
hp
invent

Business Critical Server

AlphaServer

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hp servers introduction and positioning

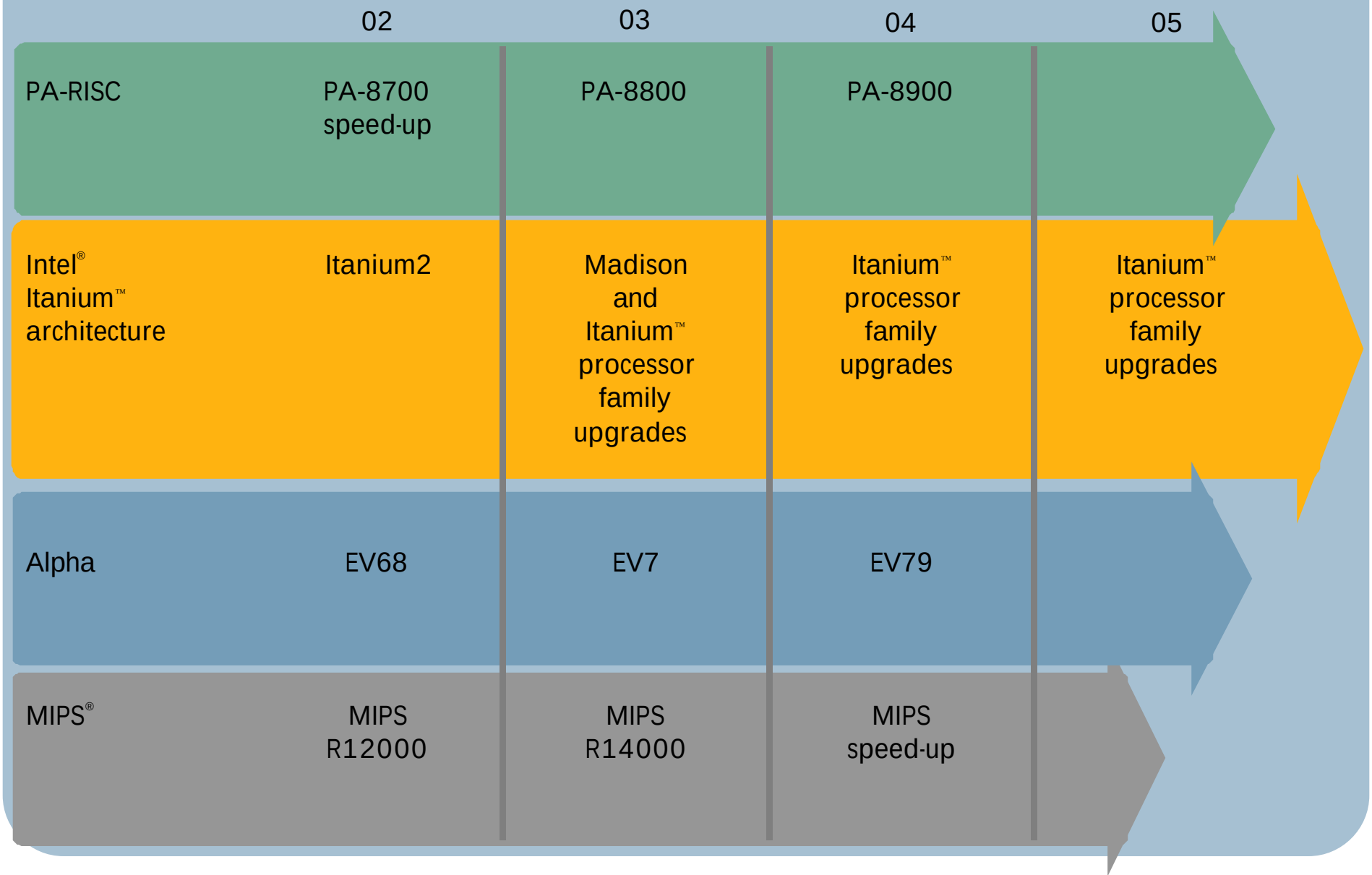
In this session we will cover:

- processor roadmap & advantages (Itanium, PA-RISC,Alpha)
- business critical servers
- partitioning continuum
- utility pricing
- best strategy for the data center (adaptive infrastructure and UDC, beyond consolidation)

processor technology

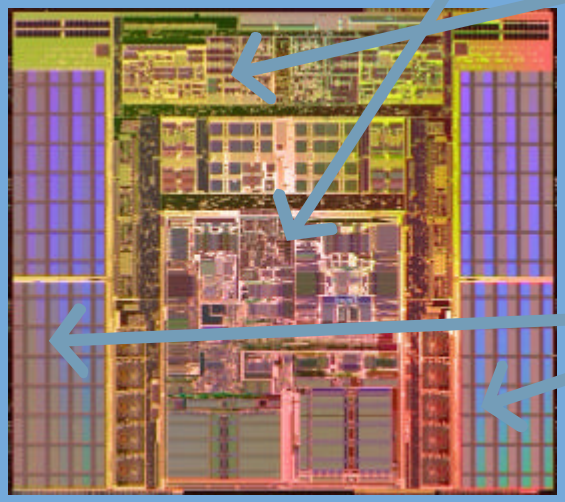
- roadmap
- alpha
- pa-risc
- itanium

hp processor roadmap: future proof growth path



EV7

AlphaServer System design innovation transparent to applications



EV6 core processor

- state-of-the-art balanced design
- preserved in EV7
  - EV6x CPU core
  - no changes to compiler or code scheduling
  - completely transparent to software

integrated memory controller

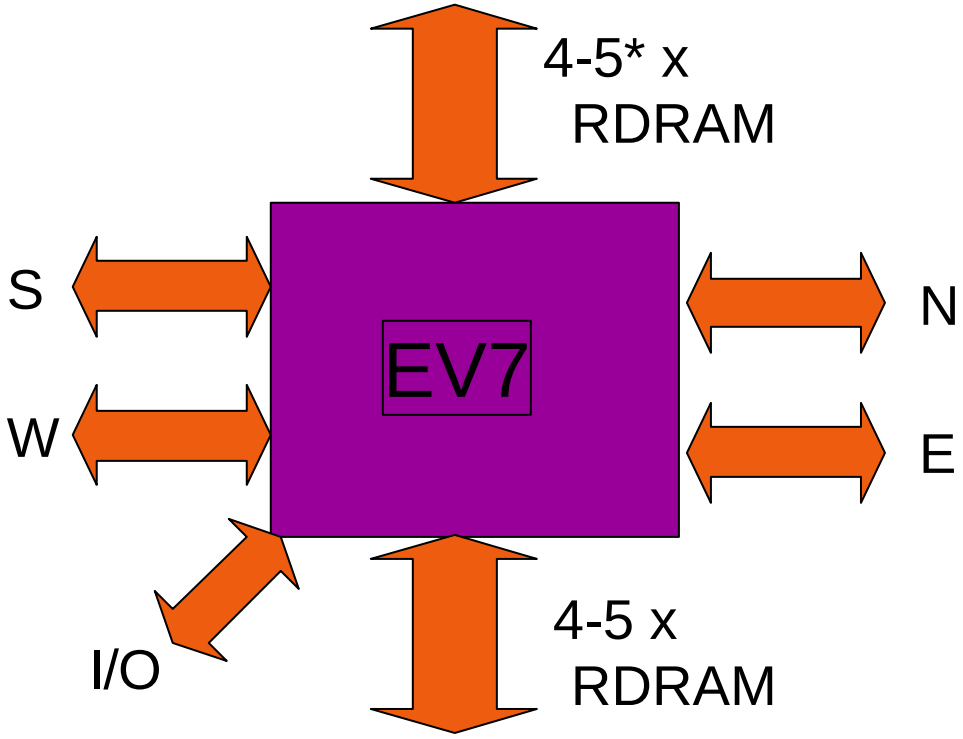
- Transparent to applications
- Significant benefit to HPTC applications

enhanced on-chip cache design

- Transparent to most applications
- Only those applications that tune to cache need pay attention

hp EV7 Microprocessor

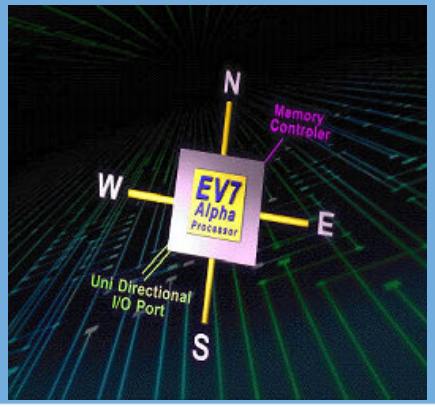
Integrated Network Router Interface



- 4 IP links; 6.2 GB/s per link
- 24.6 GB/s aggregate bandwidth
- 18nS CPU-to-CPU latency
- ECC (SBE correct, DBE detect)
- Out-of-order IP network with adaptive routing
- 1.6 GB/s (each direction) I/O interface port per EV7 processor
- Asynchronous clock forwarded protocol

EV7:

The system is the silicon



Integrated Memory Controller

- Direct RAMbus
- High data capacity per pin
- 800 Mb/s operation
- 12 GB/sec read or write bw
- 2048 open pages
- Directory based cache coherence
- ECC SECDED
- Optional RAID in memory

Integrated Mesh Interface

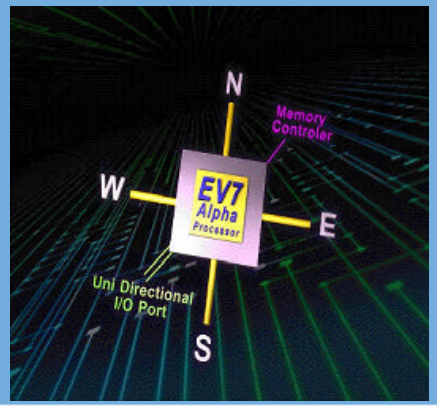
- Direct CPU-to-CPU interconnect
- 4 links@24.6GB/s per processor (@1.15Ghz)
  - Hop Latency: <40ns
  - Worst Latency <350ns (64-way)
- ECC, single error correct, double error detect, per hop
- Out-of-order network with adaptive routing
- Asynchronous clocking
- 3 GB/second I/O per processor

Integrated L2 Cache

- 1.75 MB
- 7-way set associative – performs as 8MB-12MB in testing
- 20 GB/s total read/write bw
- ECC SECDED code
- 9.6ns load to use latency

EV7:

The system is the silicon



EV7 goals, improve:

- **Single processor performance, operating frequency, and memory system**
- **SMP scaling**
- **System performance density (computes/ft3)**
- **Reliability and availability**
- **And decrease system complexity**

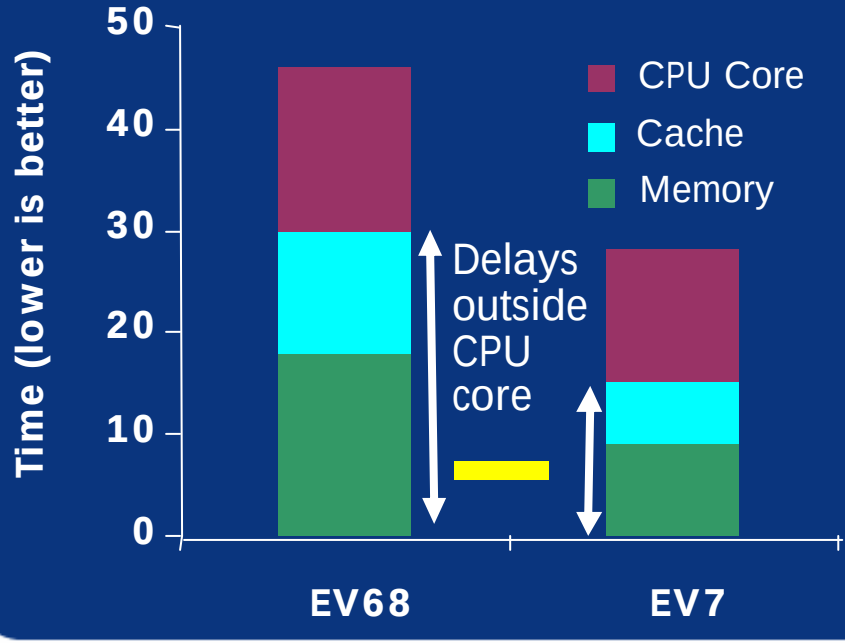
SMP CPU interconnect was external logic… Now on chip!

