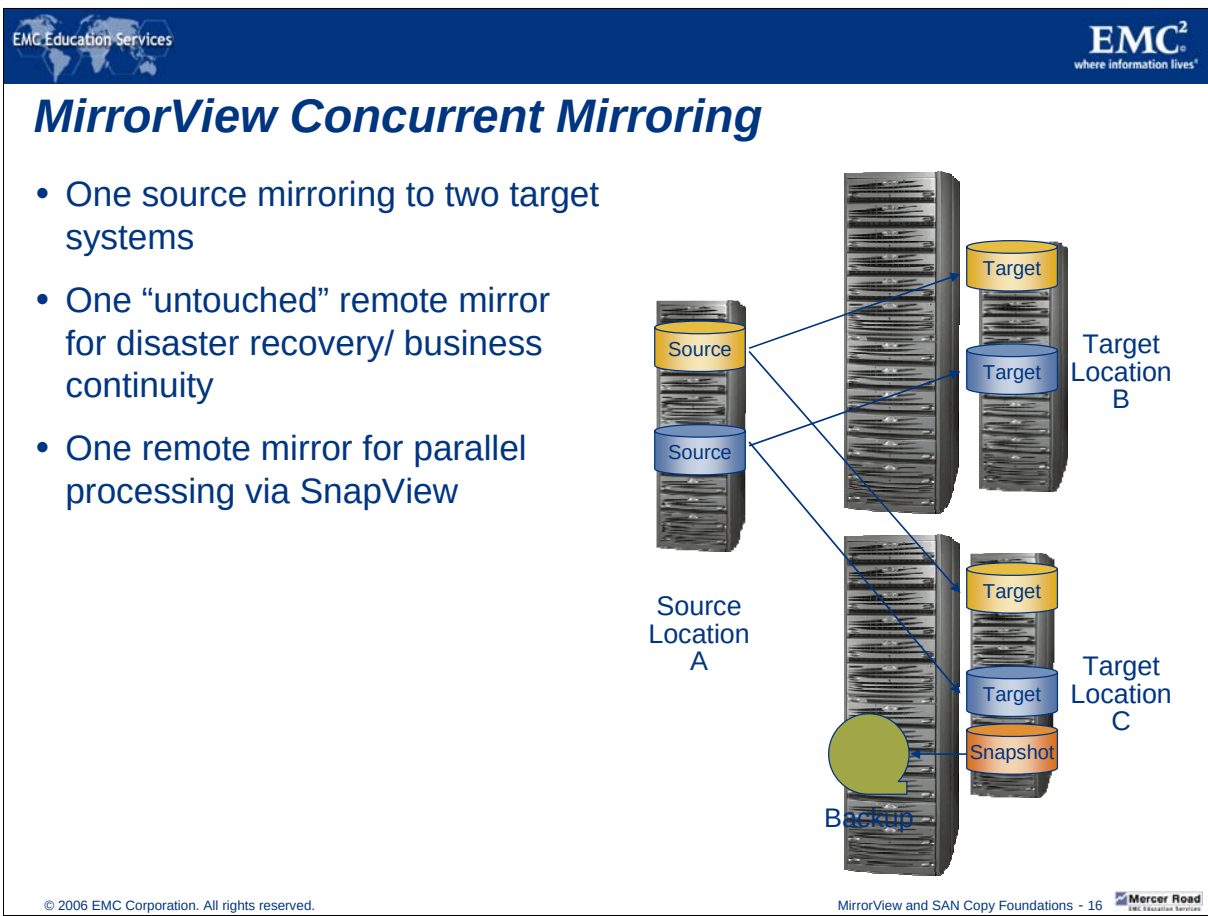
MirrorView Switched Relationships

- One CLARiiON can be both a source and a target to other systems
- Up to four relationships per CLARiiON
- Enables bi-directional remote mirroring for maximum protection of all information
- Place information exactly where you need it

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Similar to the previous consolidation example, where you can mirror four (4) source CLARiiONs to one target CLARiiON, utilizing MirrorView's bi-directional capability, any CLARiiON can be engaged in up to four relationships with other systems. That means you can have each system be both a source and a target, and the relationship can even be with different systems.

In this example, you can see that there are still four main locations and one remote location; however, instead of one failover location, you can have multiple locations protecting various data, depending on your business requirements. As before, this also applies to MirrorView/A.



MirrorView's concurrent mirroring functionality enables you to synchronously mirror one source to two different target CLARiiONs. This is particularly helpful when you require a remote failover location and remote failover data that is not part of any other activities or processes; it may even be a “lights out” bunker location. However, you can now have another exact copy of the production and failover data residing at another location for parallel processing activities such as backups or decision support queries.

The fracture log on the source array A would be used in the event that either B or C, or both, became unreachable. If the optional write intent log is used then, if A was faulted, upon recovery, a partial synchronization would occur to both B and C.

