IBM Systems Group

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Forschungszentrum Karlsruhe

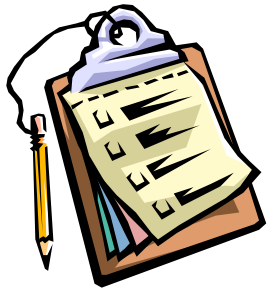
IBM Systems Group

IBM Storage with Linux 2005

Alexander Warmuth
ATS EMEA Storage

Topics

- What is supported
- The Linux SCSI subsystem
- Linux Kernel version 2.6
- Multipathing scenarios
- Tape specifics



What Is Supported

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- Linux Kernel version 2.6
- Multipathing scenarios
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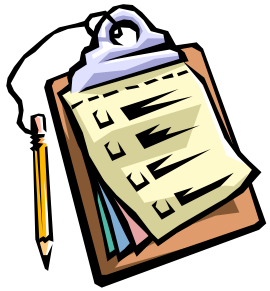


IBM Storage Support for Linux

Enterprise Storage Server

DS4000 Storage Servers

Linear Tape Open

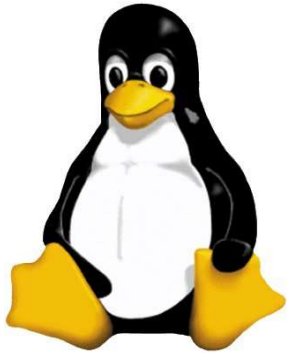
Network Attached Storage

Enterprise Tape

Storage Virtualization

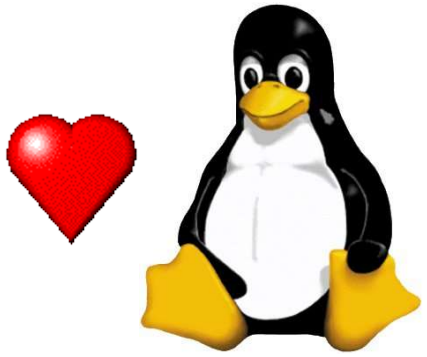
pLinux Support Disk

- **ESS: SLES8, SLES9, RH-EL 3**
  - **SDD available**
  - **JS20, p5 and OP: SLES9, RH-EL 3**
  - **Remote boot supported**
- **DS6000, DS8000: SLES8, SLES9, RH-EL 3**
  - **SDD available**
  - **JS20: SLES8, SLES9, RH-EL 3**
  - **p5 and OP: RH-EL 3 only**
  - **Remote boot supported**
- **DS4000: SLES8, SLES9, RH-EL 3**
  - **Emulex Multipulse driver for multipathing**
  - **SLES 9 single path only**
  - **Remote boot with JS20, others require RPQ**

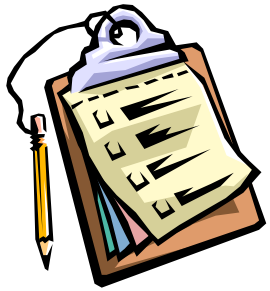


pLinux Support Tape

- **LTO: SLES 8, SLES 9, RH-EL 3**
  - **Data Path (for 3584) and Media Changer failover supported**
- **359x: SLES 8, SLES 9, RH-EL 3**
  - **Data path failover supported for 3592**
- **Parallel SCSI attachment also supported**
- **Advanced**
  - **`IBMtape` device driver**
  - **`IBMtapeutil`**



The Linux SCSI Subsystem



- What is supported
- **The Linux SCSI subsystem**
- Linux Kernel version 2.6
- Multipathing scenarios
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Linux Device Addressing

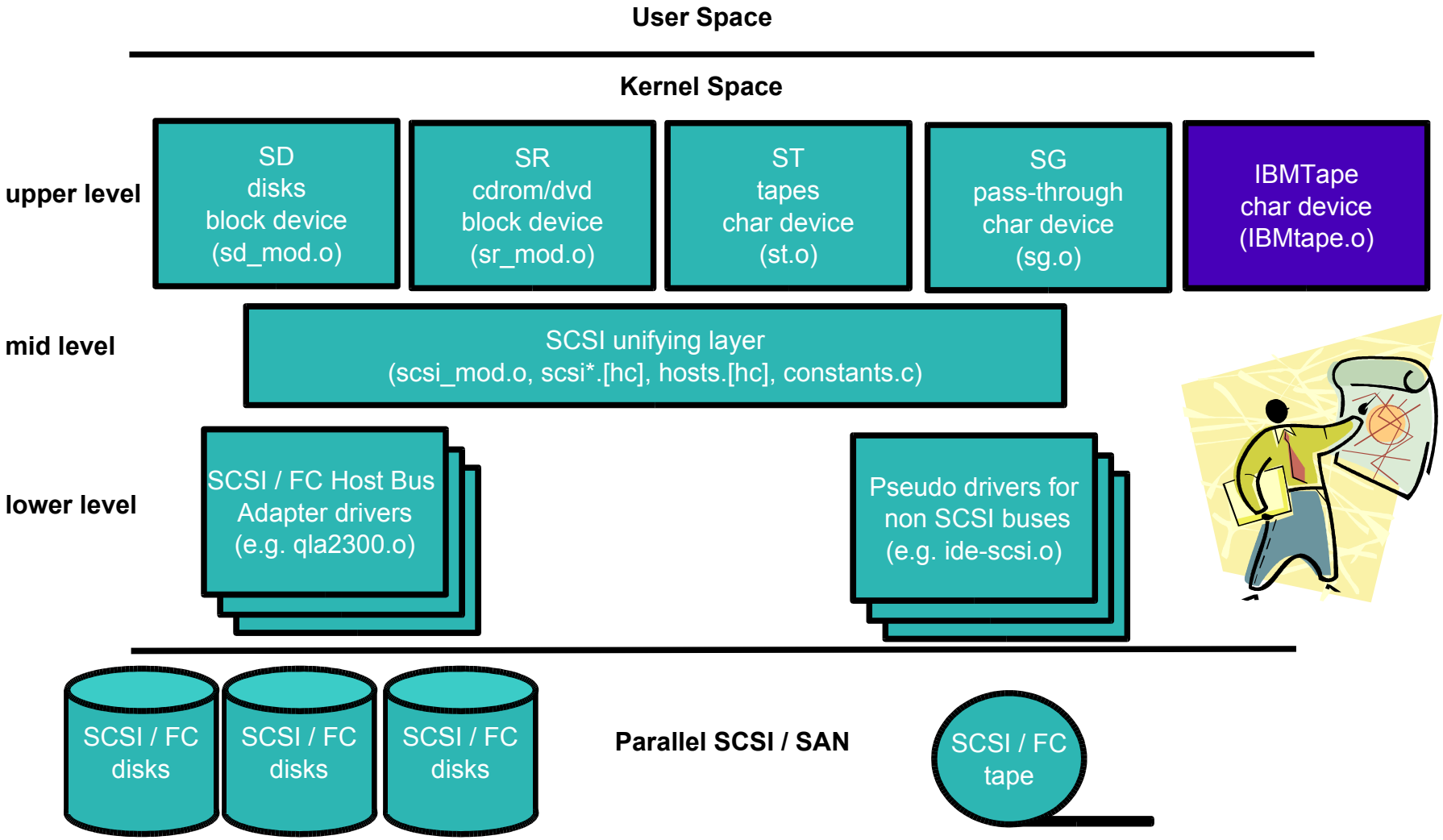
Everything is a file!

```
brw-rw----    1 root     disk       8,   0 2003-03-14 14:07 /dev/sda
brw-rw----    1 root     disk       8,   1 2003-03-14 14:07 /dev/sda1

brw-rw----    1 root     disk       3,   0 2003-03-14 14:07 /dev/hda

crw-rw----    1 root     disk       9,   0 2003-03-14 14:07 /dev/st0
crw-rw----    1 root     disk       9,  96 2003-03-14 14:07 /dev/st0a
crw-rw----    1 root     disk       9,  32 2003-03-14 14:07 /dev/st0l
crw-rw----    1 root     disk       9,  64 2003-03-14 14:07 /dev/st0m
```

