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Hitachi TagmaStore®
Adaptable Modular Storage
and Workgroup Modular Storage

Linux® Host Installation Guide

MK-95DF731-02

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Document Revision Level

Revision	Date	Description
MK-95DF731-00	June 2005	Initial Release
MK-95DF731-01	August 2005	Revision 1, supersedes and replaces MK-95DF731-00
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Source Document(s) for this Revision

The following source document was used to produce this Adaptable Modular Storage host installation guide:

- HDS review of this document

Changes in this Revision

- Updated the document to include *Hitachi TagmaStore® Adaptable Modular Storage Model AMS1000 User and Reference Guide* (MK-95DF780) and *Hitachi TagmaStore Workgroup Modular Storage Model WMS100 User and Reference Guide* (MK-95DF738).
- Added information for clarification of fibre-channel adapter (HBA) support to section 2.1.
- Updated the contact information in section 4.2.

Preface

This host installation guide describes and provides instructions for installing and configuring the devices on the Adaptable Modular Storage system for operation with the Linux® operating system. This host installation guide assumes that the user:

- Has a background in data processing and understands direct-access storage device systems and their basic functions.
- Is familiar with the Hitachi Adaptable Modular Storage or Workgroup Modular Storage system.
- Is familiar with the Linux operating system, including commands, utilities, and file systems.

Note: The terms "Adaptable Modular Storage" and "Workgroup Modular Storage" refer to the entire Hitachi Adaptable and Workgroup Modular Storage system family, unless otherwise noted. Refer to the *Hitachi TagmaStore Adaptable Modular Storage Model AMS1000 User and Reference Guide* (MK-95DF780), *Hitachi TagmaStore Adaptable Modular Storage Model AMS500 User's Guide* (MK-95DF714), *Hitachi TagmaStore Adaptable Modular Storage Model AMS200 User's Guide* (MK-95DF713) or *Hitachi TagmaStore Workgroup Modular Storage Model WMS100 User and Reference Guide* (MK-95DF738) for more information about the Adaptable Modular Storage and Workgroup Modular Storage systems.

Note: For more information about Linux, contact your Linux vendor's technical support.

Microcode Level

This document revision applies to TagmaStore Adaptable Modular Storage and Workgroup Modular Storage versions 2.0 and higher.

Convention for Storage Capacity Values

Storage capacity values for hard disk drives (HDDs) on the AMS and WMS systems are calculated based on the following values:

1 KB = 1,000 bytes
1 MB = 1,0002 bytes
1 GB = 1,0003 bytes
1 TB = 1,0004 bytes

Storage capacity values for logical units (LUs) on the AMS and WMS systems are calculated based on the following values:

1 KB = 1,024 bytes
1 MB = 1,0242 bytes
1 GB = 1,0243 bytes
1 TB = 1,0244 bytes

Referenced Documents

- *Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular* Storage: *Storage Navigator - Modular Command Line Interface (CLI) User's Guide* (MK-95DF712)
- *Hitachi TagmaStore Adaptable Modular Storage and Workgroup Modular Storage: Storage Navigator - Modular Graphical User Interface (GUI) User's Guide* (MK-95DF711)
- *Hitachi TagmaStore Adaptable Modular Storage: Storage Navigator Web User's Guide* (MK-95DF719)
- *Hitachi TagmaStore Adaptable Modular Storage Model AMS1000 User and Reference Guide* (MK-95DF780)
- *Hitachi TagmaStore Adaptable Modular Storage Model AMS500 User and Reference Guide* (MK-95DF714)
- *Hitachi TagmaStore Adaptable Modular Storage Model AMS200 User and Reference Guide* (MK-95DF713)
- *Hitachi TagmaStore Workgroup Modular Storage Model WMS100 User and Reference Guide* (MK-95DF738)

Comments

Please send us your comments on this document. Make sure to include the document title, number, and revision. Please refer to specific section(s) and paragraph(s) whenever possible.

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Thank you! (All comments become the property of Hitachi Data Systems Corporation.)

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Chapter 1 Introduction

Welcome to the Linux® Host Installation Guide for Hitachi TagmaStore® Adaptable Modular Storage and Workgroup Modular Storage.