EV68 core with L1 cache
- **1.0 & 1.150GHz at FRS**

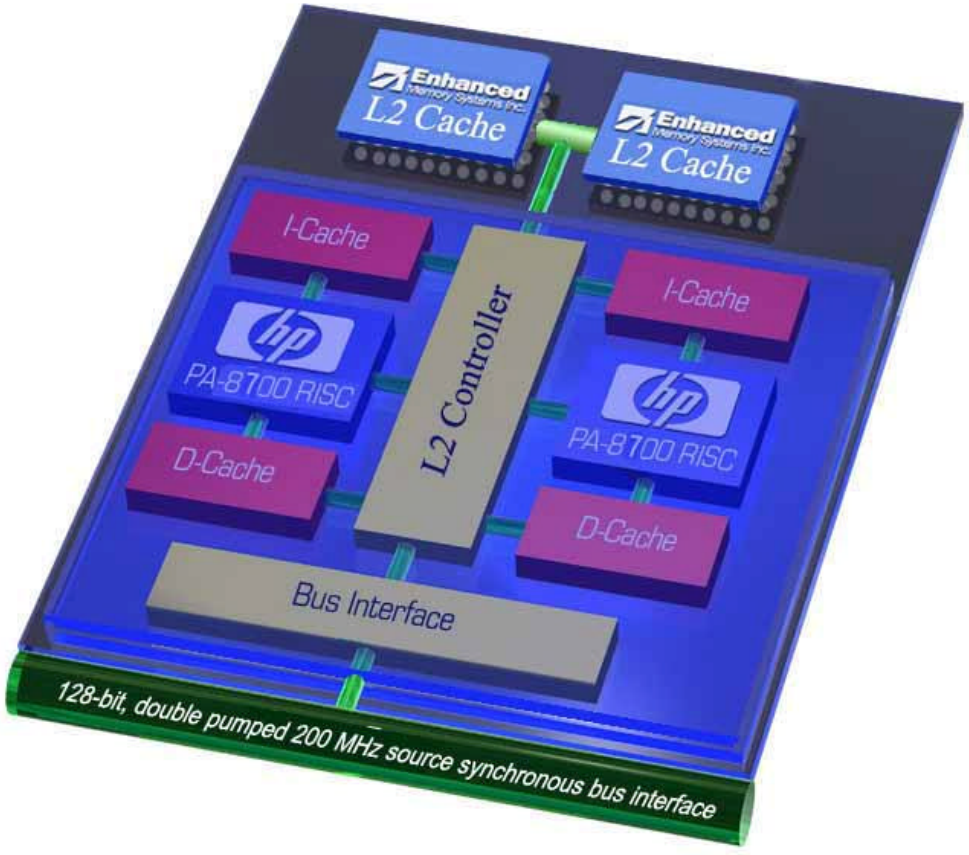
Integrated Level 2 cache

Integrated memory controllers
- **RAID Memory**

SMP & I/O Interconnects



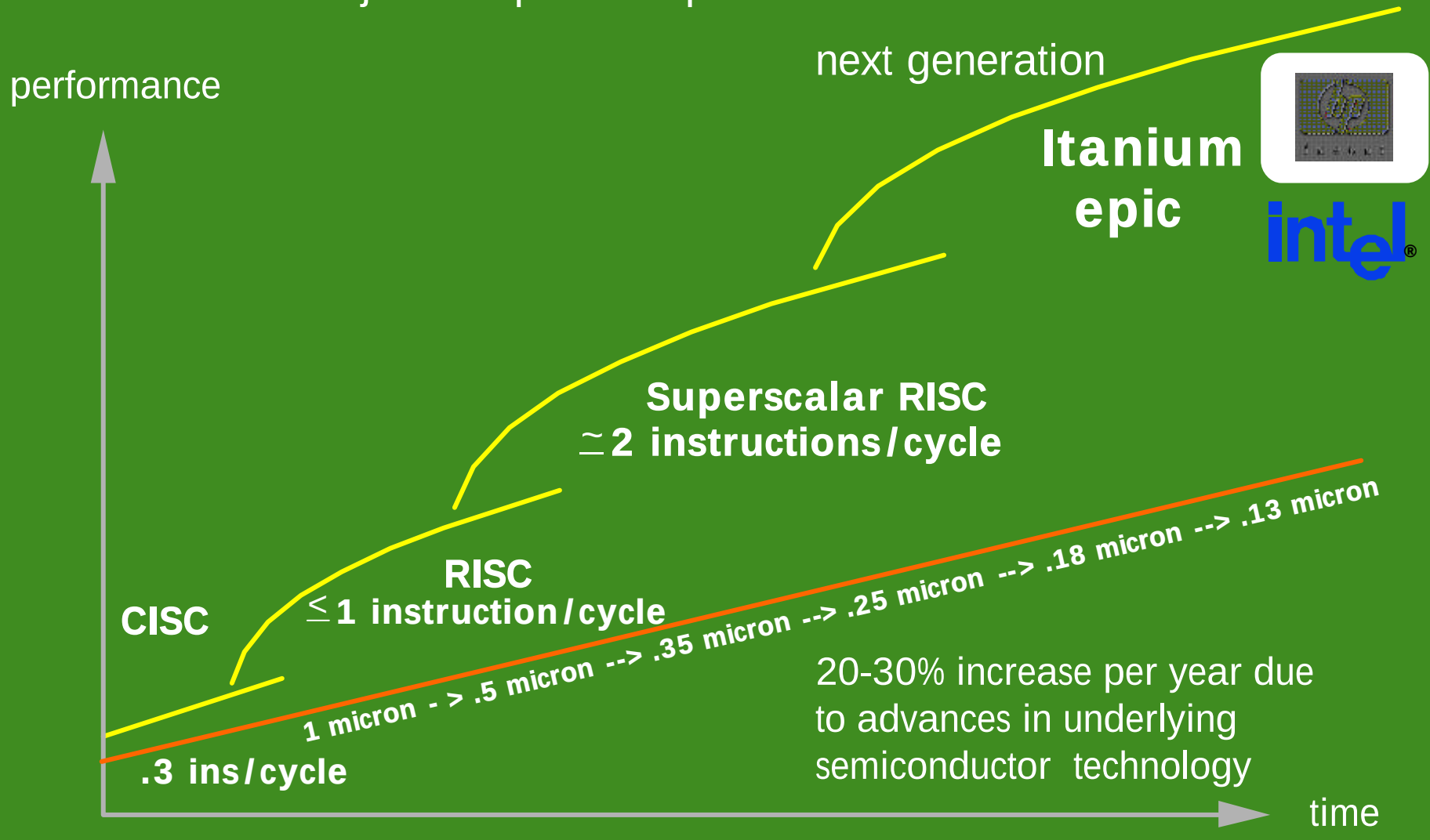
“PA-8800”



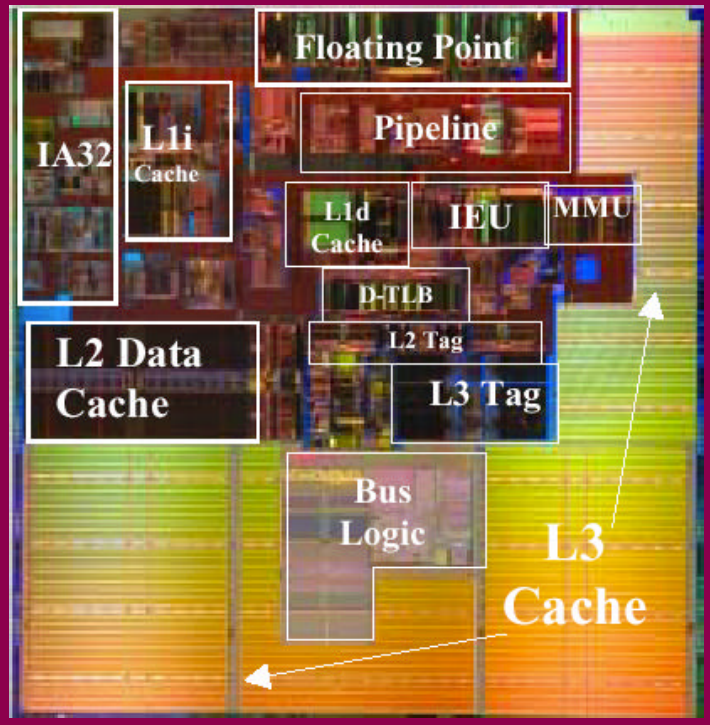
- two entire PA-8700 CPU cores
- ¾ MB L1 D-cache per core
- ¾ MB L1 I-cache per core
- 32 MB off-chip DRAM Level-2 cache
- new high-bandwidth system bus
- 1 GHz clock frequency
- massive compute power on a single chip
- caching and bus improvements utilize computational units more effectively
- balanced design will achieve 800,000 tpm.

processor evolution

itanium provides stronger performance,
just like previous processor evolutions



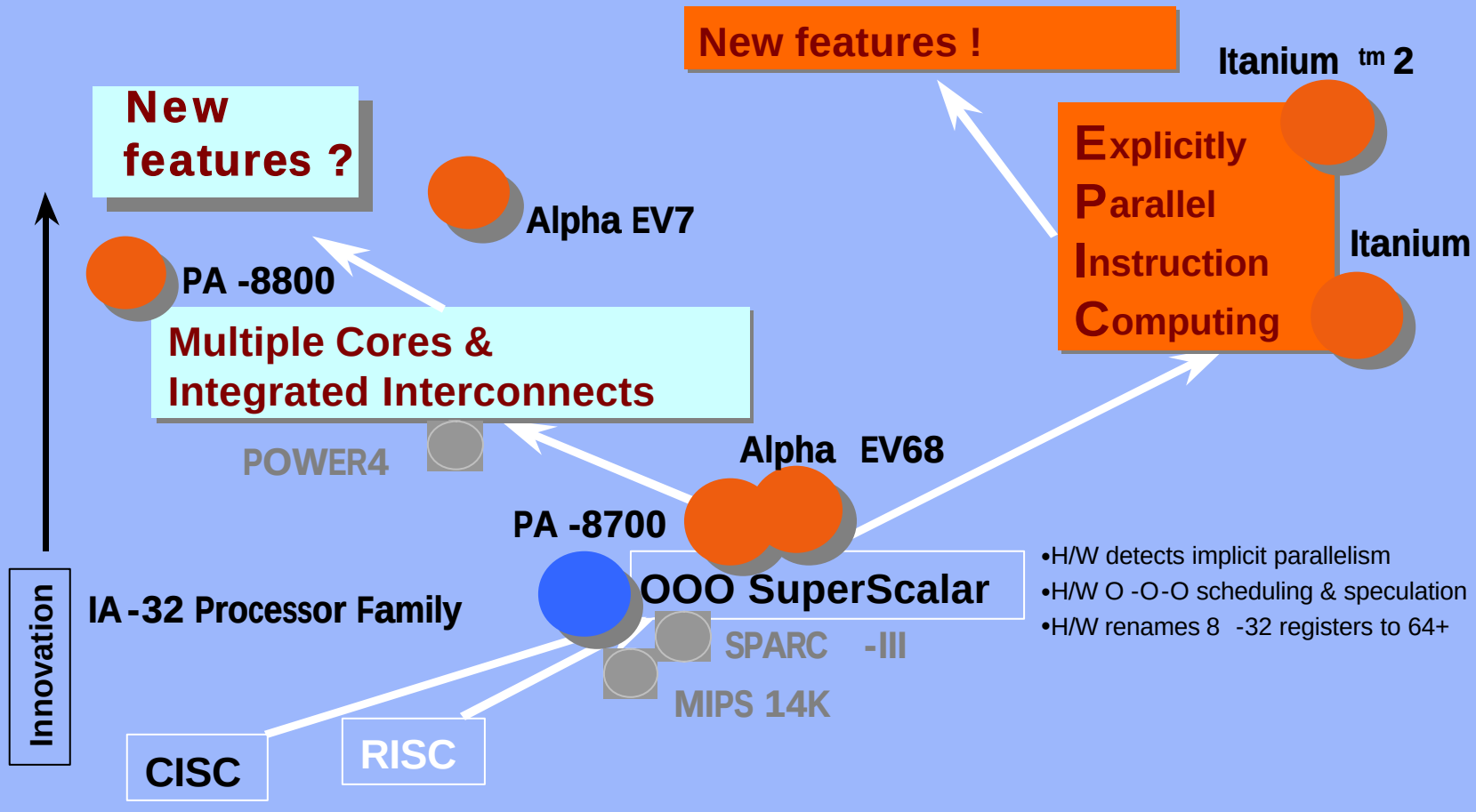
Itanium 2



- 128 bit, 200 MHz data rate bus interface
- 6.4 GB / sec bandwidth

- 4.0 GFLOP / s
- clocked at 1 GHz

Next generation processor technology



versatile roadmap to drive all key operating systems

	today & near future	future
processor technology	**PA-RISC** **Itanium™ processor family** **Alpha** **MIPS®**	**Itanium™ processor family**
server platform	**HP Servers** **HP e3000 Servers** **HP AlphaServer Systems** **HP NonStop Servers**	**HP Servers** **HP NonStop Servers**
operating system	**HP-UX** **HP Tru64 UNIX®** **HP MPE/ix** **Linux®** **HP NonStop Kernel** **HP OpenVMS**	**HP-UX (with Tru64 features)** **Linux®** **HP NonStop Kernel** **HP OpenVMS** **Windows® /64**

