HP StorageWorks External Storage XP:
An external/subordinated storage solution for the HP StorageWorks XP12000 Disk Array

Version 1.0

External storage overview and terms

This white paper is intended to supply HP StorageWorks External Storage XP information that would not otherwise be available in these other documents:

- External Storage for the XP12000 chapter of the *HP StorageWorks Command View XP for XP Disk Arrays User Guide*
- Flex Copy XP white paper
- HP StorageWorks Modular Smart Array 1000 (MSA1000) Quick Specs
- HP StorageWorks Modular Smart Array 1000 User Guide

Although Flex Copy XP will be mentioned in passing, especially in reference to differences between it and External Storage XP, this document will concentrate on External Storage XP.

"External/subordinated XP storage" is an umbrella term that covers three separate usage models for when data will be managed through the HP StorageWorks XP12000 Disk Array but held on a separate physical storage product:

1. Flex Copy XP
- A one time, point-in-time copy of data from the XP12000 Disk Array to or from the external storage device is provided.
- Host access to the external storage logical unit (LU) must be by direct connection to the external storage device and cannot be by way of the XP12000 Disk Array.
- All XP12000 Disk Array Flex Copy XP logical devices (LDEVs) imported from external storage must be of Open-V emulation type.

2. External Storage XP
- Real-time usage of external storage devices as additional XP12000 Disk Array storage capacity of up to 30 Pb and thousands of external LUs is provided.
- Host access to the external storage LU must be through the XP12000 Disk Array and must not be by direct connection to the external storage device LU.
- For external array LUs not involved with External Storage XP, direct access from a host is allowed with external HP StorageWorks XP disk arrays and disallowed with the external MSA1000.
- Difference bitmaps for any HP StorageWorks Business Copy (BC) XP volumes residing on external storage reside within the XP12000 Disk Array.
- XP12000 Disk Array LDEVs imported from external storage can be mapped in (from the XP12000 Disk Array perspective) as any standard XP disk array emulation type (for example, OPEN-3,-8,-9,-L, -K, and so on), but:
    - Should be OPEN-V if you plan to use it with Flex Copy XP
        - o The external storage will not be initialized (formatted).
        - o No external storage is lost to "management space."
    - If anything but OPEN-V:
        - o The storage will be initialized (re-sized).
        - o A small amount of storage will be forfeited as management area for each non-OPEN-V XP disk array LDEV supplied from external storage.
- External Storage XP is a software product, which requires a license key.

Figure 1.

External Storage XP
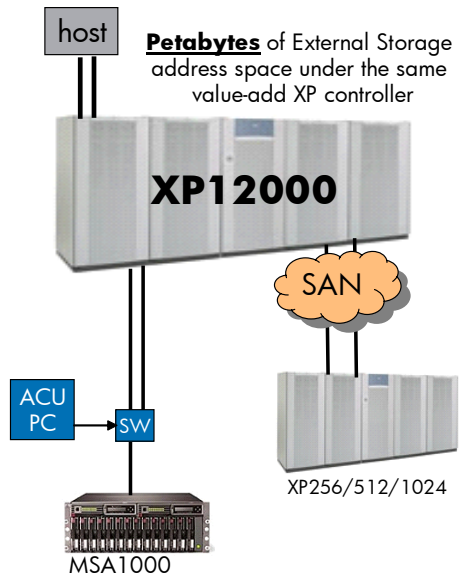
3. Offline data migration
   a. A point-in-time copy of data to and from an external device to the XP12000 Disk Array is provided.
   b. Migration will be a basic product functionality, not a software product, but will still require the appropriate Flex Copy XP or External Storage XP license.

Terms

PVOL—The primary or "production" side volume of a BC XP or Flex Copy XP pair.

SVOL—The backup or "mirror" secondary volume of a BC XP or Flex Copy XP pair.

Device group—An LU group containing one or more BC XP or Flex Copy XP pairs such that operations applied to the group effect every group LU.

External device group—A grouping of External Storage XP volumes.

External port—An array port that initiates connections to the storage area network (SAN) like a host bus adapter (HBA) on a server.

LU—Logical unit or disk volume.

LUN—Logical unit number (often misused in place of LU).

LDEV—An XP logical device manifesting in a particular RAID format and emulation type (for example, CU 1, LDEV 2 might be an OPEN-3 LDEV in 3D+1P RAID 5). After an LDEV is registered within the XP disk array, it can either be mapped directly to an LU, aggregated with other LDEVs to create a larger LU (Logical Unit Size Expansion [LUSE]), or carved up using Customized Volume Size (CVS) to create a smaller LU.

Flex Copy XP—Flex Copy XP is an HP StorageWorks XP disk array-based capability that enables the storage administrator to copy user data between an existing LU on an HP StorageWorks XP128 Disk

Array, HP StorageWorks XP1024 Disk Array, or HP StorageWorks XP12000 Disk Array and an LU on a supported external storage system (disk array). Flex Copy XP differs from the conventional BC XP functionality in that Flex Copy XP does not maintain any degree of data concurrency or perform any "delta-update" operations. Instead, Flex Copy XP completes one full copy to and from the data source and the copy destination. Because of this process, care must be taken to pause or stop all write activity on the Flex Copy XP source LU (a BC XP S-vol) before initiating a Flex Copy XP copy to and from external storage to ensure that the data copied is in a viable state.

RAID Manager XP—A host-based program capable of communicating with XP disk arrays for the purpose of CLI monitoring and manipulation of BC XP or HP StorageWorks Continuous Access (CA) XP volume pairs. HP StorageWorks RAID Manager XP can now manage Flex Copy XP and External Storage XP resources beginning with version 1.12.06. This is done in part with the newly added `-fe` option to the RAID Manager XP `raidscan` command.

External storage features, limitations, and requirements

Flex Copy XP limitations

- FlexCopy XP only works with the XP OPEN-V volume emulation.
- Flex Copy XP requires one more physical LU within the XP disk array than would be required by External Storage XP (that is, the BC XP svol).
- FlexCopy XP will not pair from or against any OPEN-V volumes that are not in simplex, unpaired (SMPL) state.
- Care must be taken to properly size LUs resident in external storage (for example, add 3 MB) so that the XP disk array CVS (VLL) function can be used to re-reference the external LU in terms of XP disk array storage dimensions (covered later). Failure to match LU sizes will most likely result in data loss.
- Maximum number of Flex Copy XP LUs is 255.
- Maximum LU size is 720 GB and the minimum is 48 MB.

External Storage XP product features

- MSA1000 (A/P controller)
- Supports HP StorageWorks XP512 Disk Array, HP StorageWorks XP48 Disk Array, HP StorageWorks XP128 Disk Array, HP StorageWorks XP1024 Disk Array, and HP StorageWorks XP12000 Disk Array
- Supported in a SAN
- Supported with HP StorageWorks Auto LUN (manual only), LUSE, CVS, and so on (implemented from the XP12000 Disk Array)
- Supported with RAID Manager/RM Lib
- Supported with BC XP
- Host access to External Storage XP devices/LUs through the XP12000 Disk Array
- LUs in an external XP disk array (not an MSA) not involved in External Storage XP can be accessed directly by a host (that is, without going through the XP12000 Disk Array)
- Distance limitation of 0.3 km Fibre Channel (FC) direct or switched
- Nishan IPS3300 IP converter/extender pair for up to 1,000 km
- External Storage XP usable as a command device

Remote XP disk array (subordinate array) features

- An active/active controller allows automatic load balancing and failover between up to eight FC links.
- The same subordinate XP disk array LU can be accessed through up to eight different links.

Remote XP disk array (subordinate array) limitations

A legacy[1] XP disk array being used for External Storage XP must have:

- Its own "phone home" remote failure reporting capability
- Its own array and LU management PC, for example, a Web console

The XP12000 Disk Array treats the subordinate XP disk array like just a bunch of disks (JBOD).

MSA1000 (subordinate array) features

- Best cost per gigabyte value for external/subordinated storage
- Maximum MSA1000 capacity—6 TB (maximum 32 LUs), 42 SCSI disks, three HP StorageWorks Modular Smart Array 30 (MSA30) enclosures, and 2-Gb FC

MSA1000 (subordinate array) limitations

An MSA1000 disk array being used for External Storage XP:

- are not considered a performance solution
- are not considered highly available (HA), so should be considered to have their application sweet spot in the area of containing BC XP svols and archive volumes, for which HA and performance are not the overriding consideration

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Note
HP strongly recommends that MSA used as external XP12000 Disk Array storage not contain the **only** instance of important customer data. XP12000 Disk Array production volumes should reside on internal LUs or highly available external storage (for example, legacy XP disk arrays).

- Must not be shared for other purposes
- Can only use a single controller
- Must have the same level of support as the XP12000 Disk Array to which it is attached
- Must have its own remote failure reporting capability
- Must have its own (or shared) array/LU management PC, in that external LUs cannot be created or managed from the XP12000 Disk Array

Software requirements

- HP StorageWorks Command View XP 2.0 or later
- HP StorageWorks LUN Configuration and Security Manager XP (for setup)
- HP StorageWorks RAID Manager XP 01.12.06 or later (if Flex Copy XP, BC XP, or both will be used)

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[1] Although the term "legacy XP disk array" is used, an additional XP12000 Disk Array is also allowed as external storage.

