HPC @ HP
LCSC Linköping
October 18, 2007

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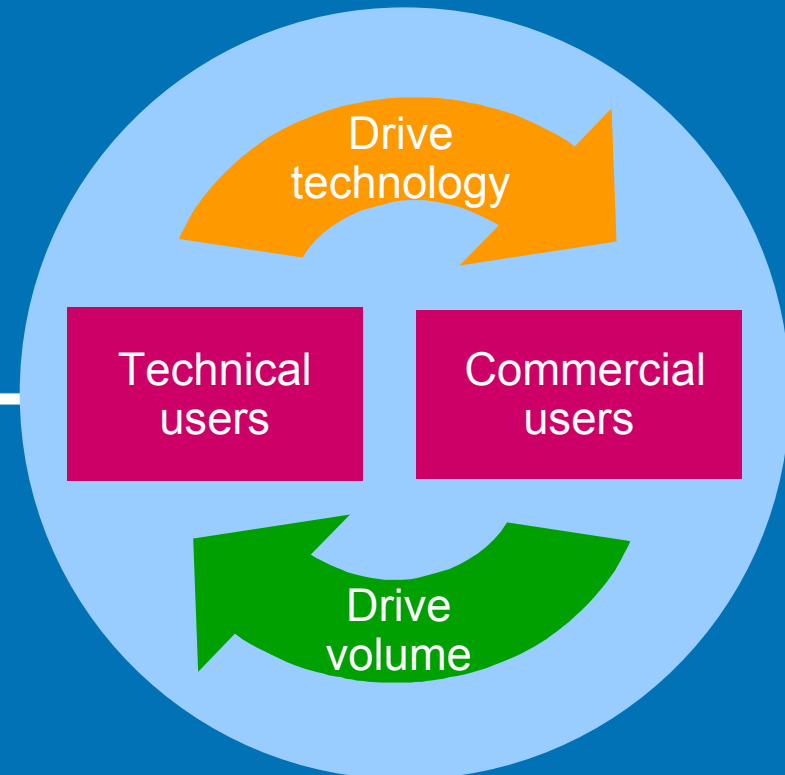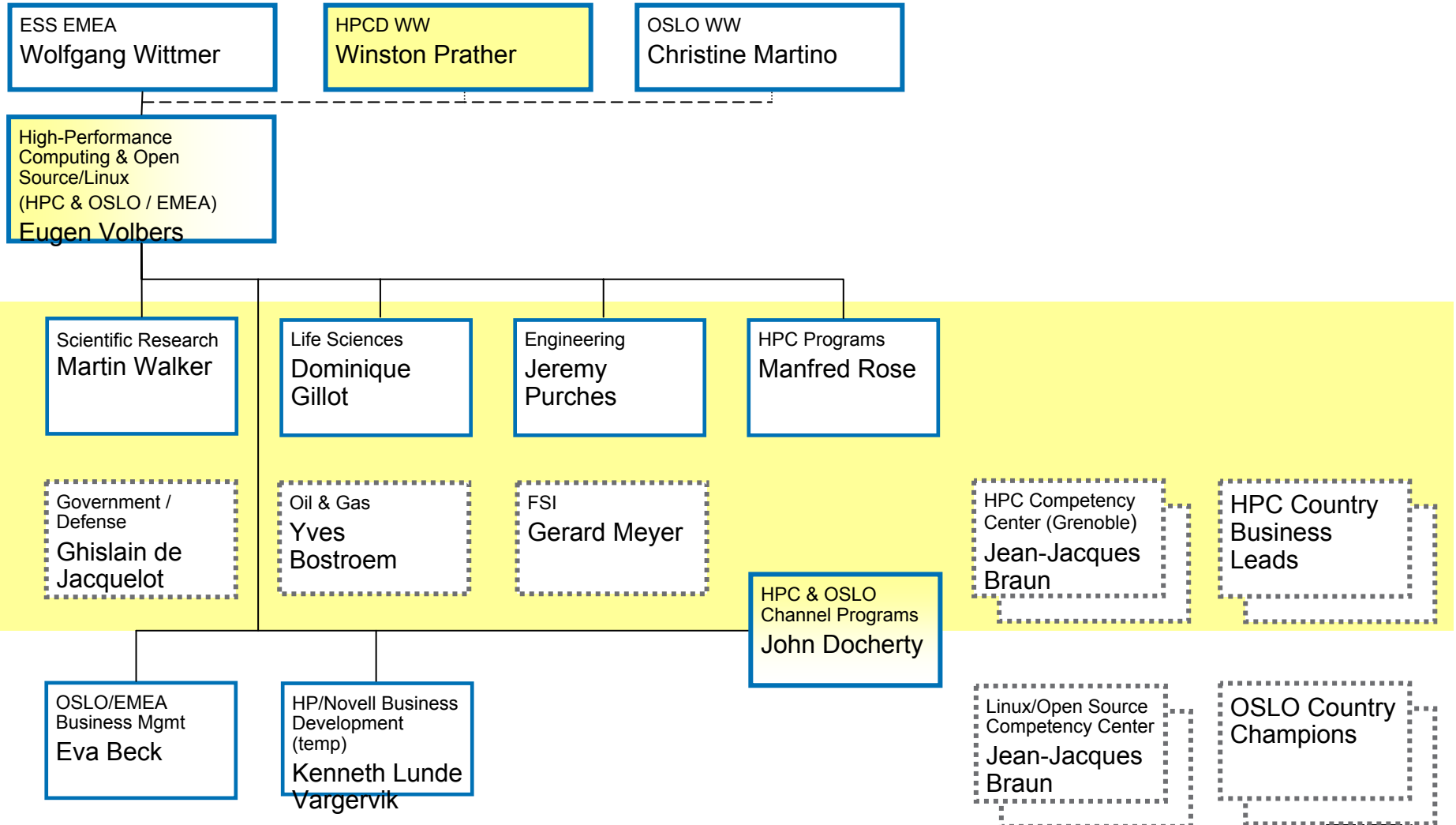
High-Performance Computing & Open Source/Linux   -   EMEA Region

ESS EMEA
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HPCD WW
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Jean-Jacques Braun

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Kenneth Lunde Vargervik

Linux/Open Source Competency Center
Jean-Jacques Braun

OSLO Country Champions

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Agenda

- The HPC landscape - some observations on the size, shape, and evolution of the market

- Meeting the challenges of HPC: the view from HP

- Application performance

- Some recent customers

- Facing the future: catalysts for HPC innovation

The HPC Landscape

- "HPC" – computers used for computationally or data intensive tasks

  - technical servers used by scientists, engineers, financial analysts and others

  - NOT commercial servers used for business and transaction processing

- The HPC market compared to "all servers"

  - HPC market 2006: $10B, 9% growth over 2005

  - WW server revenue 2006: $52B, 1.9% growth over 2005

- HPC market CAGR through 2011: 9.1%

Source: IDC briefing at ISC2007, Dresden, June 2007

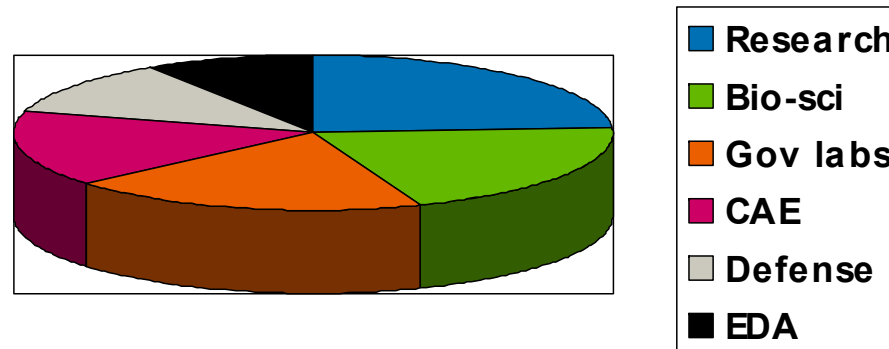# All Worldwide Servers Compared To HPC – Revenue, Units & Processors

All Servers Worldwide					
	2003	2004	2005	2006	CAGR
Sum of Factory Revenue	46,149	49,146	51,268	52,251	4.2%
Sum of Units	5,278,222	6,307,484	7,050,099	7,472,649	12.3%
Sum of Die Count Shipped	8,662,823	10,134,624	11,712,766	12,779,159	13.8%

HPC Technical Servers Worldwide					
	2003	2004	2005	2006	CAGR
Sum of WW Rev	5,698	7,393	9,208	10,030	20.7%
Count of WW Units	91,534	155,811	191,283	236,143	37.2%
Sum of PE Volume	1,005,215	1,657,787	2,642,597	3,332,186	49.1%

HPC As A Ratio Of All Servers					
	2003	2004	2005	2006	CAGR
Revenue	12.3%	15.0%	18.0%	19.2%	15.8%
Units	1.7%	2.5%	2.7%	3.2%	22.1%
Processors	11.6%	16.4%	22.6%	26.1%	31.0%

The WW HPC market (by revenue)

- Main application segments (total more than ¾ of market)

