


SAN Setup and management hints for HP's Tru64™ UNIX


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Tru64™ SAN Setup



- Purpose
 - Overview of setting up SANs in a Tru64 Unix environment
 - Tips to aid in management and troubleshooting
- Not a course in SAN fundamentals or a tutorial
- Why? Fibre channel is different from any other storage for Tru64 Unix

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Objectives



- **Storage Challenges**
- **Storage Products**
- **Console Configuration**
- **Snapshots and Clones**
- **Connectivity**
 - DRD and Multipathing
 - The Emx driver
- **Management and configuration tools**

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Storage Challenges



Storage challenges
Enabling business velocity



- Explosive data growth
- Critical data availability and integrity
- Managing complexity
- Open environment needs
- Intelligent connectivity
- Return on investment

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Tru64 has exceptional and unique strengths



Imagine solving your toughest challenges through...

- Scalable I/O and files to handle **explosive growth**
- **Available and reliable data** in all circumstances
- Access to your data **regardless of where it stands**
- Complying with the **latest standards**
- Using **smart connectivity** to increase performance and availability
- Managing it all **automatically**
- **It's all possible today on Tru64 UNIX!**

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Tru64 UNIX Optimizes SANs



- Fast data recovery
- Data availability and disaster tolerance
- Robust, qualified, huge SANs
- Integrated management and automation



- Snapshots
- Tight integration with EVM
- DRM integrates with clusters
- Big Asymmetric SAN System
- 800 TB to petabytes
- SAN management from SysMan
- Automatic detection and management of volume expansions


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StorageWorks Fibre Channel Roadmap

Tru64 UNIX handles explosive growth



AdvFS can handle file sizes of up to 16TB

Fewer mount points for easier management of growth

Infinite connection possibilities with Fibre Channel support

- 1TB physical volume
- 256 LUNs per target
- 256 targets per bus
- 255 buses

BASS (Big Asymmetric SAN System)

- 800 TB up to petabytes
- LSM for increased performance in complex configurations

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StorageWorks Array Family

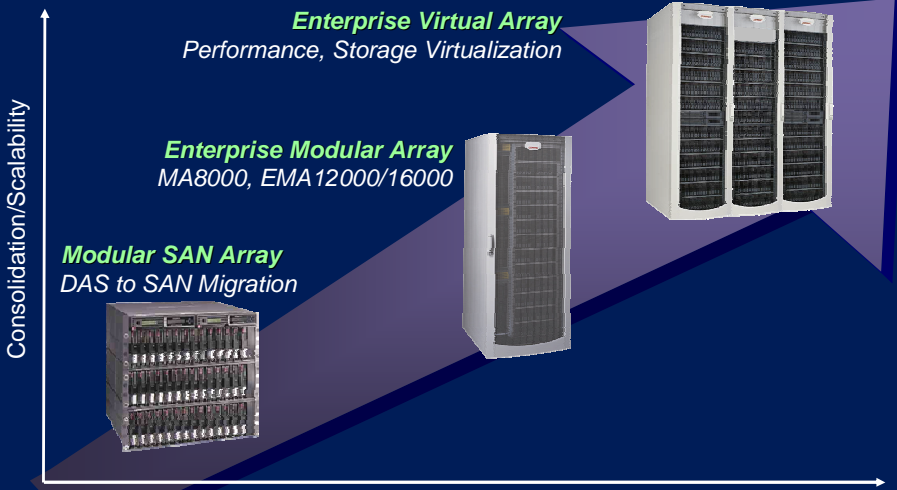
Enterprise Virtual Array
Performance, Storage Virtualization