Note that MirrorView/A allows only one remote image per primary, and that, as stated before, MirrorView/A requires (and uses) neither the Fracture Log nor the Write Intent Log.

Remote Mirror Functionality

- **High Availability**
 - Mirrors resilient to single SP failures
 - Dual SP protection (primary & secondary copies)
 - Host I/O allowed to mirror while mirror sync active
 - Checkpoint of mirror sync progress
 - Allows sync to continue from last sync checkpoint (if primary failure)
 - Quick recovery of single SP or full failure
 - Write intent log feature removes full data sync requirement
 - Mirror I/O can be multiplexed across multiple FC connections
 - For HA and performance

MirrorView makes use of standard CLARiiON high availability features. Host I/O to the primary is permitted while a secondary is being updated, thus minimizing performance impact.

Remote Mirror Functionality

- Mirrors transparent to host and host applications
 - Mirror transparent to host
 - Host applications have no knowledge that LUN is mirrored
- Off loads mirror overhead from attached host
 - Host based mirroring uses host I/O and CPU resources
- Multiple attached hosts share remote mirror FC
 - Access logix (storage-centric) mechanism
 - One management mechanism regardless of OS platform
- Sync rate throttling supported
 - Prevents syncs from consuming I/O resources
- LUN trespass supported for remote mirrored LUNs
 - Maintains mirror integrity during trespass

MirrorView makes use of the CLARiiON trespass mechanism, as does SnapView. Therefore, if a remote mirror image is snapped, and the snap is accessible to a secondary host, that host will not lose access if an SP failover occurs, and the SnapView Session is persistent.

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MirrorView Recovery Scenario

LOCAL

REMOTE

- MirrorView is protecting local production data by maintaining the synchronous mirror at the remote site
- Local application server environment becomes unavailable
- MirrorView CLI is run from script to cause failover; Write Intent and Fracture Logs are processed, if necessary
- Production continues at remote site without loss of data

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Here is a MirrorView disaster recovery scenario:

- MirrorView has established a synchronous mirror from the local production CLARiiON array to the CLARiiON array at the remote site. Notice that there is a standby server at the remote site.
- Something takes down the application server environment at the local site. You know that it will take several hours to recover and production cannot be offline this long. A disaster is declared.
- Execute the MirrorView failover script you have developed with the MirrorView Command Line Interface or trigger the failover from the MirrorView console in Navisphere. MirrorView on the remote server gathers the current Write Intent and Fracture Logs from the local CLARiiON and applies these logs to its remote mirror, if necessary.
- Production can now restart with the application server having full production data at the remote site.

Once the problem is resolved at the primary site, re-establish the MirrorView mirror. Only this time, the remote site is the primary and the local site is the remote. Once you have the mirror established, you can trigger a failover at your leisure. You will then follow this same procedure to return home.

The procedure will be almost identical in the case of MirrorView/A. In this case, though, the Fracture Log and Write Intent Log are not used. The secondary can be promoted to a primary, and will allow host access to an earlier point-in-time copy of the data.



MirrorView Foundations

CLARIION MIRRORVIEW MANAGEMENT



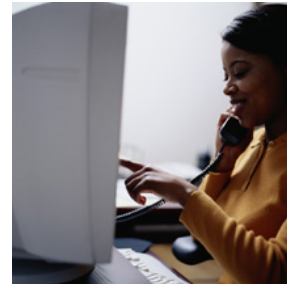
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This section will present management options.

MirrorView Management

- Centralized and simplified management
- Managed through ControlCenter Navisphere
 - optional CLI available too
- Remote management capabilities
 - Your entire EMC E-Infostructure can be managed from one location



Continuing with EMC's centralized management approach, MirrorView is managed by software called EMC ControlCenter Navisphere. MirrorView management uses the same Windows-like approach as Navisphere so your IT staff does not have to spend time learning a new interface. There is an optional CLI available for scripting of routine functions. And, if your infrastructure has CLARiiON and Symmetrix, EMC ControlCenter can manage it all from one location.



MirrorView Foundations

EXTENDING MIRRORVIEW



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The section will discuss extending MirrorView.



MirrorView and SnapView for the CLARiiON storage system are tightly integrated. Because they are both managed from within ControlCenter Navisphere, they offer an administrator a fast and efficient way to manage all mirror and snapshot activity on any system that resides on the SAN, no matter where they are physically located—in the same building or across town.

In this scenario, MirrorView is being used to provide a remote site for failover protection. However, the secondary site's system does not need to be dedicated to the mirroring process. It can function as the main system for another group of hot hosts. It can also be the main backup location for both systems. With SnapView installed on the secondary system, you can mirror from the primary and take a snapshot of the mirrored data to use for online backups, data mart refreshes, decision support tools, and report generation.

It enables you to offload backup and business processing from the production system and offer data to other user groups in your environment for testing, application development, and backups.

