OPENPLATFORM SECTION

Contents

1 GENERAL

1.1 Product Outline and Features

The openplatform optional feature can assign a partial or full of disk volume area of the DKC disk subsystem for the Mainframe and Open system hosts by installing FIBRE channel adapter (CHF) packages to the disk controller (hereinafter called DKC). This function enables a use of high reliable and high performance disk subsystem realized by the DKC for a openplatform or FIBRE system environment. This also provides the customers with a flexible and optimized system construction capability for their system expansion and migration.

Some of the major features of this FIBRE attachment option are listed below.

(1) HMRS (Hitachi Multiplatform Resource Sharing) function and FIBRE interface connectivity

In addition to the conventional Channel interface (asynchronous (ESCON) channels), the SCSI-2, standard interface in the open systems, can be mounted as one controller.
At the same time fibre channel interface can be mounted as one controller. This enables multiplatform system users to share the high reliable and high performance resource realized by the DKC disk subsystem.

The SCSI interface is complied with ANSI SCSI-3, a standard interface for various peripheral devices for open systems. Thus, the DKC can be easily connected to various open-market FIBRE host systems (e.g. Workstation servers and PC servers).

DKC460 can be connected to open system via FIBRE interface by installing Fibre Adapter (DKC-F460I-8GSE/4HSE/8HSE/8HLE).
FIBRE connectivity are provided as channel option of DKC460.
FIBRE Adapter can be installed any CHA location of DKC460 and can be co-exist with any other channel adapters.

(2) Fast and concurrent data transmission
Data can be read and written at a maximum speed of 200 M byte/s with use of FIBRE interface.(8GSE : 100M byte/s)
All of the FIBRE ports can transfer data concurrently too.

(3) All FIBRE configuration
All FIBRE configuration is also allowed either with one CHF pair or two, three or full of four CHF pairs configuration.
These will provide more flexible use of the subsystem for open system environment.

(4) HMDE (Hitachi Multiplatform Data Exchange) support
By installing HMDE mto optional feature, data in the mainframe volumes can be read from open systems and written into the open system volumes. Another way, by installing HMDE otm optional feature, data can be transferred from open system to mainframe.
This enables faster data transmission of data base files between mainframe and open systems than currently used means such as network transfer.
The HMDE mto/otm feature is available through FIBRE adapters.

(5) HMBR (Hitachi Multiplatform Backup/Restore) support
By using HMBR optional feature, data in the open system can be managed by the backup systems and utilities provided in the mainframe systems. This enables a use of rich and high reliable and high performance backup systems of mainframe world to the open system environment.
The HMBR feature is available through FIBRE adapters.

(6) Customer assets guarantee (Upgrading paths)
The FIBRE attachment options allow on-site upgrading of already installed channel-type DKC systems owned by customers.

(7) High performance
The DKC has two independent areas of nonvolatile cache memory and this mechanism also applies to the FIBRE attachment option. Thus, compared with a conventional disk array controller used for open systems and not having a cache, this disk subsystem has the following outstanding characteristics:

① Cache data management by LRU control
② Adoption of DFW (DASD Fast Write)
③ Write data duplexing
④ Nonvolatile cache

(8) High availability
The DKC is fault-tolerant against even single point of failure in its components and can successively read and write data without stopping the system. This concept is also taken over to the FIBRE attachment option, which ensures fault-tolerance against even single point of failure in its components, except the CHF. Fault-tolerance against CHF and FIBRE cable failures depends on the multi-path configuration support of the host system too.

(9) High data reliability
The FIBRE attachment option automatically creates a guarantee code of a unique eight byte data, adds it to host data, and writes it onto the disk as data. The data guarantee code is checked automatically on the internal data bus of the DKC to prevent data errors due to array-specific data distribution or integration control. Thus, the reliability of the data improves.

(10) HORC (Hitachi Open Remote Copy) Support

HORC is a function to realize the duplication of open system data by connecting the two DKC460 subsystems or inside parts of a single DKC460 using the ESCON and Fibre.
This function enables the construction of a backup system against disasters by means of the duplication of data including those of the host system or the two volumes containing identical data to be used for different purposes.

1.2 Basic Specifications

The basic specifications of the FIBRE attachment are shown in Table 1-1.

Table 1-1 Basic specifications

Item		Specification
Host Channel	Max. # of Channels	32
	Max. # of concurrent paths	32
Data transfer		100/200 M byte/sec (Fibre)
RAID level		RAID5/RAID1
RAID configuration		RAID5 (3D+1P:72 G byte, 36 G byte)
		RAID1 (2D+2D: 72 G byte, 36 G byte)
HDD		DKS2B-K36FC (36 G byte)
		DKR2D-J72FC (72 G byte)
Cache capacity	minimum	2 G bytes
	maximum	32 G bytes
	additional unit	2 G bytes

*1 : 64 M bytes DRAM

1.3 Terminology

(1) Arbitrated Loop
A configuration that allows multiple ports to be connected serially.

(2) CHA
CHannel Adapter. A hardware package to connect with a channel interface.

(3) CHF
CHannel adapter for FIBRE. A hardware package to connect with FIBRE interface.

(4) Command descriptor block (CDB)
A command block in SCSI interface used to send requests from the initiator to a target.

(5) DKA
DisK Adapter. A hardware package which controls disk drives within a DKC.

(6) DKC
DisK Controller. A disk controller unit consisting of CHA, CHF, DKA, Cache and other components except DKU.

(7) DKU
DisK Unit. Disk drives units.

(8) Fabric
The entity which interconnects various N-Ports attached to it and is capable of routing frames.

(9) FAL
File Access Library: A program package and provided as a program product for HMDE.

(10) FCU
File Conversion Utility: A program package and provided together with FAL for HMDE.

(11) HMBR
Hitachi Multiplatform Backup/Restore.

(12) HMDE
Hitachi Multiplatform Data Exchange.

(13) HMRS
Hitachi Multiplatform Resource Sharing.

(14) HA configuration
High Availability configuration

(15) Initiator
The OPEN device (usually, a host computer) that requests another OPEN device to operate.

(16) Logical unit (LU)
The logical unit of division of the subsystem data area accessible from SCSI interface.

(17) Logical unit number (LUN)
A three-bit code identifier for a logical unit. LUN0-7 can be assigned.

(18) Logical volume or logical device (LDEV)
The disk pack image, formed on an array disk, that is compatible with that of a 3390-3 in terms of cylinder and track quantities and the track capacity.

(19) Point-to-Point
A configuration that allows two ports to be connected serially.

(20) Open device
Collectively refers to the host computer, peripheral control units, and intelligent peripherals that are connected to fibre channel.

(21) Target
A Open device (usually, the DKC) that operates at the request of the initiator.

(22) VENDOR UNIQUE or VU
A manufacturer- or device-unique definable bit, byte, field, or code value.

(23) Initiator Port
A port-type used for MCU port of Fibre Remote Copy function.

(24) RCU Target Port
A port-type used for RCU port of Fibre Remote Copy function.
This port allows LOGIN of host computers and MCUs.

(25) Target port
A port-type which is different from “Initiator Port” and “RCU Target Port”.
This port is a normal target port which is used without configuration of Fibre Remote Copy.
This “Target port” allows LOGIN of host computers. It does not allow LOGIN of MCUs.

1.4 Notice about maintenance operations

There are some notices about FIBRE maintenance operations.

(1) Before LUN path configuration is changed, FIBRE I/O on the related FIBRE port must be stopped.
(2) Before FIBRE channel adapter or LDEV is de-installed, the related LUN path must be de-installed.
(3) Before FIBRE channel adapter is replaced, the related FIBRE I/O must be stopped.
(4) Before micro-program is changed, all FIBRE I/O on the DKC must be stopped, excepting another operation is instructed with HA configuration or CHF skip mode microprogram exchanging.
(5) When Fibre-Topology information is changed, pull out a Fibre cable between the port and SWITCH and put it back again. Before a change of Fibre-Topology information, pull out Fibre cable and put it back after completing the change.

2 Interface Specification

2.1 FIBRE Physical Interface Specification

The physical interface specification supported for FIBRE is shown in Table 2-1 and Table 2-2.

Table 2-1 FIBRE Physical specification

No.	Item		Specification	Remark
1	Host interface	Physical interface	Fibre Channel	FC-PH,FC-AL
		Logical interface	SCSI-3	FCP,FC-PLDA
			Fibre(Arbitrated Loop)	FC-AL
2	Data Transfer Rate	Optic fibre cable	100 M byte/s 200 M byte/s	8GSE 8HSE,4HSE,8HLE
3	Cable Length	Optic single mode fibre	10km	Longwave laser
		Optic multi mode fibre	500m	Shortwave laser
4	Connector Type		SC : 8GSE LC { 8HSE, 4HSE, 8HLE	—
5	Topology		FC-AL	—
6	Service class		3	—
7	Protocol		FCP	—
8	Transfer code		8B/10B translate	—
9	# of hosts		256/Path	—
10	# of maximum LU		512 (256)/Path	—
11	PORT/PCB	4 Port CHF	4 Port (SP Mode*) 1 Port (HP Mode*)	—
		2 Port CHF	2 Port (SP Mode*) 1 Port (HP Mode*)	—

SP Mode : Standard Performance Mode
HP Mode : High Performance Mode

Table 2-2 FC I/F support level

No.	Item	I/F type	DKC460 support level
1	Optic cable type	Optical Type (Longwave)	supported
2		Optical Type(Shortwave)	supported
3		Copper Type	not supported
4	Optic I/F	OFC (Open Fibre Control)	not supported
5		Non-OFC	supported

2.2 Specifications of Fibre Channel High Performance Mode

2.2.1 Standard Performance mode (SP mode)

In the 2, 4-port CHF, one CHPs required for one or two ports.

2.2.2 High Performance mode

To assign four CHPs or two CHPs to one port, a HUB is provided on the PCB and four fibre channel port are connected to one port. The 2, 4-port CHP, uses 4/2 CHPs for one port.

2.2.3 Restrictions of High Performance mode

The following restrictions are placed when using the High Performance mode:

- It looks as if four targets are connected to one port.
- The number of ports which can be used on the PCB drops.
- To make the most performance, accesses must be divided equally for the four targets.
- In the following cases, switching from the SP mode to the HP mode cannot be done.
  When the settings of the LUN for the 1st*, 2nd*, 3rd* and 4th* are duplicated.
  When the settings of the Loop ID (FC-AL) for the 1st*, 2nd*, 3rd* and 4th* are duplicated.
  When the settings of the Host mode for the 1st*, 2nd*, 3rd* and 4th* are different.
  When the settings of the topology for the 1st*, 2nd*, 3rd* and 4th* are different.
  When the settings of the topology for the 1st*, 2nd*, 3rd* and 4th* are Point To Point.
  When the settings of the port-type for the 1st*, 2nd*, 3rd* and 4th* are different.
  When the settings of the channel speed are different.
  (Ex.) At first you have to set both port's types same when 1st* is "Initiator Port", 2nd*, 3rd* and 4th* port is "RCU Target Port".
  And then you can change the SP/HP mode.
  *: For the "1st", "2nd", "3rd" and "4th" refer to Table 2-3 on page OPEN02-30
  In case of 4HSE, only 1st and 3rd.

2.2.4 Restrictions of the change of Standard Performance mode and High Performance mode

- The change of Performance Mode is prohibited when the system is online.
  You must shut down the hosts before the change of Performance Mode,
  or, reboot the hosts after the change of Performance Mode.
- The host recognizes devices already used as new ones because the two mode have different device number for the host to recognize.
  You can't continue to use the device after the change of the Performance Mode.
- If a port is configured as "Initiator Port", you have to remove a logical path of Fibre Remote Copy at first.
  If a port is configured as "RCU Target Port", you have to remove R-Vols at first.
  After either operation above, you can change SP/HP mode.

2.2.5 Indication format of port

Table 2-3 Indication Format of Port

	4HSE/8GSE/8GL/8GLE Fibre (Standard)	High Performance Mode
CL1-A	1A	1A
CL1-B	1B (–)	1B (1A-2nd) (–)
CL1-C	1C	1C (1A-3rd)
CL1-D	1D (–)	1D (1A-4th) (–)
CL1-E	1E	1E
CL1-F	1F (–)	1F (1E-2nd) (–)
CL1-G	1G	1G (1E-3rd)
CL1-H	1H (–)	1H (1E-4th) (–)
CL1-J	1J	1J
CL1-K	1K (–)	1K (1J-2nd) (–)
CL1-L	1L	1L (1J-3rd)
CL1-M	1M (–)	1M (1J-4th) (–)
CL1-N	1N	1N
CL1-P	1P (–)	1P (1N-2nd) (–)
CL1-Q	1Q	1Q (1N-3rd)
CL1-R	1R (–)	1R (1N-4th) (–)
CL2-A	2A	2A
CL2-B	2B (–)	2B (2A-2nd) (–)
CL2-C	2C	2C (2A-3rd)
CL2-D	2D (–)	2D (2A-4th) (–)
CL2-E	2E	2E
CL2-F	2F (–)	2F (2E-2nd) (–)
CL2-G	2G	2G (2E-3rd)
CL2-H	2H (–)	2H (2E-4th) (–)
CL2-J	2J	2J
CL2-K	2K (–)	2K (2J-2nd) (–)
CL2-L	2L	2L (2J-3rd)
CL2-M	2M (–)	2M (2J-4th) (–)
CL2-N	2N	2N
CL2-P	2P (–)	2P (2N-2nd) (–)
CL2-Q	2Q	2Q (2N-3rd)
CL2-R	2R (–)	2R (2N-4th) (–)

– : Unsupported port

(–): Uninstalled port in the case of the 4HSE PCB

3 CONFIGURATION

3.1 System Configurations

3.1.1 Multiplatform Configuration

The DKC can be connected to a FIBRE cable as one of the devices and can exchange data with host via the FIBRE cable. The conventional Channel host systems can also be connected simultaneously with the FIBRE cable. The possible system configurations with the FIBRE attachment are shown below.

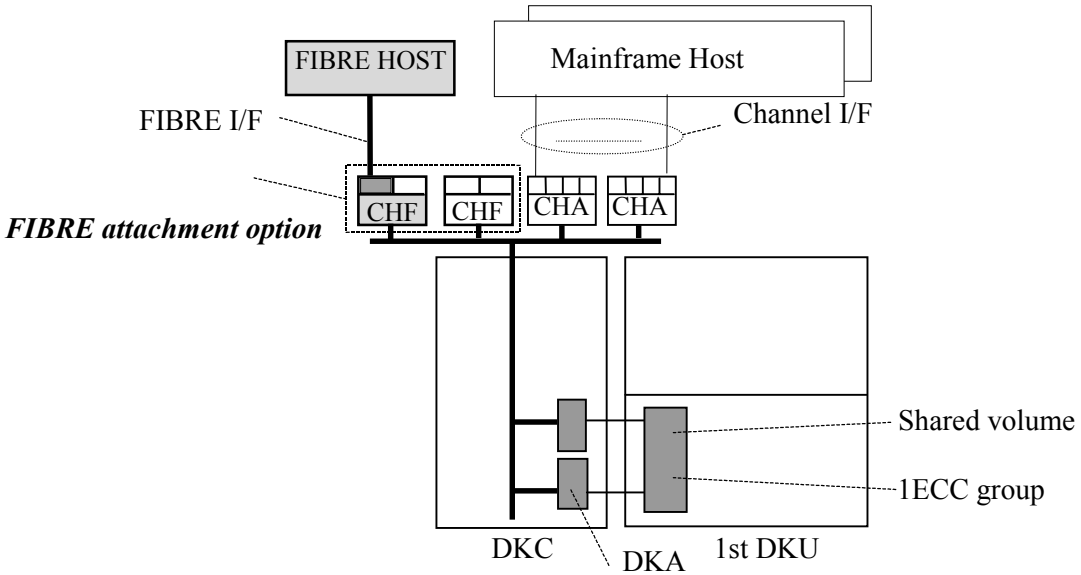

Figure 3-1 multiplatform configuration example

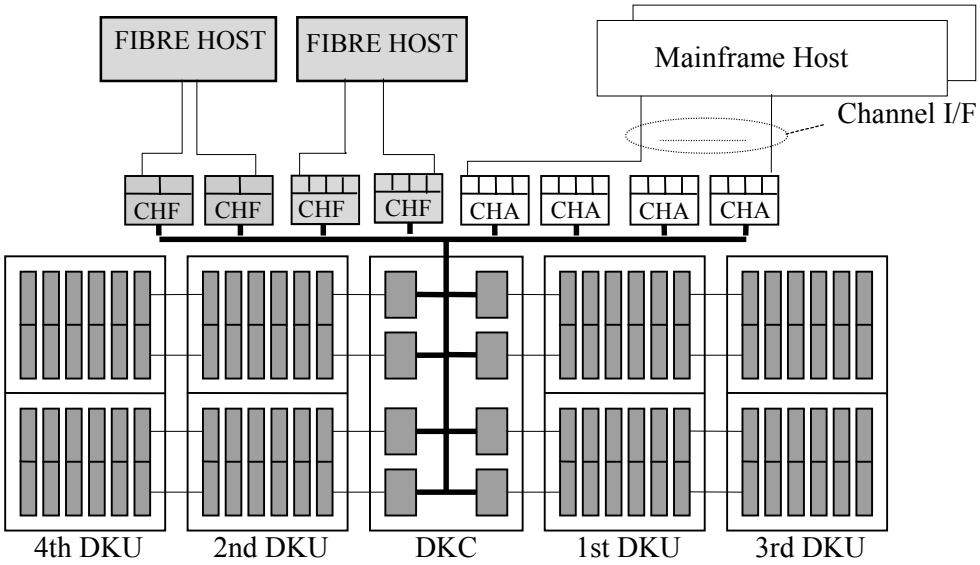

Figure 3-2 multiplatform configuration example

3.1.2 All FIBRE Configuration

The DKC can also have the ALL FIBRE interface configuration installed only by CHF adapters. The possible system configurations for the ALL FIBRE configuration are shown below.