Legend:
- Research
- Bio-sci
- Gov labs
- CAE
- Defense
- EDA

- CPU type: 77% industry standard (63% x86, 14% EPIC), 21% RISC, 2% vector

- OS: 66% of platforms run Linux

- 58% of platforms are clusters; 95% of cluster CPUs are industry standard; 90% of clusters run Linux

- 26% of platforms are blade clusters

- Geographical distribution: 49% NA, 32% EMEA, 19% APJ

Top application segments (77% of market)

University/academic	19%
Bio-science	16%
Government labs	15%
CAE	12%
Defense	9%
EDA	7%

The high-end of the HPC market: messages from the Top500

- Systems ranked by performance on the LINPACK benchmark
  - needed 4 TFLOPS to get on the list in June 2007
  - expect 1 PFLOPS by June 2008 (Nov 2007?)
- 78% of systems use industry-standard CPUs
- 75% of systems are commodity clusters
- 51% of systems are blade clusters
- Geographical distribution: 58% NA, 24% EMEA, 12% APJ, 6% RoW
- Vendors: 41% HP (1/3 of all entries are HP blades), 38% IBM, no other vendor reaches 5%

  - www.top500.org

Take-away on the HPC Market

- Rapid growth
- Industry standard CPUs
- Commodity clusters
- Blades

Observations on the HPC landscape

- Server clusters have effectively become the industry standard HPC compute platform

- Clusters have blurred the distinction between capability and capacity computing

  - clusters can run supercomputer applications as well as throughput workloads

  - has led IDC to simplify their platform classification: workgroup (<$50K), departmental ($50K to $250K), divisional ($250K to $500K), SC (>$500K)

- Clusters are still perceived as hard to use and hard to manage

Evolution and Trends

- The data explosion: Microsoft Virtual Earth geobrowser has 14 PB of data; scientific observations and experiments will deliver multiple PB of data/month for analysis

- The cost of power and cooling approaches the capital cost over the lifetime of an HPC installation

- Moore's Law will remain valid
  - semiconductor physics will keep clock frequencies about where they are today
  - semiconductor manufacturers will double the number of functional units ("cores") on a chip every 18-24 months
  - the opportunity for parallelism in applications will double every 18-24 months

"Power and cooling, multi-core, and software licensing are game-changing factors for the whole server market."

Gartner Group

Sources of Application Software

- 46% of applications are developed in-house

- 31% of applications are licensed from independent software vendors

- 12% of applications are share-ware

- 10% of applications are free-ware

              - IDC Study, 2006

"Mainstream computing needs parallelism for performance. This is new."

"A lot of very ordinary programmers will have to write parallel programs. Very few experts currently know how to do that."

Hans Boehm, Advanced Architecture Lab,
    HP Labs

Meeting customer requirements: the view from HP

- HPC strategy: innovate on standards-based technologies
  - Processors
  - Interconnects
  - System SW
- HPC product: HP Unified Cluster Portfolio
  - Modular – you choose the building blocks
  - Multifunctional: computing, data management, visualization
  - Preconfigured
  - Factory integrated and tested
  - Fully supported by HP
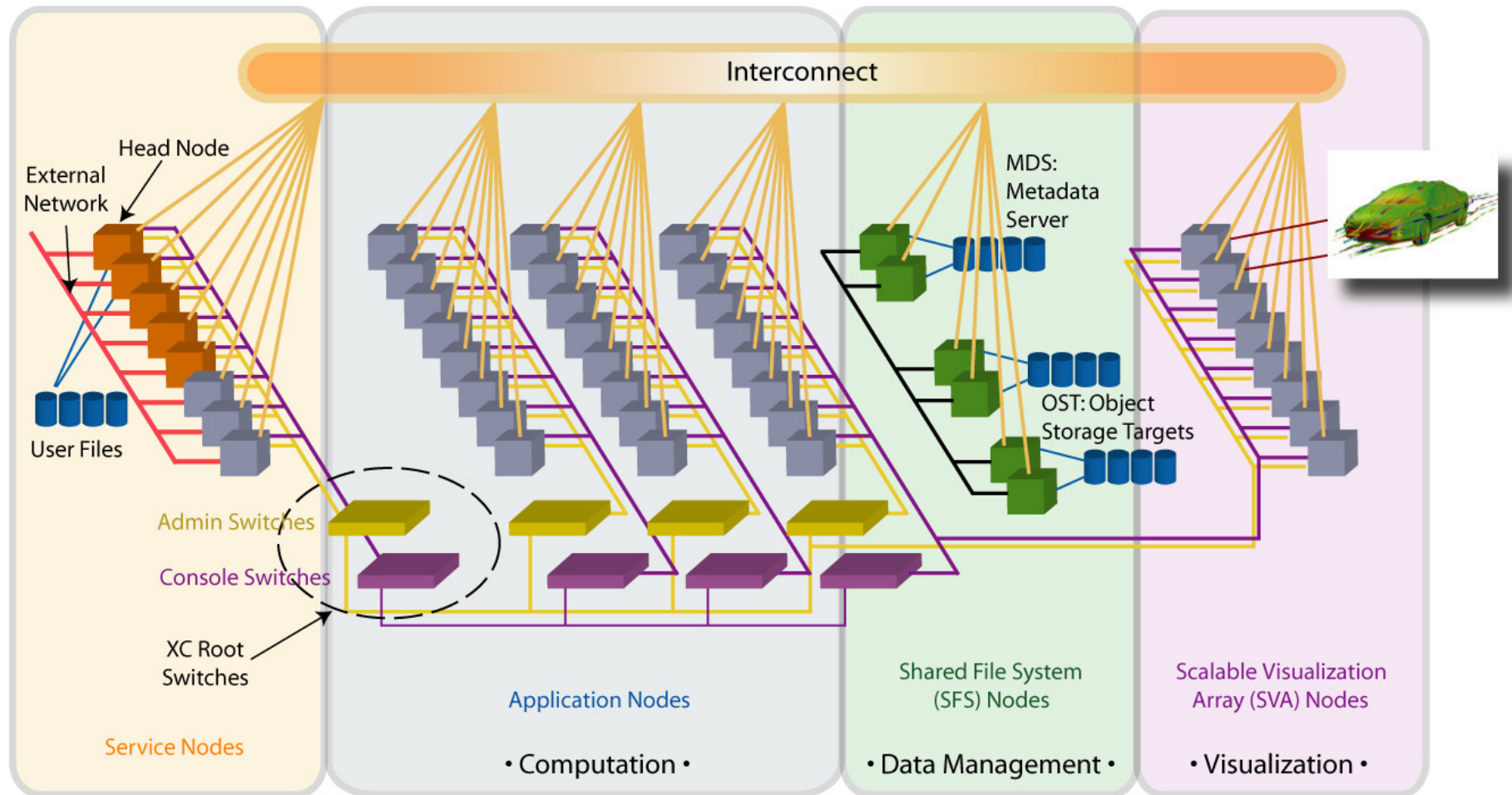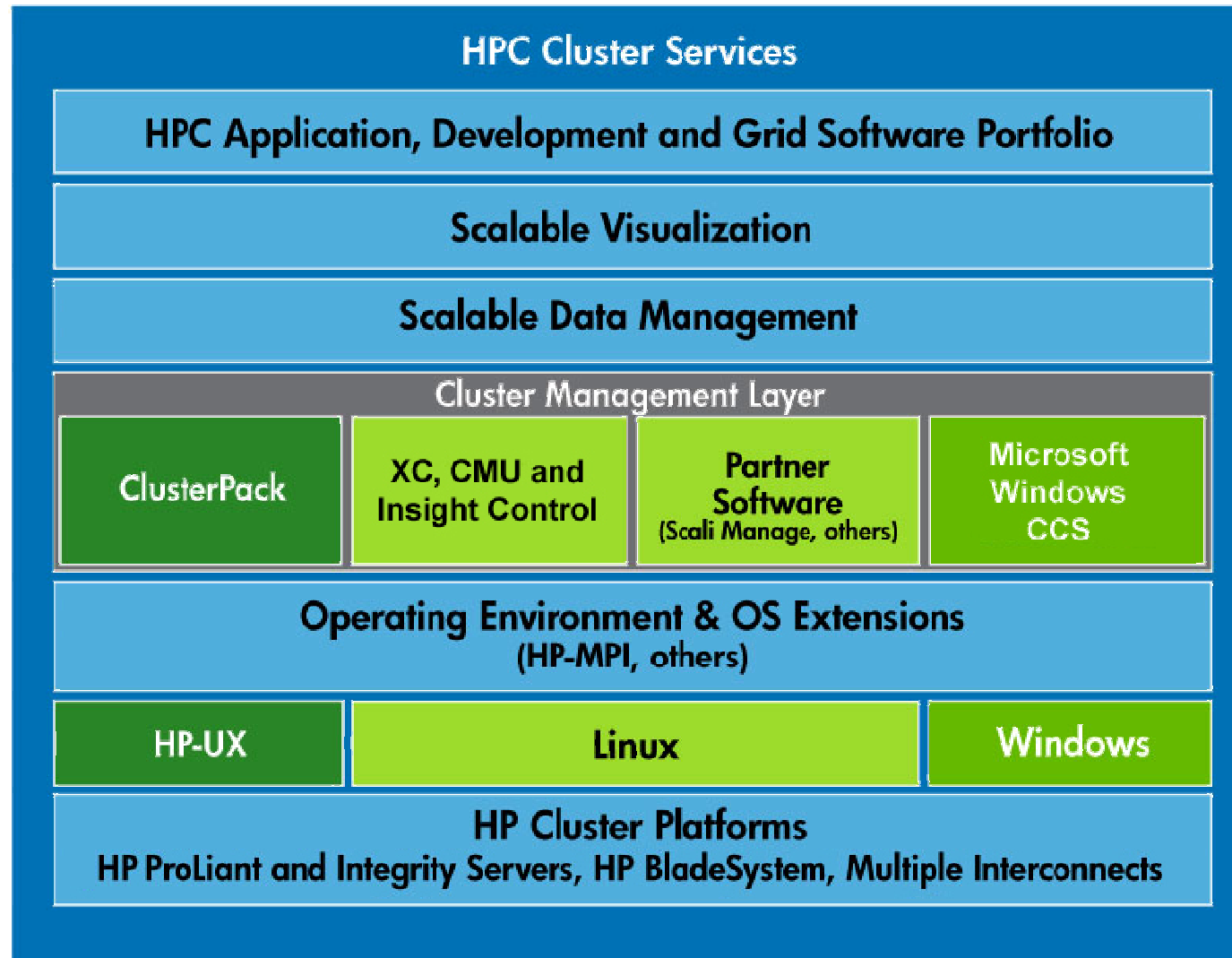- Success in the marketplace

