

## 4.6.4—HP SureStore E Disk System FC10

### Description

The SureStore E Disk System FC10 provides compact, high-speed, high-capacity data storage on ten redundantly addressable disks. A total of 100 Fibre Channel disks, in ten storage systems, fill one Fibre Channel loop. Eleven storage systems fill one 2-meter System/E cabinet, yielding 2 TBs of storage with 18.2-GB disks, 4 TBs of storage with 36.4-GB disks and 8 TBs of storage with 73.4-GB disks.

Disks and redundant modules are replaceable by the system administrator without downtime. Fans and power supplies are redundant, and Link Control Cards are redundant when the second card is connected. When one of the pair fails, storage operations continue while a replacement is obtained and installed.

Included software continually monitors the storage system and reports errors through the Event Monitoring System to a remote location according to the user configuration of the EMS. Other host software initiates port bypass and prepares logical volumes for disk swapping. Online and offline diagnostics are also available.

**Figure 4.6.4.1 HP SureStore E Disk System FC10**



**Table 4.6.4.1 HP SureStore E Disk System FC10 – Field-Racked**

A5236A		SureStore E Disk System FC10
	001	2 each Gigabit Interface Converter
	204	4×18.2GB 10K RPM Fibre Channel Drives
	208	8×18.2GB 10K RPM Fibre Channel Drives
	210	10×18.2GB 10K RPM Fibre Channel Drives
	304	4×36.4GB 10K RPM Fibre Channel Drives
	308	8×36.4GB 10K RPM Fibre Channel Drives
	310	10×36.4GB 10K RPM Fibre Channel Drives
	404	4×73.4GB 10K RPM Fibre Channel Drives
	408	8×73.4GB 10K RPM Fibre Channel Drives
	410	10×73.4GB 10K RPM Fibre Channel Drives
	504	4×18.2GB 15K RPM Fibre Channel Drives
	508	8×18.2GB 15K RPM Fibre Channel Drives
	510	10×18.2GB 15K RPM Fibre Channel Drives

**Table 4.6.4.2 HP SureStore E Disk System FC10 – Factory-Racked**

A5236AZ		SureStore E Disk System FC10
	001	2 each Gigabit Interface Converter
	204	4×18.2GB 10K RPM Fibre Channel Drives
	208	8×18.2GB 10K RPM Fibre Channel Drives
	210	10×18.2GB 10K RPM Fibre Channel Drives
	304	4×36.4GB 10K RPM Fibre Channel Drives
	308	8×36.4GB 10K RPM Fibre Channel Drives
	310	10×36.4GB 10K RPM Fibre Channel Drives
	404	4×73.4GB 10K RPM Fibre Channel Drives
	408	8×73.4GB 10K RPM Fibre Channel Drives
	410	10×73.4GB 10K RPM Fibre Channel Drives
	504	4×18.2GB 15K RPM Fibre Channel Drives
	508	8×18.2GB 15K RPM Fibre Channel Drives
	510	10×18.2GB 15K RPM Fibre Channel Drives
	OZ4	2-meter Fibre Channel Cable (Optical, A3583A)
	AFY	16-meter Fibre Channel Cable (Optical, A3531A)
	OZ5	50-meter Fibre Channel Cable
	OZ6	100-meter Fibre Channel Cable (Optical)

**Table 4.6.4.3 Upgrade Kits**

A3735A		50-meter Fibre Channel Cable (Optical)
A5234A		Add on 18.2 GB 10K RPM FC Disk Module
A5596A		Add on 36.4 GB 10K RPM FC Disk Module
A5627A		Add on 73.4 GB 10K RPM FC Disk Module
A5634A		Add on 18.2 GB 15K RPM FC Disk Module
A5245A		1 each Gigabit Interface Converter
A5250A		Rack Rail Accessory Kit
A5251A		HP Rack System /E Rack Rail Access Kit
A5612A		Field Install Swing Out Bracket for PDU
A5612AZ		Factory Install Swing Out Bracket for PDU

**Note:** Please note that as of 1 March 2000, you must order A5225A as the add-on part number for the 1 each Gigabit Interface Converter

## Features

The FC10 storage system occupies 3.5 EIA units in a standard 19-inch rack. Disk drives mount in the front of the system. Redundant power supplies, fans, Link Control Cards, and Gig-Bit Interface Converters are accessible from the rear. A front door shields the environment from RFI and provides access to the disk drives and power button.