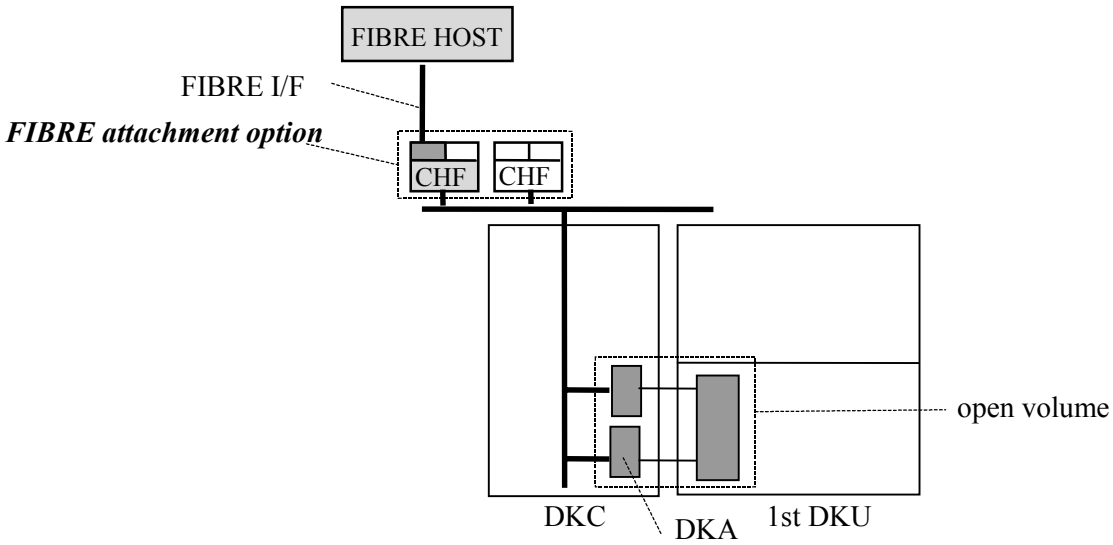

Figure 3-3 Minimum system configuration for All FIBRE

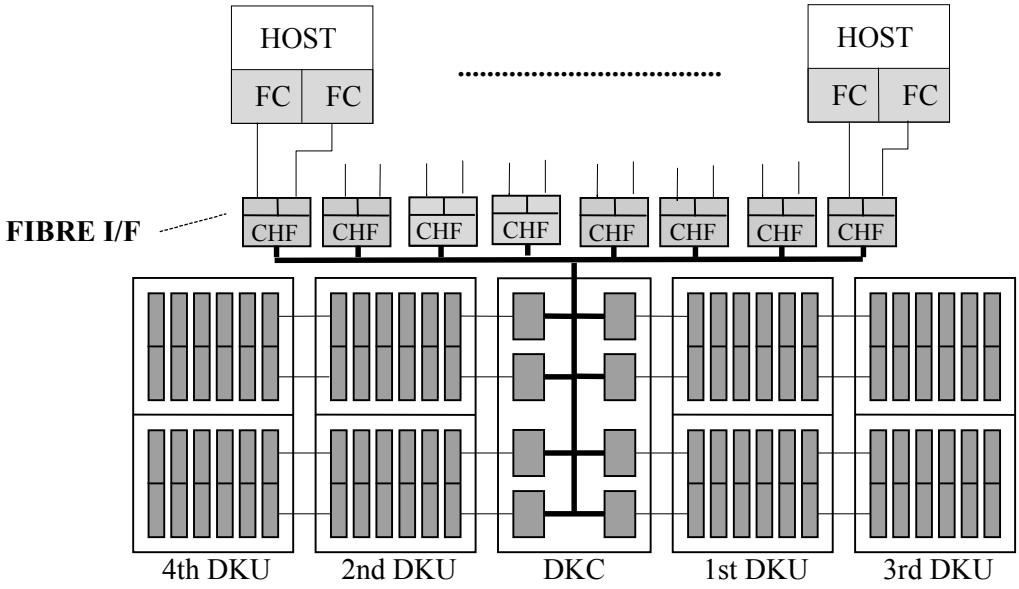

Figure 3-4 Maximum system configuration example for All FIBRE

3.2 Channel Configuration

The FIBRE attachment adapter (CHF) package must be mounted in a two-package unit.
A maximum eight packages including CHA and CHF can be installed in the DKC.
All CHF (I.e. ALL FIBRE) configuration is also allowed.
Four FIBRE ports or two FIBRE ports are mounted on a single CHF package.
Example of available channel configuration is shown in Table 3-1.

Table 3-1 Example of available channel configuration

No.	Basic	Additional 1	Additional 2	Additional 3	Remark
1	CHA	CHF	-	-	Minimum multiplatform (FIBRE)
2	CHF	-	-	-	Minimum All FIBRE
3	CHF	CHF	CHF	CHF	Maximum All FIBRE

CHF:FIBRE adapter, CHA:ESCON, -:empty

3.3 FIBRE Addressing

Each FIBRE device can set a unique Port-ID number within the range from 1 to EF.

An addressing from the FIBRE host to the FIBRE volume in the DKC can be uniquely defined with a nexus between them. The nexus through the Initiator (host) ID, the Target (CHF port) ID, and LUN (Logical Unit Number) defines the addressing and access path. The maximum number of LUNs assigned to a Target is limited to 512 LU (256 LUs without LUN Security).

The addressing configuration is shown in the Figure 3-11.

3.3.1 Number of Hosts

The number of connectable FIBRE channel hosts is limited to 256 per FIBRE port.
For RCU Target port of Fibre Remote Copy function, this limitation is as follows:
The number of FIBRE channel host connections is limited to 128 and the number of MCU connections is limited to 16 per RCU Target port.

3.3.2 LUN (Logical Unit Number)

LUNs can be assigned from 0 to 255 to each FIBRE Port. When using LUN security, 512 LUNs are available.

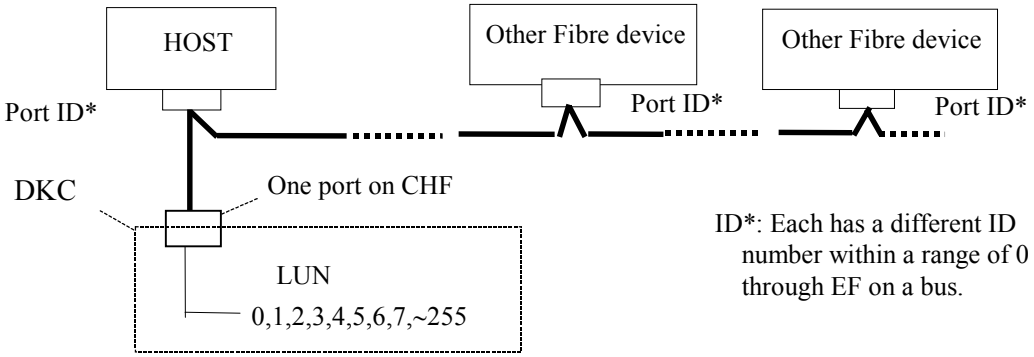

Figure 3-5 FIBRE addressing configuration from Host

3.3.3 PORT INFORMATION

A PORT address and the Topology can be set as PORT INFORMATION. The value of PORT address is EF and can be changed by user. Topology information is selected from “Fabric”, “FC-AL” or “Point to point”.

3.4 Logical Unit

3.4.1 Logical Unit Specification

The specifications of Logical Units supported and accessible from Open system hosts are defined in the Table 3-2.

Table 3-2 LU specification (1/4)

No	Item		Specification			
1	Volume name		OPEN-3	OPEN-8	OPEN-9	OPEN-E
2	Volume attribute		- OPEN volume - HMBR volume	- OPEN volume - HMBR volume	- OPEN volume - HMBR volume	- SCSI volume
3	Access right	FIBRE host	Read/Write	Read/Write	Read/Write	Read/Write
		M/F host	Read/Write (need HMBR option)	Read/Write (need HMBR option)	Read/Write (need HMBR option)	—
4	Logical Unit (LU) size	G byte (10^9)	2.4 GB	7.3 GB	7.3 GB	14.5 GB
		G byte ($1,024^3$)	2.29 GB	6.84 GB	6.88 GB	13.56 GB
5	Block size		512 Bytes	512 Bytes	512 Bytes	512 Bytes
6	# of blocks		4,806,720	14,351,040	14,423,040	28,452,960
7	LDEV emulation name		OPEN-3	OPEN-8	OPEN-9	OPEN-E
8	LDEV size : LU size		1 : 1	1 : 1	1 : 1	1 : 1

Table 3-2 LU specification (2/4)

No	Item		Specification			
1	Volume name		OPEN-L	3390-3A	3390-3B	3390-3C
2	Volume attribute		- SCSI volume	- M/F volume - HMDE volume	- M/F volume - HMDE volume	- M/F volume - HMDE volume
3	Access right	FIBRE host	Read/Write	Read/Write (need HMDE otm/mto option)	Read only (need HMDE mto option)	Read/Write (need HMDE otm/mto option)
		M/F host	—	Read/Write	Read/Write	Read only
4	Logical Unit (LU) size	G byte (10^9)	36.4 GB	—	—	—
		G byte ($1,024^3$)	33.94 GB	—	—	—
5	Block size		512 Bytes	512 Bytes	512 Bytes	512 Bytes
6	# of blocks		71,192,160	5,825,520	5,822,040	5,825,520
7	LDEV emulation name		OPEN-L	3390-3A	3390-3B	3390-3C
8	LDEV size : LU size		1 : 1	1 : 1	1 : 1	1 : 1

Table 3-2 LU specification (3/4)

No	Item		Specification			
1	Volume name		OPEN-3×n (n=2 to 36)	OPEN-8×n (n=2 to 36)	OPEN-9×n (n=2 to 36)	OPEN-E×n (n=2 to 36)
2	Volume attribute		- LU size expansion	- LU size expansion	- LU size expansion	- LU size expansion
3	Access right	FIBRE host	Read/Write	Read/Write	Read/Write	Read/Write
		M/F host	Read/Write (need HMBR option)	Read/Write (need HMBR option)	Read/Write (need HMBR option)	—
4	Logical Unit (LU) size	G byte (10^9)	OPEN-3×n	OPEN-8×n	OPEN-9×n	OPEN-E×n
		G byte ($1,024^3$)				
5	Block size		512 Bytes	512 Bytes	512 Bytes	512 Bytes
6	# of blocks		4,806,720×n	14,351,040×n	14,423,040×n	28,452,960×n
7	LDEV emulation name		—	—	—	—
8	LDEV size : LU size		1 : n	1 : n	1 : n	1 : n

Table 3-2 LU specification (4/4)

No	Item		Specification
1	Volume name		OPEN-L×n (n=2 to 36)
2	Volume attribute		- LU size expansion
3	Access right	FIBRE host	Read/Write
		M/F host	—
4	Logical Unit (LU) size	G byte (10^9)	OPEN-L×n
		G byte ($1,024^3$)	
5	Block size		512 Bytes
6	# of blocks		71,192,160×n
7	LDEV emulation name		—
8	LDEV size : LU size		1 : n

3.4.2 Logical Unit Mapping of FIBRE

Each volume name, such as OPEN-3, OPEN-8, OPEN-9, 3390-3A, 3390-3B, 3390-3C is also used as an emulation type name to be specified for each ECC group. When the emulation type is defined on an ECC group, Logical volumes (LDEVs) are automatically allocated to the ECC group from the specified LDEV#. After creating LDEVs, each LUN of FIBRE port will be mapped on any location of LDEV within DKC. This setting is performed by SVP operation or Remote Console operation (option).

This flexible LU and LDEV mapping scheme enables the same logical volume to be set to multiple paths so that the host system can configure a shared volume configuration such as a High Availability (HA) configuration. In the shared volume environment, however, some lock mechanism need to be provided by the host systems.

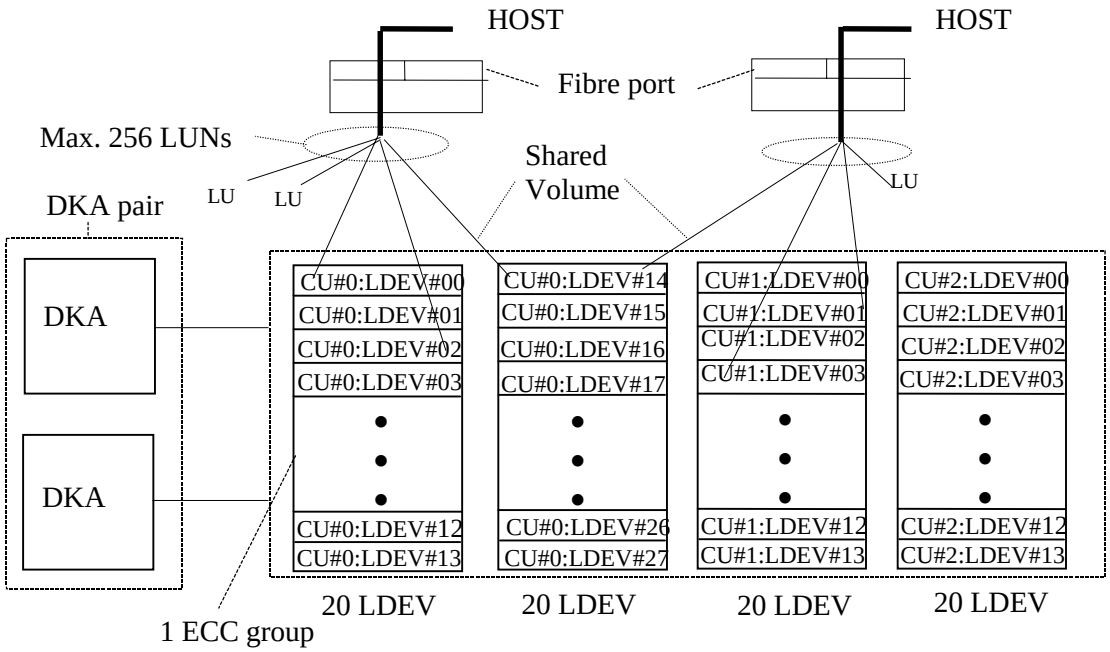

Figure 3-6 LDEV and LU mapping for FIBRE volume

3.4.3 LU size expansion

(1) Outline

This is a function to show the host the continuous LDEV of a volume exclusive for open system as a virtually large LU.

In the former configuration, one LU is one LDEV, but this expanding function can enlarge the LU size up to 265.8 G byte (using OPEN-9×36 for example) by showing the host two or more continuous LDEVs as a single LU.

Many LUs have been needed to cover the entire capacity of a disk subsystem before, but this function enables a small number of LUs to cover it from the viewpoint of host interface.

