

HP StorageWorks

Auto LUN XP user guide for the XP12000/XP10000

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Auto LUN XP user guide for the XP12000/XP10000

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About this guide

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- ["Auto LUN XP features"](#) on page 11
- ["Auto LUN XP tasks"](#) on page 11
- ["Reserve volumes"](#) on page 12
- ["Volume migration"](#) on page 12
- ["Estimating usage rates"](#) on page 13
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Supported storage platforms and firmware

In this guide, the term *array* refers to the following storage platforms:

- HP StorageWorks XP12000 Disk Array
- HP StorageWorks XP10000 Disk Array

For information about required firmware versions, see the *HP StorageWorks XP Remote Web Console user guide for XP12000/XP10000*.

Intended audience

This guide is intended for customers and HP-authorized service providers with knowledge of the following:

- Disk array hardware and software
- Data processing and RAID storage subsystems and their basic functions

Prerequisites

Prerequisites for using this product include:

- Installation of the HP StorageWorks disk array(s)
- Installation of the license key for this product

Related documentation

In addition to this guide, please refer to other documents for this product:

- *HP StorageWorks Command View XP user guide for XP Disk Arrays*
- *HP StorageWorks XP Remote Web Console user guide for XP12000/XP10000*
- *HP StorageWorks Continuous Access XP Journal user guide*
- *HP StorageWorks Performance Control XP user guide*
- *HP StorageWorks XP Disk/Cache Partition user guide*

- Hitachi True Copy for z/OS® for the XP128/XP1024/XP10000/XP1200
- HP StorageWorks RAID Manager XP user guide

You can find these documents at <http://www.hp.com/support/rwc/manuals>.

Document conventions and symbols

Table 1 Document conventions

Convention	Element
Blue text: Table 1	Cross-reference links and e-mail addresses
Blue, underlined text: (http://www.hp.com)	Web site addresses
Bold text	<ul style="list-style-type: none"> • Keys that are pressed • Text typed into a GUI element, such as a box • GUI elements that are clicked or selected, such as menu and list items, buttons, and check boxes
<i>Italic text</i>	Text emphasis
Monospace text	<ul style="list-style-type: none"> • File and directory names • System output • Code • Commands, their arguments, and argument values
<i>Monospace, italic text</i>	<ul style="list-style-type: none"> • Code variables • Command variables
Monospace, bold text	Emphasized monospace text

△ **CAUTION:** Indicates that failure to follow directions could result in damage to equipment or data.

📄 **IMPORTANT:** Provides clarifying information or specific instructions.

📖 **NOTE:** Provides additional information.

💡 **TIP:** Provides helpful hints and shortcuts.

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- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

For continuous quality improvement, calls may be recorded or monitored.

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After subscribing, locate your products by selecting **Business support** and then **Storage** under Product Category.

HP web sites

For additional information, see the following HP web sites:

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- http://www.hp.com/service_locator
- <http://www.hp.com/support/manuals>
- <http://www.hp.com/support/downloads>
- <http://www.hp.com/support/rwc/manuals>

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1 Auto LUN XP for the XP12000/XP10000

Auto LUN XP monitors resources in disk arrays and hosts connected to disk arrays. Auto LUN XP works with open system and mainframe volumes. You can analyze the information Auto LUN XP provides to optimize data storage and retrieval on disk arrays, resolve activity bottlenecks, and optimize volume allocation.

Auto LUN XP features

Auto LUN XP provides the following features:

- When a migration plan (set of detailed user-specified parameters) is in place, Auto LUN XP automatically migrates logical volumes in disk arrays.
- Auto LUN XP operations are completely non-disruptive. Data being migrated remains online to all hosts for read and write I/O operations throughout the volume migration process.
- Auto LUN XP supports manual volume migration operations and estimates performance improvements prior to migration.

Auto LUN XP begins by obtaining usage statistics about physical hard disk drives, logical volumes, processors, and other resources in disk arrays. Then, using manual or automatic migration, Auto LUN XP balances the workload among hard disk drives, logical volumes, and processors to improve system performance.

Use Performance Control XP to ensure that I/O operations requiring high performance receive higher priority than I/O operations from other, lower-priority hosts. You can set the priority of disk arrays, monitor I/O and transfer rates, and limit performance of less-critical arrays when necessary to maintain performance of high-priority arrays.

 **NOTE:** Partition-level users in the StorageAdmins group cannot use Auto LUN XP, but users with full array access can use Auto LUN XP.

For users in the StorageAdmins group, the functions you can use are limited. For more information about these limitations, see the *HP StorageWorks Command View XP user guide for XP Disk Arrays* or the *HP StorageWorks XP Remote Web Console user guide for XP12000/XP10000*.

Auto LUN XP tasks

- **Load balance disk array resources to improve performance.** Balancing resource usage can significantly improve disk array performance. Use Auto LUN XP data to optimize several areas of performance, including front-end and back-end processor usage and allocation of logical volumes to physical disk drives and RAID level.
- **Optimize disk drive access patterns.** Auto LUN XP collects and analyzes information about disk drive access patterns and can migrate volumes to optimize host access to data. For example, RAID-1 technology might provide better performance than RAID-5 under certain conditions, and one disk drive type might provide better performance than another for certain types of access. Auto LUN XP fine-tunes logical volume allocation.
- **Analyze disk array usage.** Auto LUN XP displays performance data graphically to highlight peaks and trends. Use the graph to identify activity bottlenecks.
- **Better utilize RAID levels and HDD types.** The XP12000/XP10000 supports both RAID-1 and RAID-5 technologies and a mixture of RAID-1 and RAID-5 parity groups. The XP12000/XP10000 also supports several types of hard disk drives (HDDs) and allows a mixture of HDD types within each disk array domain to provide maximum flexibility in configuration. Auto LUN XP takes into account RAID level and physical HDD performance of each parity group, enabling reallocation of logical volumes and optimization with respect to both RAID level and HDD type. The proper combination of RAID level and HDD type for logical volumes can significantly improve disk array performance.

Reserve volumes

The reserve volume function reserves target volumes for automatic and manual migration operations. After you reserve a number of target volumes, Auto LUN XP maintains this number of reserved volumes by swapping the reserve attribute after each migration operation (following the migration operation, the original source volume becomes a reserved volume).

Volume migration

Auto LUN XP volume migration operations consist of two steps:

- Copy the data on the Auto LUN XP source volume to the Auto LUN XP target volume
- Transfer host access to the target volume to complete the migration

The Auto LUN XP source volume can be online to hosts during migration. The target volume is reserved prior to migration to prevent host access during migration. The source and target volumes can be anywhere in the disk array.

The Auto LUN XP copy operation copies the entire contents of the source volume to the target volume. If write I/Os update the source volume during the copy operation, the XP12000/XP10000 uses a cylinder map to track updates and performs additional copy operations after the initial copy is complete to duplicate the updates at the target volume.

When volumes are fully synchronized (no differential data on source volume), the XP12000/XP10000 completes the migration by swapping the reserve attribute (target becomes normal and source becomes reserved) and redirecting host access to the target volume. Auto LUN XP performs all migration operations sequentially (one volume migration at a time).

Typical copy times for open system volumes (with no other I/O activity) are:

- OPEN-3: 1.5 minutes
- OPEN-8/9: 4.5 minutes
- OPEN-E: 9 minutes
- OPEN-V: variable

For automatic and manual migration operations, Auto LUN XP checks the current write pending rate. If the write pending rate is higher than 60%, Auto LUN XP cancels the migration. For auto migration, Auto LUN XP also checks current disk usage of source volumes and source and target parity groups. If current disk usage is higher than the user-specified maximum for auto migration, Auto LUN XP cancels the migration.

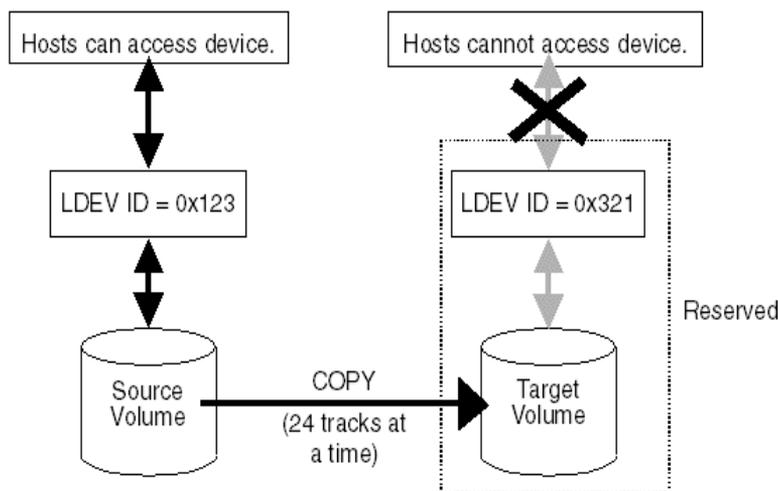


Figure 1 Data Flow during an Auto LUN XP Operation

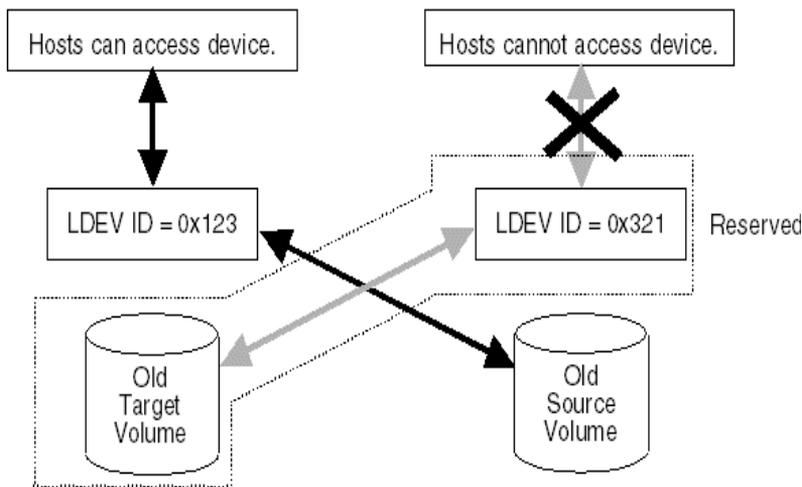


Figure 2 Data Flow after an Auto LUN XP operation

NOTE: Immediately after a source volume and a target volume replace each other, RAID level before the replacement might be displayed or an internal error might occur in the disk array. In this case, select **Refresh** to update the display.

Estimating usage rates

The estimate function calculates expected usage of source and target parity groups after a proposed volume migration. The estimate function uses subsystem usage data collected by the monitor function, HDD performance characteristics, and RAID level to estimate expected usage rates. The automatic and manual migration functions use these estimated values to verify proposed migrations.

For each proposed migration operation, Auto LUN XP automatically estimates expected usage rates for source and target parity groups. The estimate function calculates expected results of a proposed volume migration based on XP12000/XP10000 monitor data collected during the user-specified monitor data term. The estimate function considers RAID level and HDD type when estimating expected usage rates (RAID-1 and RAID-5 have different access characteristics).

The estimate function is a critical component of the auto migration function. The estimate function calculates expected parity group usage for source and target parity groups, and the auto migration function uses these estimates to verify proposed migrations. If any condition prevents Auto LUN XP from estimating an expected usage rate (for example, invalid monitor data), the auto migration function will not schedule the migration operation.

For manual migration operations, when you select the source volume, Auto LUN XP displays expected usage rates for the source parity group, so you can see the predicted effect of migrating the selected volume out of its group. When you select the target volume, Auto LUN XP displays expected usage rates for the target parity group, so you can see the predicted effect of adding the selected source volume to the selected parity group.

Auto LUN XP does not estimate processor or access path usage. You can use Auto LUN XP migration operations to improve DKP and DRR usage, but cannot use them to address CHP or access path usage.

Perform Auto LUN XP migration only when you expect a large improvement in disk array performance. Auto LUN XP migration might not provide significant improvement if parity group or volume usage varies only slightly or if overall DKP or DRR usage is relatively high. Also keep in mind that disk array tuning operations might improve performance in one area while decreasing performance in another. For example, suppose parity groups A and B have average usage values of 20% and 90%, respectively. Auto LUN XP estimates that if one logical volume is migrated from parity group B to parity group A, the usage values will become 55% and 55%. If you perform this migration operation, I/O response time for parity

group B will probably decrease and I/O response time for parity group A might increase, while the overall throughput might increase or decrease.

From an open-system host, you can also use RAID Manager command to perform manual volume migration. To use RAID Manager to perform Auto LUN XP migration, install Auto LUN XP on the XP12000/XP10000. For more information, see [“Using RAID Manager for manual Auto LUN XP migrations”](#) on page 44.

Automatic migration

Auto migration is the primary tuning method for disk arrays. Auto migration analyzes data and executes migration plans automatically based on user-specified parameters. Use Auto LUN XP to schedule auto migration operations, select data to be analyzed, and specify maximum time and performance impact of auto migration operations. Auto LUN XP displays a detailed log of auto migration activities.

Auto migration operations are based on the following major parameters:

- **Hierarchy of parity groups.** Auto LUN XP arranges parity groups in the XP12000/XP10000 in a hierarchy based on HDD type, and assigns each parity group to a class based on performance of its HDD type. Classes are ordered from highest performance drive (class A) to lowest performance drive (class B, C, or higher depending on number of HDD types available). The auto migration function uses this hierarchy to identify target volumes for auto migration operations.

The auto migration function can also specify “fixed” parity groups that are excluded from auto migration operations.

- **Maximum disk usage.** The auto migration function specifies the maximum disk usage rate for each HDD class in the XP12000/XP10000, and uses these limits to identify source volumes for auto migration operations.

You must identify and specify disk usage limits for your environment. When you use the same maximum disk usage rate for all HDD classes, HDD performance is the only factor used in determining auto migration plans. When you specify different usage limits for HDD classes, you can bias the auto migration function to favor (or avoid) certain HDD types. Migrating high-usage volumes to higher HDD classes should significantly improve host access to volumes, which can also have a large effect on disk array performance.

The auto migration function also specifies the maximum disk usage rate during auto migration operations, so you can control the impact of Auto LUN XP copy operations on disk array performance. If source or target parity group usage exceeds the specified limit during migration, the auto migration operation is canceled.

Do not perform manual migration operations while the auto migration function is active. Always turn off the auto migration function and cancel any existing auto migration plan before performing manual migration operations.

Storage management by maximum disk usage

Use the auto migration function to specify maximum usage rate for each HDD class in an XP12000/XP10000. When a parity group exceeds this limit, the auto migration function makes a plan to migrate one or more volumes in this parity group to a parity group in a higher HDD class or to a parity group in the same HDD class with lower usage.

This storage tuning method addresses and can eliminate disk drive activity bottlenecks. Auto LUN XP uses its estimated usage rates to verify each proposed auto migration, and will not perform a migration operation that might result in a target parity group exceeding the user-specified maximum disk usage rate.

The auto migration function identifies parity groups that exceed the user-specified usage limit, and selects high-usage volumes as source volumes to be migrated to parity groups in higher HDD classes or to other parity groups in the same HDD class with lower usage.

Keep reserved volumes in high HDD classes

When parity groups in the highest HDD classes start to run out of reserved (empty) volumes, Auto LUN XP maintains available reserve volumes by automatically migrating low-usage volumes from higher HDD class groups to lower HDD class groups.

The auto migration function can move a high-usage volume to a higher HDD class group, forcing a low-usage volume out of that HDD class group. To do so, the auto migration function requires a minimum of 5% difference in estimated disk usage between the two volumes. If the difference is less than 5%, this migration is considered ineffective and the volume is not moved.

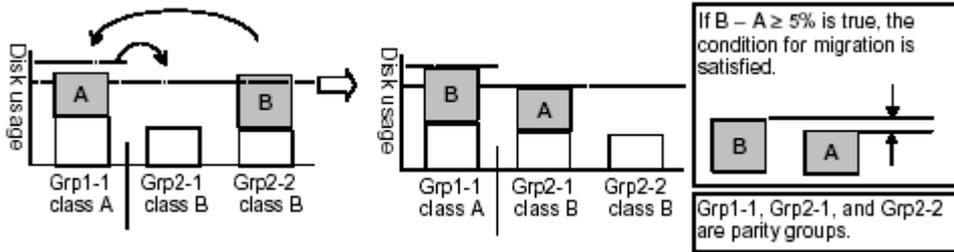


Figure 3 Auto migration function example 1

The auto migration function can also move a volume from one parity group to another group of the same HDD class, forcing another volume out of the destination parity group. To do so, the auto migration function requires a minimum of 20% difference in estimated disk usage between the two volumes. If the difference is less than 20%, this migration is considered ineffective and the volume is not moved.