Hardware requirements and supported external storage arrays

- HP StorageWorks XP48 Disk Array, HP StorageWorks XP512 Disk Array, HP StorageWorks XP128 Disk Array, HP StorageWorks XP1024 Disk Array, or HP StorageWorks XP12000 Disk Array
- License keys for BC XP, External Storage XP, and Flex Copy XP installed (if needed)

MSA1000

- Firmware 4.32 (as long as it supports the MS Windows operating system)
- Single controller
- Sufficient hard disk drives to provide storage at the appropriate RAID level
- At least one online array controller
- An attached (or shared) management PC for running the HP Array Configuration Utility (ACU)

Fibre Channel switches

- Qlogic SANSwitch 5200
- Brocade 3800/12000
- McData 6064

Extenders

- Nishan IPS3300

General External Storage XP use cases

These are some of the potential use cases foreseen for External Storage XP.

Note
These figures are just concept diagrams, so be aware that single connections shown to XP disk arrays are really at least double connections.

Figure 2. Online LU re-pathing from a legacy XP disk array to a subordinated XP disk array through middleware mirroring
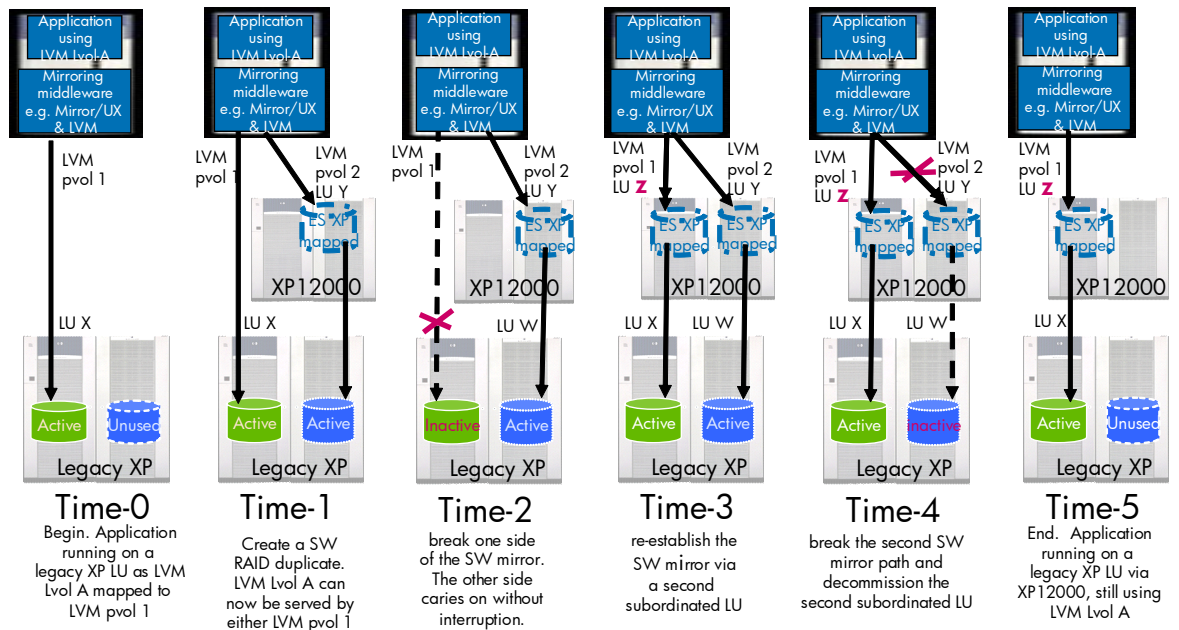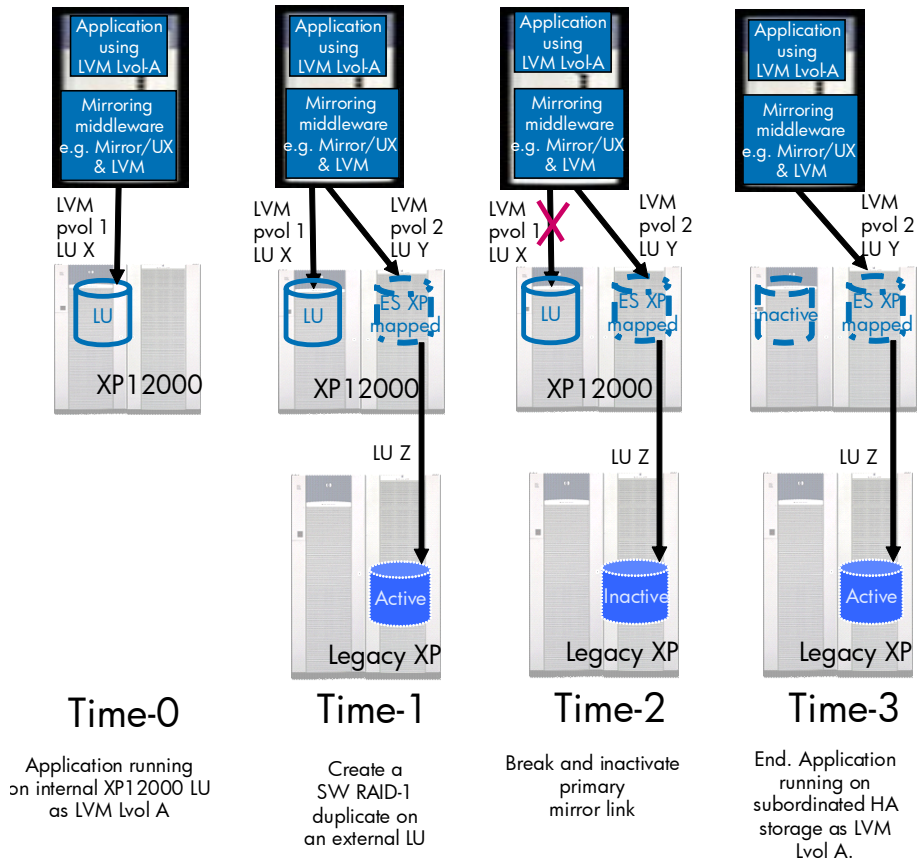

Middleware mirroring allows dynamic re-pathing of Logical Volume Manager (LVM) physical volume mirrors under an LVM logical volume, without needing to bring down the application. See "Data migration steps—Using LVM structures with MirrorDisk/UX."

Alternate scenarios to the one illustrated in Figure 2 would be:

- Move the current data to the XP12000 Disk Array, and leave it there.
- Move the current data to the XP12000 Disk Array, connect the external XP disk array, and leave the data on the XP12000 Disk Array.

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Figure 3. Online HSM-type LU migration from an internal XP12000 Disk Array to an external HA LU through middleware

Time-0	Time-1	Time-2	Time-3
Application running on internal XP12000 LU as LVM Lvol A	Create a SW RAID-1 duplicate on an external LU	Break and inactivate primary mirror link	End. Application running on subordinated HA storage as LVM Lvol A.

Middleware mirroring allows dynamic LU migration without needing to bring down the application.

**Figure 4.** Migrate older data from internal a XP12000 Disk Array to external LUs through Auto LUN XP
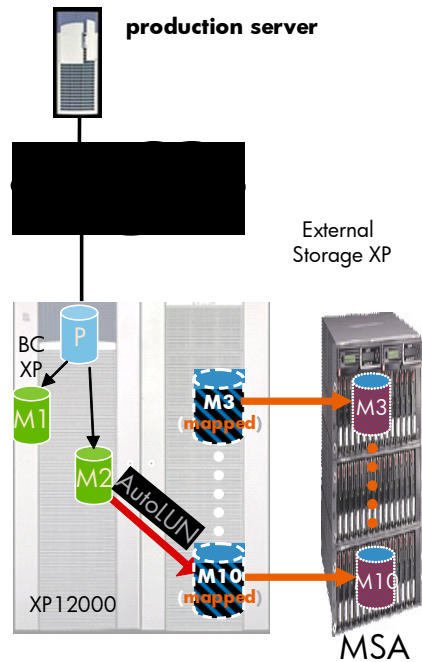
In this case, an application or database makes an archive copy volume once per month. Auto LUN XP is used so that the volumes for months 3 through 10 always reside on external storage.

Creating a new monthly archive copy

1. Initially fill M1 and M2 with one- and two-month old data and M3 through M10 with archives three to 10 months old.
2. After all volumes are full and its time to add one more month:
   - Pick the volume from M3 through M10 with the oldest data, for example, M10 (and optionally save it to tape).
   - Pick the volume from M1 and M2 with the oldest data, for example, M2 (to become the new most current internal).
   - Disassociate or un-map the M10 LU number from its LDEV.
   - Reserve the M10 LDEV for use as an Auto LUN XP target.
   - Use Auto LUN XP to move (for example, M2) data and LDEV and LU designation to an external LU, for example, M10:
     o Select the (manual mode) Auto LUN XP source and target; click **set job** and **apply.**
     o Copy (for instance) M2 data to M10.
     o The M10 LDEV number becomes associated with the old M2 LDEV and LU.
     o M2 takes on the old M10 LDEV.
   - Use BC XP to copy the production volume to the older of M1 or M2 (for example, M2).