Design



Linux Kernel Version 2.6

- What is supported
- The Linux SCSI subsystem
- **Linux Kernel version 2.6**
- Multipathing scenarios
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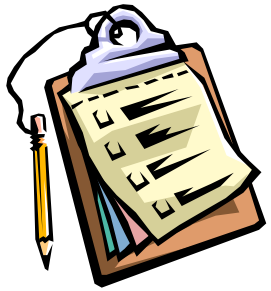
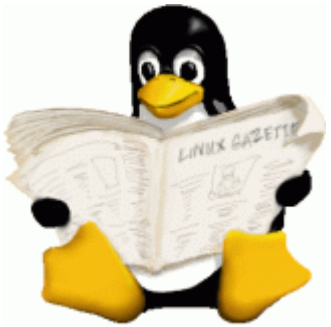


Storage Changes in Linux Kernel 2.6

- Increased number of SCSI devices
- Persistent device names
- Improved hotplugging
- Native multipathing
- LVM 2
- Improved I/O performance
- Larger devices and filesystems



Wellknown Linux SCSI Limitations

- Limited numbe
  - Up to 256 S
  - Up to 256 SCSI g
  - Up to 32 tape drives
- Gaps in LUN sequen
- Limited “on-the-fl
- Device re-or

Fixed with Kernel 2.6

Still there

Fixed with Kernel 2.6

Conditionally fixed with Kernel 2.6

Other Problems and Pitfalls

- Multiple LUN support of RH-EL
- DS4000 Specific
  - QLogic failover driver configuration
  - Potential LUN thrashing
  - UTM (Access LUN)
- ESS, DS6000, DS8000 Specific
  - SDD and LVM, ext3
  - Mounting PPRC targets
  - DS6000 Preferred Path

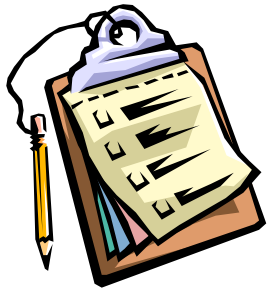
Large filesystems support

File System	File Size [Byte]	File System Size [Byte]
Ext2 or Ext3 (1 kB block size)	2^{34} (16 GB)	2^{41} (2 TB)
Ext2 or Ext3 (2 kB block size)	2^{38} (256 GB)	2^{43} (8 TB)
Ext2 or Ext3 (4 kB block size)	2^{41} (2 TB)	2^{44} (16 TB)
Ext2 or Ext3 (8 kB block size) (systems with 8 kB pages, like Alpha)	2^{46} (64 TB)	2^{45} (32 TB)
ReiserFS 3.5	2^{32} (4 GB)	2^{44} (16 TB)
ReiserFS 3.6 (under Linux 2.4)	2^{60} (1 EB)	2^{44} (16 TB)
XFS	2^{63} (8 EB)	2^{63} (8 EB)
JFS (512 byte block size)	2^{63} (8 EB)	2^{49} (512 TB)
JFS (4 kB block size)	2^{63} (8 EB)	2^{52} (4 PB)
NFSv2 (client side)	2^{31} (2 GB)	2^{63} (8 EB)
NFSv3 (client side)	2^{63} (8 EB)	2^{63} (8 EB)

