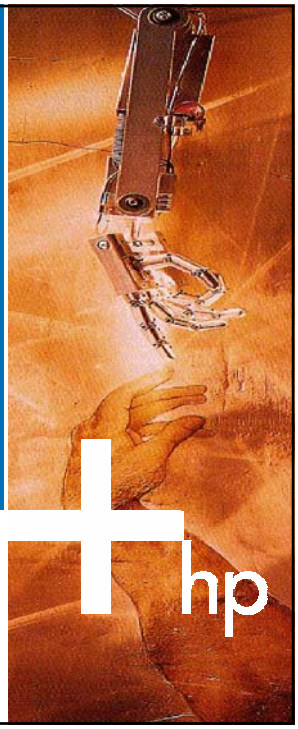
OpenVMS Integrity

Boot Environment



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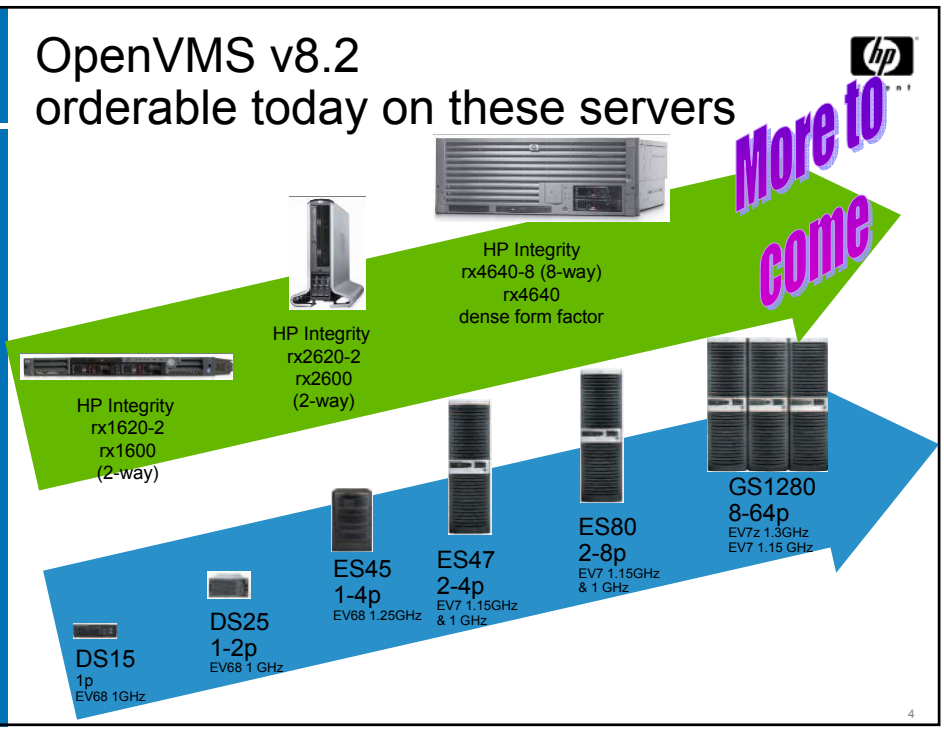
Topics

- Hardware
  - Systems
  - Options
- Boot Environment
  - EFI
  - Disk structure
  - Booting

Hardware
- -Systems
- -Options

OpenVMS v8.2 orderable today on these servers



Firmware Revisions

System	Syst. F/W	BMC	MP
rx1600 (Nemesis)	1.10	2.33	E.02.29
rx1620 (Onyx)	2.11	3.48	E.03.13
rx2600 (Long's Peak)	2.31	1.52	E.02.29
rx2620 (Badger Peak)	3.10	3.47	E.03.13
rx4640/Madison&Hondo	2.13	2.37	E.02.29
rx4640/Mad9M	3.11	3.47	E.03.13

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CPUs supported

Rx1600	1.0Ghz
Rx1620	1.3 (3MB), 1.6 (3MB) [Mad9m]
Rx2600	1.0, 1.3, 1.4, 1.5
Rx2620	1.3 (3), 1.6 (3), 1.6 (6) [Mad9m]
Rx4640	1.3 (3/6), 1.6 (3/6), Hondo 1.1
Rx4640	1.5 (4), 1.6 (6), 1.6 (9) [Mad9m]

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Memory expansion

- Rx1600/1620: 512MB – 16 GB
- Rx2600/2620: 1GB – 24GB
- Rx4640: 1GB – 64 GB/128GB (4Gb DIMMs)

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Options

- Single and 4 port 10/100 Tulip (A5230A, A5506B)
- Broadcom 5701 Gbit copper and fiber NICs (A6847A, A6825A)
- Intel Gbit copper and fiber NICs (A7011A, A7012A)
- Qlogic 2-port FC adapter (A6826A)
- U320 2p SCSI adapter (A7173A)
- Radeon 7500 graphics card (AB551A)
- FC/Broadcom 5703 copper and fiber combo cards (A9782A [Fiber], A9784A [Copper])
- Fermat 6402 and 6404 2 and 4 port U320 RAID controllers (A9890A, A9891A) [schedule - around May, 2005, on OpenVMS/Itanium; January, 2005 on Alpha]

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and now for something NEW….
„EFI“

The Extensible Firmware Interface

- A new standard from Intel
- Replaces BIOS
- EFI firmware on the system
  - Includes a user interface called the “shell”
  - EFI commands native in the firmware
  - Interface to the system hardware
  - Runs EFI applications from the EFI system partition

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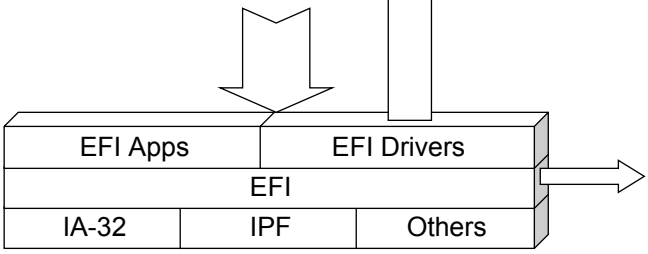
Benefits of EFI abstraction

