Operating Systems for HP Integrity Servers

HP WORLD 2004
Solutions and Technology Conference & Expo

"When should I deploy…
HP-UX ?"
Linux ?"
Windows Server 2003 ?"
OpenVMS ?"

Al Pillarelli

Business Critical Servers

BCS Customer Programs - Asia-Pacific Liaison

Technology Consultant & Strategy Manager

"When should I deploy…
HP-UX, Linux, Windows Server 2003, or OpenVMS?"

It's a frequently asked question…

but it usually implies (at least) three more:

- "I have already made a commitment to one of the operating systems available for HP Integrity servers – are you really supporting my choice?" (translation: Did he even mention my O/S?)
- "How will you be able to help me solve my business problems with your IT offerings?" (translation: Which O/S gives me the best technology solution with enabling and completer applications for my environment?)
- "What is the overall O/S strategy for Integrity Servers?" (translation: I've heard lots of "FUD"… What are your future plans?)

“Which O/S?” should not be the first question…

- Application Support
- Investment Protection
- Integration and Interoperability
- Internet Services
- Reliability
- Manageability
- Availability and/or Disaster Tolerance
- O/S Development Plans & Roadmaps
- Hardware Platform Roadmaps

An operating system embodies the philosophy of its creators…

- HP-UX® – "Deliver highest value and quality and breakthrough innovation - Industry's best rated Unix OS:
  - unsurpassed functionality - constant investment focused on customer satisfaction
  - leadership in scale-up and scale-out
  - best from Tru64 UNIX® and TruCluster technology
  - 'mission critical' solution partner support (applications!)"
- Linux® – "Hello everybody out there… I'm doing a (free) operating system" – Open Source Computing -- Large Open Source community backing – fully supported, and used by HP
- Microsoft® Windows Server™ 2003 -- for 64-bit Itanium-based systems running "memory-intensive or compute-intensive applications"
- HP OpenVMS® – "Simply put, nothing stops it! - applications and associated data are available… all the time"
- NonStop™ – "Fail-fast design philosophy to provide hardware and software fault tolerance into every aspect of the system"

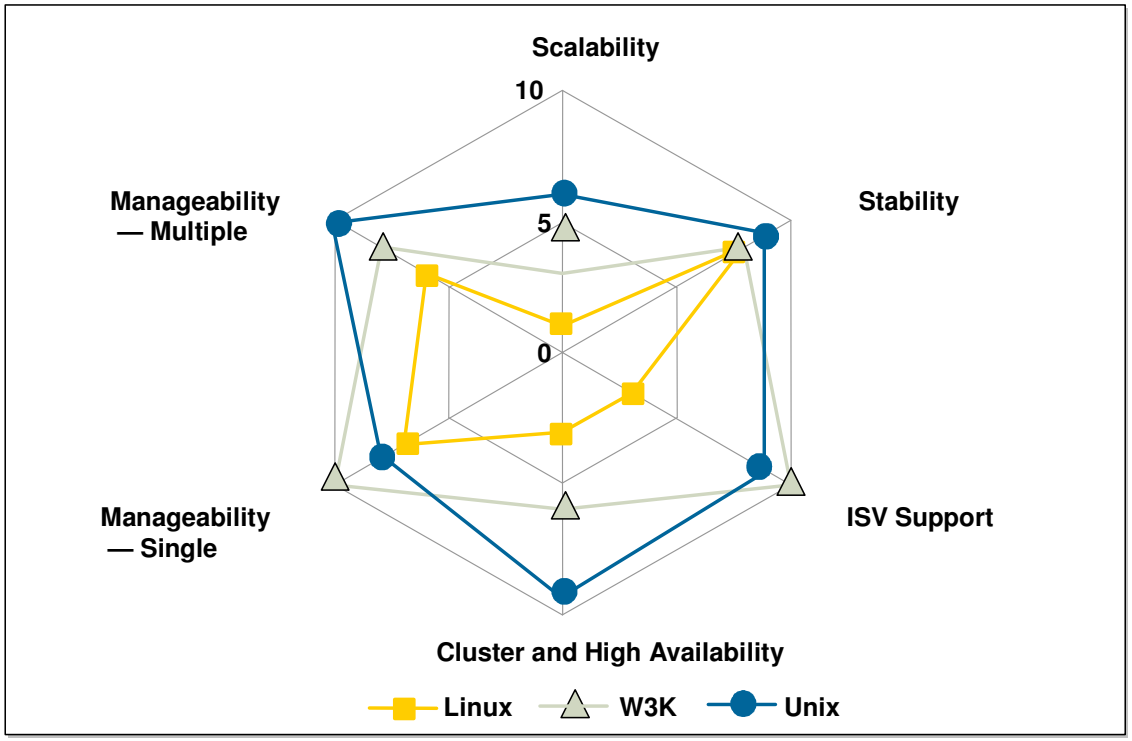
Integrity operating environments . . .

Windows and Linux further extend into the enterprise while HP-UX 11i and OpenVMS become more pervasive across the enterprise

decision criteria	access services	application services	database services
	• applications • customization	• applications • flexibility • scalability	• applications • scalability • mission critical
hp-ux 11i	HP-UX 11i v2: leading price/performance with proven performance scalability, security and reliability; seamless migration from RISC (soon to include best features of Tru64 UNIX and TruCluster technology)		
Linux	Linux open-source community leadership for optimized solutions spanning the enterprise: from secure web serving to supercomputing clusters		
Microsoft Windows Server 2003	Fully supported Windows Advanced Server LE provides #1 performance to extend Windows further into the enterprise		
OpenVMS	OpenVMS delivers growth and investment protection for your bulletproof and secure environments		

Forrester Research compares Linux, Windows and UNIX®

Figure 3: Linux, Unix and Windows — A Comparison



Source: Giga Research, a wholly owned subsidiary of Forrester Research, Inc.

UNIX Operating System Design Criteria

- Easy to use – interactive, powerful and flexible user interface
- Powerful Programming Tools – built-in compilers, powerful text & document tools
- Small, Simple Utility Programs – tools to perform generic tasks with ability to combine tools for complex applications
- Small, Simple Kernel – shells that provide interactive, user-tailorable interface with powerful and flexible commands, tools and programming features
- Tree-Based File System – logical file system accesses files by name with local and network support for file access regardless of physical storage location
- Preemptive Multitasking & Multi-user – automatic scheduling and background execution for batch processes; support for group work and ability to reach files from different user accounts
- Simple System Portability – use of a portable high-level language to build the operating system with a powerful set of tools for use, support and administration of a wide range of network services

The real strengths of UNIX…

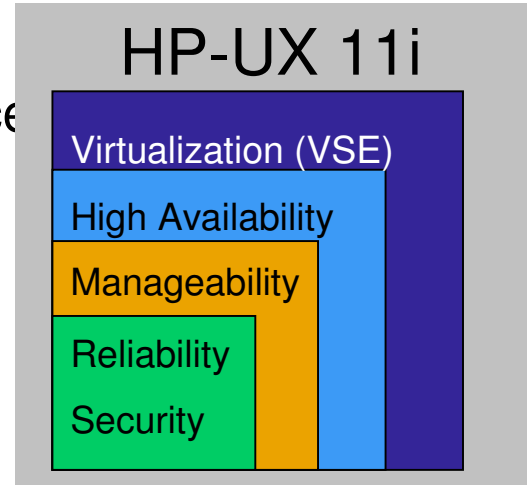
High throughput database engine -- ubiquitous foundation of the Internet…