Enterprise Modular Array
MA8000, EMA12000/16000

Modular SAN Array
DAS to SAN Migration


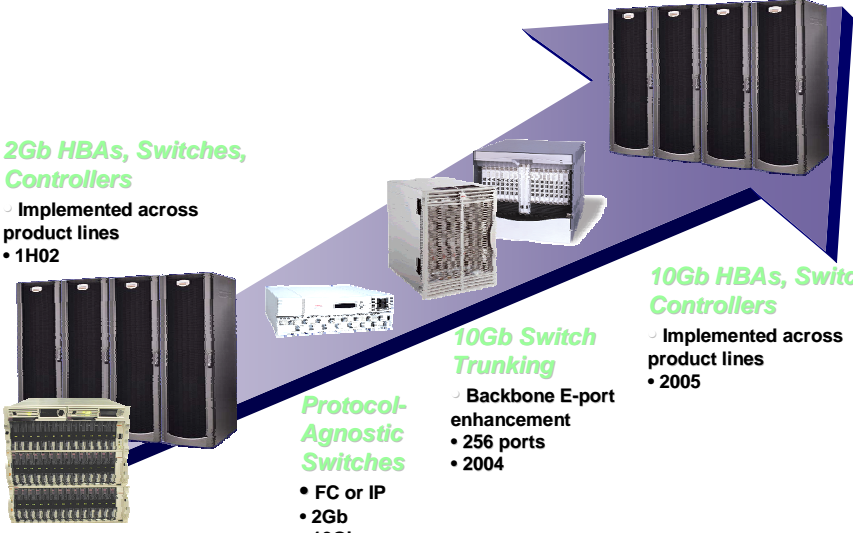
Consolidation/Scalability

Functionality



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StorageWorks Fibre Channel Products

2Gb HBAs, Switches, Controllers

- Implemented across product lines
- 1H02

Protocol-Agnostic Switches

- FC or IP
- 2Gb
- 10Gb

10Gb Switch Trunking


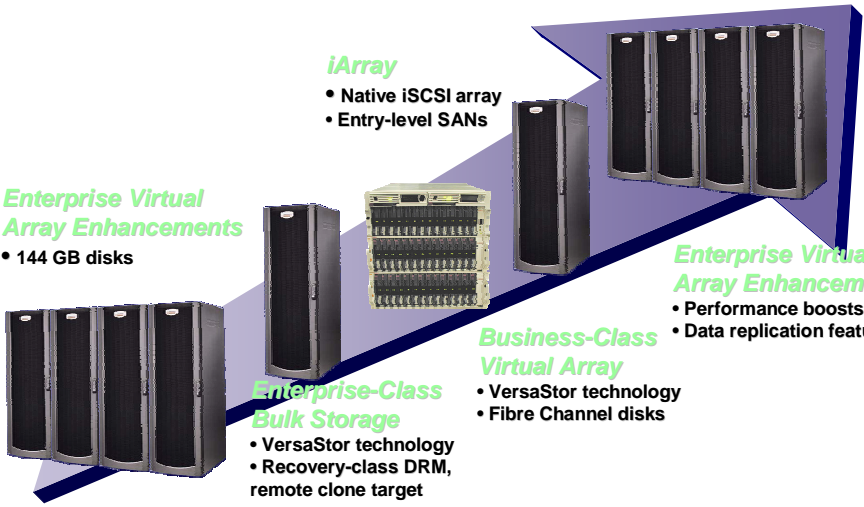
- Backbone E-port enhancement
- 256 ports
- 2004

10Gb HBAs, Switches, Controllers

- Implemented across product lines
- 2005

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StorageWorks Fibre Channel Products

Enterprise Virtual Array Enhancements

- 144 GB disks

Enterprise-Class Bulk Storage

- VersaStor technology
- Recovery-class DRM, remote clone target

iArray

- Native iSCSI array
- Entry-level SANs

Business-Class Virtual Array

- VersaStor technology
- Fibre Channel disks

Enterprise Virtual Array Enhancements

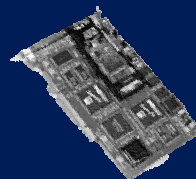
- Performance boosts
- Data replication features

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DS-KGPSA-CA (aka Emulex LP8000)

- 5V, 64-bit/33MHz PCI adapter
- Supports 1Gb fabrics
- Supports DS, ES and GS series of platforms
- DS10, DS20, DS25, ES40, ES45, GS80, GS160, GS320
- Full boot/dump support in Tru64 UNIX kernel



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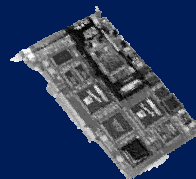
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FCA2354 (DS-KGPSA-DA – aka Emulex LP9002L)

- 3.3V or 5V, 64-bit/66MHz PCI adapter
- Supports 2Gb fabrics
- Supports DS, ES and GS series of platforms
- DS10, DS20, DS25, ES40, ES45, GS80, GS160, GS320
- Full boot/dump support in Tru64 UNIX kernel