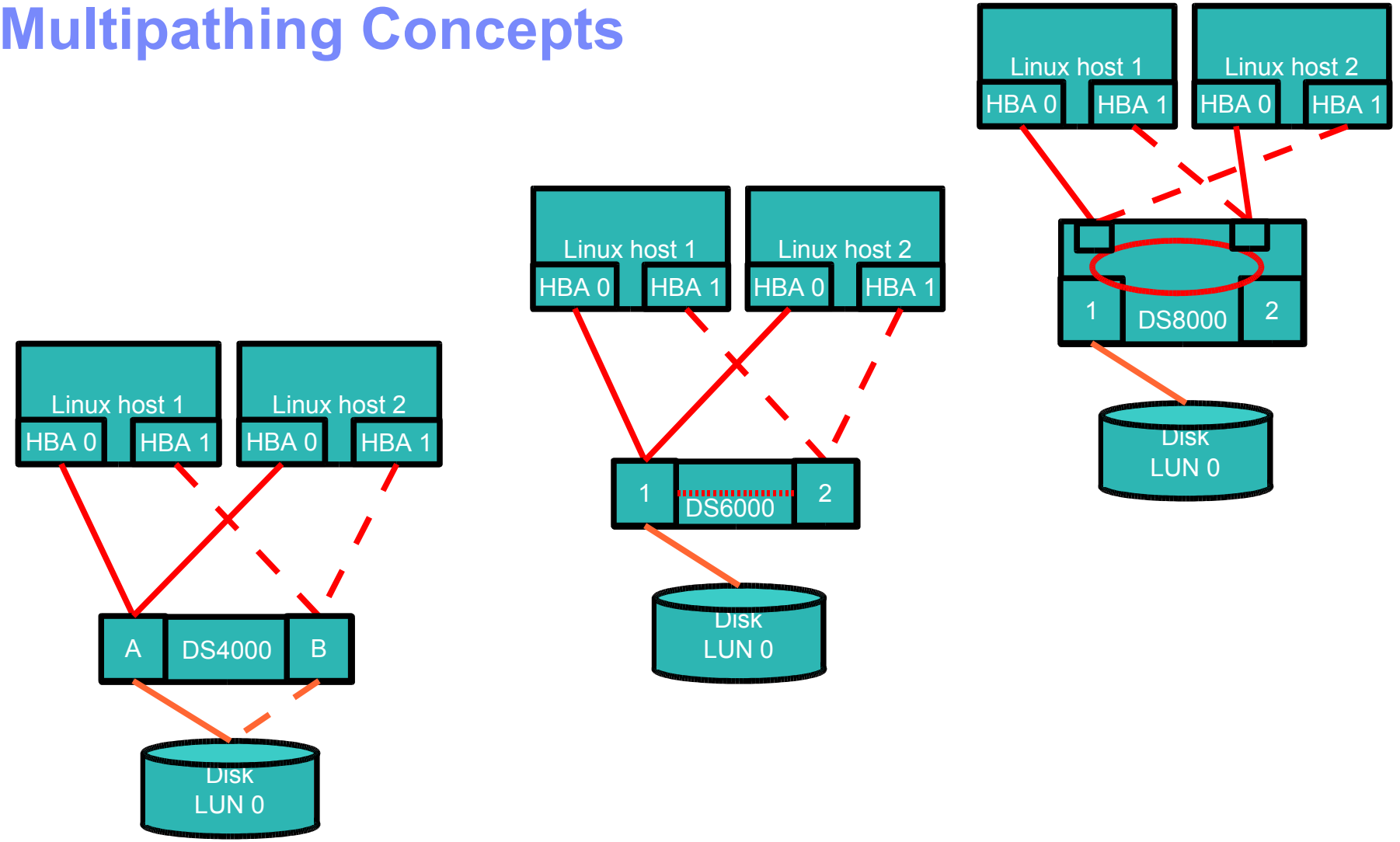
- **Linux Kernel Limits**
  - **Max file size: 2 TB (2^41 bytes)**
  - **Max file system size: 8 ZB (2^73 bytes)**

Multipathing Scenarios

- What is supported
- The Linux SCSI subsystem
- Linux Kernel version 2.6
- **Multipathing scenarios**
- Tape specifics



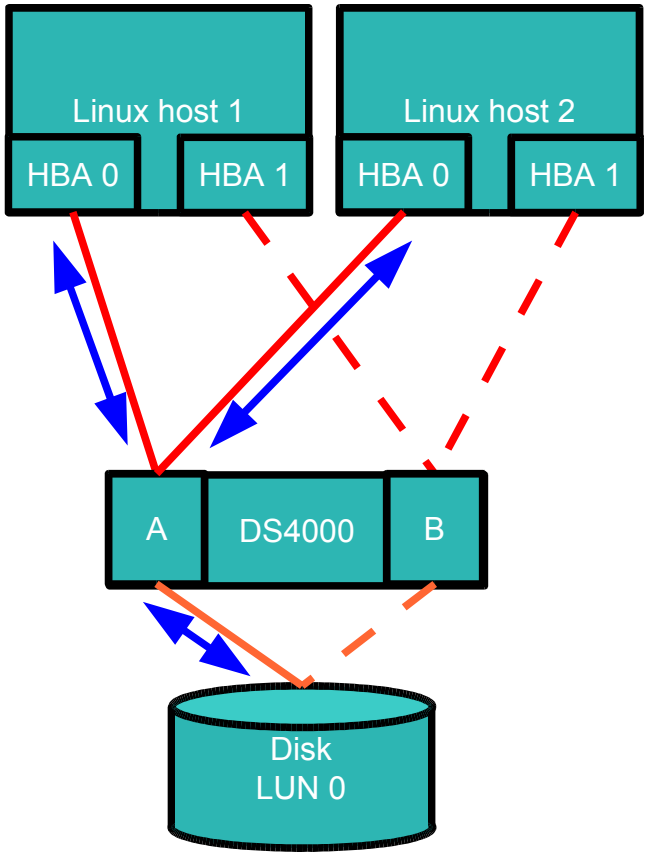
Multipathing Concepts



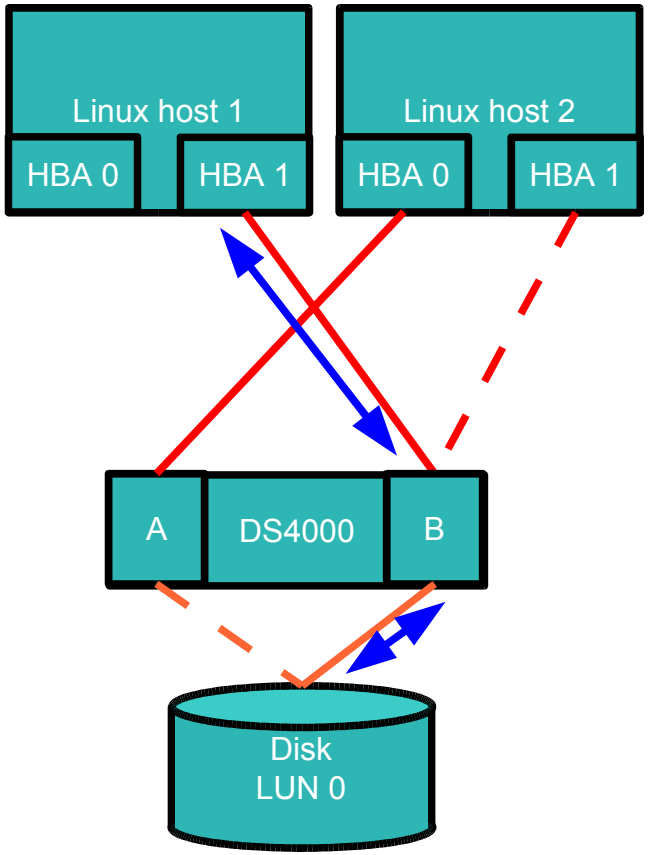
LUN Transfer to Alternate Controller

- DS4000 transfers LUNs to alternate controller
  - Volumes are owned by one controller
  - Volumes can be accessed through both controllers
  - Volume ownership is always transferred to the controller that is used for volume access -> transfer time approx 1 s
- Two multipathing solutions available
  - QLogic failover driver uses AVT
    - Difficult to configure
    - Potential LUN thrashing
  - RDAC uses inband communication
    - Self configuring
    - Suitable for data sharing scenarios