The MCU port (Initiator port) of Fibre Remote Copy function does not support LU size expansion.

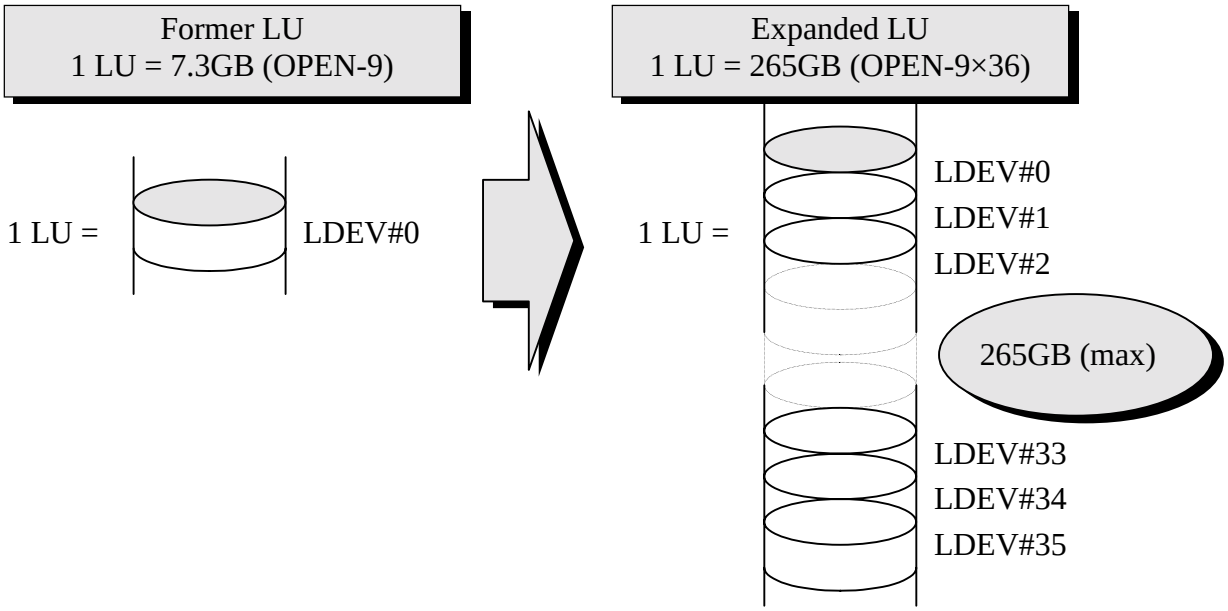

Figure 3-7 Example of LU Size Expansion

(2) Specifications

Table 3-3 shows specifications for the LU Size expansion.

Table 3-3 LU Size Expansion Specification(1/3)

Base volume	OPEN-3	OPEN-8	OPEN-9	OPEN-E	OPEN-L
LDEV Capacity	2.4 G byte	7.3 G byte	7.3 G byte	14.5 G byte	36.4 G byte
Number of connectable LDEVs/LU	2 to 36				
LU Capacity	4.9 G byte ~ 88.5 G byte	14.7 G byte ~ 264.4 G byte	14.7 G byte ~ 265.8 G byte	29.1 G byte ~ 524.4 G byte	72.9 G byte ~ 1312.2 G byte
Product name for responding to INQUIRY	OPEN-3×n	OPEN-8×n	OPEN-9×n	OPEN-E×n	OPEN-L×n
Restrictions of connecting LDEV	• Cannot connect LDEVs with different CU numbers. • Cannot connect CV with different capacity.				

n: Number of connected LDEVs

Table 3-3 LU Size Expansion Specification(2/3)

Base volume	OPEN-3-CVS	OPEN-8-CVS	OPEN-9-CVS	OPEN-E-CVS
LDEV Capacity	35 M byte ~ 2.3 G byte	35 M byte ~ 6.9 G byte	35 M byte ~ 7.0 G byte	35 M byte ~ 13.5 G byte
Number of connectable LDEVs/LU	2 to 36			
LU Capacity	70 M byte ~ 84.2 G byte	70 M byte ~ 250.2 G byte	70 M byte ~ 252.6 G byte	70 M byte ~ 487.9G byte
Product name for responding to INQUIRY	OPEN-3×n-CVS	OPEN-8×n-CVS	OPEN-9×n-CVS	OPEN-E×n-CVS
Restrictions of connecting LDEV	• Cannot connect LDEVs with different CU numbers are impossible. • Cannot connect CV with different capacity are impossible.			

n: Number of connected LDEVs

(3) Effects and restrictions of LU expanding function

1) Effects

- Restrictions of usable capacity owing to the number of the usable hosts is released.
  -Restriction of the host capacity (for example, up to 8 LUs for HP-UX)
  -Restriction of capacity owing to restriction of the number of LUs of the HA software
- The disk connection function on the host side such as VxVM becomes unnecessary.
- Effect of LU size extending with CV.
  -LU of optional size can be configured.
  -The load of PDEV can be dispersed by the LUSE configuration of CV dispersed in ECC.
  -Performance can be improved by increasing the multiplex frequency of LDEV.

2) Restrictions

- Some OSs are slow in disk accesses handling large data and may not be usable depending on environment. (Example: AIX is slow in accesses handling data larger than 2GB.)
- The capacity should be determined as necessary in a system designed to achieve a high-speed operation by making the LUs perform multiple operation.

(4) Notes on use

When the LU is expanded, the following restrictions are added to a case where no expansion is made, such as a change in capacity seen from the open host owing to the specification of the expansion.

1) The LU size cannot be changed while the LU is being used by the host. If you want to change the LU size, the host must be rebooted once. If the LU size once set is to be changed, shut down the host, change the LU size, then start up the host again.
2) If an LU to being used or expanded is reconfigured in a new configuration or as a expanded LU, data which had been used will be lost.
   Perform physical replacement work of the disk including data backup, separation of the former LU, LU connection after the configuration change, and restoration of backup data.
3) When an LDEV in the LU is blocked, an LU blocking error does not occur unless an access is made to the blocked LDEV. When the access to the blocked LDEV is made, a blocking error occurs in the expanded LU.
4) The HMRS can use the LU whose size has been expanded. A volume with an expanded LU can be used by the HMBR, however, all the volumes need to be backed up and restored.
5) The maintenance procedure when an error such as an LDEV blocking occurs is the same as before. Check the LDEV status from the SVP and perform the maintenance considering the relation between the LDEV and the LU.

3.4.4 LUN Security

(1) Outline

This function can protect to access by the host server which are prohibited to access a LUN/LUNs which is assigned to in Fibre port. Each port of host servers are distinguished by World Wide Name that belongs to each port. In the following example, the LU group A are accessible from the host server A and the LU group B are accessible from the host server B

MCU port (Initiator port) of Fibre Remote Copy function can not support LUN security.

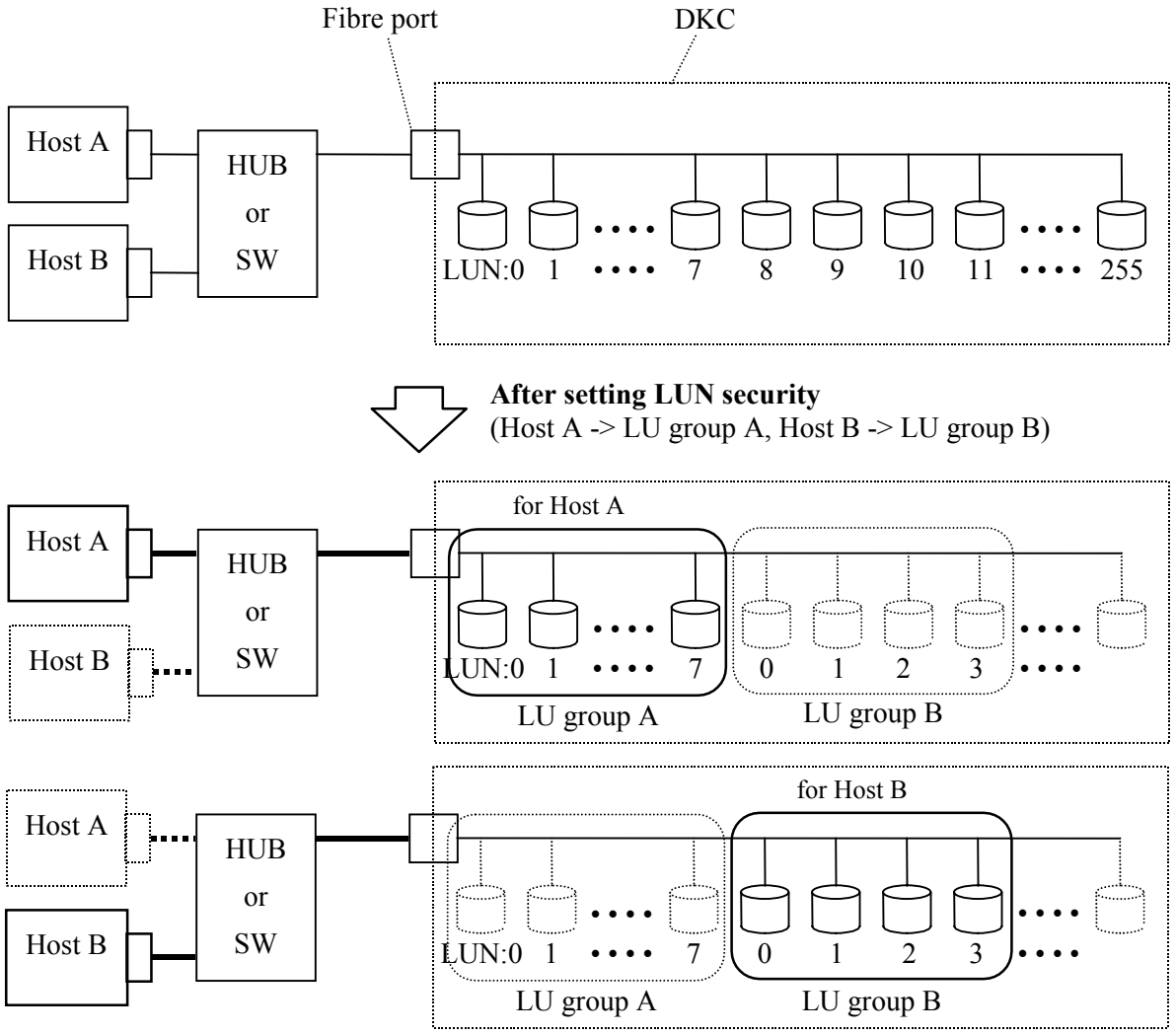

Figure 3-9 LUN Security

3.5 Volume Specification

3.5.1 Volume Specification

The Open volume specification is summarized in Table 3-4.

Table 3-4-1 List 0f RAID450 Model number

Model Number	Disk drive model	RAID Level
DKU-F455I-36K4	DKS2B-K36FC × 4	RAID5(3D+1P)
DKU-F455I-72J4	DKR2D-J72FC × 4	/RAID1(2D+2D)
DKU-F455I-36K4 × 2	DKS2B-K36FC × 8	RAID5(7D+1P)
DKU-F455I-72J4 × 2	DKR2D-J72FC × 8	

Note : As for RAID1, the two connection of a parity groups is possible (8HDDs).
In this case the number of volume become two times.

Table 3-4-2 List of RAID450 Single Cabinet Model Emulation Types for RAID5

Item			Emulation contents					
Emulation Type	DKC		–					
	DKU		OPEN-3	OPEN-8	OPEN-9	OPEN-E	OPEN-L	3390-3A/3B/3C
Storage capacity (GB/volume)			2.46	7.34	7.38	14.58	36.45	2.98
Number of volumes /parity groups	DKU-F455I-72J4		88	29	29	15	6	73
	DKU-F455I-36K4		43	14	14	7	–	35
	DKU-F455I-72J4×2		206	69	68	35	14	171
	DKU-F455I-36K4×2		101	33	33	17	–	83
Maximum number of parity groups	DKU-F455I-72J4		31	31	31	31	31	31
	DKU-F455I-36K4		31	31	31	31	–	31
	DKU-F455I-72J4×2		39	118	120	126	126	47
	DKU-F455I-36K4×2		81	126	126	126	–	98
Maximum number of volumes	DKU-F455I-72J4		2728	899	899	465	186	2263
	DKU-F455I-36K4		1333	434	434	217	–	1085
	DKU-F455I-72J4×2		8034	8142	8160	4410	1764	8037
	DKU-F455I-36K4×2		8181	4158	4158	2142	–	8134
Subsystem capacity (user area) (GB)	DKU-F455I-72J4	Min	216	213	214	219	219	218
		Max	6711	6599	6635	6780	6780	6744
	DKU-F455I-36K4	Min	106	103	103	102	–	104
		Max	3279	3186	3203	3164	–	3233
	DKU-F455I-72J4×2	Min	494	504	496	508	510	510
		Max	19282	59437	59568	63945	64210	23950
	DKU-F455I-36K4×2	Min	242	241	241	247	–	247
		Max	19634	30353	30353	31059	–	24239

Table 3-4-3 List of RAID450 Single Cabinet Model Emulation Types for RAID1(2D+2D)

Item			Emulation contents					
Emulation Type	DKC		–					
	DKU		OPEN-3	OPEN-8	OPEN-9	OPEN-E	OPEN-L	3390-3A/3B/3C
Storage capacity (GB/volume)			2.46	7.34	7.38	14.58	36.45	2.98
Number of volumes /parity groups	DKU-F455I-72J4		59	19	19	10	4	48
	DKU-F455I-36K4		28	9	9	4	–	23
Maximum number of parity groups	DKU-F455I-72J4		31	31	31	31	31	31
	DKU-F455I-36K4		31	31	31	31	–	31
Maximum number of volumes	DKU-F455I-72J4		1829	589	589	310	124	1488
	DKU-F455I-36K4		868	279	279	124	–	713
Subsystem capacity (user area) (GB)	DKU-F455I-72J4	Min	145	139	140	146	146	143
		Max	4499	4323	4347	4520	4520	4434
	DKU-F455I-36K4	Min	69	66	66	58	–	69
		Max	2135	2048	2059	1808	–	2125

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3.5.2 Intermix Specification

Table 3-5 Intermix specification

No	Item	Intermix unit	Remark
1	LDEV intermix	ECC group	-
2	MF/OPEN LDEV intermix	ECC group	-
3	RAID1/RAID5 intermix	DKA pair	-
4	Same parity group PDEV intermix	ECC group	-
5	Different parity group PDEV intermix	DKA pair	-

(1) M/F and OPEN volume intermix
ECC group
It is allowed to allocate the mainframe volumes and OPEN volumes together under a same DKA pair.

(2) LDEV emulation type intermix
ECC group

(3) Drive intermix

(4) RAID5/RAID1 intermix
DKA pair

3.5.3 HMDE volume intermix within ECC group

3.5.3.1 HMDE volume intermix within ECC group

(1) Four types, 3390-3A/-3B/-3C/-3 (or 3390-3A/-3B/-3C/-3R), of emulated disk drives can coexist within one ECC group.
(2) The type can be changed for each one volume within an ECC group.
(3) The type can be changed by the emulation type change function of the SVP.
(4) The emulation type change function allows any change of types among 3A, 3B, 3C, 3, and 3R.
(5) At "define configuration and install" or installation of disk drives, device definition and LDEV-FMT are performed in units of ECC group with any type of 3A, 3B, 3C, 3, and 3R. Afterwards the type is changed for each one volume if necessary.
When the type change is completed, all volumes are initialized (a VTOC is created for volumes) from the mainframe system.
(6) After the type change, the previous data is not assured.
After the type change, all volumes must be initialized (a VTOC must be created) from the mainframe system.
However, data is assured as before for the type change between 3390-3 and 3390-3R, and if you want to assure the data, all volumes must not be initialized (a VTOC must not be created).
Any data is not assured for a type change other than that between 3390-3 and 3390-3R.

3.5.3.2 Intermix with 3390-3R

(1) The 3390-3/-3A/-3B/-3C types can coexist within a subsystem.
Intermixing is allowed both within and beyond a 32-LDEV address boundary.
(2) The 3390-3R/-3A/-3B/-3C types can coexist within a subsystem.
- An intermixture of the 3390-3R and any of 3390-3A/-3B/-3C is allowed in units of 32-LDEV address boundary (with the same type within each boundary). It is not allowed within a 32-LDEV address boundary because of the restriction on the mainframe system.
- An intermixture of the 3390-3A/-3B/-3C is allowed within and out of units of 32-LDEV address boundary.