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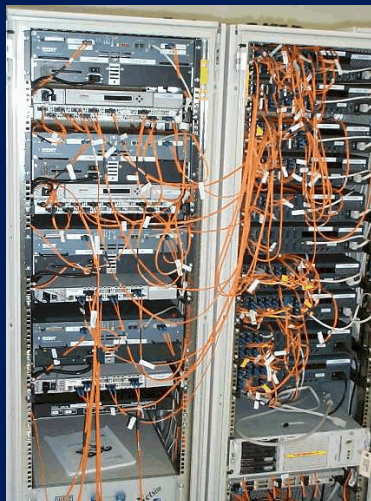
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Document architecture and design



- SAN Architecture must be designed on paper FIRST
- Why document?
 - Might this picture be a good reason?
 - This is a good example of why you want to document
- This is one of the most important aspects of the Architecture process
 - This allows you to fully review and evaluate the design beforehand
- SAN is Not Documented?
- SAN is Not Supported!!!

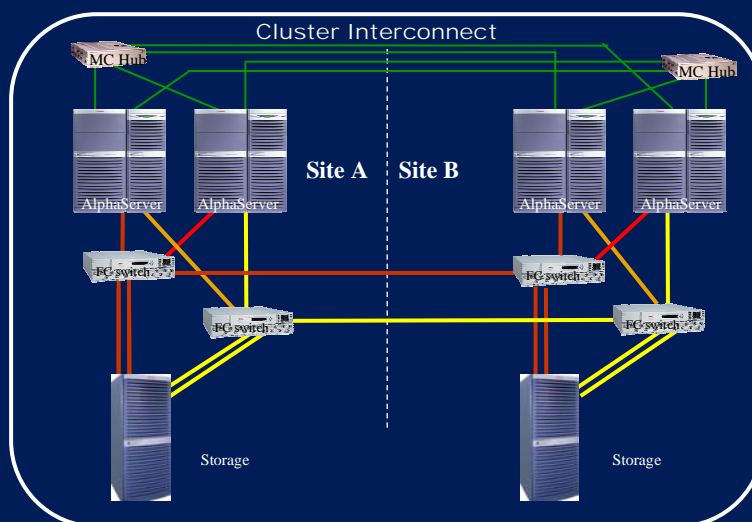


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Tru64 Unix disaster tolerant cluster



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Fibrechannel configuration



Console Configuration

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Tru64 Unix Console Setting a WWID in NV memory



scan for
fibre
devices

```
P00>>>wwidmgr -show wwid
```

```
[0] UDID:5 WWID:01000010:6000-1fe1-0000-0cb0-0009-9130-8234-003a (ev:none)
[1] UDID:4 WWID:01000010:6000-1fe1-0000-0cb0-0009-9130-8234-0039 (ev:none)
[2] UDID:3 WWID:01000010:6000-1fe1-0000-0cb0-0009-9130-8234-0038 (ev:none)
[3] UDID:2 WWID:01000010:6000-1fe1-0000-0cb0-0009-9130-8234-0037 (ev:none)
[4] UDID:1 WWID:01000010:6000-1fe1-0000-0cb0-0009-9130-8234-0036 (ev:none)
[5] UDID:-1 WWID:01000010:6000-1fe1-0000-0cb0-0009-9130-8234-0046 (ev:none)
```

map
disk
UDID 5
wwid
(wwn)

```
P00>>>wwidmgr -quickset -udid 5
```

```
Disk assignment and reachability after next initialization:
```

```
6000-1fe1-0000-0cb0-0009-9130-8234-003a
```

paths
(4)


	via adapter:	via fc nport:	connected:
dga5.1001.0.3.1	pga0.0.0.3.1	5000-1fe1-0000-0cb4	Yes
dga5.1002.0.3.1	pga0.0.0.3.1	5000-1fe1-0000-0cb2	No
dgd5.1001.0.2.0	pgd0.0.0.2.0	5000-1fe1-0000-0cb4	Yes
dgd5.1002.0.2.0	pgd0.0.0.2.0	5000-1fe1-0000-0cb2	No