- Supports single and multiprocessor platforms
- Multithreads for significant multiprocessor performance
- Large number crunching jobs can run in the background while providing fast response for jobs in foreground
- Reliable workhorse for demanding "lights out" operations
- Support for computation-intensive, technical computing
- Flexible, efficient commands combined with effective syntax can create elegant, powerful program operations
- Stability and scalability for enterprise environments
- Single UNIX specification supported by all major vendors

HP-UX 11i provides customer choice
Foundation for mission critical enterprises

Leadership resource **virtualization** provides the pathway to utility computing

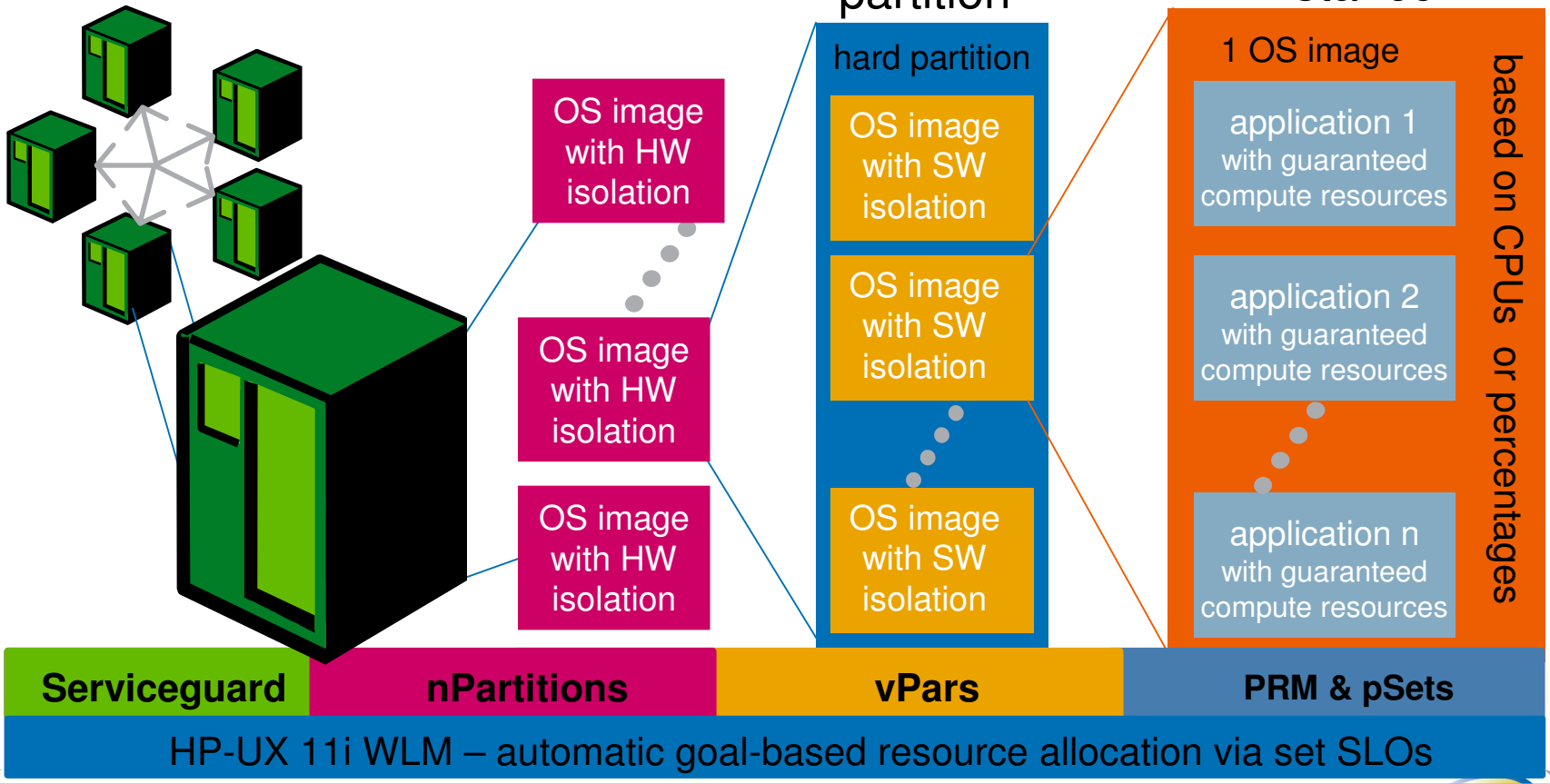
- The highest levels of availability and disaster tolerance – ***always on***
  - Proven #1 quality built in -- ***reliable and robustness***, second to none
- Superior security – **in-depth protection**
- Integration with all system management tools and frameworks – able to ***manage anytime from anywhere***
- Robust development environment HP-UX 11i and LINUX – ***flexible and heterogeneous***



