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OPENPLATFORM SECTION

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1. GENERAL

1.1 Product Outline and Features

The open platform 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 an open platform or FIBRE system environment. This also provides the customers with a flexible and optimized system construction capability for their system expansion and migration.

1.1.1 FIBRE attachment option

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), 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).

DKC515 can be connected to open system via FIBRE interface by installing Fibre Adapter (DKC-F515I-16HS/32HS).
FIBRE connectivity is provided as channel option of DKC515.
FIBRE Adapter can be installed in any CHA location of DKC515 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 2 Gbps with use of FIBRE interface.
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 eight CHF pairs configuration.
These will provide more flexible use of the subsystem for open system environment.

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(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.

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(10) HORC (Hitachi Open Remote Copy) Support

HORC is a function to realize the duplication of open system data by connecting the two DKC515 subsystems or inside parts of a single DKC515 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.

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1.1.2 iSCSI channel option

Support version of iSCSI attachment option is 50-06-xx or later.

Some of major features of this iSCSI attachment option are listed below.

(1) In addition to the FIBRE interface, the iSCSI interface can be mounted as the controller. DKC515I can be connected to open system via iSCSI interface by installing iSCSI Adapter (DKC-F515I-8ISR). iSCSI connectivity are provided as channel option of DKC515I. iSCSI Adapter can be installed any CHA location of DKC515I and can be co-exist with any other channel adapters.

(2) Data transmission
Data can be read and written at a maximum speed of 100 M byte/s with use of iSCSI interface.

(3) iSCSI configuration
iSCSI configuration is allowed only for CHI with 1 pairs.
These will provide more flexible use of the subsystem for open system environment.

(4) HMDE (Hitachi Multiplatform Data Exchange) not supported
The HMDE optional feature is not supported in iSCSI attachment option.

(5) HORC (Hitachi Open Remote Copy)
Initiator Port and RCU Target Port are not supported in iSCSI attachment option.

(6) HUR (Hitachi Universal Replicator)
Initiator Port and RCU Target Port are not supported in iSCSI attachment option.

(7) UVM (Universal Volume Manager)
External Port is not supported in iSCSI attachment option.

(8) Open Ldev Guard not supported
The Open Ldev Guard feature is not supported in iSCSI attachment option.

About the function supported by the iSCSI attachment option, refer to OPEN02-140. (2.4 iSCSI Interface Function Specifications)

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1.2 Basic Specifications

The basic specifications of the FIBRE attachment are shown in Table 1.2-1.

Table 1.2-1 Basic specifications

Item		Specification
Host Channel	Max. # of Channels	48 (*1)
	Max. # of concurrent paths	48 (*1)
Data transfer		2 Gbps (Fibre)
RAID level		RAID6/RAID5/RAID1
RAID configuration		RAID5
		RAID1
HDD		72K1 (72G 15Krpm)
		146J1 (146G 10Krpm)
		146K1 (146G 15Krpm)
		300J1 (300G 10Krpm)
		300K1 (300G 15Krpm)
		400J1 (400G 10Krpm)
Cache capacity	minimum	4 G bytes
	maximum	128 G bytes (*2)
	additional unit	4 G bytes

*1: 32HS PCB.
*2: 1 G bytes DRAM.

The basic specifications of the iSCSI attachment are shown in Table 1.2-2.

Table 1.2-2 iSCSI attachment Basic specifications

Item		Specification
Host Channel	Max. # of Channels	8
	Max. # of concurrent paths	8
Data transfer		1.25 Gbps
RAID level		RAID6/RAID5/RAID1
RAID configuration		RAID5
		RAID1
HDD		72K1 (72G 15Krpm)
		146J1 (146G 10Krpm)
		146K1 (146G 15Krpm)
		300J1 (300G 10Krpm)
		300K1 (300G 15Krpm)
		400J1 (400G 10Krpm)
Cache capacity	minimum	4 G bytes
	maximum	128 G bytes (*1)
	additional unit	4 G bytes

*1: 1 G bytes DRAM.

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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) CHI
CHannel adapter for ISCSI. A hardware package to connect with iSCSI interface.

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

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

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

(8) DKU
DisK Unit. Disk drives units.

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

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

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

(12) HMBR
Hitachi Multiplatform Backup/Restore.

(13) HMDE
Hitachi Multiplatform Data Exchange.

(14) HMRS
Hitachi Multiplatform Resource Sharing.

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(15) HA configuration
High Availability configuration

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

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

(18) Logical unit number (LUN)
Identifier for a logical unit. LUN0-1024 can be assigned.

(19) 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.

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

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

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

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

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

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

(26) 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.

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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) 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.

There are some notices about iSCSI maintenance operations.

(1) Before LUN path configuration is changed, iSCSI I/O on the related iSCSI port must be stopped.
(2) Before iSCSI channel adapter or LDEV is de-installed, the related LUN path must be de-installed.
(3) Before iSCSI channel adapter is replaced, the related iSCSI I/O must be stopped.
(4) When the iSCSI I/F controller chip firmware is exchanged, before micro-program is changed, all iSCSI I/O on the DKC must be stopped.
(5) When you change the Port Parameters and the User Authentication of iSCSI Port, please operate from the Web Console. (Refer to WEB02-50, and ‘4.8.1 Configuring iSCSI Ports’ of LUN Manager User’s Guide)

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2. Interface Specification

2.1 FIBRE Physical Interface Specification

The physical interface specification supported for FIBRE is shown in Table 2.1-1 and Table 2.1-2.

Table 2.1-1 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	FC-AL
2	Data Transfer Rate	Optic fibre cable	2 Gbps	8HSR/16HS/32HS
			4 Gbps	32FSR/8FS2R/ 16FS2R/32FS2R
3	Cable Length	Optic single mode fibre	10km	Longwave laser (*)
		Optic multi mode fibre	500m	Shortwave laser
4	Connector Type		LC: 8HSR/16HS/32HS/ 32FSR/8FS2R/ 16FS2R/32FS2R	—
5	Topology		NL-Port (FC-AL) F-Port FL-Port	—
6	Service class		3	—
7	Protocol		FCP	—
8	Transfer code		8B/10B translate	—
9	# of hosts		1024/Path	—
10	# of host Group		255/Path	—
11	# of maximum LU		1024/Path	—
12	PORT/PCB	16 Port CHF	16 Port	—

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

Table 2.1-2 FC I/F support level

No.	Item	I/F type	DKC515 support level
1	Optic cable type	Optical Type (Longwave)	supported
2		Optical Type (Shortwave)	supported
3	Optic I/F	Non-OFC	supported

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Table 2.1-3 Port name of CHA side

Cluster	Port Name	Cluster	Port Name
CLS1 CHA Location	CL1-A	CLS2 CHA Location	CL2-A
	CL3-A		CL4-A
	CL5-A (*3)		CL6-A (*3)
	CL7-A (*3)		CL8-A (*3)
	CL1-B (*3)		CL2-B (*3)
	CL3-B (*3)		CL4-B (*3)
	CL5-B (*3)		CL6-B (*3)
	CL7-B (*3)		CL8-B (*3)
	CL1-E		CL2-E
	CL3-E (*2)		CL4-E (*2)
	CL5-E (*3)		CL6-E (*3)
	CL7-E (*2)(*3)		CL8-E (*2)(*3)
	CL1-F (*1)(*3)		CL2-F (*1)(*3)
	CL3-F (*1)(*3)		CL4-F (*1)(*3)
	CL5-F (*1)(*3)		CL6-F (*1)(*3)
	CL7-F (*1)(*3)		CL8-F (*1)(*3)
	CL1-G		CL2-G
	CL3-G (*2)		CL4-G (*2)
	CL5-G (*3)		CL6-G (*3)
	CL7-G (*2)(*3)		CL8-G (*2)(*3)
	CL1-H (*1)(*3)		CL2-H (*1)(*3)
	CL3-H (*1)(*3)		CL4-H (*1)(*3)
	CL5-H (*1)(*3)		CL6-H (*1)(*3)
	CL7-H (*1)(*3)		CL8-H (*1)(*3)

*1: The port location exists on 32HS/32FSR/32FS2R, but doesn't exist on 16HS/8ISR/16FS2R.

*2: The port location doesn't exist on 8ISR.

*3: The port location doesn't exist on 8HSR/8FS2R.

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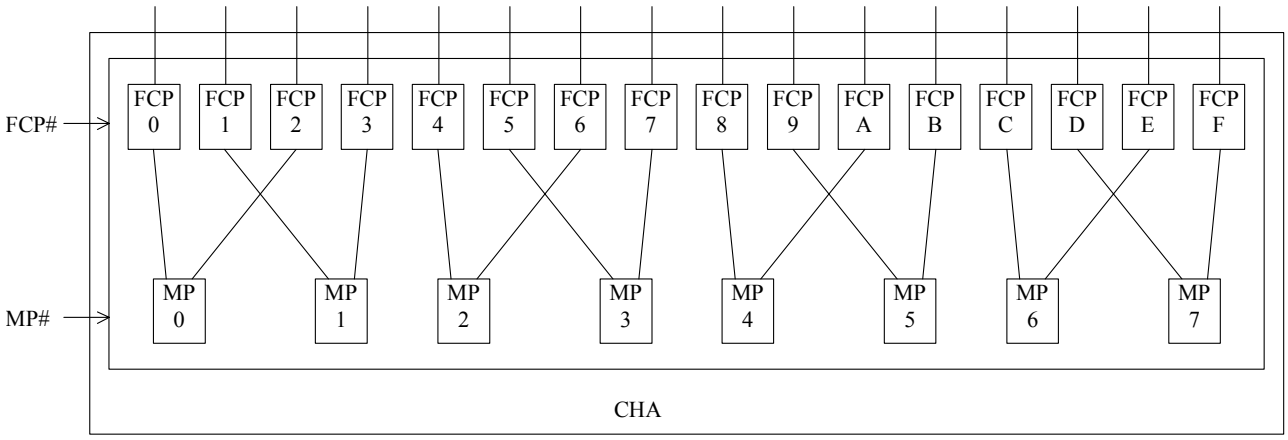

FCP# : x‘0’ to x‘F’ indicates the FCP number.
MP# : x‘0’ to x‘7’ indicates the MP number.

Fig. 2.1-1 CHA package configuration

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2.2 Specifications of Fibre Channel High Performance Mode

2.2.1 Standard Performance mode (SP mode)

In the 8/16-port CHF, one CHPs required for two ports.

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2.2.2 High Performance mode

To assign two CHPs to one port, a HUB is provided on the PCB and 2 fibre channel port are connected to one port.
The 32FSR/32FS2R/16FS2R/MIX4 PCB* does not support the mode written above.

*: The transfer rate is 4Gbps.

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2.2.3 Restrictions of High Performance mode

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

- It looks as if two 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 two targets.
- In the following cases, switching from the SP mode to the HP mode cannot be done.
  When the settings of the Loop ID (FC-AL) for the 1st* and 2nd* are duplicated.
  When the settings of the topology for the 1st* and 2nd* are different.
  When the settings of the topology for the 1st* and 2nd* are Point To Point.
  When the settings of the port-type for the 1st* and 2nd* are different.
  When the settings of the channel speed are different.

  (Eg.) At first you have to set both port's types same when 1st* is "Initiator Port", 2nd* port is "RCU Target Port".
  And then you can change the SP/HP mode.
- When the HORC path exists, the mode cannot be changed.
- When an I/O operation is being performed, the mode cannot be changed.

*: For the "1st" and "2nd" refer to Table 2.2.5-1 on page OPEN02-80.

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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.

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2.2.5 Indication format of port

Table 2.2.5-1 Indication Format of Port (CLS1 CHA Location)

	MIX2R (Standard)	16HS Fibre (Standard)	32HS Fibre (Standard)	High Performance Mode
CL1-A	1A	—	—	1A
CL3-A	3A	—	—	3A (1A-2nd)
CL5-A	5A	—	—	5A
CL7-A	7A	—	—	7A (5A-2nd)
CL1-B	1B	—	—	1B
CL3-B	3B	—	—	3B (1B-2nd)
CL5-B	5B	—	—	5B
CL7-B	7B	—	—	7B (5B-2nd)
CL1-A	—	—	—	— —
CL3-A	—	—	—	— —
CL5-A	—	—	—	— —
CL7-A	—	—	—	— —
CL1-B	—	—	—	— —
CL3-B	—	—	—	— —
CL5-B	—	—	—	— —
CL7-B	—	—	—	— —
CL1-E	—	1E	1E	1E
CL3-E	—	3E	3E	3E (1E-2nd)
CL5-E	—	5E	5E	5E
CL7-E	—	7E	7E	7E (5E-2nd)
CL1-F	—	—	1F	1F
CL3-F	—	—	3F	3F (1F-2nd)
CL5-F	—	—	5F	5F
CL7-F	—	—	7F	7F (5F-2nd)
CL1-G	—	1G	1G	1G
CL3-G	—	3G	3G	3G (1G-2nd)
CL5-G	—	5G	5G	5G
CL7-G	—	7G	7G	7G (5G-2nd)
CL1-H	—	—	1H	1H
CL3-H	—	—	3H	3H (1H-2nd)
CL5-H	—	—	5H	5H
CL7-H	—	—	7H	7H (5H-2nd)

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Table 2.2.5-2 Indication Format of Port (CLS2 CHA Location)

	MIX2R (Standard)	16HS Fibre (Standard)	32HS Fibre (Standard)	High Performance Mode
CL2-A	2A	—	—	2A
CL4-A	4A	—	—	4A (2A-2nd)
CL6-A	6A	—	—	6A
CL8-A	8A	—	—	8A (6A-2nd)
CL2-B	2B	—	—	2B
CL4-B	4B	—	—	4B (2B-2nd)
CL6-B	6B	—	—	6B
CL8-B	8B	—	—	8B (6B-2nd)
CL2-C	—	—	—	— —
CL4-C	—	—	—	— —
CL6-C	—	—	—	— —
CL8-C	—	—	—	— —
CL2-D	—	—	—	— —
CL4-D	—	—	—	— —
CL6-D	—	—	—	— —
CL8-D	—	—	—	— —
CL2-E	—	2E	2E	2E
CL4-E	—	4E	4E	4E (2E-2nd)
CL6-E	—	6E	6E	6E
CL8-E	—	8E	8E	8E (6E-2nd)
CL2-F	—	—	2F	2F
CL4-F	—	—	4F	4F (2F-2nd)
CL6-F	—	—	6F	6F
CL8-F	—	—	8F	8F (6F-2nd)
CL2-G	—	2G	2G	2G
CL4-G	—	4G	4G	4G (2G-2nd)
CL6-G	—	6G	6G	6G
CL8-G	—	8G	8G	8G (6G-2nd)
CL2-H	—	—	2H	2H
CL4-H	—	—	4H	4H (2H-2nd)
CL6-H	—	—	6H	6H
CL8-H	—	—	8H	8H (6H-2nd)

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Table 2.2.5-3 Indication format of port

Cluster1 Location	MIX2R (Standard)	8ISR iSCSI	Cluster2 Location	MIX2R (Standard)	8ISR iSCSI
CL1-A	1A	—	CL2-A	2A	—
CL3-A	3A	—	CL4-A	4A	—
CL5-A	5A	—	CL6-A	6A	—
CL7-A	7A	—	CL8-A	8A	—
CL1-B	1B	—	CL2-B	2B	—
CL3-B	3B	—	CL4-B	4B	—
CL5-B	5B	—	CL6-B	6B	—
CL7-B	7B	—	CL8-B	8B	—
CL1-E	—	1E	CL2-E	—	2E
CL3-E	—	—	CL4-E	—	—
CL5-E	—	5E	CL6-E	—	6E
CL7-E	—	—	CL8-E	—	—
CL1-F	—	—	CL2-F	—	—
CL3-F	—	—	CL4-F	—	—
CL5-F	—	—	CL6-F	—	—
CL7-F	—	—	CL8-F	—	—
CL1-G	—	1G	CL2-G	—	2G
CL3-G	—	—	CL4-G	—	—
CL5-G	—	5G	CL6-G	—	6G
CL7-G	—	—	CL8-G	—	—
CL1-H	—	—	CL2-H	—	—
CL3-H	—	—	CL4-H	—	—
CL5-H	—	—	CL6-H	—	—
CL7-H	—	—	CL8-H	—	—

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2.3 iSCSI Physical Interface Specification

The physical interface specification supported for iSCSI is shown in Table 2.3-1 and Table 2.3-2.