HP Cluster Platforms

High Level Cluster Platform Architecture
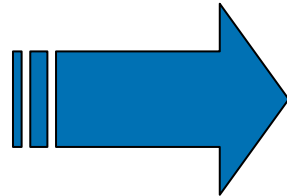
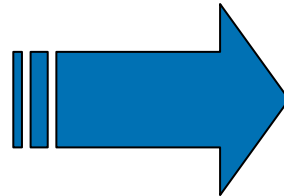With integrated XC, SFS and SVA

HP Unified Cluster Portfolio

HPC Cluster Services

HPC Application, Development and Grid Software Portfolio

Scalable Visualization

Scalable Data Management

Cluster Management Layer

ClusterPack	XC, CMU and Insight Control	Partner Software (Scali Manage, others)	Microsoft Windows CCS

Operating Environment & OS Extensions
(HP-MPI, others)

HP-UX	Linux	Windows

HP Cluster Platforms
HP ProLiant and Integrity Servers, HP BladeSystem, Multiple Interconnects

Value of Unified Cluster Portfolio

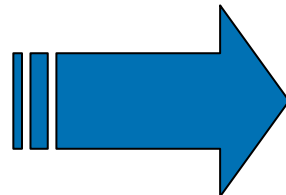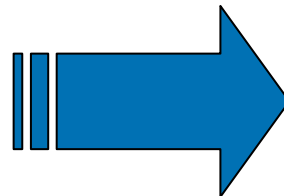|		
Built on Industry Standard Technologies	→	**Lower cost of ownership**
Partnership: open source, ISVs, suppliers and HP	→	**Rapid and confident deployment**
Seamless solution for computation, data mgmt, and visualization	→	**Tackle larger and more difficult problems**
Choice of technologies	→	**Optimal solution for your problem**

HP Cluster Platforms:
Turnkey solution for today's HPC workload

Typical cluster delivery

- Lots of choice but:
  - work
  - time
  - risk
- Not a reference design
  - Not characterized
  - Not documented
  - Software not qualified
  - Not vendor supported

HP Cluster
Platforms
Delivered:

HP Cluster
Platforms
installed

HP = choice without the pain and risk

HP Cluster Platforms

Flexible, pre-configured designs scale up to 1024 nodes

	Compute Nodes	Interconnects
HP Cluster Platform 3000 and 3000BL	ProLiant DL140 G3 *xw8400 workstations*	GigE, IB, Myrinet
	ProLiant BL460cP/BL480c	GigE, IB
HP Cluster Platform 4000 and 4000BL	ProLiant DL145 G3 ProLiant DL585 G2 xw9400 workstations	GigE, IB, Myrinet, Quadrics
	ProLiant BL465c/BL685c	GigE, IB
HP Cluster Platform 6000 and 6000BL	Integrity rx2660, other Integrity nodes for large memory/large SMP by request in CP6000	GigE, IB
	Integrity BL860c (with rx2660 as head node)	GigE, IB and Quadrics
HP Cluster Platform Express	Single rack implementations of CP3000/CP3000BL and CP4000/CP4000BL	GigE, IB

HP-MPI – *A success story!*

ABAQUS · accelrys *(A subsidiary of Pharmacopeia Inc.)* · ACUSIM SOFTWARE · A D I N A · ADVC

Altair Engineering · ANSYS · AVL · CD-adapco · COSMOlogic *(Turbomole)* · ESI GROUP *(THE VIRTUAL TRY-OUT SPACE COMPANY)*

Exa CORPORATION · FLUENT INCORPORATED · LSTC Livermore Software Technology Corp. · madymo · MAGMA · Metacomp Technologies

Molpro
University of Cardiff

MSC Software · PARALLEL GEOSCIENCE · R/A · RICARDO · roxar *(MAXIMUM RESERVOIR PERFORMANCE)*

SCM Scientific Computing & Modelling · UGS The PLM Company · THE UNIVERSITY OF TEXAS AT AUSTIN *(AMLS)*

"One of the top reasons that we went with HP-MPI is that we've had a great working relationship with HP. It was a win-win for ANSYS, HP and our customers - in terms of cost, interconnects, support and performance compared to other message passing interfaces for Linux and Unix. In addition, I've always had great turnaround from HP in response to hardware and software issues."
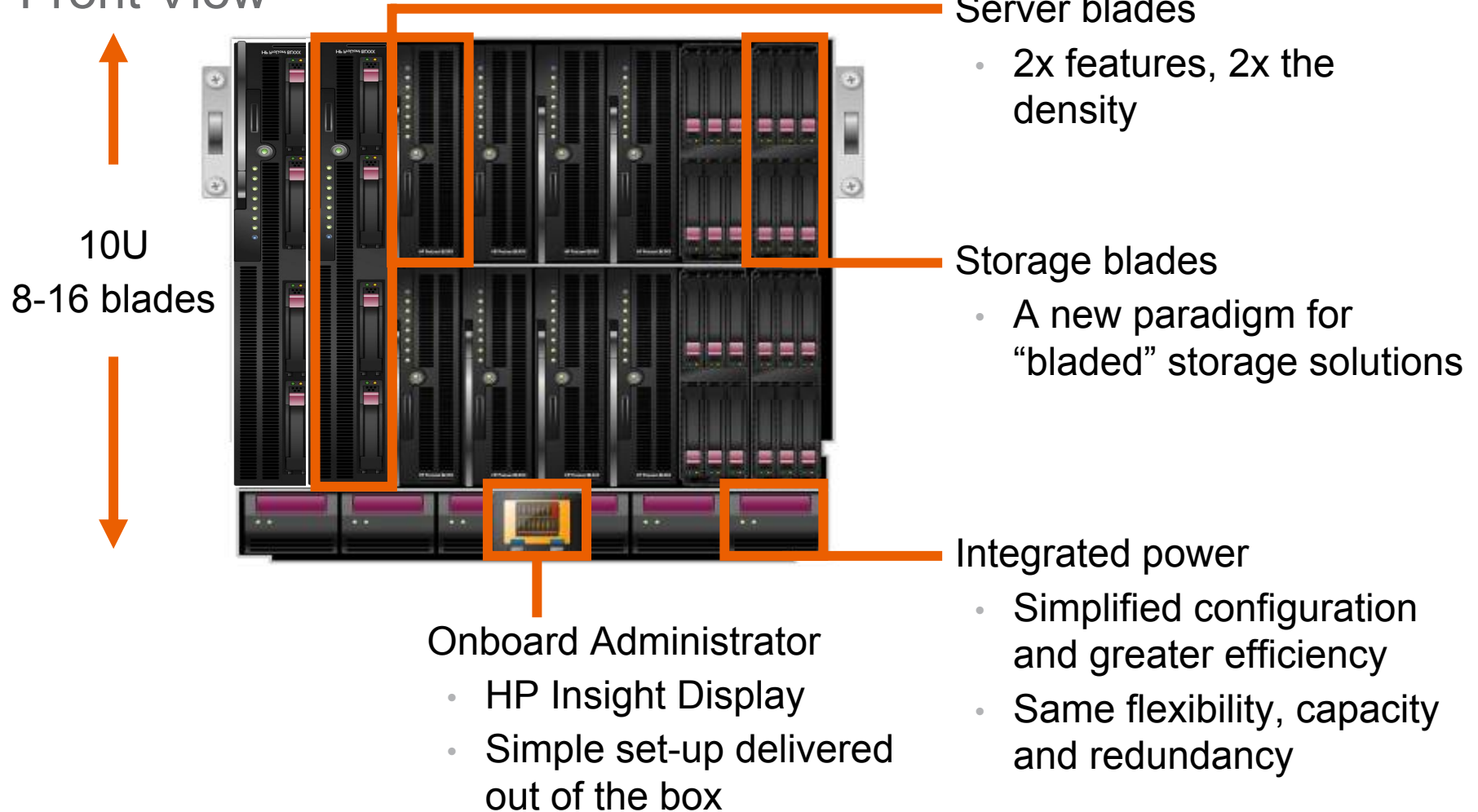Lisa Fordanich, Senior Systems Specialist, ANSYS **www.ansys.com/services/ss-interconnects.htm**