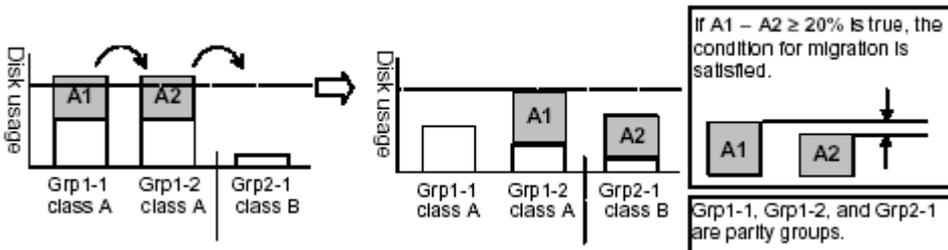


Figure 4 Auto migration function example 2

Auto migration sequence of events

The following are the typical steps to set up an auto migration plan:

1. Analyze monitor data. You specify the monitor data term to be analyzed.
2. Make auto migration plan. You specify the auto migration plan's parameters.
3. Perform auto migration plan. You specify when the auto migration plan is executed.
4. Analyze monitor data to confirm tuning results.

Manual migration

Use manual migration to select and migrate logical volumes under direct, manual control. The manual migration function displays estimated results of proposed migration operations, which you can use to determine expected performance improvements prior to the actual migration.

While auto migration operations are based on disk usage and hierarchy of parity groups, you can use manual migration operations to address back-end processor usage (DKPs and DRRs) and volume and parity group usage. If monitoring shows high or unbalanced processor usage, use manual migration operations to tune the processor performance of the XP12000/XP10000.

Requirements and restrictions

Selection of CU group

When you select CU group CU00-3F, the Auto LUN XP button is available. With all other CU group selections, the button is deactivated (grayed out).

Logical volumes

Source and target volumes must be in the same XP12000/XP10000. Also, a combination of source and target volumes should satisfy the following conditions:

- The source and target volumes have the same emulation type and capacity.
- If the emulation type is not OPEN-V, the source and target volumes are customized volumes (CVs), or the volumes are normal volumes.
- If you use LUN Security XP Extension with Auto LUN XP, volume management areas (VMA) are set on the source and target volumes, or VMAs are not set on both volumes. You cannot set VMA on a volume that is already reserved by Auto LUN XP. To set VMA on a volume, perform the VMA setting first, and then reserve that volume.
- The CU:LDEV numbers of volumes take the value between 00:00 and 3F:FF.

 **NOTE:** For users in the StorageAdmins group, the functions you can use are limited. For more information about these limitations, see the *HP StorageWorks Command View XP user guide for XP Disk Arrays* or the *HP StorageWorks XP Remote Web Console user guide for XP12000/XP10000*.

Whether you can or cannot perform volume migration with a pair consisting of CVs and normal volumes depends on the volumes' emulation type. For details, see [Table 2](#).

Table 2 Movability of volumes in pairs consisting of CV and normal values

Source volume	Target volume					
	Normal volume (not OPEN-V)	Normal volume (OPEN-V without VMA setting)	Normal volume (OPEN-V with VMA setting)	CV (not OPEN-V)	CV (OPEN-V without VMA setting)	CV (OPEN-V with VMA setting)
Normal volume (not OPEN-V)	Movable	Not movable	Not movable	Not movable	Not movable	Not movable
Normal volume (OPEN-V without VMA setting)	Not movable	Movable	Not movable	Not movable	Movable	Not movable

Table 2 Movability of volumes in pairs consisting of CV and normal values (continued)

Source volume	Target volume					
Normal volume (OPEN-V with VMA setting)	Not movable	Not movable	Movable	Not movable	Not movable	Not movable
CV (not OPEN_V)	Not movable	Not movable	Not movable	Movable	Not movable	Not movable
CV (OPEN-V without VMA setting)	Not movable	Movable	Not movable	Not movable	Movable	Not movable
CV (OPEN-V with VMA setting)	Not movable	Not movable	Movable	Not movable	Not movable	Movable

You cannot make pairs of the volumes.

Specify the logical volumes satisfying the conditions described in [Table 2](#) as the source and target volumes. The source and target volumes must be specified by LDEV ID.

Source volumes

The following describes whether volumes can be used as source volumes:

- Volumes set as command devices (reserved for use by hosts) cannot be used as source volumes.
- Volumes in an abnormal or inaccessible condition (for example, fenced) cannot be used as source volumes.
- Volumes with Cache LUN data stored in cache cannot be used as source volumes.
- iSCSI volumes (volumes to which paths are defined from iSCSI ports) cannot be used as source volumes.
- Volumes that HP StorageWorks Continuous Access XP Journal or Universal Replicator for z/OS® uses as a data or journal volume cannot be used as source volumes.
- Volumes reserved by a migration program other than Auto LUN XP cannot be used as source volumes.
- Volumes on which the RAID Manager is performing volume migration operations.
- Volumes that form a Snapshot XP pair cannot be used as source volumes.
- Volumes used by Continuous Access XP Journal or Universal Replicator for z/OS® as a journal volume.
- Volumes used by the IBM 3990 Concurrent Copy (CC) host software function.
- Virtual and pool volumes cannot be used as source volumes.
- Inaccessible volumes, or volumes in an abnormal state cannot be used as source volumes (for example, pinned track or fenced volumes).
- Volumes being shredded.
- **Universal Replicator for z/OS®:** If the status of a Universal Replicator for z/OS® volume is Pending duplex or Duplex, the volume cannot be used as a source volume. Note that if you specify a Universal Replicator for z/OS® volume as a source volume, you cannot specify an external volume as the target volume.
- **Continuous Access XP Journal.** If the status of a HP StorageWorks Continuous Access XP Journal volume is PSUS, PSUE, or SMPL, the volume can be used as a source volume. If not, the volume cannot be used as a source volume. When a Continuous Access XP Journal pair is deleted from the MCU, the status of both volumes changes to SMPL, and both volumes can be used as source volumes. When a Continuous Access XP pair is deleted from the RCU, the status of the P-VOL changes to PSUS, the status of the S-VOL changes to SMPL, and both volumes can be used as source volumes. If the status of a Continuous Access XP Journal volume is COPY or PAIR, the volume cannot be used as a source volume. Note that if you specify a Continuous Access XP Journal volume as a source volume, you cannot specify an external volume as the target volume.
- **Business Copy.** Using a BC volume as a source volume depends on the status and cascade configuration of the volume. If the status of a BC volume is not split-pending COPY(SP) or PSUS(SP), the

volume can be used as a source volume. If the status is COPY(SP) or PSUS(SP), the volume cannot be used as a source volume. This applies to cascaded and non-cascaded volumes.

Table 3 shows which non-cascaded volumes can be used as source volumes.

Table 3 Non-cascaded volumes that can be used as source volumes

Pair configuration	Use P-VOL as source volume	Use S-VOLs as source volumes
Ratio of P-VOL to S-VOLs is 1:1	Yes	Yes
Ratio of P-VOL to S-VOLs is 1:2	Yes	Yes
Ratio of P-VOL to S-VOLs is 1:3	No	Yes

Table 4 shows which cascaded volumes can be used as source volumes.

Table 4 Cascaded volumes that can be used as source volumes

Pair Configuration	Use P-VOL as source volume	Use S-VOLs as source volumes
L1 pair, ratio of P-VOL to S-VOLs is 1:1	Yes	Yes
L1 pair, ratio of P-VOL to S-VOLs is 1:2	Yes	Yes
L1 pair, ratio of P-VOL to S-VOLs is 1:3	No	Yes
L2 pair, ratio of P-VOL to S-VOLs is 1:1	Yes	No
L2 pair, ratio of P-VOL to S-VOLs is 1:2	No	No

If any of the following operations are performed on an Auto LUN XP source volume during migration, the Auto LUN XP volume migration process stops:

- Continuous Access XP operations that change the volume status to something other than PSUS, PSUE, or SMPL
- BC operations that change the volume status to COPY(SP) or PSUS(SP)
- Continuous Access XP Journal operations
- Continuous Access XP Journal or Universal Replicator for z/OS® operation that changes the volume status to COPY.

LUSE source volumes

To specify a LUSE source volume for migration, specify individual LDEVs within the LUSE volume (for example, LDEVs with high usage). Auto LUN XP migrates only specified LDEVs. If needed, specify all LDEVs of the LUSE volume to relocate the entire LUSE volume. In this case, ensure that the required reserved target LDEVs are available.

Target volumes

Target volumes must be reserved prior to migration. Hosts cannot access reserved volumes. The following volumes cannot be reserved:

- Logical Unit Size Expansion (LUSE) volumes
- Volumes set as command devices
- Volumes assigned to BC or Continuous Access XP pairs
- Volumes reserved for BC operations
- Volumes with Cache LUN data stored in cache
- iSCSI volumes (for example, volumes to which paths are defined from iSCSI ports)
- Volumes in abnormal or inaccessible conditions (for example, fenced)
- Volumes Continuous Access XP Journal uses
- Volumes specified with the Read Only or Protect attribute
- Volumes that Volume Security disabled for use as secondary volumes
- Volumes that LUN Security XP Extension specified as Read Only or Protect or disabled for use as secondary volumes

- Volumes reserved by a migration program other than Auto LUN XP
- Volumes on which the RAID Manager is performing volume migration operations.
- Volumes that form a Snapshot XP pair.
- Virtual and pool volumes.

Number of volumes

In manual migrations, the number of migration plans that can be executed concurrently might be restricted, depending on use of other Command View XP or XP Remote Web Console programs and emulation types and sizes of migrated volumes. Therefore, the number of migration plans that can be executed concurrently is not constant.

A maximum of 36 Auto LUN XP copy operations can be requested at the same time. Auto LUN XP performs migration operations sequentially (one volume at a time).

The maximum number of Auto LUN XP copy operations plus BC pairs is 1024.

Calculating the number of Auto LUN XP concurrent migration plans

When a migration plan is created, differential tables are used. Differential tables are disk array resources that are shared by Flex Copy XP, Business Copy XP, ShadowImage for z/OS[®], Hitachi FlashCopy Mirroring, Hitachi FlashCopy Mirroring Version2, Snapshot XP, and Auto LUN XP. The maximum number of differential tables that Auto LUN XP can use is the number of total differential tables in the disk array minus the number used by other applications.

When using Auto LUN XP for manual volume migration, the number of migration plans that can be executed concurrently depends on the following:

- How much shared memory is available for differential tables. The number of differential tables available in one disk array is determined by whether additional shared memory for differential tables is installed.
 - You can use 13,652 differential tables if no additional shared memory for differential tables is installed.
 - You can use 30,718 differential tables if additional shared memory for differential tables is installed.

 **NOTE:** Contact your HP account support representative for more information about adding additional shared memory.

- The emulation type and capacity of each volume to be migrated:
The number of differential tables needed to migrate one volume differs depending on the emulation type and size of the volume. For the number of differential tables needed for migrating a mainframe volume, see page 19. For the number of differential tables needed for migrating an open-system volume, see page 21.

You can estimate the maximum number of migration plans that can be executed concurrently by applying the previously described conditions to the following equation: $\Sigma(\alpha) = (\beta)$, where:

- $\Sigma(\alpha)$ is the total number of differential tables needed to migrate all volumes.
- (β) is the number of available differential tables.

For example, if you want to create 20 migration plans of OPEN-3 volumes (volume size = 2,403,360 KB), calculate the number of required differential tables (page 21) and enter this number in the equation: $[(1 \times 20) = 20] \leq 13,652$ or $30,718$.

Since this equation is true, you can create 20 migration plans of OPEN-3 volumes.

Calculating differential tables for mainframe volume migration

When you migrate mainframe volumes, use the following equation to calculate the total number of required differential tables per migration plan:

$(X + Y) \times 15 \div Z =$ Total number of differential tables per migration plan, where:

- X: The number of cylinders in the volume to be migrated. If the volume is a CVS volume, use the number of cylinders in the custom volume instead of the default value for the emulation type.
- Y: The number of control cylinders (See [Table 5](#)).
- Z: The number of slots that can be managed by a differential table: 1916×32 .

 **NOTE:** Round the result of the calculation up to the nearest whole number.

For example, if a volume has the emulation type 3390-3, and 3339 cylinders, calculate the total number of differential tables with the following equation: $(3339 + 6) \times 15 \div (1916 \times 32) = 0.81836$.

When you round 0.81836 up to the nearest whole number, it becomes 1. Therefore, the total number of differential tables for one migration plan is 1 when emulation type is 3390-3.

The following table shows the number of the control cylinders according to the emulation type.

Table 5 Control cylinders by emulation type

Emulation type	Number of control cylinders
3380-3	7
3380-3A	7
3380-3B	7
3380-3C	7
3380-F	22
3380-K	7
3380-KA	7
3380-KB	7
3380-KC	7
3390-3	6
3390-3A	6
3390-3B	6
3390-3C	6
3390-3R	6
3390-9	25
3390-9A	25
3390-9B	25
3390-9C	25
3390-L	23
3390-LA	23
3390-LB	23
3390-M	53
3390-MA	53
3390-MB	53
3390-MC	53
3390-LC	23
NF80-F	22

Table 5 Control cylinders by emulation type (continued)

NF80-K	7
NF80-KA	7
NF80-KB	7
NF80-KC	7

Calculating differential tables for open-system volume migration

When you migrate open-system volumes, use the information in [Table 6](#) to calculate the total number of required differential tables per migration plan.

Table 6 Total number of differential tables per migration plan

Emulation type	Equation
OPEN-3	Total number of differential tables per migration plan = $[(X \div 48) + (Y \times 15)] \div Z$ (X): Capacity of the volume to be migrated (KB) ^{1,2} (Y): Number of control cylinders associated with the emulation type (see Table 7) (Z): Number of slots that can be managed by a differential table (1,916 × 32)
OPEN-8	
OPEN-9	
OPEN-E	
OPEN-L	
	NOTE: Round the result of the calculation up to the nearest whole number. For example, if the volume's emulation type is OPEN-3, and it is not a custom volume, the volume capacity (X) is the default volume size, 2,403,360 KB, and the total number of differential tables is calculated as follows: $[(2,403,360 \div 48) + (8 \times 15)] \div (1,916 \times 32) = 0.81860$ When you round to the nearest whole number, the result is 1. Therefore, the total number of differential tables for one migration plan is 1 when the emulation type is OPEN-3.
OPEN-V	Total number of differential tables per migration plan = $(X \div 256) \div (Z)$ (X): Capacity of the volume to be migrated (KB) ² (Z): Number of slots that can be managed by a differential table (1,916 × 32)
	NOTE: Round the result of the calculation up to the nearest whole number. For example, if the volume capacity (X) is the maximum OPEN-V volume capacity of 3,019,898,880 KB, the total number of differential tables is calculated as follows: $(3,019,898,880 \div 256) \div (1,916 \times 32) = 192.40084$ When you round up to the nearest whole number, the result is 193. Therefore, the total number of differential tables for migration plan is 193 when the emulation type is OPEN-V.

1. If the selected volume is a CVS (custom volume size) volume, use the capacity of the custom volume instead of the default volume capacity for the emulation type. Since the OPEN-L emulation type does not support custom volume operations, you must use the default volume capacity of OPEN-L for X.
2. 1 KB equals 1024 bytes.

The following table shows the number of control cylinders according to the emulation type.

Table 7 Control cylinders by emulation type

Emulation type	Number of control cylinders
OPEN-3	8 (5,760KB)
OPEN-8	27 (19,440KB)
OPEN-9	
OPEN-E	19 (13,680KB)

Table 7 Control cylinders by emulation type (continued)

OPEN-L	7 (5,040KB)
OPEN-V	0 (0KB)

Auto migration planning

Auto LUN XP will not plan an auto migration when:

- There is no reserve volume with the same emulation type and capacity as the source volume in the same or next higher/lower HDD class (auto migration is performed only between consecutive classes or within the same class)
- Auto LUN XP cannot estimate the usage rate for the target parity group because of some condition (for example, invalid monitor data)
- The estimated usage of the target parity group or volume is over the user-specified maximum disk usage value for that HDD class
- The estimated performance improvement is not large enough

Auto migration execution

Auto LUN XP will not execute an auto migration operation when:

- The current usage (last 15 minutes) of the source or target parity group or volume is over the maximum disk usage rate for auto migration
- The current write pending rate for the disk array is 60% or higher

Manual migration execution

Auto LUN XP will execute a manual migration operation when the current write pending rate for the disk array is 60% or higher.

Copy Threshold option

If Auto LUN XP performs migration operations when the disk array workload is heavy, host server I/O performance might be degraded. To minimize this performance degradation, enable **Copy Threshold**, which temporarily stops Auto LUN XP operations when the disk array has a heavy workload. Copy operations that are stopped by the Copy Threshold option resume when the disk array workload is lighter.

△ **CAUTION:** A volume migration operation might fail if hosts frequently update the volumes being migrated. If you enable **Copy Threshold**, Auto LUN XP temporarily stops copy processing when the disk array is overloaded, which increases the possibility of a failed volume migration operation. Using the Copy Threshold operation is not recommended when hosts frequently update the volumes being migrated.

📄 **IMPORTANT:** Contact your HP support account representative for more information about the Copy Threshold option.

In addition to Auto LUN XP operations, Copy Threshold temporarily stops copy operations for the following applications when the disk array workload is heavy:

- Business Copy XP
- ShadowImage for z/OS
- Hitachi FlashCopy Mirroring
- Hitachi FlashCopy Mirroring Version 2
- Snapshot XP
- Flex Copy XP

Progress value

If a volumes with heavy and light workloads are migrated together, the migration might not complete (even though the progress value indicates 100%). If this happens perform one of the following tasks.