- Abstraction of OS from firmware
- Abstraction free of legacy interfaces
- Coherent, scalable platform interface

- No Collision
- No Space Limitation
- Support Speedy Boot
- Provide Drivers to OS



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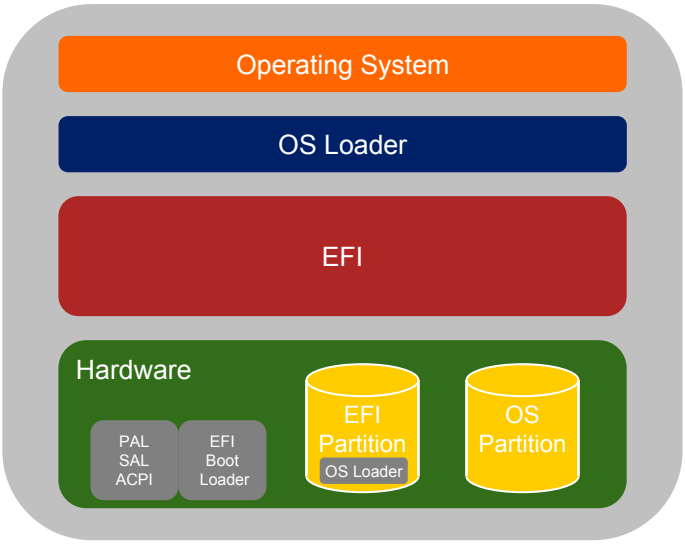
EFI structural model



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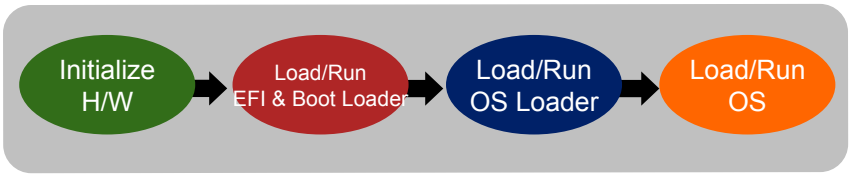
EFI operational model

- Boot starts with hardware initialization
- Continues with a sequence of loads
  - Each successive loader is a bit “smarter“
- Culminates in the loading of an operating system



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EFI system partition

- An EFI system partition is a FAT32 file system
- EFI directory in the root directory `\efi`
- Vendors use subdirectories to store their OS loaders and applications
- On HP OpenVMS I64 systems, the boot loader filename is `vms_loader.efi` and is located in `fs0:\efi\vms`

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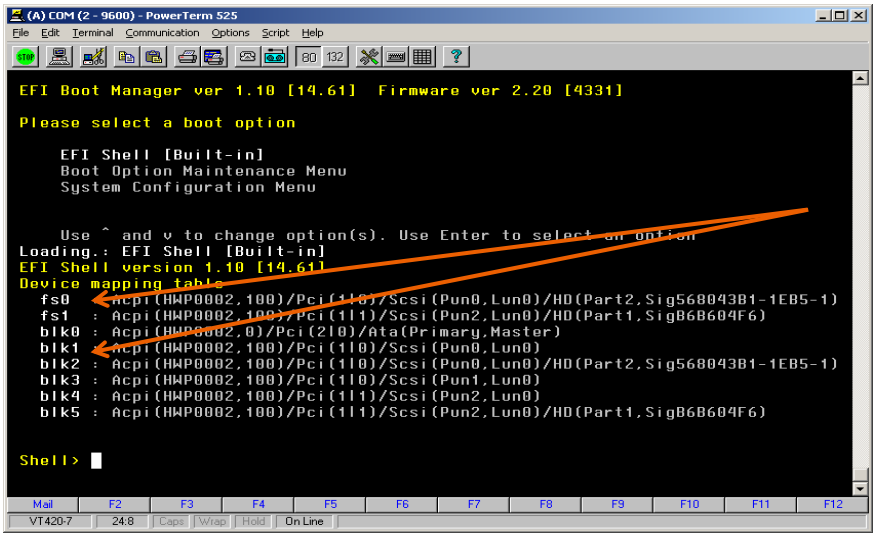
EFI Shell [Built-in]



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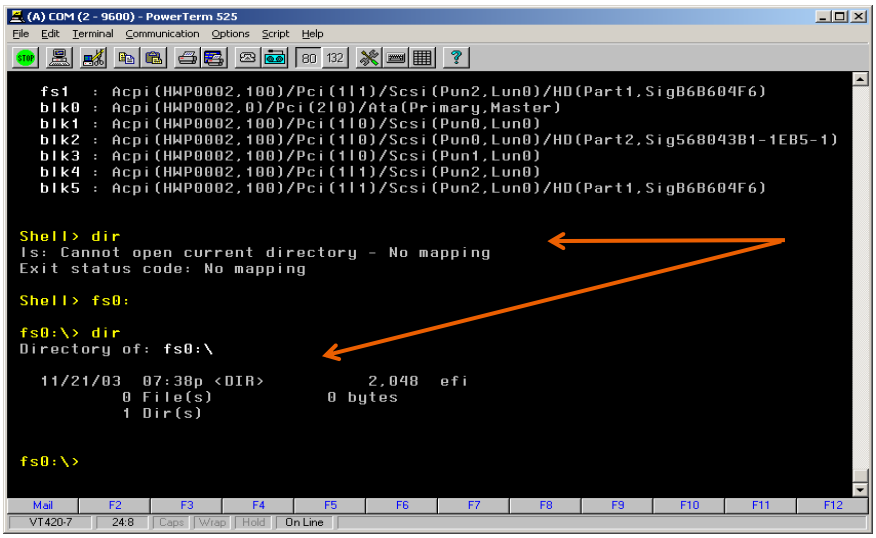
EFI system partition