Consistency Groups

- Group of secondary images treated as a unit
- Available for both MirrorView/A and MirrorView/S
- Up to 16 groups for CX600/700
- Up to 8 groups for CX400/500
- Up to 16 LUNs per group (CX600/700)
- Up to 8 LUNs per group (CX400/500)
- Local LUNs must be on the same CLARiiON
- Remote LUNs must be on the same CLARiiON
- Operations happen on all LUNs
- Ensure a restartable image

Consistency Groups allow all LUNs belonging to a given application, usually a database, to be treated as a single entity, and managed as a whole. This helps to ensure that the remote images are consistent, i.e. all made at the same point in time. As a result, the remote images are always restartable copies of the local images, though they may contain data which is not as new as that on the primary images.

It is a requirement that all the local images of a Consistency Group be on the same CLARiiON, and that all the remote images for a Consistency Group be on the same remote CLARiiON. All information related to the Consistency Group will be sent to the remote CLARiiON from the local CLARiiON.

The operations which can be performed on a Consistency Group match those which may be performed on a single mirror, and will affect all mirrors in the Consistency Group. If, for some reason, an operation cannot be performed on one or more mirrors in the Consistency Group, then that operation will fail, and the images will be unchanged.

Currently Consistency Groups are available for both MirrorView/A and MirrorView/S.

Consistency Group Operations

- **Create a Consistency Group**
 - Defines the group
 - Does not add group members
- **Destroy a Consistency Group**
 - Allowed only if it has no members
- **Add a member to a group**
 - Adds MV/A or MV/S secondary image to a group
 - Creates the group, if this is the first image added
- **Remove a member from a group**
 - Removes MV/A secondary image from a group

This slide, and the slide which follows, describe the operations which may be performed on Consistency Groups.

The Create operation creates a Consistency Group, and allows it to be named. It does not add any group members. This operation is similar to the creation of a remote mirror in MirrorView/S.

The Destroy operation will destroy a Consistency Group if it has no members. It is similar to the MirrorView/S destroy a remote mirror operation.

The Remove operation will remove a member image from the group. After the removal, the primary and secondary CLARiiONs will both be aware of the removal, and will no longer require that the removed LUN participate in Consistency Group operations.

More Consistency Group Operations

- **Fracture a Consistency Group**
 - Administratively fractures all mirrors in the group
 - Stops updates to secondary images
- **Synchronize a Consistency Group**
 - Synchronizes all mirrors in the group
 - Group must be administratively fractured, OR
 - Group must be consistent, and be set to Manual Update
- **Promote a Consistency Group**
 - Promote all mirrors in the group
 - Command must be directed at secondary CLARiiON
 - Group must be in-sync or consistent

Fracturing a Consistency Group has the same effect as fracturing all the mirrors in the group simultaneously - all updates to the secondary images will be stopped, and no further updates will be permitted. Because host access to the secondary image is not allowed at this stage, there is no danger of inconsistent data being presented to a host.

The Synchronization operation will synchronize all members of the group. It can do so only if the group is administratively fractured (a system fractured group will start synchronizing automatically), or the Manual Update option has been chosen, and the group is consistent, meaning that one or more mirrors have data to transfer.

Lastly, the Promote operation will promote all mirrors in the group. All secondary images will be promoted to primaries, and, if the primaries are manageable, they will be demoted to secondaries. If a promotion would result in the need for the new secondaries to be fully synchronized, MV/A will request confirmation, then issue a 'forced' promote. If the group is neither in-sync nor consistent, then the data state cannot be guaranteed, and promotion would be a meaningless option.

CLARIION SAN COPY OVERVIEW



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SAN Copy Foundations

Upon completion of this section, you will be able to:

- Identify and articulate the components that make up the SAN Copy tool
- Identify and articulate the SAN Copy management options
- Identify and articulate some of the SAN Copy business justification scenarios

These are the objectives for this section. Please take a moment to review them.

SAN Copy – The Data Migration Solution

- CLARiiON storage-based software that performs full or incremental copies
 - within a single array
 - between multiple arrays via SAN or SAN-IP-SAN
- Data Mobility
 - One or more CLARiiON systems act as data movement facilitator in the network
- Heterogeneous array support
 - Hosting platforms: CX400 through CX700, and FC4700
 - Sources/Targets:
 - Various CLARiiON models
 - Various Symmetrix models
 - Other vendor storage

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Data can be moved and copied for various reasons, with just as many requirements. What are your requirements? Testing and development? Centralized processing? Content distribution? CLARiiON to CLARiiON? Symmetrix to Symmetrix? Data recovery? Business continuity?

EMC has the tools to help you get your data to where you need it most. Data movement or data mobility requirements can be solved with SAN Copy, depending on the systems involved and the granularity of the data movement process. Data mobility means copying and moving data between storage systems.