### High Availability

High Availability is a general term describing hardware and software systems that are designed to minimize planned and unplanned downtime. The FC10 is designed to protect against component and system-level failures and, when there is a failure, to prevent data loss and recover system functionality in a reasonable amount of time. The following features are part of the FC10's high availability design:

- Hot-pluggable, high-capacity, high-speed Fibre Channel disks
- Dual Fibre Channel loops to each disk
- Automatic port bypass control and loop recovery
- Redundant, hot pluggable, and user-replaceable fans and power supplies
- Support for mirrored disks in the HP-UX environment
- Online firmware upgrades
- Remote monitoring and diagnostics
- Real-time error reporting

### Enclosure Services

The FC10 Link Control Card (LCC) manages system components and communicates their status to the host application. This monitoring and management of system components includes the following services:

- Number, status, monitoring, and two-speed control of installed fans
- Number, status, and control of installed power supplies
- Number of disk slots in the system (with or without disks)
- Number, temperature, and monitoring of temperature sensors
- Audio alarms
- Speaker status
- Value of the FC address for each disk slot
- Control and status of the Fault LED for all elements
- Port Bypass Circuitry management
- Host/controller status reporting and control
- Self-test

Each LCC provides status and control for all elements in the FC10, even though it does not have direct access to every element.

Additionally, the EEPROM on each LCC stores 2 Kbytes of configuration information and user-defined data (such as data center location, row, cabinet, etc.), including the manufacturer serial number, worldwide name, and product number.

### Status Indicators

LEDs on the front and back of the storage system indicate the status of individual components and of the overall system.

On the front of the FC10 there is a pair of LEDs for the whole system and one for each disk module.

- System LEDs—the first system LED is green and shows whether or not the power is plugged in and turned on. The second LED is amber and shows if one or more components have failed.
- Disk LEDs—A green and amber LED for each disk show, respectively, whether or not the disk is operating and whether or not a fault has occurred.

On the back of the system, bicolor LEDs indicate the status of replaceable modules:

- Power Supply LED—The LED is green when the power supply is operating properly, but amber when one or more of its components have failed.
- Fan LED—The fan LED is green when the fan is operating properly, but amber when one or more of its components have failed.
- LCC LED—The LED is green when the Link Control Card is operating properly, but amber when one or more of its components have failed.

### Upgradability

System administrators can increase storage capacity in several ways: 1) by replacing low-capacity disk modules with high-capacity, 2) by adding disks in unused slots, and 3) by adding storage systems to the loop. None of these actions require downtime.

Storage system firmware is upgradable through a software download function.

### Capacity

The SureStore E Disk System FC10 has ten (10) slots for storage mechanisms. Low-profile devices (1 inch high) as well as half-height devices (1.6 inches high) require 1 slot each, therefore a maximum of ten low-profile devices or a maximum of ten half-height devices can be inserted. The enclosure can accept a mixture of low-profile and half-height mechanisms, or, stated another way, the enclosure can accept multiple capacity points such as 9- and 18-GB HDDs simultaneously.

### Power Reset

An on/off button behind the system door controls power from the power supplies to the Link Control Cards and other modules. Power from the AC mains to the power supplies is controlled by the power cord or by an optional PDU circuit breaker or cabinet power switch.

**Table 4.6.4.4 HP SureStore E Disk System FC10 Summary**

Functionality	HP SureStore E Disk System FC10	
	Rackmount	
Number of 3.5 inch mechanisms	10 LP <sup>1</sup> – 10 HH <sup>1</sup>	
Disk Drive Support		
9 GB 10K Fibre Channel	Yes	
18 GB 10K Fibre Channel	Yes	
36 GB 10K Fibre Channel Ready	Yes	
73 GB 10K Fibre Channel	Yes	
Enclosures per rack	HP Standard Rack	HP Rack System/E
1.1-meter rack	4	4
1.6-meter rack	8	8
2-meter rack	10	11
High Availability Functionality		
Hot Plug	Yes	
Redundant Fans	Yes	
Redundant Power Supplies	Yes	
Number of power cords	2 with 2nd PS	
Number of Fibre Channel Loops	2	

<sup>1</sup> LP - Low-Profile, 1 inch high mechanisms HH - Half-Height, 1.6 inch high mechanisms

### Powerfail Protection

A UPS is required for powerfail protection for the current HP FC10. The 5.2-kVA UPS is recommended for use with the HP FC10.