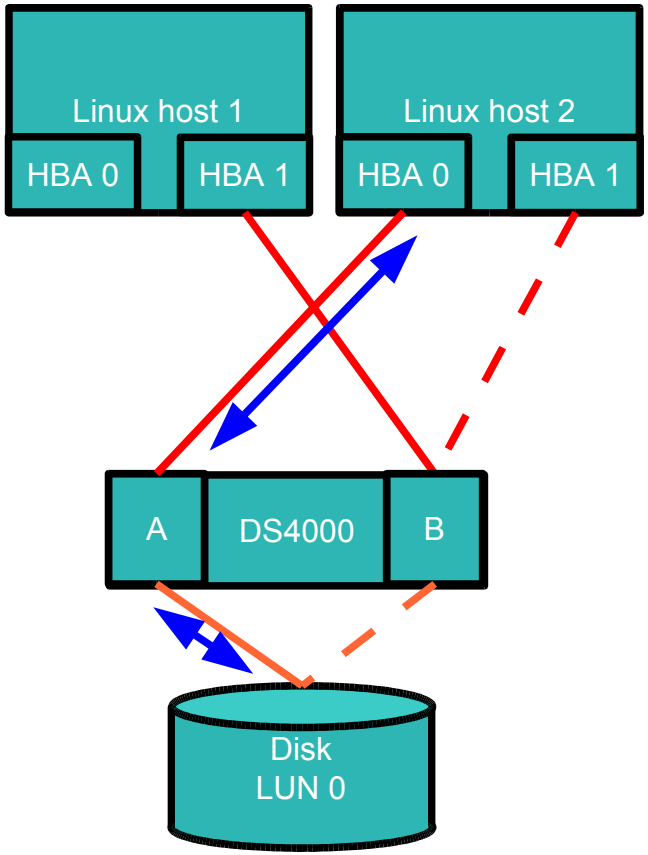
LUN Thrashing Scenario



LUN Thrashing Scenario



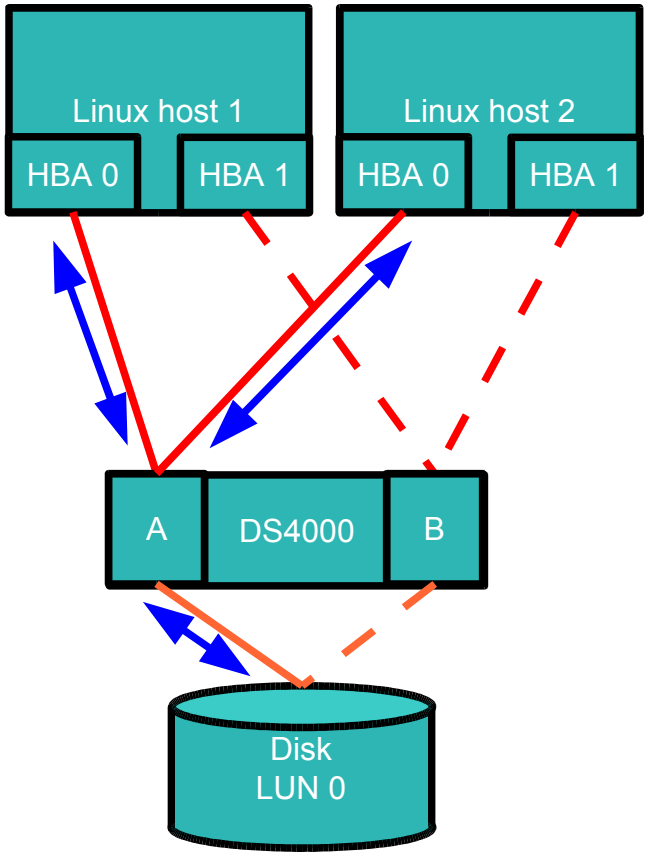
LUN Thrashing Scenario



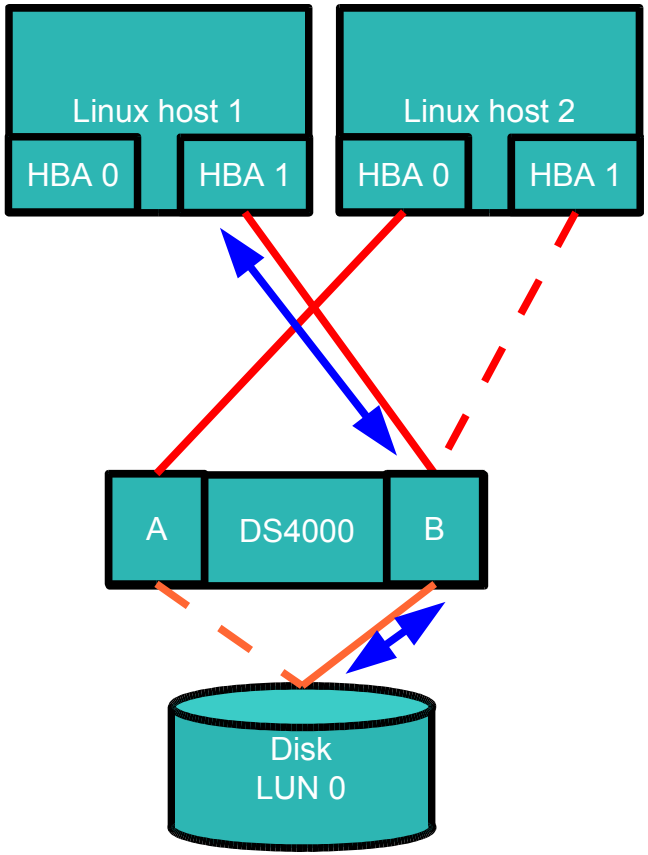
Multipathing with RDAC

- Must use QLogic non-failover driver
- Always uses current path (as reported by DS4000)
- RDAC installation
  - FC HBA driver must be installed and loaded
  - At least one LUN must be assigned and available
  - Must use Host Type LNXCLS - AVT turned off
  - Must update boot loader configuration
- Must run `mppUpdate` after each configuration change
  - Updates RDAC configuration files
  - Rebuilds Initial RAMDisk