This guide describes the requirements and procedures for connecting Adaptable Modular Storage and Workgroup Modular Storage systems to a Linux server. The Hitachi Data Systems representative performs the initial physical installation of the Adaptable Modular Storage system. The user then configures the new Adaptable Modular Storage devices with assistance as needed from the Hitachi Data Systems representative.

Configuration of the Adaptable Modular Storage disk devices for Linux operations includes:

- Setting LUs and file sizes (Chapter 2)
- Installing the Adaptable Modular Storage system (Chapter 3)
- Creating and formatting partitions (Chapter 3)
- Setting Auto Mount (Chapter 3)
- Verifying file system operations (Chapter 3)

Note on the term "SCSI disk": The Adaptable Modular Storage logical devices are defined to the host as SCSI disk devices, even though the interface is fibre-channel.

1.1 Adaptable Modular Storage System

The Hitachi Adaptable Modular Storage Series system is a high-performance, medium-capacity storage system, with added features for increasing data accessibility and enabling continuous user data access. The architecture of the Adaptable Modular Storage enables the user to scale the system to meet a wide range of capacity and performance requirements. The Adaptable Modular Storage system provides connectivity to most open systems through a standard fibre-channel interface.

For more information about the Adaptable Modular Storage system, refer to the *Hitachi TagmaStore Adaptable Modular Storage Model AMS500 User's Guide* (MK-95DF714), the *Hitachi TagmaStore Adaptable Modular Storage Model AMS200 User's Guide* (MK-95DF713), or contact your Hitachi Data Systems account team.

Chapter 2 Preparing for New Device Configuration

This chapter covers the following topics:

- Configuration requirements (section 2.1)
- Installing an Adaptable Modular Storage system (section 2.2)
- Preparing to connect Adaptable Modular Storage (section 2.3)
- Connecting the Adaptable Modular Storage system to a Linux system (section 2.4)
- Configuring the host fibre-channel adapters (section 2.5)
- Rebooting the Linux system (section 2.6)

2.1 Configuration Requirements

The requirements for undertaking an Adaptable Modular Storage Linux configuration are:

- **Hitachi TagmaStore Adaptable Modular Storage system**

  The Storage Navigator Adaptable Modular Storage software is required to configure the fibre-channel (FC) ports on the Adaptable Modular Storage system.

  Note: The availability of Adaptable Modular Storage features and functions depends on the level of microcode installed on the Adaptable Modular Storage system.

- **Linux® server**

  For information on server hardware requirements, refer to the vendor's user documentation.

  Note: Hitachi Data Systems plans to support future releases of Linux. This document will be updated as needed to cover version-specific information.

- **Superuser (root) login access to the host system**

- **Fibre-channel adapters (host bus adapters)**

  Be sure to install all utilities, tools, and drivers that come with the adapter(s).

  – The Adaptable Modular Storage system supports full-speed (1 and 2 Gbps), shortwave, non-OFC (open fibre control) optical fibre-channel interface and multimode optical cables with SC and/or LC connectors. Do not connect any OFC-type fibre-channel interface to the Adaptable Modular Storage system.

  Note: It is recommended that users read all vendor release note and vendor installation guides before setting up HBA configuration files.

  Note: For information on supported fibre-channel adapters (HBAs), HBA drivers, optical cables, and fabric switches (models and firmware), please contact your Hitachi Data Systems account team or the Hitachi Data Systems Support Center (see section 4.2). For other information on supported fibre-channel adapters and driver requirements, refer to the user documentation for the adapter or contact the vendor.

- **High-availability (HA) software (optional)**

  The Adaptable Modular Storage currently supports the following HA software products for the Linux operating system. Please contact your Hitachi Data Systems account team for the latest information on supported software products.

  – Hitachi Dynamic Link Manager (HDLM) for path failover.

  – VERITAS Volume Manager™ (VxVM) for logical volume management.