(3) The 3390-3 and 3390-3R cannot coexist within a subsystem.
- When changing the type from 3390-3 to 3390-R and vice versa by the emulation type change function, the type must be changed not partially but totally, since the 3390-3 and 3390-3R cannot coexist within a subsystem.
The SVP rejects partial change.
- The intermixture can be changed from that of the 3390-3/-3A/-3B/-3C to that of the 3390-3R/-3A/-3B/-3C (with an intermixture part of the 3390-3A/-3B/-3C remaining unchanged) and vice versa by the emulation type change function between 3390-3 and 3390-3R.

3.6 Volume Configuration

3.6.1 Volume Configuration

(1) Minimum Volume Configuration

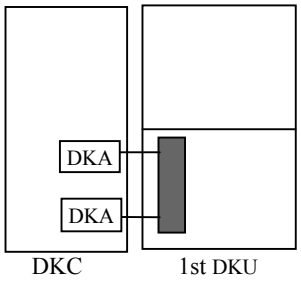


Figure 3-10 Minimum volume configuration

(2) Maximum Volume Configuration

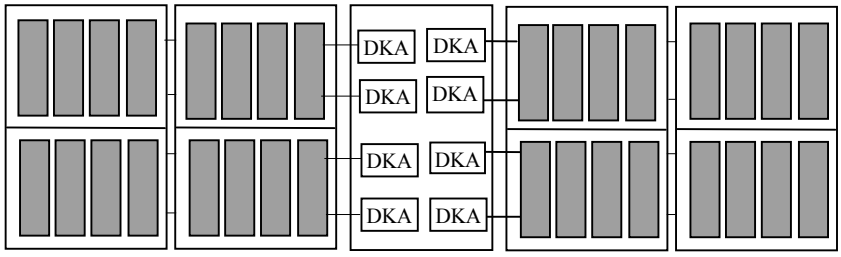


Figure 3-11 Maximum volume configuration

3.6.2 Intermix Volume Configuration

PDEV intermix of same parity group : ECC group
PDEV intermix of different parity group : DKA pair
RAID intermix : DKA pair
LDEV intermix : ECC group
MF/OPEN volume intermix : ECC group

(1) Typical LDEV intermix configuration

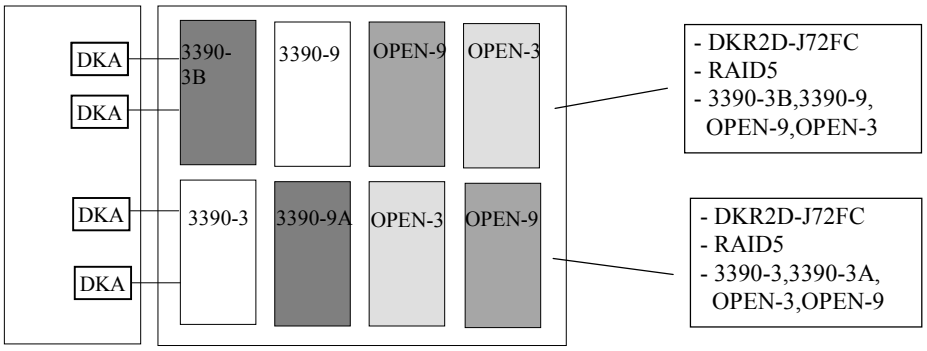


Figure 3-12 Typical LDEV intermix configuration example

(2) Typical RAID intermix configuration

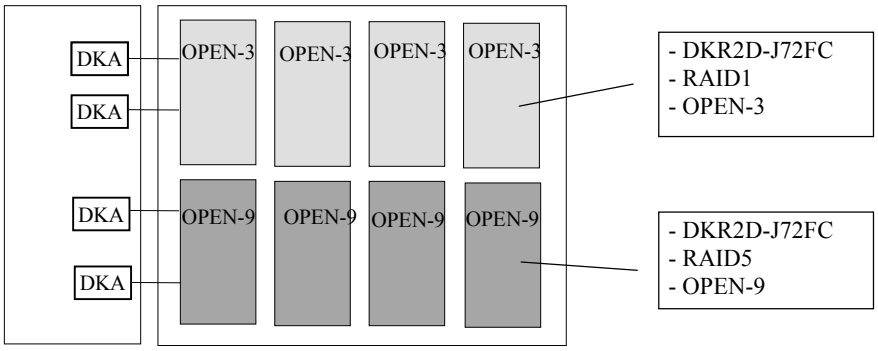


Figure 3-13 Typical RAID intermix configuration example

(3) Typical PDEV intermix configuration

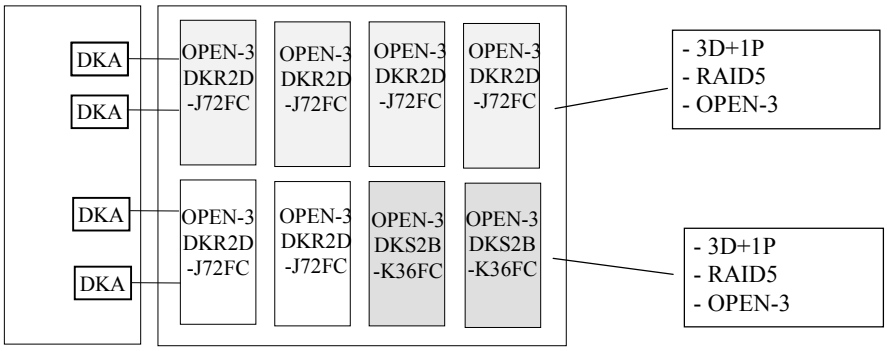


Figure 3-14 Typical PDEV intermix configuration example

3.6.3 HMDE Volume Configuration

(1) Typical volume configuration for HMDE

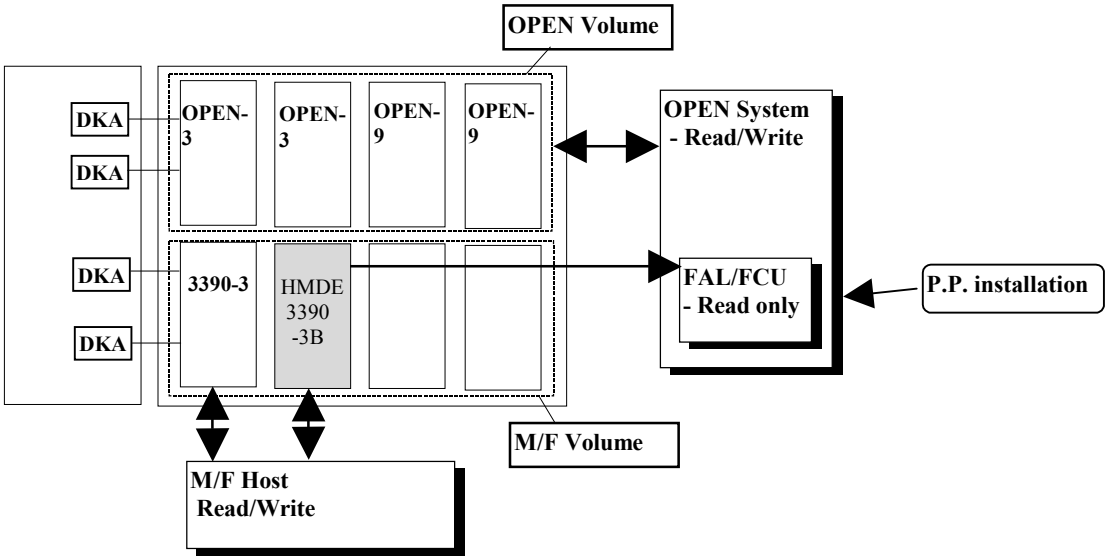


Figure 3-15 Typical volume configuration for HMDE

(2) Valid volume configuration

The configuration shown in Fig. 3-20 is valid.

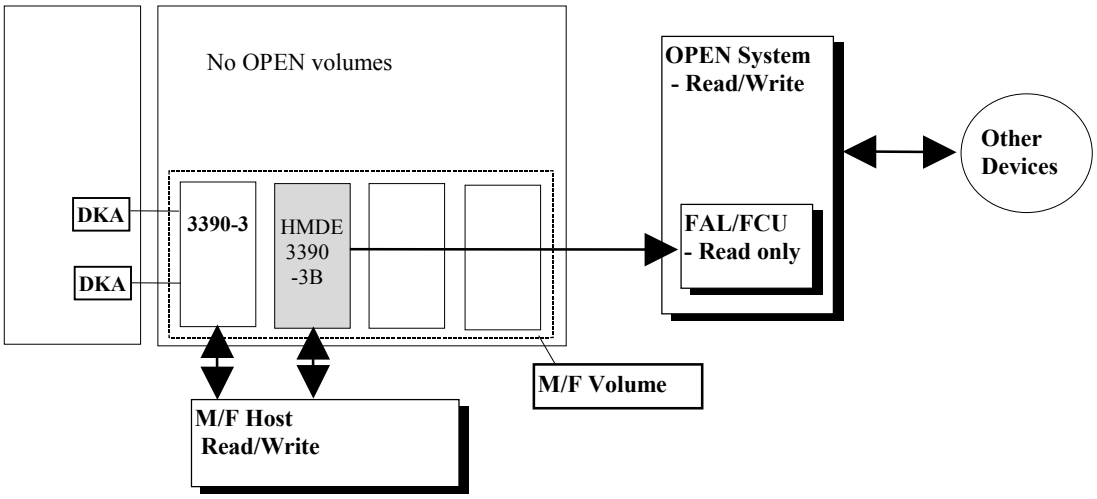


Figure 3-16 Valid volume configuration for HMDE

3.6.4 HMBR Volume Configuration

(1) Typical volume configuration example for HMBR

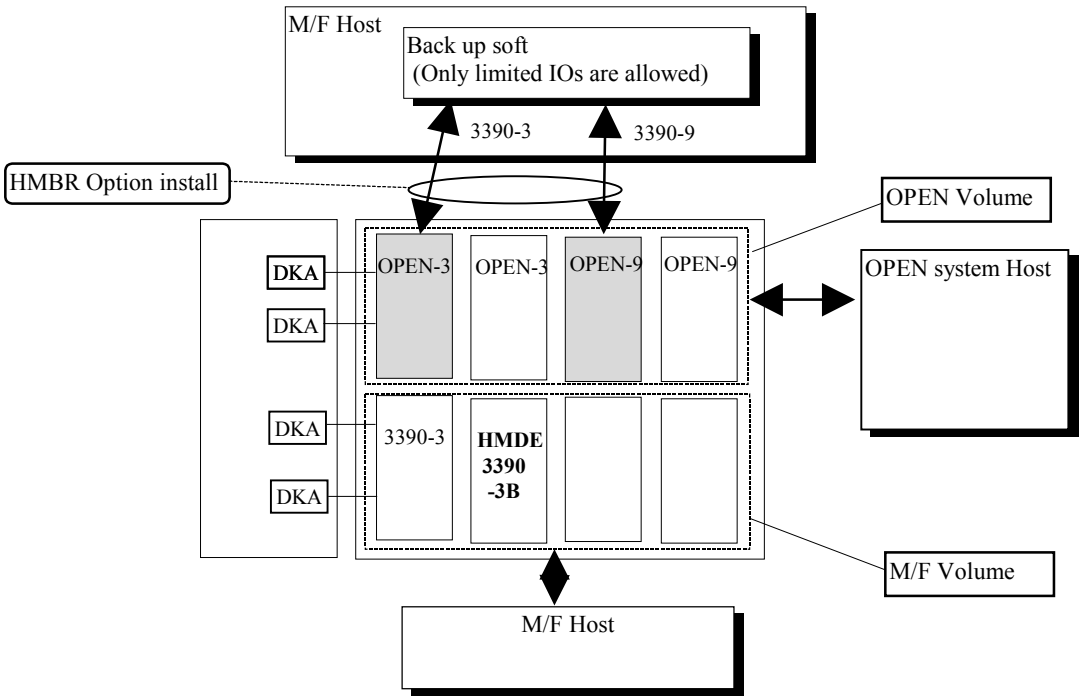


Figure 3-17 Typical volume configuration for HMBR

(2) Valid volume configuration example for HMBR

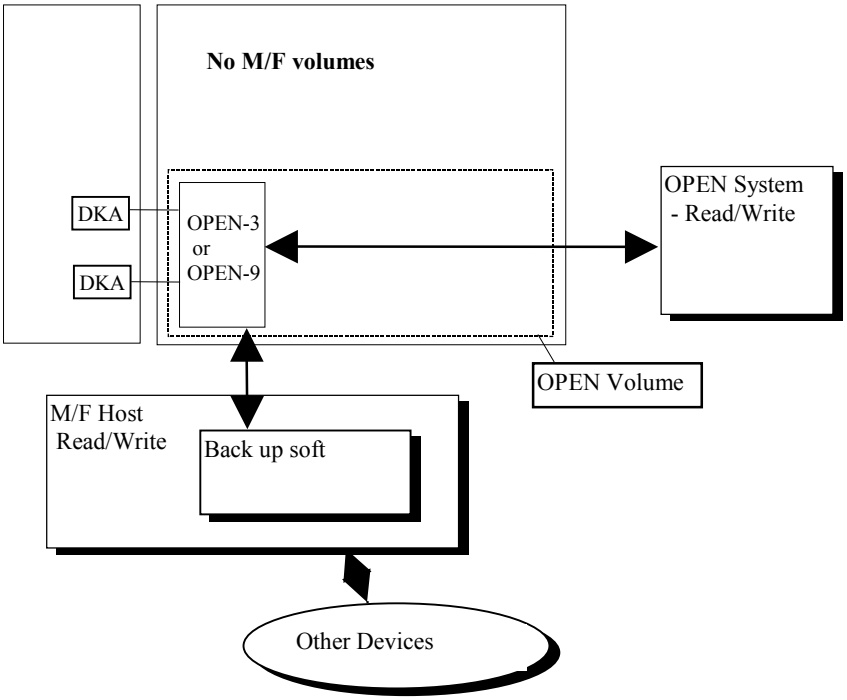


Figure 3-18 Valid volume configuration for HMBR

3.7 Open Volume Setting

3.7.1 Setting of Open volume space

The procedure of Open volume setting is performed either by using the SVP or Remote Console function (optional feature).

3.7.2 LUN setting

- LUN setting:

- Select the CHF, FIBRE port and the LUN, and select the CU# and LDEV# to be assigned to the LUN.
- Repeat the above procedure as needed.

The MCU port (Initiator port) of Fibre Remote Copy function does not support this setting.

Note 1: It is possible to refer to the contents which is already set on the SVP display.
Note 2: The above setting can be done during on-line.
Note 3: Duplicated access paths' setting from the different hosts to the same LDEV is allowed. This will provide a means to share the same volume among host computers. It is, however, the host responsibility to manage an exclusive control on the shared volume.

Refer to the INSTALLATION SECTION for more detailed procedures.

3.8 HA Software

This subsection describes about HA configuration with FIBRE I/F.
The following list shows alternate link and HA software for each host. It is necessary to set Host Mode by using SVP if you want to change a host system.
The meanings of each mode are follows.

MODE 00 : Standard mode
MODE 03 : HP host mode
MODE 09 : Solaris host mode
MODE 0C : WindowsNT/2000 mode
MODE 0F : AIX host mode
others : Reserved

Please see “LUN Management” (INST05-610 to INST05-950). Also see the operational manual for more detailed information about the alternate link and HA software.

4 CONTROL FUNCTION

4.1 Cache Usage

The DKC has two independent areas of non-volatile cache memory for the mainframe volumes. This mechanism also commonly applies to the OPEN volumes without any distinction. Thus, the high reliability and high performance realized by the following features can be commonly applied to the OPEN volumes.

① Cache data management by LRU control

Data that has been read out is stored into the cache and managed under LRU control. For upright transaction processing, therefore, a high cache hit ratio can be expected and a data-writing time is reduced for improved system throughput.

② Adoption of DFW (DASD Fast Write)

At the same time that the normal write command writes data into the cache, it reports the end of the write operations to a host. Data writing to disk is asynchronous with host access. The host, therefore, can execute the next process without waiting for the end of data writing to disk.

③ Write data duplexing

The same write data is stored into the two areas of a cache provided in the DKC. Thus, loss of DFW data can be avoided even one failure occurs in the cache.