## On-Site Power Requirements

Before installing the FC10, make sure the environment is equipped to meet power needs.

**Table 4.6.4.5 Maximum Operating Current**

Incoming Voltage AC RMS	Maximum RMS Current Drawn by One FC10
100-120 Volts	5.3-6.5 amps
200-240 Volts	2.6-3.2 amps

The FC10 is supported on 100-120 VAC or 200-240 VAC.

## Cables

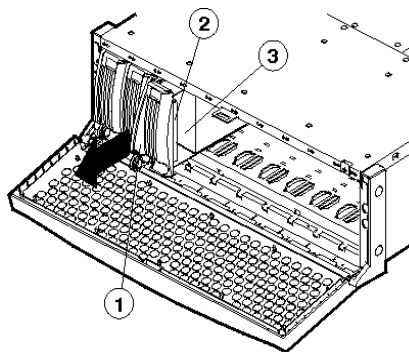
The cables must be explicitly ordered for both factory-racked and field-racked configurations. In the case of the factory racked A5236AZ, the cable may be ordered via an option. In the case of the field racked A5236A, the cables must be ordered separately.

## Configuration

**Step 1:** Determine the required number and type of Fibre Channel storage mechanisms. For example, 1 TB of Protected Storage requires 220 9.1-GB 10K Disks, or 110 18.2-GB 10K Disks. It is recommended that the FC10 is configured with a minimum disk requirement of at least two disks per power supply. Since the FC10 comes with two power supplies, it should be configured with at least four disks.

**Step 2:** Determine the number of FC10 enclosures required. Each FC10 has a spindle capacity of ten. Ten 9.1-GB LP or 10 18.2-GB HH. Make your selection based upon customer data requirements. For example, a higher spindle count usually means higher performance in OLTP, or transaction based environments. Data Warehousing, DSS, and scientific applications tend to favor larger spindle capacities, however this is not true in all cases. Also consider that protected storage configurations require twice the capacity of unprotected JBOD. For example, a 1 TB data warehouse will require 2 TBs of disk space in a mirroring configuration.

**Figure 4.6.4.2**



Consider the following ways to achieve 1 TB of protected storage with the FC10:

**Table 4.6.4.6**

	Spindle Count	FC10 Chassis
9.1 GB	220	22
18.2 GB	110	11
36.4 GB	55	6
73.4 GB	28	3

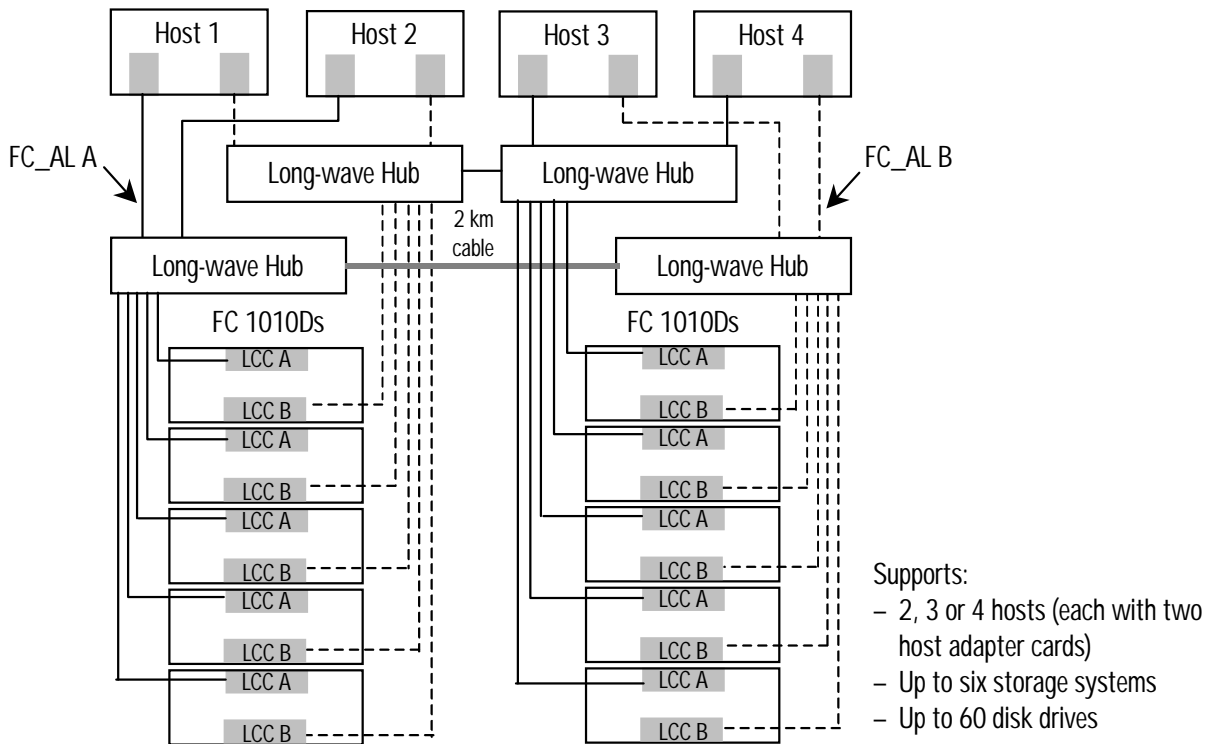
The number of enclosures required for a given capacity is equal to the spindle count / divided by ten plus an additional enclosure for any remaining spindles.