- Reduce the workloads between hosts and the disk array and complete the migration.
- Stop the migration for the volume with heavy workloads, migrate the other volume, and then retry the migration which has been stopped.

Effects on other XP products

When the workloads for update I/Os between hosts and the disk array are heavy, longer time will be required to complete the volume migration because the copy of differential data is repeatedly executed. Longer copying times may be required for other XP products when this copy of differential data is executed. These XP products include: Auto LUN XP, Business Copy XP, ShadowImage for z/OS®, Compatible Mirroring for IBM® FlashCopy®, and Flex Copy XP.

See [Figure 8](#) for the amount of affected copying time. The copying time of other XP products depends on the number of pairs set to the XP product, however, the copying time may be increased up to twice.

Table 8 The estimated delay in the copying speed

Capacity of Migrated Volume (MB)	Estimated delay in the copying speed (in minutes)
0 - 1,000	4
1,001 - 5,000	18
5,001 - 10,000	37
10,001 - 50,000	186
50,001 - 100,000	372
100,001 - 500,000	1860
500,001 - 1,000,000	3720
1,000,001 - 2,150,400	9667

The above estimates are calculated based on the assumption that the workload for update I/Os for the migrated volume is 50 IOPS for one volume.

Maintenance

Do not perform Auto LUN XP migration operations during disk array maintenance activities (for example, cache or drive installation, replacement, de-installation, or replacement of the microprogram).

Auto migration parameters

Auto migration parameters are initialized when the disk array configuration is changed (for example, when new drives or LDEVs are installed). Parameters include disk usage limit and migration time. After a change is made to the subsystem configuration, you must specify auto migration parameters again.

Powering off disk arrays

To turn the power off at the disk array, ensure that volume migration is finished. If migration is not finished, HP strongly recommends that you do not turn off the power until the migration is finished.

If you turn the power off while migration is in progress, data migration stops and some of the data are not migrated. If you turn the power on later, Auto LUN XP resumes data migration. If data remains in shared memory, which is volatile memory, Auto LUN XP attempts to copy only data that have not been migrated to the migration destination. However, if data is lost from shared memory, Auto LUN XP attempts to copy all data to the migration destination; therefore, the copy operation takes more time. Auto LUN XP attempts to

copy data that have not been migrated and data that have already been copied to the migration destination.

To power off the disk array, obtain the monitoring results first. If you do not, the **Physical** tab will not display some monitoring results. For example, if 4:00 a.m. and p.m. is specified in the **Gathering Time** option in the Auto LUN XP Monitoring Options pane and you turn off the power to the disk array at 5:00 p.m., the **Physical** tab will not display the monitoring results from 4:00 p.m. to 5:00 p.m.

Starting Auto LUN XP

1. Log in to Command View XP or XP Remote Web Console. For more information, see the *HP StorageWorks Command View XP user guide for XP Disk Arrays* or the *HP StorageWorks XP Remote Web Console user guide for XP12000/XP10000*.
2. Ensure that you are in Modify mode. For more information, see the *HP StorageWorks Command View XP user guide for XP Disk Arrays* or the *HP StorageWorks XP Remote Web Console user guide for XP12000/XP10000*.
3. Click **Auto LUN / Perf Control Base Monitor / PFC** in the left pane. The Auto LUN pane appears.

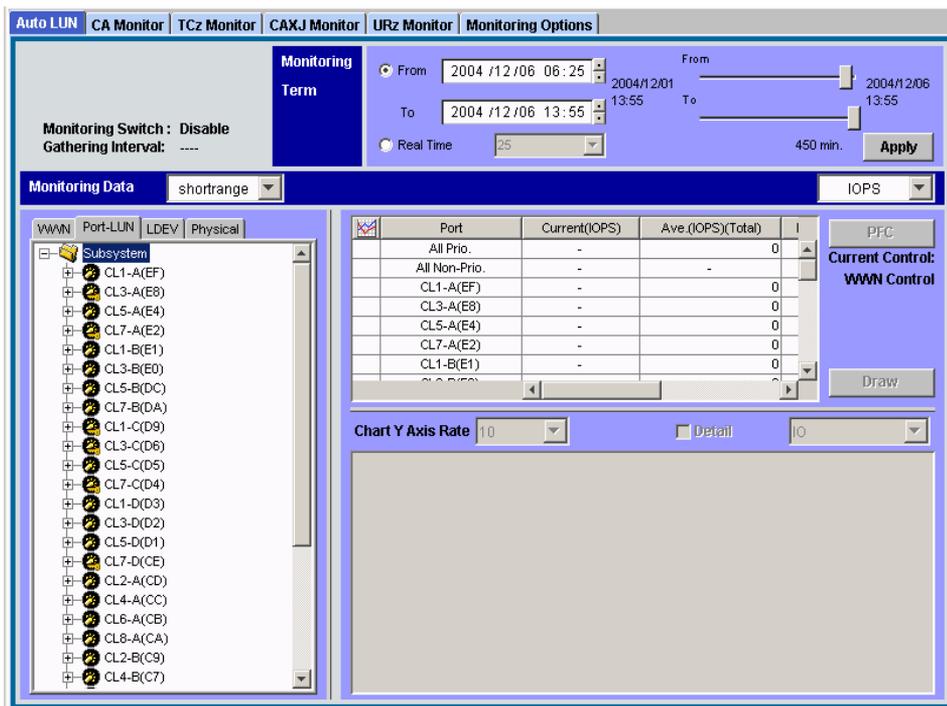


Figure 5 Auto LUN pane

4. Click **Monitoring Options**. The Monitoring Options pane appears.

Auto LUN pane

The Auto LUN pane is the performance management pane. It displays usage rates for parity groups, logical volumes, channel processors, disk processors, and so forth. The pane has several sections.

NOTE: If a hyphen appears in monitoring data columns on the Auto LUN pane, statistics cannot be collected for that item.

Tabs and selection trees

When you click one of the tabs (**WWN**, **Port-LUN**, **LDEV**, or **Physical**) in the lower-left portion of the pane, the pane displays different trees of items you can click.

The top left of the pane shows the status of the Short range Monitor and Long range Monitor. For information about these monitors, see "[Auto LUN Monitoring Options pane](#)" on page 50.

Monitoring term section

Use this section to specify the monitoring period. This setting affects all Auto LUN XP monitoring panes.

Use the **From** box and slide bar to specify the starting date for the monitoring period. Use the **To** box and slide bar to specify the ending date for the monitoring period.

Click **Real Time** to display workload statistics in real time. Use the list to specify the data range to be displayed in the graph. This check box appears dimmed when the **Physical** or **LDEV** tab is active. If the service processor is overloaded, extra time might be required for gathering monitoring results, and a portion of the results will not be displayed.

The **Apply** button applies the monitoring period settings to the disk array.

Monitoring data section

This section includes the following:

- A list on the left to specify the units in which usage are displayed (MB/s, IOPS, and so forth).
- The **CAXJ Monitor** pane displays information about Continuous Access XP Journal's continuous access operation. This information is also displayed in the **Usage Monitor** pane. For more information, see the *HP StorageWorks Continuous Access XP Journal user guide*.
- The **URz Monitor** pane displays information about the Universal Replicator for z/OS's continuous access operation. This information is also displayed in the **Usage Monitor** pane. For more information, see the *Hitachi True Copy for z/OS for the XP128/XP1024/XP10000/XP1200*.

 **NOTE:** If any continuous access function is not installed in your environment, the corresponding tab for that function is inactive and you cannot display that pane.

- A list on the right to specify the type of monitoring required: long range or short range. Long range monitoring is available only when the **Physical** tab is active.

Table section

This section displays the following:

- Statistics about traffic between host bus adapters (HBAs) in the hosts and ports on the disk array, if the **WWN** tab is active.
- Traffic statistics about WWNs and ports if the **Port-LUN** tab is active.
- Workload statistics about logical volumes if the **LDEV** tab is active.
- Statistics about parity group usage, processor usage, and so forth if the **Physical** tab is active.
- The **Plan** button is displayed when the **Physical** tab is active. Clicking this button displays Plan pane containing the **Manual Migration**, **Auto Migration**, **Attribute**, and **History** tabs.
- The **Draw** button draws a graph in the pane's graph section. The graph charts the statistics displayed in the table section.
- The **PFC** button is displayed when the **WWN** or **Port** tab is active. Clicking this button displays the Performance Control pane. For details, see *HP StorageWorks Performance Control XP user guide*.
- The **Current Control** status is displayed when the **WWN** or **Port** tab is active. It displays the status of Performance Control:
 - **Port Control:** System performance is controlled by the upper limits and threshold specified in the **Port** tab of the Performance Control pane
 - **WWN Control:** System performance is controlled by the upper limits and threshold specified in the **WWN** tab of the Performance Control pane
 - **No Control:** System performance is not controlled by Performance Control

For further information, see *HP StorageWorks Performance Control XP user guide*.

Graph section

The graph shows statistics displayed in the table. The vertical axis shows usage values. The horizontal axis shows date or time.

Use the **Chart Y Axis Rate** list to select the highest value of the Y-axis (the vertical axis). This list is not displayed when the **Plan** button is active.

If you click the **Detail** check box, the graph displays detailed statistics. This check box is displayed when the **Port-LUN** or **LDEV** tab is active. The contents of the graph depend on the item selected in the list to the right of the table, as shown in the following table.

Table 9 Graph contents based on list selection (Port-LUN tab)

Selection in list	Graph contents
I/O Rate (number of I/Os per second)	<ul style="list-style-type: none"> • Statistics in sequential access mode • Statistics in random access mode • Statistics in CFW (cache fast write) mode • If the read hit ratio or write hit ratio is high, random access mode is used for transferring data instead of sequential access mode. For example, random access mode might be used for transferring data to disk areas where Cache LUN XP is applied.
Read (number of read accesses per second) ¹	
Write (number of write accesses per second) ¹	
Read Hit (read hit ratio)	
Write Hit (write hit ratio)	
Back Transfer (backend transfer: number of I/Os between the cache memory and disk drives)	<ul style="list-style-type: none"> • Number of data transfers from the cache memory to disk drives • Number of data transfers from disk drives to cache memory in sequential access mode • Number of data transfers from disk drives to cache memory in random access mode
Trans. Rate (number of data transfers)	The graph does not display detailed information.

1. Available only when I/O rates are displayed.

WWN, Port-LUN, LDEV, and Physical tabs

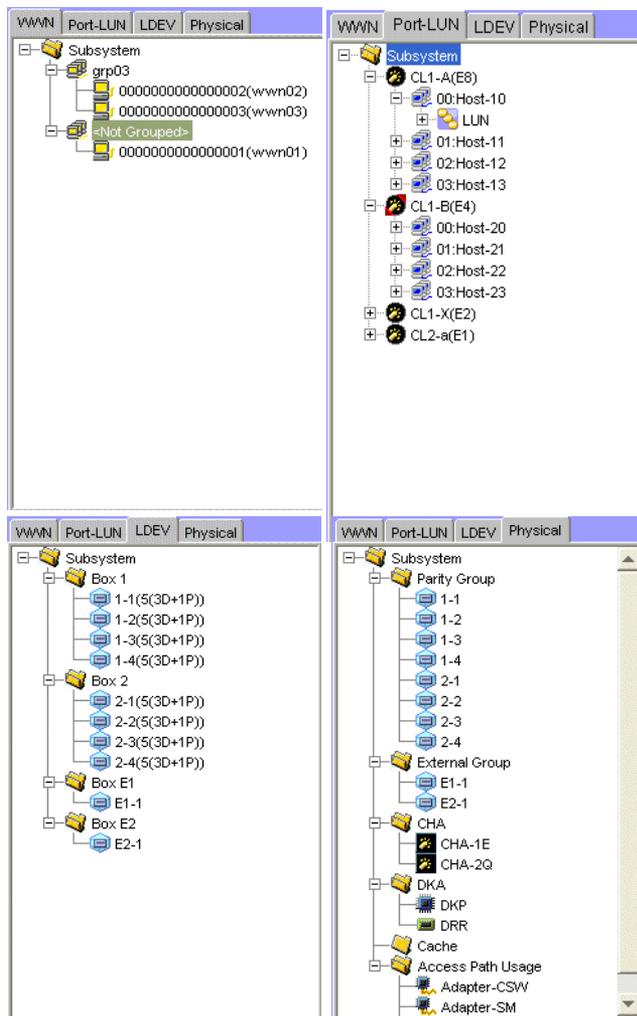


Figure 6 WWN, Port-LUN, LDEV, and Physical tabs

Click one of the tabs (**WWN**, **Port-LUN**, **LDEV**, or **Physical**) in the lower-left portion of the pane to view data about ports, LDEVs, or physical components.

When you click a tab, the selection tree in the lower-left portion of the pane changes. You can then click entities to display information in the table and graph sections of the pane.

If I/O workloads between hosts and the disk array become heavy, the disk array gives higher priority to I/O processing than monitoring processing; therefore, some monitoring data might be missing. If monitoring data are frequently missing, use the **Gathering Interval** option in the **Monitoring Options** pane to increase the collection interval.

WWN tab

This tab displays the **Subsystem** folder and PFC groups, which are groups of multiple WWNs. Double-clicking a PFC group () displays host bus adapters () in the PFC group. Double-clicking **Not Grouped** in the tree shows host bus adapters (WWNs) that do not belong to any PFC group.

To start monitoring traffic between host bus adapters and disk array ports, you must specify settings before starting monitoring.

If the SVP is overloaded, more time than the gathering interval allots might be required for updating the displayed monitoring data. In this case, some portion of monitoring data does not appear in the pane. For example, if the gathering interval is 1 minute, and the display in the pane is updated at 9 minutes and the next update occurs at 9:02, the pane (including the graph) does not display monitoring results for the period of 9:00 to 9:01. This situation occurs when you use a Command View XP or XP Remote Web Console system, and when the SVP is used to perform maintenance operations for the disk controller.

After replacing the micro program, monitoring data is not stored until a service technician releases the SVP from Modify mode.

 **NOTE:** If a host bus adapter's WWN is displayed in red in the tree, the host bus adapter is connected to two or more ports, but Performance Control does not control traffic between the HBA and some ports. For information about controlling the traffic between the HBA and all connected ports, see *HP StorageWorks Performance Control XP user guide*.

Port-LUN tab

This tab displays ports. The tree view displays the following icons.

Table 10 Auto LUN pane, Port-LUN tab icons

Icon	Status
	Short-wave Fibre Channel port in standard mode with LUN security. If the port name is followed by its fibre address, the port is a Fibre Channel port. For example, CL1-A(EF) indicates the CL1-A port is a Fibre Channel port.
	Short-wave Fibre Channel port in standard mode without LUN security.
	Short-wave Fibre Channel port in high-speed or high-speed (2 port) mode with LUN security.
	Short-wave Fibre Channel port in high-speed or high-speed (2 port) mode without LUN security.
	Long-wave Fibre Channel port in standard mode with LUN security.
	Long-wave Fibre Channel port in standard mode without LUN security.
	Long-wave Fibre Channel port in high-speed or high-speed (2 port) mode with LUN security.
	Long-wave Fibre Channel port in high-speed or high-speed (2 port) mode without LUN security.

 **NOTE:** High-speed (2 port) mode is available only if the XP disk array has firmware version 21.06.22 or later installed.

 **NOTE:** Auto LUN/Performance Control Base Monitor obtains statistics about traffic only on ports connected to open-system host groups. Statistics for ports connected to mainframe host groups cannot be obtained.

LDEV tab

This tab displays parity groups. **Box** folders appear below the **Subsystem** folder. The number at the end of a Box folder name indicates the number at the beginning of the parity group ID. For example, if you double-click the **Box 1** folder, the tree view displays a list of parity groups that have IDs beginning with 1 (such as **1-1** and **1-2**).

If you double-click a parity group, the logical volumes in the parity group appear in the table. If a parity group ID starts with the letter E, the logical volumes in the parity group are external LUs.

The parity group icon () represents a single parity group or two or more connected parity groups. If two or more parity groups are connected, logical volumes can be striped across two or more drives. Therefore, connected parity groups provide faster access (particularly faster sequential access) to data.

If the parity group icon represents a single parity group 1-3, the text 1-3 is displayed on the right of the icon. If the parity group icon represents two or more connected parity groups, all connected parity groups are displayed to the right of the icon. For example, if parity group 1-3 is connected with parity group 1-4, the text 1-3[1-4] is displayed on the right of the parity group icon. All parity groups connected with 1-3 are enclosed by square brackets.

When the Business Copy or SI390 quick restore operation is being performed, a Control View pane might display old information (status prior to the quick restore operation) on logical volume (LDEV) configurations. In this case, wait until the quick restore operation completes, and click **Refresh** () to update the Command View XP or XP Remote Web Console window.

Physical tab

This tab displays parity groups, CHAs, DKAs, and other related items. The tree view displays the following icons.