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Tru64 Unix Console accessing a fibre boot disk



mapped disk
UDID 5 now
appears


```
P00>>>show dev
dga5.1001.0.3.1 $1$DGA5 HSG80 V85F
dga5.1002.0.3.1 $1$DGA5 HSG80 V85F
dgd5.1001.0.2.0 $1$DGA5 HSG80 V85F
dgd5.1002.0.2.0 $1$DGA5 HSG80 V85F
dka0.0.0.1.1 DKA0 RZ2CA-LA N1H0
.
.
pga0.0.0.3.1 PGA0 WWN 2000-0000-c921-0d00
pgb0.0.0.5.1 PGB0 WWN 1000-0000-c920-cd9c
pgc0.0.0.1.0 PGC0 WWN 1000-0000-c920-a7ae
pgd0.0.0.2.0 PGD0 WWN 2000-0000-c921-07c4
pka0.7.0.1.1 PKA0 SCSI Bus ID 7
pkb0.7.0.2.1 PKB0 SCSI Bus ID 7 5.57
P00>>>set bootdef_dev dga5.1001.0.3.1, dga5.1002.0.3.1, dgd5.1001.0.2.1,
dgd5.1002.0.2.1
```

4 paths

Register disk
as boot device

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Tru64 OS Installation what to consider



- Only those FC devices whose SCSI-3 WWIDs are configured in the console will be presented in the installation menus.
 - Enforces console configuration before installation starts
 - As B/T/L meaningless, protects against selection of the wrong device

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Tru64 OS Installation what to consider



- To help recognize HSG80 UNITs, installation menus will display HSG80 Unit IDENTIFIER

	Device Name	Size in GB	Controller Type	Disk Model	Location
1)	dsk0	4.0	SCSI	RZ2CA-LA	bus-0-targ-0-lun-0
2)	dsk1	4.0	SCSI	RZ2CA-LA	bus-0-targ-1-lun-0
3)	dsk2	1.0	SCSI	RZ26F	bus-1-targ-1-lun-0
4)	dsk3	2.0	SCSI	RZ28	bus-1-targ-4-lun-0
5)	dsk10	8.5	SCSI	HSG80	IDENTIFIER=133
6)	dsk12	8.5	SCSI	HSG80	bus-2-targ-2-lun-2

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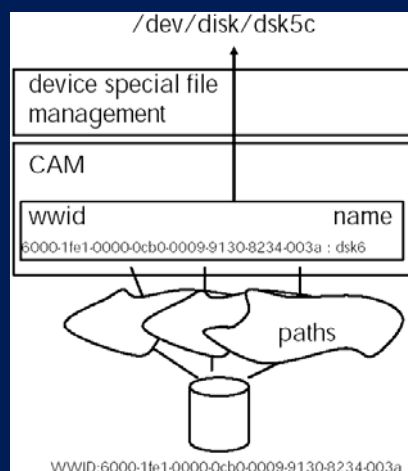
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Tru64 UNIX mapping: WWIDs to device names



Identifying a storage device

- Tru64 makes use of WWID's within CAM
 - Exports device special files to user-space
- WWID's are collected and stored by CAM
 - WWID to DSF maps are stored in databases
- how CAM collects WWID's is specified in the DDR database.
 - depends on each peripheral
 - Tru64 support WWID's for devices that do not "have them"



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Unique identification with „WWID“



example of an old device with a concocted WWID (rare)

```
# hwmgr -show scsi -did 0 -full
SCSI DEVICE DEVICE DRIVER NUM DEVICE FIRST
HWID:  DEVICEID HOSTNAME   TYPE   SUBTYPE OWNER   PATH FILE   VALID PATH
-----
17:  0             ernie    disk   none    2       2   dsk0 [0/3/0]

WWID:0410004c:"DEC RZ26 (C) DECPCB=412225056947 (ZG25056947 )";
HDA=0000030635357245"
```

```
BUS  TARGET  LUN  PATH STATE
-----
0    3       0    valid
2    3       0    valid
```

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Unique identification with „WWID“



example of a new wwid capable device

```
host1 > hwmgr -get attr -id 133
133:
name = SCSI-WWID:01000010: 6000-1fe1-0000-0cb0-0009-9130-8234-003a
category = disk
sub_category = generic
architecture = SCSI
phys_location = IDENTIFIER=5
dev_base_name = dsk17
capacity = 17768677
block_size = 512
model = HSG80
boot_capable = 1
```

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Tru64 Unix mappings are stored in hardware databases



Hardware Component Databases

- /etc/dec_hwc_ldb (binary) (CDSL)
- /etc/dec_hwc_cdb (binary)

SCSI Device Database

- /etc/dec_scsi_db (binary) (CDSL)

Hardware Persistence Database

- /etc/dec_hw_db (binary) (CDSL)