④ Nonvolatile cache

The cache in the DKC is non-volatile by battery backup. Once data has been written into the cache, its non-volatility will maintain the data, even if a power interruption occurs. Under a standard system configuration having a fully charged battery pack, data is guaranteed for at least 48 hours.

4.2 SCSI Command Multi-processing

4.2.1 Command Tag Queuing

The Command Tag Queuing function defined in the SCSI specification is supported. This function allows each FIBRE port on CHF to accept multiple SCSI commands even for the same LUN. The DKC can process those queued commands in parallel because a LUN is composed of multiple physical disk drives.
The MCU port (Initiator port) of Fibre Remote Copy function can not support this function because it does not support a connection with a host computer.

4.2.2 Concurrent data transfer

Four FIBRE ports on a CHF can perform the host I/Os and data transfer with maximum 200 M byte/s transfer concurrently. (8GSE :100M byte/s)
This is also applied among different CHFs.
The MCU port (Initiator port) of Fibre Remote Copy function can not support this function because it does not support a connection with a host computer.

5 SCSI Commands

The DASD commands defined under the SCSI-2 standards and those supported by the DKC are listed in Table 5-1.

Table 5-1 SCSI-2 DASD commands and DKC-supported commands

Group	Op Code	Name of Command	Type	×:Supported	Remarks
0 (00_H -$1F_H$)	00_H	Test Unit Ready	CTL/SNS	×	
	01_H	Rezero Unit	CTL/SNS	Nop	
	03_H	Request Sense	CTL/SNS	×	
	04_H	Format Unit	DIAG	Nop	
	07_H	Reassign Blocks	DIAG	×	For RAID5, Nop
	08_H	Read	RD/WR	×	
	$0A_H$	Write	RD/WR	×	
	$0B_H$	Seek	CTL/SNS	Nop	
	12_H	Inquiry	CTL/SNS	×	
	15_H	Mode Select	CTL/SNS	×	
	16_H	Reserve	CTL/SNS	×	
	17_H	Release	CTL/SNS	×	
	18_H	Copy	–	–	
	$1A_H$	Mode Sense	CTL/SNS	×	
	$1B_H$	Start/Stop Unit	CTL/SNS	Nop	
	$1C_H$	Receive Diagnostic Results	DIAG	–	
	$1D_H$	Send Diagnostic	DIAG	Nop	Supported only for self-test.
	$1E_H$	Prevent Allow Medium Removal	–	–	
	$1F_H$	Reserved code	–	–	
	Other	Vendor–unique	–	–	
1 (20_H -$3F_H$)	25_H	Read Capacity	CTL/SNS	×	
	28_H	Read (10)	RD/WR	×	
	$2A_H$	Write (10)	RD/WR	×	
	$2B_H$	Seek (10)	CTL/SNS	Nop	
	$2E_H$	Write And Verify	RD/WR	×	Supported only Write for DKC460I.
	$2F_H$	Verify	RD/WR	×	
	30_H	Search Data High	–	–	
	31_H	Search Data Equal	–	–	
	32_H	Search Data Low	–	–	
	33_H	Set Limits	–	–	
	34_H	Pre-Fetch	–	–	
	35_H	Synchronize Cache	CTL/SNS	×	
	36_H	Lock-Unlock Cache	–	–	
	37_H	Read Defect Data	DIAG	×	No defect always reported.
	38_H	Reserved code	–	–	
	39_H	Compare	–	–	
	$3A_H$	Copy And Verify	–	–	
	$3B_H$	Write Buffer	DIAG	×	
	$3C_H$	Read Buffer	DIAG	×	
	$3D_H$	Reserved code	–	–	
	$3E_H$	Read Long	–	–	

Table 5-1 SCSI-2 DASD commands and DKC-supported commands (Continued)

Group	Op Code	Name of Command	Type	×: Supported	Remarks
1 (20_H -$3F_H$)	$3F_H$	Write Long	–	–	
	Other	Vendor-unique	–	–	
2	40_H	Change Definition	–	–	
	41_H	Write Same	–	–	
	$4C_H$	Log Select	–	–	
	$4D_H$	Log Sense	–	–	
	55_H	Mode Select (10)	CTL/SNS	×	
	56_H	Reserve (10)	CTL/SNS	×	
	57_H	Release (10)	CTL/SNS	×	
	$5A_H$	Mode Sense (10)	CTL/SNS	×	
	Other	Reserved code	–	–	
3, 4	60_H~$9F_H$	Reserved code	–	–	
5	$A0_H$	Report LUN	CTL/SNS	×	
	$A1_H$~BF_H	Reserve code	–	–	
6	$C0_H$~$D0_H$	Vendor-unique	–	–	
7 ($E0_H$ -FF_H)	$E8_H$	Read With Skip Mask ((IBM-unique)	CTL/SNS	–	
	EA_H	Write With Skip Mask (IBM-unique)	CTL/SNS	–	
	Other	Vendor-unique	–	–	

6 HMDE (Hitachi Multiplatform Data Exchange)

6.1 Overview

The Hitachi Multiplatform Data Exchange (HMDE) optional feature provides a function to enable the SAM files of the mainframe to be accessed by the open system host by executing the File Access Library (FAL) program or File Conversion Utility (FCU) program installed in the open system host. Accessible frame files are limited to the SAM files only.
The FCU program has code conversion function between EBCDIC and ASCII.
The FAL has disclosed API and users can incorporate the FAL program directly into a user program.
This optional feature is supplied as a program product (P.P.) that consists of the following programs:

(1) File Access Library program
- C language functions and a Header file for incorporation into a user program

(2) File Conversion Utility program
- An execution-format utility program that contains the access library

The program product is supplied separately for each platform of the open system. Table 6-1 lists platforms supported for using the HMDE.

Table 6-1 Platforms supported

#	Platform supported	OS	Window System
1	SUN	Solaris	Motif 1.2
2	HP	HP-UX	Motif 1.2
3	IBM	AIX	Motif 1.2
4	(Not specified)	WindowsNT4.0/Windows2000	MFC

6.2 Installation

(1) Installation of P.P.
For the method of installing the P.P. (containing FAL and FCU) and its detailed specifications, refer to the manual attached to the P.P.

(2) HMDE volume setting
Volumes whose emulation type is 3390-3A, 3390-3B, or 3390-3C can be used for the HMDE operations. In addition to being accessible as 3390-3 type volumes from the mainframe host in the same manner as before, the 3390-3B type volumes permit read-only access from the open system host.
The 3390-3A type volumes can be accessible as 3390-3 from the mainframe host and permit a read/write access from the open system host. The 3390-3C can be read only accessible as 3390-3 from mainframe host and permit a read/write access from the open system host. The 3390-3C permit creating and updating of VTOC.

Table 6-2 HMDE volume specifications

#	Volume attribute	Emulation Type	Access right		Remarks
			Mainframe	Open system	
1	Mainframe volume	3390-3A	R/W	R/W	HMDE volume
2		3390-3B	R/W	R	HMDE volume
3		3390-3C	R	R/W	HMDE volume
7	Open volume	OPEN-3	(Backup/Restore)	R/W	HMDE volume
8		OPEN-E		R/W	HMDE volume
9		OPEN-9	(Backup/Restore)	R/W	HMDE volume
10		OPEN-L		R/W	HMDE volume
11		OPEN-8	(Backup/Restore)	R/W	HMDE volume

The 3390-3A, 3390-3B, and 3390-3C type HMDE volumes can be set during initial installation or LDEV addition. To use volumes used by the mainframe and/or OPEN as the HMDE volumes, they must be set as the HMDE volumes by removing the corresponding ECC group once and then adding them again.
This procedure is the same as the ordinary one for setting emulation type of another drive.

The drive emulation type can be changed between 3390-3 and 3390-3A and 3390-3B and 3390-3C by change emulation operation.

(3) Setting from the open system host
- To access the HMDE volumes from the open system host, it is necessary to define the connection to the open system host and to set an OPEN path. The method of defining the OPEN path for the open system host is the same as that of the ordinary OPEN path definition with the SVP.
- Refer to the manual attached to the P.P. for the method of setting the open system host to enable it to access the HMDE volumes. This setting operation requires labeling of the HMDE volumes, for example.

6.3 Notes on Use

Alike the ordinary mainframe volumes, the 3390-3B and 3390-3A type HMDE volumes can be accessed from the mainframe. The 3390-3C type HMDE volumes can be read only accessed any area except VTOC area from the mainframe.
If the OPEN path are not defined for 3390-3A/B, the volume can not be accessed from the open system host.

7 HMBR (Hitachi Multiplatform Backup/Restore)

7.1 Overview

The Hitachi Multiplatform Backup/Restore (HMBR) optional feature allows an open system volume on the DKC disk subsystem to be read from the mainframe host by a volume unit as backup data. It also allows the backup data to be restored from the mainframe host to the open system volume.

Any special additional software packages are not required to perform these functions on both mainframe host and open system host. The DKC disk subsystem can convert the different data block format between open system (fixed block length data) and mainframe system (CKD format data).
The HMBR has the following features:

(1) Enabling the existing backup/restore programs such as “DFHSM and DFDSS” or “DFSMShsm and DFSMSdss” in the mainframe to collect and restore the backup of open system data under the DKC Multiplatform disk subsystem in a unit of Logical Unit volume.

(2) Performing the backup and restore operation with high data transfer rate of ESCON 17 MB/s between mainframe host and the DKC disk subsystem.

(3) Providing the open systems with powerful backup functions being used on mainframe systems, such as backup file generation management, primary/secondary duplication management, and automatic backup control.

(4) Offering various backup media to the system, such as disk drives, magnetic tapes, or magnetic tape libraries.

7.2 System Configuration

A system configuration example and functional overview are shown in the Figure 7-1.

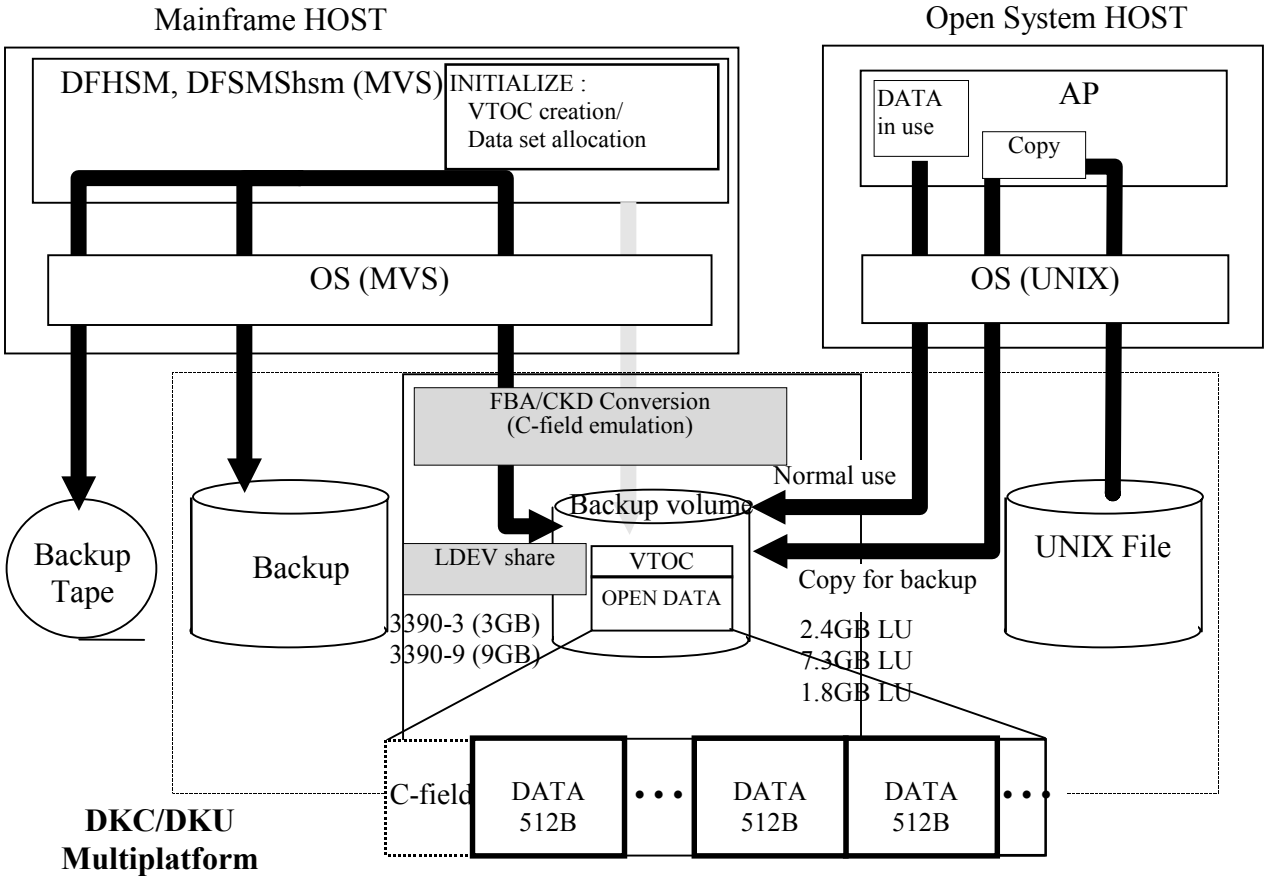


Figure 7-1 System configuration example

7.3 Basic Specification

The basic specification of HMBR is shown in the Table 7-1.

Table 7-1 Basic specification of HMBR

No	Item		Specification		Remarks
1	Attached system	Mainframe	MVS/ESA		
2		Open system	SUN (Solaris 2.6) or later HP (HP-UX 10.x) or later IBM (AIX 4.2) or later WindowsNT4.0/Windows2000		
3	Backup software	Mainframe	DFHSM, DFDSS DFSMShsm, DFSMSdss		
4	Device type	Mainframe	3390-3	3390-9	
5		Open system	OPEN-3 (LUN=2.4GB)	OPEN-8/9 (LUN=7.3GB)	
6	Maximum number of volumes for backup/restore		- As many Logical Units as specified for OPEN-3/9 for Open system.		
7	Setup for backup volume		- By installing HMBR option (on SVP), all Logical Units defined as OPEN-3/8/9 can be accessed from MVS		
8	Preparation before taking backup	VSN, VTOC creation	- DSF (INIT)		
9		Dataset allocation	- IEFBR14		
10	Backup method		- Volume full tracks dump by using DFDSS and DFSMSdss.		
11	VTOC format		- Standard VTOC. Note: Do not use SMS for backup volumes since Index VTOC is used in SMS.		
12	VTOC allocation		- Cylinder 0, Head 1 to 14 (fixed location)		
13	Data set allocated	# of data sets	- One/VOL	- Three/VOL	
14		Extent	- Cylinder 1, Head 0 to User cylinder MAX.		
15	Restrictions for mainframe side utility programs		- Other utility programs than listed above are not allowed. - For Write type commands, other than those used by the above listed utility programs are rejected. (Only FORMAT WR with 16KB data length is allowed for write type command.) Read or Control type commands can be used. - Verify option is not allowed.		

7.4 Backup Volume Specification

1) Setup for Backup Volume

Step-1 : Install the HMBR option to the DKC by using SVP. Refer to the option install procedure described in SVP section. (SVP04-10)

Step-2 : By installing the option above, all the Logical Units (OPEN-3, OPEN-8, and OPEN-9 type), already installed or newly installed, will be ready to be used for backup/restore from the mainframe host.

Note-1 Immediately after the HMBR option is de-installed, an access from the mainframe to OPEN-3, OPEN-8 or OPEN-9 will be rejected.

Note-2 The Logical Unit data already stored, which has been used before the installation of HMBR option, can be used continuously for its original use and/or for backup/restore purpose.

2) Access to Backup Volume

The specification applied to accessing the backup volume is shown in the Table 7-2.

Table 7-2 Specification of accessing the backup volume

No	Items	Specification
1	Volume type	- OPEN-3 (2.4GB), OPEN-8 (7.3GB), OPEN-9 (7.3GB)
2	Access from Open system	- No restriction.
3	Access from mainframe host	- Possible to Read/Write as 3390-3 for OPEN-3 and as 3390-9 for OPEN-8/9. - For Write type commands, only the following command is allowed: - Format Write with data length of 16 KB. - Other write type commands are rejected.