Table 11 Auto LUN pane, Physical tab icons

Icon	Description
	Parity group.
 CHA-1G (Mfibre 4Port)*	FICON channel adapter.
 CHA-1E (Fibre 16Port)*	<p>Short-wave Fibre Channel adapter in standard mode. This port icon indicates either of the following:</p> <ul style="list-style-type: none"> a Fibre Channel port in Standard mode. LUN security is not applied to this port. an iSCSI port to which LUN security is not applied <p>NOTE: Note: An iSCSI port is not supported in the present version of Command View XP.</p>
 CHA-1E (Fibre 16Port)*	<p>This port icon indicates either of the following:</p> <ul style="list-style-type: none"> a Fibre Channel port in Standard mode. LUN security is applied to this port. an iSCSI port to which LUN security is applied (Note: An iSCSI port is not supported in the present version of TagmaStore™ USP) <p>If the port name is followed by its fibre address, the port is a Fibre Channel port. If the port name is followed by two hyphens, the port is an iSCSI port. For example, CL1-A(EF) indicates that the CL1-A port is a Fibre Channel port, and CL1-A(-) indicates that the CL1-A port is an iSCSI port.</p> <p>NOTE: An iSCSI port is not supported in the present version of Command View XP.</p> <p>NOTE: For detailed information about LUN security, please refer to LUN Manager User's Guide.</p>
 CHA-1E (Fibre 16Port)*	Short-wave Fibre Channel adapter in high-speed or high-speed (2 port) mode.

Table 11 Auto LUN pane, Physical tab icons (continued)

Icon	Description
 CHA-1E (Fibre 16Port)*	a Fibre Channel port in High Speed mode. LUN security is applied to this port.
 CHA-1E (Fibre 16Port)*	a Fibre Channel adapter in Initiator/External MIX mode
 CHA-1E (Fibre 16Port)*	a Fibre Channel port in Initiator/External MIX mode. LUN security is applied to this port
	Long-wave Fibre Channel adapter in standard mode.
 CHA-2U (iSCSI 4Port)*	Channel adapter for use in an iSCSI environment
	Long-wave Fibre Channel adapter in high-speed or high-speed (2 port) mode.
 CHA-1F (NAS 4Port)*	Channel adapter for use in a NAS environment
	Disk processor (DKP).
	Data recovery and reconstruction processor (DRR).
	Access path.

* The channel adapter number and number of ports that displayed on the right side of the icon are examples.

NOTE: High-speed (2 port) mode is available only if the XP disk array has firmware version 21.06.22 or later installed.

In short range, if I/O workloads between hosts and the disk array become heavy, the disk array gives higher priority to I/O processing than monitoring processing; therefore, some monitoring data might be missing. If monitoring data is missing frequently, use the **Gathering Interval** option in the **Monitoring Options** pane to increase the collection interval.

NOTE: Short-range monitoring data and long-range monitoring data may have some margin of error.

Creating and executing migration plans

Before you use Auto LUN XP, you must first reserve logical volumes for migration destinations. See ["Reserving target volumes"](#) on page 38.

1. In the Auto LUN pane, click **Physical**.
2. Click **Plan**. The **Plan - Manual Migration** tab appears.

There are four tabs: **Manual Migration**, **Auto Migration**, **Attribute**, and **History**. Click the tabs to access that pane. By default, the Manual Migration tab appears.

Manual Migration tab

Use this tab to create and execute migration plans for manually migrating volumes.

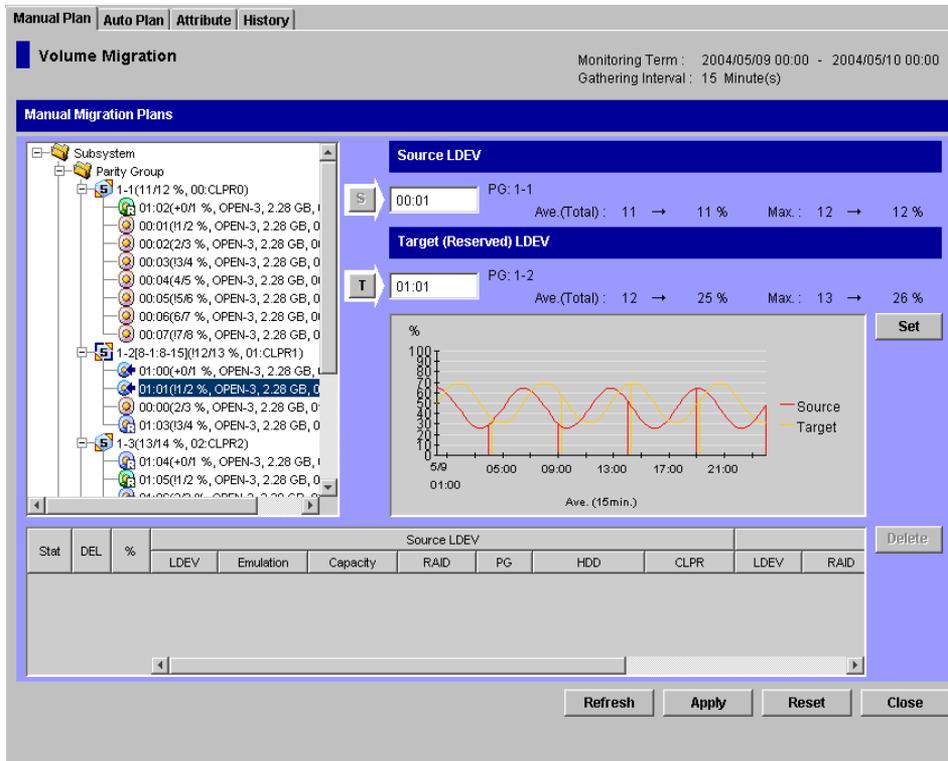


Figure 7 Manual Migration tab

Pane contents

This pane contains the following items:

- **Monitoring Term:** Displays the monitoring period specified in the Auto LUN pane, analyzes disk usage information collected by Auto LUN XP during the monitoring period, and calculates estimated usage rates of the source and target parity groups after a proposed volume migration.
- **Gathering Time:** Displays the time specified in the Auto LUN XP Monitoring Options pane. The disk array collects usage statistics about resources (such as hard disk drives) at the specified gathering time. Auto LUN XP uses collected usage statistics to estimate usage rates of parity groups after a proposed volume migration.
- **Source LDEV section:** Specifies the source volume (logical volume you want to migrate). On the right are the current usage rate for the parity group to which the source volume belongs and estimated usage rate for the parity group after a proposed volume migration.
- **Target (Reserved) LDEV section:** Specifies the target volume (where you want to migrate the source volume). On the right are the current usage rate for the parity group to which the target volume belongs and estimated usage rate for the parity group after a proposed volume migration.

Tree view

This view lists parity groups in the disk array. Double-clicking a parity group icon displays the logical volumes in that parity group.

Table view

- **Plan** columns:
 - **Stat:** Displays an error code if an error occurs during execution of a migration plan. To view detailed information about an error, select and right-click the error code, and click **Details**.
 - **DEL:** Displays the character **D** if you delete a migration plan that is waiting for execution. Migration plans indicated by **D** are deleted when you click **Apply**.
 - **%:** Displays the progress of the manual migration.

- **Source LDEV** columns:
 - **LDEV**: Logical volume ID
 - **Emulation**: Emulation type of the logical volume
 - **Capacity**: Capacity of the logical volume
 - **RAID**: RAID type
 - **PG**: Parity group ID (frame and group number)
 - **HDD**: Type of hard disk drive
 - **CLPR**: The numbers and names of CLPRs corresponding to each parity group to which the logical volume belongs
- **Target LDEV** columns:
 - **LDEV**: Logical volume ID
 - **RAID**: RAID type
 - **PG**: Parity group ID (frame and group number)
 - **HDD**: Type of hard disk drive

Buttons

- **Set**: Adds a new manual migration plan consisting of the logical volume in SourceLDEV and the logical volume in TargetLDEV. Each row in the table indicates a migration plan.
- **Delete**: Deletes the migration plan. If you select a migration plan in black (migration plan waiting for execution or being executed) and click **Delete**, the **DEL** column displays the character **D**. The selected migration plan will not be deleted until you click **Apply**.
- **Refresh**: Updates information in the tab after applying a manual migration plan (after clicking the Apply button).
- **Apply**: Applies manual migration plans in the table to the disk array.
- **Source LDEV addition**: The → button below the Source LDEV section.
- **Target LDEV addition**: The → button below the Target (Reserved) LDEV section.
- **Reset**: Cancels execution of the manual migration plan.
- **Close**: Closes this pane.

Migrating volumes manually

To migrate volumes manually, you must create migration plans. A migration plan is a pair of volumes—source volume and corresponding target (destination) volume. To migrate more than one logical volume, you must create multiple migration plans. See also [“Calculating the number of Auto LUN XP concurrent migration plans”](#)

 **NOTE:** For manual migrations, you can specify logical volumes in a fixed parity group as source or target volumes.

 **CAUTION:** Do not perform manual migrations while the Auto Migration function is active. Doing so cancels all existing auto migration plans. Use the following procedure to turn off Auto Migration and cancel any auto migration plans before doing a manual migration.

1. In the Auto LUN pane, click **Physical**.
2. Click **Plan**. The Manual Migration tab appears.
3. Before migrating logical volumes manually, click **Auto Migration** to turn off Auto Migration.
4. In Auto Migration Plans, click **Delete All** to remove all auto migration plans.
5. In Auto Migration Function, click **OFF**, and click **Set**.
6. Click **Manual Migration**.

7. In the tree, double-click a parity or external volume group. A list of logical volumes in that group appears. Logical volumes that can be migrated are indicated by the  icon.
8. From a volume with the  icon, click the source volume (logical volume to migrate), and click the **S** button. The selected volume is defined as the source volume.
9. In the tree, double-click the parity group to which you want to migrate the source volume. A list of logical volumes in that parity group appears. Click the target (destination) volume. You can click only volumes with a green pin icon or an icon framed by a blue line.
10. From the logical volumes indicated by a blue icon with a left-pointing arrow, select the logical volume to define as the target volume, and click the **T** button below the **Target (Reserved) LDEV** section. Auto LUN XP calculates estimated usage rates of the source and target parity group. Estimated results are displayed on the right of the **Source LDEV** and **Target (Reserved) LDEV** text box and in the graph.
11. Check the estimated results in **Source LDEV**, **Target (Reserved) LDEV**, and the graph. If you think you can achieve the necessary disk performance, go to the next step. If not, change the source or target volume.
12. Click **Set**.
A new migration plan, consisting of the specified source and target volumes, is added to the table. The new migration plan is shown in blue.
To migrate more than one volume manually, repeat the steps to add migration plans.
13. Click **Apply**.
Migration plans are applied to the disk array and wait for execution. Auto LUN XP performs multiple migration plans concurrently. The font color of the migration plans changes from blue to black.
When a logical volume starts migration, the **%** column displays the migration's progress. When migration is complete, the volume's migration plan disappears.
If an error occurs during migration, an error code appears.

Deleting manual migration plans

To delete a migration plan, click a migration plan, and click **Delete**.

You cannot use the **Delete** button to delete migration plans executed by programs other than Auto LUN XP.

If you select a migration plan in black (migration plan waiting for execution or being executed) and click **Delete**, the character **D** is displayed in the **DEL** column. The migration plan will not be deleted until you click **Apply**.

△ **CAUTION:** If you delete a migration plan that is being executed, the integrity of data on the target volume cannot be guaranteed.

When an error condition exists on the disk array, resource usage can increase or become unbalanced. Do not use the usage statistics collected during an error condition as the basis for planning migration operations.

Auto Migration tab

Use this tab to make settings for automating volume migrations.

 **NOTE:** Auto migration cannot use external volumes or volumes reserved by another program.

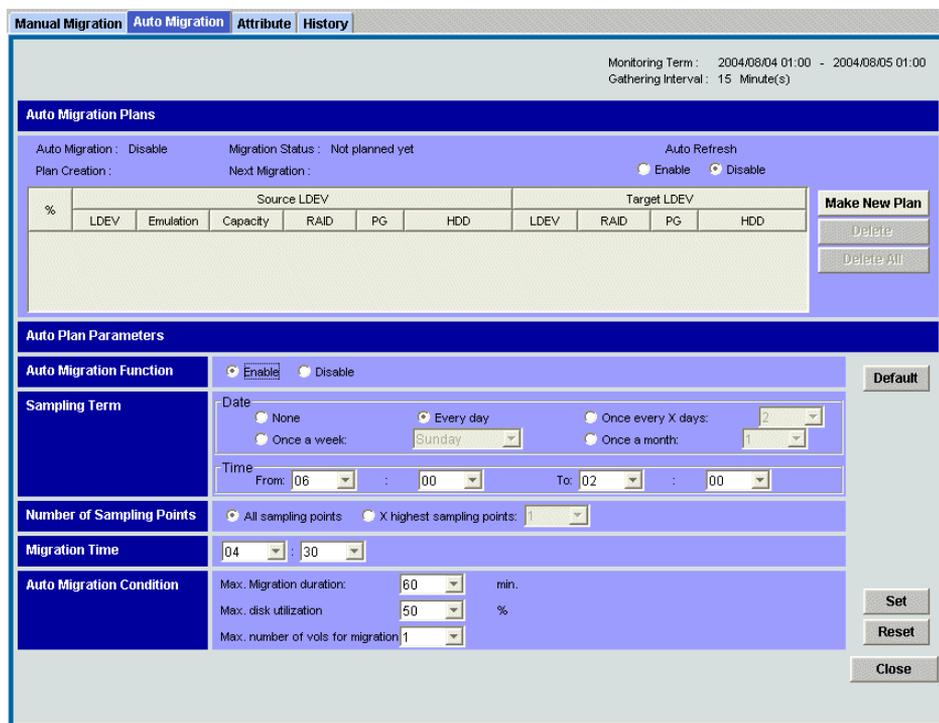


Figure 8 Auto Migration tab

Pane contents

This pane contains the following items:

- **Monitoring Term:** Displays the monitoring period specified in the Auto LUN pane, analyzes disk usage information collected by Auto LUN XP during the monitoring period, and calculates estimated usage rates of the source and target parity groups after a proposed volume migration.
- **Gathering Time:** Displays the time specified in the Auto LUN XP Monitoring Options pane. The disk array collects usage statistics about resources (such as hard disk drives) at the specified gathering time. Auto LUN XP uses collected usage statistics to estimate usage rates of parity groups after a proposed volume migration.

Auto Migration plans section

- **Auto Migration Function:** If **Auto Migration Function** is **ON**, auto migrations take place at the next migration time
- **Migration Status:** Progress of auto migration plans
 - **Not planned yet:** Has not yet created auto migration plans
 - **Not performed yet:** Has created auto migration plans, but has not executed them
 - **Failed to make plan:** Failed to create auto migration plans
 - **Under migration:** Is executing an auto migration plan
 - **Last migration has canceled (Please see log file):** Has canceled the plan
 - **Migration successfully ended. Plan has done:** Successfully executed the migration plans
- **Plan Creation Time:** When auto migration plans were created
- **Next Migration Time:** When the next auto migrations will be performed
- **Make New Plan button:** Discards existing auto migration plans and creates new auto migration plans
- **Delete button:** Deletes the selected auto migration plan
- **Delete All button:** Deletes all auto migration plans

Auto Plan parameter section

- **Auto Migration Function:** If you click **ON**, logical volumes are automatically migrated. If you click **OFF**, they are not.
- **Sampling Term:** The auto migration function analyzes resource usage within the **SAMPLING TERM** and creates auto migration plans based on that analysis. Use **Sampling Term** to narrow resource usage statistics to be analyzed.
- **Date and Time:** Specifies a date/time frequency for analyzing resource usage.
- **Number of Sampling Points:** Click **All sampling points** or **X highest sampling points**. With X highest sampling points, Auto LUN XP uses the Xth highest average usage rate during the sampling period to determine disk usage. Use the list to specify the value of X.
- **Migration Time:** Specifies the time when auto migration starts
- **Auto Migration Condition:** Specifies the following auto migration conditions:
 - **Max. migration duration:** Time limit (10-120 minutes) for an auto migration plan. If the migration is not completed within this limit, remaining migration operations are performed at the next scheduled execution time.
 - **Max. disk utilization:** Disk usage limit (10-100%) during auto migration. If the most recent usage for any source or target parity group is over this limit when auto migration starts, Auto LUN XP cancels the auto migration plan and retries the plan at the next execution time.
 - **Max. number of vols for migration:** The maximum number of volumes (1-40) that can be migrated during one auto migration plan.
- **Default button:** Sets parameters to their default values and applies them to the disk array.
- **Set button:** Applies parameters to the disk array.
- **Reset button:** Restores parameters to the value before the change.
- **Close button:** Closes this pane.