Device Special File Data Files

- /etc/dfsl.dat (text) (CDSL)
- /etc/dfsc.dat (text)

Unique ID Database

- /etc/dec_unid_db (binary)

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Preparing your data for backup



by using:

LSM
ADVFS
EVM



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Using LSM in a SAN for backup



- **Logical Storage Manager**
 - Since V5.1A ability to mirror all Cluster Filesystems
 - Alternative to Hardware backup cloning, using volassist for backups
- ***volassist snapstart volumename***
adds an extra plex to a volume and synchronizes it (mirror copy, may take a while); plex removed and used for backup later.
- ***volassist snapshot volumename tempname***
creates a temporary volume (tempname) that is now detached.
- ***Continue application or remount volume***
while backup temporary volume (tempname). When backup complete, remove the temp volume
volume stop tempname; voledit -r rm tempname.

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Hardware Cloning/Snapshotting and AdvFS



- In case of wrong usage you will be confronted with:
 - Unmountable file systems.
 - User data corruption.
 - AdvFS domain panics.
 - Tru64 UNIX kernel panics.
- Cannot clone individual filesets; must clone entire domain.
Put filesets you want to back up or use together in the same domain.

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What About Application Data Consistency?



- Before clone/snap is made, may want to quiesce or stop applications for application data consistency in clone/snap:
 - Oracle: online backup mode.
 - Flush all cached file data via *fsync()*, *O_SYNC*, *O_DSYNC*, *chfile -l on*.
 - Kill/halt application threads.
- Without application quiesce, clone/snap is “crash consistent” only.

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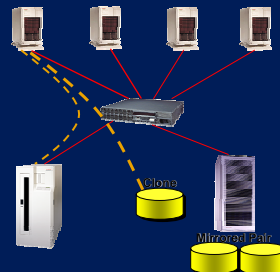
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SAN-Initiated Backup with EVM



Enterprise Volume Manager V2

- Full support for Tru64 UNIX and TruCluster Server V5 for controller-based snapshot/clone generation
 - AdvFS provides Freeze/Thaw to enable consistent clone or snapshot
 - LSM supports cloned volumes



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Connectivity



- Multipath
- Multibus
- Load Balancing
- Overview of implementation in Tru64 and HP-UX

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Multipath / Multibus / Load Balancing



- Multi-Path is the ability to connect more than one adapter to the same storage
- Multi-Bus is a more specific term , refers to the capability of devices to connect to multiple independent busses, or ports.
- Load Balancing is embedded in Tru64
 - Done on the KGPSA Adapter
 - Since V5.1 OS is starting a round robin to determine the path sending down an IO.

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Multi – Pathing



HP-UX

- not in base-os iostack drivers
 - devices have location dependent names "cXtXdX"
- multiple options at one of two levels
 1. special layered driver associated with storage array on top of default drivers
 - HP-Classic SureStore AutoPath
 - Compaq-Classic StorageWorks SecurePath
 - EMC...
 - etc.
 2. feature of volume manager
 - LVM pvlins
 - VxVM dynamic multi-pathing (DMP)

Tru64 UNIX

- built-in to base-os iostack
 - transparently and automatically enabled for all scsi/fibre devices
 - devices have physical location independent names "dskXX"
 - other methods are not required

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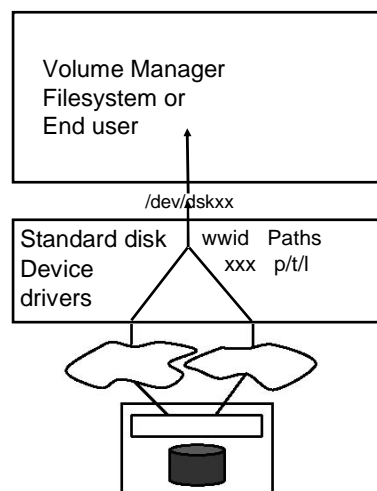
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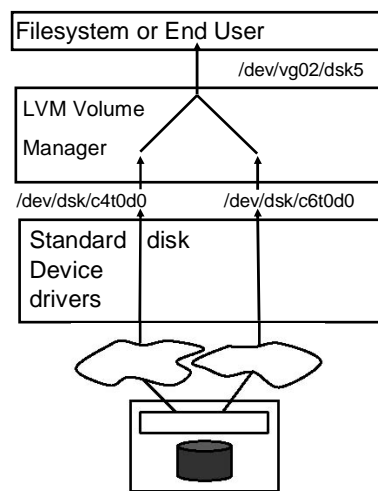
Multi – Pathing implementation