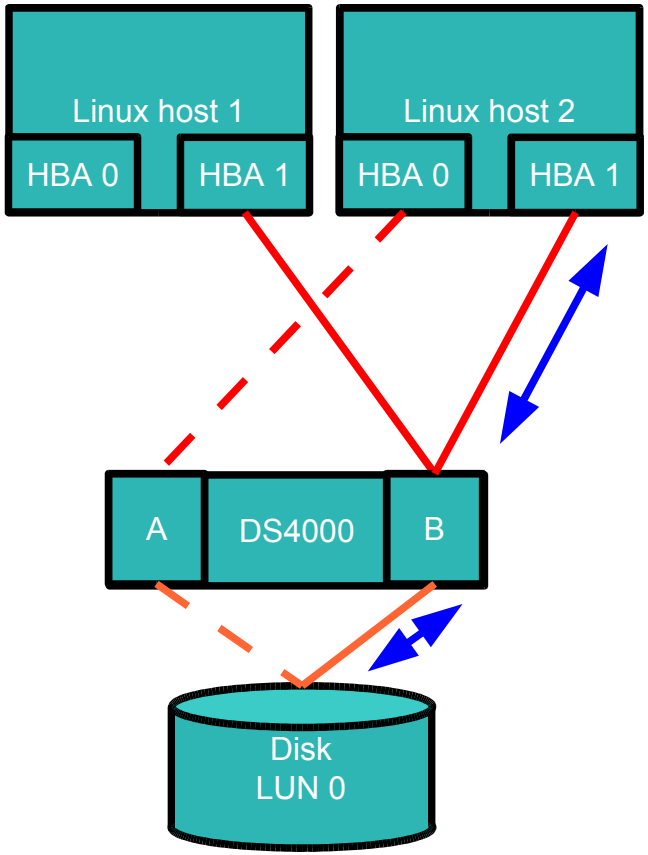
RDAC Shared Data Scenario



RDAC Shared Data Scenario



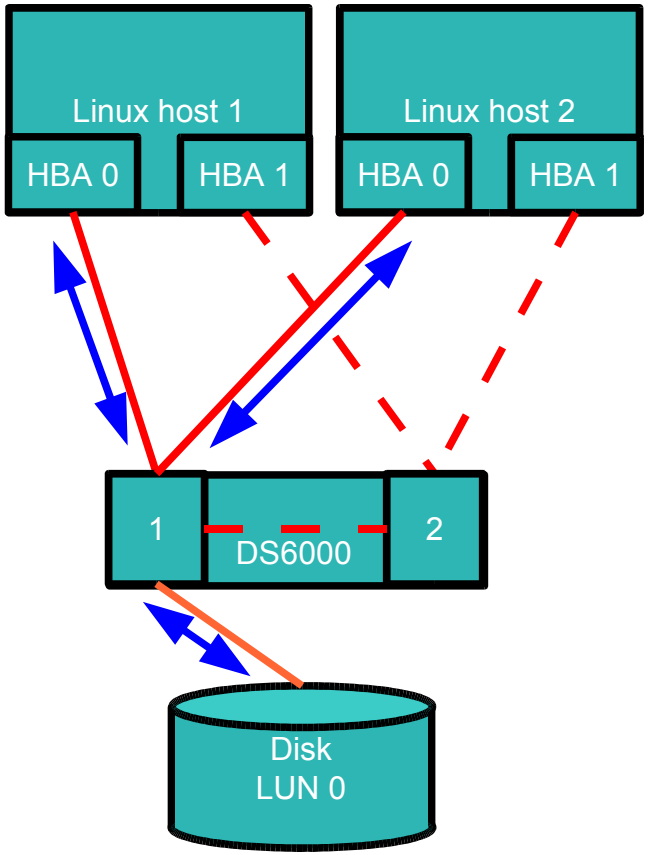
RDAC Shared Data Scenario



Preferred Path

- DS6000 uses concept of preferred path
  - Volumes are owned by one controller
  - Volumes can be accessed through both controllers
  - Data is transferred to and from owning controller to requesting controller internally -> performance penalty
- SDD knows preferred path automatically
  - Access only through owning controller if possible
  - Dynamic load balancing across ports of preferred controller
- Other multipathing solutions theoretically possible, but must (still) be configured manually

Preferred Path Shared Data Scenario



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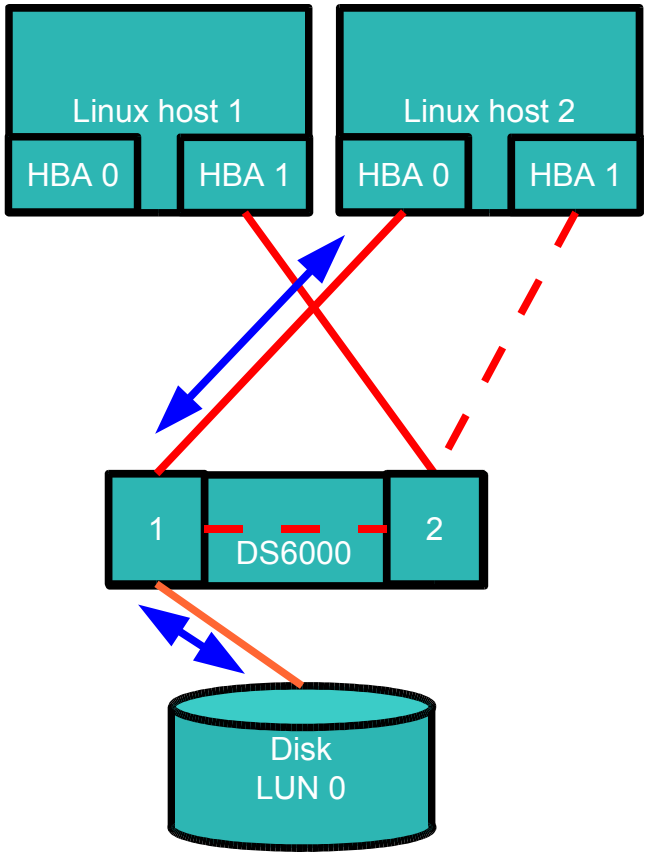

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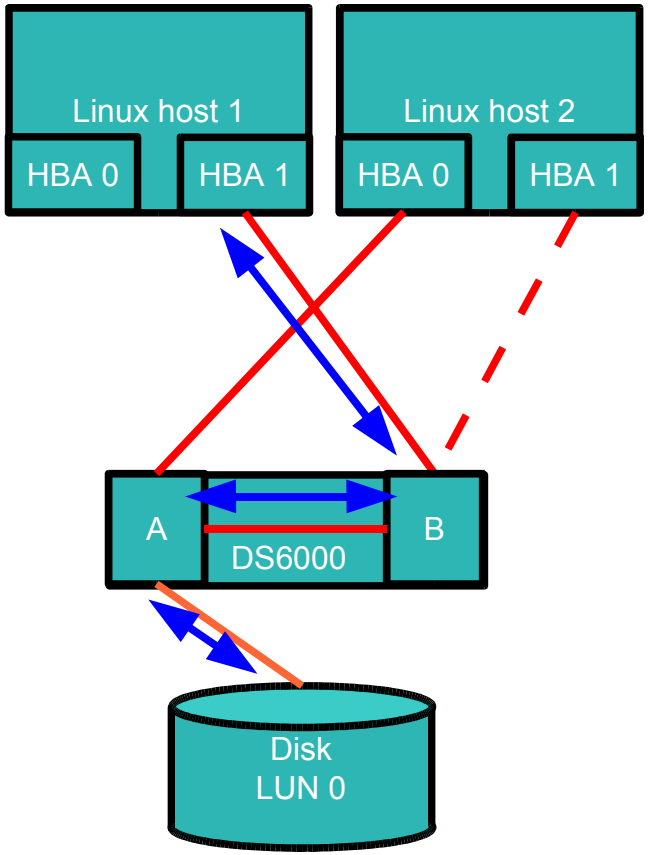