Figure 5. Hierarchical hot backup/restore with active/passive (non-HA) external arrays
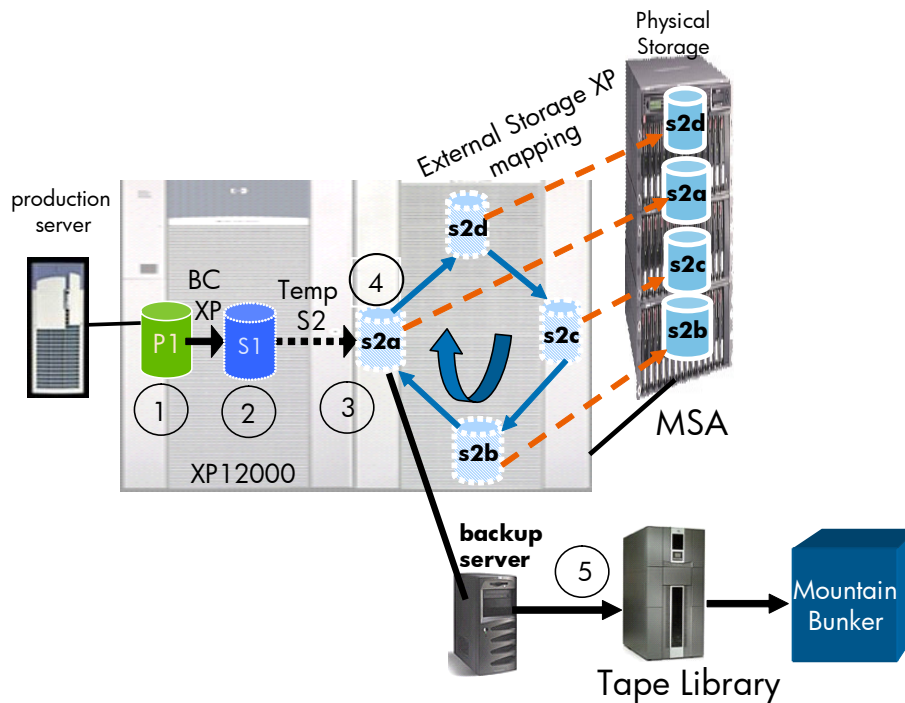
1. Application primary volume
2. BC XP actively paired copy #1
3. BC XP periodically pairs S1 to cascaded copy #2 (S2), mapped to one of a circular list of external LUs
4. BC XP cascaded copy—Connect to only one external LU at a time. Cycle through each in its own turn through periodic pair create and pair split commands. <u>Recent data resides on both the hot restore external LUs **and,** optionally, the tape library</u>.
5. Older data and copies of MSA data resides on the optional tape library.

This tiered storage configuration allows a significant improvement in HP OpenView Storage Data Protector data recovery Recovery Time Objective (RTO) in that data can be hot-restored in milliseconds as opposed to two to four minutes to find, load, and position a magnetic tape. For an application such as a stock exchange performing 10,000 updates per second, the loss of data availability for two to four minutes would have significant business impact. This configuration also has the ability to allow Storage Data Protector to improve the Recovery Point Objective (RPO), depending on the (script-driven) frequency with which S2 copies are made on the MSA. This configuration will also work without an S1.

6. Suspend the P1/S1 pair (S1 becomes data consistent).
7. Pick one of S2a through d with the oldest data as the new S2.
8. Create a BC XP pair from S1 to S2.
9. Delete the S1 through S2 connection (leaving consistent data on S2).
10. Re-sync the P1/S1 BC XP pair (S1 is inconsistent in pair state).

Note
A normal BC XP split, as opposed to a quick split, should be used to ensure that the performance of the PVOL is not adversely affected by quick split background copies to the cascaded (slower) external SVOL.

Figure 6. Use MSA external storage for noncritical testing and development
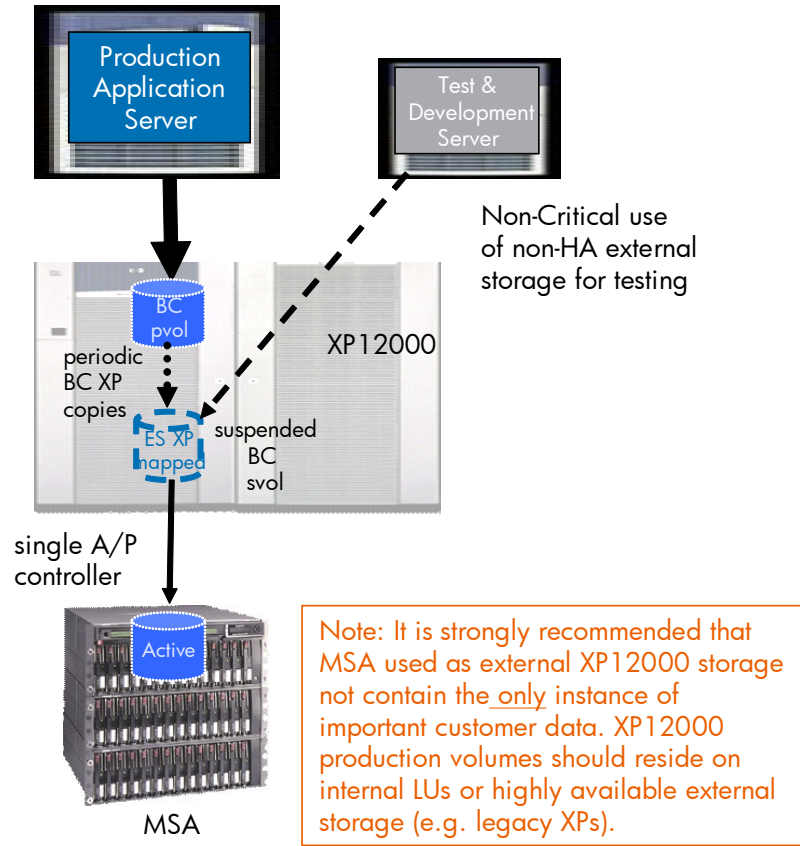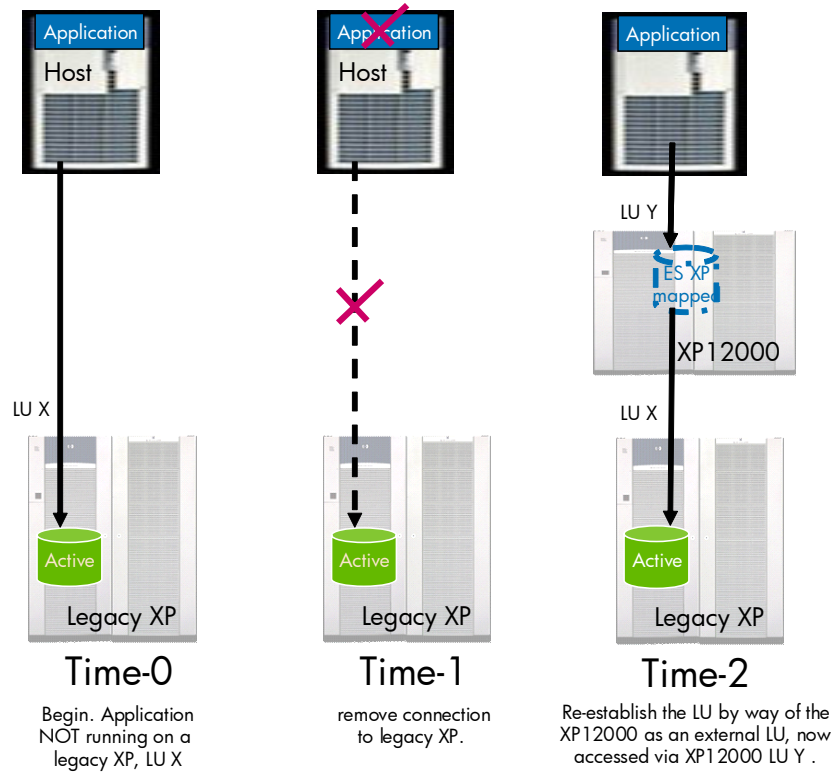

Production Application Server

Test & Development Server

Non-Critical use of non-HA external storage for testing

BC pvol

periodic BC XP copies

XP12000

ES XP mapped   suspended BC svol

single A/P controller

Active

MSA

Note: It is strongly recommended that MSA used as external XP12000 storage not contain the only instance of important customer data. XP12000 production volumes should reside on internal LUs or highly available external storage (e.g. legacy XPs).

Figure 7. Offline LU migration from subordinate array to internal XP12000 Disk Array LU

Time-0	Time-1	Time-2
Begin. Application NOT running on a legacy XP, LU X	remove connection to legacy XP.	Re-establish the LU by way of the XP12000 as an external LU, now accessed via XP12000 LU Y .