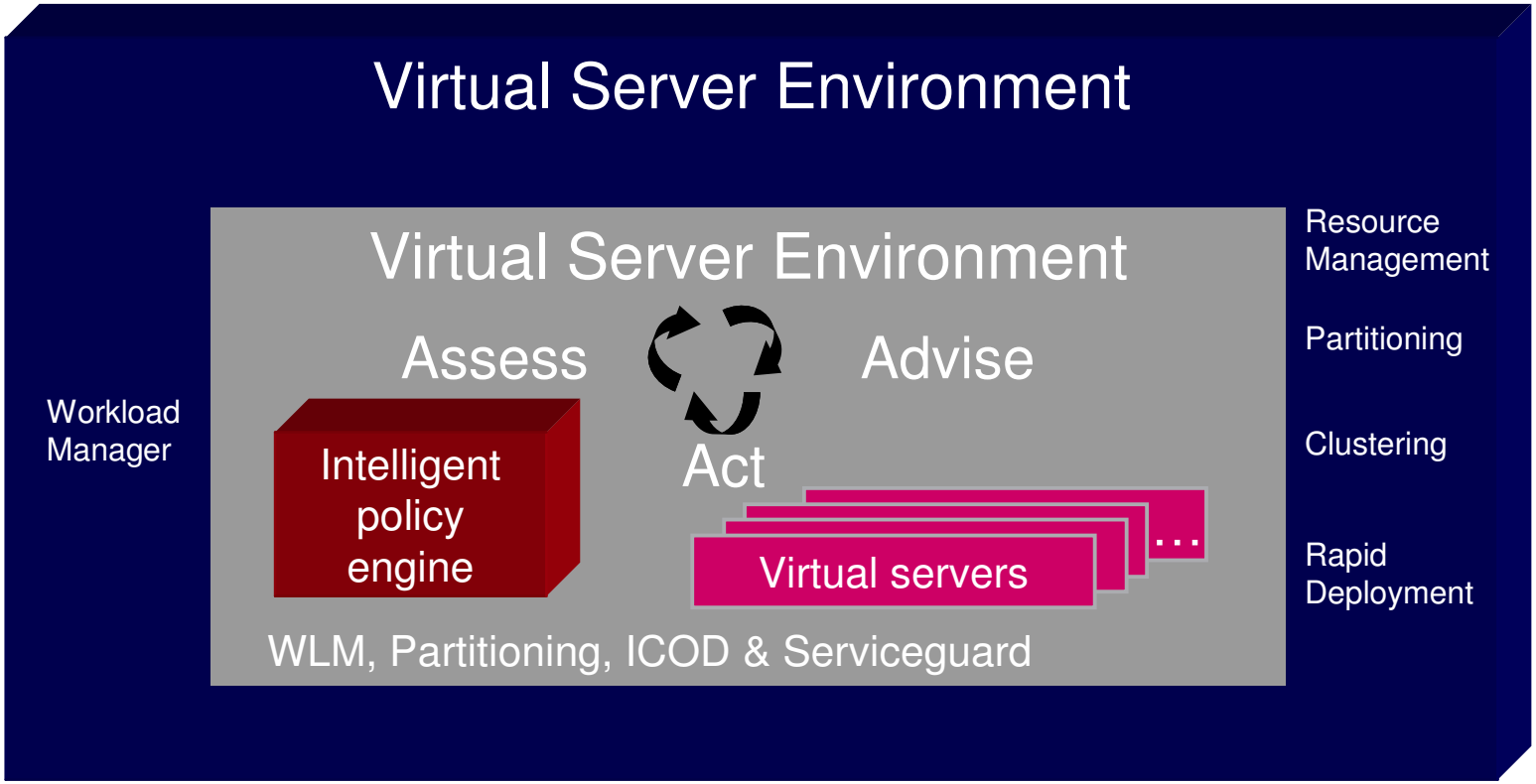
Unlimited growth

Competitive scale up, scale out and performance

HP-UX 11i Partitioning Continuum



HP-UX 11i Virtual Server Environment: intelligent orchestration of virtualized server resources



- Increased agility through tight integration of goal-based policy engine with virtualization techniques
- Reduced complexity through integration with cost-effective multi-system management tools

HP-UX 11i leads in delivering innovation focusing on mission critical customer value

Deliver the foundation for Utility Computing

- HP's long term vision - virtualization for the data center
- Leadership in scale-up and scale-out

Lead the industry in UNIX technology development

- Increase investment for breakthrough innovation
- Integrate the best from Tru64 UNIX and TruCluster technology
- Focus on customer satisfaction where mission critical matters most
- Deliver highest value and quality

Long term market share leadership

- Provide the optimal path for Tru64 UNIX customers
- HP-UX 11i #1 in the industry
- Benefits for our customers: Solution partner support (applications!) and longevity

Tru64 UNIX & TruClusters on HP AlphaServer Systems

- Continuing to provide investment protection while we are on our way to creating an even better HP-UX… Tru64 UNIX is available on AlphaServers at least through 2006… supported through 2011+
- Delivers availability and improved RoIT : when you require virtually no downtime, and demand unlimited scalability
- Update your Tru64 UNIX environment to our latest AlphaServers and V5.1B to take advantage of single system image shared across the cluster with multi-node workload balancing and no application modification
- Evolution and innovation have been hallmarks of Tru64 UNIX and TruCluster server technology and we are adding that technology to HP-UX in 11iv2 and 11iv3

What is Linux® ?

- Looks and feels much like any other UNIX® system
- UNIX® compatibility is a major design goal
- Multiuser, Multitasking System – with full set of UNIX-compatible tools
- Linux ® source code is available free on the Internet
- HP collaborates with leading Linux distributors
- Linux® Standard Base (LSB) – i.e., similar to the single UNIX® specification but for Linux®
- LSB – set of standards that increases compatibility among Linux® runtime environments and enables software applications to run on any compliant Linux®
- LSB group helps coordinate efforts to recruit software vendors to port and write products for Linux®
- LSB only standardizes the base and allows runtime environments to still be unique and provide added value

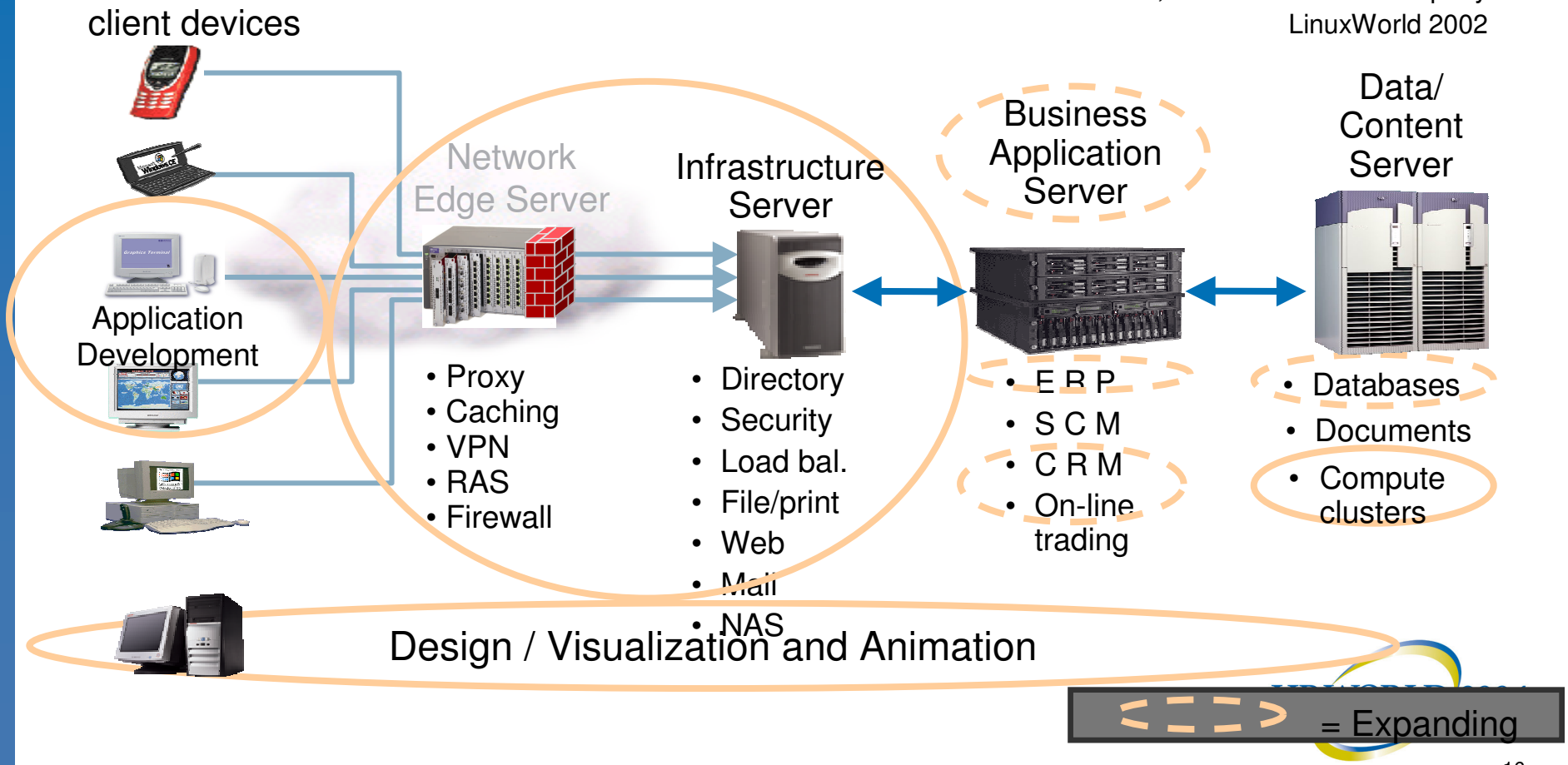
Strengths of Linux

- Very good applications server – J2EE, Weblogic, etc.
- Integrate and consolidate data from multiple sources – database libraries, middleware servers, Perl and Python programming languages, excellent batch scheduling support
- Supports all major RDBMS systems (including Microsoft SQL via middleware) and runs up to 8 CPUs & 1GB RAM
- Excellent and dramatically simplified remote management support via Internet or other access for turn-key deployment
- Multi-platform file server – can export same files in a variety of formats simultaneously
- Middleware and Application Integration – implement CORBA, C/C++, various BASICs, Ada, Fortran and Java middleware…
- Cluster-enabled configurations for greater scalability & availability
- Ideal Internet mail platform - Imap and LDAP directory services support
- Availability of source code & ability to work with open source tools allows programmers to create unique code for a given task
- Linux viruses are very rare and there's ample virus scanning software