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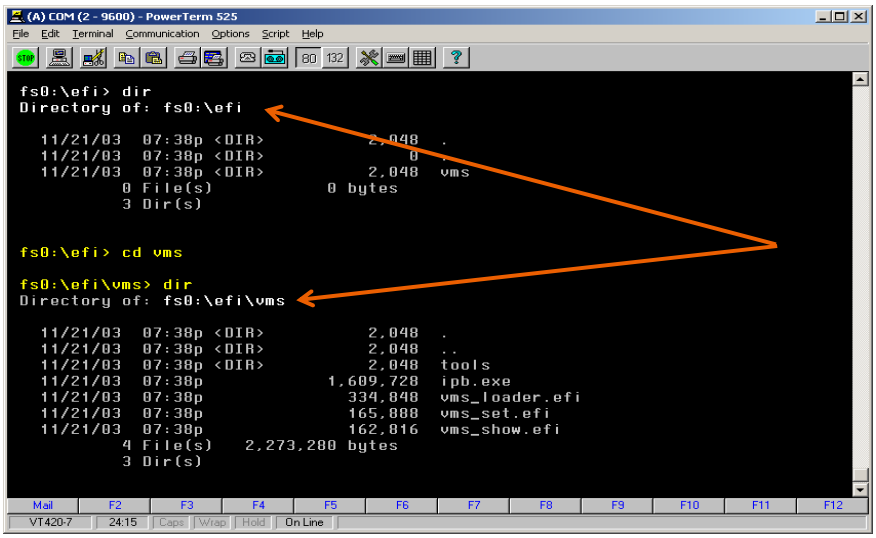
EFI system partition files



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OpenVMS I64 system disk format

- EFI requires GUID Partition Table (GPT) disk format
  - GUID = Globally Unique Identifier
- EFI requires one FAT32 partition
  - Contains EFI system partition files
- OpenVMS requires ODS-2 or ODS-5 format disk with Files-11 file structure
- OpenVMS does not support partitioned disks!
- Both formats co-exist, independent of each other

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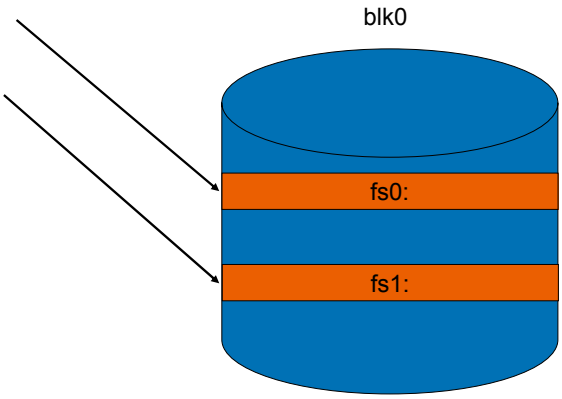
Hybrid system disk: EFI view

- GPT format with one or more FAT32 partitions
  - EFI system partition
  - Diagnostics partition (optional)
- Remaining space marked allocated



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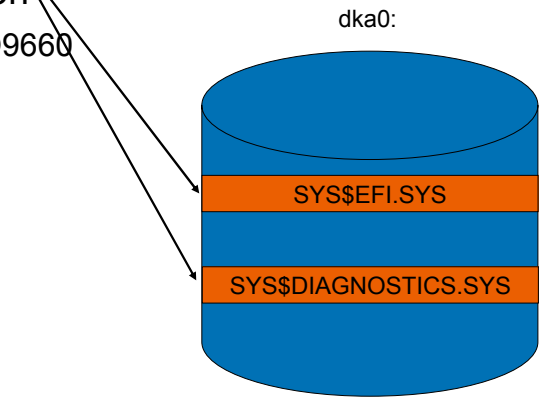
Hybrid system disk: OpenVMS view

- ODS Files-11 format disk
- One container file for each FAT32 partition
- Optical media use ISO9660 format instead of GPT



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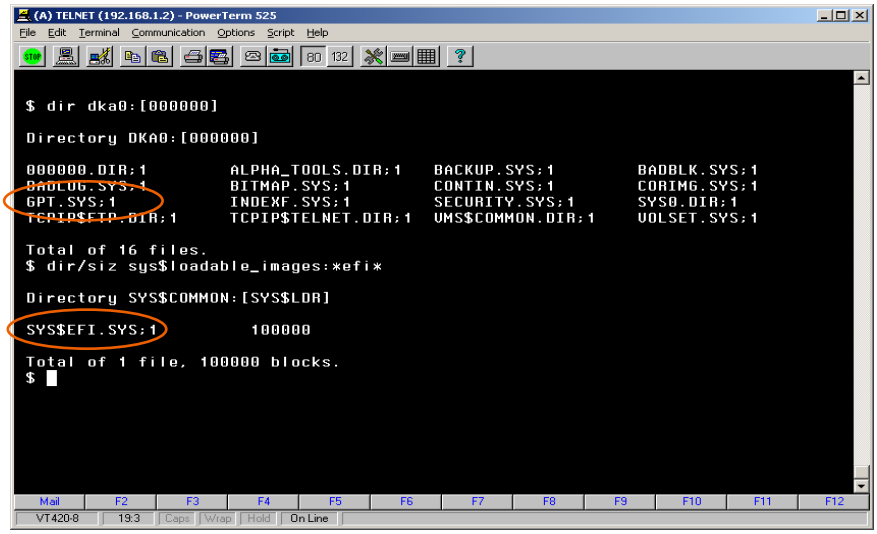
OpenVMS view of EFI system partition



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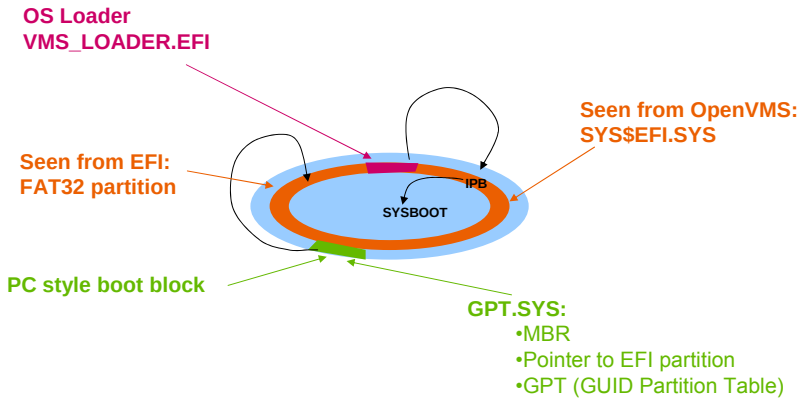
Hybrid system disk: dual view