7.5 Precautions

(1) Preparations

<System generation>

The volume for HMBR is recognized as the 3390-3 or 3390-9 from the MVS system. Specify UNIT = 3390 using the IODEVICE macro when incorporating the volume into the MVS system.

This volume can be backed up or restored using only DFDSS from the MVS system. Access from other programs is rejected.

<Volume initialization>

Use the system utility to initialize the volume from the mainframe system.

You must create VTOC in Cylinder 0. This initialization works VSN be written in an area other than the area in the volume where the open system data is written, which does not damage the open system data.

<Dataset allocation>
After volume initialization, allocate a single dataset (for OPEN-3; three datasets for OPEN-9) to the volume from the mainframe system. The extent of the dataset is from cylinder 1, head 0 to the user cylinder end.

When executing backup or restoration of the open system data by using HMBR, the backup/restoration utility in the mainframe specifies VSN/DSN of the above volume and dataset for execution. Thus you can facilitate backup or restoration by assigning to VSN and DSN names related to the device file names in the open system of the volume (LU).

(2) Unmounting the volume
When obtaining backup by using HMBR, terminate the open system processing in advance and unmount the volume in order to assure consistency of the backup data. Moreover, for backup of the volume connected to the AIX system, the varyoffvg command must be executed. If the backup utility in the mainframe is activated without doing this, the backup job may be halted awaiting operator intervention or the job may contain inconsistent, incomplete backup data.

(3) Volume exclusion
Though the volume as target for HMBR is an open volume and stores data in the open system, it also has VSN and can be accessed from the mainframe. Normally it is recommended to keep the volume off-line from the mainframe to prevent a data write from the mainframe that will damage the open system data. During backup or restoration, establish locks to prevent access to the HMBR-target volume (LU) from the open system.

(4) Backup unit
Unit of backup by HMBR is LU. Note that restoring backup data for recovery from damaged files will recover the state when backup was obtained, including other files (files which have not been damaged) within the same LU.

(5) Specification of backup-from volume and restore-to volume
When the backup-from volume (Logical Unit) and the restore-to volume (LU) differs from each other, the open system host cannot recognize the restore-to volume. Thus, specify the same volume name (LU) to the backup-from volume and the restore-to volume.

(6) Backup of the volume managed by LVM
Unit of data which can be backed up/restored by HMBR is the physical volume (LU) only. However, because the logical volume may be mapped over more than one physical volume, the consistency of the logical volume data is not assured by LU-based backup. When using HMBR in a system managed by such LVM, you must back up all physical volumes (LUs) comprising volume groups in the same occasion. This requires operational expertise as the following describes:

① **Study of physical/logical mapping (OPEN system)**
Use the commands of the OPEN system to check correspondence between the logical volume group and physical volume group (LU) for the backup target volume.

② **Creating the job control statement (JCL) (mainframe)**
From all physical volumes (LUs) comprising the backup-target volume group obtained in step ①, list the mainframe VSNs and DSNs corresponding to the device file names. When executing backup using the batch job format, create the JCL for executing the backup utility specifying VSNs and DSNs listed above.

③ **Unmounting the target logical volume**
Unmount all logical volumes in the backup-target volume group.

④ **Executing the mainframe backup utility**
Execute the mainframe backup utility to obtain backup of VSNs/DSNs corresponding to all physical volumes (LUs) comprising the backup-target volume group.

⑤ **Precautions**
In the above volume-group-based backup, all logical volumes in the volume group are backed up in the same occasion. Note that restoration is made on a per volume group basis and the entire volume group returns to the state when backup was obtained. When logical-volume-based backup or restoration is required, a volume group must contain only one logical volume.
When modification to the configuration of the logical volume or volume group is made (such as addition, deletion or splitting of logical volumes in a volume group, or addition of a new physical volume in a volume group), volume-group-based backup must be executed using the new configuration. If this is skipped and backup data obtained via HMBR is restored, only data entity is restored to the old LV/LG configuration. This may disrupt the consistency with the LVM management information stored separately from the data entity, causing damage to data.

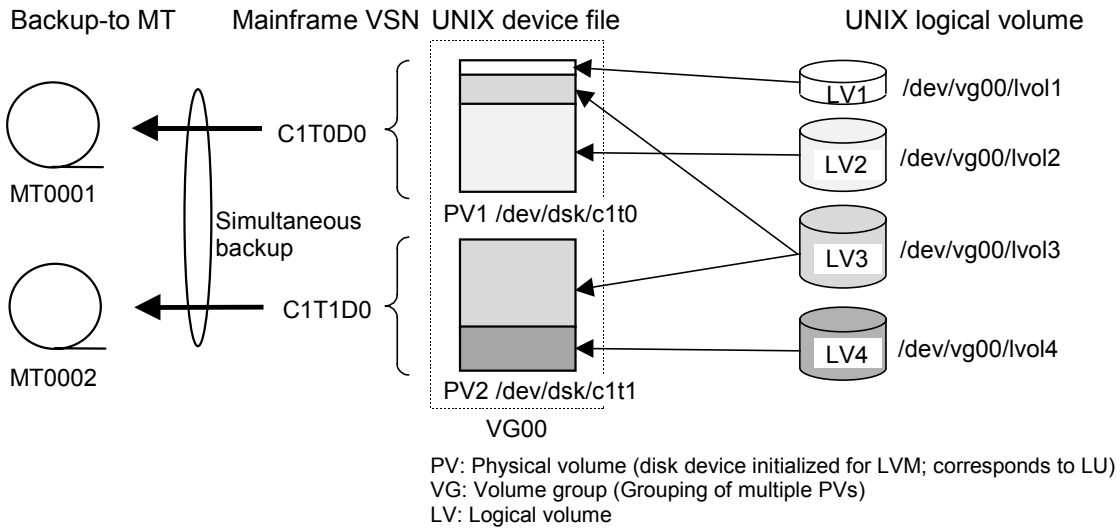


Figure 7-2 Backup of Volumes managed by LVM

(7) Backup of database
To backup a database, first terminate its operation to place it off-line before making a backup. You must backup of all LUs where data files are stored at the same occasion. Follow the required backup method for each database management system to determine whether or not backup is required and the backup method for other files comprising the database (such as control file and log file). Follow the restoration procedure or approach for each database management system to determine when a log file must be used to restore the database to the state just before fault, or the synchronicity of the control file and data file must be restored.

(8) Backup of open volume
When obtaining backup by using HMBR, do not use verify option of mainframe utility.

(9) A method of the backup and restore operations for WindowsNT system data is shown in the following.

<Backup>

(a) Delete a drive letter in the Logical Units by Disk Administrator.
(b) Re-allocate a drive letter to the Logical Units by Disk Administrator.
(c) Backup WindowsNT system data by mainframe host.

<Restore>

(a) Delete a drive letter to the Logical Units by Disk Administrator.
(b) Restore it from mainframe host to the Logical Units.
(c) Re-allocate drive letter to the Logical Units by Disk Administrator.

8 HA Software Linkage Configuration in a Cluster Server Environment

When this subsystem is linked to High-Availability software (HA software) which implements dual-system operation for improved total system fault-tolerance and availability, the open system side can also achieve higher reliability on the system scale.

8.1 Example of System Configurations

(1) Hot-standby system configuration
The HA software minimizes system down time in the event of hardware or software failures and allows processing to be restarted or continued. The basic system takes a hot-standby (asymmetric) configuration, in which, as shown in the figure below, two hosts (an active host and a standby host) are connected via a monitoring communication line. In the hot-standby configuration, a complete dual system can be built by connecting the FIBRE cables of the active and standby hosts to different CHF FIBRE ports.

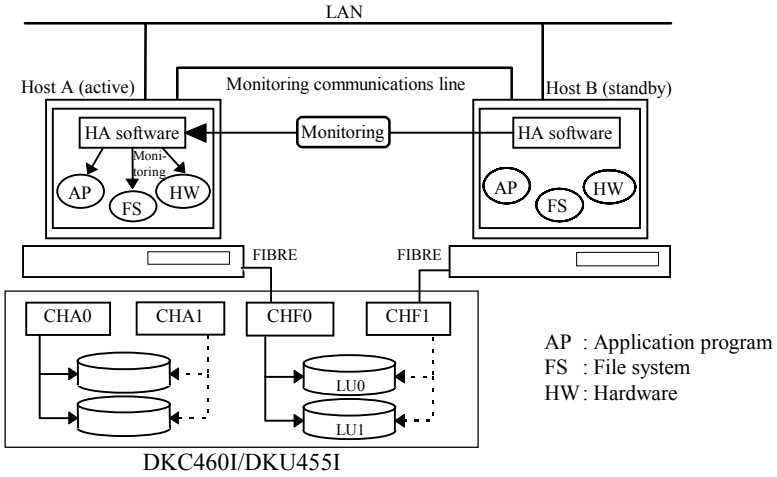


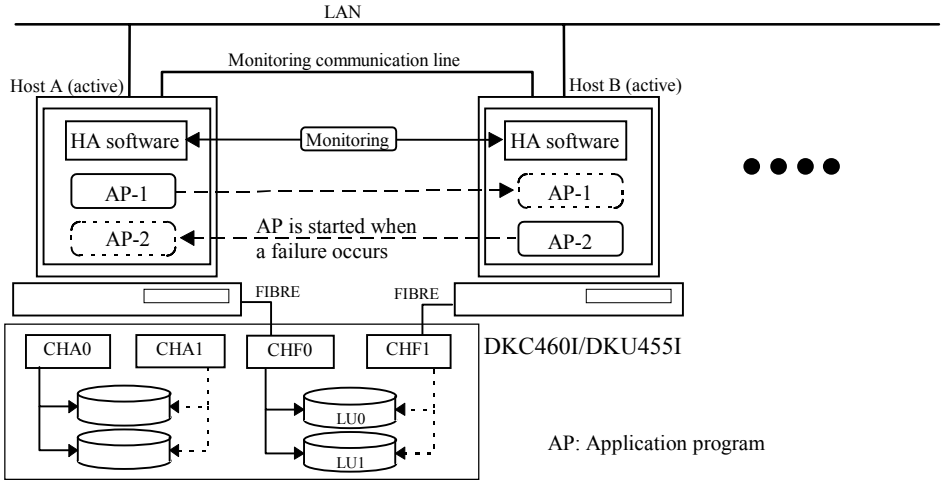
Figure 8-1 Hot-standby configuration

• The HA software under the hot-standby configuration operates in the following sequence:

a. The HA software within the active host monitors the operational status of own system by using a monitoring agent and sends the results to the standby host through the monitoring communication line (this process is referred to as "heart beat transmission"). The HA software within the standby host monitors the operational status of the active host based on the received information.
b. If an error message is received from the active host or no message is received, the HA software of the standby host judges that a failure has occurred in the active host. As a result, it transfers management of the IP addresses, disks, and other common resources, to the standby host (this process is referred to as "fail-over").
c. The HA software starts the application program concerned within the standby host to take over the processing on behalf of the active host.

- Use of the HA software allows a processing request from a client to be taken over. In the case of some specific application programs, however, it appears to the client as if the host that was processing the task has been rebooted due to the host switching. To ensure continued processing, therefore, a login to the application program within the host or sending of the processing request may need to be executed once again.

(2) Mutual standby system configuration
In addition to the hot-standby configuration described above, a mutual standby (symmetric) configuration can be used to allow two or more hosts to monitor each other. Since this subsystem has eight FIBRE ports, it can, in particular, be applied to a large-scale cluster environment in which more than two hosts exist.



- In the mutual standby configuration, since both hosts operate as the active hosts, no resources exist that become unnecessary during normal processing. On the other hand, however, during a backup operation the disadvantages are caused that performance deteriorated and that the software configuration becomes complex.
- This subsystem is scheduled to support VERITAS Software FirstWatch, Hewlett-Packard MC/ServiceGuard, and IBM HACMP and so on.

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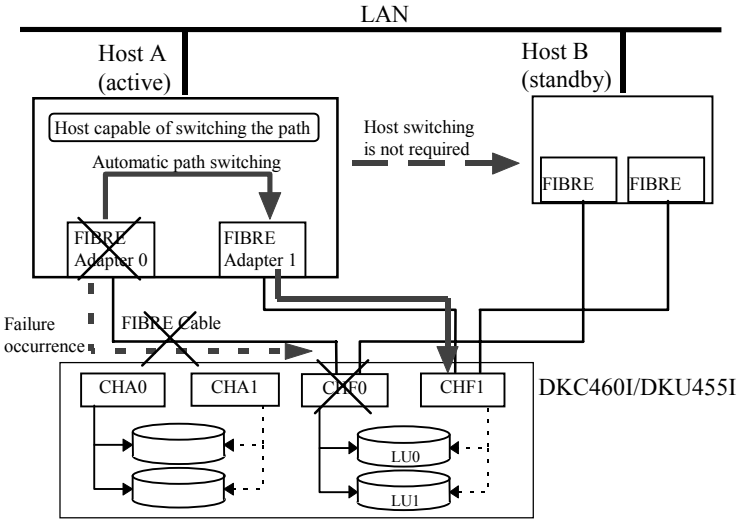
8.2 Configuration Using Host Path Switching Function

When the host is interlocked with the HA software and has a path switching capability, if a failure occurs in the FIBRE adapter, FIBRE cable, or DKC (FIBRE ports and the CHF) that is being used, automatic path switching will take place as shown below.



The path switching function enables processing to be continued without host switching in the event of a failure in the FIBRE adapter, FIBRE cable, array controller, or other components.

8.3 Procedures for online microprogram exchange and CHF replacement using alternate path

8.3.1 Outline

The alternate path function enables a microprogram exchange and a CHF replacement without stopping an I/O operation of the host connected to the CHF (that is, online exchange/replacement).

8.3.2 Prior confirmation of alternate path

An alternate path must be correctly established and the path switching must function at the time of exchange/replacement in order to exchange a microprogram or replace the CHF during the online operation. Confirm the path state by asking an SE concerned or a customer.
See "Procedures for Confirming Alternate Path State and Recovering It" shown in Table 1.