SAN Copy will enable organizations to lower their storage management costs, and lower application costs and consolidation information for maintenance or other processes.

Incremental SAN Copy helps to lower costs even further, by copying only the changes that have been made on a Source LUN to the Target(s), once an initial full copy has been made. This will lower the network bandwidth requirements in many environments, and lead to substantial reductions in the cost of network connectivity.

SAN Copy – What is it?

- Automatic check-pointing in case of link failure
 - Automatic or manual restart on link re-establishment
- Target can be larger than source
 - Data migration to larger LUN
- Transfer rate can be throttled to limit link utilization
- Copy sessions can be paused, resumed and aborted
- Very flexible link support
 - FC (inter-SAN) or FC/IP via bridge
 - Minimum link size is T1

SAN Copy performs fast, simultaneous copying of volumes across a SAN. It is host and application independent so no server resources are required. Some additional features offered by SAN Copy are:

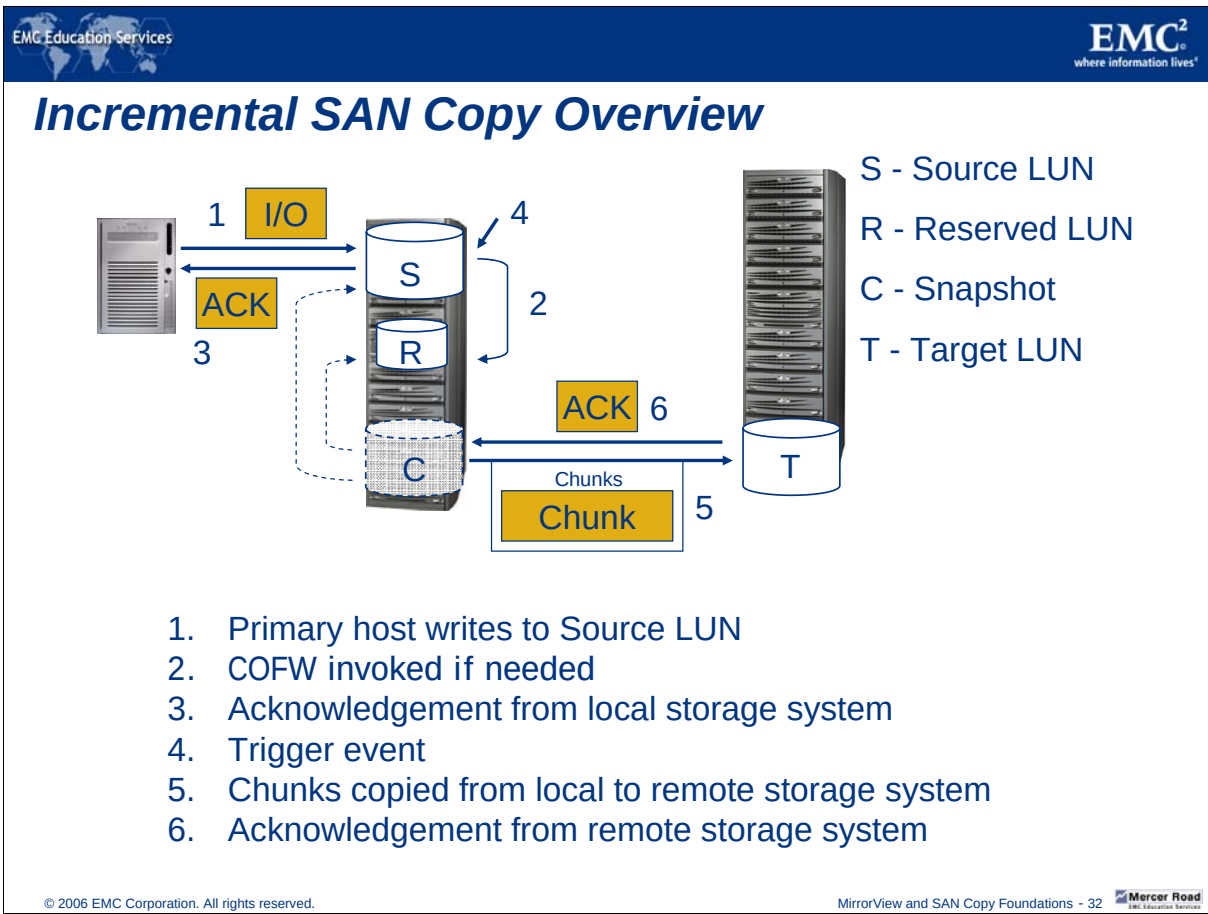
- Automatic check-pointing in case of link failure
- Larger target volumes
- Transfer rate throttle

How Does SAN Copy Work?