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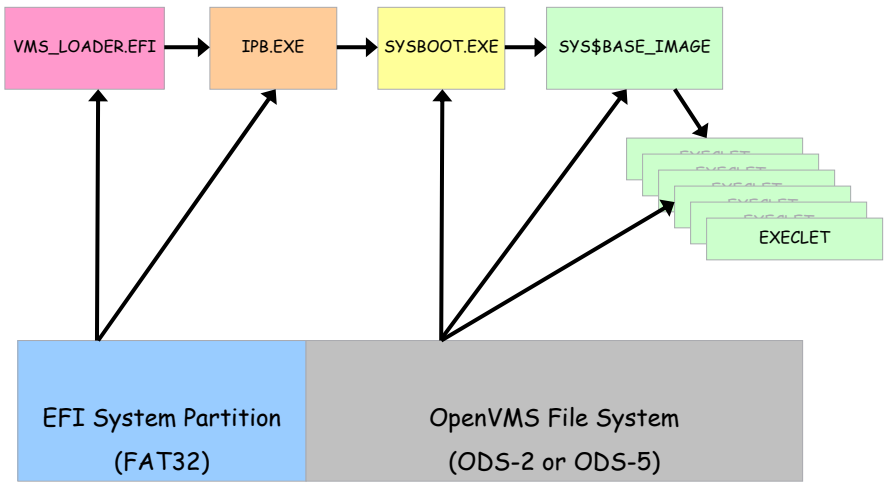
OpenVMS I64 bootstrap sequence



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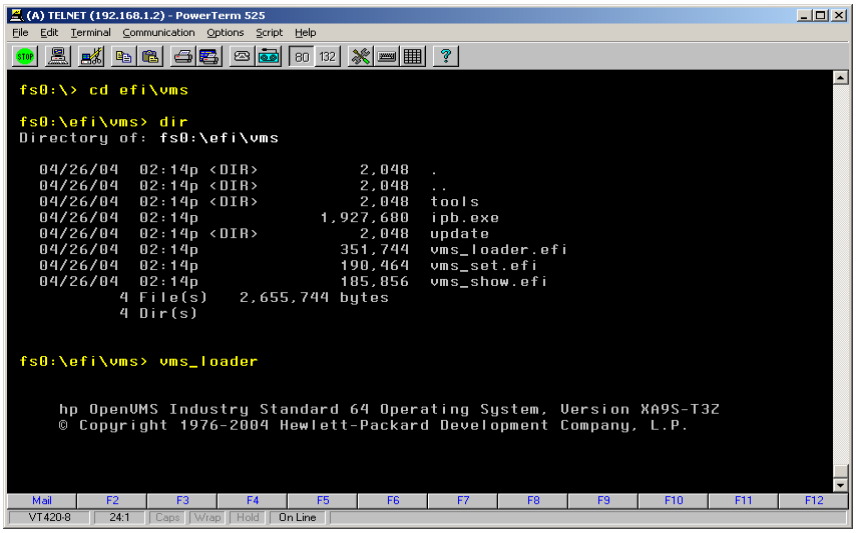
Booting OpenVMS I64



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Integrity Servers – Hardware Overview

- No “Vax like” or “Alpha like” console
- Has multiple consoles:
  - Management Processor (MP)
  - Baseboard Management Console (BMC)
  - Both attempt to be common across the entire hardware range
- Uses Extensible Firmware Interface (EFI) rather than BIOS.

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MP console

- Runs with box level power, even with system off.
- Local, remote (modem) and network connectivity
- Console configuration (terminal type, etc.)
- Network configuration (hostname, IP address, etc.)
- Multiple console sessions (one writer, many readers)
- Provides ability to copy files over the network (firmware updates)

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BMC

- Runs with main board powered up
- Local connectivity (9 pin serial)
- Power up, self tests
- Device detection
- Console configuration
- No graphics console

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EFI

- Mini operating system
- FAT formatted file system (FAT12, FAT16 and FAT32), VMS presents FAT16 partition to EFI
- Boot menu and defaults
- Environment variables (VMS_FLAGS, etc.)
- VMS_LOADER.EFI finds and loads IPB.EXE
- IPB.EXE understands the OpenVMS file system, EFI does not.

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Boot and Device detection

- EFI boot loader from FAT partition (hidden as a container file on the system disk)
- Boot flags passed through environment variables
- Reads executive into memory
- Passes control to the executive
- The system uses ACPI (Advanced Configuration and Power Interface) for device detection by the firmware
- Devices appear as a set of CSRs (Control and Status Registers) in physical memory – the I/O space.

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Boot and Device detection

- Devices have interrupt vectors which connect a device interrupt request to the device driver interrupt service routine. Device data obtained from ACPI data.
- ACPI data indicates device type.
- SYSMAN IO AUTO will query ACPI data to find devices and set up OpenVMS device drivers to communicate with the hardware
- ***Now Let's take a look, how the past 6 slides look at real life….***

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Booting VMS from the EFI Shell

- Select EFI Shell from the boot menu
- Set Boot flags environment variable, stored in NVRAM
  - IA64 flag values are generally the same as Alpha and VAX
  - Shell> set vms_flags "0,0"
- Select disk and directory
  - Shell> fs0:
  - fs0:> cd efi\vms
- Start the boot of VMS
  - fs0:> vms_loader
- Override environment variable
  - fs0:> vms_loader –flags 0,1