2.2 Installing an Adaptable Modular Storage System

The Adaptable Modular Storage system comes with all the hardware and cabling required for installation. Installation of the Adaptable Modular Storage system involves the following activities:

- **Hardware installation**

  A Hitachi Data Systems representative performs hardware installation as specified in the Hitachi TagmaStore Adaptable Modular Storage Maintenance Manual. Follow all precautions and procedures in the Adaptable Modular Storage maintenance manual. Check all specifications to ensure proper installation and configuration. Hardware installation includes:

  - Assembling all hardware and cabling
  - Installing the latest microcode level
  - Creating RAID groups and LUNs and formatting LUNs using the Storage Navigator Adaptable Modular Storage software. For information and instructions about using Storage Manager, refer to the following documents:
    - *Hitachi TagmaStore Adaptable Modular Storage - Storage Navigator Modular Command Line Interface (CLI) User's Guide* (MK-95DF712)
    - *Hitachi TagmaStore Adaptable Modular Storage - Storage Navigator - Modular Graphical User Interface (GUI) User's Guide* (MK-95DF711)
    - *Hitachi TagmaStore Adaptable Modular Storage - Storage Navigator Web User's Guide* (MK-95DF719)
  - Installing the fibre-channel adapters and cabling

- **Adaptable Modular Storage Fibre Channel Ports**

  Fibre topology parameters for each Adaptable Modular Storage fibre-channel port depend on the type of device to which the Adaptable Modular Storage port is connected. Determine topology parameters supported by the device, and set your topology accordingly (see section 2.3.1.1).

  Use Storage Navigator for Adaptable Modular Storage software to configure Adaptable Modular Storage fibre ports. For instructions about using Storage Navigator, refer to the following documents:

  - *Hitachi TagmaStore Adaptable Modular Storage - Storage Navigator Modular Command Line Interface (CLI) User's Guide* (MK-95DF712)
  - *Hitachi TagmaStore Adaptable Modular Storage - Storage Navigator - Modular Graphical User Interface (GUI) User's Guide* (MK-95DF711)
  - *Hitachi TagmaStore Adaptable Modular Storage - Storage Navigator Web User's Guide* (MK-95DF719)

2.3 Preparing to Connect Adaptable Modular Storage

Before connecting an Adaptable Modular Storage system, perform the following tasks:

- Set the host-specific parameters for the Adaptable Modular Storage fibre-channel port(s) (see section 2.3.1)
- Configure the Adaptable Modular Storage fibre-channel ports (see section 2.3.1.2)

You use the Storage Navigator Adaptable Modular Storage software to configure the Adaptable Modular Storage ports (see Figure 2.1). Some key configuration selections you can make include:

- **Topology (Connection):** Loop or Point-to-Point
- **Port Option:** Optional settings on the port that describe how the host accesses the port. Multiple options can be selected: reset/LIP mode (signal), reset/LIP mode (process), reset/ALL LIP port mode, reset target (reset bus device) mode, etc.
- **Host mode:** Standard, Open VMS, Wolfpack, TRESPASS, etc. Select the host mode for the connected platform to enable the host to "see" all LUNs on the port.
- **Extended Host Mode (Host Mode2):** Optional settings on the port that describe how the host accesses the port. Multiple options can be selected such as UA (06/2A00) suppress mode, etc.

For instructions on using Storage Navigator, refer to the following documents*:*

- *Hitachi TagmaStore Adaptable Modular Storage - Storage Navigator Modular Command Line Interface (CLI) User's Guide* (MK-95DF712)
- *Hitachi TagmaStore Adaptable Modular Storage - Storage Navigator - Modular Graphical User Interface (GUI) User's Guide* (MK-95DF711)
- *Hitachi TagmaStore Adaptable Modular Storage - Storage Navigator Web User's Guide* (MK-95DF719)

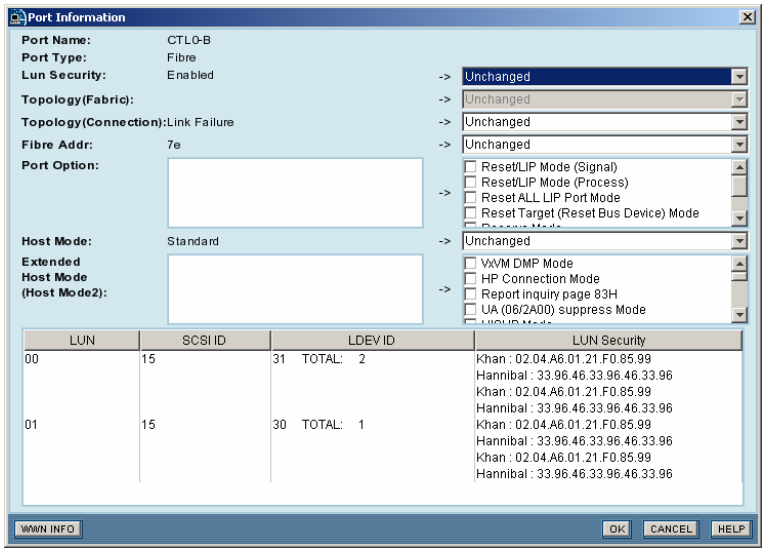

Figure 2.1 Example of Port Information

2.3.1 Setting the Host-Specific Parameters for the Adaptable Modular Storage Ports

The Adaptable Modular Storage ports must be configured for the connected operating system. Use the Storage Navigator Adaptable Modular Storage software to configure the Adaptable Modular Storage fibre ports.