Table 2.3-1 iSCSI Physical specification

No.	Item		Specification	Remark
1	Host interface	Physical interface	Ethernet	
		Logical interface	TCP/IP	
2	Data Transfer Rate	Optic fibre cable	100 M byte/s	
3	Cable Length	Optic multi mode fibre	500m	Shortwave laser
4	Connector Type		LC	—
5	# of hosts		64/Path	—
6	# of maximum LU		1024/Path	—
7	PORT/PCB	4 Port CHI	4 Port	—

Table 2.3-2 iSCSI I/F support level

No.	Item	I/F type	DKC515I support level
1	Optic cable type	Optical Type (Longwave)	not 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

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Table 2.3-3 Indication format of port

	Port Name	8ISR iSCSI		Port Name	8ISR iSCSI
Cluster1	CL1-A	1A	Cluster2	CL2-A	2A
Location	CL5-A	5A	Location	CL6-A	6A
	CL1-C	1C		CL2-C	2C
	CL5-C	5C		CL6-C	6C
	CL1-E	1E		CL2-E	2E
	CL5-E	5E		CL6-E	6E
	CL1-G	1G		CL2-G	2G
	CL5-G	5G		CL6-G	6G
	CL1-J	1J		CL2-J	2J
	CL5-J	5J		CL6-J	6J
	CL1-L	1L		CL2-L	2L
	CL5-L	5L		CL6-L	6L
	CL1-N	1N		CL2-N	2N
	CL5-N	5N		CL6-N	6N
	CL1-Q	1Q		CL2-Q	2Q
	CL5-Q	5Q		CL6-Q	6Q
	CL9-A	9A		CLA-A	AA
	CLD-A	DA		CLE-A	EA
	CL9-C	9C		CLA-C	AC
	CLD-C	DC		CLE-C	EC
	CL9-E	9E		CLA-E	AE
	CLD-E	DE		CLE-E	EE
	CL9-G	9G		CLA-G	AG
	CLD-G	DG		CLE-G	EG
	CL9-J	9J		CLA-J	AJ
	CLD-J	DJ		CLE-J	EJ
	CL9-L	9L		CLA-L	AL
	CLD-L	DL		CLE-L	EL
	CL9-N	9N		CLA-N	AN
	CLD-N	DN		CLE-N	EN
	CL9-Q	9Q		CLA-Q	AQ
	CLD-Q	DQ		CLE-Q	EQ

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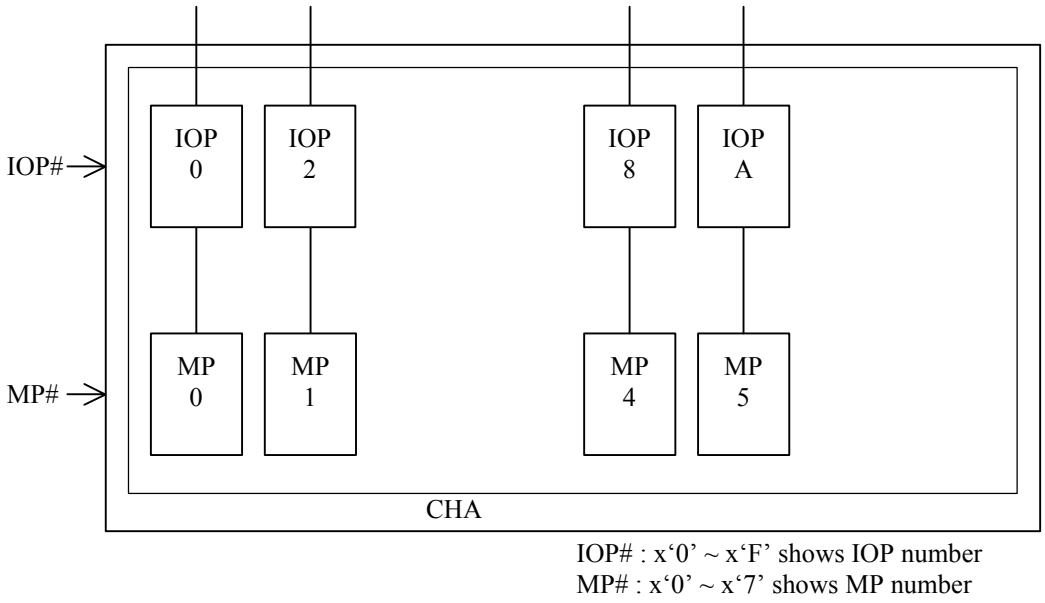

Fig. 2.3-1 CHA PCB composition

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2.4 iSCSI Interface Function Specifications

2.4.1 Physical Specification

Table 2.4.1-1 Physical Specification

No.	Item		Specification	
			USP	NSC
1	Host interface	Physical interface	Ethernet	
		Logical interface	TCP/IP	
2	Data Transfer Rate	Optic fibre cable	100 M bytes/sec (1.25Gbps)	
3	Cable Length	Optic multi mode fibre	500m Shortwave laser	
4	Connector Type		LC	
5	# of host connection (# of iSCSI Target)		64/Path (64/Port)	
6	# of maximum LU		1024/Path	
7	PORT/PCB	4 Port CHI	4 Port	
8	Channel	Max. # of Channels	48	8

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2.4.2 Network Specification

Table 2.4.2-1 Network Specification

#	Item	Support	Remarks
1	IPv4	○	
2	IPv6	×	
3	IPsec	×	
4	DHCP	×	
5	DNS	×	
6	Jumbo frame	×	
7	Ping RX/TX	○	
8	Link Aggregation	×	
9	Tag-VLAN	×	

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2.4.3 iSCSI Protocol Specification

Table 2.4.3-1 iSCSI Protocol Specification

#	Item	Support	Remarks
1	iSCSI Name (iqn 223 characters / eui)	○	Default : iqn
2	Send Target connection	○	
3	CHAP Authentication (One-way / Mutual)	○	
4	CHAP Authentication with RADIUS	×	
5	Header digest / Data digest	○	
6	Keep alive timer	○	
7	iSNS client	○	

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2.4.4 Function Specification

Table 2.4.4-1 Function Specification

#	Item	Support	Remarks
1	LUN Manager	○	LUN Security uses Host iSCSI Name.
2	LUN Expansion	○	
3	Cache Residency	○	
4	Performance management	○	The LDEV usage rate is supported. iSCSI port usage rate is unsupported.
5	True Copy (Sync/Async)	○	Copy path used are Fibre link.
6	Universal Replicator	○	Copy path used are Fibre link.
7	Shadow Image	○	
8	CoW Snapshot	○	
9	Serverless Backup	×	
10	Data Retention	×	
11	Database Validator	×	
12	Universal Volume Manager	○	External path used are Fibre link.
13	Rapid Exchange	×	
14	Virtual Partition Manager	○	
15	Configuration File Loader	×	

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2.4.5 Maintenance Specification

Table 2.4.5-1 Maintenance Specification

#	Item	Support	Remarks
1	Non-stop SCSI MICRO-FC	○	If the iSCSI controller firmware is upgraded, all iSCSI ports will operate in Stop SCSI mode. *

*: See MICRO-FC Section (MICRO-FC10-30).

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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.

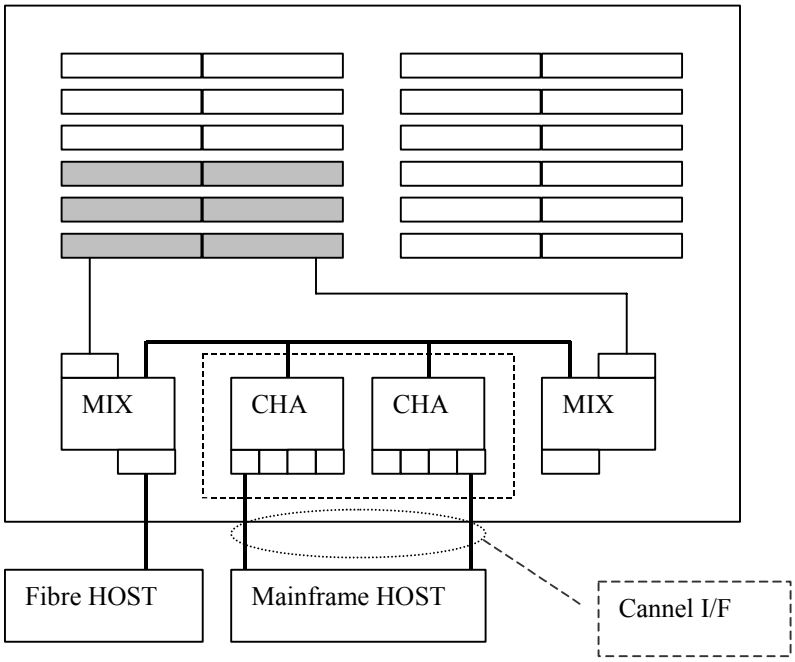

Fig. 3.1.1-1 multiplatform configuration example

MIX is the combination of the CHF port and the DKF of the four ports.

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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.

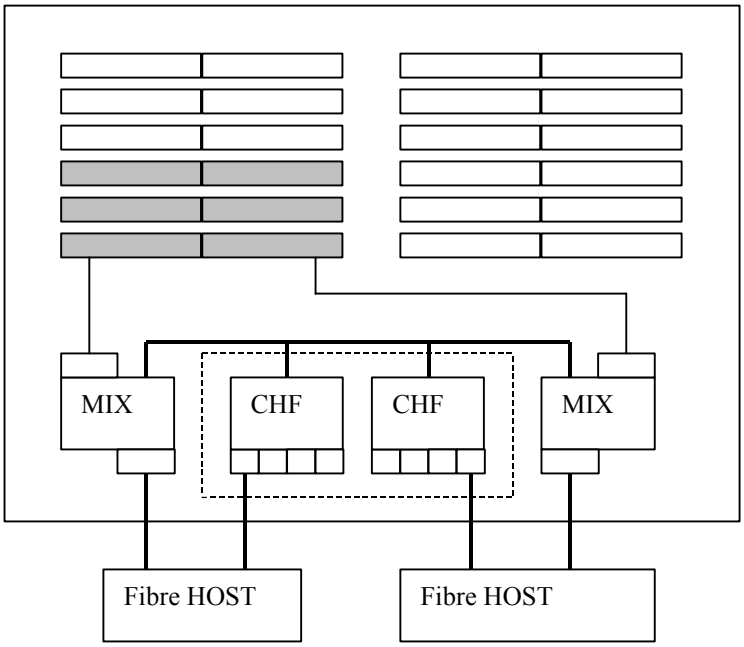

Fig. 3.1.2-1 Maximum system configuration example for All FIBRE

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3.1.3 Example of the open system configuration (Fibre/iSCSI mix)

The DKC can construct the Fibre/iSCSI mix configuration when the CHI is installed. The example of the Fibre/iSCSI mix configuration is shown.

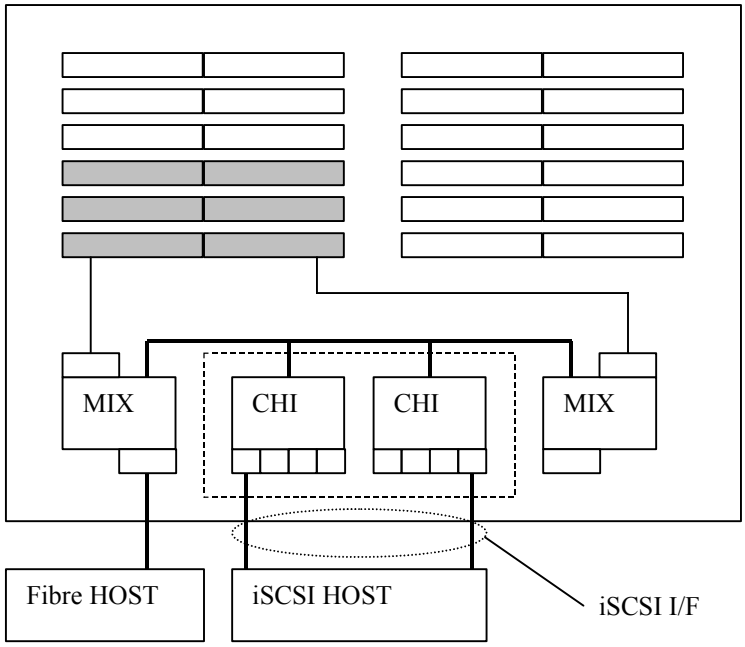

Fig. 3.1.3-1 The example of the open system configuration (Fibre/iSCSI mix)

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3.2 Channel Configuration

The channel adapter (CHF or CHI) PCBs must be used in sets of two.
It is any one set of the CHF and the CHI which can be installed in the DKC.
Examples of channel configurations are shown in Table 3.2-1.

Table 3.2-1 Example of available channel configuration

No.	Basic	Addition 1	Remark
1	MIX	—	Minimum FIBRE
2	MIX	CHF	Maximum FIBRE
3	MIX	CHI	Maximum iSCSI

CHF:FIBRE adapter, MIX:FIBRE/DKF MIX adapter, —:empty
CHI:iSCSI adapter

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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 that can be assigned to one port is 1024.

The addressing configuration is shown in the Fig. 3.3.3-1.

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3.3.1 Number of Hosts

For Fibre channel, the number of connectable hosts is limited to 256 per Fibre port.
For MCU port of Fibre Remote Copy function, this limitation is as follows:
The number of MCU connections is limited to 16 per RCU Target port.
For iSCSI channel, the number of connectable hosts is limited to 64 per iSCSI port.

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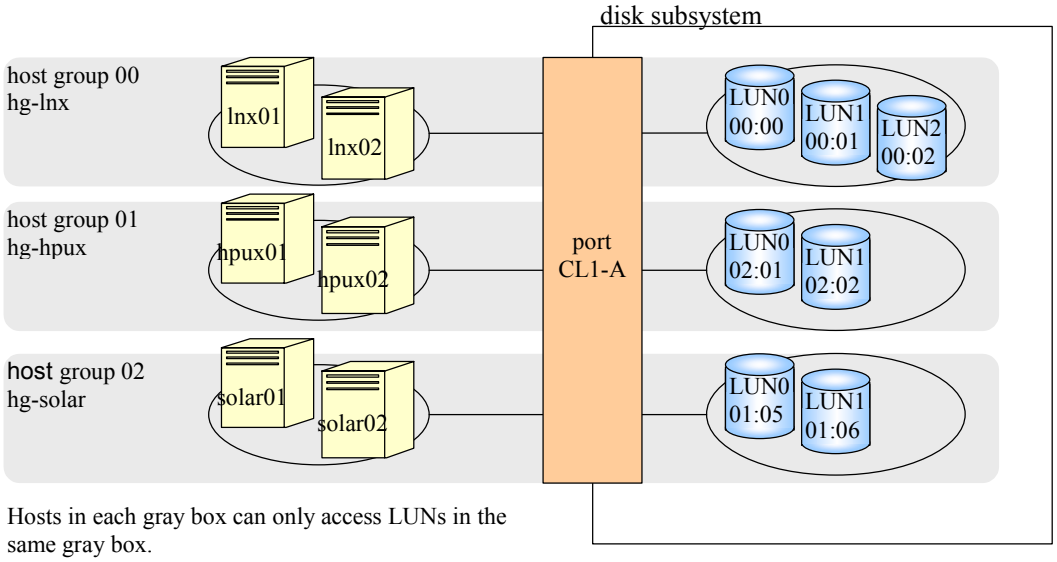
3.3.2 Number of Host Groups

You can define a host group admitted access for the some LU by LUN Security as a Host Group. For example, the two hosts in the hg-lnx group can only access the three LUs (00:00, 00:01, and 00:02). The two hosts in the hg-hpux group can only access the two LUs (02:01 and 02:02). The two hosts in the hg-solar group can only access the two LUs (01:05 and 01:06).