**Step 3:** Determine the required overall configuration of the FC10. The FC10 supports high availability through a variety of configurations. Each redundant loop in the storage system can be connected to a different adapter in the same or different hosts. Connecting the loops to a hub provides a degree of redundancy, but connecting them to different hubs provides a higher degree of redundancy.

**4-way Disaster Tolerant MC/ServiceGuard Configuration**

The following configuration maximizes disaster recovery by incorporating a series of storage systems over a long-wave hub at distances of up to 10 kilometers on redundant loops. Each loop is connected to two adapters, each in a different server. This is an appropriate configuration for remote sites as well as 4-way configurations not requiring disaster tolerance using the HP A3721A/AZ short-wave hub. The FC10 supports data mirroring between the two internal busses of the same enclosure in non-MC/ServiceGuard configurations.

**Figure 4.6.4.3 4-way Disaster Tolerant MC/ServiceGuard Configuration**

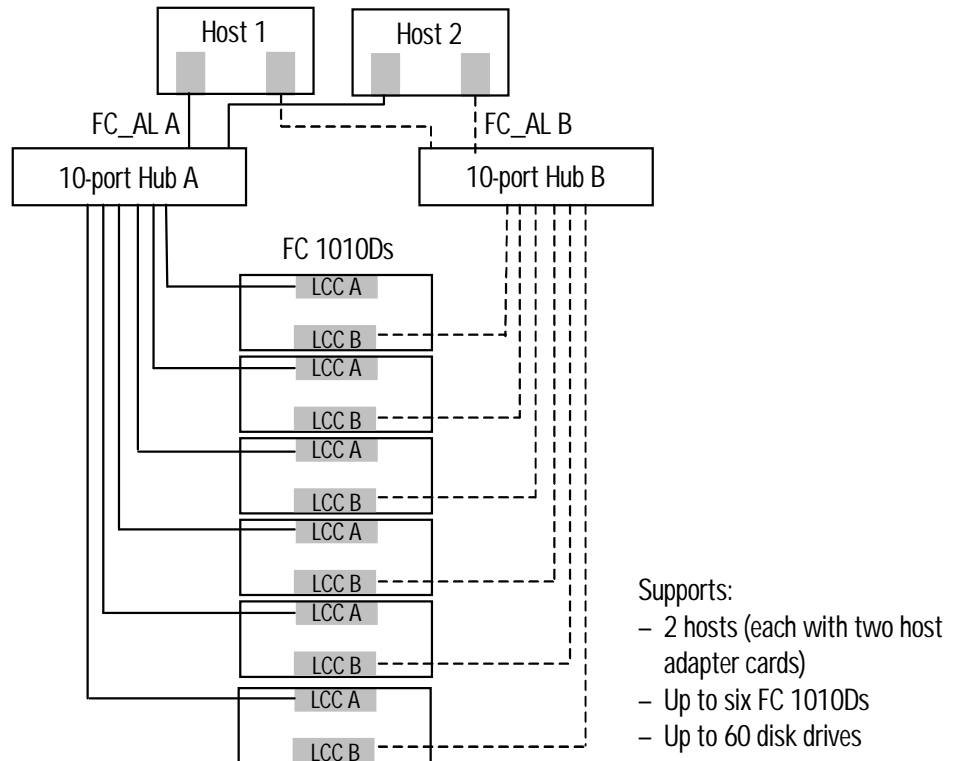


**Note:** Currently, as of 1 February 1999, the maximum supported FC10 enclosures in this topology is 6.

### 2-way MC/ServiceGuard Configuration

Each FC10 can be connected to different 10-port FC-AL short-wave hubs (HP A3721A/AZ) on different hosts, as shown in figure. The FC10 supports data mirroring between the two internal loops of the same enclosure in non-MC/ServiceGuard configurations. The maximum number of FC10's on any Fibre Channel loop in this configuration is 6.

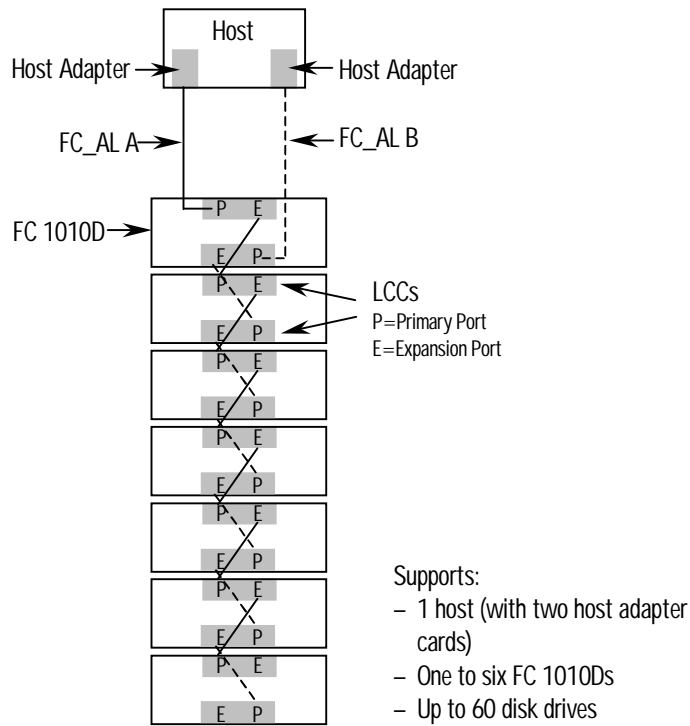