Setting auto migration parameters

1. In the Auto LUN pane, click **Physical**.
2. Click **Plan**. The Manual Migration tab appears.
3. Click **Auto Migration**. The Auto Migration tab appears.
4. In the **Date** and **Time** boxes in **Sampling Term**, specify a period to analyze resource usage statistics. Ensure that the data term and auto migration execution time are separated by at least one hour. For example, if the sampling term is from 10:00 to 14:00, auto migration should not be performed between 09:00 and 15:00.
5. In **Number of Sampling Points**, click **All sampling points** or **X highest sampling points**, and click the value of X in the list.
6. In **Migration Time**, specify when to start auto migration operations. The following scheduling restrictions apply to **Migration Time**:
 - Must be at least 15 minutes plus the specified maximum migration duration earlier than disk array auto-reboot or data gathering.
 - Must be at least 30 minutes later than disk array auto-reboot or data gathering.
 - Must be at least 15 minutes plus the specified maximum migration duration earlier than the specified Data Term start time.
 - Must be at least 60 minutes later than the specified Data Term end time.
7. If necessary, set the auto migration parameters as follows:
 - **Max. migration duration:** Set a time limit for auto migrations. If auto migration is not completed within this limit, Auto LUN XP cancels operations.
 - **Max. disk utilization:** Set a disk usage limit.
 - **Max. number of vols for migration:** Specify the maximum number of volumes that can be auto migrated at the same time.
8. In Auto Migration Function, click **ON**.
9. Click **Set**.

10. Click **Close**.

Deleting auto migration plans

- To delete all auto migration plans, click **Delete All**.
- To delete one auto migration plan, click the plan in the table, and click **Delete**.

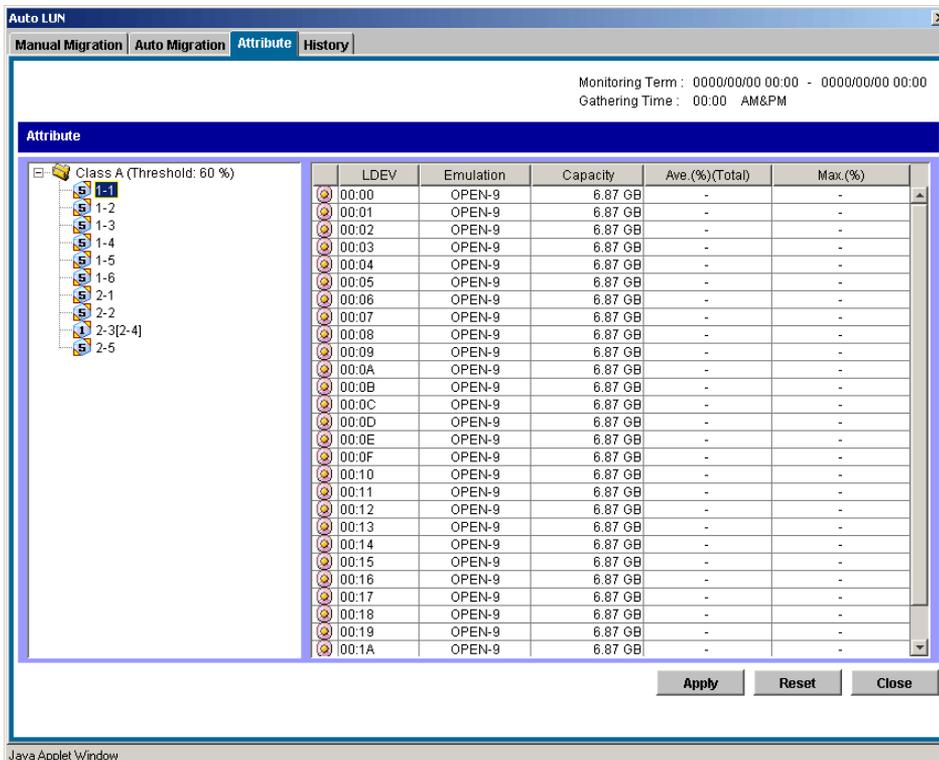
Remaking auto migration plans

If auto migration operations do not produce enough improvements in disk access performance, discard the current migration plans and create new auto migration plans.

1. In the Auto LUN pane, click **Physical**.
2. Click **Plan**. The Manual Migration tab appears.
3. Click **Auto Migration**. The Auto Migration tab appears.
4. In the Auto Migration tab, change the limit on the disk usage rate for HDD classes.
5. Make any other changes in the **Auto Plan Parameters** section of the pane.
6. Click **Make New Plan**. The existing auto migration plans are deleted and new auto migration plans are created.
7. Click **Close**.

Attribute tab

Use this tab to find out which parity group belongs to which HDD class. The tab also displays information about parity groups, such as parity group usage, logical volume capacity, and RAID type.



The screenshot shows the 'Attribute' tab in the Auto LUN interface. It displays monitoring terms and gathering time, followed by a tree view of Class A (Threshold: 60 %) and a table of parity groups. The table has columns for LDEV, Emulation, Capacity, Ave. (%)(Total), and Max. (%). The data shows 20 parity groups (00:00 to 00:1A) with a capacity of 6.87 GB each and an average usage of 0%.

LDEV	Emulation	Capacity	Ave. (%)(Total)	Max. (%)
00:00	OPEN-9	6.87 GB	-	-
00:01	OPEN-9	6.87 GB	-	-
00:02	OPEN-9	6.87 GB	-	-
00:03	OPEN-9	6.87 GB	-	-
00:04	OPEN-9	6.87 GB	-	-
00:05	OPEN-9	6.87 GB	-	-
00:06	OPEN-9	6.87 GB	-	-
00:07	OPEN-9	6.87 GB	-	-
00:08	OPEN-9	6.87 GB	-	-
00:09	OPEN-9	6.87 GB	-	-
00:0A	OPEN-9	6.87 GB	-	-
00:0B	OPEN-9	6.87 GB	-	-
00:0C	OPEN-9	6.87 GB	-	-
00:0D	OPEN-9	6.87 GB	-	-
00:0E	OPEN-9	6.87 GB	-	-
00:0F	OPEN-9	6.87 GB	-	-
00:10	OPEN-9	6.87 GB	-	-
00:11	OPEN-9	6.87 GB	-	-
00:12	OPEN-9	6.87 GB	-	-
00:13	OPEN-9	6.87 GB	-	-
00:14	OPEN-9	6.87 GB	-	-
00:15	OPEN-9	6.87 GB	-	-
00:16	OPEN-9	6.87 GB	-	-
00:17	OPEN-9	6.87 GB	-	-
00:18	OPEN-9	6.87 GB	-	-
00:19	OPEN-9	6.87 GB	-	-
00:1A	OPEN-9	6.87 GB	-	-

Figure 9 Attribute pane

Pane contents

This pane contains the following items:

- **Monitoring Term:** Displays the monitoring period specified in the Auto LUN pane, analyzes disk usage information collected by Auto LUN XP during the monitoring period, and calculates estimated usage rates of the source and target parity groups after a proposed volume migration.
- **Gathering Time:** Displays the time specified in the Auto LUN XP Monitoring Options pane. The disk array collects usage statistics about resources (such as hard disk drives) at the specified gathering time.

Auto LUN XP uses collected usage statistics to estimate usage rates of parity groups after a proposed volume migration.

- **Attribute** tree: Lists HDD classes. When you double-click an HDD class icon, a list of parity groups in that HDD class appears.
- **Apply** button: Applies settings in the **Attribute** tab to the disk array.
- **Reset** button: Discards changes in the **Attribute** tab and restores the original settings.
- **Close** button: Closes this pane.
- Class table boxes: When you click a class in the Attribute tree, the table displays information about parity groups in that class.

PG	HDD	Ave.(%)(To...	Max.(%)	Total	Reserved	CLPR
5 1-1	DKR2E-J146FC	0	0	58	0	02:CLPR2
5 1-2	DKR2E-J146FC	0	0	56	0	00:CLPR0
5 1-3	DKR2E-J146FC	0	0	58	0	00:CLPR0
5 1-4	DKR2E-J146FC	0	0	58	0	00:CLPR0
5 2-1	DKR2E-J146FC	0	0	58	0	00:CLPR0
5 2-2	DKR2E-J146FC	0	0	58	0	00:CLPR0
5 2-3	DKR2E-J146FC	0	0	58	0	00:CLPR0
5 2-4	DKR2E-J146FC	0	0	58	0	00:CLPR0

Figure 10 Class table boxes

- **PG:** Parity group ID.
- **HDD:** Type of hard disk drive.
- **Ave.:** Average usage rate for the parity group. If an exclamation mark (!) appears, the reported usage rate might be inaccurate because the configuration has changed (for example, volumes have been moved by a migration plan or changed by VSC).
- **Max.:** Maximum usage rate for the parity group. If an exclamation mark (!) appears, the reported usage rate might be inaccurate.
- **Total:** Total number of logical volumes in the parity group.
- **CLPR:** The number and name of the CLPR that corresponds to the parity group to which the logical volume belongs, in the format **CLPR number:CLPRname**. For more information, see the *HP StorageWorks XP Disk/Cache Partition user guide*.
- Parity group table boxes: When you click a parity group, the table displays information about logical volumes in that parity group.

LDEV	Emulation	Capacity	Ave.(%)	Max.(%)
0:08	OPEN-9	7.21GB	!10	!20
0:09	OPEN-9	7.21GB	15	25
0:0A	OPEN-9	7.21GB	0	0
0:0B	OPEN-9	7.21GB	0	0
0:0C	OPEN-9	7.21GB	0	0
0:0D	OPEN-9	7.21GB	0	0
0:0E	OPEN-9	7.21GB	0	0
0:0F	OPEN-9	7.21GB	0	0

Figure 11 Parity group table boxes

- **Icons:** A reserved volume (🔒), which can be used as a migration destination; a normal volume (🔓), which cannot be used as a migration destination; free space (🔑); and so forth.
- **LDEV:** Logical volume ID.
- **Emulation:** Emulation type of logical volume.
- **Capacity:** Capacity of logical volume.
- **Ave.:** Average usage rate for logical volume. If an exclamation mark (!) appears, the reported usage rate might be inaccurate.
- **Max.:** Maximum usage rate for logical volume. If an exclamation mark (!) appears, the reported usage rate might be inaccurate.

- **CLPR:** Number and name of the CLPR that corresponds to the parity group to which the logical volume belongs, in the format **CLPR number:CLPRname**. For more information about CLPRs, see the *HP StorageWorks XP Disk/Cache Partition user guide*.
- **Owner:** Program that reserved the volume. If Auto LUN XP reserved this volume, **USP** is displayed. If another program reserved this volume, **Other[XX]** is displayed, where **[XX]** is the program ID. If this volume is not reserved and is a normal volume, a hyphen (-) is displayed.

Reserving target volumes

To migrate volumes, you must reserve logical volumes as migration destinations (targets) regardless of the migration method (manual or automatic). Migration will not take place if no logical volume is reserved.

 **NOTE:** The term *reserved volume* refers to a volume that is reserved for use as a migration destination. Reserved volumes are denoted by blue  icons. The term *normal volume* sometime refers to a volume that is not reserved as a migration destination.

1. In the Auto LUN pane, click **Physical**.
2. Click **Plan**. The Manual Migration tab appears.
3. Click **Attribute**. The Attribute tab appears.
4. In the Attribute tree, locate a logical volume to use as a migration destination. First click an HDD class to display a list of parity groups in that class. Next, click a parity group to display a list of logical volumes in that group.
5. In the table on the right, locate logical volumes preceded by the  or  icons. From those logical volumes, choose the logical volume, and right-click.
6. Click **Reserved LDEV**. The icon changes to .
7. Click **Apply**. The settings in the pane are applied to the disk array. The specified logical volume is reserved as a migration destination.

If you right-click a logical volume preceded by the  icon (reserved volume) and click **Normal LDEV**, the icon changes to , and you cannot use the volume as a migration destination. This procedure does not work when the logical volume is preceded by the green **Reserved** icon, which indicates another program reserved the volume.

Setting (fixing) parity groups

The auto migration function excludes fixed parity groups. However, volumes in a fixed parity group can be used for manual migration operations.

1. In the Auto LUN pane, click **Physical**.
2. Click **Plan**. The Manual Migration tab appears.
3. Click **Attribute**. The Attribute tab appears.
4. In the tree, double-click an HDD class folder.

The table on the right displays a list of parity groups in the HDD class. An icon indicates parity groups that can include source or target volumes. A different icon indicates fixed parity groups, which cannot include source nor target volumes.

5. Right-click the parity group you want to fix.

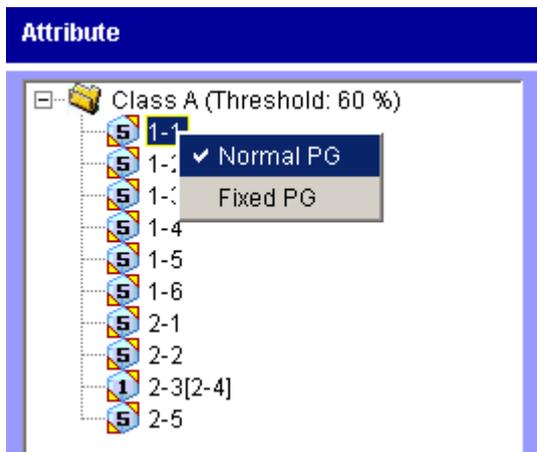


Figure 12 Attribute tab tree

6. Click **Fixed PG**. The parity group becomes fixed and is marked with an icon.
7. Click **Apply**.

Releasing (unfixing) parity groups

To move logical volumes in a fixed parity group to another parity group, change the fixed parity group to a normal parity group. To do this, go to the Attribute tab, right-click the fixed parity group, and click **Normal PG**.

Changing maximum disk usage rates for HDD classes

Each HDD class has a default disk usage rate. This limit affects auto migration behavior. You can change the limit on disk usage rate.

1. In the Auto LUN pane, click **Physical**.
2. Click **Plan**. The Manual Migration tab appears.
3. Click **Attribute**. The Attribute tab appears.
4. In the Attribute tree, right-click an HDD class folder, and click **Change Class Threshold**. The Change Threshold pane appears.
5. Click the value you want to use as the limit.
6. Click **OK**. In the Attribute tree, the selected value is displayed to the right of the specified class.
7. Click **Apply**. The new limit is applied to the disk array.

History tab

Use this tab to display information about automatic and manual migration operations that occurred in the past. You can find out when migration operations took place and whether they finished successfully.

Manual Plan | Auto Plan | Attribute | History

Volume Migration Monitoring Term : 2005/12/09 00:00 - 2005/12/15 00:00
Gathering Interval : 15 Minute(s)

Auto Migration History

2005/12/14 14:48 The parameters for creating auto migration plans were initialized.
2005/12/14 00:07 The parameters for creating auto migration plans were initialized.
2005/12/13 23:44 The parameters for creating auto migration plans were initialized.
2005/12/13 15:40 The parameters for creating auto migration plans were initialized.
2005/12/13 15:11 The parameters for creating auto migration plans were initialized.
2005/12/12 20:38 The parameters for creating auto migration plans were initialized.
2005/12/09 20:06 Failed to create the auto migration plans. Cause: Failed to get utilization statistical data
0 auto migration plan(s) were created.
2005/12/09 20:04 The creation of auto migration plans started.
2005/09/18 10:03 Source candidate = 00:00 in Group 1-1
Failed to specify proper target volumes.
2005/09/18 10:01 Source candidate = 00:00 in Group 1-1

Migration History

Date	Time	Action	Source[Parity Gr.]	Target[Parity Gr.]	Owner
2005/12/12	02:17	Migration Started	06:00[3-1]	00:00[2-1]	Other [FF]
2005/12/12	02:32	Migration Completed	06:01[3-1]	00:01[2-1]	Other [FF]
2005/12/12	02:47	Migration Canceled by User	06:02[3-1]	00:02[2-1]	Other [FF]
2005/12/12	03:02	Migration Failed	06:03[3-1]	00:03[2-1]	Other [FF]
2005/12/12	03:17	Migration Canceled by Controller	06:04[E1-1]	00:04[4-1]	USP
2005/12/12	03:32	Migration Canceled by ShadowImage	06:05[E1-1]	00:05[4-1]	USP
2005/12/08	03:47	Migration Canceled by TC	06:06[E1-1]	00:06[4-1]	USP
2005/12/08	04:02	Migration Canceled by Data Migration	06:00[XX-XX]	00:00[XX-XX]	USP

Refresh Close

Figure 13 History tab

Pane contents

This pane contains the following items:

- **Monitoring Term:** Displays the monitoring period specified in the Auto LUN pane, analyzes disk usage information collected by Auto LUN XP during the monitoring period, and calculates estimated usage rates of the source and target parity groups after a proposed volume migration.
- **Gathering Time:** Displays the time specified in the Auto LUN XP Monitoring Options pane. The disk array collects usage statistics about resources (such as hard disk drives) at the specified gathering time. Auto LUN XP uses the collected usage statistics to estimate usage rates of parity groups after a proposed volume migration.
- **Auto Migration History:** Displays log information, showing the creation and execution of auto migration plans. The **Erase** button erases the information.
- **Migration History:** Displays a log of volume migration events and a log or migration plan executed by programs other than Auto LUN XP. The table displays the following information:
 - **Date:** Event date
 - **Time:** Event time
 - **Action:** Description of migration operation or event
 - **Source[Parity PR.]:** Source volume and parity group
 - **Destination:** Target volume and parity group
 - **Owner:** Program that reserved the volume. If Auto LUN XP reserved this volume, **USP** is displayed. If another program reserved this volume, **Other[XX]** is displayed, where **[XX]** is the program ID.
- **Refresh** button: Updates information in the **History** tab.
- **Close** button: Closes this pane.