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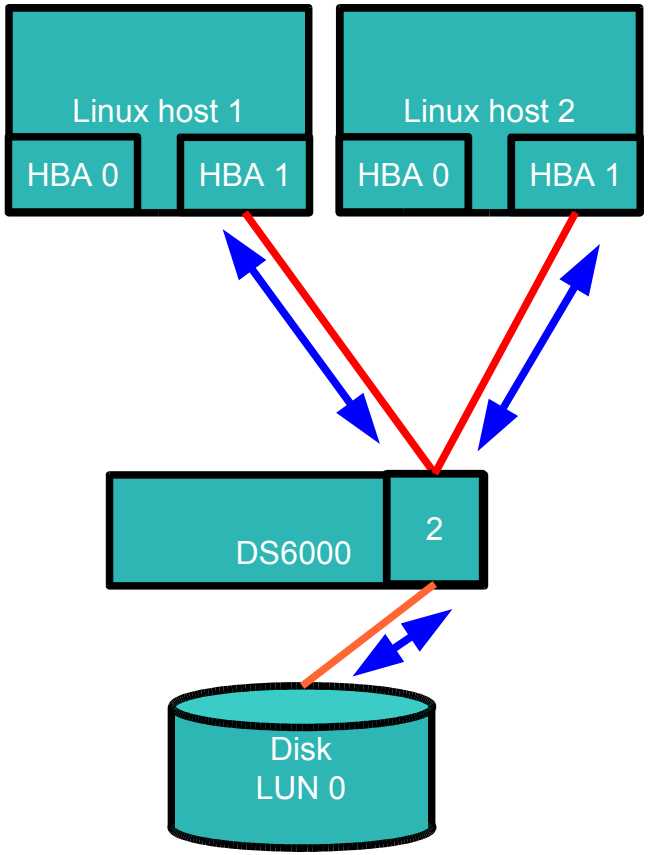
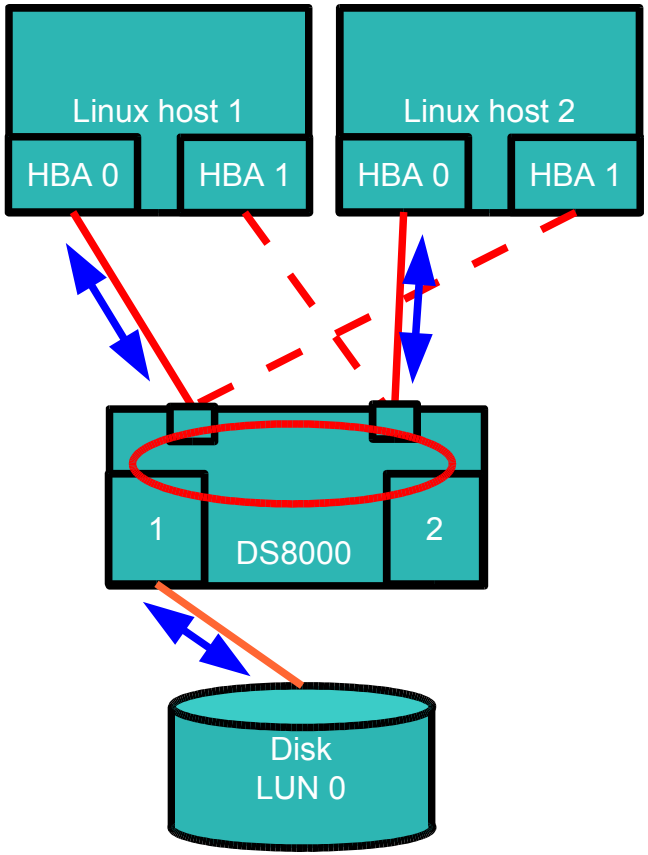


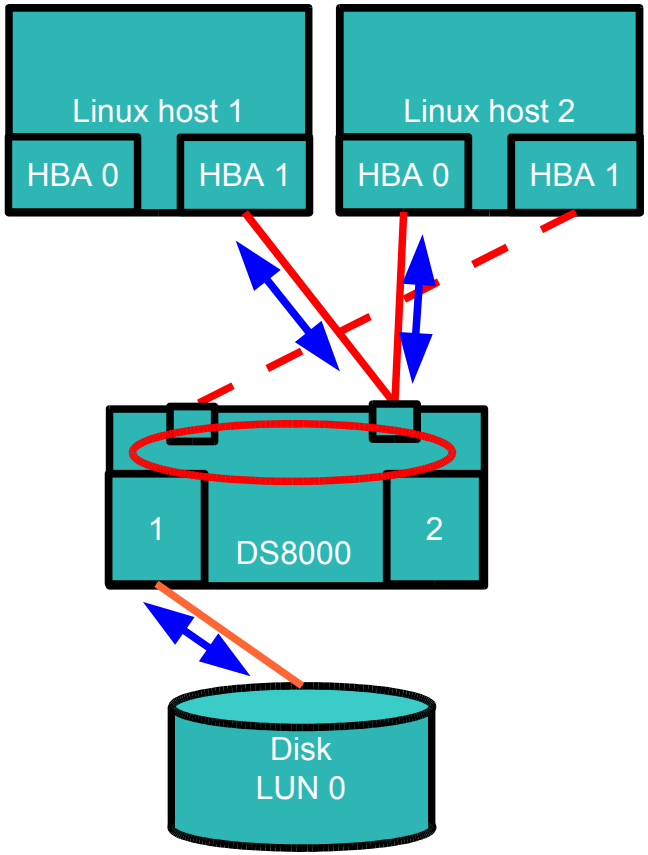
Host Ports Independent of Controller

- **ESS and DS8000 have independent host ports**
  - **Volumes are owned by one controller**
  - **All host ports can communicate with both controllers**
  - **Dynamic load balancing across all ports possible**