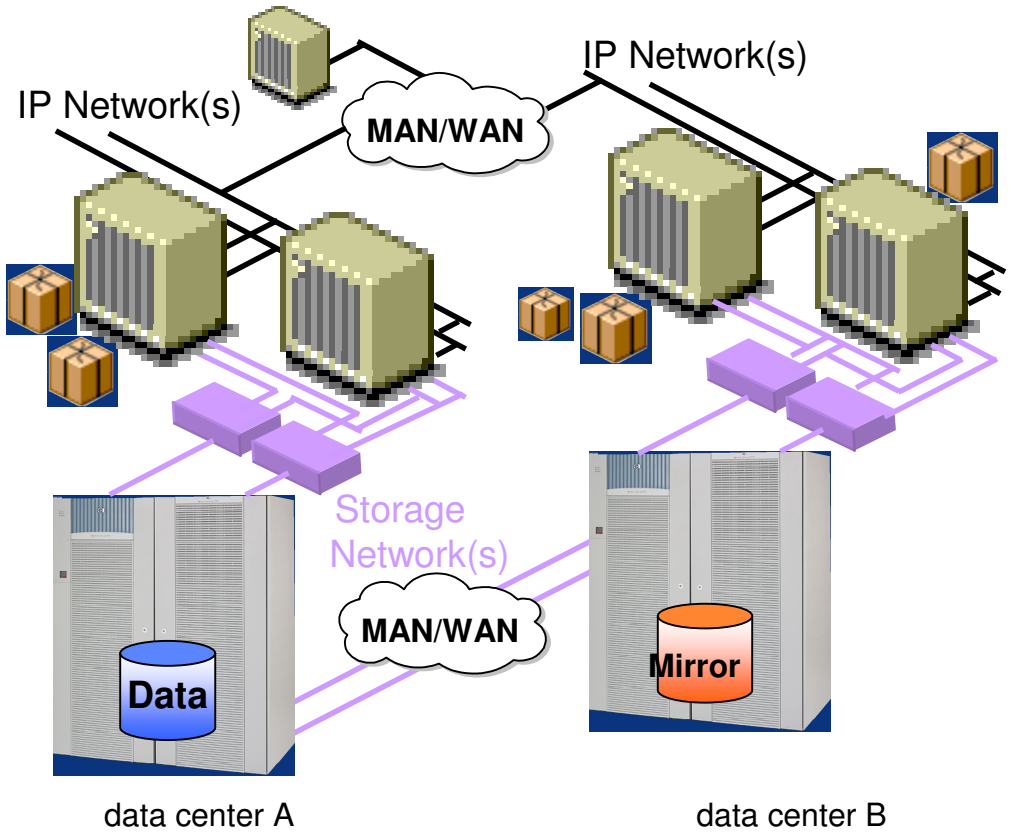
Linux Workloads and HP Solution Focus

"The question for us isn't 'Will Linux dominate the world?", but 'What part of the world will Linux dominate?'"

Carly Fiorina
CEO, Hewlett-Packard Company
LinuxWorld 2002



Disaster tolerant HP Serviceguard for Linux solution



metropolitan-wide distances or farther

- Disaster recovery to protect against the risk of downtime, whether planned or unplanned
- Automatic failover/failback to reduce the complexity involved in a disaster recovery situation
- Ensures the highest standards in data integrity by leveraging the inherent advantages of HP StorageWorks XP disk array remote mirroring

World's first Disaster Recovery solution on Linux!

HP's use of Linux

"The question for us isn't 'Will Linux dominate the world?", but 'What part of the world will Linux dominate?'"

Carly Fiorina
CEO, Hewlett-Packard Company
LinuxWorld 2002

Over 3200 systems and growing …

- All external email is routed through Linux rim servers on HP's firewalls - to the tune of >3TB/year.
- DNS infrastructure is rolling out on Linux (~100 systems at present).
- Enterprise Directory service hosted on Linux clusters.
- Client DHCP service delivery hosted on Linux.
- Network time is provided by Linux rim servers - NTP is a critical element to keeping our routers and network in sync.
- HP's internal and secure instant messaging network (Jabber) is implemented on Linux servers.
- Linux clients and servers in use for electronic design automation [Synopsys]
- Utility Data Center deployment including 36 node Itanium Linux cluster used for HP Labs research computing
- Oracle 9iRAC application testing and validation for production deployment

Windows Server 2003 Editions

- Target: Data centers, large RDBMS, LOB apps, DW
- 64-bit, support for up to 64-way SMP & 512 GB RAM, IA-32 EL
- 32-bit, support for up to 32-way SMP & 64 GB RAM, HT
- 8-node clustering, NUMA, WSRM (resource manager)

- Target: Medium to large enterprises, LOB apps, DB
- 64-bit, support for up to 8-way SMP & 64 GB RAM, IA-32 EL
- 32-bit, support for up to 8-way SMP & 32 GB RAM, HT
- 8-node clustering, NUMA, WSRM (resource manager)

- Target: Small or departmental environments, enabling basic file and print and collaboration
- 64-bit, support for up to 4-way SMP & 32 GB RAM, IA-32 EL*
- 32-bit, support for up to 4-way SMP & 4 GB RAM, HT

* Standard Edition for Itanium®-based systems available at Service Pack 1 release

Windows Server 2003 Family

HP meets the needs of Enterprise Windows customers

Customers Requirements

- Application performance and scalability to handle
  - Higher-bandwidth tasks
  - Secure processing
  - More users
- Greater flexibility and reliability
- Greater support for complex workloads
- Industry standard technology across the data center
- Lower costs, better price/performance

- *HP delivers with Integrity Servers + Windows*

Database solutions

- SQL Server Scale-Up
- OLTP Performance
- Business Intelligence
- Data Warehouse
- Decision Support/OLAP
- Migration from UNIX-based Database with Windows Applications
- Easy Migration from a 32-bit SQL Server 2000 Database