For instructions about using Storage Navigator, refer to the following documents:

- *Hitachi TagmaStore Adaptable Modular Storage - Storage Navigator Modular Command Line Interface (CLI) User's Guide* (MK-95DF712)
- *Hitachi TagmaStore Adaptable Modular Storage - Storage Navigator - Modular Graphical User Interface (GUI) User's Guide* (MK-95DF711)
- *Hitachi TagmaStore Adaptable Modular Storage - Storage Navigator Web User's Guide* (MK-95DF719)

2.3.1.1 Fibre Topology

Configure the Adaptable Modular Storage FC ports to define the fibre topology parameters and port addresses. The Adaptable Modular Storage systems support up to 512 LUNs. You will select the appropriate settings for each Adaptable Modular Storage FC port based on the device to which the port is connected. Determine the topology parameters supported by the device, and set your topology accordingly.

Note: If you plan to connect different types of servers to the Adaptable Modular Storage via the same fabric switch, use either **zoning** on the switch or the Hitachi Volume Security (LUN Management) feature on the Adaptable Modular Storage, or a combination of both.

2.3.1.2 Port Address

In fabric environments, the port addresses are assigned automatically by fabric switch port number and are not controlled by the Adaptable Modular Storage port settings. In FC arbitrated-loop (FCAL) environments, the port addresses are set by entering an AL-PA (arbitrated-loop physical address, or loop ID, or port address). The host communicates with the devices comprising the loop with 8-bit AL-PA (see Table 2.1).

Table 2.1 shows the available Adaptable Modular Storage AL-PA values. Fibre-channel protocol uses the AL-PAs to communicate on the fibre-channel link, but the software driver of the platform host adapter translates the AL-PA value assigned to the Adaptable Modular Storage port to a SCSI TID. See Appendix A for a description of the AL-PA-to-TID translation.

Note on loop ID conflict: The Linux system assigns port addresses from lowest (01) to highest (EF). To avoid loop ID conflict, assign the port addresses from highest to lowest (i.e., starting at EF). The AL-PAs should be unique for each device on the loop to avoid conflicts. Do not use more than one port address with the same TID in same loop (e.g., addresses EF and CD both have TID 0, see Table A.1.).

Table 2.1 Available AL-PA Values

EF	CD	B2	98	72	55	3A	25
E8	CC	B1	97	71	54	39	23
E4	CB	AE	90	6E	53	36	1F
E2	CA	AD	8F	6D	52	35	1E
E1	C9	AC	88	6C	51	34	1D
E0	C7	AB	84	6B	4E	33	1B
DC	C6	AA	82	6A	4D	32	18
DA	C5	A9	81	69	4C	31	17
D9	C3	A7	80	67	4B	2E	10
D6	BC	A6	7C	66	4A	2D	0F
D5	BA	A5	7A	65	49	2C	08
D4	B9	A3	79	63	47	2B	04
D3	B6	9F	76	5C	46	2A	02
D2	B5	9E	75	5A	45	29	01
D1	B4	9D	74	59	43	27	
CE	B3	9B	73	56	3C	26	

2.4 Connecting the Adaptable Modular Storage System to a Linux System

The Adaptable Modular Storage system comes with all the hardware and cabling required for connection to the host system(s). Connection of the Adaptable Modular Storage system involves the following steps. Some of these steps are performed by the Hitachi Data Systems representative, while other steps are performed by the user.

Note: The Hitachi Data Systems representative must use the Adaptable Modular Storage maintenance manual during all installation activities. Follow all precautions and procedures in the maintenance manual, and always check all specifications to ensure proper installation and configuration.