"HP-MPI is an absolute godsend," notes Keith Glassford, director of the Materials Science division at San Diego, CA-based *Accelrys Software Inc. "It allows us to focus our energy and resources on doing what we're good at, which is developing scientific and engineering software to solve customer problems."*

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HP cClass BladeSystem c7000 Enclosure

Front View

10U
8-16 blades

Server blades
- 2x features, 2x the density

Storage blades
- A new paradigm for "bladed" storage solutions

Integrated power
- Simplified configuration and greater efficiency
- Same flexibility, capacity and redundancy

Onboard Administrator
- HP Insight Display
- Simple set-up delivered out of the box

c7000 Enclosure

Rear View

Active Cool fans

- Adaptive flow for maximum power efficiency, air movement & acoustics, redundant

Interconnect bays

- 8 bays; up to 4 redundant I/O fabrics
- Up to 94% reduction in cables
- Ethernet, Fibre Channel, InfiniBand

Onboard Administrator

- Remote administration view
- Robust, multi-enclosure control
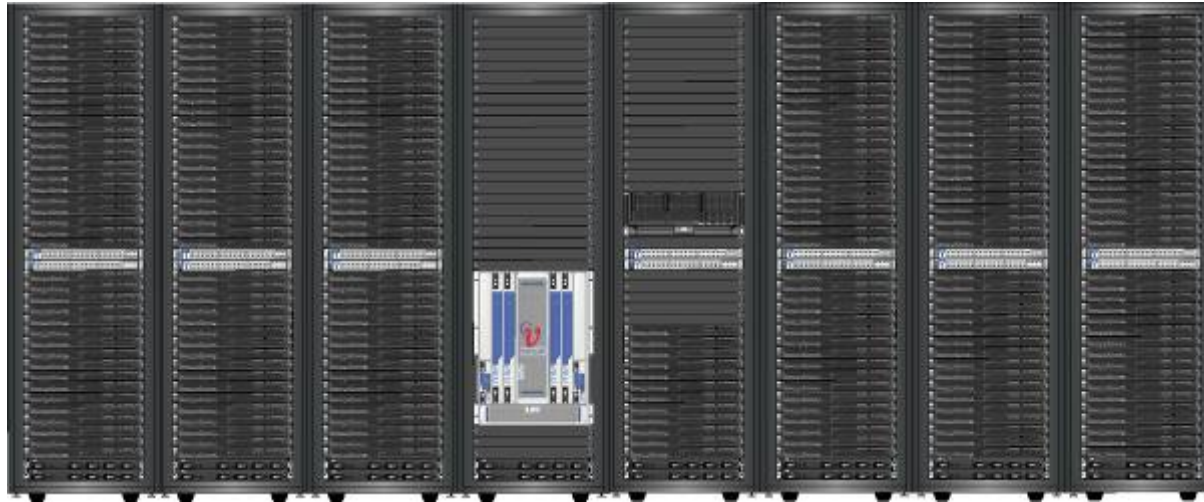- Redundant active/passive, enclosure will run even both OA fail

Power management

- Choice of single-phase or three-phase enclosures
- AC redundant mode or power supply redundant mode
- Best performance per watt

PARSEC architecture

- Parallel, redundant and scalable cooling and airflow design

From rack-mount to blade

Example configuration:

256-node cluster

w/ InfiniBand

HP cClass BladeSystem

Power: *32% saving*

Floor space: from *8 racks to 5 racks*

Network cables: *up to 78% less*
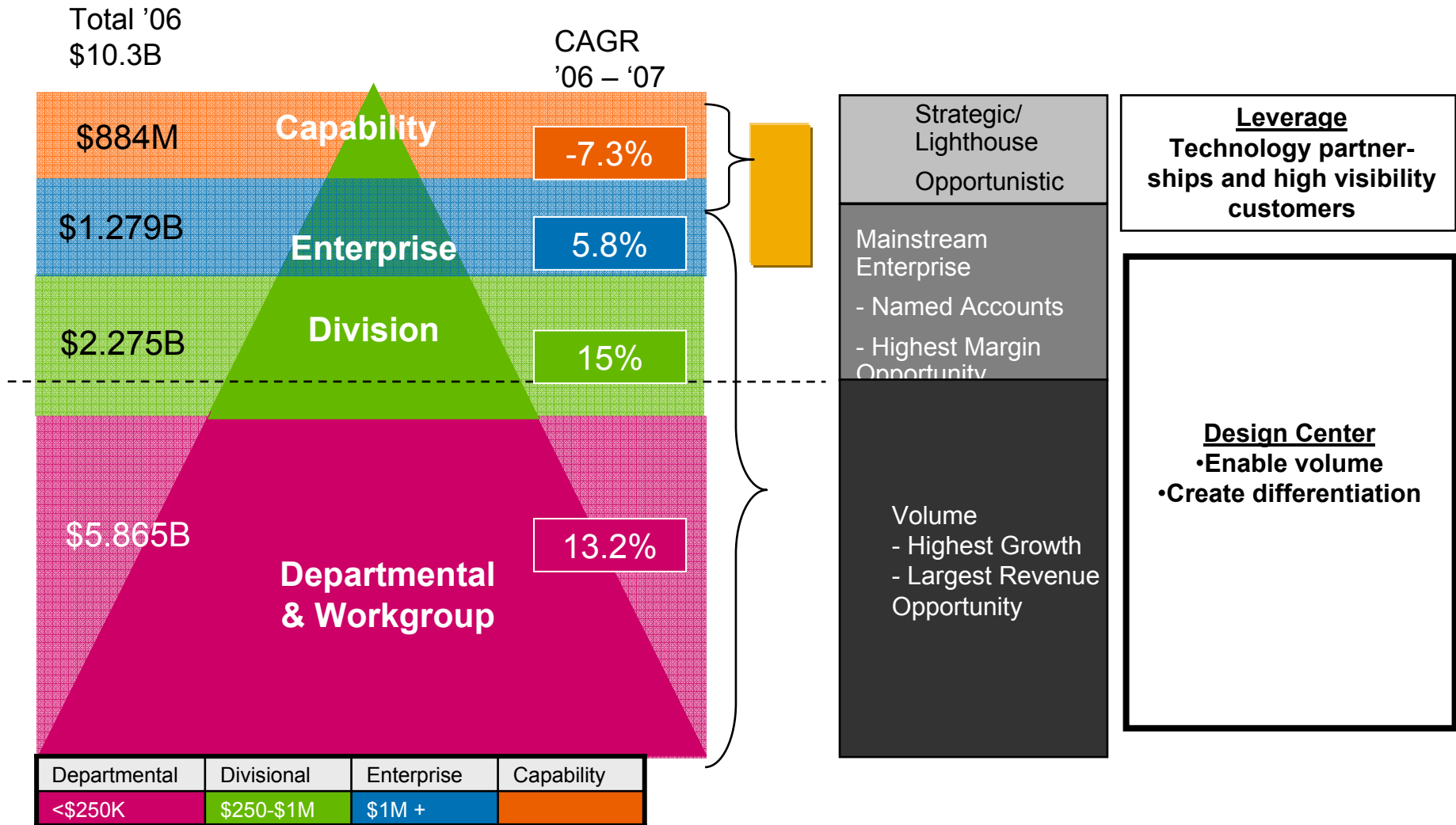
And excellent manageability!