8.3.3 Types of microprogram exchange

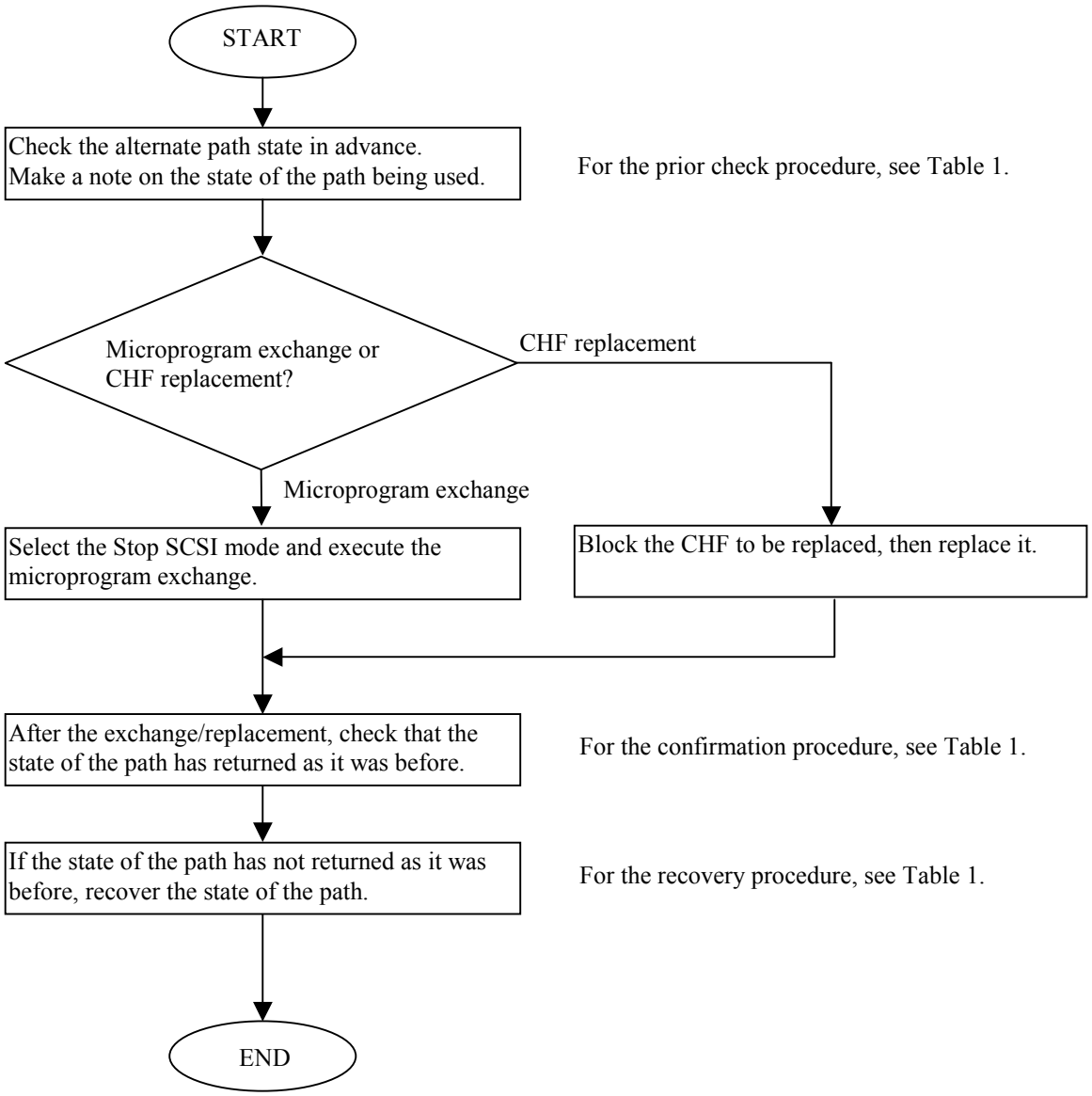
For HP-UX:	STOP SCSI mode
Solaris, AIX, WindowsNT and Windows2000:	Alternate SCSI Path mode

8.3.4 Restrictions

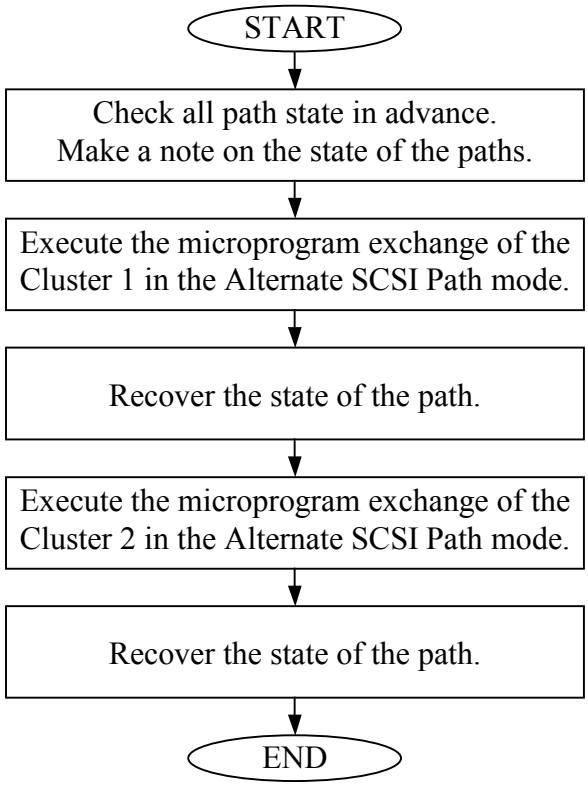
(1) Check that the alternate path is correctly set.
(2) Online exchange/replacement is possible when both primary and alternate paths are normal. If the path state is abnormal, recover it to be normal, then perform the online exchange/replacement.
(3) An alternate path function cannot be used with respect to HMDE volume. Disable I/Os to the HMDE volume concerned when exchanging a microprogram or replacing the CHF.
(4) Disable I/Os to the LDEV for which the alternate path is not set.
(5) The microprogram exchange on HP is executed in the Stop SCSI mode. And the microprogram exchange on Solaris, AIX, WindowsNT or Windows2000, is executed in the Alternate SCSI Path mode. When these coexist on the same DKC, determine the mode to be either the Stop SCSI mode or the Alternate SCSI Path mode in which to exchange a microprogram, and disable I/Os of a platform in the other mode before exchanging a microprogram.
(6) In the case of the Dual Active configuration, a load may concentrate on one of the two paths during the microprogram exchange or CHF replacement. Take preventive measures against it such as to choose a period (time zone) when the host load is low to perform the online exchange/replacement.

8.3.5 Procedures for online microprogram exchange and CHF replacement

(1) Procedures for microprogram exchange or CHF replacement executed on HP-UX



(2) Procedures for microprogram exchange executed on Solaris, AIX or Windows NT

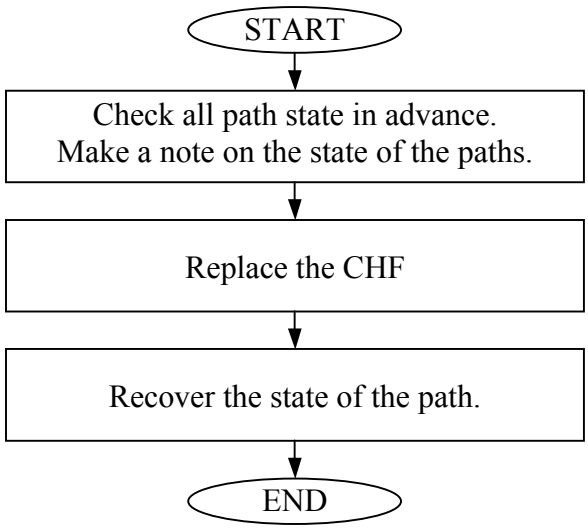


For the confirmation procedure, see Table 1.

For the recovery procedure, see Table 1.

For the recovery procedure, see Table 1.

(3) Procedures for CHF replacement executed on Solaris, AIX or Windows NT



For the confirmation procedure, see Table 1.

For the recovery procedure, see Table 1.

Table 1 Procedures for Confirming and Recovering Alternate Path State (1 of 2)

No.	Platform	Alternate path state confirmation procedure	Recovery procedure
1	HP	Display and confirm the path states (Pstates) of all the devices (LUs) by the "vgdisplay-v" command. If "PV Name" is displayed as Alternate Link, the path has been switched to the alternate path.	Automatic recovery Display and confirm the path states (Pstates) of all the devices (LUs) by the "vgdisplay-v" command.
2	Sun	[VxVM DMP] Display and confirm the path states of all the devices (LUs) by the "vxdisk list *diskxx*" or "vxdisk list *cxtxdxsx*" command of VxVM. Perform one of the following operations depending on the path state. • Disabled: The path is faulty. (Or, after the microprogram exchange or CHF replacement, the path concerned has not been recovered yet.) After recovery, check it again according to this procedure. • Enabled: After recording this state, execute the microprogram exchange or CHF replacement. Note: If there is at least one failed path, do not execute the online microprogram exchange or CHF replacement. Be sure to execute the exchange or replacement after recovering the failure.	[VxVM DMP] Step ①: Recover the path by the "vxdctl enable" command of VxVM. Step ②: Confirm that all the paths are in the Enabled state (initial state) by the "vxdisk list *diskxx*" or "vxdisk list *cxtxdxsx*" command. If the path in the Disabled state remains, execute the procedure again from Step ① after the path is recovered. Or recover the path failure, then execute the procedure again from Step ①.

Table 1 Procedures for Confirming and Recovering Alternate Path State (2 of 2)

No.	Platform	Alternate path state confirmation procedure	Recovery procedure
3	Windows NT Windows 2000	[Path Manager] Confirm the states of all adapters by using the "datapath query adapter" command. Perform one of the following operations depending on the Adapter State. • All NORMAL: All paths are in use. It is possible to exchange microprogram or replace CHF. • DEGRAD or FAILED: The path is faulty. Recover the path failure, then set the path online according to the Recovery procedure.	[Path Manager] Step ①: Check the number of the DEGRAD or FAILED adapter which must be set to online, using the "datapath query adapter" command. Step ②: Use the "datapath set adapter *n* online" command. (*n* is the adapter number checked by Step ①.) Step ③: Check the states of all adapters have returned to NORMAL, using the "datapath query adapter" command again. • All NORMAL: All paths are in use. • DEGRAD or FAILED: The path is faulty. After the microprogram exchange or CHF replacement, execute the procedure again from Step ① after the path is recovered. Or recover the path failure, then execute the procedure again from Step ①.
4	AIX	[Path Manager] Confirm the states of all adapters by using the "datapath query adapter" command. Perform one of the following operations depending on the Adapter State. • All NORMAL: All paths are in use. It is possible to exchange microprogram or replace CHF. • DEGRAD or FAILED: The path is faulty. Recover the path failure, then set the path online according to the Recovery procedure.	[Path Manager] Step ①: Check the number of the DEGRAD or FAILED adapter which must be set to online, using the "datapath query adapter" command. Step ②: Use the "datapath set adapter *n* online" command. (*n* is the adapter number checked by Step ①.) Step ③: Check the states of all adapters have returned to NORMAL, using the "datapath query adapter" command again. • All NORMAL: All paths are in use. • DEGRAD or FAILED: The path is faulty. After the microprogram exchange or CHF replacement, execute the procedure again from Step ① after the path is recovered. Or recover the path failure, then execute the procedure again from Step ①.

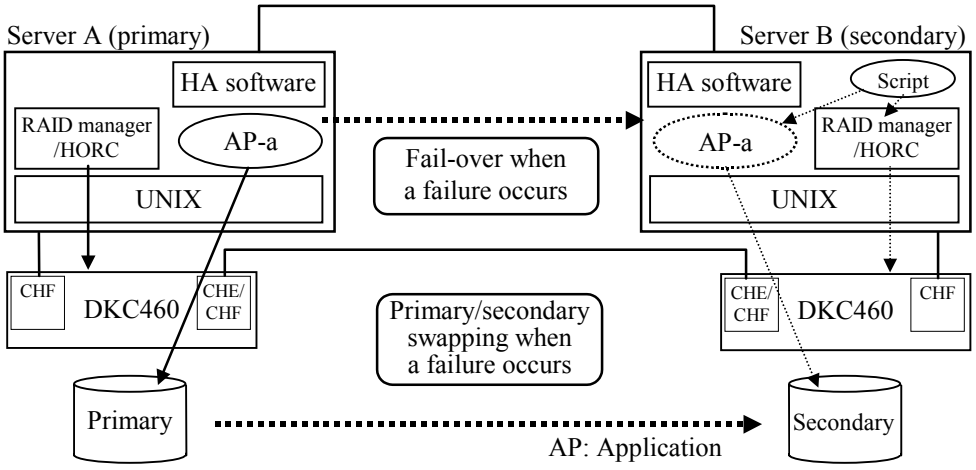
9 HORC (Hitachi Open Remote Copy)

9.1 Overview

The Hitachi Open Remote Copy function can remotely duplicate data (volumes) under the control of the subsystem by directly connecting the two DKC460s. A backup system against disasters can be constructed by installing one of the two DKC460s at the main site and the other at the recovery site and configuring the HA cluster on the server side by means of the HA (High Availability) software.
This function also enables the two volumes containing identical data to be used for different purposes by duplicating data (volumes) within the same DKC460 or between the two DKC460s and separating the volumes in a primary-and-secondary relation at any time.
An online database can be backed up or batch programs can be executed while the database is being accessed.
The HORC makes various settings and it controls operations by means of the RAID manager/HORC, which runs on the open system. The RAID manager/HORC provides various commands for user applications to control the HORC functions. Creation of a user shell script using these commands enables the HORC control being interlocked with server's fail-over executed by the HA software.

There are two kinds of Serial interface (ESCON/ACONARC) and Fibre channel interface of connection form between CUs.
But, Serial interface connections is not supported.

Outline of HORC Function and Example of Application to HA Configuration
(Hot Standby Configuration)



9.2 Basic Specifications

Basic HORC specifications are shown below.

Basic Specifications of HORC

No.	Item	Description	Remarks
1	Host interface on open system side	Fibre Channel	Supporting for HP-UX, Solaris, Win/NT and AIX4.2
2	Supporting platform	HP-UX, AIX, Solaris, Windows/NT 4.0, Windows2000	They are HP-UX, AIX, Solaris, Windows/NT, Windows2000 in the case of Fibre Remote Copy.
3	Connection between the CUs	ESCON, ACONARC/Fibre Channel	An ESCON/ACONARC connection can't be mixed with the Fibre Channel connection.
4	Means for setting the paired LU	Command instruction from the RAID Manager/HORC	
		Remote console	
		SVP	
5	Number of LUs capable of the duplicated writing	Maximum 8191 pairs	
6	LU size capable of the duplicated writing (The paired VOL must be the same DEV type.)	OPEN-3 (2.4G byte)	
		OPEN-8 (7.3G byte)	
		OPEN-9 (7.3G byte)	
		LUSE	
		CVS Volume	
		OPEN-E (14G byte)	
		OPEN-L (36G byte)	
7	Duplicated writing mode	Synchronized, Asynchronized	
8	Combination of the CUs	One-to-one correspondence N-to-one correspondence one-to-N correspondence	
9	Fence level	Data, Status, Never	Supports a function equivalent to the MF HRC.
10	Number of logical paths between the CUs	Maximum 8 paths per CU	
11	Multiple CUs support	Yes	For CU#0 through CU#31, HORC pairs can be created.
12	Control of the MF HRC and the open HRC in DKC mixture	Can be mixed	

(1) Means for setting the paired LU:
The following three means are provided:
- Command instruction from the RAID Manager/HORC
- Instruction from the remote console
- Instruction from the SVP

Not only the pairing but also a series of pair state changes are possible by using these three means. However, the user can use two means only: the command instruction from the RAID Manager/HORC and the instruction from the remote console.

(2) LU size capable of the duplicated writing:
OPEN-3, OPEN-8, OPEN-9, OPEN-E, OPEN-L, CVS volume and LUSE are supported as the LU sizes capable of the duplicated writing. Provided that the paired VOL must be the same DEV type.

(3) Fence level:
The HORC, alike the HRC, supports three types of fence level: Data, Status, and Never.

(4) Control of the HRC pairs and the HORC pairs mixture:
Control of the mixture of the HRC pairs and the HORC pairs is possible within the one DKC.

(5) S-VOL (secondary VOL) access:
① An RD access to the secondary VOL is permitted to accept the RD command issued to the disk label when the secondary server is started.
② In order to support the DataPlex function, write access to the secondary VOL is permitted on condition that the pair is being suspended.
Using the RAID Manager/HORC or SVP, you can indicate the permission of write operation to S-VOL. After this indication, if the server performs any write operation to S-VOL, in Pair Resync (Resume) operation all tracks on P-VOL will be copied to S-VOL.
If using SVP, the permission of write operation to S-VOL is executed by setting “S-VOL write Enable” on Suspend Pair display in the indication of S-VOL Suspend on MCU.
Also, you can confirm using RAID manager/HORC or SVP whether “S-VOL write Enable” on S-VOL is permitted or not.

(6) HMBR function for the HORC paired VOL
① Overview
Open time traveler function makes possible to make a backup and restoration of HORC pair volumes using a mainframe machine. (HMBR function for the HORC paired VOL)
After splitting HORC pairs by a HORC command of RAID Manager/TT, you can make a backup from a mainframe machine. In this case the backup data is got from S-Vols.
Therefore to make a backup, you don’t have to stop processes from open systems to P-Vols.
Before restoring backup data, you must delete HORC pairs and make them simplex volumes by a HORC command of RAID Manager/TT. After restoring data, create HORC pairs using the same volumes as P-Vols or S-Vols before deleting pairs. Thus you can create the same duplicated status as before.

② Preparation for Backup
Before making a backup of HORC pair volumes using HMBR function, you need to set VSN, and to create VTOC from a mainframe machine as written in "4.7.3 HMBR". These operations must be done before HORC pairs are created.

③ VSN, VTOC in HORC pairs
By the initial copy of a HORC pair, VSN and VTOC in the P-Vol are copied to S-Vol. As a result, both P-Vol and S-Vol have the same VSN and VTOC. If you need to set the different VNS to S-Vol, after splitting the pair, you can change VNS in S-Vol.

④ Write operation from a mainframe machine to HORC pair volumes.
Once a HORC pair is created, all write operations from a mainframe machine to the HORC pair volume are rejected, except rewriting of VNS to S-Vol. Therefore a mainframe machine cannot erase original data written by an open system.