- CLARiiON system acts as a “Copy Manager”
 - Runs on CLARiiON CX400 through CX700, and FC4700/FC4700-2
- Can achieve TBs/Hour performance
 - Depends on network infrastructure
- Block-level moving/copying of full LUNs
 - Simultaneous push and pull (bidirectional) data movement supported
- 64 KB granularity for incremental copies
- Communicates via World Wide Names
 - Over SAN, LAN or WAN (via FC/IP conversion)
- Uses the following devices as “source” data
 - SnapView Snapshot (full copies only) or Clone
 - TimeFinder BCV
 - Idle production LUN

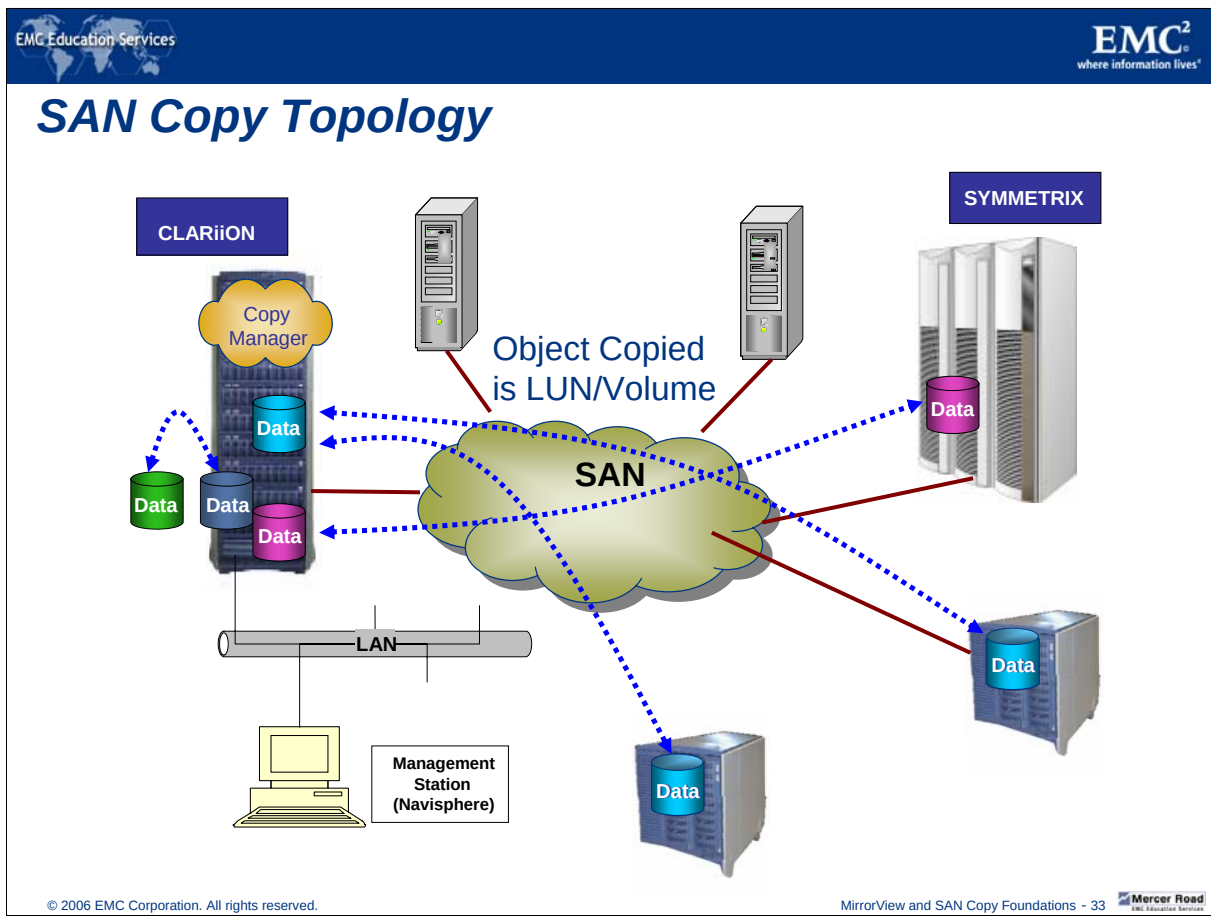
SAN Copy, running on a CLARiiON system, communicates with other storage systems via the simple use of World Wide Names. This eliminates the need for host or storage system agent software for each participating system. It supports local data movement over the SAN and extended distance data movement over the Wide Area Network (WAN) via very common FC to IP conversion (a T1 line is the minimum network supported). The movement is performed at the block level and full LUNs or volumes are moved from system to system. For incremental copies, a 64 KB granularity is used to determine which data should be copied. This 64 KB size is the chunk size used by SnapView, and it is used because of the SAN Copy reliance on SnapView to track changes in data.

When configuring a SAN Copy session, you can use several devices as “sources” of the movement—SnapView snapshots (for full copies only), SnapView BCVs, TimeFinder BCVs, and/or an idle production LUN. SnapView Snapshots cannot be used as the Source for an incremental session because that would involve taking a Snapshot of a Snapshot - an illegal operation.