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VMS_SHOW

- EFI utility to associate VMS device name with EFI pathnames

```
fs0:\efi\vms> vms_show devices
VMS: EIA0
EFI: Acpi(000222F0,0)/Pci(3|0)/Mac(00306E3829B5)

VMS: DKA0
EFI: fs0: Acpi(000222F0,100)/Pci(1|0)/Scsi(Pun0,Lun0)

VMS: EWA0
EFI: Acpi(000222F0,100)/Pci(2|0)/Mac(00306E38B938)

VMS: DKC200
EFI: fs1: Acpi(000222F0,200)/Pci(1|0)/Scsi(Pun2,Lun0)
```

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VMS_SET

- EFI utility to allow selection of dump devices and HLL debugger port:

```
fs0:\efi\vms> vms_set dump_dev dka0,dkc200
VMS: DKA0
EFI: fs0: Acpi(000222F0,100)/Pci(1|0)/Scsi(Pun0,Lun0)

VMS: DKC200
EFI: fs1: Acpi(000222F0,200)/Pci(1|0)/Scsi(Pun2,Lun0)

fs0:\efi\vms> vms_show dump_dev
VMS: DKA0
EFI: fs0: Acpi(000222F0,100)/Pci(1|0)/Scsi(Pun0,Lun0)

VMS: DKC200
EFI: fs1: Acpi(000222F0,200)/Pci(1|0)/Scsi(Pun2,Lun0)
```

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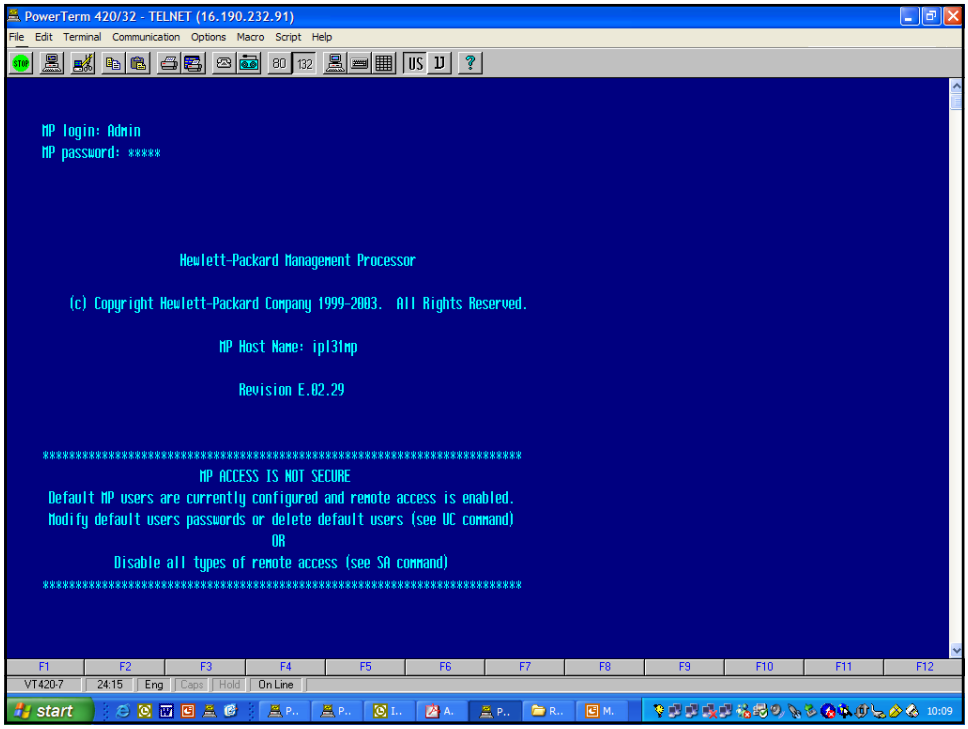
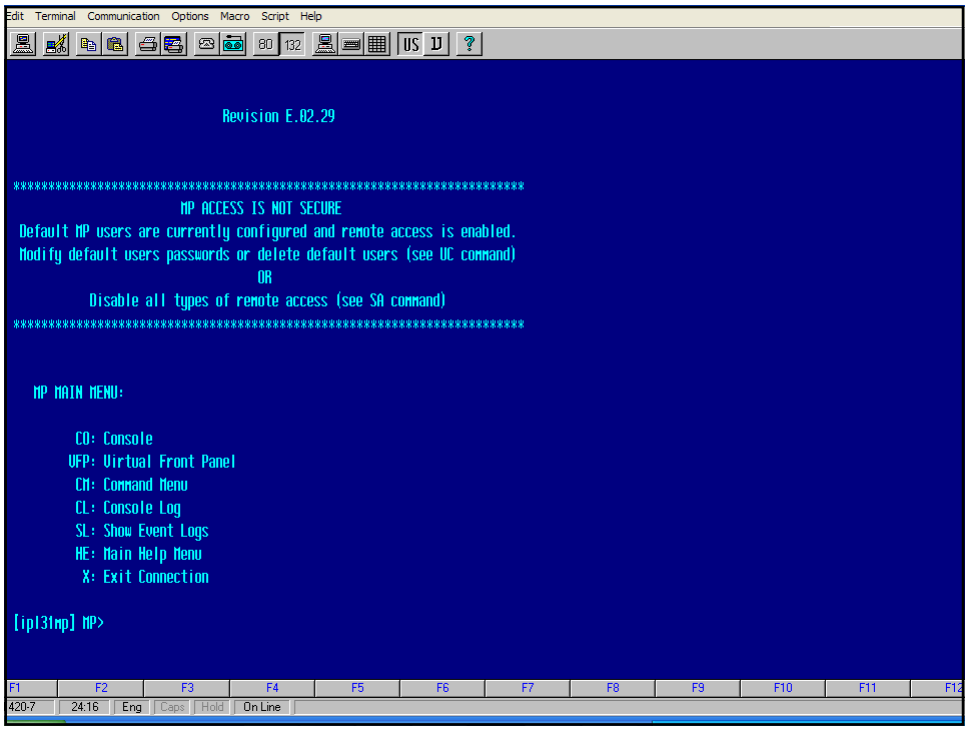
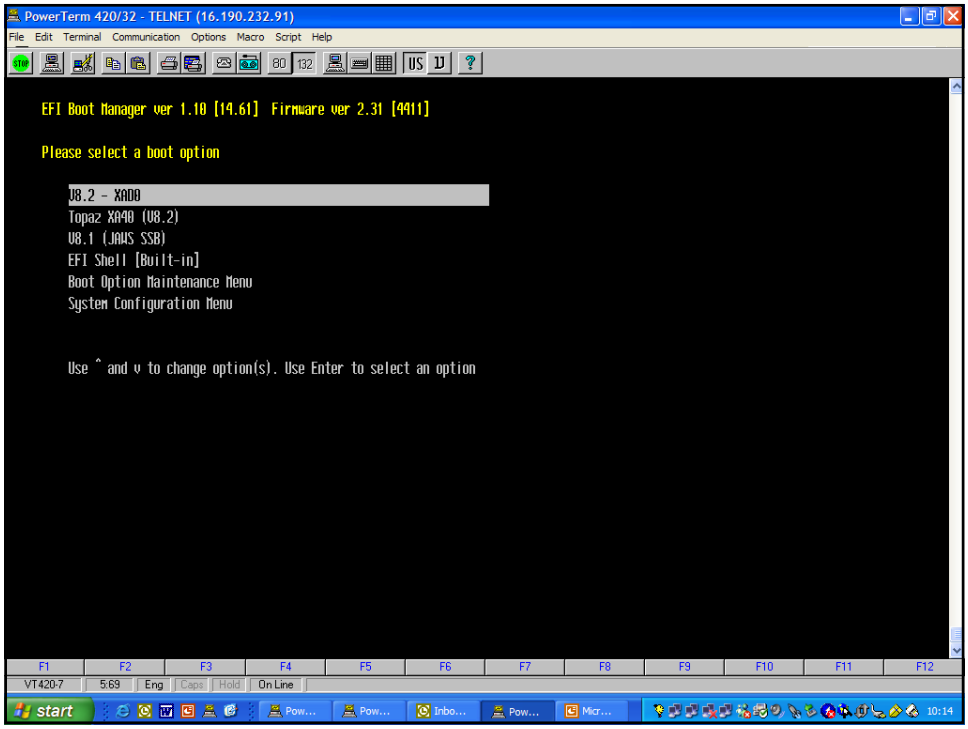
Forcing a system crash