Hosts in each gray box can only access LUNs in the same gray box.

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3.3.3 LUN (Logical Unit Number)

LUNs can be assigned from 0 to 1023 to each FIBRE/iSCSI Port.

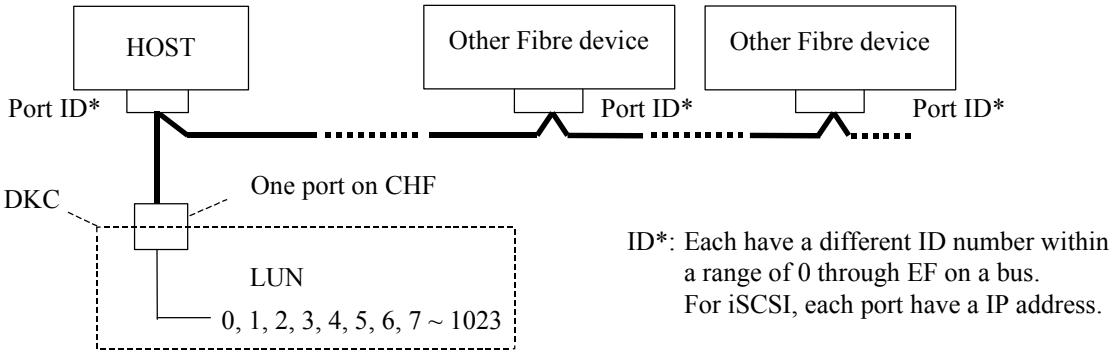

Fig. 3.3.3-1 FIBRE addressing configuration from Host

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3.3.4 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”.

For iSCSI, an IP address can be set as PORT INFORMATION.

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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 3.4.1-1.

Table 3.4.1-1 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	G byte (10^9)	2.4 GB	7.3 GB	7.3 GB	14.5 GB
	(LU) size	G byte ($1,024^3$)	2.29 GB	6.84 GB	6.87 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 3.4.1-1 LU specification (2/4)

No	Item		Specification				
1	Volume name		OPEN-L	OPEN-V (Note1)	3390-3A	3390-3B	3390-3C
2	Volume attribute		- SCSI volume	- 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	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	G byte (10^9)	36.4 GB	(Note1)	—	—	—
	(LU) size	G byte ($1,024^3$)	33.94 GB	(Note1)	—	—	—
5	Block size		512 Bytes	512 Bytes	512 Bytes	512 Bytes	512 Bytes
6	# of blocks		71,192,160	(Note 1)	5,825,520	5,822,040	5,825,520
7	LDEV emulation name		OPEN-L	OPEN-V	3390-3A	3390-3B	3390-3C
8	LDEV size : LU size		1 : 1	1 : 1	1 : 1	1 : 1	1 : 1

Note1: OPEN-V is CVS basis. The default capacity of OPEN-V is nearly equals to the size of the parity group. So it depends on RAID level and DKU (HDD).
The capacity is limited by 2.812TB (1024^4), 3.019TB (10^{12}) or 6039,797,248 blocks logically.

Note2: "0" is added to the emulation type of the V-VOLs (ex. OPEN-0V).
When you create a Copy-on-Write Snapshot pair, specify the volume whose emulation type is displayed with "0" like OPEN-0V as the S-VOL.

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Table 3.4.1-1 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 3.4.1-1 LU specification (4/4)

No	Item		Specification	
1	Volume name		OPEN-L×n (n=2 to 36)	OPEN-V×n (Note2) (n=2 to 36)
2	Volume attribute		- LU size expansion	- LU size expansion
3	Access right	FIBRE host	Read/Write	Read/Write
		M/F host	—	—
4	Logical Unit (LU) size	G byte (10^9)	OPEN-L×n	OPEN-V×n
		G byte ($1,024^3$)		
5	Block size		512 Bytes	512 Bytes
6	# of blocks		71,192,160×n	(Note2)
7	LDEV emulation name		—	—
8	LDEV size : LU size		1 : n	1 : n

Note2: The maximum size of OPEN-V×n is up to 60TB (1024^4) or 128,849,011,200 blocks.

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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.

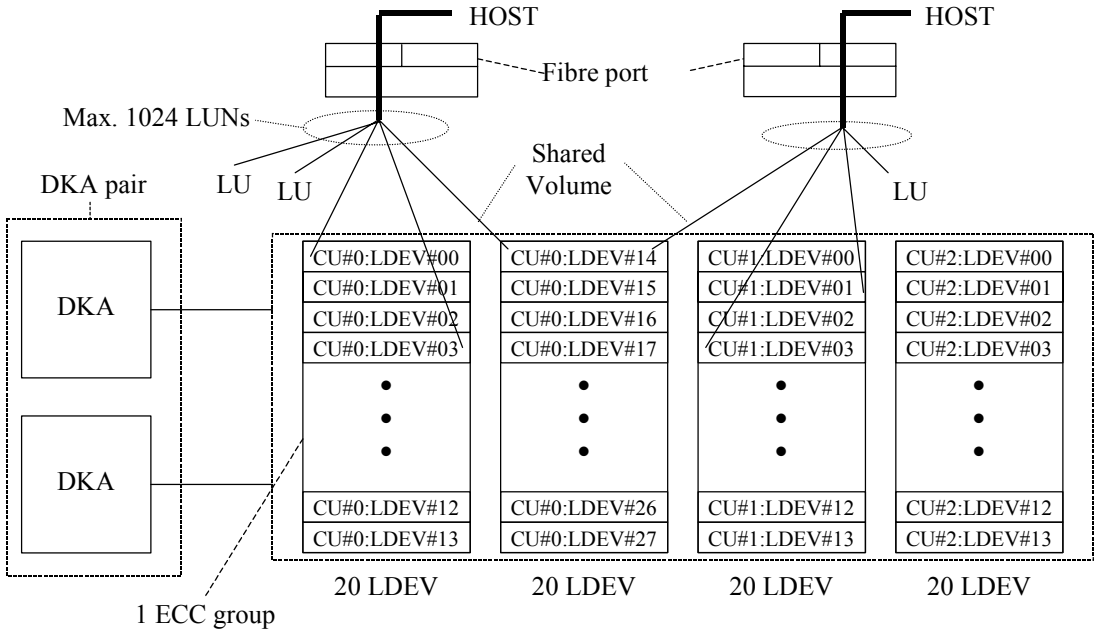

Fig. 3.4.2-1 LDEV and LU mapping for FIBRE volume

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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.

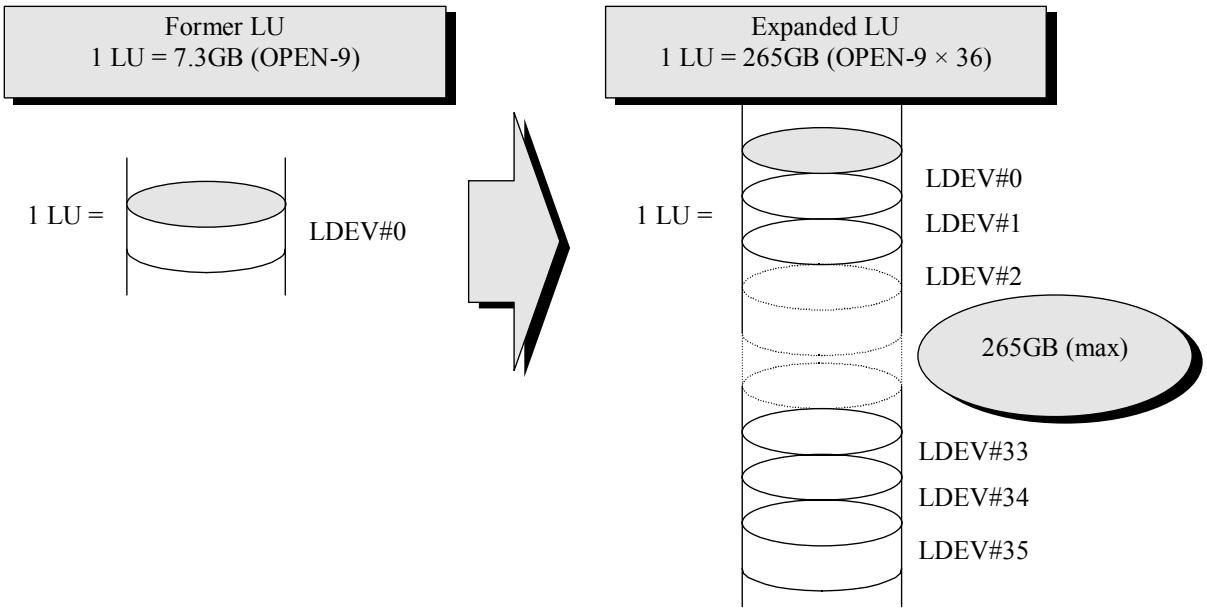

Fig. 3.4.3-1 Example of LU Size Expansion

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(2) Specifications

Table 3.4.3-1 shows specifications for the LU Size expansion. (1 KB = 1024 Byte)

Table 3.4.3-1 LU Size Expansion Specification(1/2)

Base volume	OPEN-3	OPEN-8	OPEN-9	OPEN-E	OPEN-L	OPEN-V (Note1)
LDEV Capacity	2.3 G byte	6.8 G byte	6.9 G byte	13.5 G byte	33.9 G byte	46.0 M byte ~ 2.8 T byte
Number of connectable LDEVs/LU	2 to 36					
LU Capacity	(2.3 G byte + 35 M byte) to 82.5 G byte	(6.8 G byte + 35 M byte) to 246.4 G byte	(6.9 G byte + 35 M byte) to 247.6 G byte	(13.5 G byte + 35 M byte) to 488.4 G byte	67.9 G byte to 1222.1 G byte	92.0 M byte to 60 T byte
Product name for responding to INQUIRY	OPEN-3×n	OPEN-8×n	OPEN-9×n	OPEN-E×n	OPEN-L×n	OPEN-V×n

Table 3.4.3-1 LU Size Expansion Specification(2/2)

Base volume	OPEN-3-CVS	OPEN-8-CVS	OPEN-9-CVS	OPEN-E-CVS
LDEV Capacity	35 M byte to 2.3 G byte	35 M byte to 6.8 G byte	35 M byte to 6.9 G byte	35 M byte to 13.5 G byte
Number of connectable LDEVs/LU	2 to 36			
LU Capacity	70 M byte to 82.5 G byte	70 M byte to 246.4 G byte	70 M byte to 247.6 G byte	70 M byte to 488.4 G byte
Product name for responding to INQUIRY	OPEN-3×n-CVS	OPEN-8×n-CVS	OPEN-9×n-CVS	OPEN-E×n-CVS

n: Number of connected LDEVs

Note1: OPEN-V is the volume of CVS basis.

Note2: LDEVs can be connected with different CU number and capacity though OPEN-L does not have CVS Volume type.

Note3: “0” is added to the emulation type of the V-VOLs (ex. OPEN-0V).
When you create a Copy-on-Write Snapshot pair, specify the volume whose emulation type is displayed with “0” like OPEN-0V as the S-VOL.

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(3) Effects and restrictions of LU expanding function

(a) Effects

- Restrictions of usable capacity owing to the number of the usable hosts is released.
  -Restriction of the host capacity
  -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.

(b) 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.

(a) 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.

(b) 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.

(c) 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.

(d) 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.

(e) 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.

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3.4.4 LUN Security

(1) Outline

This function connects various kinds of servers into a segregated, secure environment via the switch in the fibre channel port or iSCSI port, and thus enables the storage and the server to be used in the SAN environment.

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

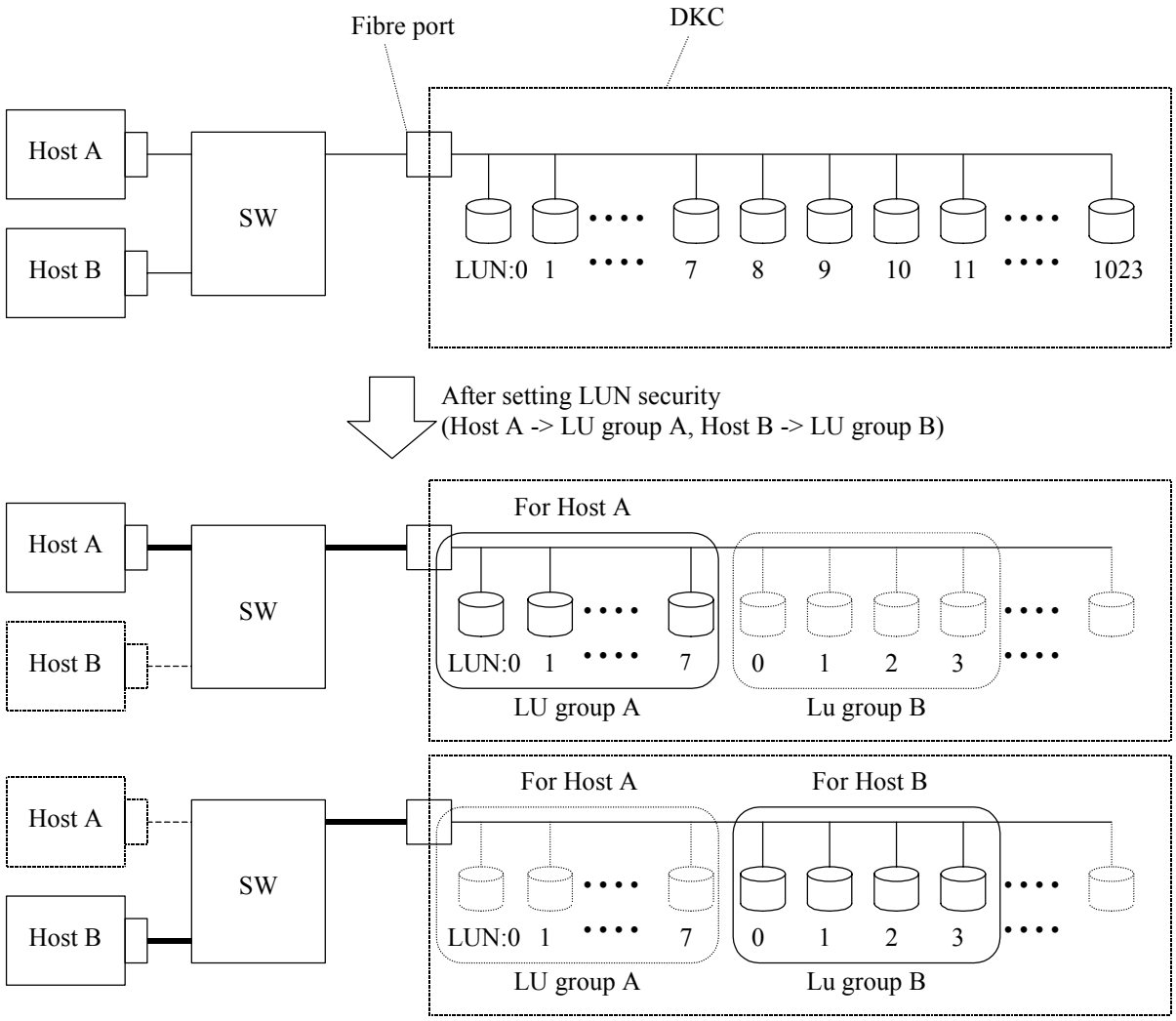

Fig. 3.4.4-1 LUN Security

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3.5 Volume Specification

3.5.1 Volume Specification

The open volume specification is summarized in Table 3.5.1-1.