Incremental SAN Copy (ISC) allows the transfer of changed chunks only, from source to destination. ISC will copy all changes made until a user-defined point in time, and will use SnapView Snapshot technology as required to keep track of where those changes are. The changed chunks are then copied from source to destination, and a checkpoint mechanism tracks the progress of the transfer.

The Source LUN is available to the host at all times. The Target LUN is only of use to an attached host once the transfer is completed. At that point, the Target LUN will be a consistent, restartable, but previous point-in-time copy of the Source LUN.



SAN Copy is a CLARiiON software application that is installed on a CLARiiON networked storage system. Customers can use SAN Copy to simultaneously move information, no matter what the host operating system or application. This is valuable for content distribution, moving applications, or supporting application data to distributed environments to aid in performance. It acts as the facilitator of data movement from system to system over the SAN or LAN\WAN infrastructure, eliminating the need for critical server CPU cycles and LAN bandwidth.

SAN Copy can move and copy data within a single CLARiiON system, between CLARiiON systems, between CLARiiON and Symmetrix systems, and it can even be used with other vendors' storage systems. Importantly, the management of all SAN Copy operations is performed through the same graphical user interface that all CLARiiON system management is performed with: Navisphere Manager. Or, for routine processes, you can schedule data mobility sessions via the Navisphere CLI.

SAN Copy – Scalable and Flexible

- Up to 16 simultaneous, bi-directional SAN Copy sessions
 - Queues up to 300 jobs, runs 16 simultaneously, moves through queue until all 300 completed
 - One source can have up to 100 destinations (systems)
- Dynamically pause and resume copy sessions
 - Pause/Resume check points available for each session
 - Delivers end-to-end data integrity
- Raise or lower priority settings for copy process
 - Ensures top priority goes to production I/O

SAN Copy is extremely flexible, enabling you to configure an environment that meets your specific business requirements. You can run up to 16 active sessions, with 300 jobs configured and queued to go. You can create up to 100 destinations from one source, allowing you to move large numbers of LUNs and volumes at one time.

SAN Copy also allows you to start, pause, and resume copy operations with continuous checkpoints so that each time you resume the copy process, it picks up from the point it was stopped, thereby eliminating the need to send the complete dataset over again and ensuring data integrity. If your SAN Copy operations coincide with heavy system usage, you can use Navisphere to throttle the priority of the SAN Copy operation, relative to the other activities on the system.