Tru64 Unix Multi-pathing



Hp-UX pvlins Multi-pathing



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Multi – path capabilities



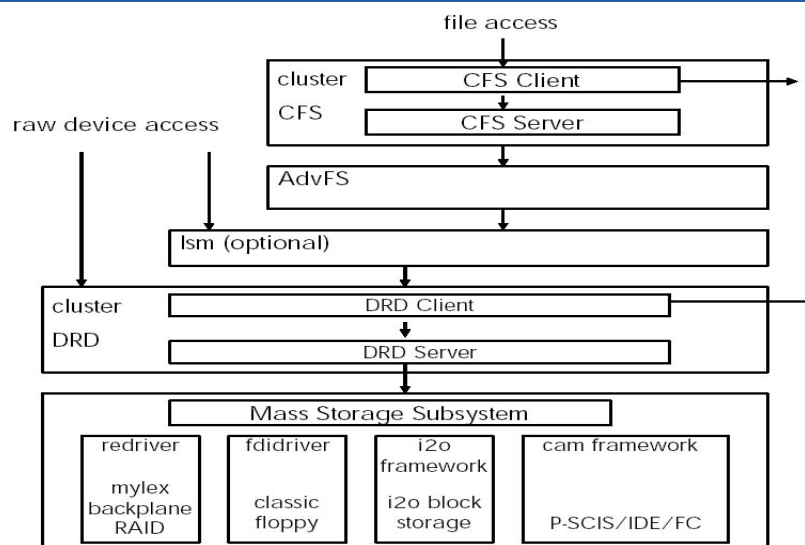
Description	HP-UX SureStore AutoPath	HP-UX LVM PVLinks	HP-UX VxVM DMP	Tru64 UNIX CAM
Fail Over: automatically fails over to an alternate path when the primary path is no longer available	✓	✓	✓	✓
Fail Back: automatically recognizes the newly available path when a failed path comes back up alive.	✓		✓	✓
Active/Active - Static Load-balancing: Balances I/O load among all available paths with user selectable load-balancing policies.	✓		✓ ₂	✓ ₂
Active/Active - Dynamic Load-balancing: System automatically balances I/O load among all available paths based on run-time statistics such as device queue depths etc.				✓

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Tru64 IO - stack



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what does the emx driver do?



- maps each adapter to a logical SCSI Bus
- logs into the fabric's F-Port if available (Switch)
- logs into all visible N-Ports in the fabric (Storage Endpoints)
- maps each FCP-Target N-Port to a SCSI Target
- receives SCSI commands from the peripheral driver
- sends SCSI commands wrapped in Fibre Channel frames to the devices

emx driver parameters in sysconfig



Driver Version

```
# sysconfig -q emx Driver_Version
emx:
Driver_Version = 2.07
#
```

Number of HBAs being Managed

```
# sysconfig -q emx Num_Attached
emx:
Num_Attached = 2
#
```

Emx messages during boot.

The diagram illustrates the Emx boot messages with the following callouts:

- Emx driver instance
- PCI Bus
- PCI Slot Number
- Adapter Part Number
- Adapter Type (Bx=7000, Cx=8000, Dx=9000*)
- Emx driver revision
- Emulex Firmware Revision
- Adapter's WWID

```

emx0 at pci1 slot 3

KGPSA-CA : Driver Rev 2.07 : F/W Rev 3.81a4 (2.01N0) :
  wwn 1000-0000-c921-0d00

emx0: tuning console topology setting of
  
```

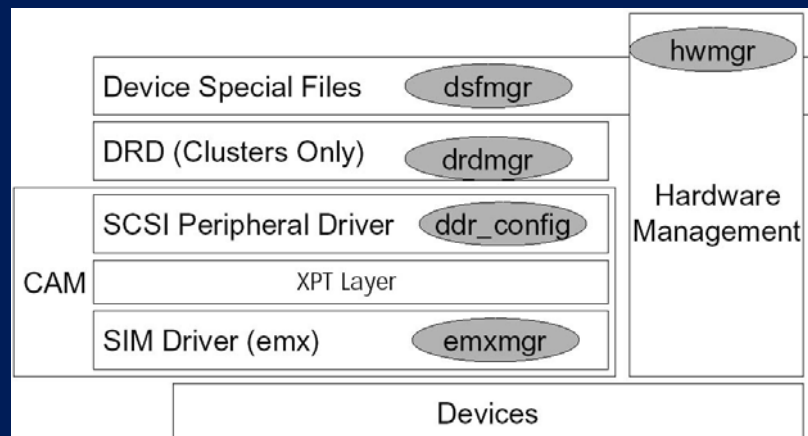
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Hardware management tools