⑤ Others
While an initial copy for HORC pairs is executed, the link between S-Vol and a mainframe machine should be off-line. If the link is on-line, the initial copy is aborted.
While there exists any I/O from a mainframe machine to an open volume, don't start initial copy from the volume to another. When you start the copy operation, a mainframe I/O is aborted.
When you start initial copy, you need to stop a mainframe I/O to a open volume which is to be a P-Vol of a HORC pair.

◆Restrictions:

(1) Command device:
① The HORC provides users with a command to enable a state change and status display of the HORC pair from the server.
② Assign a special LUN called a command device so that the DKC460 can receive this pair state change and pair status display commands.
③ Users cannot use the command device. A command device with a capacity of 2.4GB within the subsystem cannot be used (when the OPEN3 is assigned as a command device). If you install the micro version supporting CVS function for Open volume, you can specify CVS volume as command device. In this case, the minimum capacity of command device is 36MB.
④ Use the SVP to specify the command device.

(2) Flashing updated data in the server:
When the HORC is used as a DataPlex function, split the primary/secondary paired VOL. A Sync command or the like must be issued before splitting it and a file system buffer must be flashed when acquiring a backup from the secondary VOL. Thus, the latest backup can be acquired.

(3) P-VOL (primary VOL) access:
Pair suspend operation (pairsplit-P option) from RAID Manager/HORC can be executed to HORC pair volumes but can't be executed to HORCA pair volumes.

10 LUN installation

10.1 Overview

LUN installation feature makes it enable to add LUNs to DKC460 FIBRE ports while I/Os are still running.
Some host operations are required before the added volumes are recognized and become usable from FIBRE host operating systems.
MCU port (Initiator port) of Fibre Remote Copy function does not support LUN installation.

10.2 Specifications

(1) General
1) LUN installation feature supports FIBRE interface.
2) LUN installation is supported.
3) LUN installation can be executed by SVP or by Web Console.
4) Some operating systems require reboot operation to recognize the newly added volumes.
5) When new LDEVs should be installed for LUN installation, install the LDEVs by SVP first. Then add LUNs by LUN installation from SVP or Web Console.
6) MCU port (Initiator port) of Fibre Remote Copy function does not support LUN installation.

(4) Platform support
Host Platforms supported for LUN installation are shown in Table 10-1.

Table 10-1 Platform support level.

Support level	FIBRE
(A) LUN installation and LUN recognition.	Solaris, HP-UX, AIX
(B) LUN installation only. Reboot is required before new LUNs are recognized.	WindowsNT Windows2000
(C) LUN installation is not supported. Host must be shutdown before installing LUNs and then must be rebooted.	—

10.3 Operations

(1) Operations
Step 1: Execute LUN installation from SVP or from JAVA = “Web Console”.
Step 2: Check whether or not the initiator platform of the FIBRE port supports LUN recognition with Table 10-2.
Support (A) -> Execute LUN recognition procedures in Table 10-2.
Not support (B) -> Reboot host and execute normal install procedure.

(2) Host operations
Host operations for LUN recognition are shown in Table 10-2.

Table 10-2 LUN recognition procedures outline for each platform

Platform	LUN recognition procedures
HP-UX	(1) **`ioscan`** (check device added after IPL) (2) **`insf -e`** (create device files)
Solaris	(1) **`/usr/sbin/drvconfig`** (2) **`/usr/sbin/devlinks`** (3) **`/usr/sbin/disks`** (4) **`/usr/ucb/ucblinks`**
AIX	(1) **Devices-Install/Configure Devices Added After IPL** By SMIT
Windows 2000	Automatically detected

11 LUN de-installation

11.1 Overview

LUN de-installation feature makes it enable to delete LUNs to DKC460 FIBRE ports while I/Os are still running.
MCU port (Initiator port) of Fibre Remote Copy function does not support LUN de-installation.

11.2 Specifications

(1) General

1) LUN de-installation feature supports FIBRE interface.
2) LUN de-installation can be used only for FIBRE ports on which LUNs are already existing.
3) LUN de-installation can be executed by SVP or by "Web Console".
4) When LUNs should be de-installed for LUN de-installation, stop Host I/O of concerned LUNs.
5) If necessary , execute backup of concerned LUNs.
6) De-install concerned LUNs from HOST.
7) In case of AIX, release the reserve of concerned LUNs.
8) In case of HP-UX do not delete LUN=0 under existing target ID.
9) MCU port (Initiator port) of Fibre Remote Copy function does not support LUN de-installation.

(Note)
If LUN de-installation is done without stopping Host I/O, or releasing the reserve, it would fail. Then stop HOST I/O or release the reserve of concerned LUNs and try again. If LUN de-installation would fail after stopping Host I/O or releasing the reserve, there is a possibility that the health check command from HOST is issued. At that time, wait about three minutes and try again.

(2) Platform support
Host platforms supported for LUN de-installation are shown in Table 11-1.

Table 11-1 Support platform

Platform	OS	Fibre
HP	HP-UX	○
SUN	Solaris	○
RS/6000	AIX	○
PC	WindowsNT	×
PC	Windows 2000	○

(example) ○: support, ×: not support

11.3 Operations

(1) Operations

Step 1: Confirm whether or not the initiator platform of the FIBRE port supports LUN de-installation with Table 11-1.
Support :Go to Step 2.
Not support : Go to Step 3.

Step 2: If HOST MODE of FIBRE port is not 00 or 04 or 07 use, go to Step 4.

Step 3: Stop Host I/O of concerned LUNs.

Step 4: If necessary, execute backup of concerned LUNs.

Step 5: De-install concerned LUNs form HOST.

Step 6: In case AIX, release the reserve of concerned LUNs.
If not, go to Step 7.

Step:7 Execute LUN de-installation from SVP or from “Web Console”.

(2) Host operations

Host operations for LUN de-installation procedures are shown in Table 11-2.

Table 11-2 LUN de-installation procedures outline for each platform

Platform	LUN de-installation procedures
HP-UX	mount point:/01, volume group name:vg01 (1) **umount /01** (umount) (2) **vgchange -a n vg01** (deactive volume groups) (3) **vgexport /dev/vg01** (export volume groups)
Solaris	mount point:/01 (1) **umount /01** (unmout)
AIX	mount point:/01, volume group name:vg01, device file name:hdisk1 (1) **umount /01** (umount) (2) **rmfs -r" /01** (delete file systems) (3) **varyoffvg vg01** (vary off) (4) **exportvg vg01** (export volume groups) (5) **rmdev -I 'hdisk1' '-d'** (delete devime files)

12 Prioritized Port Control (PPC)

12.1 Overview

The Prioritized Port Control (PPC) feature allows you to use the DKC for both production and development. The assumed system configuration for using the Prioritized Port Control option consists of a single DKC that is connected to multiple production servers and development servers. Using the Prioritized Port Control function under this system configuration allows you to optimize the performance of the development servers without adversely affecting the performance of the production servers.
MCU port (Initiator port) of Fibre Remote Copy function does not support Prioritized Port Control (PPC).

The Prioritized Port Control option has two different control targets: fibre port and open-systems host's World Wide Name (WWN). The fibre ports used on production servers are called prioritized ports, and the fibre ports used on development servers are called non-prioritized ports. Similarly, the WWNs used on production servers are called prioritized WWNs, and the WWNs used on development servers are called non-prioritized WWNs.
Note: The Prioritized Port Control option cannot be used simultaneously for both the ports and WWNs for the same DKC. Up to 32 ports or 1024 WWNs (32 WWNs × 32 ports) can be controlled for each DKC.

The Prioritized Port Control option monitors I/O rate and transfer rate of the fibre ports or WWNs. The monitored data (I/O rate and transfer rate) is called the performance data, and it can be displayed in graphs. You can use the performance data to estimate the threshold and upper limit for the ports or WWNs, and optimize the total performance of the DKC.

- Prioritized Ports and WWNs

  The fibre ports or WWNs used on production servers are called prioritized ports or prioritized WWNs, respectively. Prioritized ports or WWNs can have threshold control set, but are not subject to upper limit control. Threshold control allows the maximum workload of the development server to be set according to the workload of the production server, rather than at an absolute level. To do this, the user specifies whether the current workload of the production server is high or low, so that the value of the threshold control is indexed accordingly.

- Non-Prioritized Ports and WWNs

  The fibre ports or WWNs used on development servers are called non-prioritized ports or prioritized WWNs, respectively. Non-prioritized ports or WWNs are subject to upper limit control, but not threshold control. Upper limit control makes it possible to set the I/O of the non-prioritized port or WWN within a range that does not affect the performance of the prioritized port or WWN.

12.2 Overview of Monitoring

- Monitoring Function

  Monitoring allows you to collect performance data, so that you can set optimum upper limit and threshold controls. When monitoring the ports, you can collect data on the maximum, minimum and average performance, and select either per port, all prioritized ports, or all non-prioritized ports. When monitoring the WWNs, you can collect data on the average performance only, and select either per WWN, all prioritized WWNs, or all non-prioritized WWNs.

  The performance data can be displayed in graph format either in the real time mode or offline mode. The real time mode displays the performance data of the currently active ports or WWNs. The data is refreshed in every minute, and you can view the varying data in real time. The offline mode displays the stored performance data. The data can be stored for up to one week, and can be displayed in increments ranging from five minutes, one hour, one day, or one week. A graph is plotted per unit of one minute regardless of the displayed scale (unit of grid).

- Monitoring and Graph Display Mode

  When you activate the Prioritized Port Control option, the Select Mode panel where you can select either **Port Real Time Mode**, **Port Offline Mode**, **WWN Real Time Mode**, or **WWN Offline Mode** opens. When you select one of the modes, monitoring starts automatically and continues unless you stop monitoring. However, data can be stored for up to one week. To stop the monitoring function, exit the Prioritized Port Control option, and when a message asking if you want to stop monitoring is displayed, select the **Yes** button.

  - The **Port/WWN Real Time Mode** is recommended if you want to monitor the port or WWN performance for a specific period of time (within 24 hours) of a day to check the performance in real time.
  - The **Port/WWN Offline Mode** is recommended if you want to collect certain amount of the port or WWN performance data (maximum of one week), and check the performance in non-real time.

To determine a preliminary upper limit and threshold, run the development server by using the performance data collected from the production server that was run beforehand and check the changes of performance of a prioritized port. If the performance of the prioritized port does not change, set a value by increasing an upper limit of the non-prioritized port. After that, recollect and analyze the performance data. Repeat these steps to determine the optimized upper limit and threshold. (See Figure 12-1.)

12.3 Procedure (Flow) of Prioritized Port Control

To perform the prioritized port control, determine the upper limit to the non-prioritized port by checking that the performance monitoring function does not affect production. Figure 12-1 shows the procedures for prioritized port control.

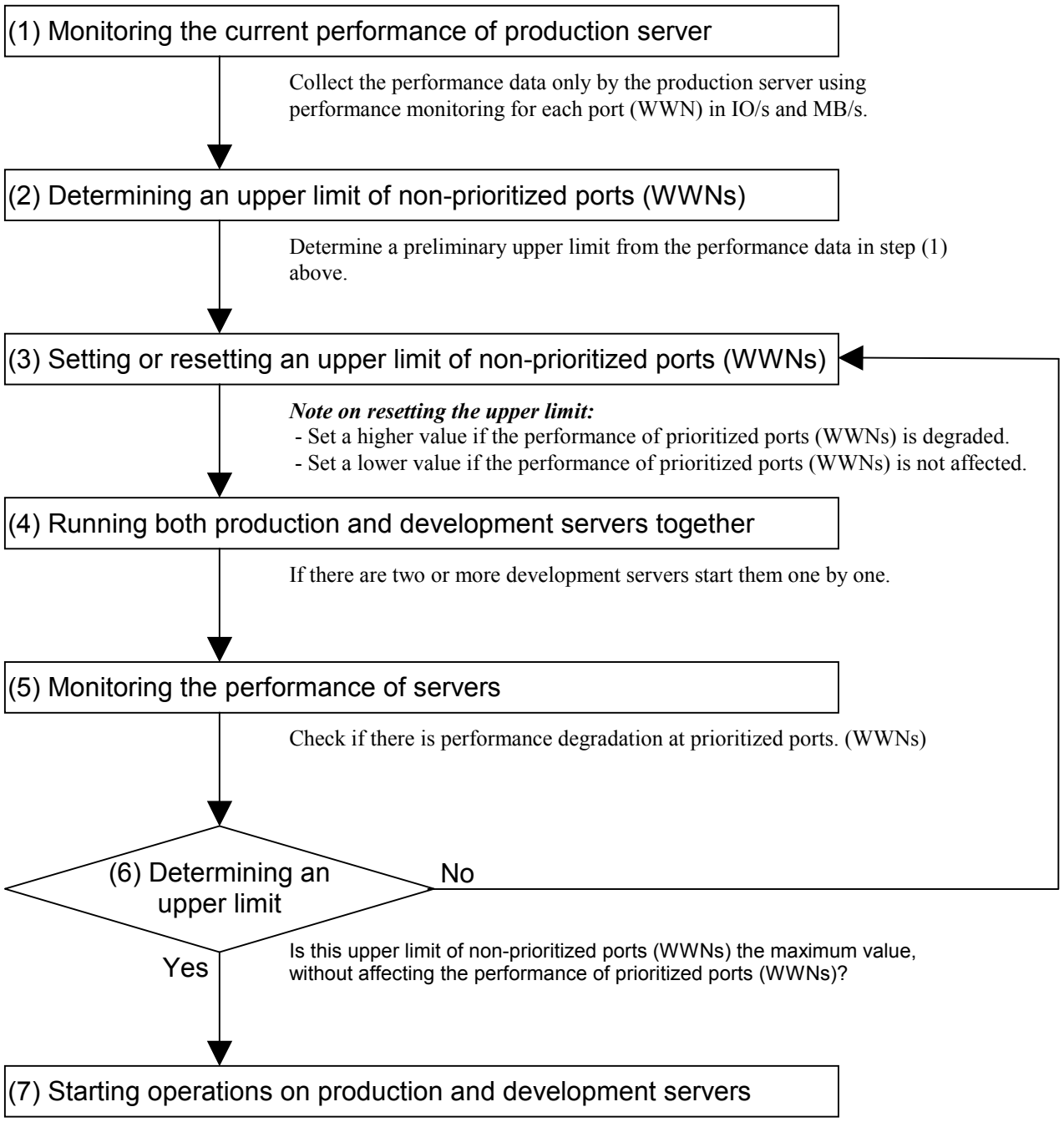


Figure 12-1 Flow of Prioritized Ports Control

13 Hi-speed microcode upgrade

13.1 Overview

By reducing offline time at online microprogram exchange, it is possible to perform microprogram exchange during executing an I/O operation of the host connected to the CHF. So, under system configuration without the alternate path function, it is possible to operate a microprogram exchange without stopping an I/O operation of the host connected to the CHF.

13.2 Conditions for hi-speed microcode upgrade

The following platform condition enables a microprogram exchange during executing an I/O operation of the host connected to the CHF without installing the alternate path function.
See "Supported platform on Hi-speed microcode upgrade" shown in Table 13-1.

Table 13-1 Supported platform on Hi-speed microcode upgrade

Platform	Host Adapter	Setup value of Host Adapter Queue-Depth	Microprogram Exchange Mode
HP-UX	HP A3740A/A3404A/A3591B	≤ 1024 per port AND = 8 per LU (default)	Stop SCSI host
Solaris	Jaycor FC64-1063/FCI-1063	≤ 256 per port AND ≤ 32 (default) per LU	Stop SCSI host
AIX	IBM 6227	≤ 256 per port AND ≤ 32 per LU	Stop SCSI host
Windows NT	Emulex LP7000E/LP8000	≤ 256 per port AND ≤ 32 per LU	Stop SCSI host
Windows 2000	Emulex LP8000	≤ 256 per port AND ≤ 32 per LU	Stop SCSI host

High-speed microcode upgrade is invalid on the AIX system via Switch.

On the system in which an alternate path software is installed, Hi-speed microcode upgrade causes a path fail over. Because the system detects the short offline period and alternates the I/O path from primary to secondary.
High-speed microcode upgrade is invalid on the system

When the subsystem is used as Boot Disk, it is necessary to stop host I/O even though performing High-speed microcode upgrade. Number of retry for Boot Disk is less than that for other LUNs.

Except for the above platform, an alternate path function must be correctly established or a microprogram exchange must be performed by stopping an I/O operation of the host connected to the CHF.
It is recommended that a microprogram exchange is performed to choose a period when host load is low.