Table 3.5.1-1 List of RAID500 Model number

Model Number	Disk drive model	RAID Level
DKU-F505I-72KS/KSR	DKS2C-K72FC	RAID5 (3D+1P, 7D+1P)
	DKS2D-K72FC	/RAID1 (2D+2D)
	DKS2E-K72FC	/RAID6 (6D+2P)
	DKS2F-K72FD	
	DKS2G-K72FD	
	DKR2F-K72FC	
	DKR2G-K72FC	
	DKR2J-K72FD	
DKU-F505I-146JS/146JSR	DKR2E-J146FC	
	DKR2F-J146FC	
	DKR2G-J146FC	
	DKR2J-J146FD	
	DKS2D-J146FC	
	DKS2E-J146FC	
	DKS2G-J146FD	
DKU-F505I-146KSR	DKS2D-K146FC	
	DKS2E-K146FC	
	DKS2F-K146FC	
	DKS2G-K146FD	
	DKR2F-K146FC	
	DKR2G-K146FC	
	DKR2J-K146FD	
DKU-F505I-72JSR	DKR2F-J72FD	
	DKR2G-J72FD	
	DKR2J-J72FD	
DKU-F505I-300JSR	DKR2F-J300FC	
	DKR2G-J300FC	
	DKR2J-J300FC	
	DKS2D-J300FC	
	DKS2E-J300FC	
	DKS2G-J300FC	
DKU-F505I-300KSR	DKS2E-K300FC	
	DKS2F-K300FC	
	DKS2G-K300FC	
	DKR2G-K300FC	
	DKR2H-K300FC	
	DKR2J-K300FC	
DKU-F505I-400JSR	DKS2E-J400FC	
	DKS2G-J400FC	

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Note: As for RAID1, the concatenation of two parity groups is possible (8HDDs).
In this case the number of volumes required is doubled.
Two concatenation and four concatenation (16HDDs and 32HDDs) of the RAID Groups are possible for RAID5 (7D+1P).
In this case, the number of volumes becomes twice or four times.
When OPEN-V is set in the parity group of the above-mentioned connection configuration, the maximum volume size becomes the parity cycle size of the source (2D+2D) or (7D+1P). It does not become twice or four times.

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Table 3.5.1-2 List of RAID500 Model Emulation Types for RAID5(3D+1P) (1/2)

Emulation Type	DKC		—					
	DKU		OPEN-3	OPEN-8	OPEN-9	OPEN-E	OPEN-L	OPEN-V
Storage capacity (GB/volume)			2.461	7.347	7.384	14.567	36.450	(*1)
Number of volumes/ parity groups	DKU-F505I-400JSR		250	160	159	81	32	1
	DKU-F505I-300JSR/ 300KSR		250	117	116	59	23	1
	DKU-F505I-146JS/ 146JSR/146KSR		174	58	58	29	11	1
	DKU-F505I-72KS/72KSR		86	29	28	14	5	1
	DKU-F505I-72JSR		88	29	29	15	6	1
Maximum number of parity groups	DKU-F505I-400JSR		59	59	59	59	59	59
	DKU-F505I-300JSR/ 300KSR		59	59	59	59	59	59
	DKU-F505I-146JS/ 146JSR/146KSR		59	59	59	59	59	59
	DKU-F505I-72KS/72KSR		59	59	59	59	59	59
	DKU-F505I-72JSR		59	59	59	59	59	59
Maximum number of volumes	DKU-F505I-400JSR		14750	9440	9381	4779	1888	59
	DKU-F505I-300JSR/ 300KSR		14750	6903	6844	3481	1357	59
	DKU-F505I-146JS/ 146JSR/146KSR		10266	3422	3422	1711	649	59
	DKU-F505I-72KS/72KSR		5074	1711	1652	826	295	59
	DKU-F505I-72JSR		5192	1711	1711	885	354	59
Subsystem capacity (user area) (GB)	DKU-F505I-400JSR	Min	615	1176	1174	1180	1166	1182
		Max	36300	69356	69269	69616	68818	69709
	DKU-F505I-300JSR/ 300KSR	Min	615	860	857	859	838	865
		Max	36300	50716	50536	50708	49463	51006
	DKU-F505I-146JS/ 146JSR/146KSR	Min	428	426	428	422	401	431
		Max	25265	25141	25268	24924	23656	25441
	DKU-F505I-72KS/ 72KSR	Min	212	213	207	204	182	214
		Max	12487	12571	12198	12032	10753	12650
	DKU-F505I-72JSR	Min	217	213	214	219	219	219
		Max	12778	12571	12634	12892	12903	12903

*1: The value of OPEN-V is the default one in the installation of parity group. In case of OPEN-V, storage capacity differs depending on RAID level and DKU(HDD) type because OPEN-V is CVS basis. The default volume size is nearly equal to that of a parity group.

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Table 3.5.1-2 List of RAID500 Model Emulation Types for RAID5(3D+1P) (2/2)

Emulation Type	DKC		—			
	DKU		3390-9A/9B/9C	3390-3A/3B/3C	3390-LA/LB/LC	3390-MA/MB/MC
Storage capacity (GB/volume)			8.924 (8.510) (*2)	2.975 (2.838) (*2)	29.185 (27.800) (*2)	58.370 (55.589) (*2)
Number of volumes/ parity groups	DKU-F505I-400JSR		132	250	40	20
	DKU-F505I-300JSR/ 300KSR		96	250	29	14
	DKU-F505I-146JS/ 146JSR/146KSR		48	144	14	7
	DKU-F505I-72KS/72KSR		23	71	7	3
	DKU-F505I-72JSR		24	73	7	3
Maximum number of parity groups	DKU-F505I-400JSR		59	59	59	59
	DKU-F505I-300JSR/ 300KSR		59	59	59	59
	DKU-F505I-146JS/ 146JSR/146KSR		59	59	59	59
	DKU-F505I-72KS/72KSR		59	59	59	59
	DKU-F505I-72JSR		59	59	59	59
Maximum number of volumes	DKU-F505I-400JSR		7788	14750	2360	1180
	DKU-F505I-300JSR/ 300KSR		5664	14750	1711	826
	DKU-F505I-146JS/ 146JSR/146KSR		2832	8496	826	413
	DKU-F505I-72KS/72KSR		1357	4189	413	177
	DKU-F505I-72JSR		1416	4307	413	177
Subsystem capacity (user area) (GB)	DKU-F505I-400JSR	Min	1178	744	1167	1167
		Max	69500	43881	68877	68877
	DKU-F505I-300JSR/ 300KSR	Min	857	744	846	817
		Max	50546	43881	49936	48214
	DKU-F505I-146JS/ 146JSR/146KSR	Min	428	428	409	409
		Max	25273	25276	24107	24107
	DKU-F505I-72KS/72KSR	Min	205	211	204	175
		Max	12110	12462	12053	10331
	DKU-F505I-72JSR	Min	214	217	204	175
		Max	12636	12813	12053	10331

*2: The value in parenthesis is the capacity for Main Frame Host.

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Table 3.5.1-3 List of RAID500 Model Emulation Types for RAID5(7D+1P) (1/2)

Emulation Type	DKC		—					
	DKU		OPEN-3	OPEN-8	OPEN-9	OPEN-E	OPEN-L	OPEN-V
Storage capacity (GB/volume)			2.461	7.347	7.384	14.567	36.450	(*1)
Number of volumes/ parity groups	DKU-F505I-400JSR		500	374	372	189	75	1
	DKU-F505I-300JSR/ 300KSR		500	273	272	138	55	1
	DKU-F505I-146JS/ 146JSR/146KSR		407	136	135	69	27	1
	DKU-F505I-72KS/72KSR		202	67	67	34	13	1
	DKU-F505I-72JSR		206	69	68	35	14	1
Maximum number of parity groups	DKU-F505I-400JSR		28	28	28	28	28	28
	DKU-F505I-300JSR/ 300KSR		28	28	28	28	28	28
	DKU-F505I-146JS/ 146JSR/146KSR		28	28	28	28	28	28
	DKU-F505I-72KS/72KSR		28	28	28	28	28	28
	DKU-F505I-72JSR		28	28	28	28	28	28
Maximum number of volumes	DKU-F505I-400JSR		14000	10472	10416	5292	2100	28
	DKU-F505I-300JSR/ 300KSR		14000	7644	7616	3864	1540	28
	DKU-F505I-146JS/ 146JSR/146KSR		11396	3808	3780	1932	756	28
	DKU-F505I-72KS/72KSR		5656	1876	1876	952	364	28
	DKU-F505I-72JSR		5768	1932	1904	980	392	28
Subsystem capacity (user area) (GB)	DKU-F505I-400JSR	Min	1231	2748	2747	2753	2734	2757
		Max	34454	76938	76912	77089	76545	77193
	DKU-F505I-300JSR/ 300KSR	Min	1231	2006	2008	2010	2005	2017
		Max	34454	56160	56237	56287	56133	56484
	DKU-F505I-146JS/ 146JSR/146KSR	Min	1002	999	997	1005	984	1006
		Max	28046	27977	27912	28143	27556	28176
	DKU-F505I-72KS/ 72KSR	Min	497	492	495	495	474	500
		Max	13919	13783	13852	13868	13268	14011
	DKU-F505I-72JSR	Min	507	507	502	510	510	510
		Max	14195	14194	14059	14276	14288	14288

*1: The value of OPEN-V is the default one in the installation of parity group. In case of OPEN-V, storage capacity differs depending on RAID level and DKU(HDD) type because OPEN-V is CVS basis. The default volume size is nearly equal to that of a parity group.

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Table 3.5.1-3 List of RAID500 Model Emulation Types for RAID5(7D+1P) (2/2)

Emulation Type	DKC		—			
	DKU		3390-9A/9B/9C	3390-3A/3B/3C	3390-LA/LB/LC	3390-MA/MB/MC
Storage capacity (GB/volume)			8.924 (8.510) (*2)	2.975 (2.838) (*2)	29.185 (27.800) (*2)	58.370 (55.589) (*2)
Number of volumes/ parity groups	DKU-F505I-400JSR		308	500	94	47
	DKU-F505I-300JSR/ 300KSR		225	500	69	34
	DKU-F505I-146JS/ 146JSR/146KSR		112	337	34	17
	DKU-F505I-72KS/72KSR		55	167	17	8
	DKU-F505I-72JSR		57	171	17	8
Maximum number of parity groups	DKU-F505I-400JSR		28	28	28	28
	DKU-F505I-300JSR/ 300KSR		28	28	28	28
	DKU-F505I-146JS/ 146JSR/146KSR		28	28	28	28
	DKU-F505I-72KS/72KSR		28	28	28	28
	DKU-F505I-72JSR		28	28	28	28
Maximum number of volumes	DKU-F505I-400JSR		8624	14000	2632	1316
	DKU-F505I-300JSR/ 300KSR		6300	14000	1932	952
	DKU-F505I-146JS/ 146JSR/146KSR		3136	9436	952	476
	DKU-F505I-72KS/72KSR		1540	4676	476	224
	DKU-F505I-72JSR		1596	4788	476	224
Subsystem capacity (user area) (GB)	DKU-F505I-400JSR	Min	2749	1488	2743	2743
		Max	76961	41650	76815	76815
	DKU-F505I-300JSR/ 300KSR	Min	2008	1488	2014	1985
		Max	56221	41650	56385	55568
	DKU-F505I-146JS/ 146JSR/146KSR	Min	999	1003	992	992
		Max	27986	28072	27784	27784
	DKU-F505I-72KS/72KSR	Min	491	497	496	467
		Max	13743	13911	13892	13075
	DKU-F505I-72JSR	Min	509	509	496	467
		Max	14243	14244	13892	13075

*2: The value in parenthesis is the capacity for Main Frame Host.

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Table 3.5.1-4 List of RAID500 Model Emulation Types for RAID1(2D+2D) (1/2)

Emulation Type	DKC		—					
	DKU		OPEN-3	OPEN-8	OPEN-9	OPEN-E	OPEN-L	OPEN-V
Storage capacity (GB/volume)			2.461	7.347	7.384	14.567	36.450	(*1)
Number of volumes/ parity groups	DKU-F505I-400JSR		250	106	106	54	21	1
	DKU-F505I-300JSR/ 300KSR		233	78	77	39	15	1
	DKU-F505I-146JS/ 146JSR/146KSR		116	39	38	19	7	1
	DKU-F505I-72KS/72KSR		57	19	19	9	3	1
	DKU-F505I-72JSR		59	19	19	10	4	1
Maximum number of parity groups	DKU-F505I-400JSR		59	59	59	59	59	59
	DKU-F505I-300JSR/ 300KSR		59	59	59	59	59	59
	DKU-F505I-146JS/ 146JSR/146KSR		59	59	59	59	59	59
	DKU-F505I-72KS/72KSR		59	59	59	59	59	59
	DKU-F505I-72JSR		59	59	59	59	59	59
Maximum number of volumes	DKU-F505I-400JSR		14750	6254	6254	3186	1239	59
	DKU-F505I-300JSR/ 300KSR		13747	4602	4543	2301	885	59
	DKU-F505I-146JS/ 146JSR/146KSR		6844	2301	2242	1121	413	59
	DKU-F505I-72KS/72KSR		3363	1121	1121	531	177	59
	DKU-F505I-72JSR		3481	1121	1121	590	236	59
Subsystem capacity (user area) (GB)	DKU-F505I-400JSR	Min	615	779	783	787	765	788
		Max	36300	45948	46180	46410	45162	46468
	DKU-F505I-300JSR/ 300KSR	Min	573	573	569	568	547	576
		Max	33831	33811	33546	33519	32258	34002
	DKU-F505I-146JS/ 146JSR/146KSR	Min	285	287	281	277	255	288
		Max	16843	16905	16555	16330	15054	16963
	DKU-F505I-72KS/ 72KSR	Min	140	140	140	131	109	143
		Max	8276	8236	8277	7735	6452	8431
	DKU-F505I-72JSR	Min	145	140	140	146	146	146
		Max	8567	8236	8277	8595	8602	8602

*1: The value of OPEN-V is the default one in the installation of parity group. In case of OPEN-V, storage capacity differs depending on RAID level and DKU(HDD) type because OPEN-V is CVS basis. The default volume size is nearly equal to that of a parity group.

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Table 3.5.1-4 List of RAID500 Model Emulation Types for RAID1(2D+2D) (2/2)

Emulation Type	DKC		—			
	DKU		3390-9A/9B/9C	3390-3A/3B/3C	3390-LA/LB/LC	3390-MA/MB/MC
Storage capacity (GB/volume)			8.924 (8.510) (*2)	2.975 (2.838) (*2)	29.185 (27.800) (*2)	58.370 (55.589) (*2)
Number of volumes/ parity groups	DKU-F505I-400JSR		88	250	26	13
	DKU-F505I-300JSR/ 300KSR		64	193	19	9
	DKU-F505I-146JS/ 146JSR/146KSR		32	96	9	4
	DKU-F505I-72KS/72KSR		15	47	4	2
	DKU-F505I-72JSR		16	48	4	2
Maximum number of parity groups	DKU-F505I-400JSR		59	59	59	59
	DKU-F505I-300JSR/ 300KSR		59	59	59	59
	DKU-F505I-146JS/ 146JSR/146KSR		59	59	59	59
	DKU-F505I-72KS/72KSR		59	59	59	59
	DKU-F505I-72JSR		59	59	59	59
Maximum number of volumes	DKU-F505I-400JSR		5192	14750	1534	767
	DKU-F505I-300JSR/ 300KSR		3776	11387	1121	531
	DKU-F505I-146JS/ 146JSR/146KSR		1888	5664	531	236
	DKU-F505I-72KS/72KSR		885	2773	236	118
	DKU-F505I-72JSR		944	2832	236	118
Subsystem capacity (user area) (GB)	DKU-F505I-400JSR	Min	785	744	759	759
		Max	46333	43881	44770	44770
	DKU-F505I-300JSR/ 300KSR	Min	571	574	555	525
		Max	33697	33876	32716	30994
	DKU-F505I-146JS/ 146JSR/146KSR	Min	286	286	263	233
		Max	16849	16850	15497	13775
	DKU-F505I-72KS/72KSR	Min	134	140	117	117
		Max	7898	8250	6888	6888
	DKU-F505I-72JSR	Min	143	143	117	117
		Max	8424	8425	6888	6888

*2: The value in parenthesis is the capacity for Main Frame Host.