Viewing migration history logs

The History tab displays logs of automatic and manual migration operations.

1. In the Auto LUN pane, click **Physical**.
2. Click **Plan**. The Manual Migration tab appears.
3. Click the **History** tab. The History tab appears.

To view logs of auto operations, look at **Auto Migration History**.

To view logs of manual migration operations, look at **Migration History**.

The migration logs may display the following messages.

Normal end of migration:

```
Migration Complete (CU:LDEV->CU:LDEV) Start:yyyy/mm/dd hh:min:sec -> End:yyyy/mm/dd  
hh:min:sec
```

```
                (a)                (b)                (c)                (d)
```

- (a) Source volume
- (b) Target volume
- (c) Copy start time
- (d) Copy end time

Migration was canceled (over the limit duration):

```
Migration Canceled (CU:LDEV->CU:LDEV) Start:yyyy/mm/dd hh:min:sec -> End:yyyy/mm/dd  
hh:min:sec
```

```
                (a)                (b)                (c)                (d)
```

- (a) Source volume
- (b) Target volume
- (c) Copy start time
- (d) Copy end time

Migration was canceled (invalid parity group):

```
Migration Canceled (CU:LDEV (X-X)->CU:LDEV (X-X)) yyyy/mm/dd hh:min:sec (Invalid Parity  
Group)
```

```
                (a)                (b)                (c)                (d)                (e)
```

- (a) Source volume
- (b) Parity group of the source volume
- (c) Target volume
- (d) Parity group of the target volume
- (e) Canceled time

Migration was stopped (other reason):

Migration Stopped (CU:LDEV->CU:LDEV) yyyy/mm/dd hh:min:sec (XXXXXXXXXXXXX)
(a) (b) (c) (d)

- (a) Source volume
- (b) Target volume
- (c) Canceled time
- (d) Reason for cancellation:

- No reserve volume. No reserved volume is set. Please make another plan.
- Reserve volume emulation is different. The reserved volume's emulation type is different.
- Utilization check. The usage rate is over the limit, or there is no monitor data.
- Migration failed. Error code: XXXX. The migration operation failed.
- Reserve volume size is different. Reserve volume size is different.
- Reserve volume emulation is not supported. The emulation type of reserved volume is not supported.
- Utilization check failed. The check of the usage rate finished abnormally.
- Reserve volume check failed. The check of the reserved volume finished abnormally.

Migration plan was deleted (because the previous plan had been deleted):

Migration Plan deleted (CU:LDEV->CU:LDEV) yyyy/mm/dd hh:min:sec (Pre-Plan is deleted)
(a) (b) (c)

- (a) Source volume
- (b) Target volume
- (c) Canceled time

Started making an auto migration plan:

yyyy/mm/dd hh:min : MakePlan function starts
(a)
(a) Start time

Finished making an auto migration plan:

yyyy/mm/dd hh:min : MakePlan function finishes
(a)
(a) End time

Output the auto migration plans:

X plans are output
(a)
(a) Number of plans

Contents of auto migration plan:

PlanXXX: Src LDEV CU:LDEV in Grp X-X, Dst LDEV CU:LDEV in Grp X-X
(a) (b) (c) (d) (e)
(a) Plan number
(b) Source volume
(c) Parity group of the source volume
(d) Target volume
(e) Parity group of the target volume

Failed making an auto migration plan:

yyyy/mm/dd hh:min : MakePlan is terminated by error: XXXXXXXXXXXX

(a)

(b)

(a) End time

(b) Reason for failure:

- Cannot make proper migration plan: The program could not make a proper migration plan. Check the number of the reserved volumes and their locations. Check the maximum disk usage and change if necessary.
- Failed to get XXXXXXXXXXXX (information or data): The program failed to get the information or data to make a plan. In the case of information, make the initial value again by selecting [Initialize]. In the case of data, check the status of gathered data and get them again.
- Failed to write to XXXXXXXXXXXX (information or data): The program failed to write the information to make a plan.
- Invalid XXXXXXXXXXXX (information or data): The required information/data could not be used because the information was invalid. In the case of information, make the initial value again by selecting [Initialize]. In the case of data, check the status of gathered data and get them again.
- Memory allocation error: The program failed to allocate the memory to make the plan.
- "C:\dkc200\others\Auto LUNatm.ini does not exist.": Auto LUN failed to make plans because the Auto LUN atm.ini file did not exist. Click the [Initialize] button before making plans again.

Log entry that the auto migration plan could not be made:

Cannot make plan: Class X Grp X-X

(a)

(b)

(a) Class

(b) Parity group

Some monitor data samples were invalidated:

Grp X-X: X samples are invalidated because of migration.

New volumes have been installed:

New entries are added for following LDEVs: CU:LDEV, CU:LDEV, ...

Invalid data:

Too many invalid data: invalidated all data

Volume utilization check failed:

Utilization check failed

Check volume usage failed because the necessary data could not be obtained. Please get the data again.

Volume reserve attribute check failed:

Reserve volume check failed

Check volume reserve attribute failed because the necessary data could not be obtained. Please get the data again.

The migration logs may display the following messages:

Table 12 Migration log messages

Message	Meaning
Migration Start	Migration operation started
Migration Complete	Migration operation completed successfully
Migration Cancel	User canceled the migration operation
Migration Failed	Migration operation failed
Migration Give Up	Migration operation was canceled by Auto LUN XP (for example, volume usage rate exceeded specified maximum)
Migration Canceled by Controller	The migration operation was canceled by Auto LUN XP (e.g., volume usage rate exceeded specified maximum).
Migration Canceled by Controller (Business Copy XP)	Because each XP product started processing, the migration operation was canceled by Auto LUN XP.
Migration Canceled by Controller (CA (*1))	
Migration Canceled by Controller (Data Migration (*2))	
Migration Canceled by Controller (CA (*3))	
Migration Canceled by Controller (XRC(*4))	
Migration Canceled by Controller (CC(*5))	
<p>*1 : It indicates Continuous Access XP or Continuous Access XP Journal.</p> <p>*2 : It indicates Hitachi Online Data Migration.</p> <p>*3 : It indicates Continuous Access XP or Continuous Access XP Journal.</p> <p>*4 : It indicates Compatible Replication for IBM® XRC, which is abbreviated as XRC Replication.</p> <p>*5 : It indicates IBM 3990 Concurrent Copy.</p>	

Troubleshooting Auto LUN XP

Auto LUN XP displays error messages on the Command View XP or XP Remote Web Console GUI when error conditions occur during Auto LUN XP operations.

If you need to contact your HP account support representative, provide as much information about the problem as possible, including the error codes.

Using RAID Manager for manual Auto LUN XP migrations

Use RAID Manager to perform manual Auto LUN XP migrations from an open-system host when Auto LUN XP is installed on the XP12000/XP10000. See the *HP StorageWorks RAID Manager XP user guide* for more information.

The following is an example of the procedure for using RAID Manager commands to perform manual Auto LUN XP migrations. In this example, `group1` is the group name in the RAID Manager configuration file, and `pair1` is the name of the volume pair that is a target of the operation.

1. Start RAID Manager.

2. Type the following command for an SMPL pair to begin the Auto LUN XP migration:

```
paircreate -g group1 -d pair1 -m cc -v1
```

When Auto LUN XP migration starts, the status of the pair changes to COPY.

3. Type the following command to check the pair's status:

```
pairdisplay -g group1 -d pair1 -fcex
```

When the Auto LUN XP migration completes, the pair's status becomes PSUS. If the Auto LUN XP migration fails, the pair's status becomes PSUE.

4. When the pair's status becomes PSUS or PSUE, use the following command to return the pair status to SMPL:

```
pairsplit -s -g group1 -d pair1
```

 **NOTE:** If the migration fails (the pair's status becomes PSUE), repeat [step 2](#) and [step 3](#). If the pair's status still becomes PSUE, contact your HP account support representative.

The status transition chart of a pair when the volume migration is performed by using RAID Manager is shown in [Figure 14](#). You can view the status shown in this chart by typing `pairdisplay` in RAID Manager.

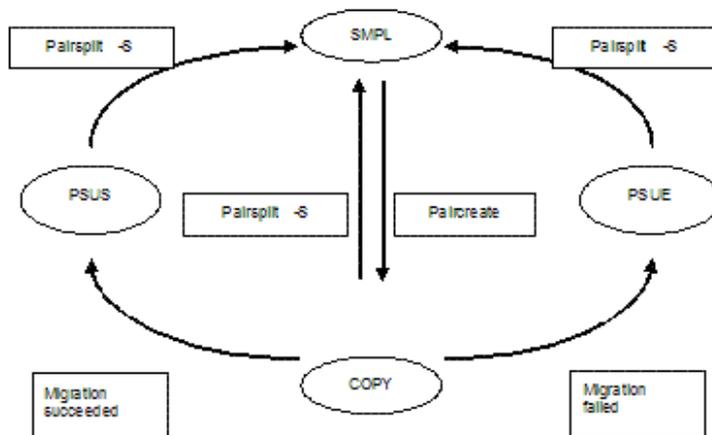


Figure 14 Pair status transitions during Auto LUN XP migrations using RAID Manager

When you perform Auto LUN XP migrations using RAID Manager, the following restrictions apply:

- An Auto LUN XP reserved volume cannot be used.
- A migration plan being executed by Auto LUN XP cannot be canceled from RAID Manager.
- A migration plan created by Auto LUN XP cannot be displayed using RAID Manager.
- Before checking RAID Manager settings in a Command View XP or XP Remote Web Console pane, click **All Refresh**.
- Migration cannot be performed when either of the specified volumes is a LUSE volume.

- When you try Auto LUN XP migrations or migration cancellations using RAID Manager, EX_CMDRJE might appear and the command might be refused, depending on the condition in the disk controller. Table 13 shows error codes, causes, and solutions for this case.

Table 13 Errors during Auto LUN XP migrations or migration cancellations using RAID Manager

Error code	Cause	Solution
2051	Migration target volume is being used with LUN Security XP Extension.	Release the volume from LUN Security XP Extension, and perform the volume migration.
2055	Migration target volume is being used with Continuous Access XP Journal.	Release the volume from Continuous Access XP Journal, and perform the volume migration.
2056	Migration source volume is being used with Continuous Access XP Journal.	Release the volume from Continuous Access XP Journal, and perform the volume migration.
2057	VMA setting is different between the migration target and source volumes.	Volume migration cannot be executed. Check the configuration definition file.
2058	Migration target and source volumes belong to the same parity group.	Volume migration cannot be executed. Check the configuration definition file.
2301	Auto LUN XP is not installed on the XP12000/XP10000.	Install Auto LUN XP, and perform the volume migration.
2306	LBA size does not match between the migration target and source volumes.	Volume migration cannot be executed. Check the configuration definition file.
2309	Maximum number of pairs that can be set in the disk array is exceeded.	Reduce the number of pairs set in the disk array, and perform the volume migration (see "Calculating the number of Auto LUN XP concurrent migration plans").
2311	Auto LUN XP already reserved the migration target volume.	Cancel the Auto LUN XP reservation, and perform the volume migration.
2312	Migration source volume is online with the host.	Take the migration source volume off-line from the host, and perform the volume migration.
232F	Migration source volume is already specified as an Auto LUN XP target volume.	Release the volume from Auto LUN XP, and perform the volume migration.
2331	Consider the following causes: <ul style="list-style-type: none"> • Auto LUN XP already reserved the migration source volume. • Number of slots in the migration target and source volumes does not match. 	Do the following: <ol style="list-style-type: none"> 1. Cancel the Auto LUN XP reservation, and perform the volume migration. 2. Volume migration cannot be executed. Check the configuration definition file.
2332	You cannot add pair settings any more to the migration source volume.	Reduce the number of pair settings of the specified volume, and perform the migration (see "Calculating the number of Auto LUN XP concurrent migration plans").
2333	Volume specified by the migration cancellation is not a migration source volume.	RAID Manager is trying to perform the migration cancellation for a pair that is not migrating. Check the configuration definition file.
2336	Emulation type of the migration target and source volumes does not match.	Volume migration cannot be executed. Check the configuration definition file.
2337	Migration source volume is a Business Copy XP leaf volume.	Release the Business Copy XP pair, and perform the volume migration.
233B	Migration target volume is a Business Copy XP primary volume.	Release the Business Copy XP pair, and perform the volume migration.
233C	Migration target volume is a Business Copy XP secondary volume.	Release the Business Copy XP pair, and perform the volume migration.

Table 13 Errors during Auto LUN XP migrations or migration cancellations using RAID Manager

Error code	Cause	Solution
2342	Migration target volume is already specified as an Auto LUN XP target volume.	Release the Auto LUN XP volume, and perform the volume migration.
2344	Volume specified by the migration cancellation is not a migration target volume.	RAID Manager is trying to perform the migration cancellation for a pair that is not migrating. Check the configuration definition file.
2346	Migration target volume is a Continuous Access XP primary volume.	Release the Continuous Access XP pair, and perform the volume migration.
2347	Migration target volume is a Continuous Access XP secondary volume.	Release the Continuous Access XP pair, and perform the volume migration.
234B	Migration target volume is already specified as an Auto LUN XP source volume.	Release the volume from Auto LUN XP, and perform the volume migration.
2355	Volume Management setting in the migration target and source volumes is different.	Volume migration cannot be executed. Check the configuration definition file.
2356	Migration target volume is being used with Flex Copy XP.	Release the Flex Copy XP pair, and perform the volume migration.
2362	Migration source volume is an XRC primary volume.	Release the XRC pair, and perform the volume migration.
2363	Migration target volume is an XRC primary volume.	Release the XRC pair, and perform the volume migration.
2366	Migration target volume is a Concurrent Copy primary volume.	Release the Concurrent Copy pair, and perform the volume migration.
2368	Migration source volume is a Continuous Access XP primary volume that is not in the SUSPEND status.	Put the Continuous Access XP pair in the SUSPEND status or release the Continuous Access XP pair, and perform the volume migration.
236B	Migration source volume is a Business Copy XP volume that is in the SP-PEND status.	Perform the volume migration after the Business Copy XP pair is changed to the SPLIT status.
2372	Migration source volume is being formatted.	Perform the volume migration after formatting is completed.
2373	Migration source volume is a command device.	Volume migration cannot be executed. Check the configuration definition file.
237C	Migration source volume is an external volume specified as a Continuous Access XP primary volume.	Release the Continuous Access XP pair, and perform the volume migration.
237E	Specified pair is being used with Flex Copy XP.	Release the Flex Copy XP pair, and perform the volume migration.
2382	Migration target volume is being formatted.	Perform the volume migration after formatting completes.
2383	Migration target volume is a command device.	Volume migration cannot be executed. Check the configuration definition file.
2389	Cache LUN XP is set on the migration source volume.	Release the Cache LUN XP setting, and perform the volume migration.
238A	Cache LUN XP is set on the migration target volume.	Release the Cache LUN XP setting, and perform the volume migration.
238B	Migration source and target volumes are specified as LUSE volumes.	Volume migration cannot be executed. Check the configuration definition file.

Table 13 Errors during Auto LUN XP migrations or migration cancellations using RAID Manager

Error code	Cause	Solution
238C	Migration target volume is a Business Copy XP reserved volume.	Cancel the Business Copy XP reservation, and perform the volume migration.
239D	Migration target volume is an ENAS system volume.	Volume migration cannot be executed. Check the configuration definition file.

2 Auto LUN/Performance Control Base Monitor

Auto LUN XP statistics

Disk arrays automatically collect statistics twice a day (in the morning and afternoon). Auto LUN XP monitors disk arrays and obtains usage statistics about resources such as front-end and back-end processors, hard disk drives, and logical volumes every 15 minutes.

Auto LUN XP displays statistics collected for the last three months. Statistics over three months old are discarded.

You can specify a time period and view a graph illustrating how usage rates change within that time period. You can also view average and maximum usage rates.

You can analyze information displayed on the pane and identify overloaded resources. If necessary, take load-balancing measures to improve system performance.