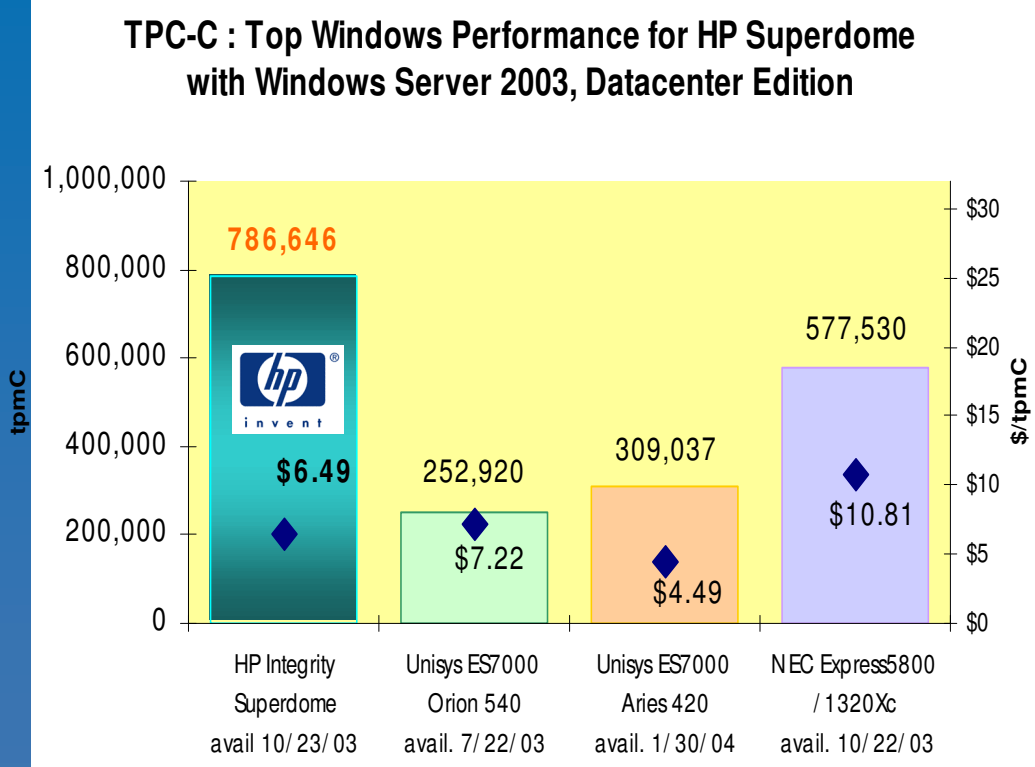
ERP solutions

- SAP
- Siebel

HP Integrity Servers: Broadest line of Itanium® 2–based systems supporting Windows Server 2003

Microsoft Windows Server 2003 Datacenter Edition	HP Integrity Superdome		Up to 64p scalability and hard partitioning capability for leading consolidation
Microsoft Windows Server 2003 Datacenter Edition Microsoft Windows Server 2003 Enterprise Edition	HP Integrity rx8620-32 server		32p scalability and hard partitioning capability for consolidation
Microsoft Windows Server 2003 Datacenter Edition Microsoft Windows Server 2003 Enterprise Edition	HP Integrity rx7620-16 server		16p flexibility with high-performance, density, and partitioning capabilities
Microsoft Windows Server 2003 Enterprise Edition	HP Integrity rx4640-8 server		8p high-performance server in ultra-dense and highly scalable models
Microsoft Windows Server 2003 Enterprise Edition	HP Integrity rx2600-2 server		2p ultra-dense, power-packed server redefines entry-level computing

Industry Leading TPC-C Windows Server 2003 Performance on HP Integrity Superdome!!



Availability date for the HP Integrity Superdome server configured is October 23, 2003

Data as of March 31, 2004. See complete results at www.tpc.org.

- HP Integrity Superdome with 64 Itanium 2 6M processors running 64-bit SQL Server 2000 and Windows Server 2003 delivers record breaking database performance
  - #1 published Windows Server 2003 performance at 786,646 tpmC
    - 211 % better than Unisys Orion 540 (Xeon based)
    - 155% better than Unisys Aries 420 (Itanium based)
    - 36 % better than NEC Express5800 (Itanium based)
  - Exceptional enterprise price performance of $ 6.49 /tpmC beats Unisys and NEC systems greater than 16-way!

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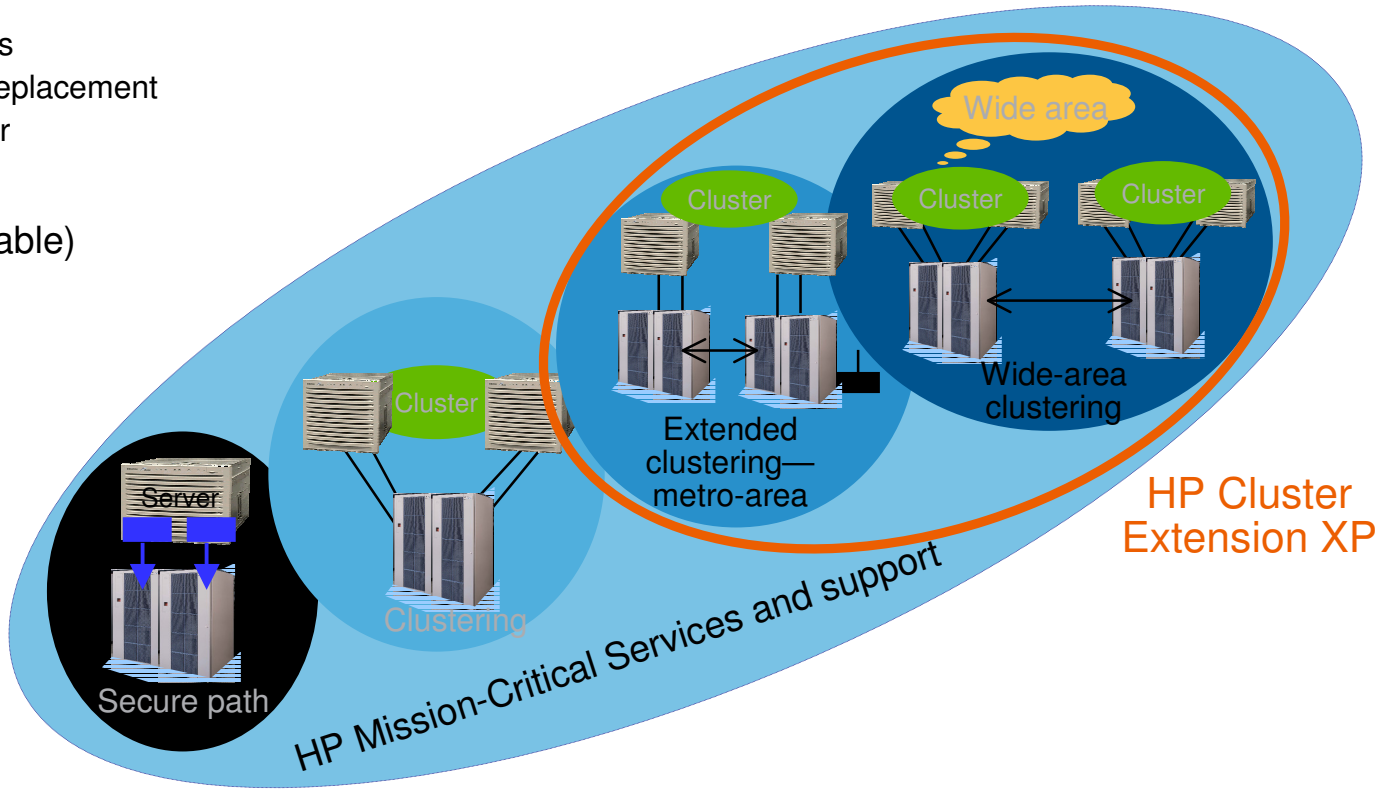
Mission-critical Microsoft and HP Integrity Server solutions

RISC-level reliability, availability, and serviceability for Windows

High-availability features
- Fault-isolation technologies
- I/O cards online removal/replacement
- Redundant AC input power

n+1 features (hot swappable)
- Cabinet blowers
- I/O fans
- DC power supplies
- Cell backplane DC
- Power supplies

Error correction
- ECC on CPU cache
- Parity-protected CPU and I/O links
- Single-wire correction on fabric and I/O
- ECC on all fabric and memory paths
- Chipkill memory