hp servers roadmaps

bcs server family

world's broadest, most robust enterprise offering

high-end

AlphaServer GS320/1280
SC 20/45/1280

Superdome

NonStop

mid-range

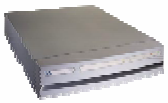
AlphaServer ES4x/80

rp7410

rp8400

entry-level

AlphaServer
DS series



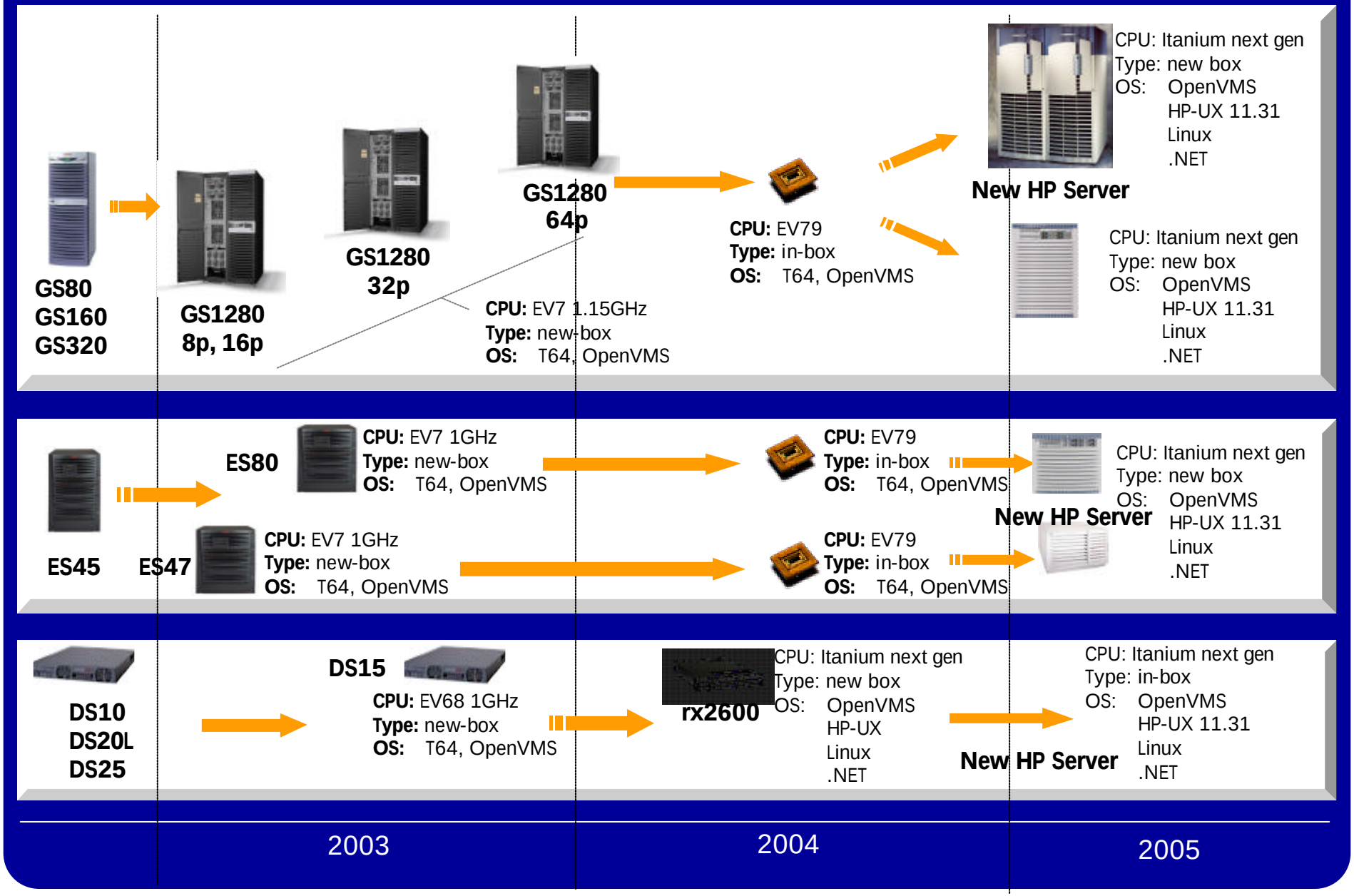
rx2600

rp2400 series

rp5400 series

rx5670

hp AlphaServer roadmap



hp server roadmap (pa-risc & itanium)

Superdome

PA-8700

CPU: Madison
Type: In-box
OS: - HP-UX 11iv2
- Linux
- Windows

CPU: PA-8800
Type: In-box
OS: HP-UX 11i

CPU: Itanium next gen
Type: In-box
OS: - HP-UX11iv2
- Linux
- Windows

CPU: PA-8900 & Itanium
Type: In-box
OS: - HP-UX 11i and 11iv3 for PA; HP-UX 11iv3, Windows, & Linux for Itanium

rp8400
rp7410

PA-8700

CPU: Madison
Type: In-box
OS: - HP-UX 11iv2
- Linux
- Windows

CPU: PA-8800
Type: In-box
OS: HP-UX 11i

CPU: Itanium next gen
Type: In-box
OS: - HP-UX11iv2
- Linux
- Windows

CPU: PA-8900 & Itanium
Type: In-box
OS: - HP-UX 11i and 11iv3 for PA; HP-UX 11iv3, Windows, & Linux for Itanium

rp54xx
rx5670

PA-8700

CPU: Madison
Type: In-box
OS: - HP-UX 11iv2, Linux, Windows

"Diablo"

CPU: Madison
Type: new box
OS: - HP-UX 11iv2
- Linux
- Windows

CPU: PA-8800
Type: In-box
OS: HP-UX 11i

CPU: Itanium next gen
Type: In-box
OS: - HP-UX11iv2
- Linux
- Windows

CPU: PA-8900 & Itanium
Type: In-box
OS: - HP-UX 11i and 11iv3 for PA; HP-UX 11iv3, Windows, & Linux for Itanium

rp24xx
rx2600

PA-8700

CPU: Madison
Type: In-box
OS: - HP-UX 11iv2
- Linux
- Windows

CPU: PA-8800
Type: In-box
OS: HP-UX 11i

CPU: Itanium next gen
Type: In-box
OS: - HP-UX11iv2
- Linux
- Windows

CPU: PA-8900 & Itanium
Type: In-box
OS: - HP-UX 11i and 11iv3 for PA; HP-UX 11iv3, Windows, & Linux for Itanium

2003 2004 2005

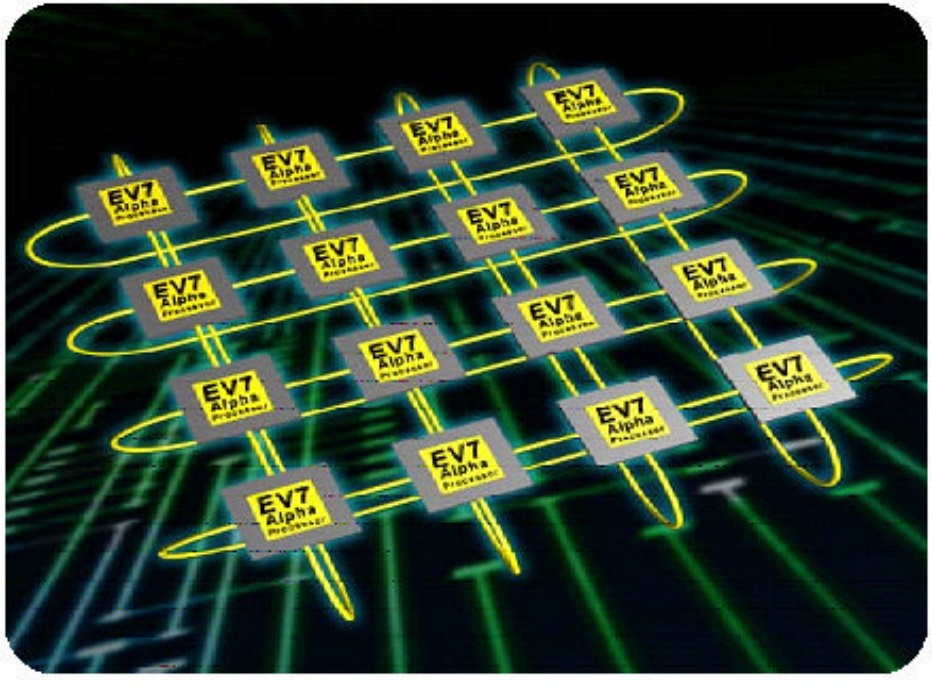
Note: multi-OS availability on Itanium servers may not coincide with the platform release in all cases

Marvel System Architecture

“Switch-less”
Mesh Architecture

Improving Application Performance

- Incredible memory and I/O bandwidth based on a high performance microprocessor
- Robust NUMA Architecture
- No intermediate logic to cause delays



Improving System Reliability

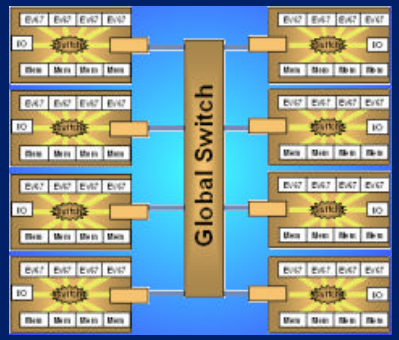
- Fewer components
- Electrical isolation between partitions

Improving System Flexibility

- More granular system partitions (1-2 CPUs)
- Improving scalability for all classes of applications

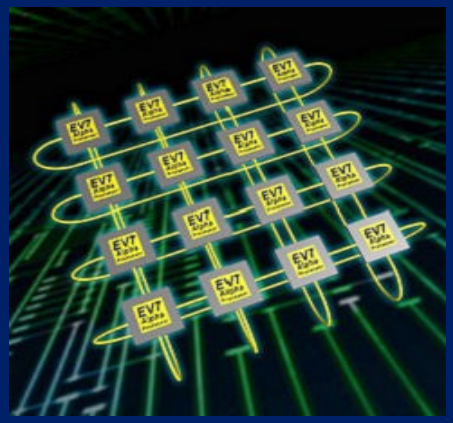
implementing a switch-less architecture

Hierarchical Switch Architecture



HP AlphaServer GS320

Mesh Architecture



Next Generation HP AlphaServer

Performance hard to outgrow:

- **Scalability to 64 Alpha EV7/EV79 Processors**
- **Nearly limitless memory, I/O capacity and bandwidth**
- **Real application performance and scalability**
  - **Robust NUMA implementation**
  - **Significantly reduced latency penalties**
  - **Significantly increased bandwidth**

Isolated hard partitions

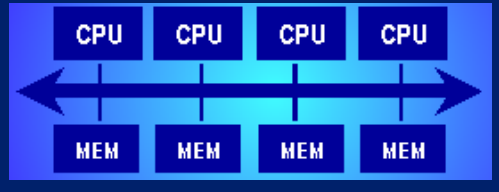
Alternative System Architectures

Bus-based Topology

Bus bandwidth is shared by all processors and I/O

Data must be transferred in relatively small blocks

Latency can vary significantly dependent upon number of outstanding transactions

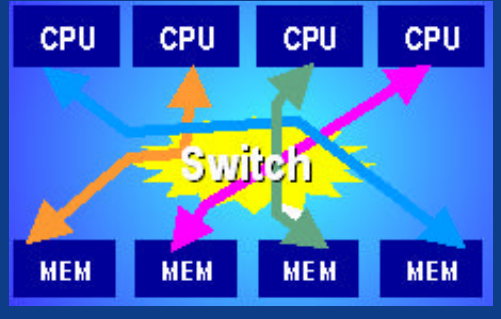


Cross-Bar Topology

Simultaneous connection to all CPUs

Dedicated bandwidth for large blocks of data between each pair

Well-defined latency, limited request queuing

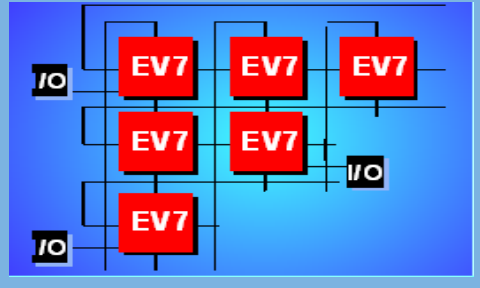


Mesh Architecture

Direct processor-to-processor and I/O interconnects

6.4GB/s SMP links

Extremely high bandwidth and very low latency

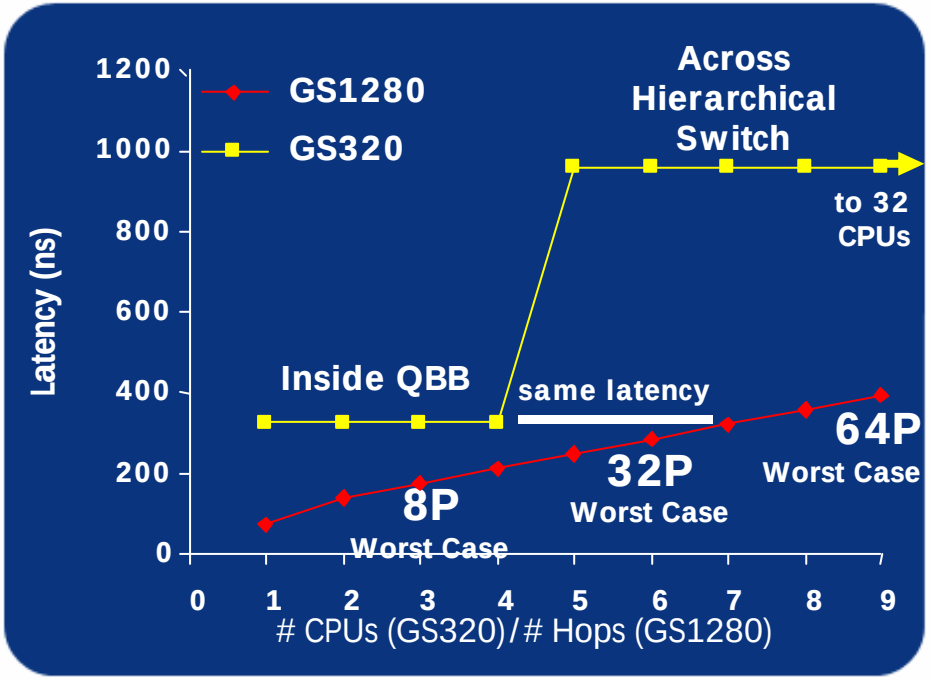


A robust NUMA implementation

Latencies scale with distance of external memory reference

32P worst case latency better than today's AlphaServer GS320 best case latency

355	319	283	247	211	247	283	319
319	283	247	211	175	211	247	283
283	247	211	175	140	175	211	247
247	211	175	140	75	140	175	211
283	247	211	175	140	175	211	247
319	283	247	211	175	211	247	283
355	319	283	247	211	247	283	319
391	355	319	283	247	283	319	355



Modular Building Blocks

Modular building blocks for the future

Common Components

3 Basic Components

Build 2 System Building Blocks

With common features and system management across the entire family

building a broad range of HP AlphaServer systems!