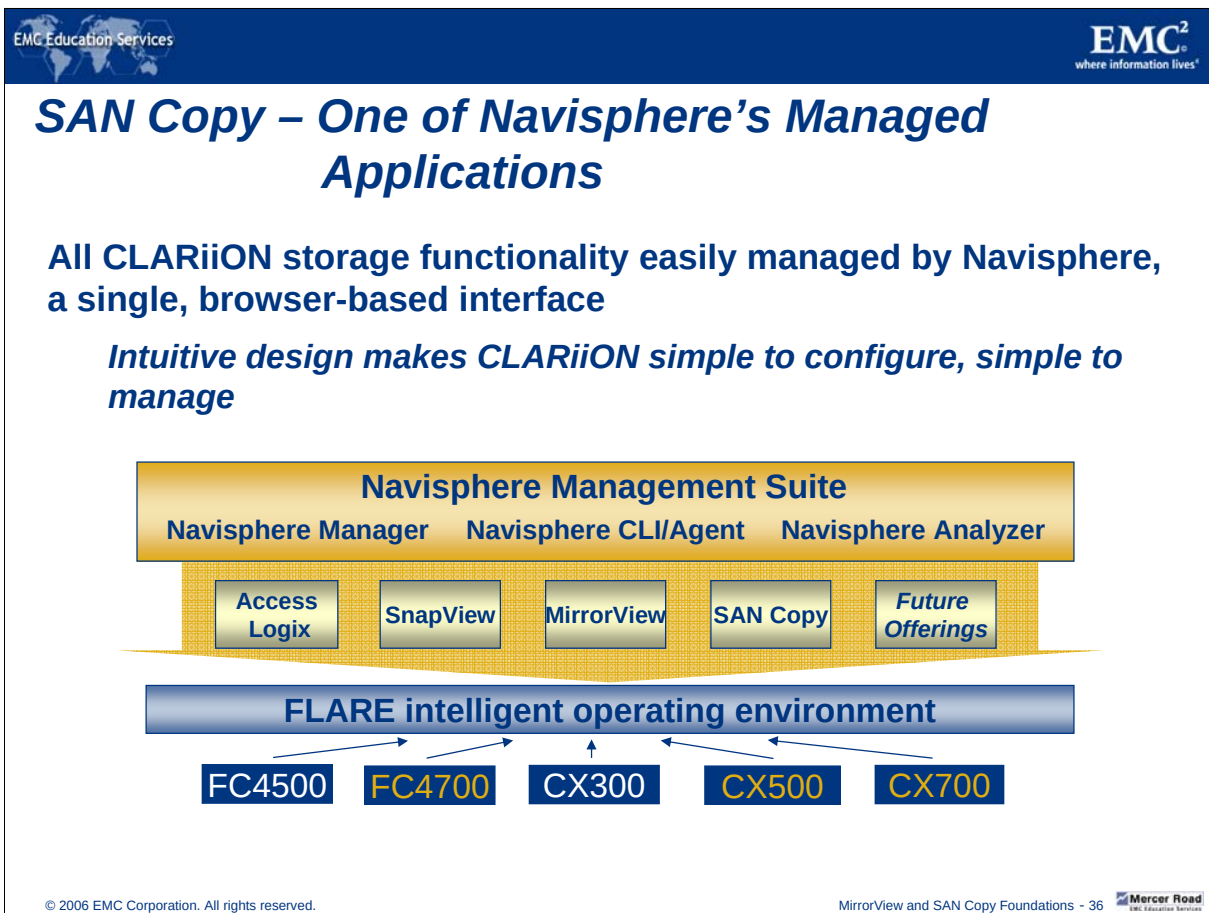
SAN COPY MANAGEMENT



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This slide graphically represents the CLARiiON software family and SAN Copy's place in that family.

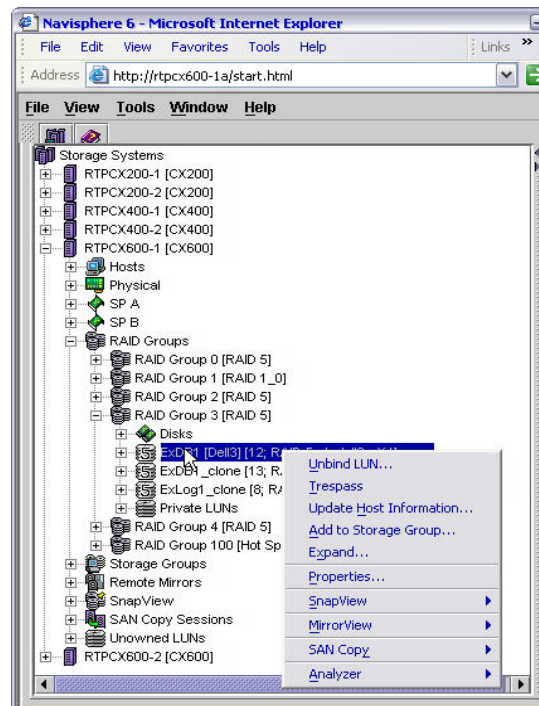
The most important thing to notice is that all functionality is managed via the Navisphere Management Suite and all advanced operations are carried down to the hardware family via FLARE.

Navisphere Manager is the single management interface to all CLARiiON storage system functionality.

FLARE performs advanced RAID algorithms, disk scrubbing technologies, and LUN expansion, to name a few of the many things it is capable of doing.

SAN Copy – Ease of Use

- All applications for CLARiiON managed by Navisphere
 - Manage all CLARiiON platform applications via single Navisphere interface
 - Easily scripted via Navisphere CLI
 - Easy to change as business demands
- Intuitive SAN Copy interface allows for easy and fast setup
 - Get up and running faster
 - Easily manage and configure 100s of copy sessions



Continuing with EMC's centralized management approach, SAN Copy is managed from within the CLARiiON management software called Navisphere Manager. SAN Copy management uses the same browser based Navisphere Manager interface as all the other CLARiiON storage system software (MirrorView, SnapView, metaLUN and LUN Expansion), so your IT staff does not have to spend time learning a new interface.

To schedule SAN Copy sessions, the easy to use Navisphere CLI allows for flexible SAN Copy scheduling and management.

SAN Copy Ext (SANCopy/E) Overview

- Objective – extend core-to-edge replication options
 - Includes WAN implementations
- Provides incremental copy from CX300/AX100 array to larger CX arrays running Full SAN Copy
 - Allows bi-directional data replication between CX300/AX100 array and larger CX arrays running Full SAN Copy
 - “Larger CX” = CX400 > CX700
- Replication Options
 - Source or Destination on SAN Copy Ext array (CX300/AX100)
 - Incremental replication supported

EMC SAN Copy/E software runs on a SAN Copy/E storage system. The CLARiiON storage system that owns the copy session SAN Copy/E copies data from CX300 and AX-Series storage systems to CX-Series storage systems running SAN Copy. It copies data directly from a source logical unit on one storage system to destination logical units on other systems, without using host resources. It connects directly or through a SAN, and also supports protocols that let you use the IP WAN (wide area network) to send data over extended distances. SAN Copy/E can perform multiple copies, each in its own copy session, simultaneously. The RAID type of the logical units participating in a copy session does not have to be the same; that is, the source and destination logical units can be different RAID types.