- emxmgr
- dsfmgr
- drdmgr
- scu
- hwmgr

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Tru64 Tools



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emxmgr




- **emxmgr**
 - Replaced in 5.1B with “hwmgr –view topology”
 - Useful to obtain FC topology information
 - Can look at
 - Adapter mappings
 - FC Port Ids
 - Ports logged in

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emxmgr example



```
# emxmgr -d
```

The available adapter instances are:

```
emx0 emx2 emx3 emx4
```

```
foo> emxmgr -t emx0
```


emx0 state information:

```
Link :connection is UP
      Point to Point
      Fabric attached
      FC DID 0x210513
Link is SCSI bus 2 (e.g. scsi2)
      SCSI target id 255
      portname is 1000-0000-C921-0D00
      nodename is 2000-0000-C921-0D00
```

- This adapter's link state
- This adapter's Topology
- An F – Port exists on this Fabric
- Fabric assigned Fabric ID
- CAM has assigned SCSI-BUS 2 to this adapter
- The adapter's target ID is 255
- The adapter's port and nodename

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device and hardware management tools



device discovery and configuration

- automated device discovery
 - during boot process
 - or by automated polling of FC busses
- automated loading of drivers based on connected devices
- device special files created automatically

hwmgr

- used to view capabilities, connectivity and properties of devices
- used to modify properties of a disk device

dsfmgr

- used to view, verify and manage HW to DSF mappings

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Adding a new device after boot



- “Connect” the device to the fabric or make it visible to the system.
- Run “hwmgr –scan scsi” to make the system poll for new devices.
- Run “dsfmgr –k” to add device special files for the new devices.
- Go for it!

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Device Special File Specific Commands



<i>Description</i>	<i>Command</i>
<i>List all Device Special File entries</i>	<code>dsfmgr -v</code>
<i>Remove Device Special File entry</i>	<code>dsfmgr -R hwid <#></code>
<i>Rename Device Special Files</i>	<code>dsfmgr -m <bn_1> <bn_2></code>
-m move	<code>dsfmgr -e <bn_1> <bn_2></code>
-e exchange	
<i>List devt information</i>	<code>ls -l <device_special_file></code>
-l cluster devt (if available)	<code>ls -ID <device_special_file></code>
-ID local devt	

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The scu command



- Moving a device to another path (controller failover)

```
# scu
```

```
scu> set nexus bus 3 target 1 lun 2
```

**this should be a path on the controller
you have the lun preferred to**

Device: HSG80, Bus: 3, Target: 1, Lun: 2, Type: Direct Access

```
scu> start
```

```
scu> quit
```

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Viewing events with EVM



- A graphical event viewer, fully integrated in the Sysman Application suite
- Set of command line utilities
 - **evmwatch** is used to monitor events as they occur
 - **evmget** to retrieve stored events from log files
 - **evmsort** to sort a set of retrieved events
 - **evmshow** to format the output of the retrieved events

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hwmgr



- ***What's in the database?***
 - Displaying database contents
- ***Are the databases ok?***
 - Validating databases
 - Correcting/cleaning databases
- ***More information?***
 - Hardware Component information
 - SCSI information
 - Hardware Configuration changes
 - Device Special File information

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Example: Display contents of Hardware Database



```
tagque> hwmgr -show comp
```