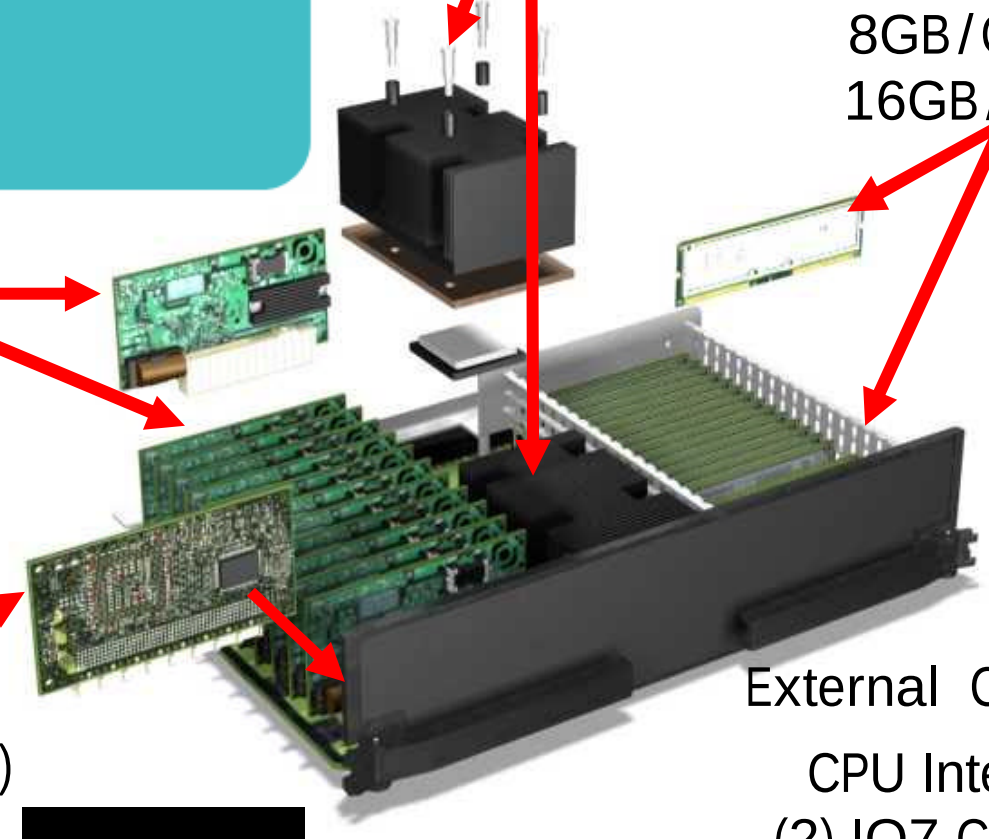
Dual Processor Module

"Dynamic Duo"

Dual EV7 CPU's
& Heatsink

Rambus Memory
Modules (RIMM's)
8GB/CPU @FRS
16GB/CPU Later

N+1 Voltage
Regulator
Modules

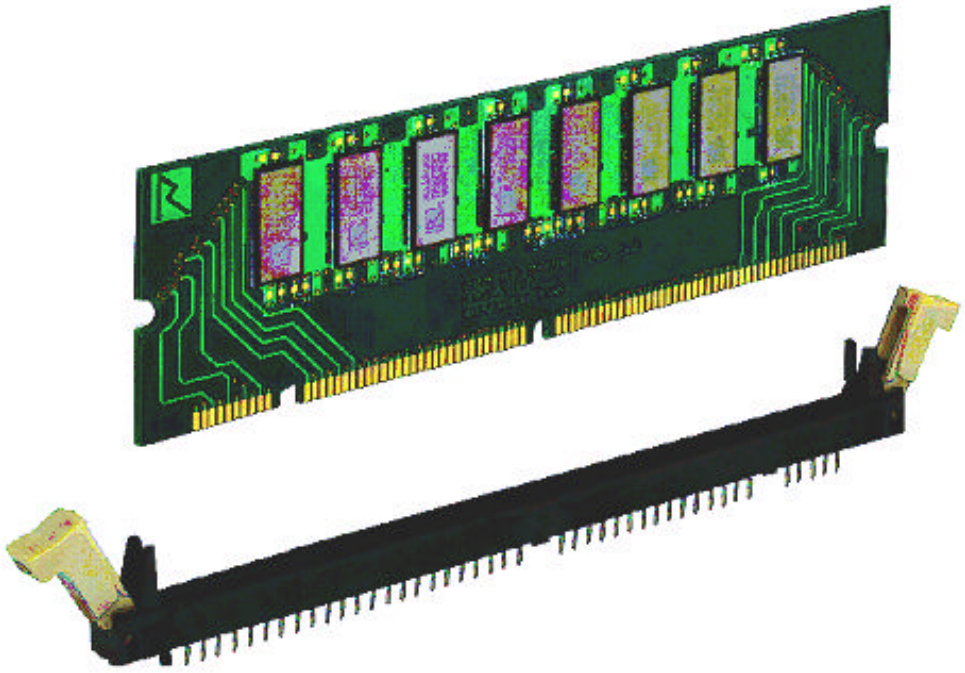


CPU
Management
Module (CMM)

External Connections:

CPU Interconnect
(2) IO7 Connections

Rambus™ RIMM Modules

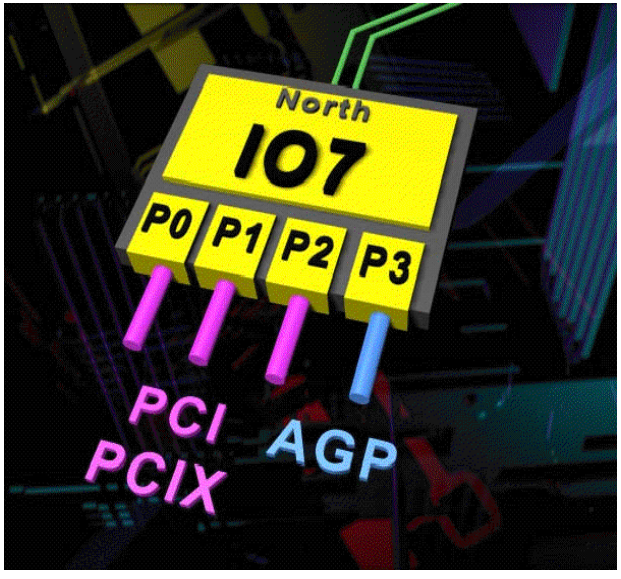


- EV7 system distributed shared-memory system
- Direct, low-latency, high bandwidth connection to EV7 memory controller
- Global memory accessible through EV7 router
- ECC protected
- Optional RAID - like ECC option for double-bit error detection and correction
- Various density RIMM's available … up to 8GB/CPU initially

IO7

A Bridge from EV7

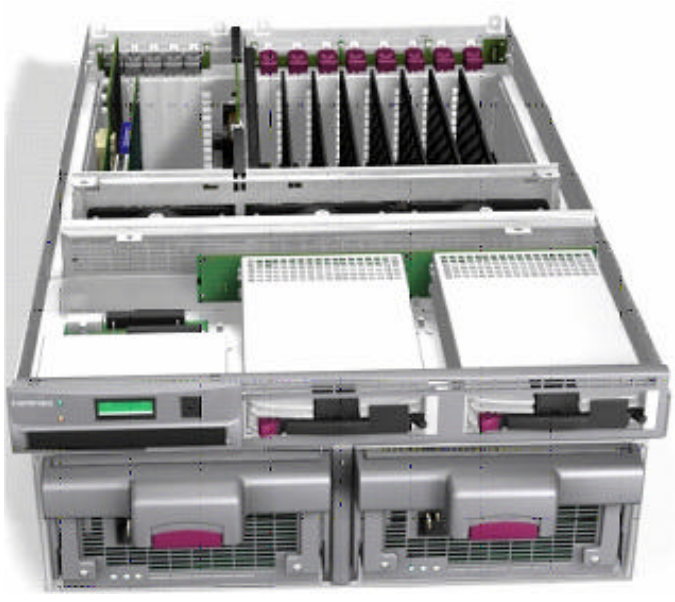
- **(1.6 GB/S in each direction)**
- **Four standard IO Ports:**
  - **3 PCI/PCI-X**
  - **1 2xAGP bus (@ FRS)**
- **IO Port clocks: 33 To 133 MHz**
- **32 & 64 Bit width IO bus**



Implemented in three ways:

- Integral part of 2P System Building block
- Standard External I/O Drawer
- High Performance External I/O Drawer

Standard External I/O Drawer



High performance I/O link

- 1.6 GB/s up & 1.6 GB/s down (full duplex)
- Low latency EV7 pin to IO7 pin connectivity
- Full ECC coverage on all paths

Accessible to all processors in the same partition

Supports 11 plug-in option slots

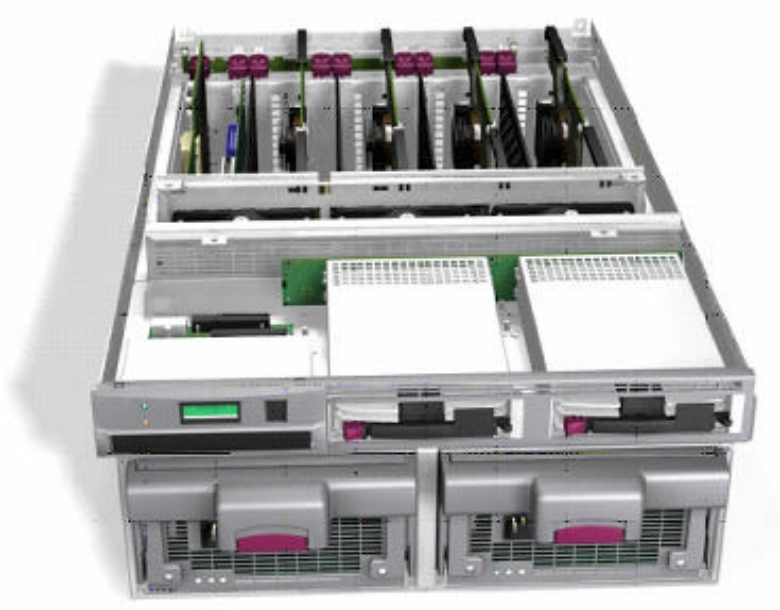
- Single AGP 2x slot (also supports AGP PRO 3-slot)
- 8 PCI or PCI-X slots
- 2 +5V legacy PCI slots (CI & MC2)

Optional:

- 1 standard I/O PCI slot (controller for internal media)
- 2 SCSI Drives and CD R/W

High Performance External I/O Drawer

- Up to four IO7 links for highest possible I/O bandwidth and performance
- Independently powered and partitionable
- Each link supports two PCI-x 133MHz bus slots



Supports 8 plug-in option slots

One high performance I/O option per bus

No support for AGP cards

Optional:

- 1 standard I/O PCI slot (controller for internal media)
- 2 SCSI Drives and CD R/W

2P Drawer

Building block for the hp AlphaServer ES47 and ES80 systems

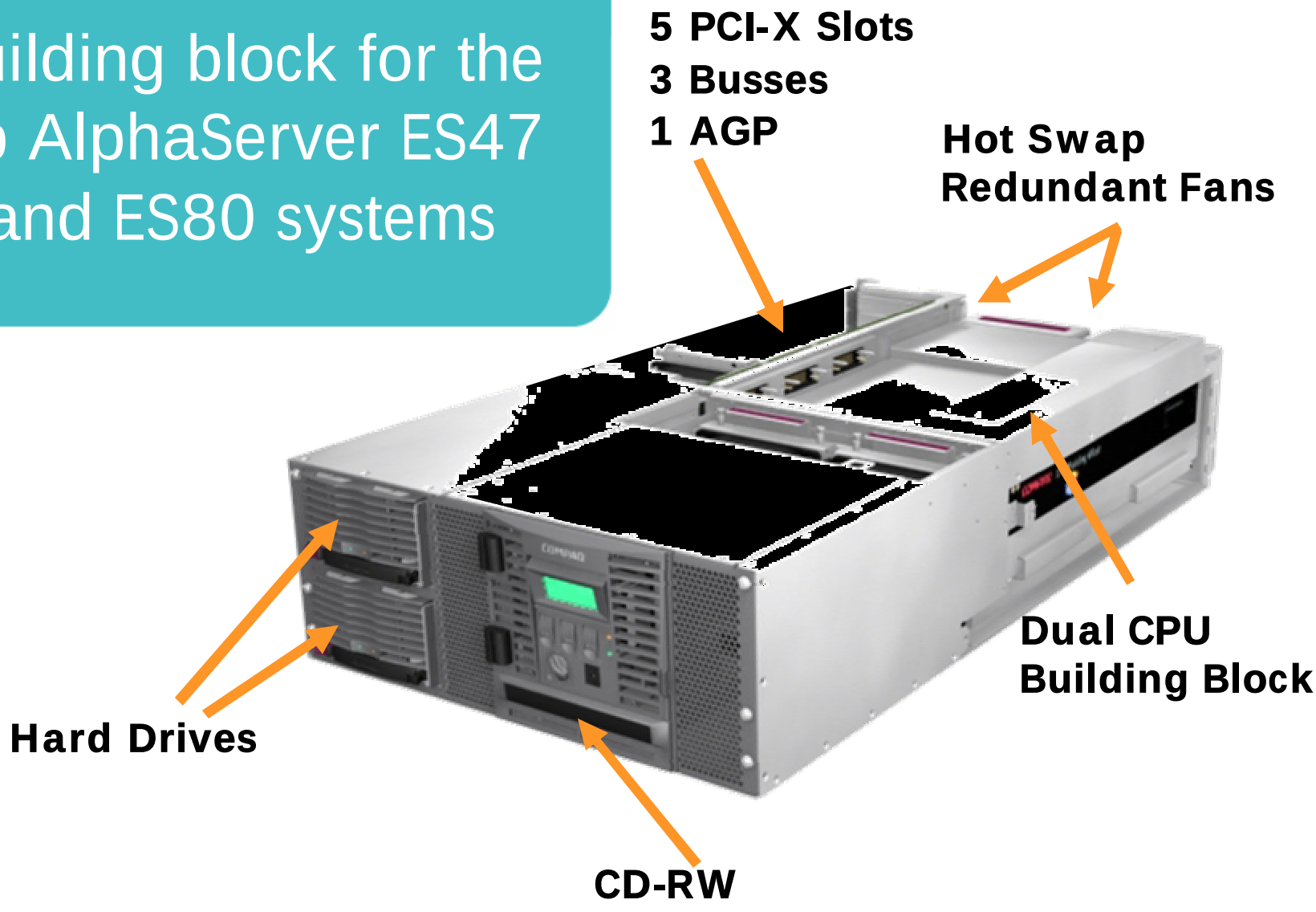
Available in 2 System Enclosures

- Rack Mount style (4U Profile) for HP AlphaServer ES47 and ES80
- Tower style (upright, feet & skins) for HP AlphaServer ES47
- Ring Architecture
- Identical contents and capabilities