SANCopy/E Replication Limitations

- “Larger CX arrays” must participate at one end of copy
 - Must be running R19
- Intra-array copies NOT supported (within CX300/AX100)
- Copies between SAN Copy Ext arrays NOT supported
 - CX300 <-> CX300 not supported
 - AX100 <-> AX100 not supported
 - CX300 <-> AX100 not supported
- Only includes FC arrays

This slide details the limits of SANCopy/E replication limitations.

SAN Copy Foundations

SAN COPY BUSINESS JUSTIFICATION

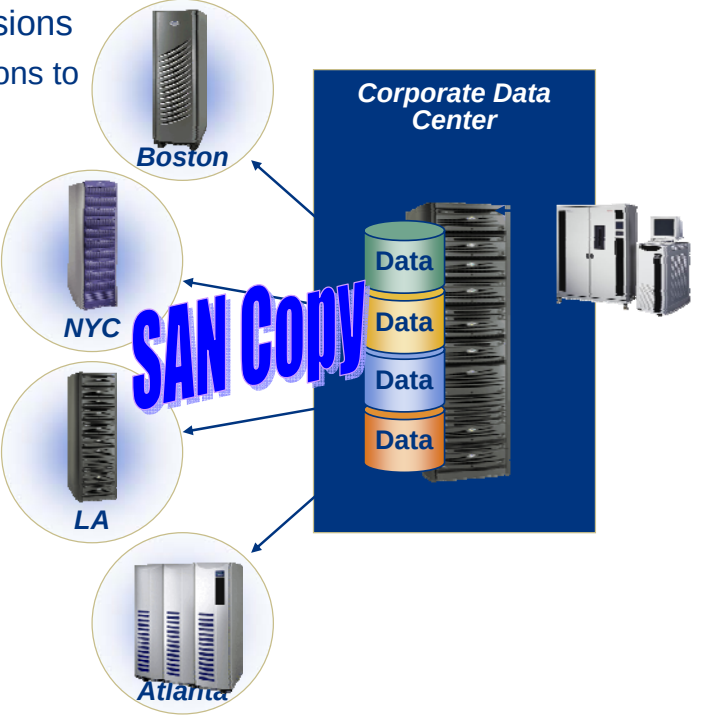
This section will detail the business justification for SAN Copy.

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SAN Copy: Data Mobility for Business

- Enable better business decisions
 - Pull data from remote locations to data center
 - Gather daily sales records, Inventory updates
- Stop costly data errors
 - Push data to distributed locations
 - Applications, daily pricing updates, Inventory updates
- Reduce operational costs
 - Centralize data for easier management



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SAN Copy mobilizes business, removing the physical barriers to faster, better business decisions.

Take a retail environment, for example. In a traditional environment, daily sales and inventory data is collected and sent back to the corporate data center to populate data warehouses and data marts. SAN Copy will copy or move that data utilizing your SAN and/or WAN infrastructure, increasing operational efficiencies while reducing costs and risk associated with data movement.

SAN Copy can stop costly data errors and reduce backup costs by cost effectively mobilizing data to be managed centrally.



SAN Copy: Lower Application Development Costs

- Lower the cost of application development
 - Increase IT staff productivity
 - Distribute development work, locally or remotely
 - No impact on production environment
- Reduce the cost of storing application data files
 - Copy data to lower-cost media
 - Take advantage of high capacity FC or ATA CLARiiON disk
- Lower business risk
 - Use real data to test new applications
 - Speed time to deployment

**CLARiiON
with ATA
drives**

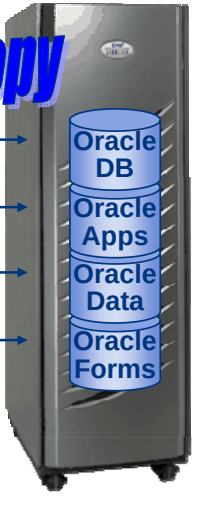


Dev, Stage or Test

SAN Copy



**Symmetrix
DMX**



Production

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Here is another example of how SAN Copy delivers business value. This is an example of application testing where a customer needs to use real production data against the new application to see how it will respond under stress. In the past, you were only able to do this inside a single CLARiiON or Symmetrix system, but now with SAN Copy, you can use a lower cost CLARiiON (with either Fibre Channel or ATA drives) as your test environment. The benefit is a lower-cost test environment that still has all of the performance, functionality, and availability of the CLARiiON CX Series.

Module Summary

- The functional concepts of Remote Replication on the CLARiiON Storage Platform
- The benefits of Remote Replication on the CLARiiON Storage Platform
- The differences of the various EMC CLARiiON Remote Replication Solutions

These are the key points covered in this training. Please take a moment to review them.