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Operating System and Cluster Management Choice

- Linux, Microsoft Windows or HP-UX
  - Select what's right for your environment

- Linux cluster management
  - Range of options from basic tool to full turnkey solution

- HP-UX
  - Cluster Pack: all you need for HP-UX on an HPC cluster

- Windows CCS
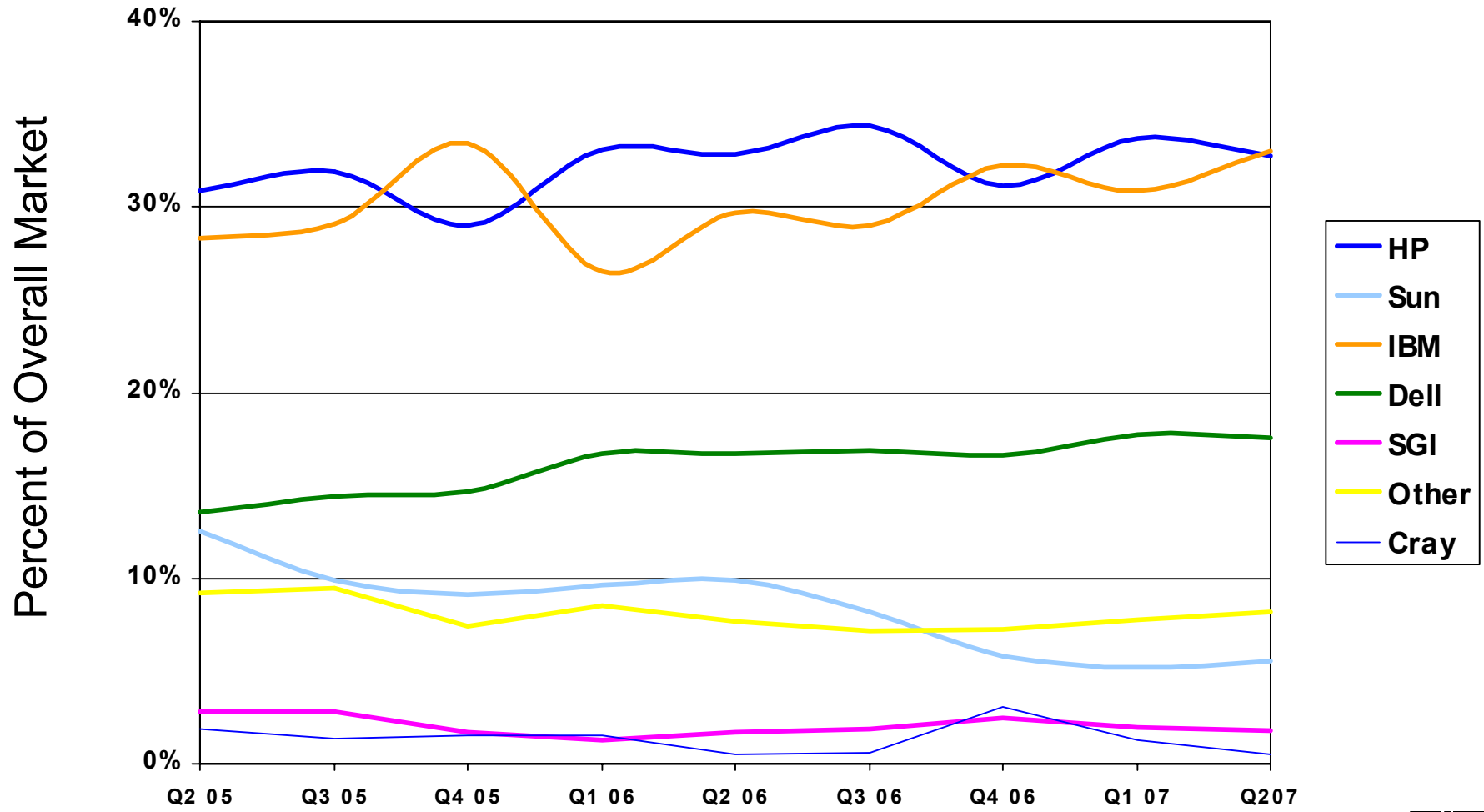 - Brings HPC cluster capabilities to the non-Linux world

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HP Services available for UCP

- Cluster solutions are rack integrated at the factory
- On-site
  - Rack installation by HP technicians
  - Set-up and startup service from C&I
- Standard product support and warranties
- Optional services include:
  - Cluster integration management
  - Cluster system quickstart
  - Cluster applications quickstart
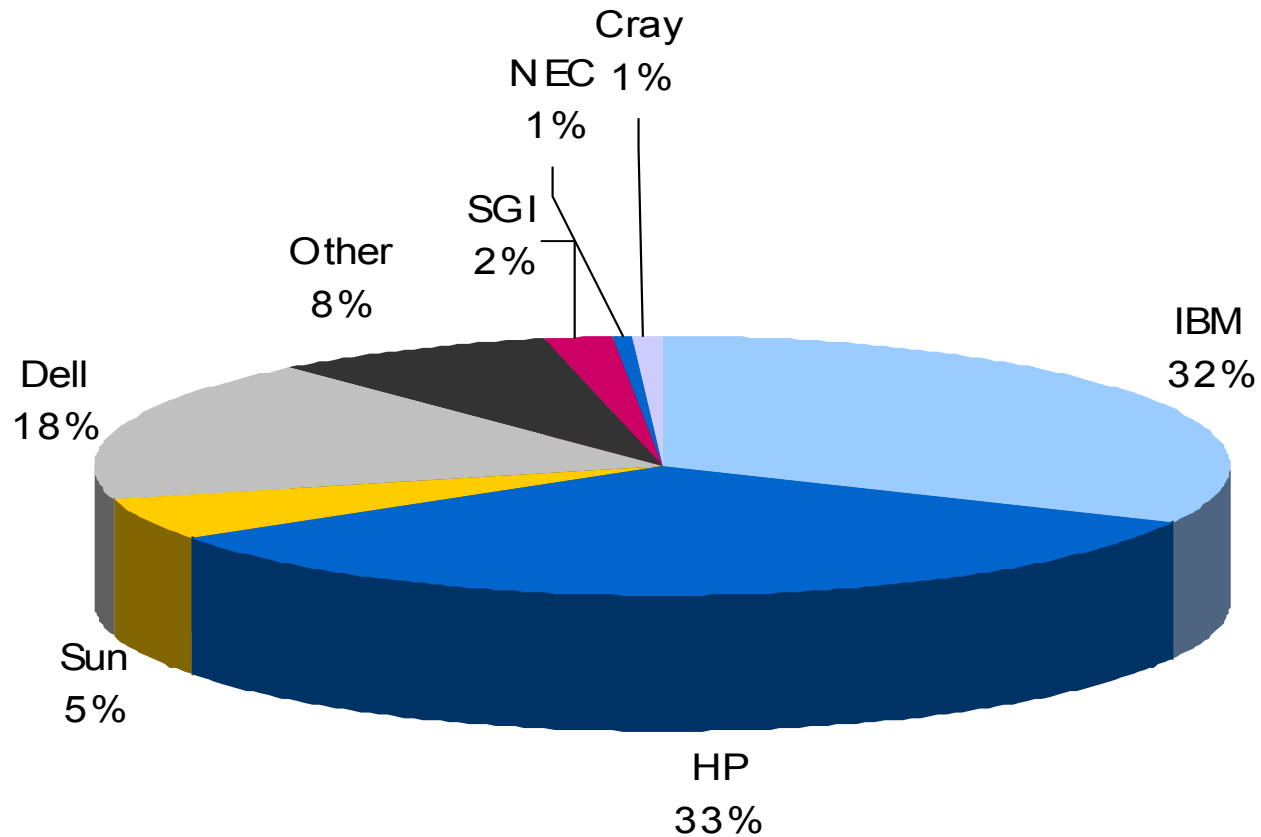 - Training

HPCD Market Segment Approach

Total '06
$10.3B

CAGR '06 – '07

	Capability	-7.3%
$884M		
$1.279B	Enterprise	5.8%
$2.275B	Division	15%
$5.865B	Departmental & Workgroup	13.2%

Departmental	Divisional	Enterprise	Capability
<$250K	$250-$1M	$1M +	

Strategic/ Lighthouse

Opportunistic

Mainstream Enterprise
- Named Accounts
- Highest Margin Opportunity

Volume
- Highest Growth
- Largest Revenue Opportunity

Leverage
Technology partner-ships and high visibility customers

Design Center
•Enable volume
•Create differentiation

Source: IDC WW Technical Computing Systems 2006-2010 Forecast Doc# 201733

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IDC HPC marketshare trends – Overall (%)

Percent of Overall Market

Legend:
- HP
- Sun
- IBM
- Dell
- SGI
- Other
- Cray

X-axis: Q2 05, Q3 05, Q4 05, Q1 06, Q2 06, Q3 06, Q4 06, Q1 07, Q207

Y-axis: 0%, 10%, 20%, 30%, 40%

30

HP Market Leadership

HPC IDC H1 CY2007 Revenue Share

Cray 1%
NEC 1%
SGI 2%
Other 8%
Dell 18%
Sun 5%
IBM 32%
HP 33%

WW HPC Revenue H1 CY07

IDC server classes:
workgroup   <50k$
departmental   50k$ - 250K$
divisional   250K$ - 1M$
enterprise   >1M$ industry
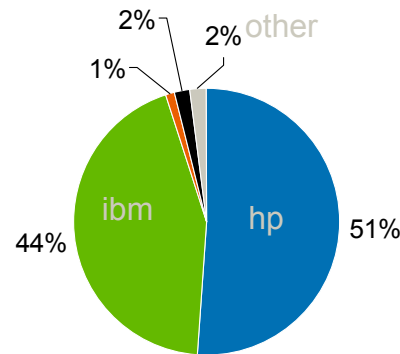capability   >1M$ supers
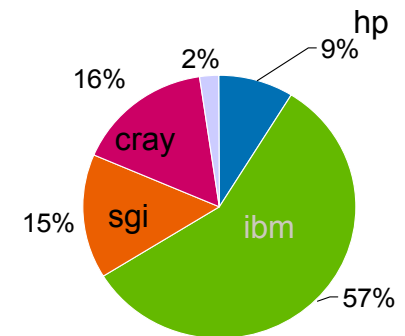
Total Market Size