Offline migration is the easier case, in that the application can be shut down before the change.

Figure 8. Remote extenders for External Storage XP
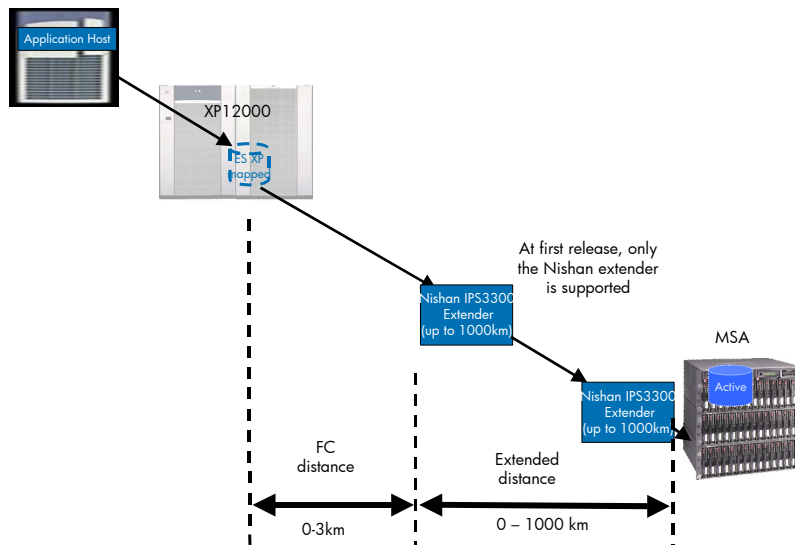
Although external storage will typically reside local to the XP12000, it is also possible to locate the external storage at a very significant distance from the XP12000. For those nervous about the potential data security issues of having data very far from the XP12000, data encryption appliances are available (which would reside between the host and the XP12000).

Data migration steps—Using LVM structures with MirrorDisk/UX

Step 1—Edit the /etc/lvmpvg file to include entries for production physical volumes in volume group (if not done previously).

```
/etc/lvmpvg:
VG /dev/vgprod
PVG pvg_production
<production physical volume #1>
<production physical volume #2>
```

Step 2—Change the extent allocation policy of the product logical volume to "PVG-Strict" with the lvchange (1M) command.

```
# lvchange -s g /dev/vgprod/production
```

Step 3—Create LVM physical volumes from the XP12000 Disk Array LUs with the pvcreate (1M) command.

```
# pvcreate -f <XP12K phyiscal volume>
```

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Step 4—Extend the production volume group with `vgextend` (1M) command to include XP12000 Disk Array physical volumes.

```
# vgextend /dev/vgprod <XP12K physical volume #1> <XP12K physical volume #2> ….
```

Step 5—Edit the /etc/lvmpvg file to include entries for a new physical volume group containing the migration physical volumes added in step 3.

```
/etc/lvmpvg:
VG /dev/vgprod
PVG pvg_production
<production physical volume #1>
<production physical volume #2>
PVG pvg_migration
<XP12K physical volume #1>
<XP12K physical volume #2>
```

Step 6—Create a mirror for the production logical volume on the XP12000 Disk Array physical volume group created in step 4 with the `lvextend` (1M) command.

```
# lvextend –m 1 /dev/vgprod/production pvg_migration
```

Step 7—Split the mirror, bringing the original production logical volume (not the XP12000 Disk Array resident) offline with the `lvsplit` (1M) command, leaving the XP12000 Disk Array resident logical volume online for application use.

```
# lvsplit –g pvg_production /dev/vgprod/production
```

Step 8 (optional)—Remove offline production logical volume with `lvsplit` (1M) command.

```
# lvremove /dev/vgprod/productionb
```

Note

The lvsplit command in step 6 results in the offline production volume being renamed "productionb."

Step 9 (optional)—Remove unused physical volumes from production volume group using `vgreduce` (1M) command.

```
# vgreduce /dev/vgprod <production physical volume #1> <production physical volume #2> ..
```

Note

The file */etc/lvmpvg* is automatically updated with the execution of this command.

External Storage XP with HA and non-HA subordinated storage

Non-HA external storage LUs are for restricted use in that they are not as highly available as internal XP disk array disks. Therefore, this type of storage is highly recommended to be restricted to use with non-HA and non-performance applications, such as for BC XP SVOLs containing quickly accessible medical record archives.

Other than the restrictions already noted, HA external storage LUs (for example, from a legacy XP disk array) have the same basic capabilities as XP12000 Disk Array internal LUs. Therefore (as long as performance is considered), HA external LUs can host application volumes, BC XP primary volumes, SVOLs, and so on.

Evaluated configurations

While other permutations are possible, the configurations presented in this section represent the appropriate usefulness of the MSA1000 and legacy XP disk arrays as subordinate external storage to the XP12000 Disk Array. Central to this intention is the preceding strong recommendation prohibiting the production copy of the customer application data from residing on non-HA subordinated storage. The MSA1000 is presented in these configurations as subordinated non-HA storage, primarily charged with maintaining the BC SVOLs. The configurations tested were:

- BC with XP128 Disk Array and MSA1000[2]
- BC with MSA1000
- BC with XP128 Disk Array
- XP12000 Disk Array pass-thru to XP128 Disk Array (that is, no use of BC XP and production volume on XP128 Disk Array)

The BC configuration that utilizes (as subordinate storage) a legacy XP product (in this case, a XP128 Disk Array) and an MSA1000 is illustrated in Figure 9. In this configuration, the storage administrator can use a preexisting legacy XP disk array product such as a XP128 Disk Array as high-availability subordinate storage for the production copy of customer application data. The volume containing the customer data on the XP128 Disk Array is designated as the PVOL in a Business Copy configuration created through the XP12000 Disk Array. The SVOL is resident on the subordinate/external MSA1000 disk array.

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[2] The MSA disk array does not require any special firmware level or hardware additive to be usable by External Storage XP, other than the requirement that the firmware level used support Microsoft® Windows® (for example, 4.32).

**Figure 9.** BC with legacy XP128 Disk Array and MSA1000
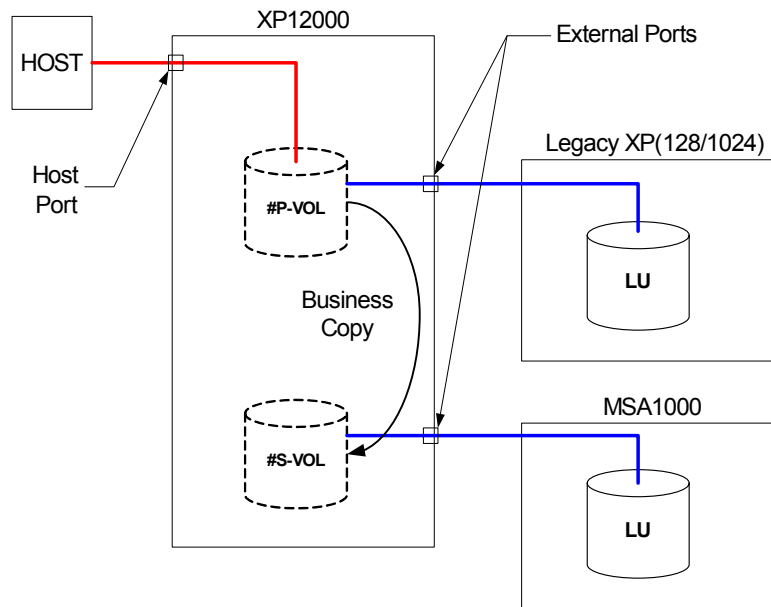
This configuration is especially relevant when the intention is to use inexpensive storage such as the MSA1000 in place of a tape backup facility to increase the rate[3] at which data archived on the MSA1000 can be restored to the production volume. Business Copy operations executed from the XP12000 Disk Array can allow multiple backup instances of the production data to be stored on one MSA1000 LU or multiple MSA1000 LUs, if BC cascading is desired.

A BC configuration that utilizes XP12000 Disk Array storage for production data and an MSA1000 as subordinate storage is illustrated in Figure 10. This configuration takes advantage of the high-performance storage offered by the XP12000 Disk Array for the storage and access of customer production data while utilizing the subordinated MSA1000 as an inexpensive alternative for the placement of the mirror copy of the production data. The BC configuration defined through the XP12000 Disk Array designates the production application data on the XP12000 Disk Array as the PVOL and the corresponding SVOL as the LU on the subordinate MSA1000.


[3] That is, a faster RPO.

Figure 10. BC with MSA1000
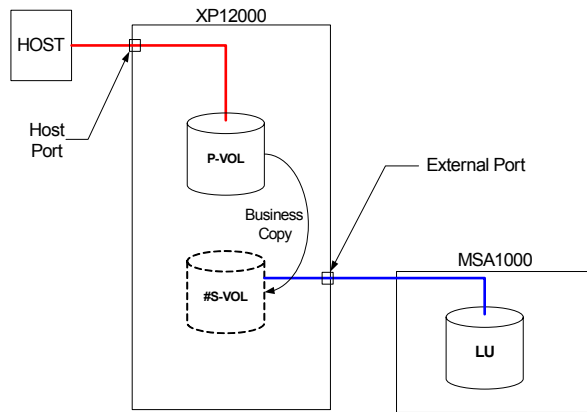
The benefits of this configuration are most apparent when considering the cost of native XP12000 Disk Array storage compared to that of the MSA1000.