16GB @FRS; 32GB Later
Up to 5 PCI-x or PCI bus slots
33 To 133 MHz operation
Supports a single AGP2x card
Supports two IP ports
1 external I/O expansion shelf port
Embedded Server Management LAN
Misc. I/O plug-in option cabling to external storage shelves, LAN's, etc.
N+1 hot swap power converters
N+1 hot swap cooling fans

2P Drawer

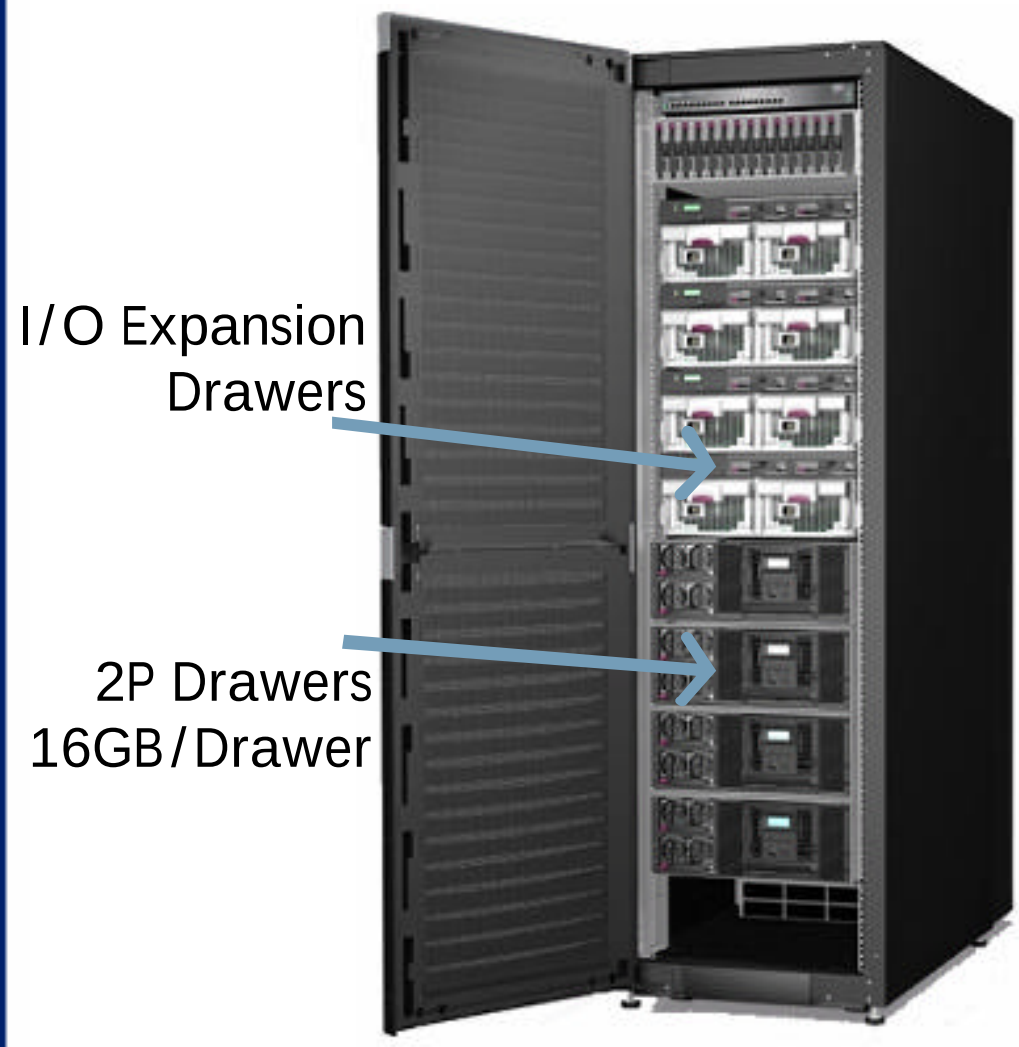
Building block for the hp AlphaServer ES47 and ES80 systems



2 and 2-4/8 SMP system and I/O expansion using 2P building blocks

Rack and Tower Variants

- **Up to 64GB Memory**
- **Up to 52 PCI-X slots**
- **Up to 12 PCI slots**
- **Up to 8 AGP slots**



8P Drawer

Building Block for the hp AlphaServer GS1280 and SC1280 Systems

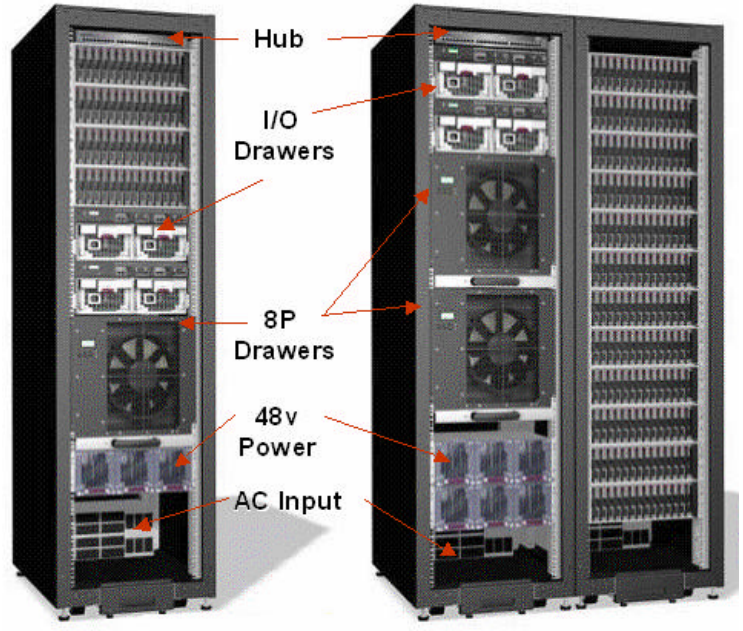
Basis of all large system configurations

Supports

- **up to 4 EV7/EV79 dual processor modules**
- **up to 64GB memory @FRS**
- **Up to 8 external I/O shelves (2 at FRS)**

- **10U rack profile, stackable 4 high in a 2m GS1280 rack**
- **Integrated Server Management**
- **N+1 Power & Cooling**
- **Backlit LCD Operator Control Panel (OCP)**
- **Engineered for IO & IP cable management**

2P-64P expandable systems using 8P building block drawers



- **up to 64 EV7 and EV79 Processors**
- **up to 1TB Memory (½TB at FRS)**
- **Up to 512 PCI-X slots**
- **Up to 196 PCI slots**
- **Up to 64 AGP slots**

System Models

hp AlphaServer ES47 Systems

the workgroup wizard

- Configuration Flexibility:
  - 2-4 1GHz Processors
  - Up to 32GB Memory
  - 5-32 I/O Slots
  - Tru64 UNIX® v5.1B, OpenVMS v7.3-1 and Linux®
- Reliability Enhancements
  - Redundant Components
  - Optional "RAID" memory
  - Family-wide RAS features
- Flexibility & Manageability
  - Partitions
  - Embedded Server Management
- Complementary product to HP AlphaServer DS25 and ES45 systems

The new hp AlphaServer ES47 Tower

	DS25	ES47 Tower
Processors	1-2 1.0 Ghz EV68	2 1.0GHz EV7
Cache	8MB	1.75MB 7-way Set Associative
Memory	Up to 16GB @ 8.0GB/sec BW 2,850 MB/s STREAMS	Up to 16GB @ 10.7GB/sec BW 10,000 MB/sec STREAMS (est.)
I/O Subsystem	Embedded Dual Ultra3 SCSI and Ethernets 4 64-bit PCI Busses, 1.85GB/s BW	Up to 5 PCI-X slots on 3 PCI Busses 6.4 GB/s BW
SPECint2000	678 SPECint2000 15.5 SPECint_rate2000	775 SPECint2000 (est.) 18 SPECint_rate2000 (est.)
SPECfp2000	985 SPECint2000 21.5 SPECfp_rate2000	1,275 SPECfp2000 (est.) 30 SPECfp_rate2000 (est.)
OS	OpenVMS v7.3, Tru64 UNIX® v5.1a, Linux®	OpenVMS v7.3-1, Tru64 UNIX® v5.1b, Linux®
Other Features		Enterprise RAS, RAID Memory
Pricing (UNIX List)	Entry: $26,300 2P/1GB: $37,250	Entry: $39,700 2P/2GB: $45,000

Date of comparison: 22 October 2002

Published results for DS25, preliminary results for ES47 Tower

The new hp AlphaServer ES47 Rack

	ES45	ES47 Rack
Processors	1-4 1.25 GHz EV68	2-4 1.0GHz EV7
Cache	16MB	1.75MB 7-way Set Associative
Memory	Up to 32GB @ 8.0GB/sec BW 3,584 MB/sec STREAMS	Up to 32GB @ 10.7GB/sec BW 21,906 MB/sec STREAMS (est.)
I/O Subsystem	Up to 10 PCI Slots/4 PCI Busses 1.85GB/sec I/O Bandwidth	Up to 32 PCI/PCI-X slots on 12 PCI Busses 12.8GB/sec I/O Bandwidth
SPECint2000	928 SPECint2000 42.0 SPECint_rate2000	775 SPECint2000 (est.) 35.4 SPECint_rate2000 (est.)
SPECfp2000	1,364 SPECfp2000 50.0 SPECfp_rate2000	1,275 SPECfp2000 (est.) 59.1 SPECfp_rate2000 (est.)
TPCC	56,375 tpmC @$9.28/tpmC	50K-55K tpmC (engineering estimate)
OS	OpenVMS v7.3, Tru64 UNIX® v5.1a, Linux®	OpenVMS v7.3-1, Tru64 UNIX® v5.1b, Linux®
Other Features		Enterprise RAS, Partitionable, RAID Memory
Pricing (UNIX List)	Entry: $ 54,087 4P/4GB: $133,092	Entry: $ 64,400 4P/4GB: $137,000

hp AlphaServer ES80 System

the departmental diva

- Configuration Flexibility:
  - 2-8 1GHz Processors
  - Up to 64GB Memory
  - 5-64 I/O Slots
  - Tru64 UNIX® v5.1B, OpenVMS v7.3-1 and Linux®
- Reliability Enhancements
  - Redundant Components
  - Optional “RAID” memory
  - Family-wide RAS features
- Flexibility & Manageability
  - Partitions
  - Embedded Server Management
- Replacement system for AlphaServer GS80 system

The new hp AlphaServer ES80

	GS80	ES80
Processors	1-8 1.224 GHz EV68	2-8 1.0GHz EV7
Cache	16MB	1.75MB 7-way Set Associative
Memory	Up to 64GB @ 6.4GB/sec BW 5,462 MB/sec STREAMS	Up to 64GB @ 10.7GB/sec BW 42,609 MB/sec STREAMS (est.)
I/O Subsystem	UP to 56 PCI Slots on 14 Busses 3.2 GB/sec I/O Bandwidth	Up to 64 PCI/PCI-X slots on 24 PCI Busses 25.6 GB/s BW
SPECint2000	833 SPECint_2000 76.4 SPECint_rate2000	775 SPECint2000 (est.) 70.8 SPECint_rate2000 (est.)
SPECfp2000	1,014 SPECfp_2000 81.0 SPECfp_rate2000	1,275 SPECfp2000 (est.) 117 SPECfp_rate2000 (est.)
TPCC	75K tpmC (engineering estimate)	90K-100K tpmC (engineering estimate)
OS	OpenVMS v7.3, Tru64 UNIX® v5.1a, Linux®	OpenVMS v7.3-1, Tru64 UNIX® v5.1b, Linux®
Other Features	Enterprise RAS, Up to 2 Partitions	Enterprise RAS, Up to 4 Partitions, RAID Memory
Pricing (UNIX List)	Entry: $ 97,500 8P/8GB: $330,000	Entry: $ 81,000 8P/8GB: $275,000

hp AlphaServer GS1280 System

the enterprise impresario

- Configuration Flexibility:
  - 2-64 1.15GHz Processors
  - Up to ½ TB Memory
  - 10-640 I/O Slots
  - Tru64 UNIX® v5.1B, OpenVMS v7.3-1
- Reliability Enhancements
  - Redundant Components
  - Optional "RAID" memory
  - Family-wide RAS features
- Flexibility & Manageability
  - Partitions
  - Embedded Server Management
- Replacement offering for AlphaServer GS80, GS160 and GS320 systems