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Table 3.5.1-5 List of RAID500 Model Emulation Types for RAID6(6D+2P) (1/2)

Emulation Type	DKC		—					
	DKU		OPEN-3	OPEN-8	OPEN-9	OPEN-E	OPEN-L	OPEN-V
Storage capacity (GB/volume)			2.461	7.347	7.384	14.567	36.450	(*1)
Number of volumes/ parity groups	DKU-F505I-400JSR		500	320	319	162	64	1
	DKU-F505I-300JSR/ 300KSR		500	234	233	118	47	1
	DKU-F505I-146JS/ 146JSR/146KSR		349	117	116	59	23	1
	DKU-F505I-72KS/72KSR		173	58	57	29	11	1
	DKU-F505I-72JSR		177	59	59	30	12	1
Maximum number of parity groups	DKU-F505I-400JSR		28	28	28	28	28	28
	DKU-F505I-300JSR/ 300KSR		28	28	28	28	28	28
	DKU-F505I-146JS/ 146JSR/146KSR		28	28	28	28	28	28
	DKU-F505I-72KS/72KSR		28	28	28	28	28	28
	DKU-F505I-72JSR		28	28	28	28	28	28
Maximum number of volumes	DKU-F505I-400JSR		14000	8960	8932	4536	1792	28
	DKU-F505I-300JSR/ 300KSR		14000	6552	6524	3304	1316	28
	DKU-F505I-146JS/ 146JSR/146KSR		9772	3276	3248	1652	644	28
	DKU-F505I-72KS/72KSR		4844	1624	1596	812	308	28
	DKU-F505I-72JSR		4956	1652	1652	840	336	28
Subsystem capacity (user area) (GB)	DKU-F505I-400JSR	Min	1231	2351	2355	2360	2333	2363
		Max	34454	65829	65954	66076	65318	66164
	DKU-F505I-300JSR/ 300KSR	Min	1231	1719	1720	1719	1713	1729
		Max	34454	48138	48173	48129	47968	48415
	DKU-F505I-146JS/ 146JSR/146KSR	Min	859	860	857	859	838	863
		Max	24049	24069	23983	24065	23474	24150
	DKU-F505I-72KS/ 72KSR	Min	426	426	421	422	401	429
		Max	11921	11932	11785	11828	11227	12009
	DKU-F505I-72JSR	Min	436	433	436	437	437	437
		Max	12197	12137	12198	12236	12247	12247

*1: The value of OPEN-V is the default one in the installation of parity group. In case of OPEN-V, storage capacity differs depending on RAID level and DKU(HDD) type because OPEN-V is CVS basis. The default volume size is nearly equal to that of a parity group.

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Table 3.5.1-5 List of RAID500 Model Emulation Types for RAID6(6D+2P) (2/2)

Emulation Type	DKC		—			
	DKU		3390-9A/9B/9C	3390-3A/3B/3C	3390-LA/LB/LC	3390-MA/MB/MC
Storage capacity (GB/volume)			8.924 (8.510) (*2)	2.975 (2.838) (*2)	29.185 (27.800) (*2)	58.370 (55.589) (*2)
Number of volumes/ parity groups	DKU-F505I-400JSR		264	500	80	40
	DKU-F505I-300JSR/ 300KSR		193	500	59	29
	DKU-F505I-146JS/ 146JSR/146KSR		96	289	29	14
	DKU-F505I-72KS/72KSR		47	143	14	7
	DKU-F505I-72JSR		48	146	14	7
Maximum number of parity groups	DKU-F505I-400JSR		28	28	28	28
	DKU-F505I-300JSR/ 300KSR		28	28	28	28
	DKU-F505I-146JS/ 146JSR/146KSR		28	28	28	28
	DKU-F505I-72KS/72KSR		28	28	28	28
	DKU-F505I-72JSR		28	28	28	28
Maximum number of volumes	DKU-F505I-400JSR		7392	14000	2240	1120
	DKU-F505I-300JSR/ 300KSR		5404	14000	1652	812
	DKU-F505I-146JS/ 146JSR/146KSR		2688	8092	812	392
	DKU-F505I-72KS/72KSR		1316	4004	392	196
	DKU-F505I-72JSR		1344	4088	392	196
Subsystem capacity (user area) (GB)	DKU-F505I-400JSR	Min	2356	1488	2335	2228
		Max	65966	41650	65374	62372
	DKU-F505I-300JSR/ 300KSR	Min	1722	1488	1722	1615
		Max	48225	41650	48214	45219
	DKU-F505I-146JS/ 146JSR/146KSR	Min	857	860	846	780
		Max	23988	24074	23698	21830
	DKU-F505I-72KS/72KSR	Min	419	425	409	390
		Max	11744	11912	11441	10915
	DKU-F505I-72JSR	Min	428	434	409	390
		Max	11994	12162	11441	10915

*2: The value in parenthesis is the capacity for Main Frame Host.

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Table 3.5.1-6 The relation between OPEN-V capacity, RAID level and DKU type

DKU type		Capacity			Number of LDEV
		MB	CYL	Logical Blocks	
RAID5 (3D+1P)	DKU-F505I-400JSR	1181537.0	1201921.6	2307689472	1
	DKU-F505I-300JSR/300KSR	864589.2	879505.6	1688650752	1
	DKU-F505I-146JS/146JSR/146KSR	431293.5	438734.4	842370048	1
	DKU-F505I-72JS/72JSR	218741.3	222515.2	427229184	1
	DKU-F505I-72KS/72KSR	214488.3	218188.8	418922496	1
RAID5 (7D+1P)	DKU-F505I-400JSR	2756919.7	2804483.7	5384608768	1
	DKU-F505I-300JSR/300KSR	2017374.8	2052179.7	3940185088	1
	DKU-F505I-146JS/146JSR/146KSR	1006351.4	1023713.6	1965530112	1
	DKU-F505I-72JS/72JSR	510396.5	519202.1	996868096	1
	DKU-F505I-72KS/72KSR	500472.7	509107.2	977485824	1
RAID1 (2D+2D)	DKU-F505I-400JSR	787691.3	801281.1	1538459648	1
	DKU-F505I-300JSR/300KSR	576392.8	586337.1	1125767168	1
	DKU-F505I-146JS/146JSR/146KSR	287529.0	292489.6	561580032	1
	DKU-F505I-72JS/72JSR	145827.6	148343.5	284819456	1
	DKU-F505I-72KS/72KSR	142992.2	145459.2	279281664	1
RAID6 (6D+2P)	DKU-F505I-400JSR	2363074.0	2403843.2	4615378944	1
	DKU-F505I-300JSR/300KSR	1729178.4	1759011.2	3377301504	1
	DKU-F505I-146JS/146JSR/146KSR	862586.9	877468.8	1684740096	1
	DKU-F505I-72JS/72JSR	437482.7	445030.4	854458368	1
	DKU-F505I-72KS/72KSR	428976.6	436377.6	837844992	1

*4: In case of OPEN-V, the relationship between Capacity[MB] and Cylinder number is as follows.
A[MB] = B[Cyl] * 15 * 128 * 512 / 1000 / 1000 (1MB = 1000^2 byte)
or
A[MB] = B[Cyl] * 15 * 128 * 512 / 1024 / 1024 (1MB = 1024^2 byte)
where A is the capacity by MB, B is that by Cylinder number.

The relationship between Capacity[MB] and Logical Blocks is as follows.
A[MB] = C * 512 / 1000 / 1000 (1MB = 1000^2 byte)
or
A[MB] = C * 512 / 1024 / 1024 (1MB = 1024^2 byte)
where C is the capacity by Logical Blocks.

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3.5.2 Intermix Specification

Refer to 3.7.2 Emulation Device Type (2) of THEORY03-280 about Intermix Specification.

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3.5.3 HMDE volume intermix within ECC group

3.5.3.1 HMDE volume intermix within ECC group

(1) Four emulation types of volume can coexist within one ECC group about each groups below.
   ① 3390-3A, -3B, -3C, -3 (or 3390-3A, -3B, -3C, -3R)
   ② 3390-9A, -9B, -9C, -9
   ③ 3390-LA, -LB, -LC, -L
(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.

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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.

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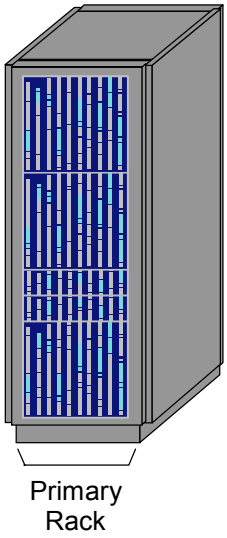
3.6 Volume Configuration

3.6.1 Volume Configuration

(1) Minimum Volume Configuration

Single Rack configuration

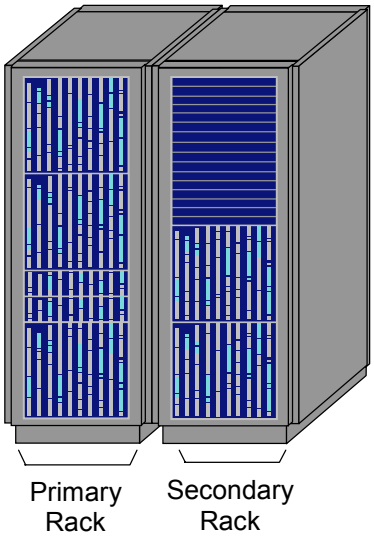


- 1 MIX Pair is installed
- 5 HDDs including 1 spare drive / 8 disk paths (1 ECC Group)

Fig. 3.6.1-1 Minimum volume configuration

(2) Maximum Volume Configuration

Twin Rack configuration



- 1 MIX Pair is installed
- 240 HDDs including 16 spares drives / 8 disk paths
  (56 ECC Groups when 3D+1P is composed)
  (28 ECC Groups when 7D+1P is composed)

Fig. 3.6.1-2 Maximum volume configuration

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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

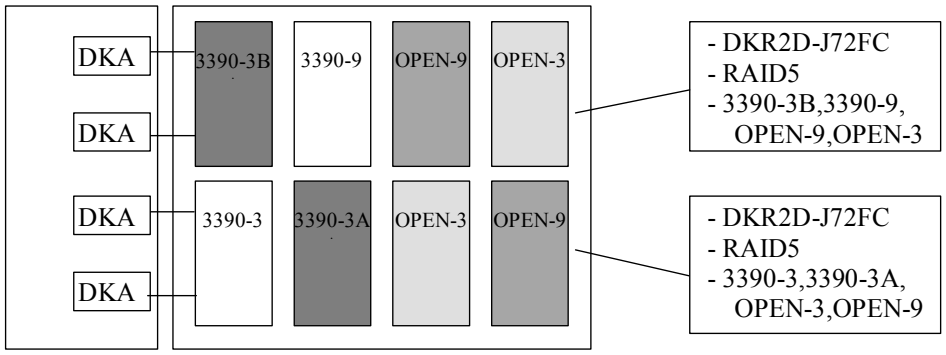

Fig. 3.6.2-1 Typical LDEV intermix configuration example

(2) Typical RAID intermix configuration

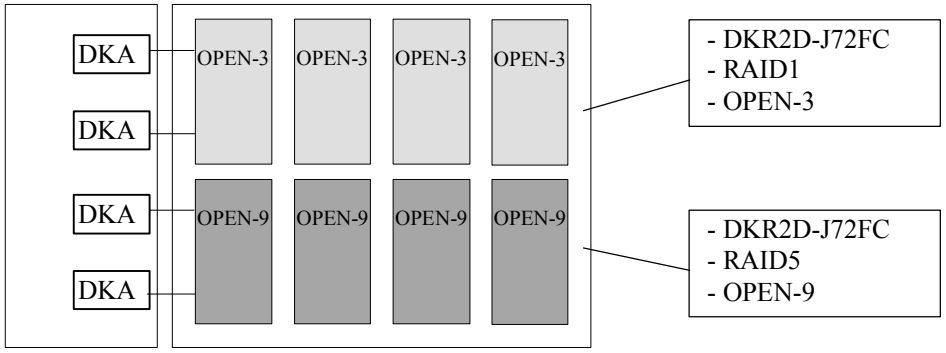

Fig. 3.6.2-2 Typical RAID intermix configuration example

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(3) Typical PDEV intermix configuration

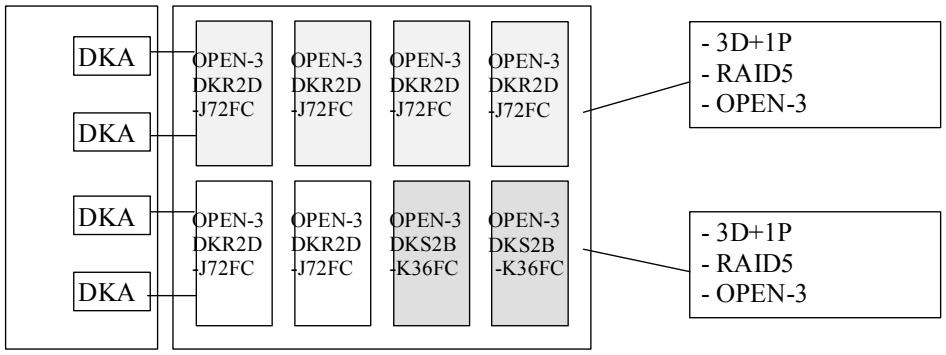

Fig. 3.6.2-3 Typical PDEV intermix configuration example

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3.6.3 HMDE Volume Configuration

(1) Typical volume configuration for HMDE

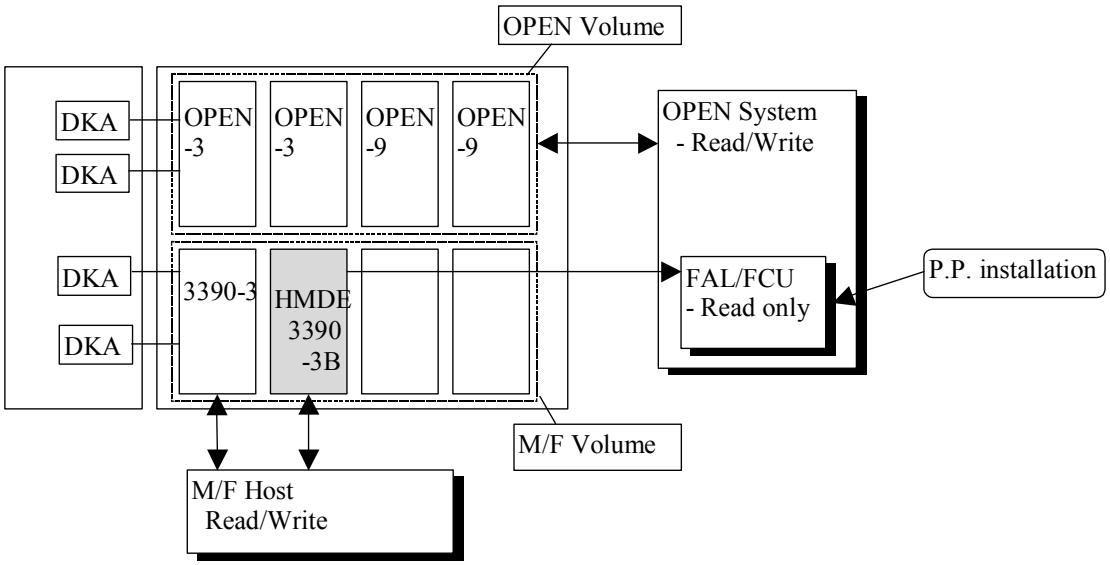

Fig. 3.6.3-1 Typical volume configuration for HMDE

(2) Valid volume configuration
The configuration shown in Fig. 3.6.3-2 is valid.