**Figure 4.6.4.4 2-way MC/ServiceGuard Configuration**



**Single Host Configuration**

The FC10 has built-in hub functionality to allow daisy chained configurations of up to 6 enclosures. This is another way of achieving a level of high availability without incurring the cost of a hub. In **Figure 4.6.4.5**, one of the two adapter cards in each server can reach any storage system through its primary or secondary path. This configuration requires ordering an additional Opt. 001 per (count -1) FC10 to enable daisy chaining of the expansion port.

**Figure 4.6.4.5 Single-host Configuration**





## Single Host, One FC10 Disk System

Connecting one disk system to one host will not achieve high availability. The FC10 is supported in single-host, single-enclosure environments for those customers who desire a cost-reduced implementation and are willing to trade off high availability features. The FC10 now supports data mirroring between the two internal FibreChannel loops of the same enclosure in non-MC/ServiceGuard configurations. It is expected that customers will use this configuration for performance reasons, and should not expect any level of data availability from a single-host, one-disk system per data mirror configuration. Yes, data is mirrored, but a failure of the midplane in this configuration could result in downtime.

### Racking Considerations

Currently the FC10 is available only in a racked configuration. When installing the FC10 in an existing customer rack, be sure to determine the rack model. The FC10 ships with rack rail kits for either existing HP rack series or the new Rack System/E. In addition, determine whether or not the FC10 is to be racked at the factory. If so, assume the A4900A, A4901A, or A4902A rack models. If installing the FC10 in a Rittal 9000 series rack, order A5656A. Also, order A5612A or A5612AZ when installing the FC10 in a rack with a 30-Amp PDU.