A BC configuration that utilizes XP12000 Disk Array storage for the production data and a legacy XP128 Disk Array as subordinate storage is illustrated in Figure 11. This configuration takes advantage of the high-performance storage offered in the XP12000 Disk Array for customer production data, while utilizing the subordinated HA XP128 Disk Array as a less expensive alternative for the placement of the mirror copy of the production data. The BC configuration defined through the XP12000 Disk Array designates the production application data on the XP12000 Disk Array as the PVOL and the corresponding SVOL as the LU on the subordinate XP128 Disk Array.

Figure 11. BC with XP128 Disk Array
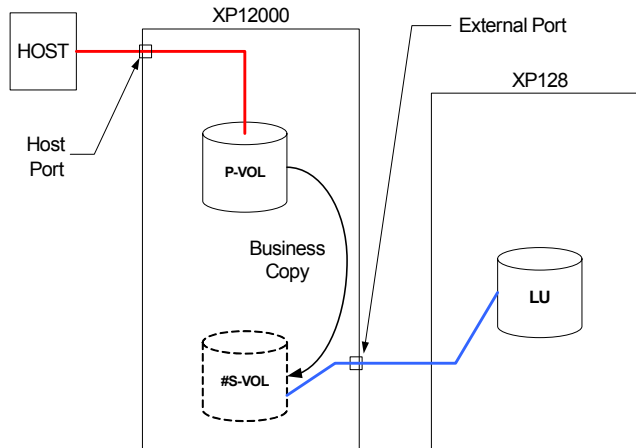
A configuration in which the XP12000 Disk Array External Storage XP capabilities are being used to facilitate a pass-thru connection to storage on an HA XP128 Disk Array is presented in Figure 12. This configuration enables the storage administrator to combine a legacy XP disk array product with the

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XP12000 Disk Array within the same CU:LDEV addressing space. The benefits of this coincident addressing capability are most apparent if the administrator wants to combine several legacy XP disk array products in the same addressing space (for example, up to 32 PB).

Figure 12. XP12000 Disk Array as pass-thru to XP128 Disk Array
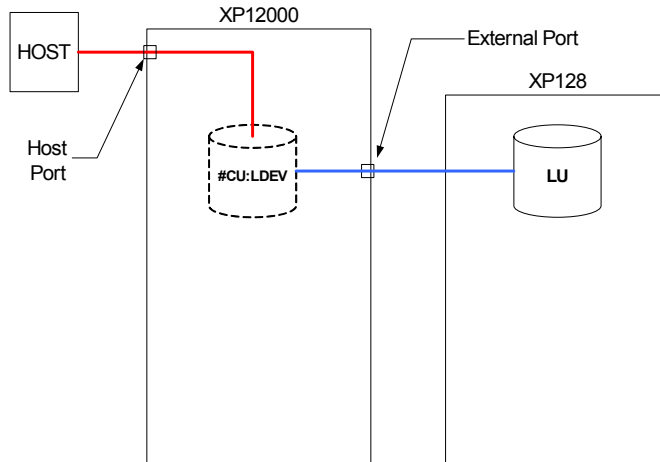
Subordinate array (MSA1000) setup

The steps necessary to configure the MSA1000 for use as a storage subsystem subordinate to the XP12000 Disk Array are as follows:

1. MSA1000 array object definition
2. MSA1000 LU definition
3. Elective use of Selective Storage Presentation (SSP)

After the MSA1000 array object is defined, individual storage LUs can be specified within the array object. At this point, it is possible to institute LUN security on the MSA1000 using the ACU SSP functionality. Use of SSP is not required, but it is suggested to improve the security of MSA1000-resident data.

The MSA1000 can be configured for its role as a subordinate storage subsystem with the ACU. The ACU is run from a server attached by an FC path to the MSA1000.

The MSA1000 does not require any special firmware level or hardware additive to be usable by External Storage XP.

MSA array object definition
The ACU should be used to define at least one internal MSA1000 array object (see Figure 13) during the initial setup of the array. After an array object has been defined, LUs can then be specified within the new array object.

**Figure 13.** MSA1000 array object definition
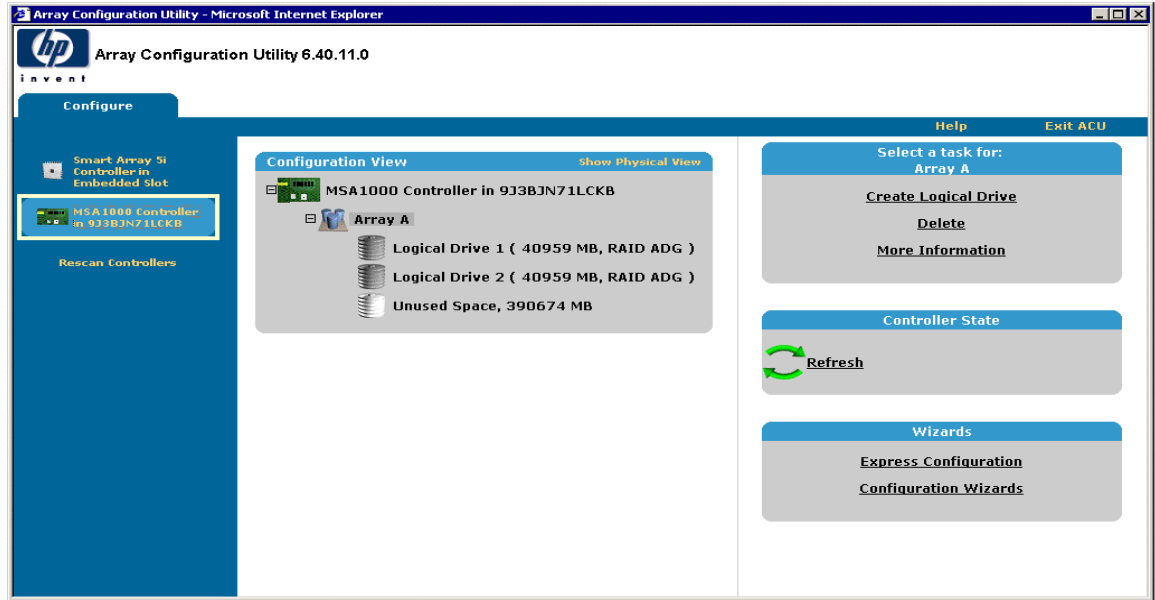
MSA LU size calculations and LU definition

It is imperative that the user portions of each XP disk array and MSA1000 LU to be used together in a BC XP mirroring configuration be geometrically identical. This requirement is an important concern, given that the XP disk array and the MSA1000 calculate the user size of their LUs in a different manner.

The ACU used for configuring the MSA1000 uses an optimization algorithm to calculate the user size of a new LU given a size in megabytes requested by the user (see Figure 14). Because the optimization algorithm cannot be disabled or bypassed by the user, it is necessary to compensate for this optimization so that MSA1000 LUs will be created at the correct size. When requesting a new LU through the ACU, it is typically necessary to make the request 2 to 3 MB larger than what is needed. For example, if a storage administrator is attempting to create a 40-GB (40,960-MB) LU on the MSA1000 for use as XP12000 Disk Array external storage and the request is made for only the exact size needed, the ACU will optimize the LU to a size of 40,959 MB, which is 1 MB smaller than needed. The optimization algorithm in use by the ACU can be overridden by specifying a size of 40,963 MB, which will result in the correct size of 40,960 MB (40 GB).