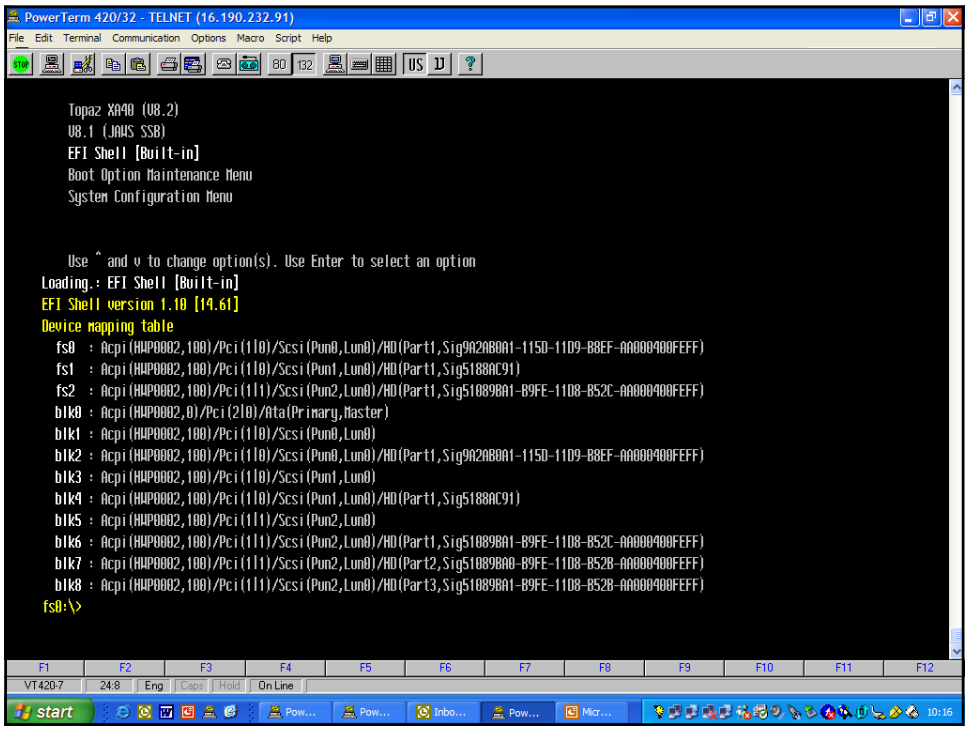
- History
  - On VAX and early Alpha system, ^P was detected by special hardware and handled by the console
  - Commodity serial ports pushed ^P detection in console software, if IPL < DEVICE_IPL
- EFI console ignores ^P, no way to return to EFI Shell
- IA64 VMS console terminal driver handles ^P
  - Calls XDELTA, if loaded
  - Prompts for forced crash, if IPL < DEVICE_IPL
- Remote console command generates Transfer of Control signal (BMC:TOC, MP:TC)
  - Handled by IA64 VMS as a non-maskable exception and