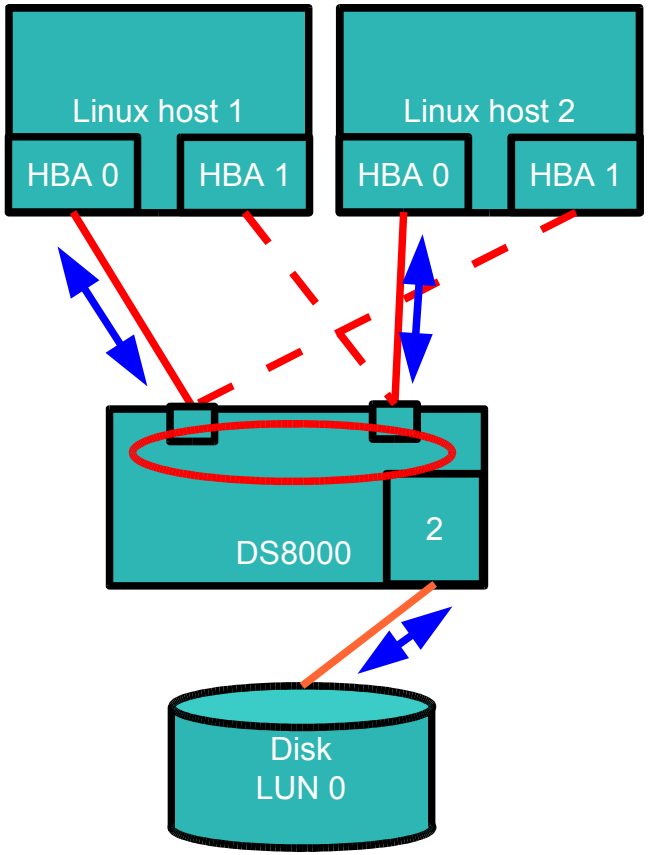
Independent Host Port Shared Data Scenario



Independent Host Port Shared Data Scenario



Independent Host Port Shared Data Scenario



Tape Specifics

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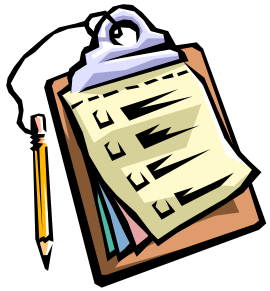


IBMtape driver

- For download as binary rpm package
- Kernel module `IBMtape.o`
  - Required to utilize all LTO capabilies
  - Manages medium changer failover
  - Provides new devices and ioctl
- Daemon `IBMtaped`

```
NDMC-7:/ # ls -l /dev/IBM*
crw-rw-rw-    1 root     root     253, 128 Sep 25 11:18 /dev/IBMchanger0
crw-r--r--    1 root     root     253, 255 Dec  9 09:41 /dev/IBMtape
crw-rw-rw-    1 root     root     253,   0 Sep 25 11:18 /dev/IBMtape0
crw-rw-rw-    1 root     root     253,  64 Sep 25 11:18 /dev/IBMtape0n
crw-rw-rw-    1 root     root     253,   1 Sep 25 11:18 /dev/IBMtape1
crw-rw-rw-    1 root     root     253,  65 Sep 25 11:18 /dev/IBMtape1n
```

IBMtapeUtil

- For download as source code
  - Exerciser tool
  - Software example
- Build and install using make
- Provides
  - IBMtapeutil
  - IBMtapeconfig

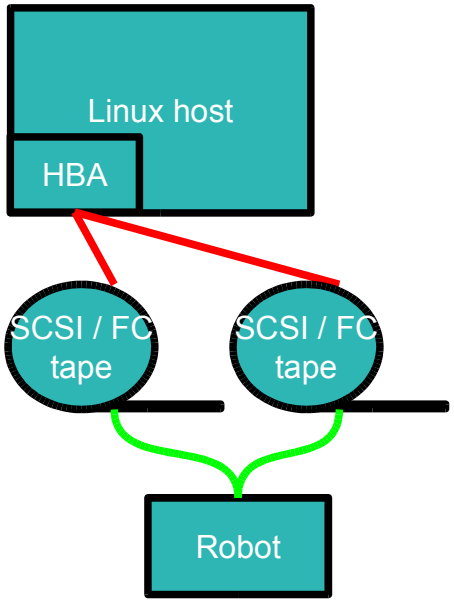
```
-------------------------- General Commands: -----------------------------
    1. Open a Device                  7. Request Sense
    2. Close a Device                 8. Log Sense Page
    3. Inquiry                        9. Mode Sense Page
    4. Test Unit Ready               10. Switch Tape/Changer Device
    5. Reserve Device                11. Create Special Files
    6. Release Device                12. Query Driver Version
    Q. Quit IBMtapeutil
------------------------ Medium Changer Commands: ----------------------
   60. Element Information           65. Load/Unload Medium
   61. Position To Element           66. Initialize Element Status
   62. Element Inventory             67. Prevent/Allow Medium Removal
   63. Exchange Medium               68. Initialize Element Status Range
   64. Move Medium                   69. Read Device Identifiers
------------------------- Service Aid Commands: ------------------------
   70. Dump Device                   72. Load Ucode
   71. Force Dump                    73. Reset Drive
------------------------------------------------------------------------
   99. Back To Main Menu
```

Use LTO Devices

- Native
  - tools: mt, mtx, IBMtapeutil
  - applications: cpio, tar, taper, afio
- 3rd party applications
  - All major backup solutions available for Linux
  - Attention: some are only tested with parallel SCSI attachment
  - Check ISV Martrix for LTO

Native Library Management

- **Linux tool for media changers: mtx**
- **Media changer is addressed through SCSI generic device**



/dev/sg0 - internal SCSI disk, not relevant here

/dev/sg1 - 1st SCSI tape drive

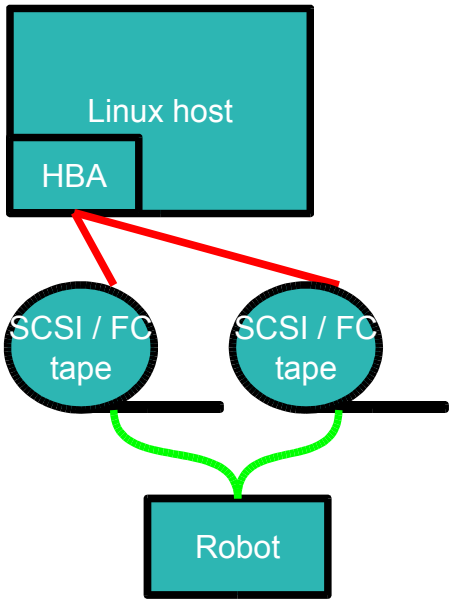
/dev/sg2 - tape robot (media changer)

/dev/sg3 – 2nd SCSI tape drive

```
mtx -f /dev/sg1 inquiry
mtx -f /dev/sg2 status
mtx -f /dev/sg2 load <slotnum> [ <drivenum> ]
```