Figure 14. MSA LU definition
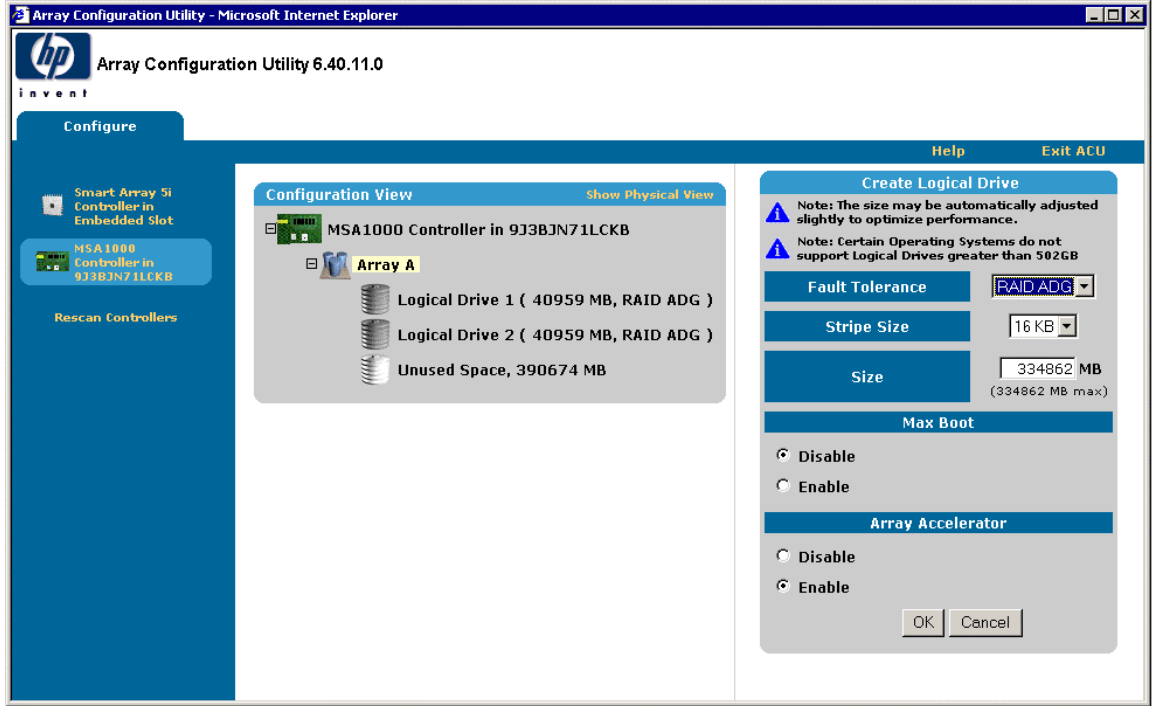
SSP

It is also possible to institute LUN security on the MSA1000 using the ACU SSP functionality (Figure 15). SSP enables the storage administrator to limit to selected hosts (or a XP12000 Disk Array), access to MSA1000 LUs by specifying HBA WorldWide Names (WWNs). If SSP is used, the storage administrator must set the operating system mode corresponding to the XP12000 Disk Array port WWN to Windows. For more information on configuring the MSA1000 using the ACU, consult the *ACU Online User's Guide.*

Figure 15. SSP
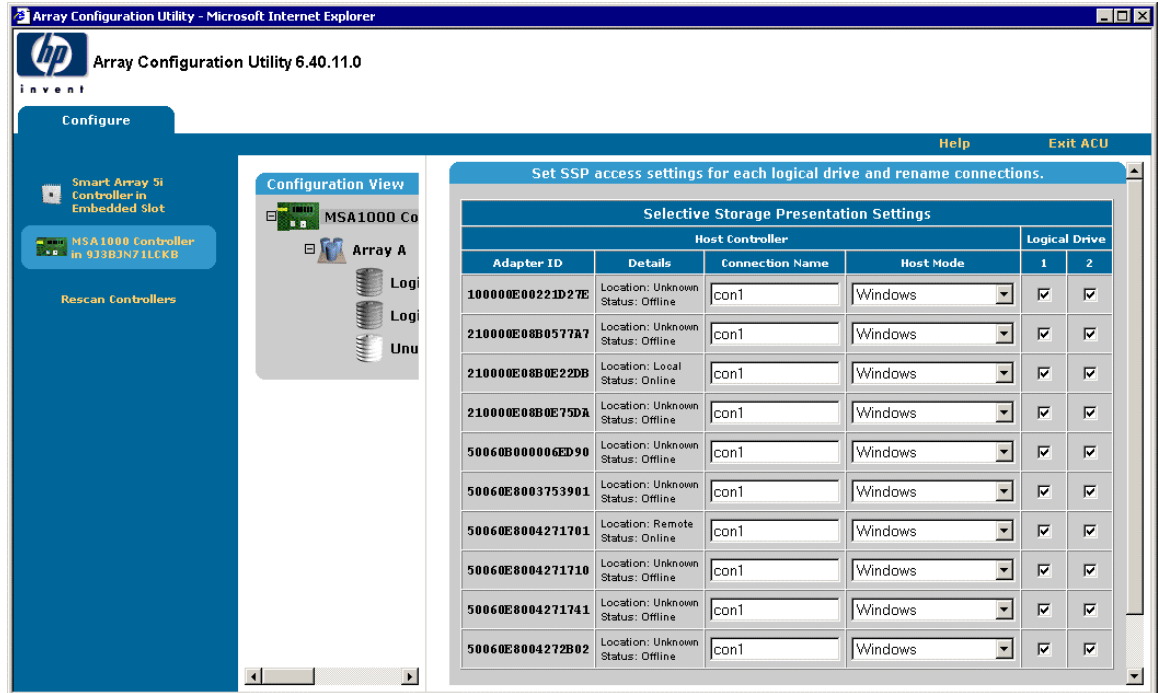
Subordinate array (legacy XP disk array) setup

Configuration of XP disk arrays to be used as subordinate storage is similar to configuring the same arrays for use by Windows hosts. For further information on individual port configurations and supported host most, refer to the *HP StorageWorks Disk Array XP12000 User's Guide*.

Supervising array (XP12000 Disk Array) setup

The steps required to configure the XP12000 to identify and utilize subordinate storage are as follows:

1. XP12000 Disk Array external port definition
2. External storage LDEV definition

First, the XP12000 Disk Array FC ports that are intended to communicate with subordinate storage are defined as external ports within the XP12000 Disk Array. This definition causes the XP12000 Disk Array to effectively act as a host when communicating through these defined ports. After the external ports are defined and the subordinate has been made visible to the XP12000 Disk Array, external LUs that are visible to the XP12000 Disk Array can be defined as external storage LDEVs. Note that if an XP disk array is to be used as subordinate storage, care must be taken to configure at least one port on two separate clusters within the XP12000 Disk Array for use by external XP disk array subsystems.

HP StorageWorks Command View (CV) XP can be used to configure the XP12000 Disk Array for both these steps.
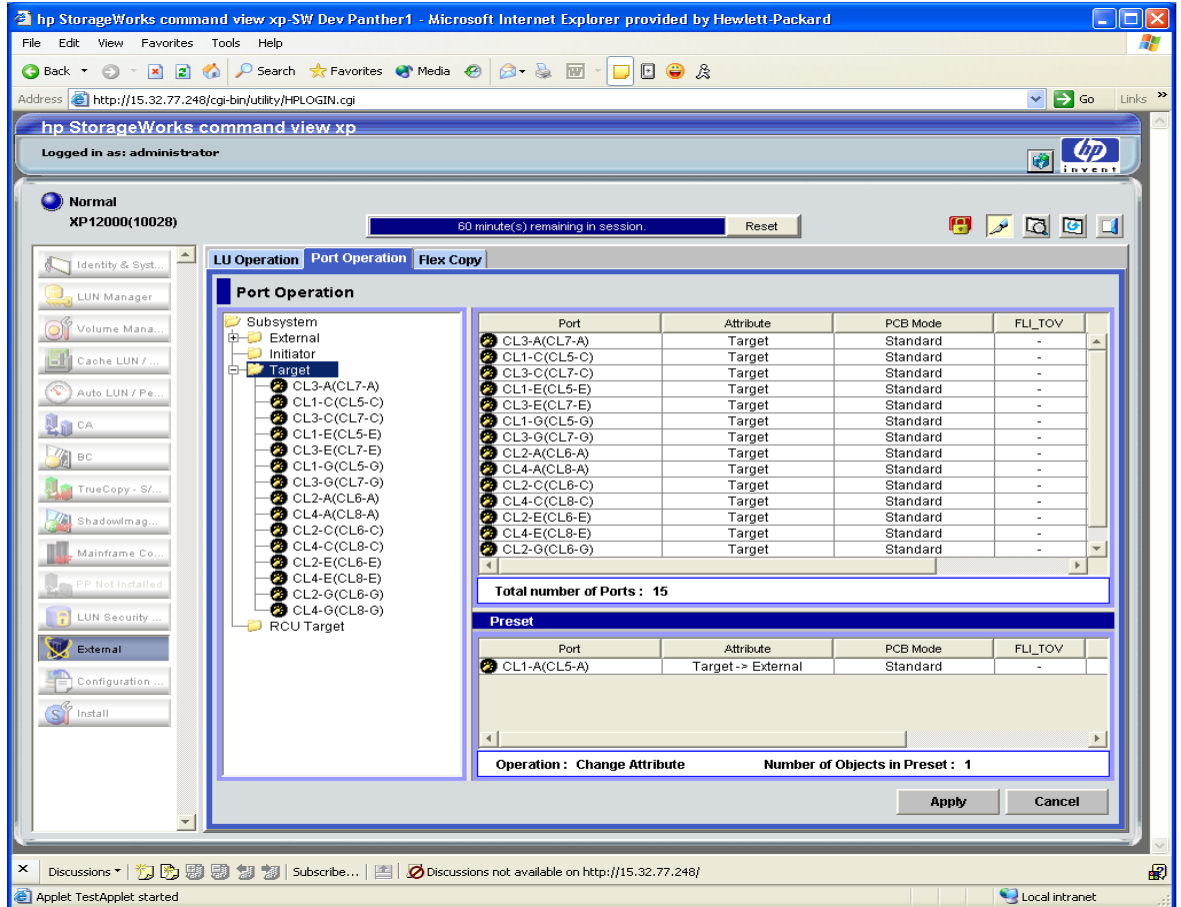
XP12000 Disk Array external port definition

Before XP disk array external ports are defined, it is necessary to first set these ports to the correct FC topology. Figure 16 illustrates this step being performed using CV XP.