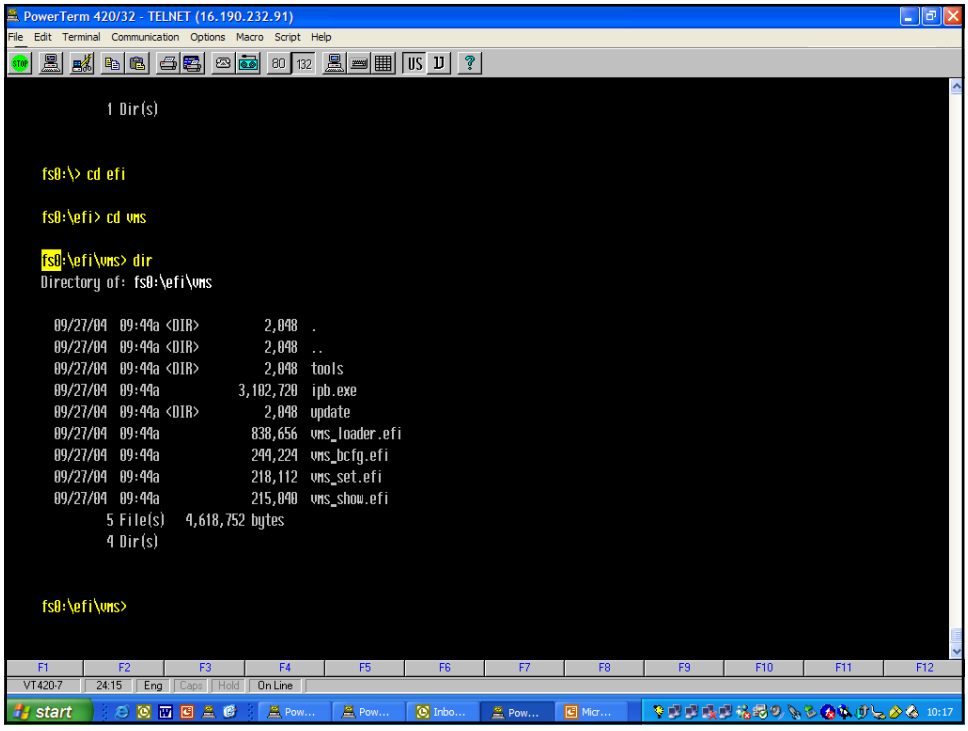
35

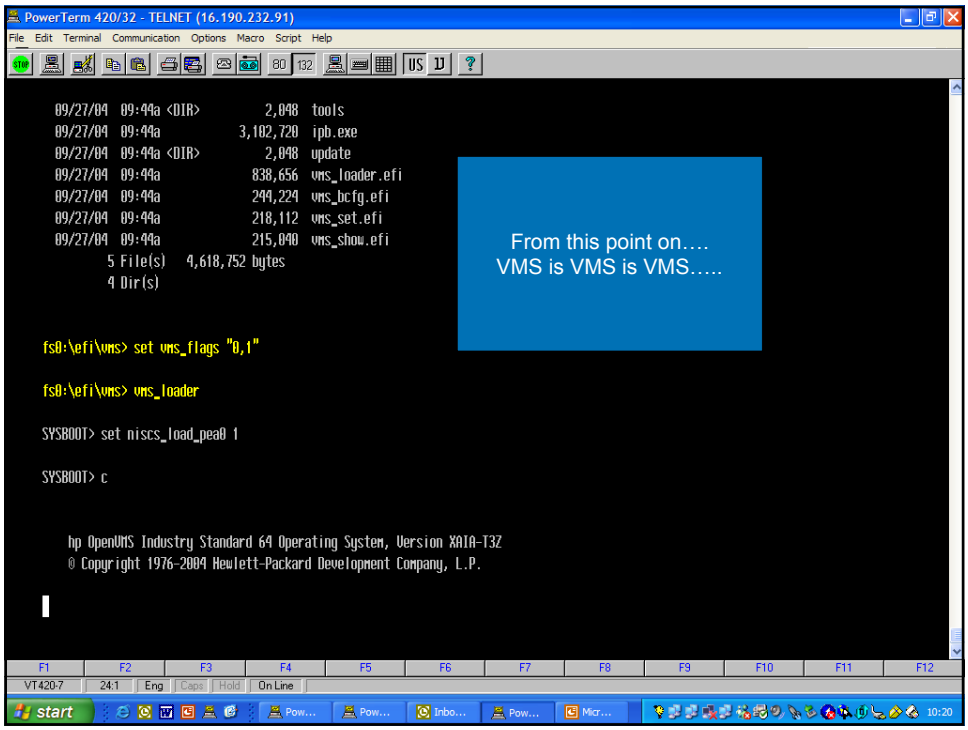



Edit Terminal Communication Options Macro Script Help
Revision E.02.29
MP ACCESS IS NOT SECURE
Default MP users are currently configured and remote access is enabled.
Modify default users passwords or delete default users (see UC command)
OR
Disable all types of remote access (see SA command)
MP MAIN MENU:
CO: Console
VFP: Virtual Front Panel
CM: Command Menu
CL: Console Log
SL: Show Event Logs
HE: Main Help Menu
X: Exit Connection
[ipl31mp] MP>


PowerTerm 420/32 - TELNET (16.190.232.91)
File Edit Terminal Communication Options Macro Script Help
EFI Boot Manager ver 1.10 [14.61] Firmware ver 2.31 [4911]
Please select a boot option
U8.2 - XA00
Topaz XA40 (U8.2)
U8.1 (JAWS SSB)
EFI Shell [Built-in]
Boot Option Maintenance Menu
System Configuration Menu
Use ^ and v to change option(s). Use Enter to select an option
start