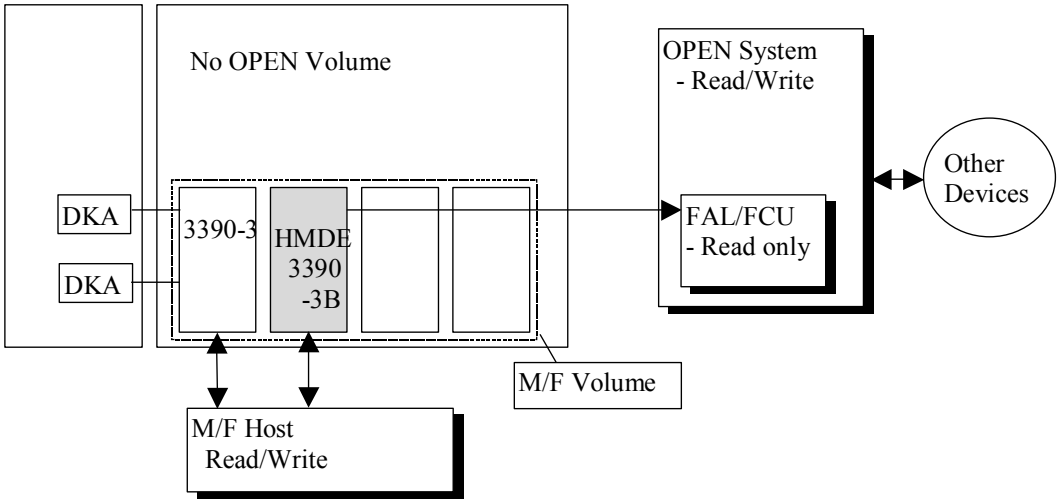

Fig. 3.6.3-2 Valid volume configuration for HMDE

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3.6.4 HMBR Volume Configuration

(1) Typical volume configuration example for HMBR

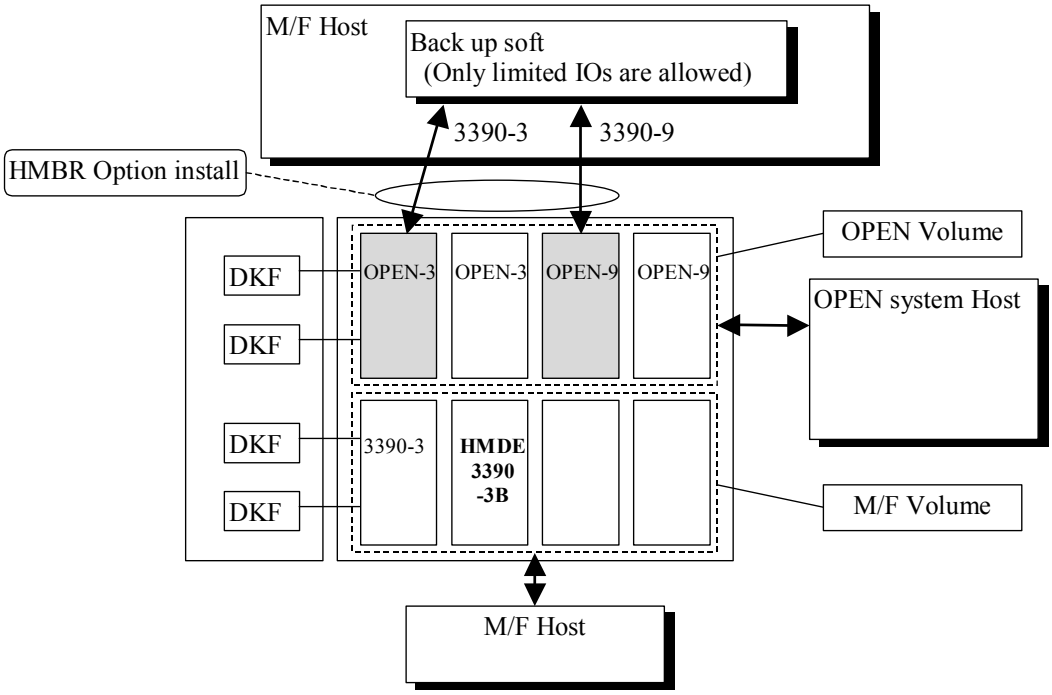

Fig. 3.6.4-1 Typical volume configuration for HMBR

(2) Valid volume configuration example for HMBR

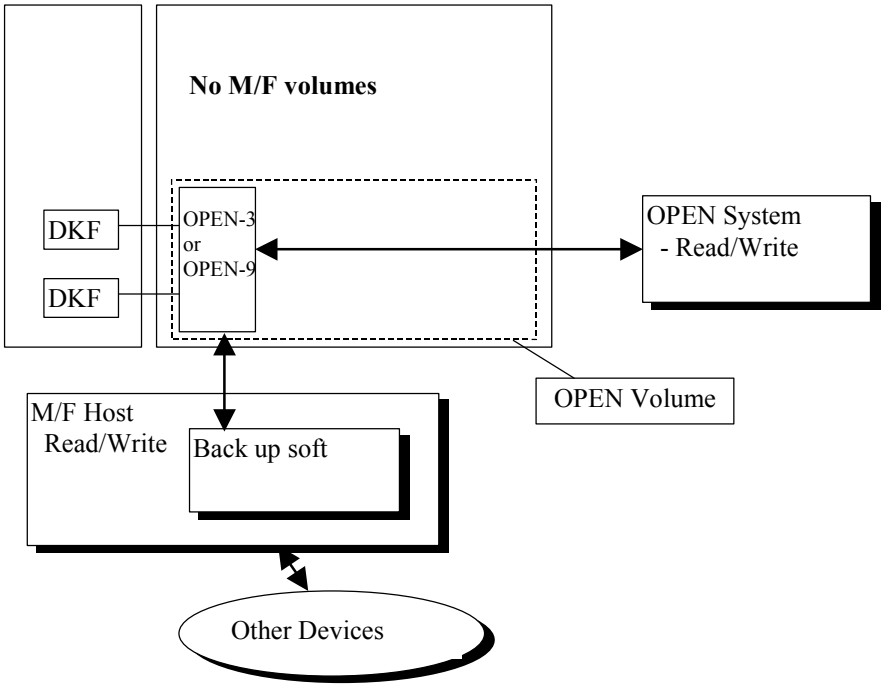

Fig. 3.6.4-1 Valid volume configuration for HMBR

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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).

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3.7.2 LUN setting

- LUN setting:

- Select the CHF, FIBRE port or CHI, iSCSI 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.

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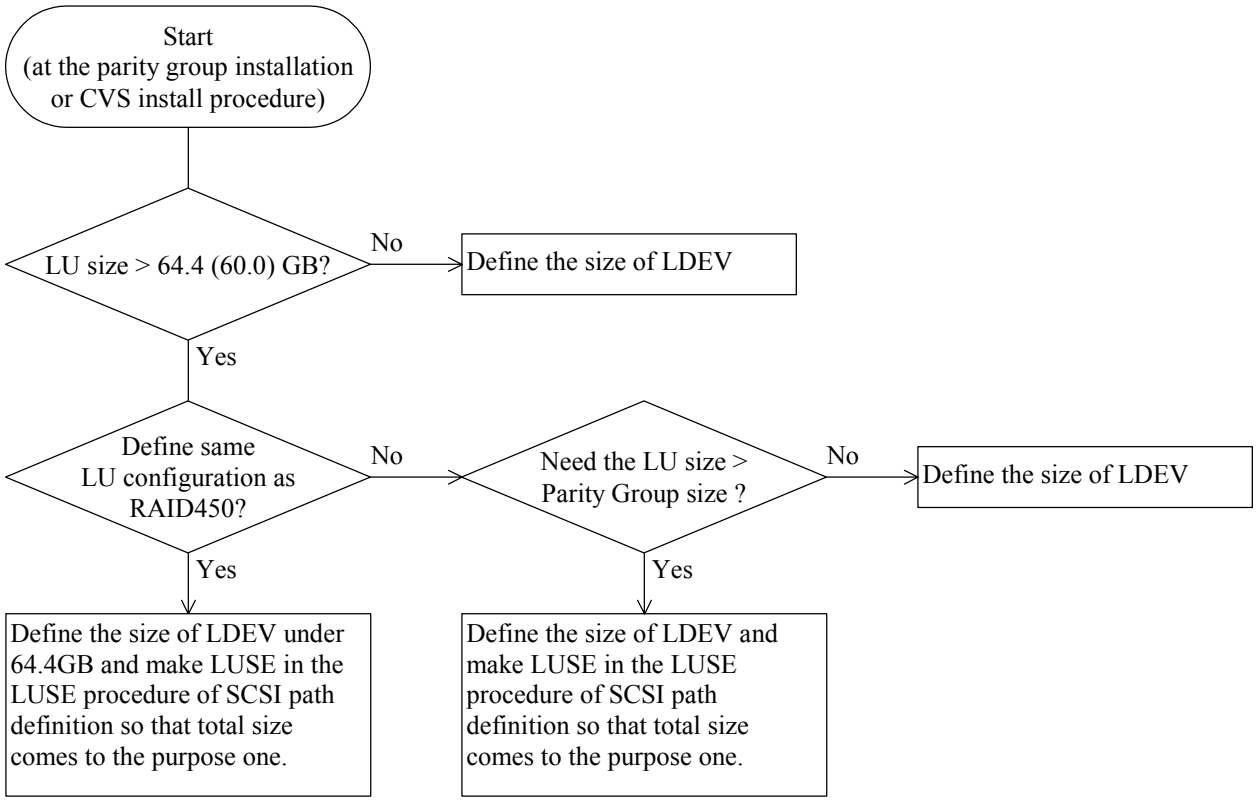
3.7.3 OPEN-V Setting

OPEN-V is CVS volume basis. The default capacity of OPEN-V is nearly equals to the size of the parity group. So it depends on RAID level and DKU(HDD) type.
In case of conform to LU configuration over 64.4GB of RAID450 which is set as OPEN-V*n automatically within a parity group, both CVS and LUSE setting is necessary for RAID500.
The following is the OPEN-V definition guidelines for the customizing capacity.



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3.8 Host mode setting

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.

*******HDS RAID Controller Models**********
MODE 00 : Standard mode (Linux)
MODE 03 : HP-UX host mode *1
MODE 05 : OpenVMS host mode
MODE 07 : Tru64 host mode
MODE 09 : Solaris host mode
MODE 0A : NetWare host mode, VMWare host mode
MODE 0C : Windows 2000/2003
MODE 0F : AIX host mode
MODE 2C : Windows 2000/2003 host mode (Online LUSE)
MODE 4C : UVM connection host mode *2
others : Reserved
****

*******HP RAID Controller Models**********
MODE 00 : Standard mode (Linux)
MODE 05 : OpenVMS host mode
MODE 07 : Tru64 host mode
MODE 08 : HP-UX host mode *1
MODE 09 : Solaris host mode
MODE 0A : NetWare host mode
MODE 0C : Windows 2000/2003, VMWare, NonStop OS
MODE 0F : AIX host mode
MODE 2C : Windows 2000/2003 host mode (Online LUSE), NonStop OS (Online LUSE)
MODE 4C : UVM connection host mode *2
others : Reserved
****

Please set the HOST MODE OPTION if required.
Please see “LUN Management” (INST05-850 to INST05-1350). Also see the operational manual for more detailed information about the alternate link and HA software.

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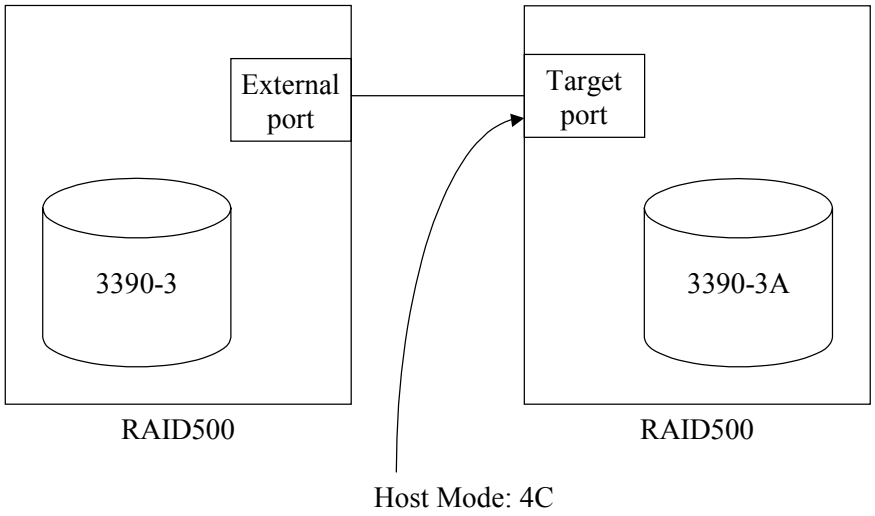
*1: For iSCSI, it is required to set HOST MODE OPTION 12.

*2: If setting this mode to ON when RAID500 is being used as an External Storage, the data of the MF-VOL (Multi-platform VOL emulation only) in the RAID500 can be succeeded.

Connection example:



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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

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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.

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4.2.2 Concurrent data transfer

Four FIBRE ports on a CHF can perform the host I/Os and data transfer with maximum 2 Gbps transfer concurrently.
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.

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5. SCSI Commands

5.1 Fibre

The DASD commands defined under the SCSI-2 standards and those supported by the DKC are listed in Table 5.1-1.

Table 5.1-1 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 (6)	RD/WR	○	
	$0A_H$	Write (6)	RD/WR	○	
	$0B_H$	Seek (6)	CTL/SNS	Nop	
	12_H	Inquiry	CTL/SNS	○	
	15_H	Mode Select (6)	CTL/SNS	○	
	16_H	Reserve	CTL/SNS	○	
	17_H	Release	CTL/SNS	○	
	18_H	Copy	–	–	
	$1A_H$	Mode Sense (6)	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 (10)	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 (10)	RD/WR	○	Supported only Write for DKC515I.
	$2F_H$	Verify (10)	RD/WR	○	
	30_H	Search Data High	–	–	
	31_H	Search Data Equal	–	–	
	32_H	Search Data Low	–	–	
	33_H	Set Limits (10)	–	–	
	34_H	Pre-Fetch (10)	–	–	
	35_H	Synchronize Cache (10)	CTL/SNS	Nop	
	36_H	Lock-Unlock Cache (10)	–	–	
	37_H	Read Defect Data (10)	DIAG	○	No defect always reported.
	38_H	Reserved code	–	–	
	39_H	Compare	–	–	

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Table 5.1-1 SCSI-2 DASD commands and DKC-supported commands (Continued)

Group	Op Code	Name of Command	Type	○:Supported	Remarks
1 (20_H -$3F_H$)	$3A_H$	Copy And Verify	–	–	
	$3B_H$	Write Buffer	DIAG	○	
	$3C_H$	Read Buffer	DIAG	○	
	$3D_H$	Reserved code	–	–	
	$3E_H$	Read Long	–	–	
	$3F_H$	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	○	
	$5E_H$	Persistent Reserve IN	CTL/SNS	○	
	$5F_H$	Persistent Reserve OUT	CTL/SNS	○	
	Other	Reserved code	–	–	
3	60_H~$7F_H$	Reserved code	–	–	
4	83_H	Extended Copy	CTL/SNS	○	
	84_H	Receive Copy Result	CTL/SNS	○	
	88_H	Read (16)	RD/WR	○	
	$8A_H$	Write (16)	RD/WR	○	
	$8D_H$	Write And Verify (16)	RD/WR	○	
	$8F_H$	Verify (16)	RD/WR	○	
	91_H	Synchronized Cache (16)	CTL/SNS	○	
	$9E/10_H$	Read Capacity (16)	CTL/SNS	○	
	Other	Vendor-unique	–	–	
5	$A0_H$	Report LUN	CTL/SNS	○	
	$A8_H$	Read (12)	RD/WR	○	
	AA_H	Write (12)	RD/WR	○	
	AE_H	Write And Verify (12)	RD/WR	○	
	AF_H	Verify (12)	RD/WR	○	
	$B7_H$	Read Defect Data (12)	CTL/SNS	Nop	
	$A1_H$~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	–	–	

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5.2 iSCSI

The DASD commands defined under the SCSI-2 standards and those supported by the DKC are listed in Table 5.2-1.