- The FC10 takes 4U per enclosure plus rail set in the A1883A/A1896A, A1884A/A1897A, and A3656A.
- The FC10 takes 3.5U per enclosure and rail set in the A4900A, A4901A, or A4902A rack models.
- Redundant PDU configurations as shown are defined as including redundant power cords to the wall. Non-redundant PDU (power) configurations can be built but are not recommended for high availability environments.

The following table details the available configurations for the HP Rack models A1883A/A1896A, A1884A/A1897A, and A3656A.

**Table 4.6.4.7 Maximum number of FC10 enclosures per HP Rack (A1883A/A1896A, A1884A/A1897A, and A3656A)**

Required PDU/PDRU Type	1.1-meter (21 U)	1.6-meter (32 U)	2.0-meter (41U)	Rack Switch Support
2 x 3 ft., 16 Amp	4	–	–	Yes
2 x 5 ft., 16 Amp	–	4	4	Yes
2 x 19 in., 16 Amp	4	4	4	–
4 x 19 in., 16 Amp	–	–	8	–
2 x 19 in., 30 Amp	–	8	8	–
2 x 19 in., 30 Amp and 2 x 19 in., 16 Amp	–	–	10	–
2 x 19 in., 60 Amp	–	–	10	–

**Table 4.6.4.8 Maximum number of FC10 enclosures per HP Rack System/E (A4900A/J1502A, A4901A/J1501A, and A4902A/J1500A)**

Required PDU/PDRU Type	Power cords to wall	1.25-meter (25 U)	1.6-meter (33 U)	2.0-meter (41U)	Rack Switch Support
2 x 16 Amp	2	4	4	4	Yes, add 1 x dual 16-amp PRU
4 x 16 Amp or 2 x 30 Amp	4	–	8	8	Yes, add 2 x 3 0-amp PDRU
	2	–	8	8	yes
6 x 16 Amp or 2 x 30 Amp and 2 x 16 Amp or 2 x 60 Amp	6	–	–	11	Add 2 x 60-amp PDRU
	4	–	–	11	–
	2	–	–	11	Yes

## Notes

1. FC10 takes up 4U per box plus rail set in Rack System, and 3.5U per box and its rail set in Rack System/E
2. Redundant PDU configurations shown are defined as including redundant power cords to the wall. Non-redundant PDU configurations can also be constructed per User needs.
3. Groupings show solution options to achieve 4, 8, or 11 FC10 in the racks. Options within the groups vary w.r.t. the number of power cords going the wall AC.
4. (\*) These are traditional (existing for HP Rack System) PDUs.
5. (\*\*) To achieve the highest rack densities, large PDRUs must be placed behind the storage systems. Installed with hinged brackets, these PDUs can rotate up or down for convenient servicing of rear FRUs.
6. The 60-amp PDRU will not be available at first release.
7. The on/off switch option for HP Rack System/E will work only with the 2×16A PDUs (need to add the dual 16-amp PRU), and with the large PDRUs. The 4×16A and the 6×16A combinations do not support the on/off switching. Combinations of 16 amp plus 30 or 60 amp PDU/PDRUs can be configured to always support on/off switching.
8. The 4 and 6×16A configurations will be susceptible to high inrush currents during start-up scenarios. The 30- and 60-amp PDRUs are designed to minimize inrush compared to the 16-amp PDUs.

## HBA Considerations—Fibre Channel Host Bus Adapters

Fibre Channel interconnects can be implemented in three different topologies; point-to-point, arbitrated loop and switched fabric. The point-to-point topology is the simplest. It is made up of two ports connected by a single link. Hewlett-Packard does not support the point-to-point topology for storage devices. The arbitrated loop topology is designed to allow multiple devices to be connected to a common loop. The switched fabric topology permits many ports to be interconnected.

Hewlett Packard's implementation of Fibre Channel is arbitrated loop. Two arbitrated loop topologies are supported: direct connect and hub connect. Direct connect is the simplest topology. It looks like the point-to-point topology, but is actually a two node loop. The system interface card is connected via optical cable directly to a peripheral device such as an EMC array. Each I/O interface card can support only a single connection. Hub connect is implemented with the short-wave and long-wave Fibre Channel hubs (A3724A/AZ and A4839A/AZ) which permit multiple connections per I/O interface card

HP's Fibre Channel implementation for mass storage supports 100 MB per second half duplex, 200 MB per second full duplex. This may also be referred to as 1 Gbit Fibre Channel or full-speed Fibre Channel. To differentiate between the mass storage interconnect and networking interconnect, remember that the HP networking interconnect (for EPS) is 266 Mbits per second or quarter speed.