HWID:	HOSTNAME	FLAGS	SERVICE	COMPONENT NAME
1:	tagque	r----	none	COMPAQ AlphaServer DS10 466 MHz
2:	tagque	r----	none	CPU0
3:	tagque	r-d--	none	scp
4:	tagque	r-d--	none	kevm
5:	tagque	r----	none	pci0
6:	tagque	r----	none	pci0slot1
7:	tagque	-----	none	Unconfigured-device- (<NULL>) -at-pci0slot1
25:	tagque	r----	none	isa0
26:	tagque	r----	none	isa0slot0
36:	tagque	r----	none	fdi0
37:	tagque	r-d--	iomap	FDI-fdi0-unit-0
38:	tagque	r----	none	tu0
40:	tagque	r----	none	ata0
41:	tagque	r----	none	scsi0
42:	tagque	r----	none	scsi1
43:	tagque	-----	none	itpsa0
44:	tagque	r----	none	scsi2
50:	tagque	r-d--	iomap	SCSI-WWID:0710002c:"COMPAQ CDR 8435:d05b000t00000100000"
51:	tagque	rcds-	iomap	SCSI-WWID:0c000008:0020-37ff-fe5f-66cc
52:	tagque	rcd--	iomap	SCSI-WWID:0c000008:4d41-4739-d301-8034
53:	tagque	rcd-i	iomap	SCSI-WWID:0c000008:4d41-4739-d301-8037
54:	tagque	-cd--	iomap	SCSI-WWID:0c000008:0020-37ff-fe5e-2280
57:	tagque	r----	none	itpsa1
61:	tagque	-cd--	iomap	SCSI-WWID:0c000008:0020-37ff-fe5e-2632

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Example: Display contents of SCSI Database



```
tagque# hwmgr -show scsi
```

HWID:	SCSI DEVICEID	HOSTNAME	DEVICE TYPE	DEVICE SUBTYPE	DRIVER OWNER	NUM PATH	DEVICE FILE	FIRST VALID PATH
0:	6	tagque	cdrom	none	0	1	(null)	
50:	0	tagque	cdrom	none	0	1	cdrom0	[0/0/0]
51:	1	tagque	disk	none	0	1	dsk0	[2/0/0]
52:	2	tagque	disk	none	2	1	dsk1	[2/1/0]
54:	4	tagque	disk	none	0	1	(null)	
61:	5	tagque	disk	none	0	1	(null)	
62:	3	tagque	disk	none	0	1	dsk2	[2/2/0]

```
tagque# hwmgr -show comp -nr
```

HWID:	HOSTNAME	FLAGS	SERVICE	COMPONENT NAME
1:	tagque	----	none	COMPAQ AlphaServer DS10 466 MHz
7:	tagque	----	none	Unconfigured-device-(<NULL>)-at-pci0slot1
17:	tagque	----	none	Unconfigured-device-(<NULL>)-at-pci0slot14
45:	tagque	----	none	isp0
54:	tagque	-cd--	iomap	SCSI-WWID:0c000008:0020-37ff-fe5e-2280
57:	tagque	----	none	itpsal
58:	tagque	----	none	ispl
61:	tagque	-cd--	iomap	SCSI-WWID:0c000008:0020-37ff-fe5e-2632

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hwmgr



- To view hardware topology
 - # hwmgr --view hierarchy
- To find EMX controllers
 - # hwmgr --view hierarchy | grep -E "qbb|emx"
 - or in 5.1B
 - # hwmgr --view topology
- Display "stale" path information
 - # hwmgr --show scsi --full
 - "in kernel" view
 - # hwmgr --get attr current | egrep "dev_base_name|path_state"

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hwmgr



- SCSI Device Specific Commands

- # hwmgr --show scsi --full
 - display extended SCSI database information
- # hwmgr --show scsi --did <#> --full
 - displays SCSI WWID in text
- # hwmgr --show scsi --id <#> --full
 - displays SCSI path information
- # hwmgr --refresh scsi
 - remove stale paths

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Checking databases consistency



- Database Validation

- Local and Cluster Hardware Database

```
# hwmgr --show comp -i
# hwmgr --show comp -i --full
```

- Device Special File Structure

```
# dsfmgr -v
```

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If you find inconsistencies....



- Correcting/Cleaning Databases

```
# dsfmgr -vF
```

- fix inconsistencies in the Device Special File data files

```
# hwmgr -delete comp -id <#>
```

- remove an entry from all databases

```
# hwmgr -refresh comp
```

- purge all non-registered entries from every database

hwmgr




- Path usage

```
# hwmgr -get attr current | egrep \  
"dev_base_name|path_state|path_xfer"
```

- "Cross RAD" I/O information

```
# hwmgr -get attr current | egrep \  
"dev_base_name|cross_rad|path_xfer"
```

Where to Get More Information



hwmgr man pages – new format for v5.1a and later

man hwmgr:

- hwmgr_ops
- hwmgr_view
- hwmgr_get
- hwmgr_show

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