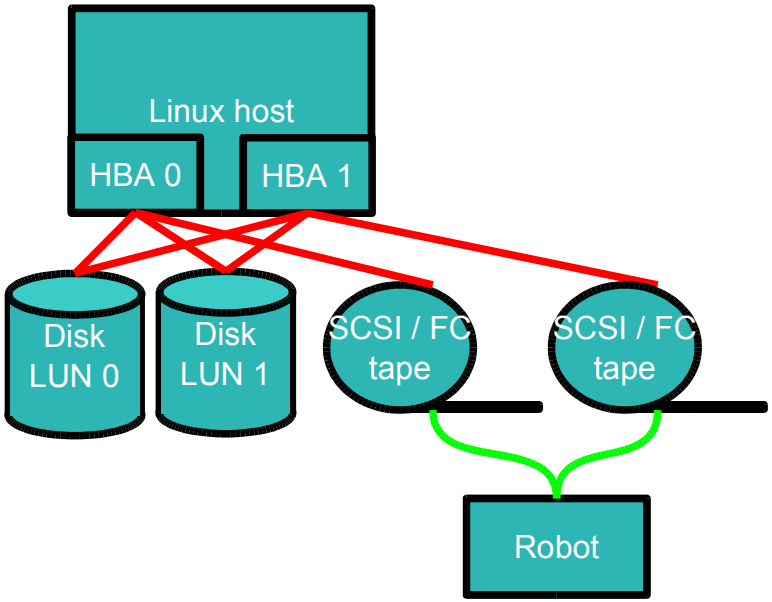
Medium Changer Failover

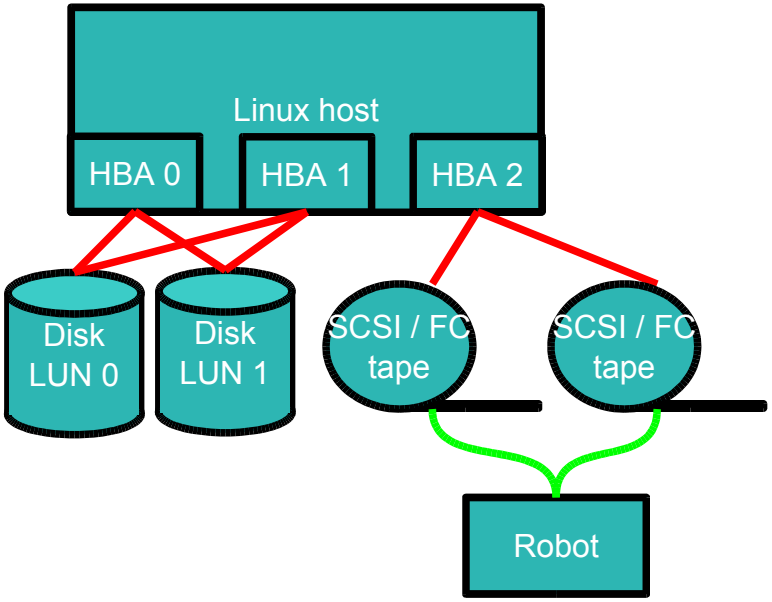
- **Automatitcally moves robot control to another drive in case of a failure**
- **Available for 2582, 3583, 3584**
- **Enabled as an option for IBMtape driver**
- **Check the `/proc/scsi/IBMchanger` file**



Tape and Disk Connected to the Same HBA

- **Possible, but not recommended**
- **Use separate switch zone, too**
- **One driver for all HBAs!**





Questions & Discussion

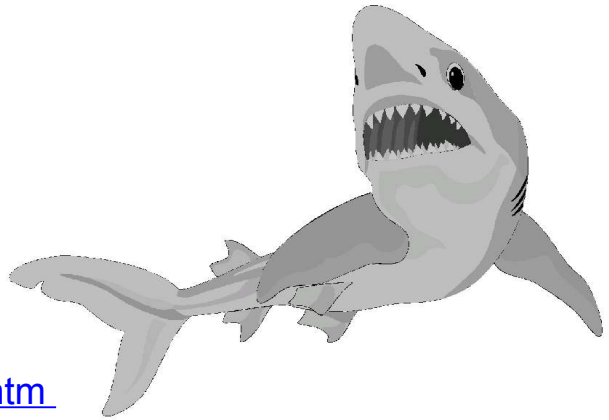
More Questions?

What are your customers needs?

Contact: warmuth@de.ibm.com

ESS / DS6000 / DS8000 Resources

- **Enterprise Storage Server interoperability matrix**
- **Subsystem Device Driver (SDD)**
- **Fibre channel host bus adapter firmware and driver level**
- **Additional supported configurations**
- **ESS host systems attachment guide**



http://www.storage.ibm.com/disk/ess/ess800/supserver.htm

http://www.storage.ibm.com/disk/ds8000/supserver.htm

http://www.storage.ibm.com/disk/ds6000/supserver.htm

DS4000 Resources

- **DS4000 Storage interoperability matrix**
- **Fibre channel host bus adapter firmware and driver level**
- **Additional supported configurations**

http://www.ibm.com/servers/storage/disk/ds4000/interop-matrix.html

- **DS4000 Technical Support**
- **DS4000 Downloads**

http://www.ibm.com/servers/storage/support/disk/

LTO Resources

- **LTO Compatibility Information**
- **LTO ISV Matrix**

http://www.storage.ibm.com/tape/lto/compatibility.html

- **LTO Downloads**

http://www.ibm.com/servers/storage/support/lto/ltodownloads.html

ftp://ftp.software.ibm.com/storage/devdrvr/Linux/

Redbooks

- **Implementing Linux with IBM Disk Storage**
  http://www.redbooks.ibm.com/redbooks/pdfs/sg246261.pdf
- **Linux with xSeries and FAStT: Essentials**
  http://www.redbooks.ibm.com/redbooks/pdfs/sg247026.pdf
- **Implementing IBM LTO in Linux and Windows**
  http://www.redbooks.ibm.com/redbooks/pdfs/sg246268.pdf
- **Linux Clustering with CSM and GPFS**
  http://www.redbooks.ibm.com/redbooks/pdfs/sg246601.pdf

White Papers

- **FAStT and Linux HowTo**
  http://www.ibm.com/developerworks/eserver/articles/install_fibre/index.html
- **FAStT and RH AS Cluster**
  http://www.ibm.com/servers/esdd/articles/redhat/index.html
- **ESS Attachment to United Linux 1 (IA-32)**
  http://www.ibm.com/support/docview.wss?uid=tss1td101235
  http://w3.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/TD101235
- **Addendum to the Solution Assurance Process**
  http://ulrich.walter.de.userv.ibm.com/portal.htm

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