VMS (now OpenVMS) Design Philosophy

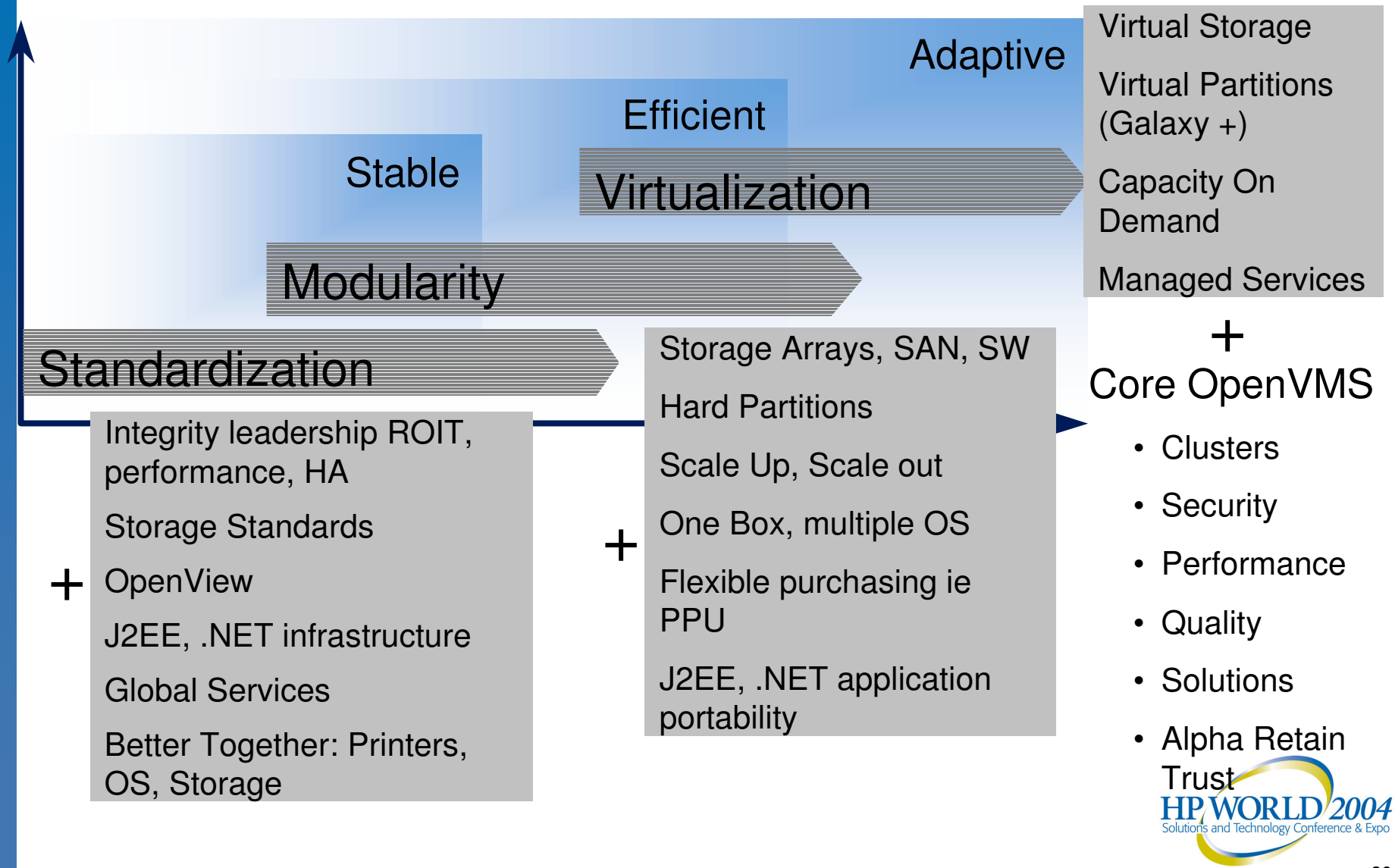
Originated with VAX computers, same software runs unmodified on a range of computers from desktop to very large systems; same story on AlphaServers and Integrity Servers!

- ✓ **One Company: One Architecture** – Porting; Itanium wasn't our first!
- ✓ **Well informed users shielded from O/S internals** – powerful self-contained commands and sophisticated process management & detailed messaging
- ✓ **"King of Clusters"** -- applications must have ability to process transactions without interruption. When failures do occur, recovery must occur quickly and recovery must be transparent to customers
- ✓ **"Cool and Unhackable"** -- range of security products and services to protect a company's vital assets that even Kevin Mitnik couldn't breach!
- ✓ **Choose application & data integrity with efficiency** –continuously maintain integrity of data files, so that only recent operations need to be scrutinized upon restart; greater efficiency and expediency during a recovery.

Strengths of OpenVMS

- Multiple Instances (Galaxy) on a single computer with dynamic system resource assignment – mapping compute power to applications as needed without rebooting
- Premier OpenVMS Clustering – ensures high availability – Net result is data and application availability for your knowledge workers, partners and customers 24 hours a day, every day, anywhere in the world
- Scalability – Runs on everything from workstations to high-end AlphaServers and OpenVMS Clusters – with no change to the applications
- Ported to Itanium® - continued investment protection – long supported on VAX and Alpha platforms and mixed architecture clusters and, now with v8.1, runs on Itanium-based systems; v8.2 will be released by end of 2004
- Reliability – highest quality engineering standards and rigorous testing are standard operating procedure
- Excellent Interoperability – built in Windows application integration, increasing application portability of Linux and Unix applications -- making software maintenance easier and less expensive
- High Performance Networking – new and improved TCP/IP services for unsurpassed reliability and functionality

Adaptive Enterprise Leadership and OpenVMS

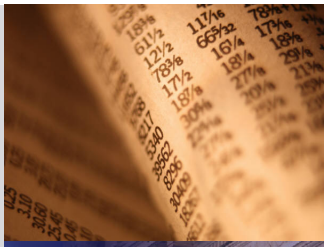


OpenVMS Today – supporting Alpha and Integrity Servers

OpenVMS

Mission Critical Leadership

- ✓ Reliability
- ✓ Availability
- ✓ Scalability
- ✓ Flexibility
- ✓ Security
- ✓ Global Services
- ✓ Solutions