Figure 16. XP12000 Disk Array FC port topology settings
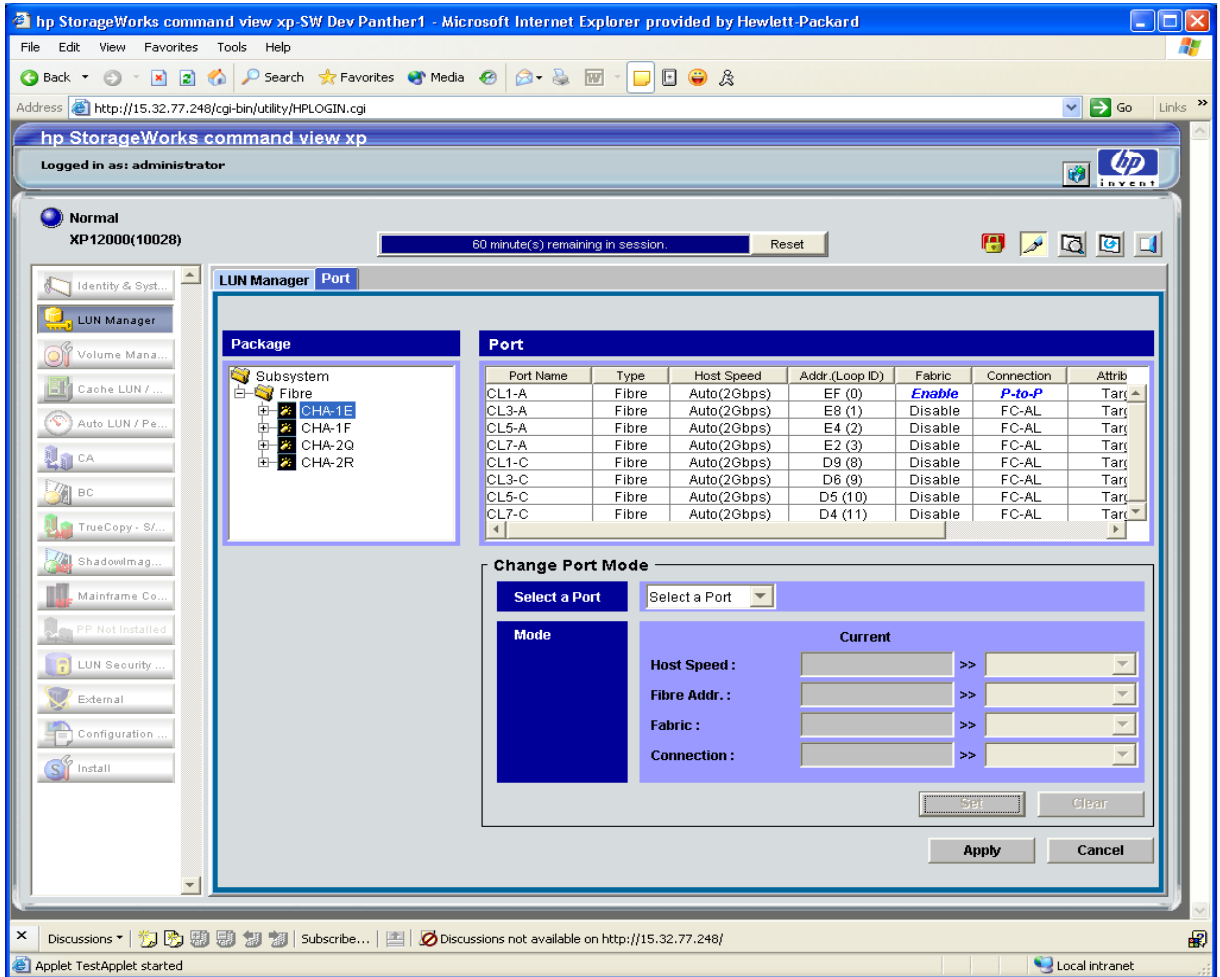
After the correct topology for the application is set, the administrator can then define these ports as external though the Port Operations tab located in the CV XP External panel. Figure 17 illustrates this definition process.

**Figure 17.** XP12000 Disk Array external port definition

After the ports have been defined as external, the process of defining external LDEVs can begin.

### External storage LDEV definition within the XP12000 Disk Array

The process of defining external storage LDEVs with the XP12000 Disk Array is essentially assigning an LDEV number within a XP12000 Disk Array control unit (also know as a CU:LDEV) to an external LU. This can be done in the LU Operations tab in the CV XP External panel. The left sub-panel of this panel (shown in Figure 18) consists of a tree of subordinate storage subsystems that have been detected by the XP12000 Disk Array. The tree is organized by subsystem serial (soft serial number) and presents each external LU found through a corresponding subsystem controller WWN.

Figure 18. CV XP LU Operations tab
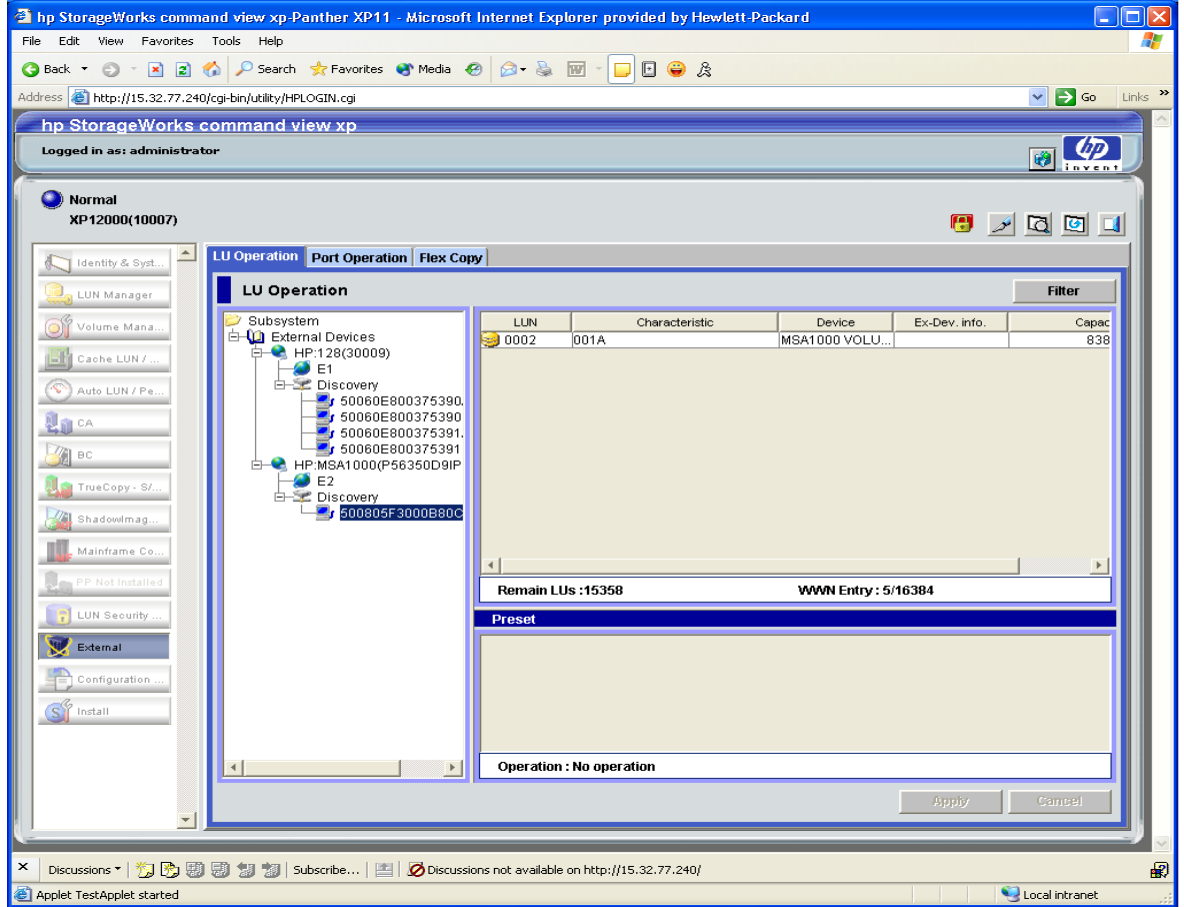
After the administrator has selected an external LU for LDEV assignment, the assignment process can be started by right-clicking the selected LU and selecting **Add LU.** The Add LU sub-window will appear (see Figure 19) and the administrator can then select the attributes for the LDEV, or set of LDEVs, to be defined.