	GS1280 M8	GS1280 M16	GS1280 M32	GS1280 M64
CPU: MHz; Cache/CPU	1150 MHz 1.75MB on chip	1150 MHz 1.75MB on chip	1150 MHz 1.75MB on chip	1150 MHz 1.75MB on chip
CPUs Min-Max	2-8	2-16	2-32	2-64
Memory	Up to 32GB ECC/RAID	Up to 128GB ECC/RAID	Up to 256GB ECC / RAID	Up to 512GB ECC / RAID
Bandwidth per CPU	25.6 GB/sec	25.6 GB/sec	25.6 GB/sec	25.6 GB/sec
PCI Buses Slots Bandwidth	3-12 buses 11-44 slots 12.8GB/s	3-24 buses 11-88 slots 25.6GB/s	3-48 buses 11-176 slots 51.2GB/s	3-96 buses 11-352 slots 102.4GB/s
Partitioning	Up to 4-way	Up to 8-way	Up to 16-way	Up to 32-way
Mixed speed CPUs	Yes	Yes	Yes	Yes
Hot warm swap	Power, Fans PCI -X	Power, Fans PCI -X	Power, Fans PCI -X	Power, Fans PCI -X
Upward Growth	To 128 processors; EV79, Clusters	To 128 processors; EV79, Clusters	To 128 processors; EV79, Clusters	To 128 processors; EV79, Clusters
Performance TPC-C	100K at 8P estimated	200K at 16P estimated	380K at 32P estimated	750K at 64P estimated
Packaging	1 Datacenter cabinet	1 Datacenter cabinet	2-3 Datacenter cabinets	2-4 Datacenter cabinets
	GS1280 M8	**GS1280 M16**	**GS1280 M32**	**GS1280 M64**

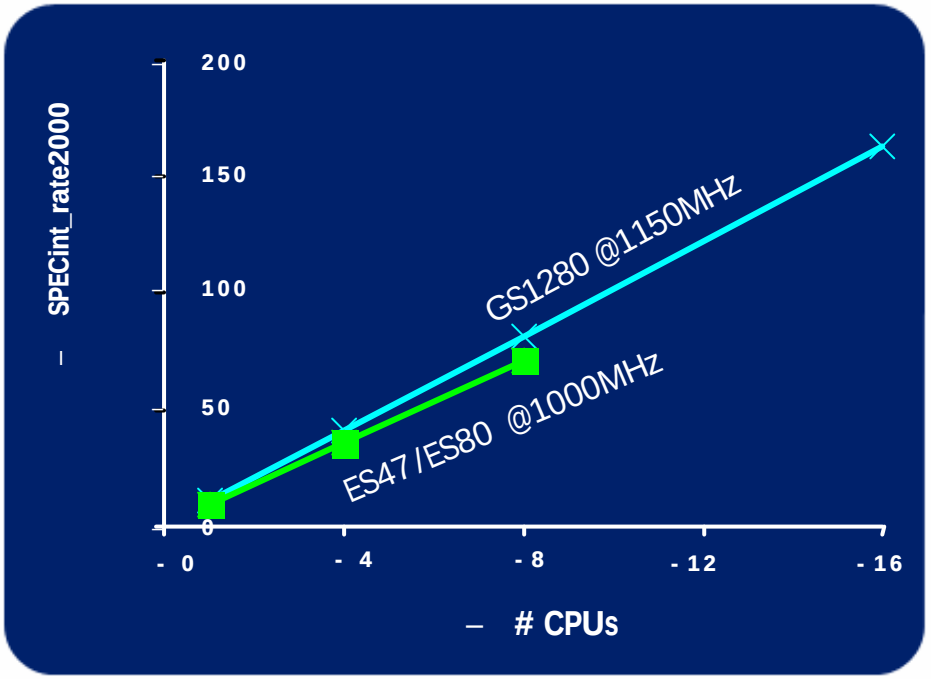
The new hp AlphaServer GS1280

	GS1280 8P	GS160	GS1280 16P
Processors	2-8 1.15 GHz EV7	1-16 1.224 GHz EV68	4-16 1.15 GHz EV7
Cache	1.75MB 7-way Set Associative	16MB	1.75MB 7-way Set Associative
Memory	Up to 64GB @ 12.3GB/sec 49,000 MB/sec STREAMS	Up to 128GB @ 6.4GB/sec BW 10,971 MB/sec STREAMS	Up to 128GB @ 12.3GB/sec 95,000 MB/sec STREAMS
I/O Subsystem	Up to 96 PCI/PCI-X slots on 24 Busses; 25.6 GB/s BW	UP to 112 PCI Slots/28 Busses 6.4 GB/sec I/O Bandwidth	Up to 192 PCI/PCI-X slots on 48 Busses; 51.2GB/s BW
SPECint2000	891 SPECint2000 (est.) 81.5 SPECint_rate2000 (est.)	833 SPECint2000 148 SPECint_rate2000	891 SPECint2000 (est.) 163 SPECint_rate2000 (est.)
SPECfp2000	1,466 SPECfp2000 (est.) 135 SPECfp_rate2000 (est.)	1,014 SPECfp2000 161 SPECfp_rate2000	1,466 SPECfp2000 (est.) 269 SPECfp_rate2000 (est.)
TPC-C	90K-105K tpmC (est.)	143K tpmC (est.)	180K-210K tpmC (est.)
OS	OpenVMS v7.3-1 Tru64 UNIX® v5.1b	OpenVMS v7.3, Tru64 UNIX® v5.1a	OpenVMS v7.3-1 Tru64 UNIX® v5.1b
Other Features	Enterprise RAS, up to 4 Partitions, RAID Memory	Enterprise RAS, 4 Partitions	Enterprise RAS, up to 8 Partitions, RAID Memory
Pricing (UNIX List)	Entry: $117,000 8P/8GB: $315,000	Entry: $290,000 16P/16GB: $901,000	16P/16GB: $650,000

The new hp AlphaServer GS1280

	GS320	GS1280 32P	GS1280 64P
Processors	1-32 1.224 GHz EV68	4-32 1.15 GHz EV7	8-64 1.15 GHz EV7
Cache	16MB	1.75MB 7-way Set Associative	1.75MB 7-way Set Associative
Memory	Up to 256GB @ 6.4GB/sec BW 21,176 STREAMS	Up to 256GB @ 12.3GB/sec 185,000 MB/sec STREAMS (est.)	Up to 512GB @ 12.3GB/sec n/a STREAMS
I/O Subsystem	UP to 224 Slots/56 Busses 12.8 GB/sec I/O Bandwidth	Up to 384 PCI/PCI-X slots on 96 Busses 102.4GB/s BW	UP to 768 PCI/PCI-X Slots/112 Busses 204.8 GB/sec I/O BW
SPECint2000	833 SPECint2000 296 SPECint_rate2000	891 SPECint2000 (est.) 326 SPECint_rate2000 (est.)	891 SPECint2000 (est.) n/a SPECint_rate2000
SPECfp2000	1,014 SPECfp2000 320 SPECfp_rate2000	1,493 SPECfp2000 (est.) 523 SPECfp_rate2000 (est.)	1,493 SPECfp2000 (est.) n/a SPECfp_rate2000
TPC-C	271K tpmC (est.)	370K-405K tpmC (est.)	n/a
OS	OpenVMS v7.3 Tru64 UNIX® v5.1a	OpenVMS v7.3-1 Tru64 UNIX® v5.1b	OpenVMS v7.3-1 Tru64 UNIX® v5.1b
Other Features	Enterprise RAS, Up to 8 Partitions	Enterprise RAS, up to 16 Partitions, RAID Memory	Enterprise RAS, Up to 32 Partitions, RAID Memory
Pricing (UNIX List)	Entry: $ 667,000 32P/32GB: $1,675,000	32P/32GB: tbd	64P/64GB: tbd

Performance Differences between the ES47/ES80 and the GS1280

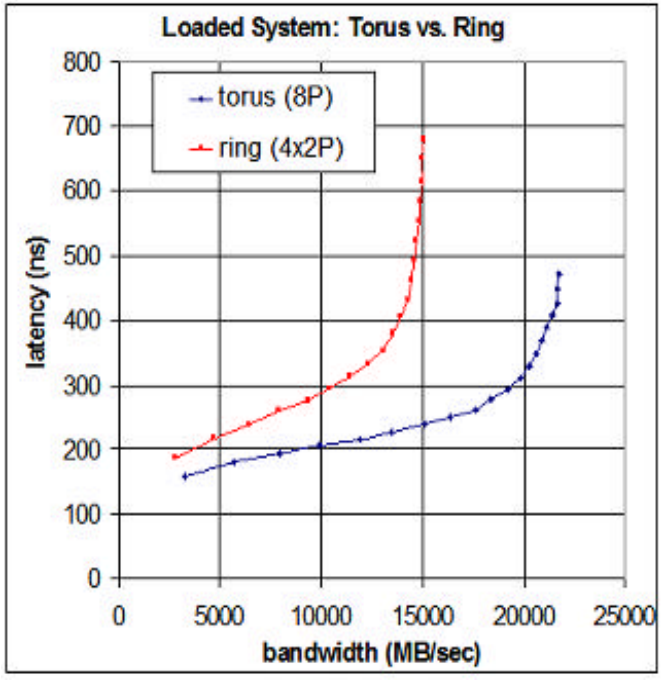


Differences in Systems:

- Mesh vs. Ring architectures
- 1150Mhz vs. 1000MHz CPU speeds

Result:

- 15% Difference at 8P for SPECint_rate2000 and SPECfp_rate2000
- ES47/ES80 Memory bw 25% less than GS1280
- Applications that don't stress interprocessor links should not see any performance difference



hp AlphaServer SC1280 System

Supercomputing's superstar

- Uses AlphaServer GS1280 nodes
  - 8 or 16 CPUs per node
  - 128 nodes, 2,048 CPUs maximum at first release
    - Larger configurations by request
  - Up to 128 GB memory/node, 10+ TB memory per system
- Quadrics Interconnect
  - Per rail:
    - 16 GB/s bisection bandwidth
    - 3 µs latencies
  - Supporting up to 2 rails
  - Next generation Quadrics interconnect 2H 2003
- AlphaServer SC software based on Tru64 UNIX®
  - Global and parallel file systems
- 100s TB storage capacity using Fiber Channel SANs
- Available 2H 2003

hp alpha servers systeme

ds-series (up to2)
es-series (up to8)
gs-series (up to 64)

key takeaways

!

hp alpha servers

- ✓alpha is the fastest processor
- ✓ev7 defines the next level of competitive performance
- ✓TruCluster technology is leading and will be integrated in hp-ux
- ✓further development until 2006
- ✓strong performance in commercial environments
- ✓ outstanding performance in technical computing environments

pa-risc servers

superdome
rp8400
rp7410
rp54xx
rp24xx

bcs server family

world's broadest, most robust enterprise offering

high-end

AlphaServer GS320/1280
SC 20/45/1280

Superdome

NonStop

mid-range

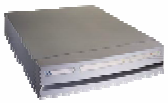
AlphaServer ES4x/80

rp7410

rp8400

entry-level

AlphaServer
DS series



rp2400 series

rx2600

rp5400 series

rx5670

rp2400 series powered by pa-8700

	rp2430	rp2470
PA-RISC processor	650MHz PA-8700	650MHz PA-8700 750MHz PA-8700
Nr of processors	1 way	1-2 way
Max. memory	2 GB	8 GB
PCI I/O slots	2	4
Internal storage	146GB	146GB

- aggressively priced
- high performance density
- industry-leading performance density
  2 X vs. SUN 280R
- extends market success of A-Class

the rp5430 and the rp5470

	hp server rp5430	hp server rp5470
positioning	[illegible] to the 4-way, new business	[illegible] performance [illegible], new business
processors	PA-8700 750MHz & 875MHz (1-2 way) "Stretch" high performance core electronics	PA-8700 750MHz & 875MHz (1-4 way) "Stretch" high performance core electronics
form	7U (5 per 1.95m rack)	7U (5 per 1.95m rack)
memory	8GB maximum memory	16GB maximum memory
I/O slots	5 hot-plug independent PCI slots	10 PCI slots: 8 hot-plug independent channel; 2 shared channel
core I/O	Ultra2 SCSI and 100Base-T	Ultra2 SCSI and 100Base-T
internal storage	4 hot-plug Ultra2 SCSI bays DVD or DAT removable media bay	4 hot-plug Ultra2 SCSI bays DVD or DAT removable media bay
storage capacity	292GB internal	292GB internal
built-in high availability	redundant, hot-swap fans and power hot-plug disks and I/O	redundant, hot-swap fans and power hot-plug disks and I/O
operating system	HP-UX 11 and 11i	HP-UX 11 and 11i

the hp server rp7410

system features

- 2- to 8-way PA 8700 CPUs at 650 to 875 MHz
- up to 64 GB of memory*
- up to 2 hard partitions
- up to 8 “virtual” partitions*
- 15 PCI slots & 2 core I/Os

performance & scalability

- 100,000+ OLTP performance (est.)
- leading java, web and ERP/CRM/SCM performance

software functionality

- goal-based workload management based on service level objectives
- hp-ux 11i operating environments with over 1100 ISV applications