**Note:** 100 MB per second half duplex (200 MB per second full duplex) is the maximum bandwidth supported by the channel. However, actual performance will vary with each configuration and application, and will rarely actually achieve the maximum. Always consult a technical resource to ensure that proper expectations are set.

For Fibre Channel mass storage interconnect with HP-UX 10.20 (TFC), the software driver must be ordered in addition to the interface card. The Fibre Channel mass storage driver and license product number is J3630BA. With HP-UX 11.0 the driver for Fibre Channel mass storage is integrated into the core OS.

The following table details the supported Fibre Channel Host Bus Adapters and supported operating system releases for the FC10.

**Table 4.6.4.9 Fibre Channel Interfaces/Infrastructure**

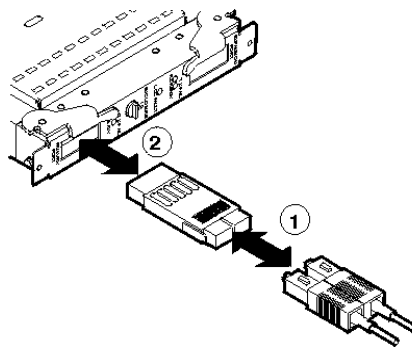
Interfaces				
System Class	Product Number	Description	OS Release	Maximum number of cards per system
V-Class	A3740A	1 GB PCI Fibre Channel Interface	HP-UX 11.0	20
T-Class	A3636A	1 GB HP-HSC FC interface for T-Class	HP-UX 10.20 TFC, 11.0	22
K-Class	A3404A	1 GB HP-HSC FC interface for K-Class	HP-UX 10.20 TFC, 11.0	5 or 9 (equal to HSC slots)
D-Class	A3591A	1 GB HP-HSC FC interface for D-Class	HP-UX 10.20 TFC, 11.0	2 on D-Class, except 3 on D350, D360, D370, and D380 (one of the FC adapters must be plugged-in to the turbo slot).

Please refer to the HPSO Configuration Matrix for the most up-to-date information regarding storage system configurations on HP 9000 Enterprise Servers as well as HP 9000 Visualize workstations at <http://esbu.boi.hp.com/esbuatc/>

The FC10 has built in hub functionality to allow daisy chaining of enclosures on the same loop. Up to six enclosures can be daisy chained without the use of the HP hubs A3724A/AZ (short-wave) or A4839A/AZ (long-wave). Configurations of six to ten FC10s on the same loop require the use of one of the aforementioned hubs. Ten FC10s on the same loop, with the use of a hub, is the maximum configuration per loop. This configuration is not currently supported.

**Step 4:** Determine the number of Gigabit Interface Converter (GBIC) requirements. Two GBICs are required to interface optical signals to electrical signals on the primary Fibre Channel port of the LCC. Two additional GBICs are required for the expansion port in daisy chained configurations. For example, the GBIC count of **Figure 4.6.4.6** is x.

**Figure 4.6.4.6**



**Step 5:** Determine the optical cabling requirements. One optical cable is required to interface to the HBA of the host, and additional optical cables are required for redundant connections and for daisy chaining.

**Step 6:** Determine the count and type of PDUs required. See above PDRU table.

## Miscellaneous

### Operating System Support

**Table 4.6.4.10**

Functionality	SureStore E Disk System FC10
HP-UX 9.04	No
HP-UX 10.0	No
HP-UX 10.01	No
HP-UX 10.10	No
HP-UX 10.20	Yes
HP-UX 11.00	Yes
HP-UX 11.01	
Windows NT Server v4.0 SP3	No
Windows NT Server Enterprise Edition v4.0 SP3	No
MPE	No
Boot—Single-host	Yes
Boot—Multi-host	No
Root	Yes
Swap	Yes
Install	Yes
LVM	Yes
SwitchOver/UX	No
MirrorDisk/UX	Yes
MC/ServiceGuard	Yes
Cluster Lock Disk	Yes
MC/LockManager with OPS environments up to 4 nodes	No
Hot Swap	Yes