Finance

Government

Healthcare

Telecomm

Manufacturing

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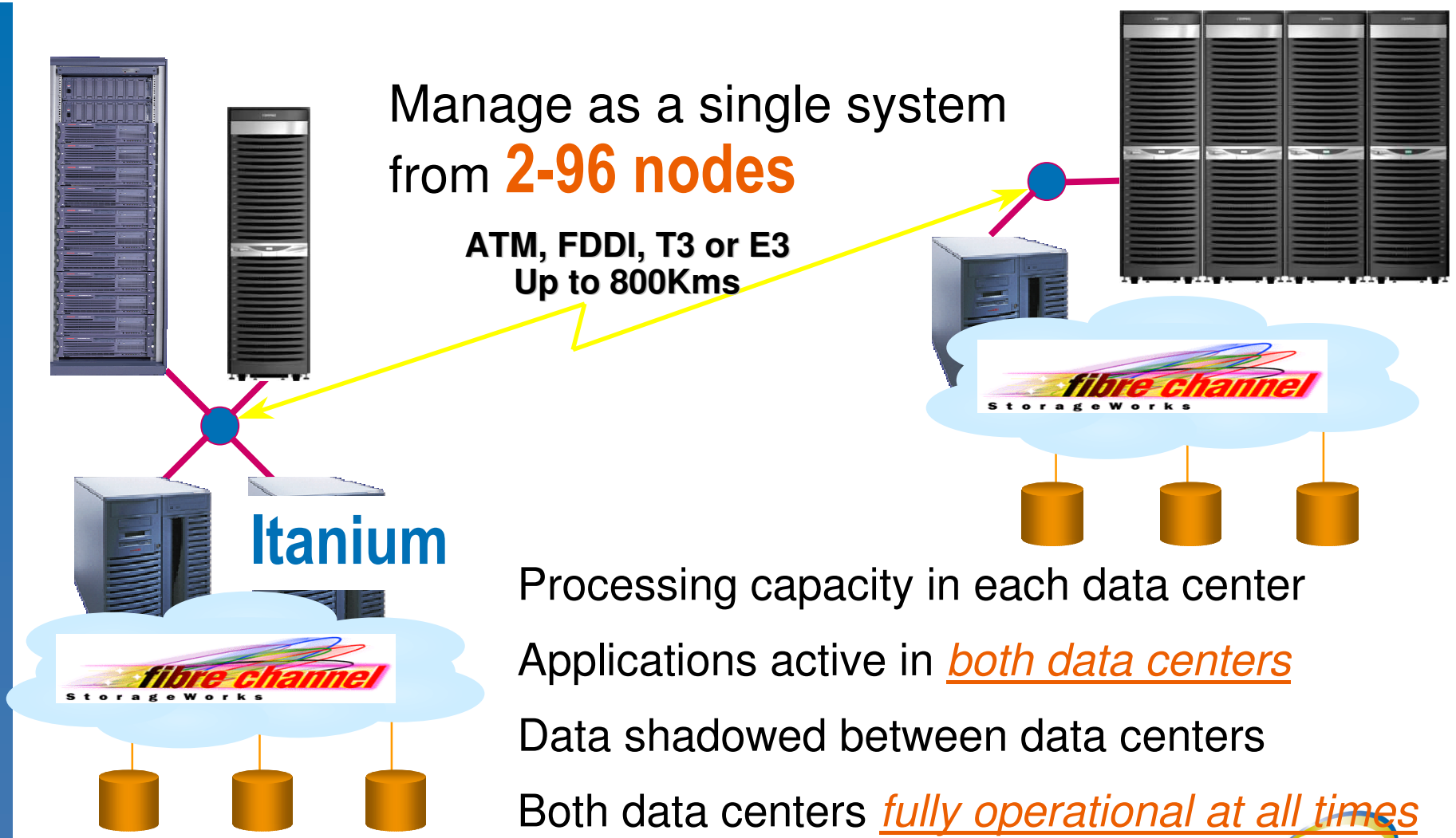
High Availability and Disaster Tolerance…
Clusters & Galaxy— multiple sites— long distances