* available DEC’02

high availability

- cache self-healing
- memory chip-sparing technology
- OLAR PCI cards
- Redundant core I/O
- MC/ServiceGuard for in-box and cluster failover

physical specifications

- high density (10U form factor)
- 4 servers per standard 2m rack
- leading accessibility and serviceability

investment protection

- in-box upgrades to future pa-risc and IPF technologies
- upgrade to hp server rp8400 (16-way system)
- utility pricing (pay-per-forecast, pay-per-use, and processor and cell board (ICOD)

the hp server rp8400

performance and scalability

- 140,240 tpmC with $16.48/tpmC, (with 750MHz pa8700)
- leading java, integer and SAP performance

key system features

- 2- to 16-way industry leading pa8700 CPUs at 650 to 875 MHz
- up to 2 hard partitions
- up to 16 “virtual” partitions with Vpars

investment protection

- board upgrades to future pa-risc and IPF technologies
- utility pricing (including pay-per-forecast, iCOD, and pay-per-use options)

high availability

- OLAR PCI cards
- DMR and DPR
- memory “chip-spare” technology
- HA clustering in a box (using partitions)

physical specifications

- high density (17U form factor)

software functionality

- complete provisioning continuum through multi-system WLM
- hp-ux 11i operating environment with over 16000 applications

midrange technology leadership

hp superdome

- performance & scalability
  - single node:
    - 16, 32, 64 CPUs
    - 64, 128, 256 GBs
    - 48, 96, 192 PCI slots
  - HP-UX 11i OS

- partitioning continuum
  - hp hyperplex
  - nPartitions
  - virtual partitions
  - resource management

- built for the future
  - current releases: pa-8700 pa8700+ (875MHz)
  - future releases: pa-risc & ia-64
  - multi-os

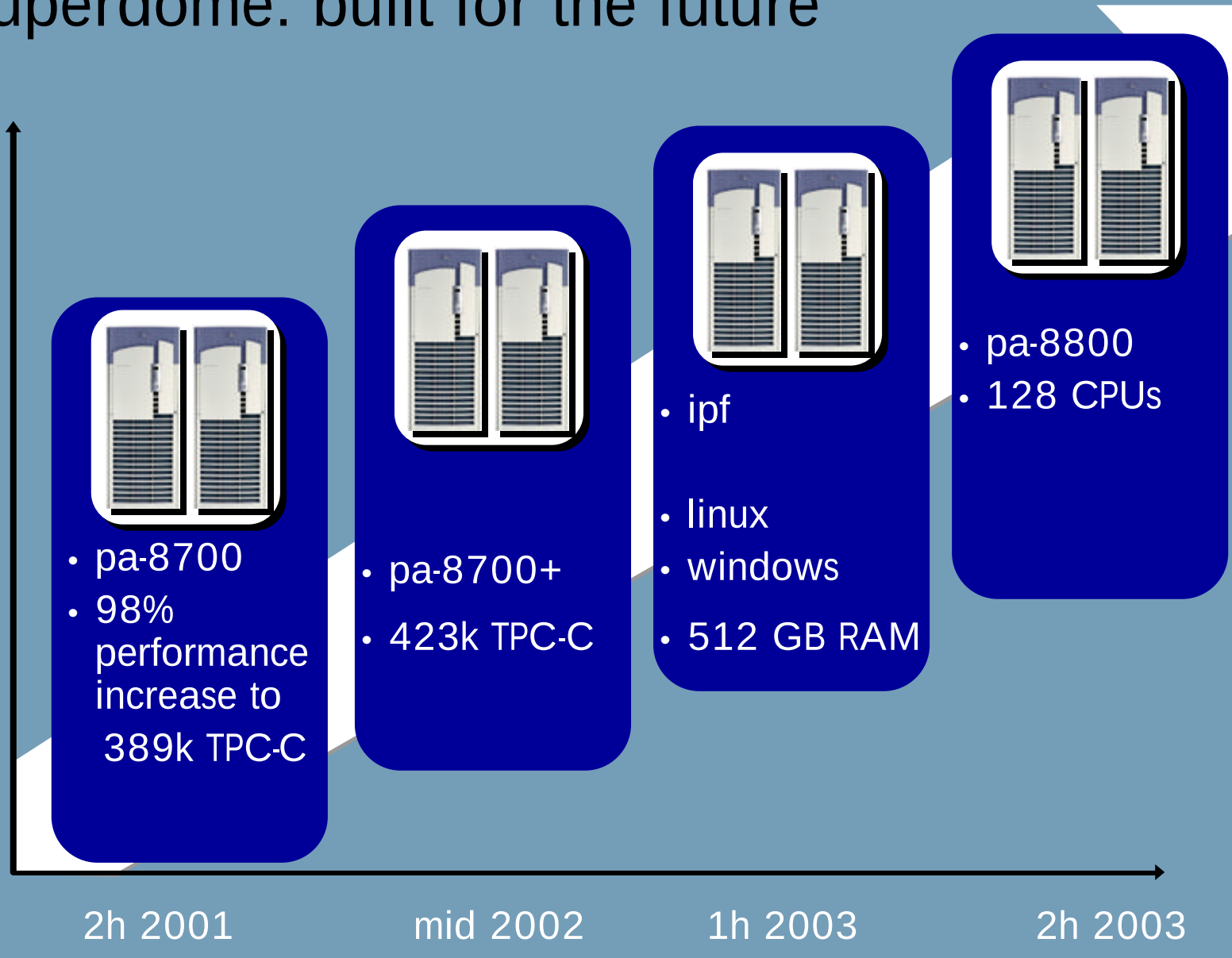
- high availability
  - N+1 OLR fans
  - N+1 OLR power supplies
  - dual power source
  - OLAR CPU, memory *
  - OLAR PCI I/O cards
  - parity protected I/O data paths
  - ECC on CPU cache
  - ECC on all fabric and memory paths
  - dynamic processor resilience
  - dynamic memory resilience

- utility technology & pricing
  - iCOD, tiCOD
  - utility pricing, pay-per-use

* note: os version dependent planned 2003

true differentiation in all major areas

hp superdome: built for the future



subject to change without notice (September 2002)

hp itanium servers

rx2600
rx5670

hp zx1 chipset unleashes the full power of Itanium 2

high memory bandwidth, low memory latency

- enables top application performance
- consistent response times
- supports more users and processes

high memory capacity

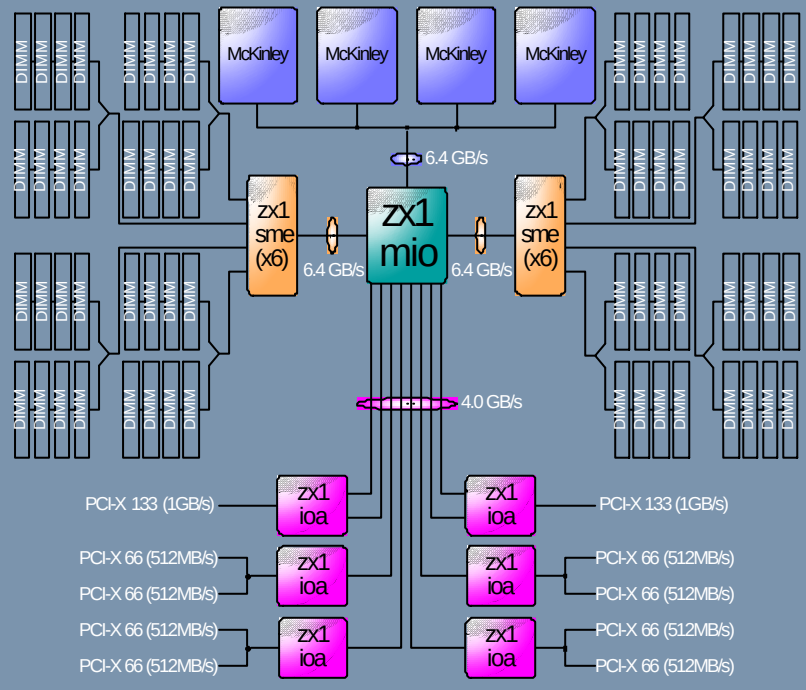
- supports DDR RAM
- enables optimum performance for large models/databases

high I/O bandwidth and capacity

- consolidate applications / number of servers
- very large or multiple large databases
- four high-speed channels provide ~4 GB/s available bandwidth

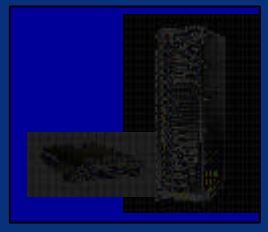
scalability

- enables a family of systems to be tuned to meet a variety of needs



the fastest Itanium2 platforms on the planet

Itanium® 2-based servers from hp



hp server rx2600

hp server rx5670

	hp server rx2600	hp server rx5670
processors	1-2 way 900 MHz and 1 GHZ Intel® Itanium® 2 processors	1-4 way 900 MHz and 1 GHZ Intel® Itanium® 2 processors
memory	up to 12GB DDR SDRAM	up to 48GB DDR SDRAM
bandwidth	6.4 GB/s system; 5.5 GB/s memory; 4.0 GB/s I/O	6.4 GB/s system; 12.8 GB/s memory; 4.0 GB/s I/O
pci-x/pci slots	4 PCI-X @ 133MHz	9 PCI-X (3 @ 133MHz, 6 @ 66MHz); 1 PCI (33MHz)
internal storage	up to 219GB	up to 292GB
operating system	HP-UX 11i v 1.6, Windows®, Linux®	HP-UX 11i v 1.6, Windows®, Linux®
est. street pricing	entry: € 6590 avg: € 19K	entry: € 24000 avg: € 46K

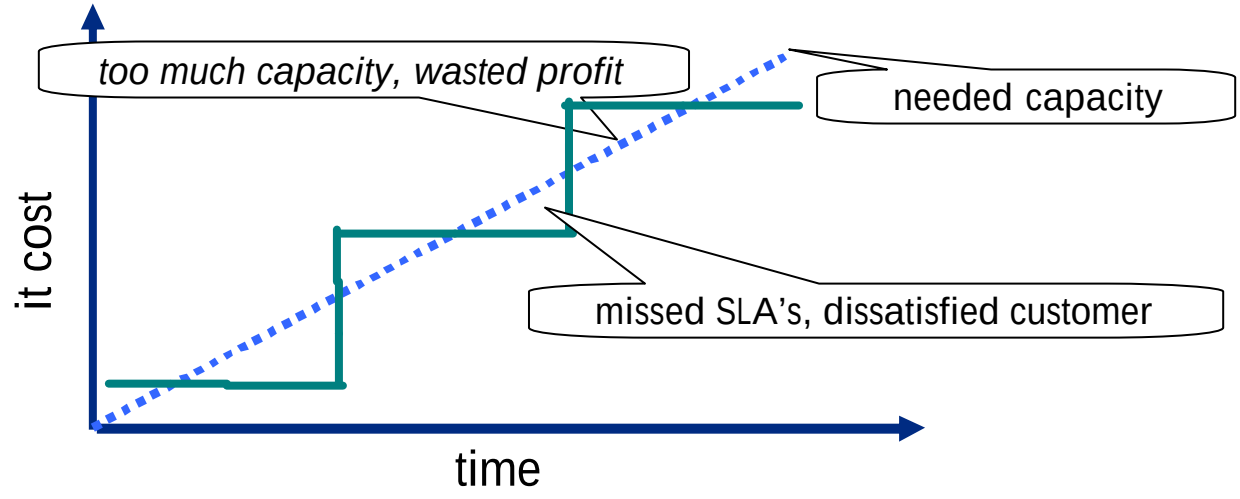
HP partitioning continuum

why is partitioning important?	hp partitioning customer benefits
pressure to offer service level guarantee at reasonable costs	meet service level agreements with best return-on-investment
under utilization of servers	80-90% + utilization of compute power
address high fluctuation of web and app traffic	fast and dynamic implementation of changing requirements
flexibility with privacy and high availability	“right” level of application isolation with uptime

HP utility pricing solutions

our customers' problem

the traditional business model is challenged in the internet age

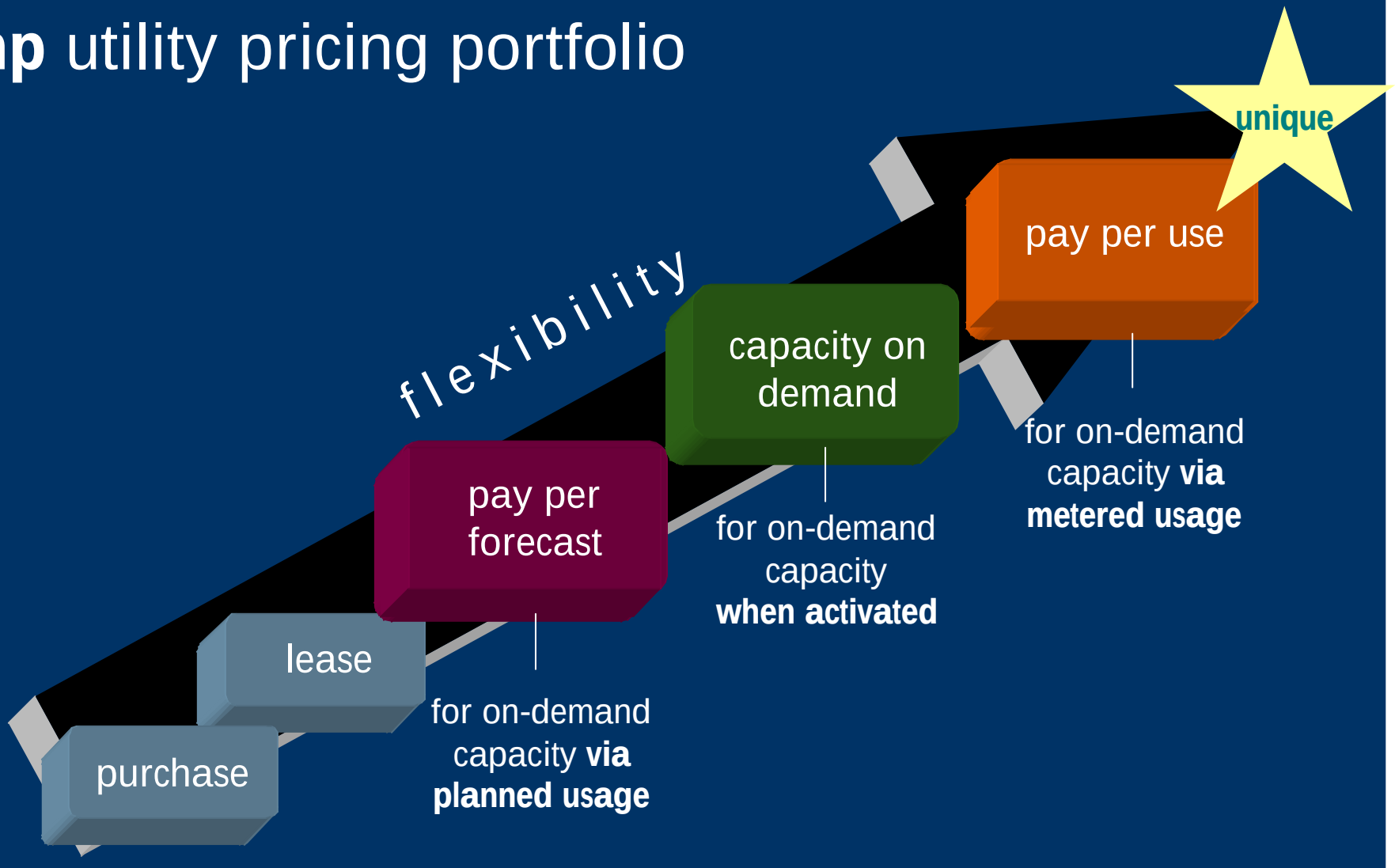


traditional capacity planning meant sizing for an unknown but anticipated peak

customer issues

- significant upfront investments
- costs not in line with revenues
- correct capacity is a moving target
- supply struggles with demand
- competitive advantage challenging