Table 5.2-1 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	Nop	
	36_H	Lock-Unlock Cache	—	—	
	37_H	Read Defect Data	DIAG	○	No defect always reported.
	38_H	Reserved code	—	—	
	39_H	Compare	—	—	

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Table 5.2-1 SCSI-2 DASD commands and DKC-supported commands (Continued)

Group	Op Code	Name of Command	Type	○:Supported	Remarks
1 (20_H -$3F_H$)	$3A_H$	Copy And Verify	—	—	
	$3B_H$	Write Buffer	DIAG	○	
	$3C_H$	Read Buffer	DIAG	○	
	$3D_H$	Reserved code	—	—	
	$3E_H$	Read Long	—	—	
	$3F_H$	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	○	
	$5E_H$	Persistent Reserve IN	CTL/SNS	—	
	$5F_H$	Persistent Reserve OUT	CTL/SNS	—	
	Other	Reserved code	—	—	
3	60_H ~ $7F_H$	Reserved code	—	—	
4	83_H	Extended Copy	CTL/SNS	—	
	84_H	Receive Copy Result	CTL/SNS	—	
	Other	Vendor-unique	—	—	
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	—	—	

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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 6.1-1 lists platforms supported for using the HMDE.

Table 6.1-1 Platforms supported

#	Platform supported	OS	Window System
1	SUN	Solaris	Motif 1.2
2	HP	HP-UX, Tru64	Motif 1.2
3	IBM	AIX	Motif 1.2
4	(Not specified)	WindowsNT4.0/Windows2000 Windows2003	MFC
5	(Not specified)	Linux	MFC

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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, 3390-3C, 3390-9A, 3390-9B, 3390-9C, 3390-LA, 3390-LB, 3390-LC, 3390-MA, 3390-MB, 3390-MC, 3380-3A, 3380-3B and 3380-3C can be used for the HMDE operations. In addition to being accessible as 3390-3/9/L/M type volumes from the mainframe host in the same manner as before, the 3390-3B/9B/LB/MB type volumes permit read-only access from the open system host.
The 3390-3A/9A/LA/MA type volumes can be accessible as 3390-3/9/L/M from the mainframe host and permit a read/write access from the open system host. The 3390-3C/9C/LC/MC can be read only accessible as 3390-3/9/L/M from mainframe host and permit a read/write access from the open system host. The 3390-3C/9C/LC/MC permit creating and updating of VTOC.
The 3380-3B type volumes permit read-only access from the open system host. The 3380-3A type volumes can be accessible as 3380-3 from the mainframe host and permit a read/write access from the open system host. The 3380-3C can be read only accessible as 3380-3 from mainframe host and permit a read/write access from the open system host. The 3380-3C permit creating and updating of VTOC.

Table 6.2-1 HMDE volume specifications

#	Volume attribute	Emulation Type	Access right		Remarks
			Mainframe	Open system	
1	Mainframe volume	3390-3A/9A/LA/MA	R/W	R/W	HMDE volume
2		3390-3B/9B/LB/MB	R/W	R	HMDE volume
3		3390-3C/9C/LC/MC	R	R/W	HMDE volume
4		3380-3A	R/W	R/W	HMDE volume
5		3380-3B	R/W	R	HMDE volume
6		3380-3C	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
12		OPEN-V		R/W	HMDE volume

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The 3390-3A, 3390-3B, 3390-3C, 3390-9A, 3390-9B, 3390-9C, 3390-LA, 3390-LB, 3390-LC, 3390-MA, 3390-MB, 3390-MC, 3380-3A, 3380-3B and 3380-3C 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. The drive emulation type can be changed between 3390-9 and 3390-9A and 3390-9B and 3390-9C by change emulation operation. The drive emulation type can be changed between 3390-L and 3390-LA and 3390-LB and 3390-LC by change emulation operation. The drive emulation type can be changed between 3390-M and 3390-MA and 3390-MB and 3390-MC by change emulation operation. The drive emulation type can be changed between 3380-3 and 3380-3A and 3380-3B and 3380-3C 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.

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6.3 Notes on Use

A like the ordinary mainframe volumes, the 3390-3B, 3390-3A, 3390-9B, 3390-9A, 3390-LB, 3390-LA, 3390-MB, 3390-MA, 3380-3B and 3380-3A type HMDE volumes can be accessed from the mainframe. The 3390-3C, 3390-9C, 3390-LC, 3390-MC and 3380-3C 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, 3390-9A/B, 3390-LA/B, 3390-MA/B or 3380-3A/B, the volume can not be accessed from the open system host.
Sun/Solaris can not use 3390-MA, 3390-MB and 3390-MC.

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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 restoreFd 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. Moreover, it performs with high data transfer rate of FICON 100/200/400 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.

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7.2 System Configuration

A system configuration example and functional overview are shown in the Fig. 7.2-1.

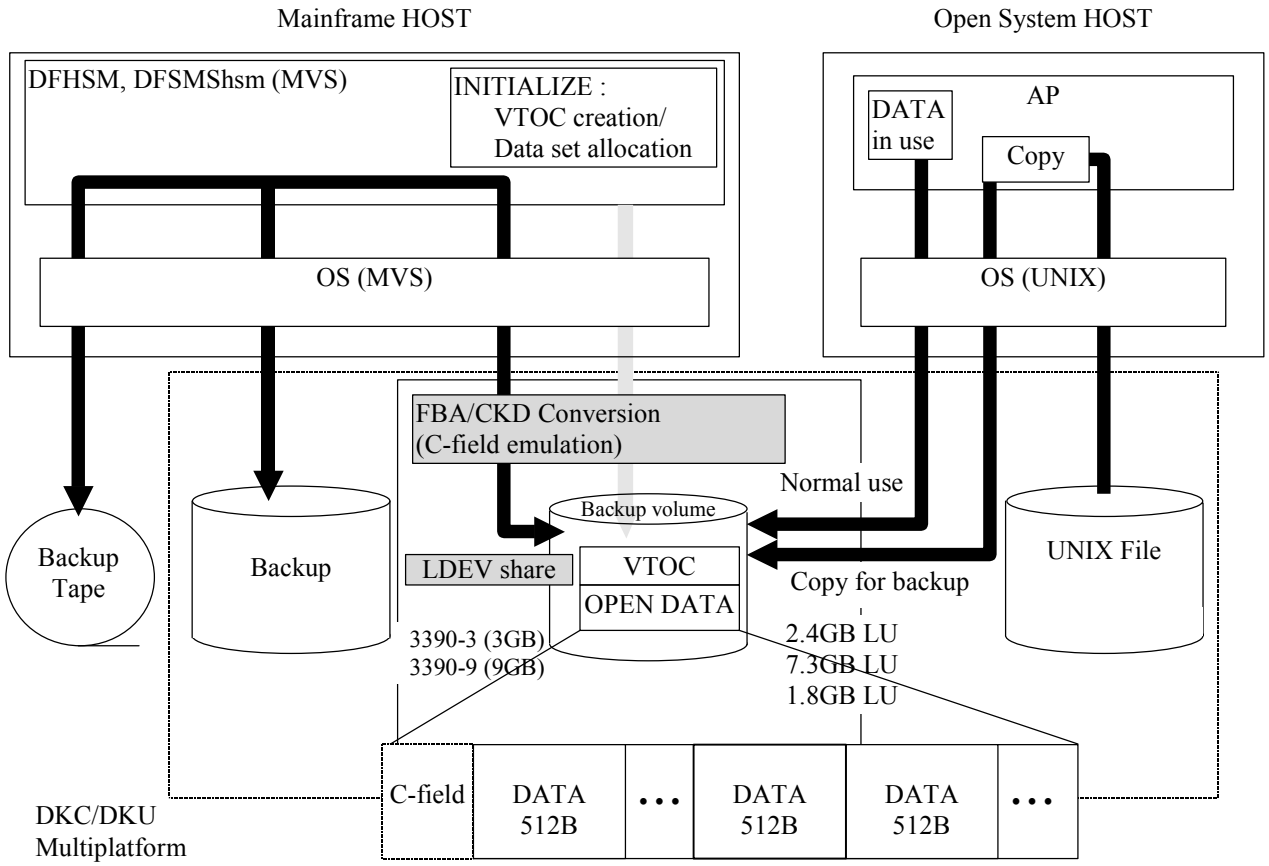

Fig. 7.2-1 System configuration example

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7.3 Basic Specification

The basic specification of HMBR is shown in the Table 7.3-1.

Table 7.3-1 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.		

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7.4 Backup Volume Specification

(1) Setup for Backup Volume

Step-1: Install the HMBR option to the DKC by using StorageNavigator.

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 toOPEN-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 7.4-1.

Table 7.4-1 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.

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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.

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(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.

(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.

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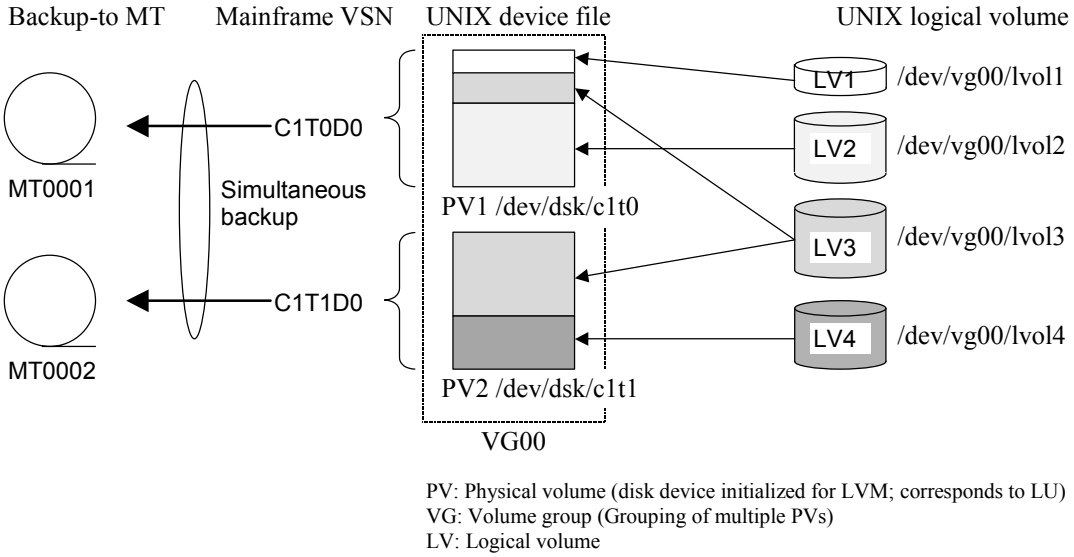

Fig. 7.5-1 Backup of Volumes managed by LVM

(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.
Re-allocate drive letter to the Logical Units by Disk Administrator.

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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.

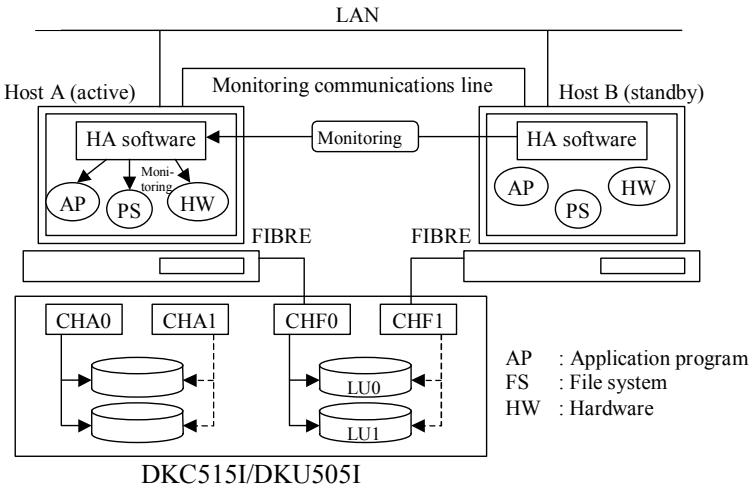

Fig. 8.1-1 Hot-standby configuration

• 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.

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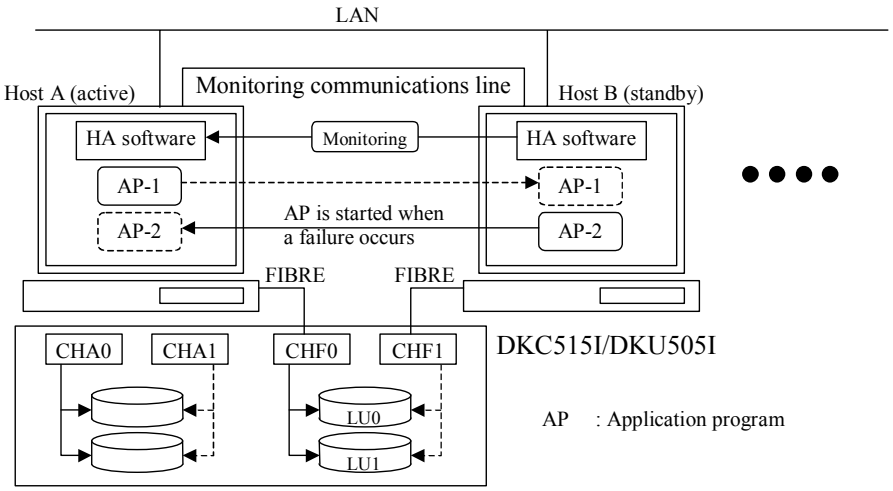
- Use of the HA software allows a processing request from a client to be taken over. In the case of some specific application programs, however, it appears to the client as if the host that was processing the task has been rebooted due to the host switching. To ensure continued processing, therefore, 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 SUN Microsystems SUN CLUSTER, VERITAS Software Cluster server, Hewlett-Packard MC/ServiceGuard, and IBM HACMP and so on.

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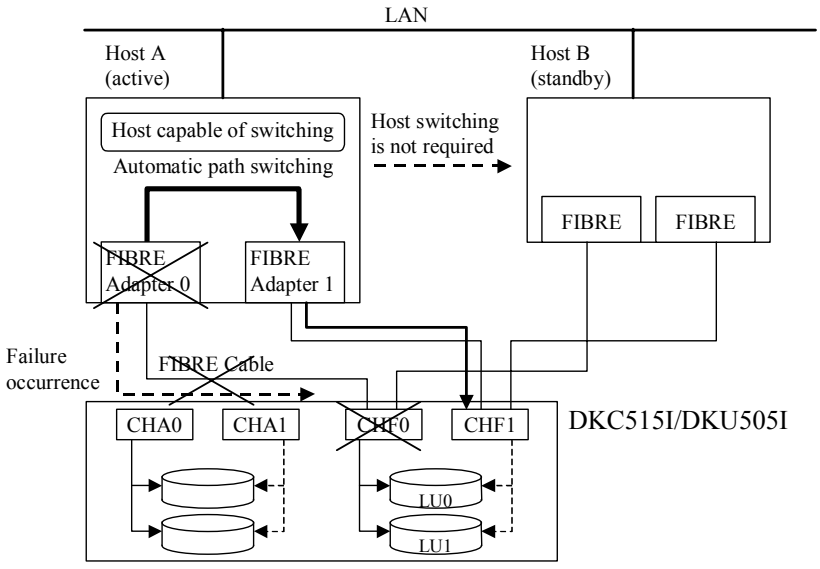
8.2 Configuration Using Host Path Switching Function

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.