1. **Verify system installation.** A Hitachi Data Systems representative verifies the fibre port address configuration and the status of the FC adapters and LDEVs (normal).
2. **Shut down the Linux system.** The user shuts down and powers off the Linux system before connecting the Adaptable Modular Storage:
   a) Shut down the Linux system.
   b) Power off all peripheral devices, except the Adaptable Modular Storage system.
   c) Power off the Linux system. You are now ready to connect the Adaptable Modular Storage system.
3. **Connect the Adaptable Modular Storage to the Linux system.** The Hitachi Data Systems representative installs the fibre-channel cables between the Adaptable Modular Storage and the Linux system.
4. **Power on the Linux system.** The user or Hitachi Data Systems representative powers on the Linux system after connecting the Adaptable Modular Storage system:
   a) Power on all peripheral devices. The Adaptable Modular Storage system should already be on and the fibre-channel ports should already be configured. If the Adaptable Modular Storage fibre ports are configured after the Linux system is powered on, the system must be restarted to recognize the new devices.
   b) Confirm the ready status of all devices.
   c) Power on the Linux system.

2.5 Configuring the Host Fibre-Channel Adapters

After setting and recognizing the LUs, configure the host fibre-channel adapter(s) (HBAs) connected to the Adaptable Modular Storage.

HBAs have many configuration options. Be sure to read the MAN pages and user documentation for the adapter.

2.6 Rebooting the Linux System

After setting and recognizing the LUs and configuring the HBAs, reboot the Linux system.

Chapter 3 Configuring the New Devices

After Adaptable Modular Storage installation and connection procedures have been performed, the devices on the Adaptable Modular Storage system are ready to be configured for use.

Configuration of the Adaptable Modular Storage devices should only be performed by a Linux system administrator and/or a Hitachi Data Systems representative. Configuration requires superuser/root access to the host system. If you have questions or concerns, please contact the Hitachi Data Systems Support Center.

This chapter covers the following Adaptable Modular Storage device configuration procedures:

- Setting the number of logical units (section 3.1)
- Partitioning the new devices (section 3.2)
- Creating, mounting, and verifying the file systems for the new devices (section 3.3)

3.1 Setting the Number of Logical Units

Important: The Adaptable Modular Storage supports up to 512 logical units per fibre-channel port (256 per host group), but the Linux system only supports a maximum of 64 LUNs in one system. If other devices already exist on different host adapters, the number of available LUs will be reduced accordingly.

To set the number of LUs:

1. Edit the `/etc/modules.conf` file to add a line similar to the following:

   ```
   options scsi_mod max_scsi_luns=16
   ```

2. To set the Emulex driver, as shown in Figure 3.3, add the following line to the `/etc/modules.conf` file:

   ```
   Alias scsi_hostadapter lpfcdd
   ```

3. To activate the above modification, make an image file for booting. For example:

   ```
   # mkinitrd /boot/initrd-2.4.x.scsiluns.img `uname -r`
   ```

4. To change the setting of Bootloader, use one of the following methods:

   a) **LILO used as Bootloader.** You need to edit the lilo.conf file as shown in Figure 3.1, and then execute the **lilo** command to activate the lilo.conf setting with selecting the label. For example: # lilo

   b) **GRUB (GRand Unified Bootloader) is used as Bootloader.** Edit the `/boot/grub/grub.conf` file as shown in Figure 3.2.

5. Reboot the system.

```
image=/boot/vmlinuz-qla2x00
       label=Linux-qla2x00
       append="max_scsi_luns=16"
       # initrd=/boot/initrd-2.4.x.img                    ← Comment out this line.
       initrd=/boot/initrd-2.4.x.scsiluns.img                    ← Add this line.
 root=/dev/sda7
 read-only
#sbin/lilo
```

Figure 3.1 Setting the Number of LUs (LILO)

```
kernel /boot/vmlinuz-2.4.x ro root=/dev/hda1
# initrd /boot/initrd-2.4.x.img                    ← This line is commented out.
initrd /boot/initrd-2.4.x.scsiluns.img                    ← Add this line.
```

Figure 3.2 Setting the Number of LUs (GRUB)

```
      Alias scsi_hostadapter lpfcdd                    ← Add this to
                                                       /etc/modules.conf
```

Figure 3.3 Setting the Emulex Driver

3.2 Partitioning the Devices

After setting the number of LUs, you can set the partitions for the new devices. In a Red Hat® Linux environment, one LU can be divided into a maximum of four primary partitions. Alternatively, you can make a maximum of one extended partition.