Figure 19. CV XP Add LU subwindow
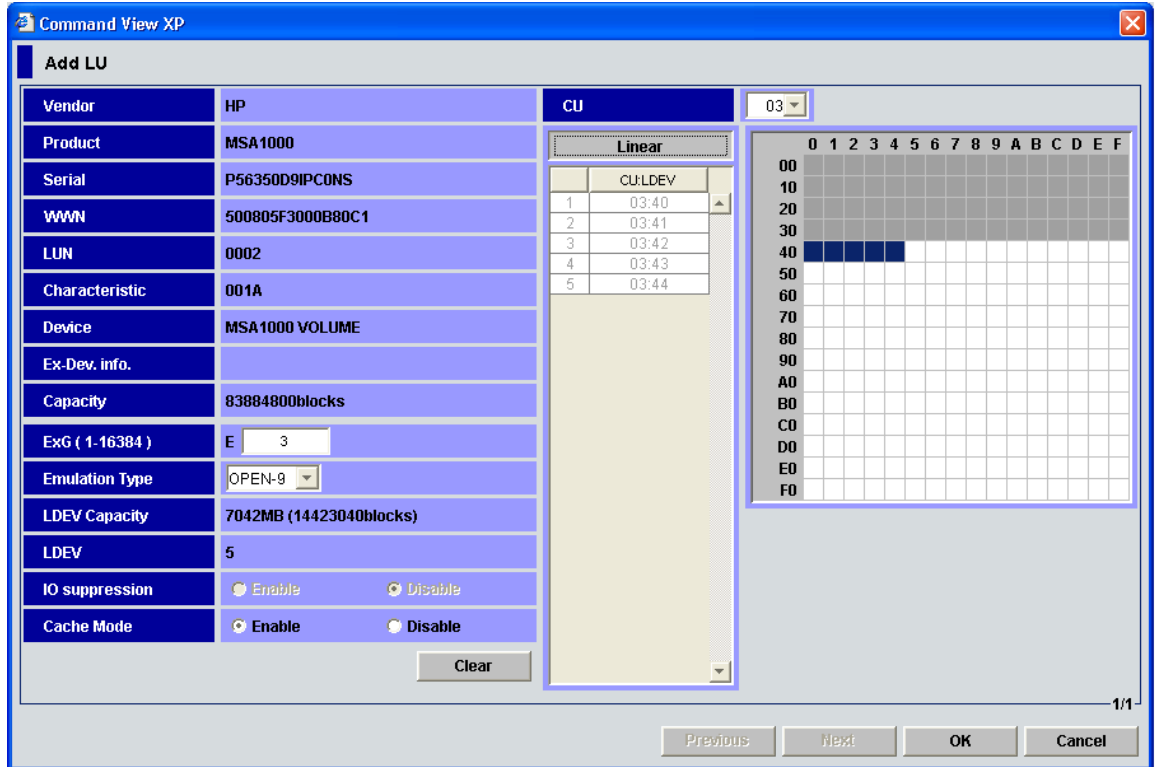
As part of the operation of defining an external LDEV, the user must make several fundamental choices concerning the attributes each LDEV. The choices are:

- External group (ExG) number
- Volume emulation (OPEN-3, -8, -9, -E, -L, or -V)
- I/O suppression
- Caching
- CU:LDEV designation

Choosing an external group number for an external LDEV is mandatory. Subsequent operations that might be performed, such as using CVS to remake the LDEV in question, require this definition. The external group number can be from 1 to 16,384.

The step of defining a specific volume emulation for the new LDEV must be done with caution. If an emulation type other than OPEN-V is chosen, the XP12000 Disk Array will automatically allocate a small portion of the available external LU for management purposes, leaving the actual user space of the LDEV smaller. It is also possible to create multiple external LDEVs from a single large external LU.

Host connect to external LU

After the external LDEVs have been defined, CV XP can then be used to assign these LDEVs to ports on the XP12000 Disk Array for access by hosts. In CV XP, external LDEVs are annotated with the "#" symbol to enable the user to differentiate between external and local LDEVs. The action of assigning paths to external LDEVs is similar to assigning local LDEVs. As Figure 20 illustrates, LDEVs can be assigned to port through CV XP using the LUN Manager panel.

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Figure 20. LUN Manager panel
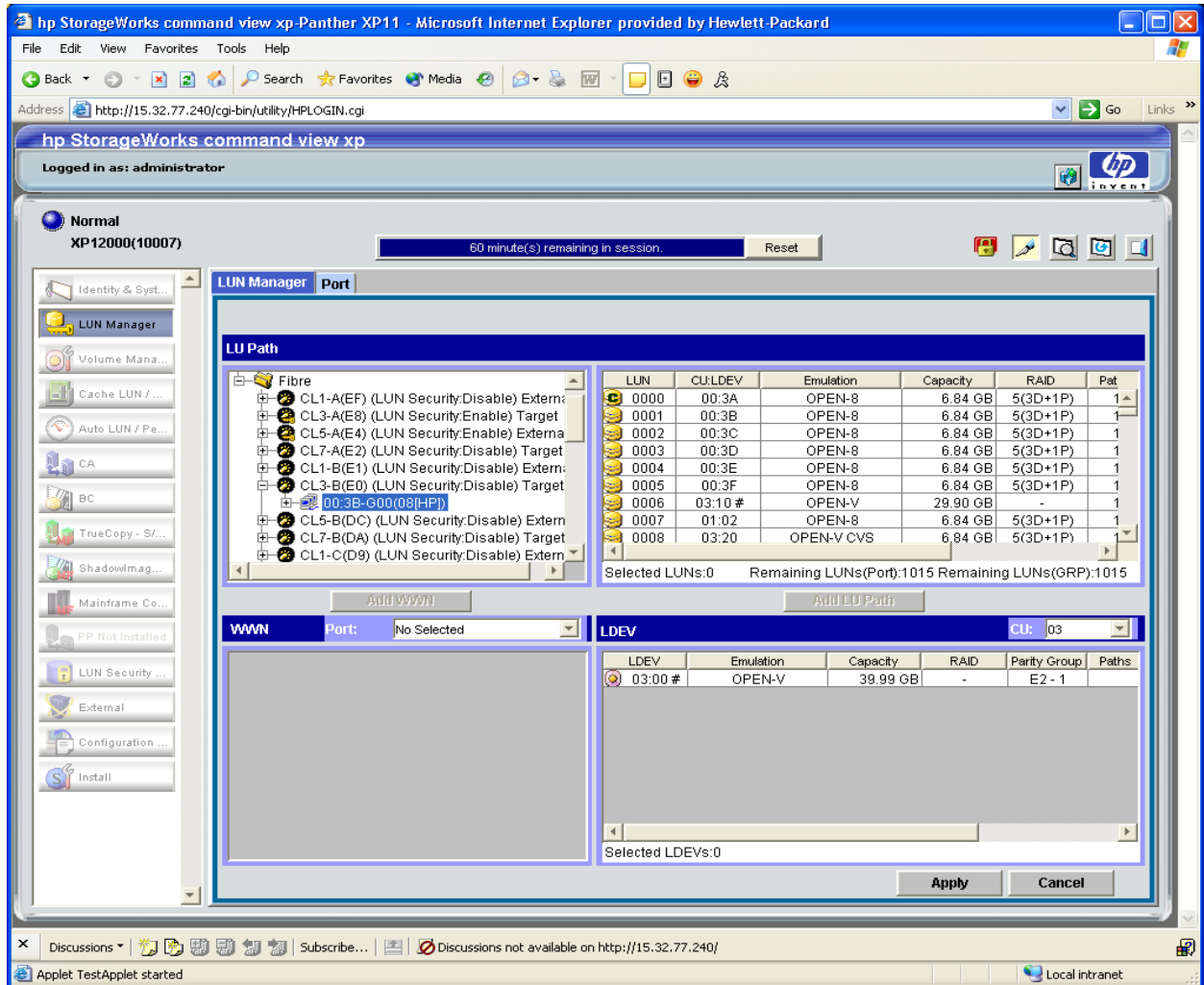
When paths have been assigned to external LDEVs, attached hosts may gain access to them when their operating environments have conducted the appropriate detection scans.

Use of Command View to detect external storage

Using Command View (path connectivity) to detect external storage LUs will yield correct information concerning individual LDEV statistics, but will not yield any information concerning which disk mechanisms (disk mech's) are being used to maintain an external LDEV. These fields will remain blank as the XP12000 does not currently gather such information for SCSI mode page 83 data.

Differences in RAID Manager XP functionality

RAID Manager XP can detect and manipulate external storage (through the XP12000 Disk Array) beginning with version 1.12.06. Current versions allow the `raidscan` command to be used with the `-fe` option to allow external storage to be displayed separate from local XP12000 Disk Array storage.

Discussion

The configurations discussed in this section have served to illuminate the pragmatics and the appropriate use of the XP12000 Disk Array external storage capabilities. The MSA1000 has been presented as a low-cost alternative to native XP12000 Disk Array SVOL storage for prospective BC operations. Conversely, the XP128 Disk Array legacy product has been presented here as a lower cost alternative to native XP 12000 Disk Array storage and as a more flexible and highly available external storage subsystem than the MSA1000.