H1 CY07 $5,442M

YoY Growth 15.1%

cray 1%
dell 18%
1%
hp 33%
other 3%
sgi 2%
sun 5%
ibm 32%

Departmental / Workgroup
hp 30%
10%
dell 25%
ibm 25%
sun 9%
1%

divisional
1%
3%
7%
dell 10%
hp 38%
3%
ibm 39%

enterprise
2%
2% other
1%
ibm 44%
hp 51%

capability
hp 9%
2%
16%
cray
sgi 15%
ibm 57%

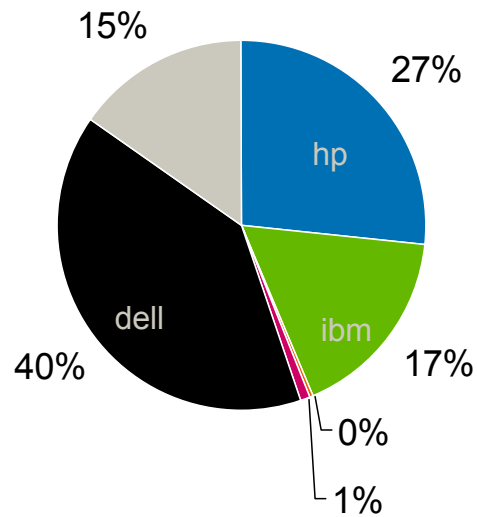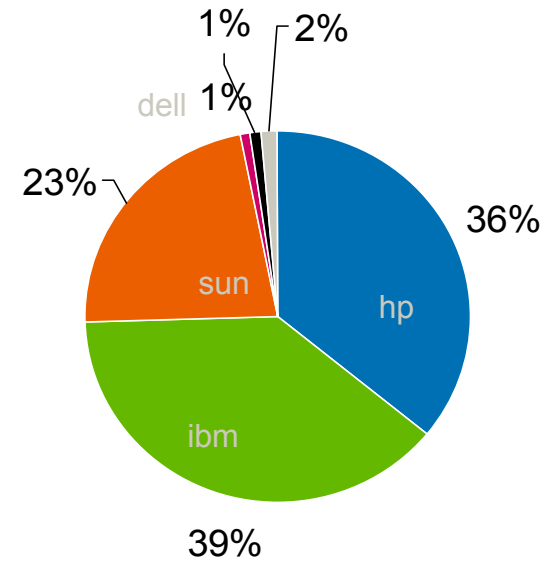# WW HPC Revenue H1 CY07

Departmental

workgroup

IDC server classes:
workgroup   <50k$
departmental   50k$ - 250K$
divisional   250K$ - 1M$
enterprise   >1M$ industry
capability   >1M$ supers

IDC
Analyze the Future

33

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Cluster Market Share

Total Vendor HPC Cluster Revenue H1 2007 by IDC Segment

2007 H1 IDC Cluster by Revenue

Other 13%
Dell 28%
IBM 28%
HP 30%

Workgroup Departmental Divisional Enterprise Capability
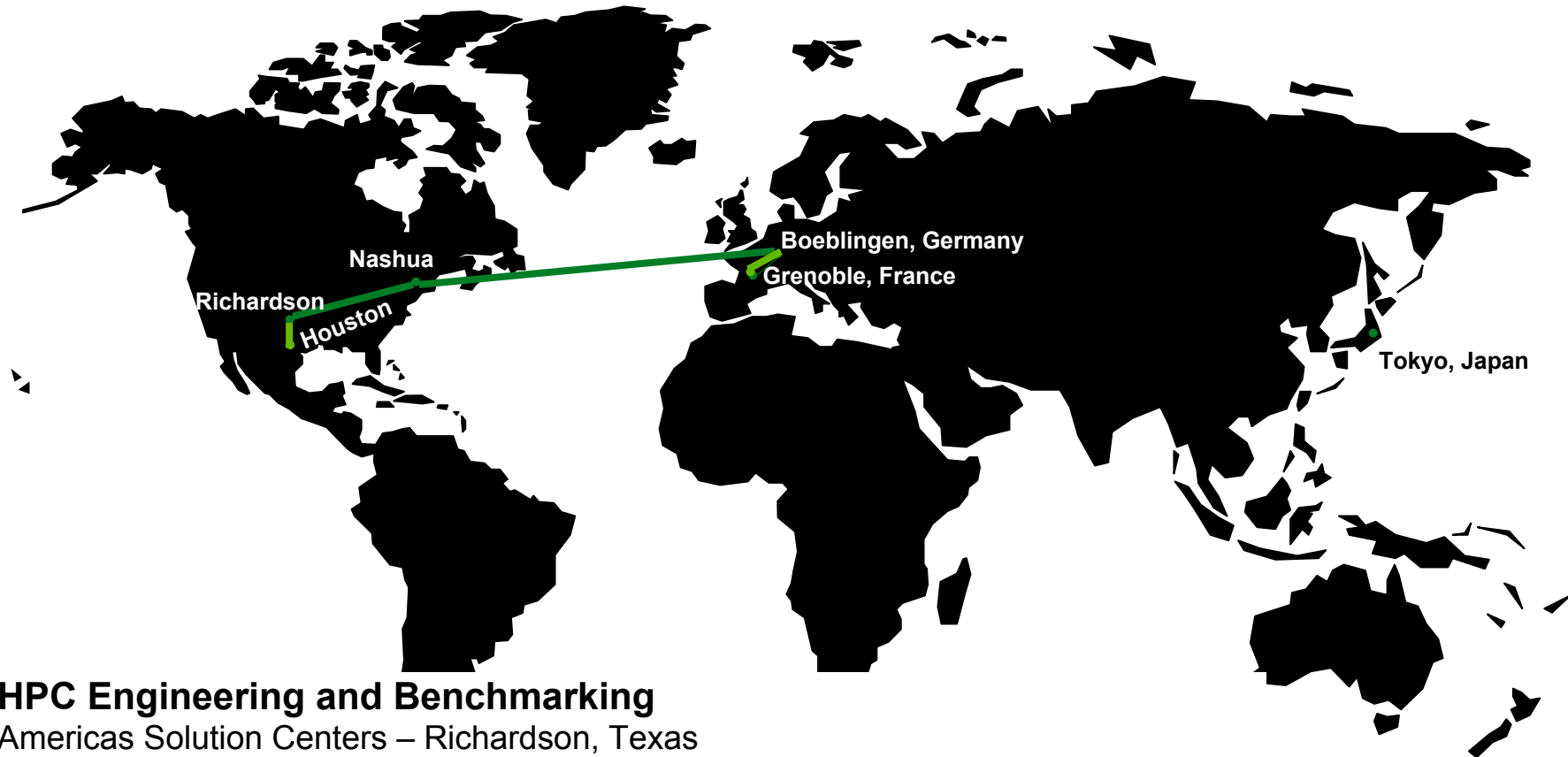
HP Dell IBM

Application Performance
This data is brought to you by the HPC in-house grid

HPCD Sites
- Richardson, Texas
- Nashua, New Hampshire

ISS Site
- ISS-HPC – Houston, Texas

Nashua

Richardson
Houston

Boeblingen, Germany
Grenoble, France

Tokyo, Japan
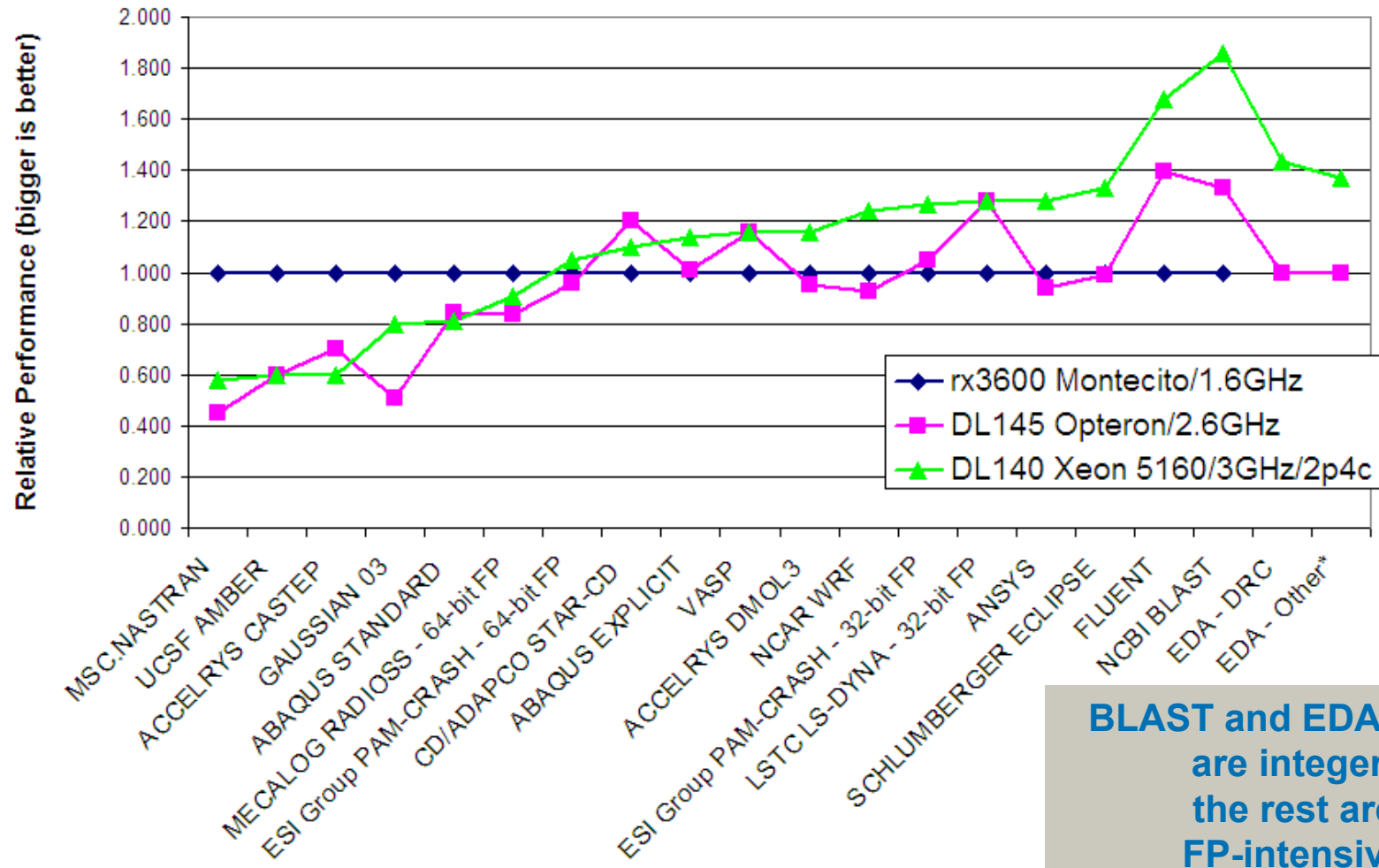
HPC Engineering and Benchmarking