Processing capacity in each data center

Applications active in *both data centers*

Data shadowed between data centers

Both data centers *fully operational at all times*

Minimal effect on performance

HP OpenVMS
Still exceeding expectations

OpenVMS V8.2 Production Quality Release
(AlphaServer & Integrity servers) 2H2004

OpenVMS V8.1 Evaluation Release
December, 2003

Mixed Alpha Integrity Superdome Cluster
January, 2004

16 Processor System Boot
January, 2004

Runs in a Superdome Cell
November, 2003

1st ISV Applications ported
August, 2003

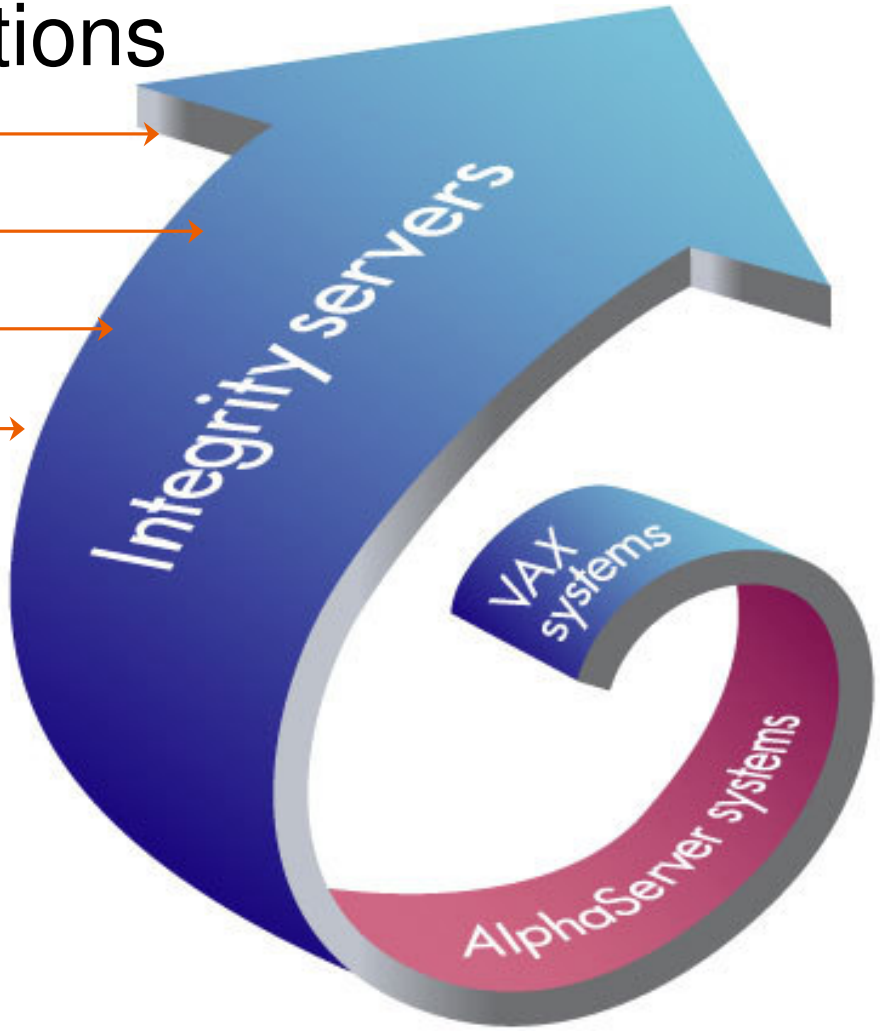
OpenVMS V8.0 in DSPP
August, 2003

OpenVMS V8.0 Evaluation Release
June 30, 2003

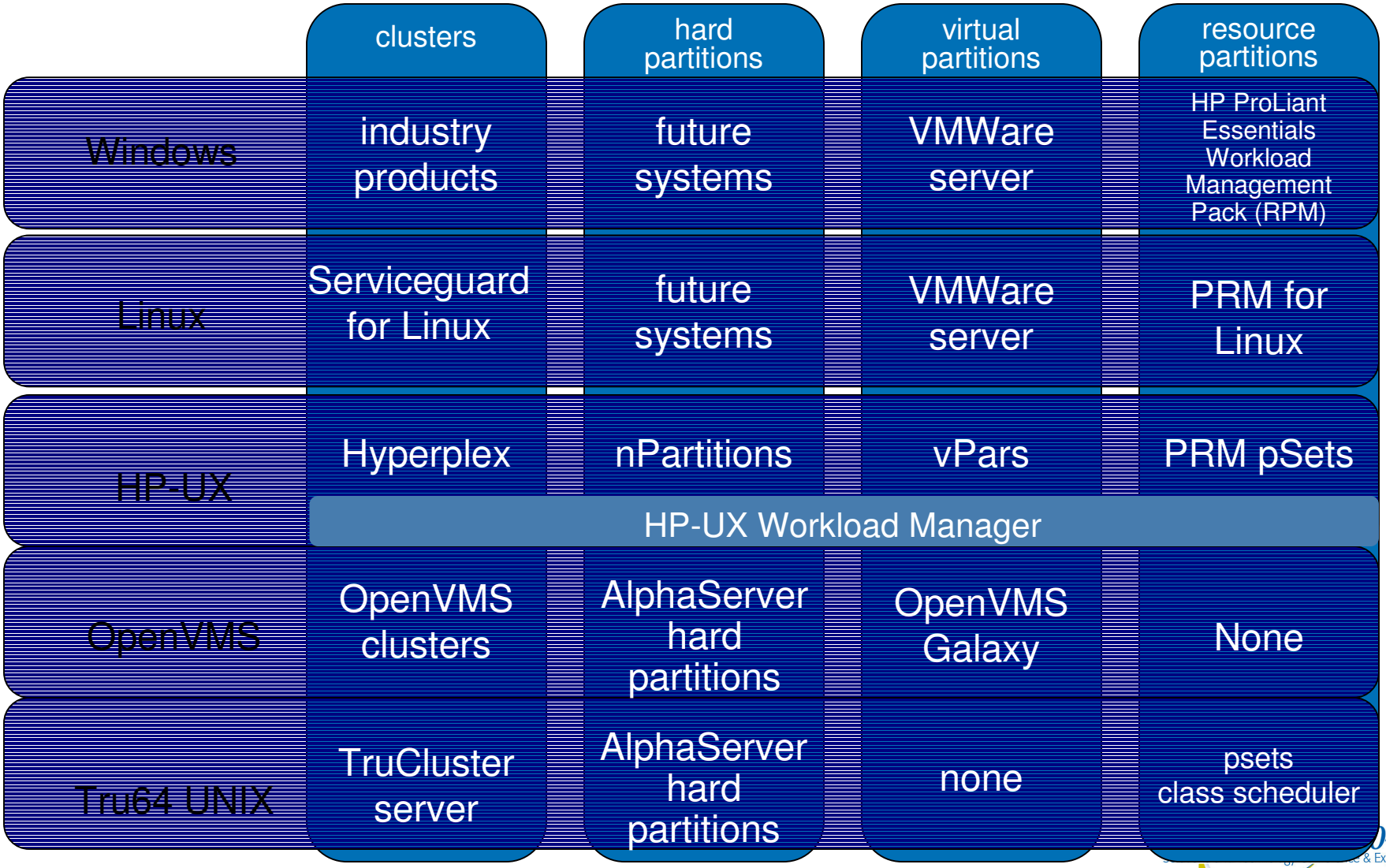
1st Application Port & Mixed Cluster
May 15, 2003

Boot to rx 2600 server
March 17, 2003

1st Boot to Itanium® system
January 31, 2003



HP partitioning continuum products



Some thoughts on when process management may be a consideration…

The O/S's handle user-requested activity differently:

- UNIX/Linux employ Fork/Execution Process Model
  - Separate into two distinct operations
    - Creation of processes by a FORK system call
    - Running a new program
- OpenVMS controls process creation - creates a new process, loads a specified program into that process, and starts running it
- Windows 2003 supports either model - parent's address space may be duplicated or parent may specify name of program to be loaded into address space of new process

Commonalities & Differences – Windows or Linux/Unix?

- Task such as queuing print jobs are “services” in Windows and “daemons” in Linux (and UNIX)
- In Windows, start & stop threads; In Linux/UNIX, start & stop processes
- Registry (Windows) vs. Kernel – to control operating system
- All three O/S’s support multiple users and let each of them multitask
- All three O/S’s support pre-emptive multitasking to prevent a task from tying up a processor
- All three are multi-user, client/server operating systems
- Windows database size is 10GB, Linux (and UNIX) is unlimited
- Linux users can run any application remotely on a Linux server
- X-windows application displays can be exported to other Linux systems
- Windows must be rebooted to change configurations, add devices, etc.,
- Linux contains loadable device modules and does not need to be rebooted
- Properly configured Linux is less susceptible to Internet viruses
- Linux & UNIX system administration can be fully automated
- All three O/S’s have the ability to run POSIX compliant utilities
- All three O/S’s are capable of being used in a C2 security environment

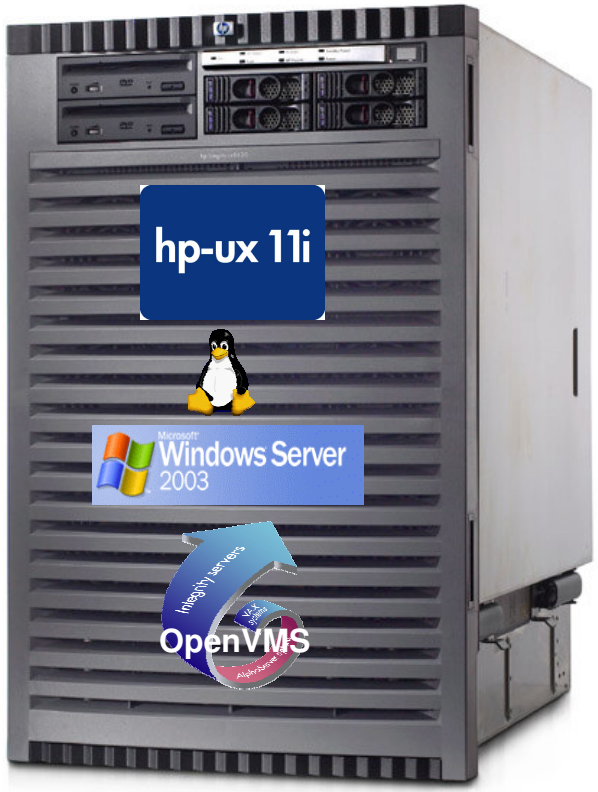
Operating System Features Assessment

Feature	HP-UX11i (PA-RISC & Integrity)	Linux (Integrity)	Windows Server 2003 (Integrity)	OpenVMS (Alpha & Integrity)
HA Clusters	✓ HP Serviceguard	✓ HP Serviceguard	✓ RISC-level availability	✓ SSI with transparent failover & recovery
Disk Mirroring	✓	✓	✓	✓
# Nodes & inter-site distance	16 – continental	16 – 100KM	8 extended & wide-area	96+ nodes up to 800KM & “continental”
Disaster Tolerance	✓ HP Serviceguard	✓ HP Serviceguard	✓ HP Cluster Extension XP	✓ DTCS & Custom
32-bit Appl Support 64-bit Appl Support	✓ ✓	✓ ✓	✓ ✓	✓ ✓
Goal-Based resource partitioning	✓	No	Future	✓
Scalability -- # of processors	64	8 (future 32)	64	32 (v8.2) Arch limit is 1024
Memory & File Size	1TB / 8TB	32GB/1TB	128GB / 4GB	256GB* / 1TB Arch limit is 1024TB
iCOD	✓	No	Future	Future

Operating Environments for HP Integrity servers

So, When should you deploy…

- HP-UX ?
- Linux ?
- Windows Server 2003 ?
- OpenVMS ?
- or an integrated combination?



It depends

on the business and IT problems that you are trying to solve.

BCS has the breadth to help you meet a wide spectrum of requirements.


invent