PowerTerm 420/32 - TELNET (16.190.232.91)
File Edit Terminal Communication Options Macro Script Help
Topaz XA90 (V8.2)
V8.1 (JAWS SSB)
EFI Shell [Built-in]
Boot Option Maintenance Menu
System Configuration Menu
Use ^ and v to change option(s). Use Enter to select an option
Loading.: EFI Shell [Built-in]
EFI Shell version 1.10 [14.61]
Device mapping table
fs0 : Acpi(HWP0002,100)/Pci(1|0)/Scsi(Pun0,Lun0)/HD(Part1,Sig9A2AB0A1-115D-11D9-B8EF-AA000400FEFF)
fs1 : Acpi(HWP0002,100)/Pci(1|0)/Scsi(Pun1,Lun0)/HD(Part1,Sig5188AC91)
fs2 : Acpi(HWP0002,100)/Pci(1|1)/Scsi(Pun2,Lun0)/HD(Part1,Sig51089BA1-B9FE-11D8-B52C-AA000400FEFF)
blk0 : Acpi(HWP0002,0)/Pci(2|0)/Ata(Primary,Master)
blk1 : Acpi(HWP0002,100)/Pci(1|0)/Scsi(Pun0,Lun0)
blk2 : Acpi(HWP0002,100)/Pci(1|0)/Scsi(Pun0,Lun0)/HD(Part1,Sig9A2AB0A1-115D-11D9-B8EF-AA000400FEFF)
blk3 : Acpi(HWP0002,100)/Pci(1|0)/Scsi(Pun1,Lun0)
blk4 : Acpi(HWP0002,100)/Pci(1|0)/Scsi(Pun1,Lun0)/HD(Part1,Sig5188AC91)
blk5 : Acpi(HWP0002,100)/Pci(1|1)/Scsi(Pun2,Lun0)
blk6 : Acpi(HWP0002,100)/Pci(1|1)/Scsi(Pun2,Lun0)/HD(Part1,Sig51089BA1-B9FE-11D8-B52C-AA000400FEFF)
blk7 : Acpi(HWP0002,100)/Pci(1|1)/Scsi(Pun2,Lun0)/HD(Part2,Sig51089BA0-B9FE-11D8-B52B-AA000400FEFF)
blk8 : Acpi(HWP0002,100)/Pci(1|1)/Scsi(Pun2,Lun0)/HD(Part3,Sig51089BA1-B9FE-11D8-B52B-AA000400FEFF)
fs0:\>
F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12
VT420-7 24:8 Eng Caps Hold On Line
start
10:16


PowerTerm 420/32 - TELNET (16.190.232.91)
File Edit Terminal Communication Options Macro Script Help
1 Dir(s)
fs0:\> cd efi
fs0:\efi> cd vms
fs0:\efi\vms> dir
Directory of: fs0:\efi\vms
09/27/04 09:44a <DIR> 2,048 .
09/27/04 09:44a <DIR> 2,048 ..
09/27/04 09:44a <DIR> 2,048 tools
09/27/04 09:44a 3,102,720 ipb.exe
09/27/04 09:44a <DIR> 2,048 update
09/27/04 09:44a 838,656 vms_loader.efi
09/27/04 09:44a 244,224 vms_bcfg.efi
09/27/04 09:44a 218,112 vms_set.efi
09/27/04 09:44a 215,040 vms_show.efi
5 File(s) 4,618,752 bytes
4 Dir(s)
fs0:\efi\vms>
F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12
VT420-7 24:15 Eng Caps Hold On Line
start
10:17


PowerTerm 420/32 - TELNET (16.190.232.91)
File Edit Terminal Communication Options Macro Script Help
09/27/04 09:44a <DIR> 2,048 tools
09/27/04 09:44a 3,102,720 ipb.exe
09/27/04 09:44a <DIR> 2,048 update
09/27/04 09:44a 838,656 vms_loader.efi
09/27/04 09:44a 244,224 vms_bcfg.efi
09/27/04 09:44a 218,112 vms_set.efi
09/27/04 09:44a 215,040 vms_show.efi
5 File(s) 4,618,752 bytes
4 Dir(s)
fs0:\efi\vms> set vms_flags "0,1"
fs0:\efi\vms> vms_loader
SYSBOOT> set niscs_load_pea0 1
SYSBOOT> c
hp OpenVMS Industry Standard 64 Operating System, Version XAIA-T3Z
© Copyright 1976-2004 Hewlett-Packard Development Company, L.P.
From this point on....
VMS is VMS is VMS.....
F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 F12
VT420-7 24:1 Eng Caps Hold On Line
start
10:20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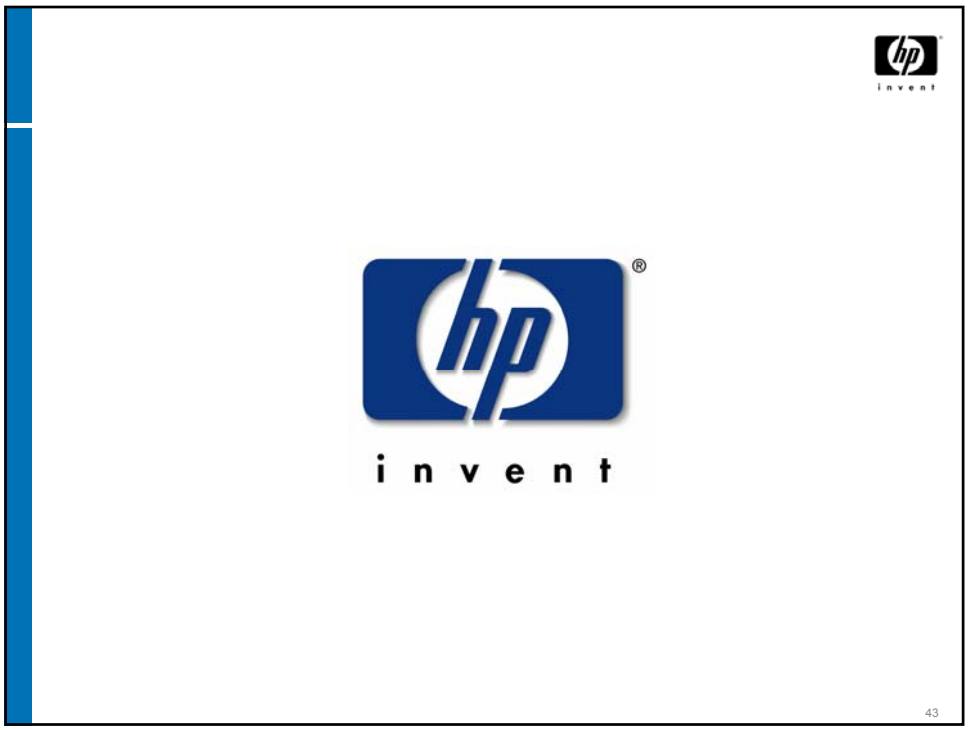
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