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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 DKC515s. A backup system against disasters can be constructed by installing one of the two DKC515s 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 DKC515 or between the two DKC515s 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 is Fibre channel interface of connection form between CUs.

* Serial interface of connection form (ESCON/ACONARC) between CUs is not Supported.

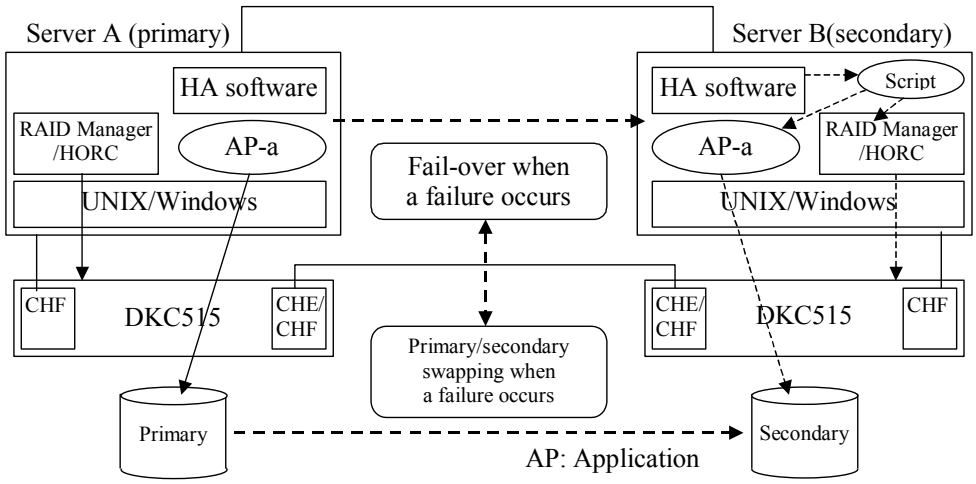

Fig. 9.1-1 Outline of HORC Function and Example of Application to HA Configuration (Hot Standby Configuration)

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9.2 Basic Specifications

Basic HORC specifications are shown below.

Table 9.2-1 Basic Specifications of HORC

No.	Item	Description	Remarks
1	Host interface on open system side	Fibre Channel	Conforming to base platform function.
2	Supporting OS platform	Conforming to base platform function.	
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	RAID Manager/HORC	
		Storage Navigator	
		WebConsole	
5	Number of LUs capable of the duplicated writing	Maximum 16384 pairs	Depending on emulation type
6	LU size capable of the duplicated writing (The paired VOL must be the same DEV type.)	All basic emulation types (include OPEN-V*)	
		LUSE	
		CVS	
7	Duplicated writing mode	Synchronized (Sync), Asynchronized (Async)	
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 DKC	Maximum 256 paths	Maximum 8 paths per CU when serial interface is used.
11	Multiple DKC support	Yes	For CU#0 through CU#62, HORC pairs can be created.
12	Control of the MF HRC and the open HRC in DKC mixture (HMBR function)	Can be mixed	

*: Since OPEN-V is based on CVS, the capacity changes with RAID-level or DKU (HDD) type. Please refer to "3.4.1 Logical Unit Specification" for details.

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(1) Means for setting the paired LU:
The following three means are provided:
- RAID Manager/HORC
- SVP
- Storage Navigator

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:
All emulation types' volumes are replicable.
(Condition: The primary volume and the secondary volume must have the same emulation type.)
If two LUSE volumes are paired with TrueCopy, a LUSE P-VOL must be paired with S-VOL of the same size and the same structure. For example, if a LUSE P-VOL is connected with the volumes of 1GB, 2GB, and 3GB in this order, you must specify the LUSE volume which has exactly the same size and the same connection order as the S-VOL.
In addition, ESCON connection HORC does not support the OPEN-V.

(3) Copy Mode:
Async: The copy operation and the host I/O can be performed asynchronously, but it must to ensure the update sequence consistency of Write progress across multiple primary volumes (The data written late cannot be copied earlier.). In addition, when a failure occurs, the function (for multiple pairs) having multiple pairs blocked while keeping the update sequence consistency is available. In this way, the group composed of pairs, which are the control objects, is called Consistency Group.

(4) Fence level:
The HORC, alike the HRC, supports three types of fence level: Data, Status, and Never.
In case of HORC Async, "Never" is displayed on SVP/Storage Navigator; "Async" is displayed on RAID Manager.

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(5) 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.

- 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.

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- HMBR function for the HORC paired VOL

① Overview
Open Remote Copy 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 suspending 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 "7.5 Precautions". 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 not copied to S-Vol. As a result, both P-Vol and S-Vol have different VSN and VTOC.

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.

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(6) Connections between DKC505 and DKC410 or DKC460 Subsystems
Usable configurations depending on combinations of models of MCU and RCU to be connected are shown in the following table.
Descriptions following the (1), (2), and (3) in the table express extents of the usable ports, CU#'s, and LUNs respectively.
Also, descriptions on the left and right of a slash (/) express the extents of the usable models of the MCU and RCU respectively.

MCU \ RCU	DKC410I (01-19-81-xx/xx)	DKC460I (21-12-00-xx/xx)	DKC505I (50-03-xx-xx/xx)
DKC410I (01-19-81-xx/xx)	(1) 1A ~ 2R/1A ~ 2R (2) 00 ~ 0F/00 ~ 0F (3) 00 ~ FF/00 ~ FF	(1) 1A ~ 2R/1A ~ 4R (2) 00 ~ 0F/00 ~ 1F (3) 00 ~ FF/00 ~ FF	(1) 1A ~ 2R/1A ~ 4R (2) 00 ~ 0F/00 ~ 1F (3) 00 ~ FF/00 ~ FF
DKC460I (21-12-00-xx/xx)	(1) 1A ~ 4R/1A ~ 2R (2) 00 ~ 1F/00 ~ 0F (3) 00 ~ FF/00 ~ FF	(1) 1A ~ 4R/1A ~ 4R (2) 00 ~ 1F/00 ~ 1F (3) 00 ~ FF/00 ~ FF	(1) 1A ~ 4R/1A ~ GR (2) 00 ~ 1F/00 ~ 3F (3) 00 ~ FF/00 ~ 3FF

(7) Planned Outage of HORC Asynchronous Components
Please refer to THEORY03-1870 for the procedure when the subsystem stops planning with the HORC asynchronous pair formed.

Note: If there is any HORC asynchronous pairs created for NAS user LUs, suspend all these pairs before executing the subsystem stops process.

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◆ 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 DKC515 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 35MB.

④ Use the WebConsole 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 HORC Async pair volumes.

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10. LUN installation

10.1 Overview

LUN installation feature makes it enable to add LUNs to DKC515 FIBRE/iSCSI ports while I/Os are still running.
Some host operations are required before the added volumes are recognized and become usable from the host operating systems.
MCU port (Initiator port) of Fibre Remote Copy function does not support LUN installation.

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10.2 Specifications

(1) General
  (a) LUN installation feature supports FIBRE interface and iSCSI interface.
  (b) LUN installation is supported.
  (c) LUN installation can be executed by SVP or by Web Console.
  (d) Some operating systems require reboot operation to recognize the newly added volumes.
  (e) 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.
  (f) MCU port (Initiator port) of Fibre Remote Copy function does not support LUN installation.

(2) Platform support
Host Platforms supported for LUN installation are shown in Table 10.2-1.

Table 10.2-1 Platform support level.

Support level	FIBRE
(A) LUN installation and LUN recognition.	Solaris, HP-UX, AIX, Windows2000, Windows2003
(B) LUN installation only. Reboot is required before new LUNs are recognized.	—
(C) LUN installation is not supported. Host must be shutdown before installing LUNs and then must be rebooted.	—

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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/iSCSI port supports LUN recognition with Table 10.3-1.

Support (A) -> Execute LUN recognition procedures in Table 10.3-1

Not support (B) -> Reboot host and execute normal install procedure.

(2) Host operations

Host operations for LUN recognition are shown in Table 10.3-1.

Table 10.3-1 LUN recognition procedures outline for each platform

Platform	LUN recognition procedures
HP-UX	(1) **`ioscan`** (check device added after IPL) (2) **`insf`** (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
Windows2000 Windows2003	Automatically detected

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11. LUN de-installation

11.1 Overview

LUN de-installation feature makes it enable to delete LUNs to DKC515 FIBRE/iSCSI ports while I/Os are still running.
MCU port (Initiator port) of Fibre Remote Copy function does not support Online LUN de-installation.

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11.2 Specifications

(1) General
- (a) LUN de-installation feature supports FIBRE interface and iSCSI interface.
- (b) LUN de-installation can be used only for the ports on which LUNs are already existing.
- (c) LUN de-installation can be executed by SVP or by “Web Console”.
- (d) When LUNs should be de-installed for LUN de-installation, stop Host I/O of concerned LUNs.
- (e) If necessary , execute backup of concerned LUNs.
- (f) De-install concerned LUNs from HOST.
- (g) In case of AIX, release the reserve of concerned LUNs.
- (h) In case of HP-UX do not delete LUN=0 under existing target ID.
- (i) MCU port (Initiator port) of Fibre Remote Copy function does not support Online 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 11.2-1.

Table 11.2-1 Support platform

Platform	OS	Fibre
HP	HP-UX	○
SUN	Solaris	○
RS/6000	AIX	○
PC	Windows 2000 Windows2003	○

(example) ○: support, ×: not support

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11.3 Operations

(1) Operations

Step 1: Confirm whether or not the initiator platform of the FIBRE/iSCSI port supports LUN de-installation with Table 11.2-1.
Support :Go to Step 2.
Not support :Go to Step 3.

Step 2: If HOST MODE of the 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 Remote "Web Console".

(2) Host operations

Host operations for LUN de-installation procedures are shown in Table 11.3-1.

Table 11.3-1 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)

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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 224 ports or 2048 WWNs 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.

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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 Fig. 12.3-1.)

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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. Fig. 12.3-1 shows the procedures for prioritized port control.

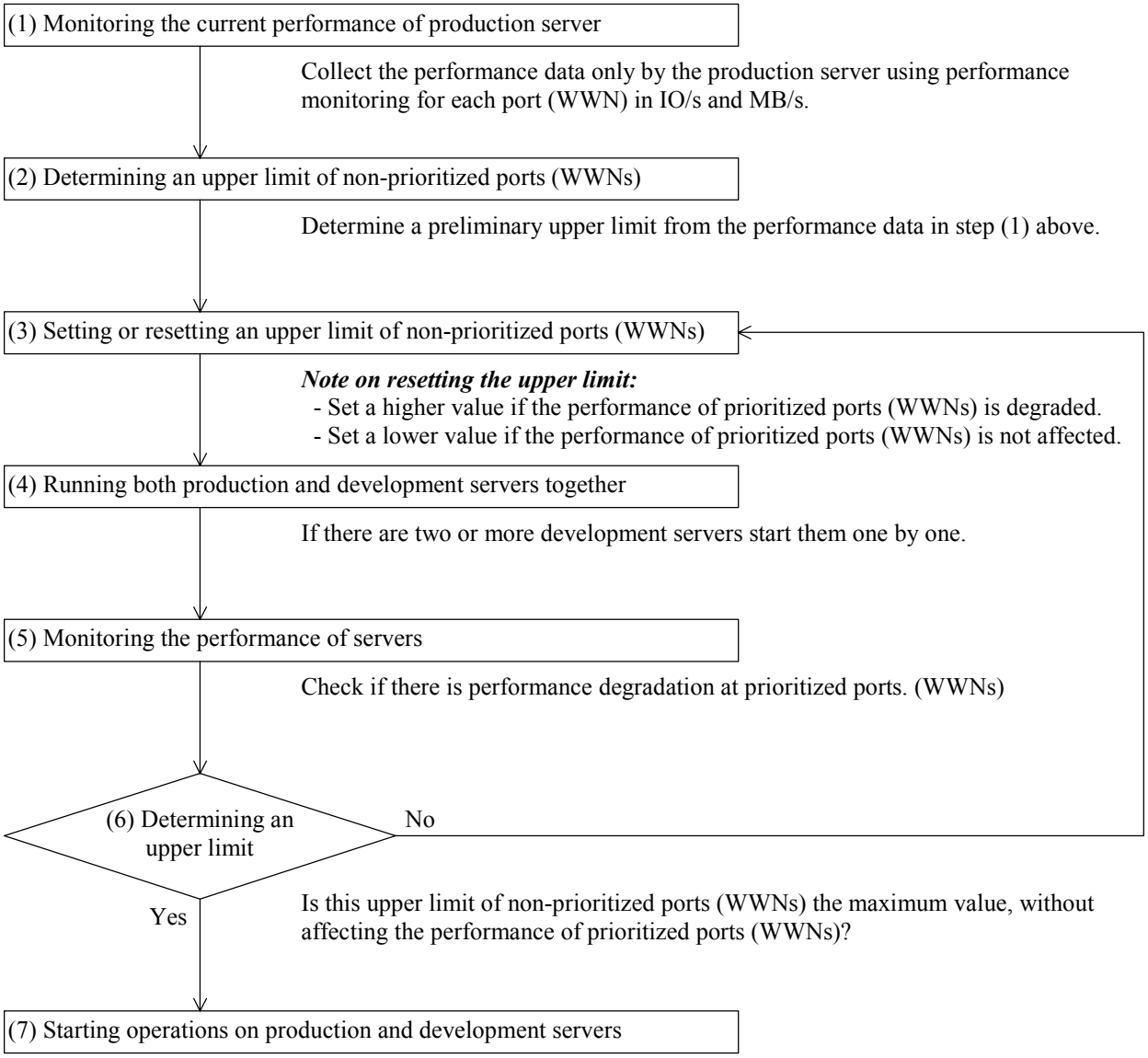

Fig. 12.3-1 Flow of Prioritized Ports Control

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13. Auto Alternate SCSI Path Mode

13.1 Overview

An enhancement was made to both the RAID500 SVP program and HDLM version 5.4 (or higher) to assist the microcode exchange in an automatic alternate path mode.

The microcode exchange process for an MP (microprocessor) requires the microcode to be loaded into each MP and then that MP must be rebooted to activate the new code. During the reboot time, this MP is offline.

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13.2 Micro-program Exchange process used in Alternate SCSI Path Mode

When using Alternate SCSI Path mode the new micro-program is loaded into the MPs on Cluster1. When these MPs reboot, the MPs go offline, HDLM senses the lost path and automatically switches these paths to their alternate in Cluster2. A Wait Time function has been added which will allow these paths to fail over and then allow time for the reboot to finish before attempting recovery of the path. It is therefore important to set both the Wait Time value via the SVP (per formula in MM) and also to set Automatic Fail Back (AFB) mode in HDLM.

After the Fail Back time, which depends on alternate path software, has passed (Wait Time needs to be set accordingly), the blocked processor will be recovered, and the alternate path will be recovered. When the blocked MPs have recovered, the process will continue on the remaining MPs in Cluster2.

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13.3 Settings required to operate in Auto Alternate SCSI Path Mode

For setting values of Wait Time in Auto Alternate Path Mode and the settings of the Auto Fail Back feature in HDLM, see MICRO-FC04-70.

Note: When this feature is used, the alternate path software may report a path failure to the OS at the time of MP reboot. When the user enables the trap report of the path failure, it may be reported. Therefore, the customer must full understand that these errors will be logged.