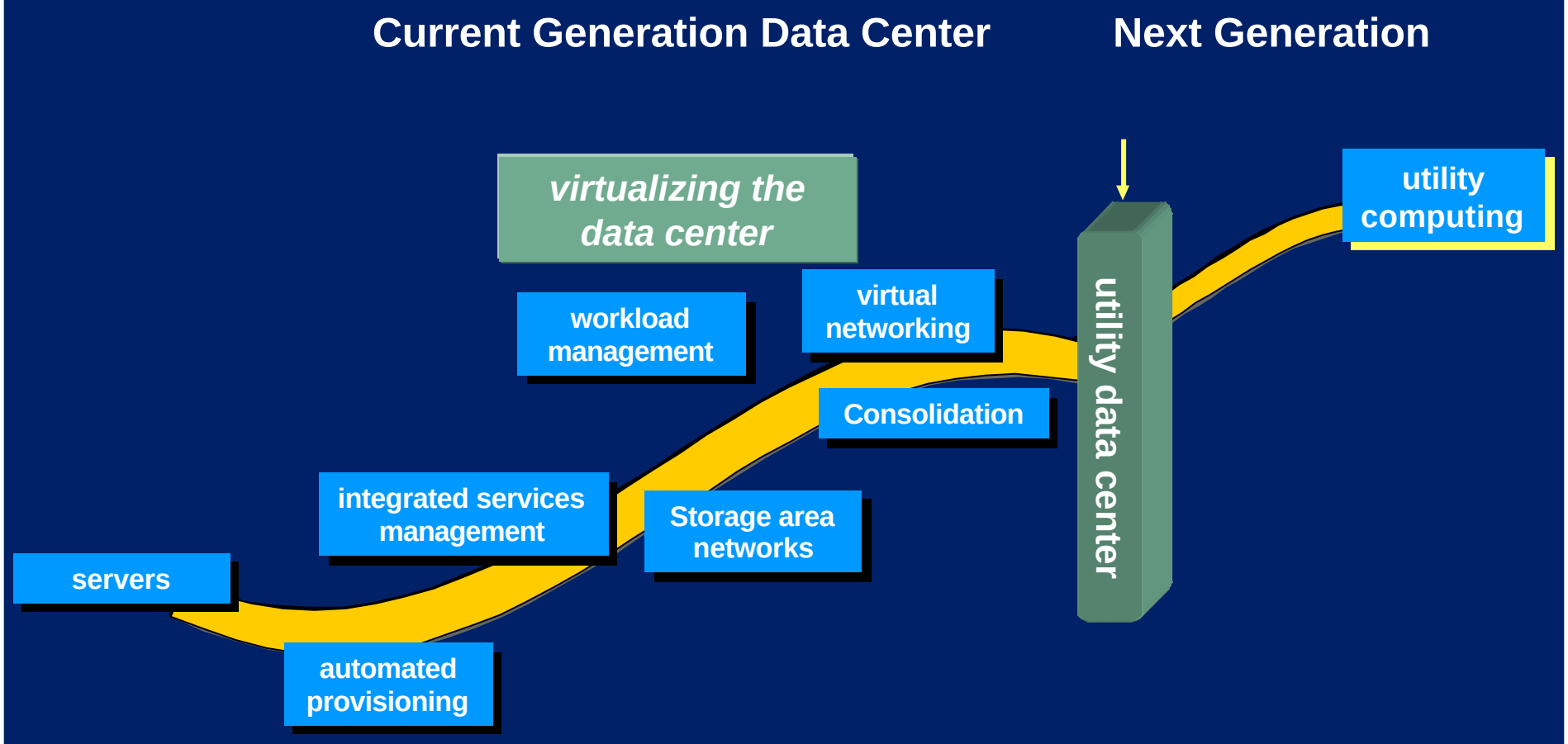
hp utility pricing portfolio



best solutions for the datacenter

- support of all datacenter environments
- adaptive infrastructure

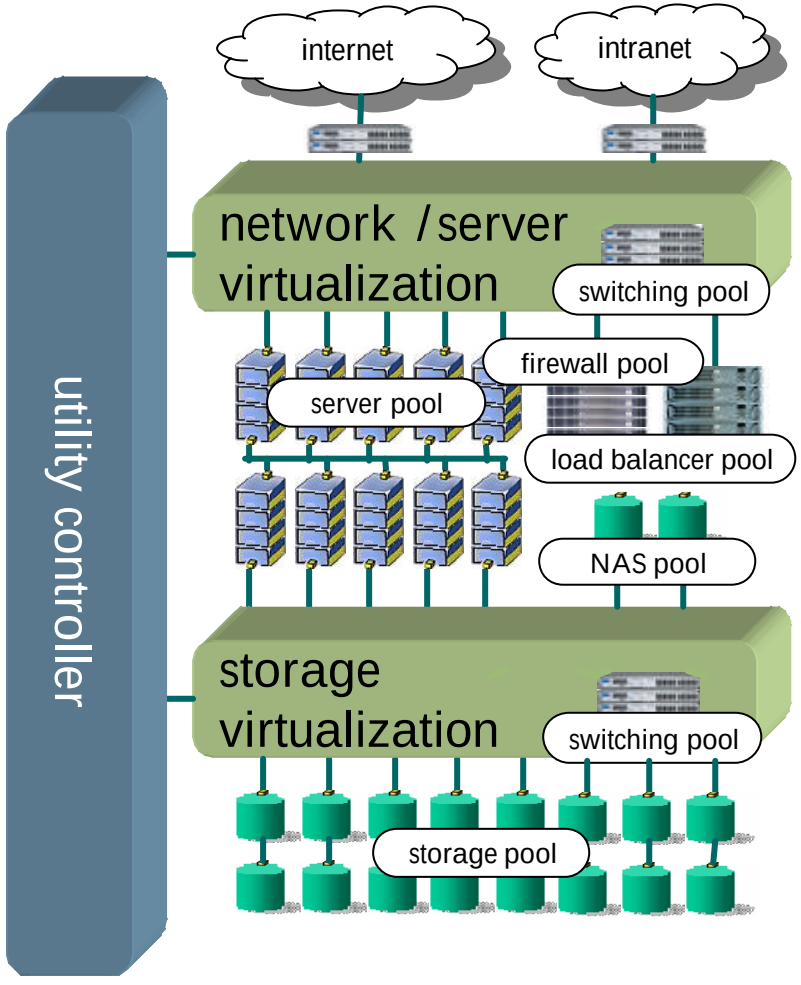
creating the future
technology stepping stones for the datacenter



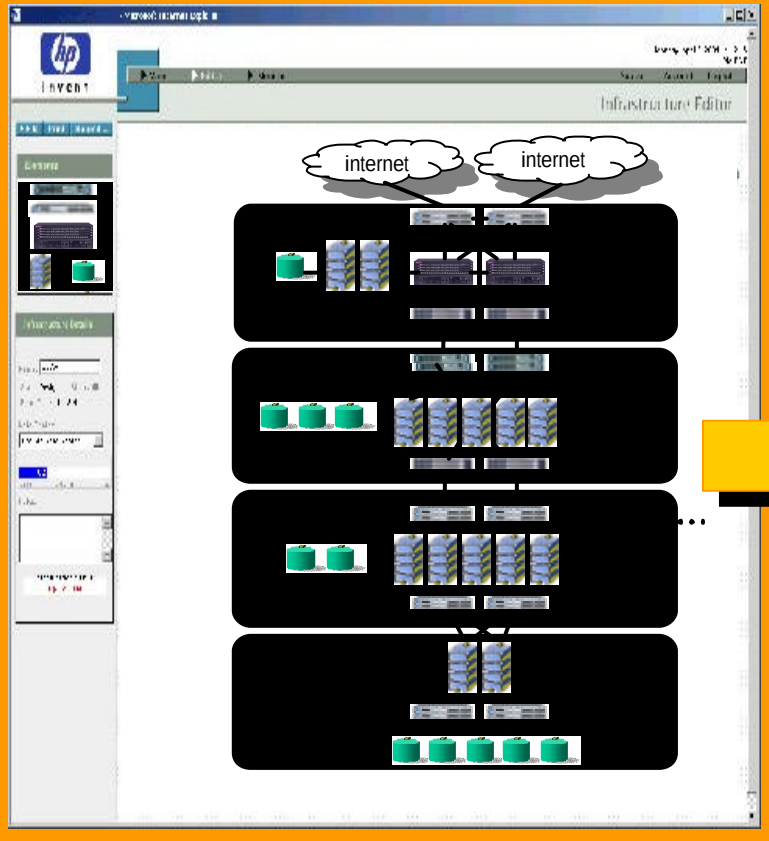
hp utility data center

is a fully integrated software and hardware solution that enables virtual provisioning of application environments to optimize asset utilization and reduce administrative staff

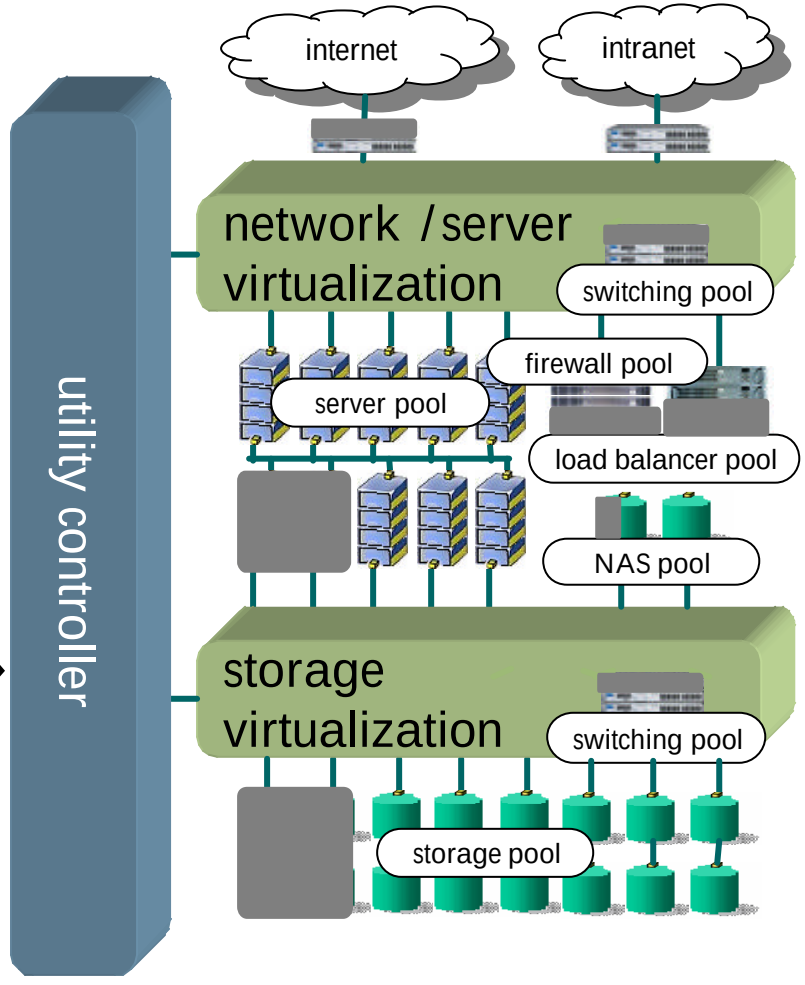
1. wire once
   all components are wired once to support virtual allocation of resources for the entire system
2. resource virtualization
   all networking, storage, and server components are wired once, and can be allocated and reallocated many times without having to rewire any physical components.
3. utility controller
   simple user interface allows administrators to architect new systems and activate the using available resources



architect a new service in a simple web interface



activate it in the hp utility data center



bcs servers

the best in
the industry

thank you !!