Auto LUN XP displays the following types of information:

- **Usage statistics about parity groups.** If data shows overall high parity group usage, consider installing additional HDDs and using Auto LUN XP to migrate high-usage volumes to the new parity groups. If monitor data shows unbalanced parity group usage, use Auto LUN XP to migrate volumes from high-usage parity groups to low-usage parity groups.
- **Usage statistics about logical volumes.** Auto LUN XP displays average and maximum usage, including sequential and random access, for each LDEV in a parity group. Logical volume usage is the time in use (sequential and random access) of the physical drives of each LDEV, averaged by number of physical drives in the parity group.
If data shows overall high logical volume usage, consider installing additional hardware (for example, HDDs, DKAs, or cache). If monitor data shows unbalanced volume usage, use Auto LUN XP to migrate high-usage volumes to higher HDD classes and/or lower-usage parity groups. You can also use logical volume usage data to analyze access characteristics of volumes and determine appropriate RAID level and/or HDD type for the volumes.
- **Usage statistics about channel adapters and channel processors.** Channel adapters (CHAs) process host commands and control data transfer between hosts and cache. A channel adapter contains multiple channel processors (CHPs), which process host commands and control data transfer.
If data shows overall high CHA usage, consider installing additional CHAs. If data shows unbalanced CHP usage, consider moving some devices defined on overloaded ports to ports with lower-usage CHPs to balance front-end usage.
- **Usage statistics about disk adapters and disk processors.** Disk adapters (DKAs) control data transfer between cache and disk devices. A disk adapter contains multiple disk processors (DKPs), which control data transfer.
If data shows overall high DKP usage, consider installing additional HDDs and/or DKAs and using Auto LUN XP to migrate high-write-usage volumes (especially sequential writes) to the new parity groups. If data shows unbalanced DKP usage, use Auto LUN XP to migrate logical volumes from high-usage parity groups to low-usage parity groups.
Auto LUN XP cannot estimate DKP usage. Use Auto LUN XP migration only for obvious cases of high or unbalanced DKP usage. Auto LUN XP migration might not improve performance if DKP usage values vary only slightly or if overall DRR usage values are relatively high.
- **Usage statistics about data recovery and reconstruction processors.** Data recovery and reconstruction processors (DRRs) are microprocessors located on DKAs that generate parity data for RAID-5 parity groups. DRRs use “old data + new data + old parity” to generate new parity.
If data shows overall high DRR usage, this might indicate a high write penalty. Consult your HP representative about high write penalty conditions. If data shows unbalanced DRR usage, consider using Auto LUN XP to relocate volumes to balance DRR usage within the disk array.
- **Write pending rate.** The write pending rate indicates the ratio of write-pending data to cache memory capacity. The Auto LUN pane displays average and maximum write pending rates for the specified time

period. The pane also displays a graph indicating how the write pending rate changed within that period.

- **Usage statistics about access paths.** An access path is a path through which data and commands are transferred within a disk array.

In a disk array, channel adapters control data transfer between hosts and cache memory. Disk adapters control data transfer between cache memory and disk drives. Data transfer does not occur between channel adapters and disk adapters. Data is transferred via the cache switch (CSW) to cache memory.

When hosts issue commands, they are transferred via channel adapters to shared memory (SM). Disk adapters check the contents of shared memory.

Auto LUN XP monitors and displays usage rates for the following access paths:

- Between channel adapters and the cache switch
 - Between disk adapters and the cache switch
 - Between the cache switch and cache memory
 - Between channel adapters and shared memory
 - Between disk adapters and shared memory
- **Statistics about logical devices.** You can check whether I/O operations converge on particular logical volumes or how much data is read from logical volumes into cache memory.

Auto LUN XP displays the following information:

- Number of read and write requests made to logical devices (or parity groups)
- Number of data transfers occurring between logical devices (or parity groups) and cache memory
- Size of data transferred to logical devices (or parity groups)
- Read hit rate
- Write hit rate

For read I/Os, when requested data is already in cache, the operation is a read hit. For example, if ten read requests were made from hosts to devices during a time period, and the read data was already in cache memory for three of the ten requests, the read hit rate for that time period is 30 percent. Higher read hit rates imply higher processing speed because fewer data transfers are made between devices and cache memory.

For write I/Os, when requested data is already in cache, the operation is a write hit. For example, if ten write requests were made from hosts to devices during a time period, and the write data was already in cache memory for three of the ten requests, the write hit rate for that time period is 30 percent. Higher write hit rates imply higher processing speed because fewer data transfers are made between devices and cache memory.

- **Statistics about port traffic.** Auto LUN XP monitors host ports and disk array ports to obtain statistics about I/O and transfer rates. If you analyze these rates, you can determine which host issues the most I/O requests and which host transfers the most data.
- **Statistics about LU path traffic.** Auto LUN XP monitors LU paths to obtain statistics about I/O and transfer rates. If you analyze these rates, you can determine which LU paths are used to make many of the I/O requests to disks and which LU paths are used to transfer much of the data to disks.

Auto LUN Monitoring Options pane

Use this pane to set the gathering time for monitoring.

 **NOTE:** When statistics are collected, a heavy workload is likely to be placed on servers. This might slow down client processing.

The pane contents vary according to your disk array.

 **NOTE:** Settings in the **Monitor Options** pane work with settings for Continuous Access XP and Continuous Access XP Journal. Therefore, changes you make to one pane affect the settings in the other panes.

XP12000/XP10000 disk arrays

 **NOTE:** To begin monitoring the disk array, Command View XP or XP Remote Web Console must be in **Modify** mode. A yellow background color signals **Modify** mode. A gray background color signifies **View** mode. You cannot change in the Monitoring Options pane in **View** mode.

To change settings, when the background color of the lock icon is blue, click the lock icon. If the background of the lock icon is red, wait a few minutes and try again.

XP12000/XP10000 arrays display the following pane:

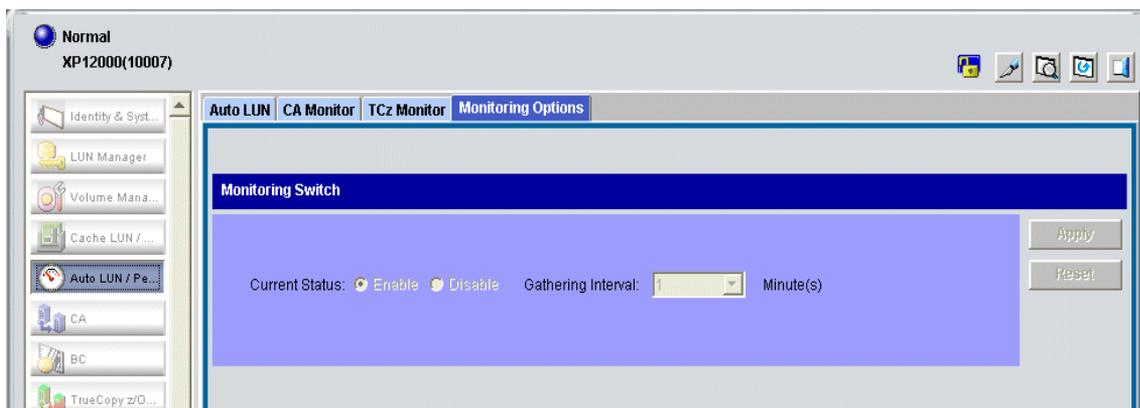


Figure 15 Auto LUN Monitoring Options pane

This pane contains the following items:

- **Current Status:** Specifies whether the disk array is monitored. Click **Enable** to start monitoring. Click **Disable** to stop monitoring. The default is **Disable**.
- **Gathering Interval:** If **Current Status** is **Enable**, specifies the collection interval during which statistics are collected, in minutes. For example, if you enter **2**, statistics are gathered every two minutes. The default is **1** minute. The interval in long range is fixed at 15 minutes.

Usage statistics

Collecting usage statistics about disk array resources

To obtain usage statistics about a disk array's resources, complete the following instructions to start monitoring the disk array.

1. In the Auto LUN pane, click **Monitoring Options**. The Monitoring Options pane appears.
2. Click **Enable** for the **Current Status** option.
3. Use the **Gathering Interval** box to specify the collection interval during which the disk array collects statistics. The interval in long range is fixed at 15 minutes.
4. Click **Apply**. Auto LUN XP starts monitoring the disk array.

To stop monitoring the disk array, complete the following instructions. If you stop monitoring, Auto LUN XP stops collecting statistics.

1. In the Auto LUN pane, click **Monitoring Options**. The Monitoring Options pane appears.
2. Click **Disable** for the **Current Status** option.
3. Click **Apply**.

Viewing parity group usage statistics

Auto LUN XP monitors parity groups, and displays average and maximum usage rates for the specified period. Auto LUN XP also displays a graph illustrating changes in parity group usage within that period.

1. In the Auto LUN pane, click **Physical**, and click the **Parity Group** folder. The table displays usage statistics about the parity group.

	PG	RAID	Drive Type	Usage(%)		CLPR
				Ave.(Total)	Max.	
	1-1	5(3D+1P)	DKR2E-J146FC	-	-	02:CLPR2
	1-2	5(3D+1P)	DKR2E-J146FC	0	0	00:CLPR0
	1-3	5(3D+1P)	DKR2E-J146FC	0	0	00:CLPR0
	1-4	5(3D+1P)	DKR2E-J146FC	0	0	00:CLPR0
	2-1	5(3D+1P)	DKR2E-J146FC	0	0	00:CLPR0
	2-2	5(3D+1P)	DKR2E-J146FC	0	0	00:CLPR0
	2-3	5(3D+1P)	DKR2E-J146FC	0	0	00:CLPR0

Figure 16 Parity group usage statistics

NOTE: If an exclamation mark (!) appears before a usage rate, that parity group usage rate might be inaccurate because the configuration has changed (for example, volumes have been moved by a migration plan or changed by VSC).

2. To display a graph illustrating changes in usage rates, click the parity groups in the table, and click **Draw**.

The table displays the following items:

- **Graph column:** The check mark icon indicates the graph is currently illustrating data for that item.
- **PG:** Parity group ID.
- **RAID:** RAID level (RAID-5 or RAID-1).
- **Drive Type:** Hard disk drive type.
- **Usage:** The **Ave. (Total)** column displays the average usage rate in the specified period. The **Max.** column displays the maximum usage rate in the specified period.
- **CLPR:** The number and name of the CLPR that corresponds to the parity group. For more information about CLPRs, see the *HP StorageWorks XP Disk/Cache Partition user guide*.

Viewing logical volume usage statistics

1. In the Auto LUN pane, click **Physical**, and double-click the **Parity Group** folder. The folder opens. A list of parity groups appears below the folder.
2. Click the parity group. The table displays usage statistics about logical volumes in the specified parity group.

NOTE: To view the ratio of Business Copy XP and ShadowImage for z/OS processing to all processing in the physical drive, select **Short Range**.

	LDEV	Emulation	Usage(%)		Read Rate(%)		Write Rate(%)		Parity Gr.Use[Exp](%)		CLPR
			Ave.(Total)	Max.	Rnd.	Seq.	Rnd.	Seq.	Ave.(Total)	Max.	
	00:63	OPEN-8	0	0	-	-	-	-	0 -> 0	0 -> 0	02:CLPR2
	00:68	OPEN-8	0	0	-	-	-	-	0 -> 0	0 -> 0	02:CLPR2
	00:6E	OPEN-8	0	0	-	-	-	-	0 -> 0	0 -> 0	02:CLPR2
	00:74	OPEN-8	0	0	-	-	-	-	0 -> 0	0 -> 0	02:CLPR2
	00:76	OPEN-8	0	0	-	-	-	-	0 -> 0	0 -> 0	02:CLPR2
	00:77	OPEN-8	0	0	-	-	-	-	0 -> 0	0 -> 0	02:CLPR2
	00:78	OPEN-8	0	0	-	-	-	-	0 -> 0	0 -> 0	02:CLPR2

Figure 17 Logical volume usage statistics

 **NOTE:** If an exclamation mark (!) appears before a usage rate, that parity group usage rate might be inaccurate because the configuration has changed (for example, volumes have been moved by a migration plan or changed by VSC).

3. To display a graph illustrating changes in usage rates for parity groups, click the parity groups in the table, and click **Draw**.

The table displays the following items:

- **Graph column:** The check mark icon indicates the graph is currently illustrating data for that item.
- **LDEV:** Logical volumes (LDEVs). The number on the left of the colon is the CU image number. The number on the right of the colon is the LDEV number.
- **Emulation:** Device emulation type.
- **Usage:** The **Ave.** column displays the average usage rate in the specified period. The **Max.** column displays the maximum usage rate in the specified period.
- **Read Rate:** The **Rnd.** column indicates the random read rate, which is the ratio of random read requests to read and write requests. The **Seq.** column indicates the sequential read rate, which is the ratio of sequential read requests to read and write requests.
- **Write Rate:** The **Rnd.** column indicates the random write rate, which is the ratio of random write requests to read and write requests. The **Seq.** column indicates the sequential write rate, which is the ratio of sequential write requests to read and write requests.
- **Parity Gr. Use[Exp](%):** Expected (estimated) average and maximum usage rates of the parity group, if the volume was migrated out of the group (or de-installed). The **Ave. (Total)** column indicates an estimated change in average usage rate. The **Max.** column indicates an estimated change in maximum usage rate. For example, if the **Ave. (Total)** box for volume 0:01 displays **20 -> 18**, average usage rate of the parity group to which the volume belongs is 20 percent. If the volume was migrated out of the parity group, average usage rate of that group is expected to drop to 18 percent.
- **Business Copy:** (Displayed only when you select **Short Range** as the storing period of statistics.) For each logical volume, the percentage of processing of the following programs to all processing of the physical drives:
 - ShadowImage for z/OS
 - Business Copy XP
 - Flex Copy XP
 - Hitachi® FlashCopy® Mirroring
 - Hitachi® FlashCopy® Mirroring Version 2
 - Auto LUN XP
 - Snapshot XP

This value is found by dividing access time to physical drives by the following programs by all the access time to physical drives. The **Ave. (Total)** column indicates the average percentage of processing in the specified period for the programs listed above. The **Max.** column indicates the maximum percentage of processing of the programs listed above in the specified period. For more information, see the programs' documentation.

- **CLPR:** The number and name of the CLPR that corresponds to the parity group to which the logical volume belongs, in the format **CLPR number:CLPR name**. For more information about CLPRs, see the *HP StorageWorks XP Disk/Cache Partition user guide*.

Viewing channel adapter (CHA) usage statistics

Auto LUN XP monitors channel adapters, and displays average and maximum usage rates in the specified period.

1. In the Auto LUN pane, click **Physical**, and click the **CHA** folder. The table displays usage statistics about channel adapters (CHAs).

	ID	Usage(%)	
		Ave.(Total)	Max.
	CHP00-1P	-	-
	CHP01-1P	-	-
	CHP02-1P	-	-
	CHP03-1P	-	-
	CHP40-2V	-	-
	CHP41-2V	-	-
	CHP42-2V	-	-
	CHP43-2V	-	-

Figure 18 CHA usage statistics

2. To display a graph illustrating changes in usage rates for channel adapters, click the channel adapters in the table, and click **Draw**.

The table displays the following items:

- **Graph column:** The check mark icon indicates the graph is currently illustrating data for that item.
- **ID:** Channel processor ID numbers.
- **Usage:** The **Ave. (Total)** column displays the average usage rate in the specified period. The **Max.** column displays the maximum usage rate in the specified period.

Viewing channel processor (CHP) usage statistics

Auto LUN XP monitors channel processors in each channel adapter, and displays average and maximum usage rates in the specified period.

1. In the Auto LUN pane, click **Physical**, and double-click the **CHA** folder. A list of channel adapters appears below the CHA folder.
2. Click a channel adapter. The table displays usage statistics about channel processors in the selected channel adapter.

	ID	Usage(%)	
		Ave.	Max.
	CHP00-1P	20	82
	CHP01-1P	20	82
	CHP02-1P	20	82
	CHP03-1P	20	82

Figure 19 CHP usage statistics

3. To display a graph illustrating changes in usage rates for channel processors, click the channel processors in the table, and click **Draw**.

The table displays the following items:

- **Graph column:** The check mark icon indicates the graph is currently illustrating data for that item.
- **ID:** Channel processor ID numbers.
- **Usage:** The **Ave. (Total)** column displays the average usage rate in the specified period. The **Max.** column displays the maximum usage rate in the specified period.

Viewing disk adapter (DKA) usage statistics

Auto LUN XP monitors disk adapters, and displays average and maximum usage rates in the specified period. If you click the ACP folder, the table displays a list of disk adapters and indicates whether each disk adapter is located in Cluster-1 or Cluster-2.

In the Auto LUN pane, click **Physical**, and click the **ACP folder**. The table displays a list of disk adapters.

Adapter	Cluster-1	Cluster-2
DKA-1B	0	-
DKA-1C	0	-
DKA-2H	-	0
DKA-2J	-	0

Figure 20 DKA usage statistics

The table displays the following items:

- **Adapter:** Disk adapter ID numbers.
- **Cluster-1:** If the Cluster-1 column displays 0 and the Cluster-2 column displays a hyphen, the disk adapter is located in Cluster-1.
- **Cluster-2:** If the Cluster-2 column displays 0 and the Cluster-1 column displays a hyphen, the disk adapter is located in Cluster-2.

Viewing disk processor (DKP) usage statistics

Auto LUN XP monitors disk processors, and displays average and maximum usage rates in the specified period.

1. In the Auto LUN pane, click **Physical**, and double-click the **ACP folder**. A list of disk processors appears below the ACP folder.
2. Click the DKP. The table displays usage statistics about disk processors in the disk adapter.

	ID	Usage(%)	
		Ave.(Total)	Max.
<input checked="" type="checkbox"/>	DKP80-1A	+0	4
<input type="checkbox"/>	DKP81-1A	+0	1
<input type="checkbox"/>	DKP82-1A	+0	4
<input type="checkbox"/>	DKP83-1A	+0	1
<input type="checkbox"/>	DKP84-1A	+0	4
<input type="checkbox"/>	DKP85-1A	+0	1
<input type="checkbox"/>	DKP86-1A	+0	4

Figure 21 DKP usage statistics

3. To display a graph illustrating changes in usage rates for disk processors, click the disk processors in the table, and click **Draw**.