Americas Solution Centers – Richardson, Texas
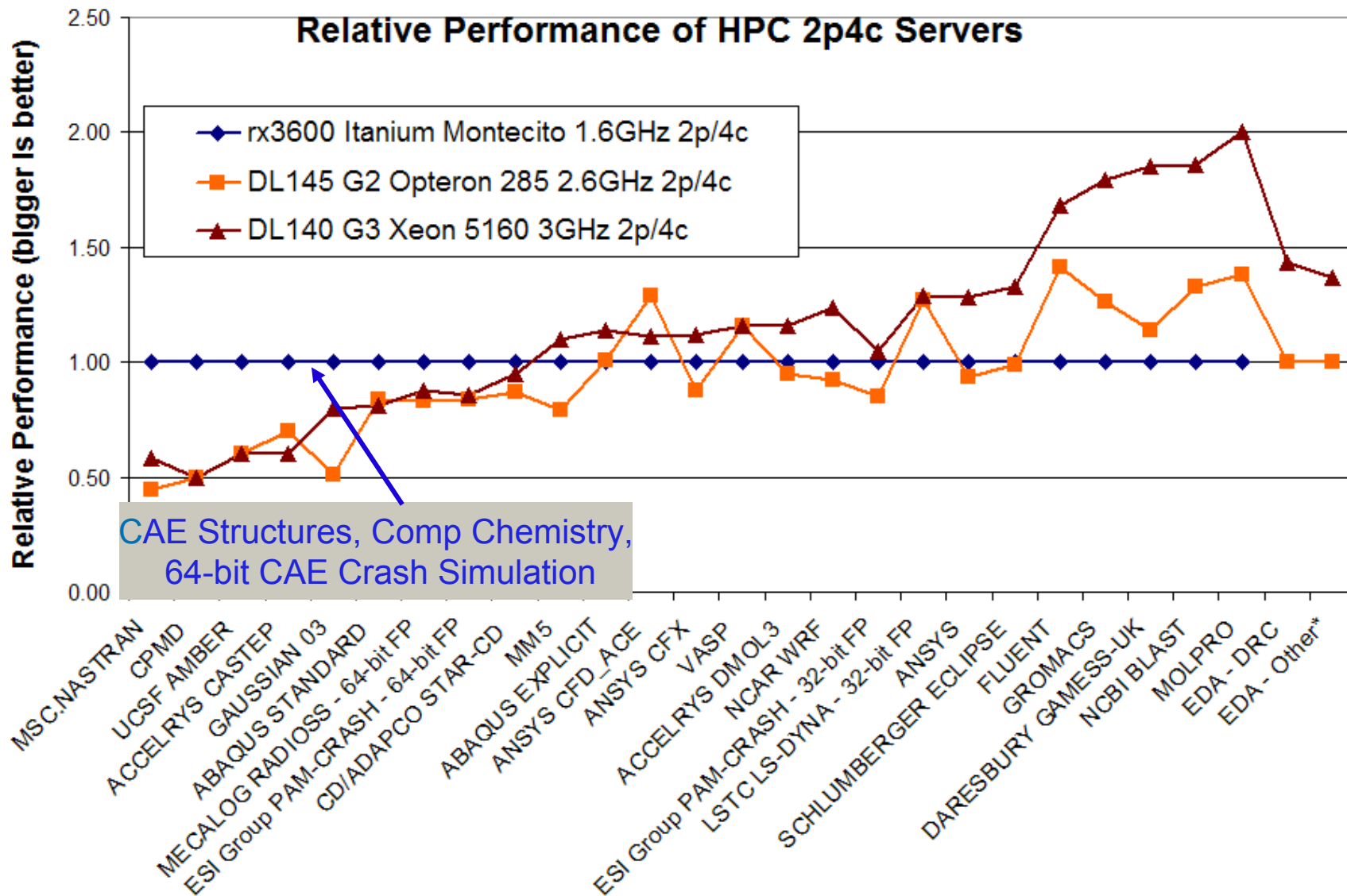
EMEA HPTC and Linux Competence Center – Grenoble, France

EMEA Performance Center – Boeblingen, Germany

Core for Core Performance Comparison

Relative Performance of HPC Servers

BLAST and EDA codes are integer; the rest are FP-intensive
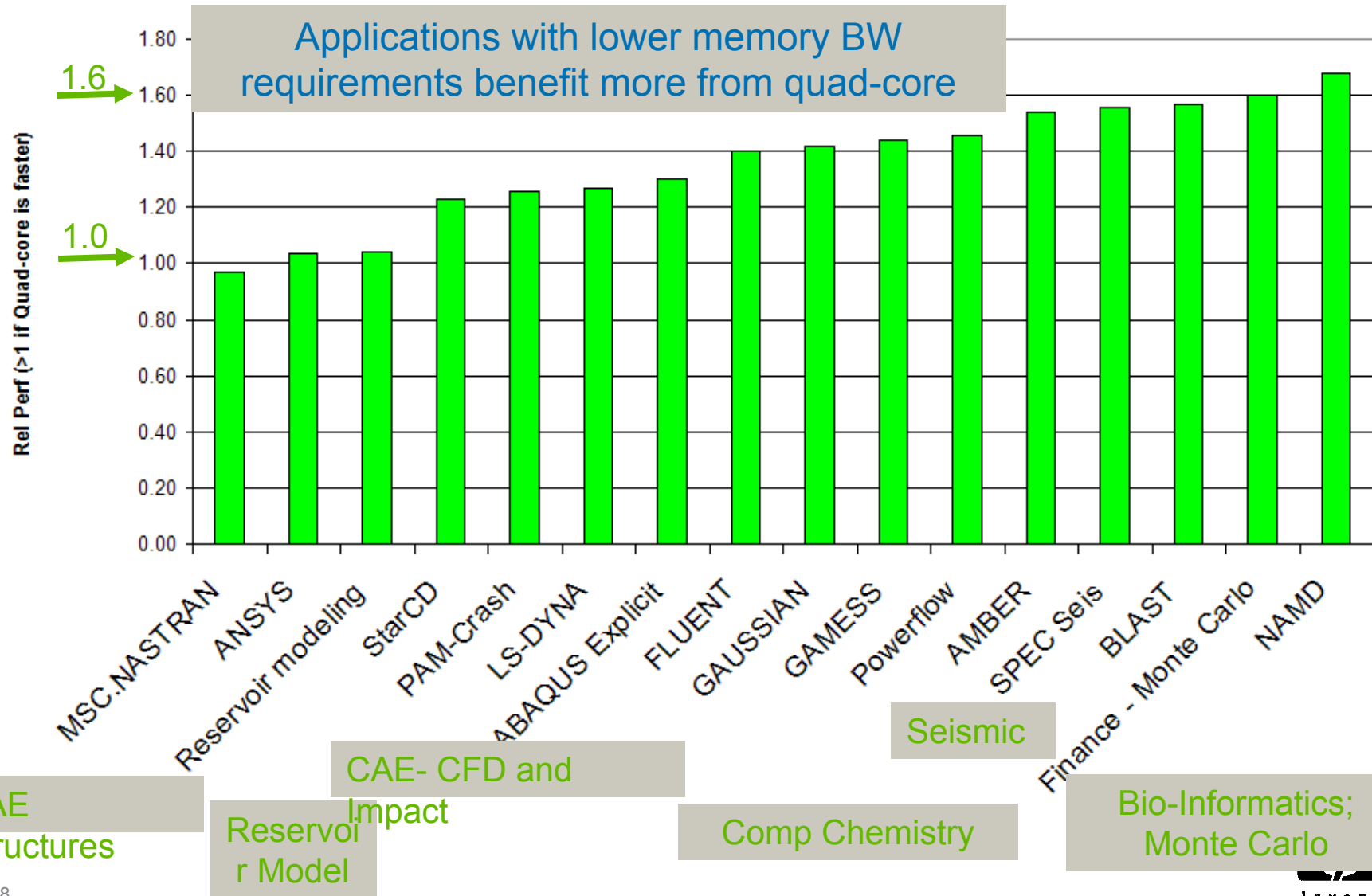
•Other EDA: simulation, verification, synthesis, physical design