To partition the Adaptable Modular Storage disk devices:

1. Enter `fdisk_/dev/<device_name>` (for example, `fdisk_/dev/sda`**,** where **/dev/`sda`** is the device file name).
2. Select **p** to display the present partitions.
3. Select **n** to make a new partition. You can make up to four primary partitions (1-4), or as an alternative, you can make one extended partition. The extended partition can be divided into a maximum of 11 logical partitions, which can be assigned partition numbers from 5 to 15.
4. Select **w** to write the partition information to disk and complete the **fdisk** command.

   Note: Other commands you might want to use include:

   - To remove partitions, select **d**.
   - To stop a change, select **q**.
5. Repeat the above steps for each new Adaptable Modular Storage disk device.

3.3 Creating, Mounting, and Verifying the File Systems

3.3.1 Creating the File Systems

After you partition the devices, you can create the file systems. If you do, be sure they are appropriate for the primary and/or extended partition for each logical unit.

To create the file system, execute the **mkfs** command:
`# mkfs /dev/sda1` (where **/dev/sda1** is device file of primary partition number 1.)

3.3.2 Creating the Mount Directories

To create the mount directories, execute the **mkdir** command:

```
# mkdir / Adaptable Modular Storage-LU00
```

3.3.3 Mounting the New File Systems

Use the **mount** command to mount each new file system (see example in Figure 3.4). The first parameter of the **mount** command is the device file name (**/dev/sda1**), and the second parameter is the mount directory, as shown in Figure 3.4.

```
# mount /dev/sda1 / Adaptable Modular Storage-LU00
        ↖ Device file name  ↖ Mount directory name
#
```

Figure 3.4 Mounting the New Devices

3.3.4 Verifying the File Systems

After mounting the file systems, you should verify the file systems (see example in Figure 3.5).

```
# df -h
Filesystem           Size     Used    Avail    Used%    Mounted on
/dev/sda1            1.8G     890M     866M     51%      /
/dev/sdb1            1.9G     1.0G     803M     57%      /usr
/dev/sdc1            2.2G      13k     2.1G      0%      / Adaptable Modular Storage-LU00
#
```

Figure 3.5 Verifying the File System

3.3.5 Setting the Auto-Mount Parameters

To set the auto-mount parameters, edit the **/etc/fstab** file (see example in Figure 3.6).

```
# cp -ip /etc/fstab /etc/fstab.standard                ← Make a backup of /etc/fstab.
# vi /etc/fstab                                                ← Edit /etc/fstab.
:
/dev/sda1         / Adaptable Modular Storage-LU00 ext2    defaults   0   2  ← Add new
                                                                                 device.
```

Figure 3.6 Setting the Auto-Mount Parameters

Chapter 4 Troubleshooting

4.1 Troubleshooting

For troubleshooting information about Adaptable Modular Storage system, refer to the *Hitachi TagmaStore Adaptable Modular Storage Model AMS500 User's Guide* (MK-95DF714) or *Hitachi TagmaStore Adaptable Modular Storage Model AMS200 User's Guide* (MK-95DF713).

Table 4.1 lists potential error conditions during Adaptable Modular Storage device configuration for Linux and provides instructions for resolving each condition. If you are unable to resolve an error condition, please contact your Hitachi Data Systems representative for help, or call the Hitachi Data Systems Support Center for assistance.

Table 4.1 Troubleshooting

Error Condition	Recommended Action
The logical devices are not recognized by the system.	Make sure that the READY indicator lights on the Adaptable Modular Storage system are ON. Make sure that the LUNs are properly configured. The LUNs for each target ID must start at 0 and continue sequentially without skipping any numbers.
The file system cannot be created.	Make sure that the device name is entered correctly with **mkfs**. Make sure that the LU is properly connected and partitioned.
The file system is not mounted after rebooting.	Make sure that the system was restarted properly. Make sure that the auto-mount information in the **/etx/fstab** file is correct.
LUNs cannot be recognized beyond 16.	Red Hat® Linux versions 7.1 and 7.2 support a maximum of 16 LUNs in one system. If there are other devices on other host adapters, the maximum number is reduced accordingly.
LUNs cannot be recognized beyond 64.	Red Hat® Linux versions AS2.1, ES3 support a maximum of 64 LUNs in one system. If there are other devices on other host adapters, the maximum number is reduced accordingly.