The table displays the following items:

- **Graph column:** The check mark icon indicates the graph is currently illustrating data for that item.
- **ID:** Disk processor ID numbers.
- **Usage:** The **Ave. (Total)** column displays the average usage rate in the specified period. The **Max.** column displays the maximum usage rate in the specified period.

Viewing data recovery and reconstruction processor (DRR) usage statistics

Auto LUN XP monitors data recovery and reconstruction processors (DRRs), and displays average and maximum usage rates in the specified period.

1. In the Auto LUN pane, click **Physical**, and double-click the **ACP folder**. A list of DRRs appears below the ACP folder.

- Click the DRR below the disk adapter. The table displays usage statistics about DRRs in the disk adapter.

CLPR	Write Pending(%)	
	Ave.(Total)	Moment Max.
00:CLPR0	0	0
01:ClprUno	0	0
02:CLPR2	0	0
03:ksmani_cache	0	0

Figure 22 DRR usage statistics

- To display a graph illustrating changes in usage rate for DRRs, click the DRRs in the table, and click **Draw**.

The table displays the following items:

- Graph column:** The check mark icon indicates the graph is currently illustrating data for that item.
- ID:** DDR ID numbers.
- Usage:** The **Ave. (Total)** column displays the average usage rate in the specified period. The **Max.** column displays the maximum usage rate in the specified period.

Viewing write pending rates

Auto LUN XP displays write pending rates. The write pending rate indicates the ratio of write-pending data to cache memory capacity. Auto LUN XP displays average and maximum write pending rates in the specified period.

- In the Auto LUN pane, click **Physical**, and click the **Cache** folder.

CLPR	CLPR Name	Write Pending(%)	
		Ave.(Total)	Moment Max.
0	CLPR0	6	70

Figure 23 Write pending rates

- To display a graph illustrating changes in the write pending rate, click the write pending rate in the table, and click **Draw**.

The table displays the following items:

- Graph column:** The check mark icon indicates the graph is currently illustrating data for that item.
- CLPR:** The number and name of the CLPR that corresponds to the parity group to which the logical volume belongs, in the format **CLPR number:CLPR name**. For more information about CLPRs, see the *HP StorageWorks XP Disk/Cache Partition user guide*.
- Write Pending (%):** The **Ave.** column displays the average write pending rate for the specified period. The **Moment Max.** column displays the maximum write pending rate for the specified period.

Viewing access path usage statistics

Channel adapters (CHAs) and disk adapters (DKAs) transfer data to the cache switch (CSW) and shared memory (SM) when I/O requests are issued from hosts to the disk array. Also, the cache switch transfers data to cache memory.

Auto LUN XP monitors these data transfer paths, and displays average and maximum usage rates for the paths in a specified period.

- In the Auto LUN pane, click **Physical**, and double-click the **Access Path Usage** folder.

2. Do any of the following:

- To check usage statistics about paths between adapters (CHAs and DKAs) and the cache switch, click **Adapter-CSW** below the Access Path Usage folder.

	Adapter	CSW	Usage(%)	
			Ave.(Total)	Max.
<input checked="" type="checkbox"/>	CHA-1E	CSW-1D	+0	2
<input type="checkbox"/>	CHA-1E	CSW-2P	+0	2
<input type="checkbox"/>	CHA-2Q	CSW-1D	0	0
<input type="checkbox"/>	CHA-2Q	CSW-2P	0	0
<input type="checkbox"/>	DKA-1A	CSW-1D	0	0
<input type="checkbox"/>	DKA-1A	CSW-2P	0	0
<input type="checkbox"/>	DKA-2M	CSW-1D	0	0

Figure 24 Usage statistics about paths between adapters and the cache switch

- To check usage statistics about paths between adapters (CHAs and DKAs) and shared memory, click **Adapter-SM** below the Access Path Usage folder.

	Adapter	SM	Usage(%)	
			Ave.(Total)	Max.
<input checked="" type="checkbox"/>	CHA-1E	SM-1SA	6	20
<input type="checkbox"/>	CHA-1E	SM-2SB	2	8
<input type="checkbox"/>	CHA-2Q	SM-1SA	5	19
<input type="checkbox"/>	CHA-2Q	SM-2SB	1	8
<input type="checkbox"/>	DKA-1A	SM-1SA	2	4
<input type="checkbox"/>	DKA-1A	SM-2SB	2	4
<input type="checkbox"/>	DKA-2M	SM-1SA	2	4

Figure 25 Usage statistics about paths between adapters and shared memory

- To check usage statistics about paths between cache switches and cache memory, click **CSW-Cache** below the Access Path Usage folder.

	CSW	Cache	Usage(%)	
			Ave.(Total)	Max.
<input type="checkbox"/>	CSW-1D	CACHE-1CA	0	0
<input type="checkbox"/>	CSW-2P	CACHE-1CA	0	0
<input type="checkbox"/>	CSW-1D	CACHE-2CB	0	0
<input type="checkbox"/>	CSW-2P	CACHE-2CB	0	0

Figure 26 Usage statistics about paths between cache switches and cache memory

3. To display a graph illustrating changes in usage statistics about paths, click the paths in the table, and click **Draw**.

The table displays the following items:

- Graph column:** The check mark icon indicates the graph is currently illustrating data for that item.
- Usage(%):** The **Ave. (Total)** column displays the average path usage rate in the specified period. The **Max.** column displays the maximum path usage rate in the specified period.

Workload and traffic statistics

Collecting workload and traffic statistics about disk drives, ports, and LU paths

To obtain usage statistics about workloads, port traffic, LU path traffic, and traffic between host bus adapters and ports, complete the following instructions to start monitoring the disk array:

- In the Auto LUN pane, click **Monitoring Options**. The Monitoring Options pane appears.
- Click **Enable** for the **Current Status** option.
- Use the **Gathering Interval** box to specify the collection interval during which the disk array collects statistics. The interval in long range is fixed at 15 minutes.

4. Click **Apply**. Auto LUN XP starts monitoring the disk array.

To stop monitoring the disk array, complete the following instructions. If you stop monitoring, Auto LUN XP stops collecting statistics.

1. In the Auto LUN pane, click **Monitoring Options**. The Monitoring Options pane appears.
2. Click **Disable** for the **Current Status** option.
3. Click **Apply**.

Viewing disk drive workload statistics

Use the **LDEV** tab of the Auto LUN pane to check workloads on physical disk drives (parity groups) or logical volumes. The pane displays the following information:

- Number of I/O requests issued to parity groups and logical volumes
- Amount of data transferred to parity groups and logical volumes
- Read hit rate
- Write hit rate
- Number of data transfers between parity groups (or logical volumes) and cache memory

1. In the Auto LUN pane, click **LDEV**. The LDEV tree displays a list of parity groups.
2. In the list on the right, click **IOPS** to specify I/Os per second, or click **MB/s** to specify megabytes transferred per second.
3. In the LDEV tree, do one of the following:
 - To check workload statistics for all parity groups, click the folder containing the parity groups.

	PG	IO Rate(IOPS)	Read(IOPS)	Write(IOPS)
	1-1	0	0	
	1-2	0	0	
	1-3	0	0	

Figure 27 Workload statistics for all parity groups

- To check workload statistics for certain parity groups, click a **Box** folder. For example, if you click the **Box 1** folder, the table displays only parity groups that have IDs beginning with 1-.

	PG	IO Rate(IOPS)	Read(IOPS)	Write(IOPS)
	1-1	0	0	0
	1-2	0	0	0
	1-3	0	0	0

Figure 28 Workload statistics for a specific parity group

- To check workload statistics for logical volumes in a parity group, click the parity group.

	LDEV	Emulation	IO Rate(IOPS)	Read(IOPS)	Write
	00:00	OPEN-8	0	0	
	00:01	OPEN-8	0	0	
	00:02	OPEN-8	0	0	
	00:03	OPEN-3	0	0	
	00:04	OPEN-8	0	0	

Figure 29 Workload statistics for logical volumes in a parity group

4. To display a graph, click the parity groups or logical volumes, use the list on the lower-right side of the table to select the type of information you want to view, and click **Draw**. A graph displays below the table. The horizontal axis indicates the time.
5. To view detailed information in the graph, click the **Detail** check box on the lower-right side of the table, and click **Draw**. The graph contents change. If you specify more than one parity group or logical volume, you cannot click the **Detail** check box to view detailed information.

If the graph does not display changes in workload statistics, change the value in the **Chart Y Axis Rate** list. For example, if the largest value in the table is 200 and the value in Chart Y Axis Rate is 100, select a value larger than 200 from Chart Y Axis Rate.

The table displays the following:

- **Graph column:** The check mark icon indicates the graph is currently illustrating data for that item.
- **Group:** Parity group ID. If the ID starts with the letter **E**, logical volumes in the parity group are external LUs.
- **LDEV:** Logical volume ID. If the ID ends with the symbol **#**, logical volume is an external LU.
- **Type:** Emulation type.
- **IO Rate (IOPS):** Number of I/O requests to the parity group (or logical volume) per second. This column is displayed when **IOPS** is selected in the list on the upper-right side of the table.
- **Read (IOPS):** Number of read accesses to the parity group (or logical volume) per second. This column is displayed when **IOPS** is selected in the list on the upper-right side of the table.
- **Write (IOPS):** Number of write accesses to the parity group (or logical volume) per second. This column is displayed when **IOPS** is selected in the list on the upper-right side of the table.
- **Trans.(MB/s):** Size (in megabytes) of data transferred to the parity group (or logical volume) per second. This column is displayed when **MB/s** is selected in the list on the upper-right side of the table.
- **Read Hit(%):** Read hit rate.
- **Write Hit(%):** Write hit rate.
- **Back Trans.(count/sec):** Number of data transfers between parity group (or logical volume) and cache memory.
- **Response Time (ms):** Time (in microseconds) for replying from an external volume group when I/O accesses are made from the disk array to the external volume group. Average response time in the period specified for **Monitoring Term** is displayed.
- **CLPR:** The number and name of the CLPR that corresponds to the parity group to which the logical volume belongs, in the format **CLPR number:CLPRname**. For more information, see the *HP StorageWorks XP Disk/Cache Partition user guide*.

Viewing disk array port traffic statistics

1. In the Auto LUN pane, click **Port-LUN**, and click the **Subsystem** folder in the tree. The Port-LUN tree lists ports on the disk array. When you double-click a port, a list of host groups for the port appears. When you double-click a host group, the **LUN** icon appears.
2. To check the number of I/Os, click **IOPS** in the list on the right side of the pane. To check the amount of data transferred, click **MB/s**. To view IOPS or amount of data in real time, select the **Real Time** option, specify the number of collections to display, and click **Apply**.
3. In the Port-LUN tree, do one of the following:
 - To view traffic statistics about ports in the disk array, click the root.

	Port	Current(IOPS)	Ave.(IOPS)...	Peak...	Response...	A:
	All Non-Prio.	-	-	-	-	Nc
	All Prio.	-	0	0	-	
	CL1-A(EF)	-	0	0	-	
	CL1-B(E1)	-	0	0	-	
	CL1-C(D9)	-	0	0	-	

Figure 30 Traffic statistics about ports in a disk array

- To view traffic statistics about host ports to which a disk array port is connected, click the disk array port.

	WWN	PFC Name	Current...	Ave...	Max...	Response...
	0000000000000001	wwn01	-	0	0	-
	0000000000000002	wwn02	-	0	0	-
	0000000000000003	wwn03	-	0	0	-
	Others	-	-	0	0	-

Figure 31 Traffic statistics about host ports to which a disk array port is connected

- To view traffic statistics about host ports in a host group, click the host group.

	WWN	Nickname	Current...	Ave....	Max....	Response...

Figure 32 Traffic statistics about host ports in a host group

- To view traffic statistics about LU paths, click the **LUN** icon.

	LUN	CU:LDEV	Emulation	Paths	Current(IOPS)	Ave....	Max....	Respon

Figure 33 Traffic statistics about LU paths

- To find out how traffic has changed, click the ports, WWNs, or LUNs, and click **Draw**. A graph appears below the table.
- To view more detailed information in the graph, click the **Detail** check box on the lower-right side of the table, and click **Draw**. The graph contents change.

The table displays the following:

- **Graph column:** The check mark icon indicates the graph is currently illustrating data for that item.
- **Port:** Ports on the disk array.
- **WWN:** WWNs of the host bus adapters.
- **LUN:** LUNs (logical unit numbers).
- **PFC Name:** PFC names of host bus adapters.
- **Nickname:** Nickname for host bus adapters. LUN Manager allows you to assign a nickname to each host bus adapter so you can easily identify each host bus adapter in the LUN Manager panes.
- **CU:LDEV:** Logical volume IDs. The number on the left of the colon is the CU image number. The number on the right of the colon is the LDEV number. If a logical volume ID ends with the symbol #, the logical volume is an external LU.
- **Emulation:** Emulation types.
- **Paths:** Number of LU paths.
- **Current:** Current I/O rate.
- **Ave.:** Average I/O rate for the specified period.
- **Max.:** Maximum I/O rate for the specified period.
- **Response Time (ms):** Time (in microseconds) for replying from an external volume group when I/O accesses are made from disk array to external volume group. Average response time in the period specified for Monitoring Term is displayed.

If you select a port in the list, click **Draw**, and select the **Detail** check box, a detailed graph of the port I/O rate is drawn. The Peak value means the top of the Max. line in this graph.

- **Attribute:** Priority of each port. **Prio.** indicates a prioritized port. **Non-Prio.** indicates a non-prioritized port. When calculating I/O rates to be displayed in the **All Prio.** row, Auto LUN XP uses I/O rates of other prioritized ports.

Viewing HBA/port traffic statistics

If Performance Control XP is enabled, Auto LUN XP monitors paths between host bus adapters (HBAs) in host servers and ports on disk arrays. You can view both I/O and transfer rates between HBAs and ports.

- In the Auto LUN pane, click **WWN**.

The tree view displays a list of PFC groups (). The **Not Grouped** item appears below the PFC groups.

- If you double-click a PFC group, host bus adapters () in the PFC group are displayed.

- If you double-click **Not Grouped**, host bus adapters () that do not belong to any PFC group are displayed.
2. In the list on the right side of the pane, do either of the following:
 - To view I/O rates, select **IOPS**.
 - To view transfer rates, select **100KB/s (MB/s [XP 12000])**.
 3. In the tree view, do one of the following:
 - To view traffic statistics for host bus adapters in a PFC group, click the PFC group.

	WWN	PFC Name	Current...	Ave.(I...	Max.(IOPS)	Response Time(ms)	Attribute
	0000000000000003	wwn03	-	0	0	-	Non-Prio.
	0000000000000002	wwn02	-	0	0	-	Non-Prio.

Figure 34 Traffic statistics for host bus adapters

- To view traffic statistics for host bus adapters that do not belong to any PFC group, click **Not Grouped** (see [Figure 34](#)).
- To view the I/O or transfer rates at each PFC group, click the **Subsystem** folder.

	Group	Current(IOPS)	Ave.(IOPS)...	Max.(IOPS)	Response...	...
	grp03	-	0	0	-	...
	<Not Grouped>	-	-	-	-	...

Figure 35 Traffic statistics for each PFC group

- To view traffic statistics for each port connected to a given host bus adapter, click the HBA.

	Port	Current(IOPS)	Ave.(IOPS)(Total)	Max.(IOPS)	Re
	CL1-A	-	0	0	
	CL3-A	-	0	0	
	CL5-A	-	0	0	

Figure 36 Traffic statistics for each port connected to a specified HBA

4. To find out how traffic has changed, in the table, click the PFC groups or WWNs, and click **Draw**. A graph appears below the table.

 **NOTE:** If a host bus adapter's WWN is displayed in red in the tree view, the host bus adapter is connected to two or more ports, but Performance Control XP does **not** control traffic between the HBA and some ports. When many-to-many connections are established between HBAs and ports, monitor all traffic between HBAs and ports. For information about controlling traffic between the HBA and connected ports, see *HP StorageWorks Performance Control XP user guide*.

5. To view more detailed information in the graph, click the **Detail** check box on the lower-right side of the table, and click **Draw**. The graph contents change.

The table displays the following:

- **Graph column:** The check mark icon indicates the graph is currently illustrating data for that item.
- **Group:** PFC groups.
- **PFC Name:** PFC names of host bus adapters.
- **Port:** Ports on the disk array.
- **Current:** Current I/O or transfer rate.
- **Ave.:** Average I/O or transfer rate for the specified period.
- **Max.:** Maximum I/O or transfer rate for the specified period.
- **Response Time:** Time between when the DKC receives the read/write command and when the DKC responds to the command. The value is average response time over one minute.
- **Attribute:** Priority of each host bus adapter. **Prio.** indicates a high-priority HBA (prioritized WWN). **Non-Prio.** indicates a low-priority HBA (non-prioritized WWN). When calculating I/O rates displayed in the **All Prio.** row, Auto LUN XP uses I/O rates of other prioritized ports.

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