•Other EDA: simulation, verification, synthesis, physical design

RELATIVE PERFORMANCE -- Per Xeon PROCESSOR
Quad-core Xeon 5355/2.66GHz vs. Dual-core Xeon 5160/3.0GHz

Applications with lower memory BW requirements benefit more from quad-core

Some recent HP customer examples

- CSC Finland: 11 TFLOPS CP4000, 512 BL465c, IB, XC, MCS, 100 TB SFS

- KIT Germany: 16 TFLOPS CP4000, 750 DL145, IB, XC, MCS, 56 TB SFS

- NSC Sweden: 60 TFLOPS CP3000, 805 DL140, IB

- University of Tromsø, Norway: 60 TFLOPS CP3000, 704 BL460c, MCS

- PNNL USA 163 TFLOPS

- Project Ellen: 182 TFLOPS, 2128 BL460c

HP HPC Momentum in EMEA
September 2007

HP's **TOP10 HPC** customers in EMEA

- deploy more than **12,000** cluster nodes,

- delivering a total of more than **840** peak TFLOPS

- **70%** of the nodes and **80%** of the performance are based on c-class blades.

Note 1: Several of these customer installations are not available as a reference.

Note 2: Some customers deploy more than one system.

Note 3: Installation of some of these systems has not been completed yet.

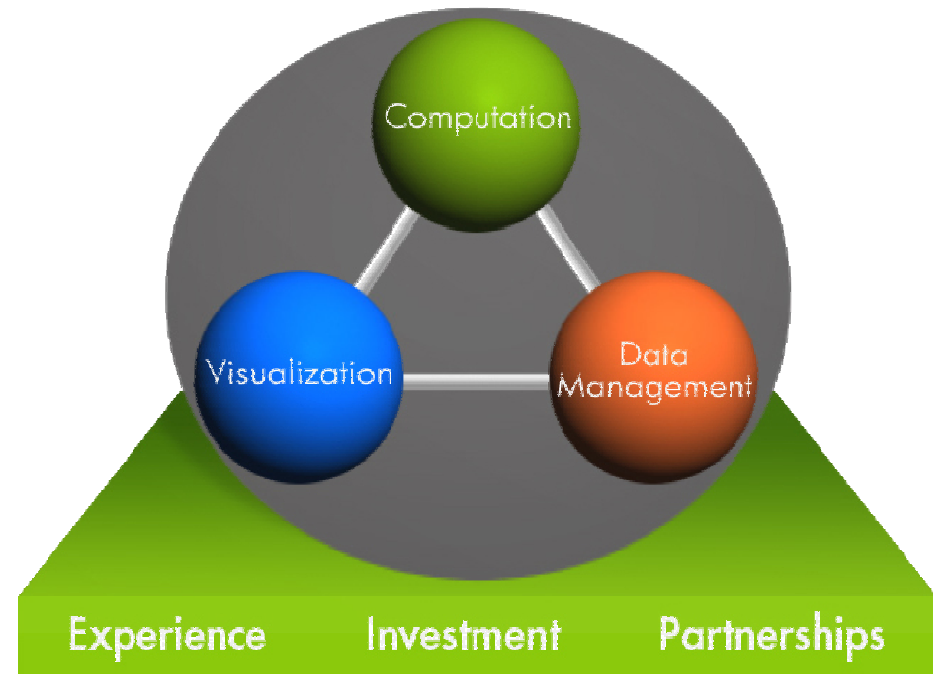# The future: HP catalysts for HPC innovation

- Accelerators

- Converged fabrics

- Grid

- Multi-core

- Parallel compositing

- Collaborative file caching

- Dense computing
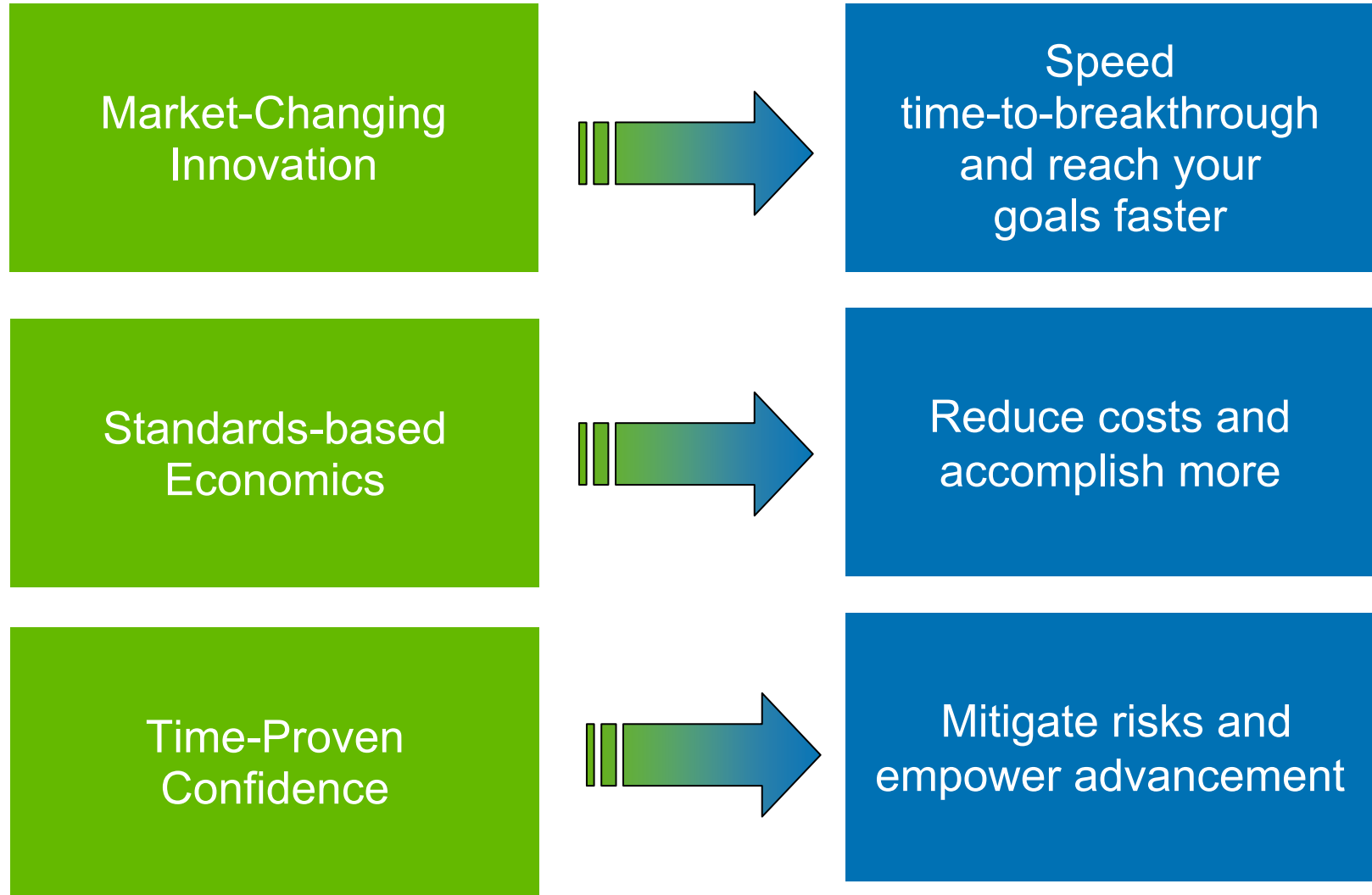
HP Multi-Core Optimization Program

- More processor cores vs more core performance

- Standards-based, collaborative initiative

- Broad set of technology leaders
  - HP: balanced systems (DL14x), HP-MPI, XC/SLURM
  - Academic Partners: Karlsruhe Institute of Technology, Stanford Pervasive Parallelism Lab
  - Technology partners: AMD, Intel, TotalView Technologies
  - Application partners: Accelrys

- Focused advanced development activities

Advancing innovation and high productivity computing

- ## Market-changing innovation
  - Leading solutions that bring HPC advantages into the mainstream
- ## Standards-based economies
  - Simplified and standardized choices making HPC more affordable
- ## Time-proven confidence
  - Expertise, integration and reliability you can count on to speed success

HP is advancing innovation for high performance computing

Market-Changing Innovation	→	**Speed time-to-breakthrough and reach your goals faster**
Standards-based Economics	→	**Reduce costs and accomplish more**
Time-Proven Confidence	→	**Mitigate risks and empower advancement**