4.2 Calling the Support Center

If you need to call the Hitachi Data Systems Support Center, make sure to provide as much information about the problem as possible, including the circumstances surrounding the error or failure and the exact content of any error messages displayed on the host system(s).

The worldwide Hitachi Data Systems Support Centers are:

- Hitachi Data Systems North America/Latin America
  San Diego, California, USA
  1-800-446-0744
- Hitachi Data Systems Europe
  Contact Hitachi Data Systems Local Support
- Hitachi Data Systems Asia Pacific
  North Ryde, Australia
  61-2-9325-3300

Appendix A SCSI TID Map for Fibre-Channel Adapters

When an arbitrated loop (AL) is established or re-established, the port addresses are assigned automatically to prevent duplicate TIDs. With the SCSI over fibre-channel protocol (FCP), there is no longer a need for target IDs in the traditional sense. SCSI is a bus-oriented protocol requiring each device to have a unique address since all commands go to all devices. For fibre channel, the AL-PA is used instead of the TID to direct packets to the desired destination. Unlike traditional SCSI, once control of the loop is acquired, a point-to-point connection is established from initiator to target. To enable transparent use of FCP, the Linux system "maps" a TID to each AL-PA.

The host maps SCSI protocol to fibre-channel protocol and detects and accesses fibre-connected devices using device files (**/dev/dsk/c*t*d*** and **/dev/rdsk/c*t*d***) in the same way as for SCSI-connected devices. The device files for fibre-connected devices are configured in a different way than SCSI-connected devices, because fibre supports 126 addresses per path while SCSI supports 16 TIDs per path.

Table A.1 identifies the fixed mappings between the TID values assigned by the Linux system and the FC native addresses (AL_PA/SEL_ID) for FC adapters. For each device file (**/dev/dsk/c*t*d***), the **c** value is the adapter number, and the **t** value is the target ID.

Note: The mapping defined in Table A.1 cannot be guaranteed under the following conditions:

- When Adaptable Modular Storage devices and other types of devices are connected in the same loop,
- When information for unused devices remains in server system, or
- When multiple ports participate in the same arbitrated loop.

Table A.1 AL-PA to SCSI TID Mapping (t value) for Linux Systems

AL-PA	t value	AL-PA	t value	AL-PA	t value	AL-PA	t value	AL-PA	t value	AL-PA	t value	AL-PA	t value	AL-PA	t value
EF	0	CD	0	B2	0	98	0	72	0	55	0	3A	0	25	0
E8	1	CC	1	B1	1	97	1	71	1	54	1	39	1	23	1
E4	2	CB	2	AE	2	90	2	6E	2	53	2	36	2	1F	2
E2	3	CA	3	AD	3	8F	3	6D	3	52	3	35	3	1E	3
E1	4	C9	4	AC	4	88	4	6C	4	51	4	34	4	1D	4
E0	5	C7	5	AB	5	84	5	6B	5	4E	5	33	5	1B	5
DC	6	C6	6	AA	6	82	6	6A	6	4D	6	32	6	18	6
DA	7	C5	7	A9	7	81	7	69	7	4C	7	31	7	17	7
D9	8	C3	8	A7	8	80	8	67	8	4B	8	2E	8	10	8
D6	9	BC	9	A6	9	7C	9	66	9	4A	9	2D	9	0F	9
D5	10	BA	10	A5	10	7A	10	65	10	49	10	2C	10	08	10
D4	11	B9	11	A3	11	79	11	63	11	47	11	2B	11	04	11
D3	12	B6	12	9F	12	76	12	5C	12	46	12	2A	12	02	12
D2	13	B5	13	9E	13	75	13	5A	13	45	13	29	13	01	13
D1	14	B4	14	9D	14	74	14	59	14	43	14	27	14	00	-
CE	15	B3	15	9B	15	73	15	56	15	3C	15	26	15		

Acronyms and Abbreviations

CLI	command line interface
FCP	fibre-channel protocol
GUI	graphical user interface
LU	logical unit
LUN	logical unit number
MB	megabytes
OFC	open fibre control
OS	operating system
PC	personal computer system
RAID	redundant array of independent disks
VxVM	VERITAS Volume Manager