Axceleon Enfuzion for LC Series

Session 3279

Dan Cox

Manager – ISS HPTC Programs
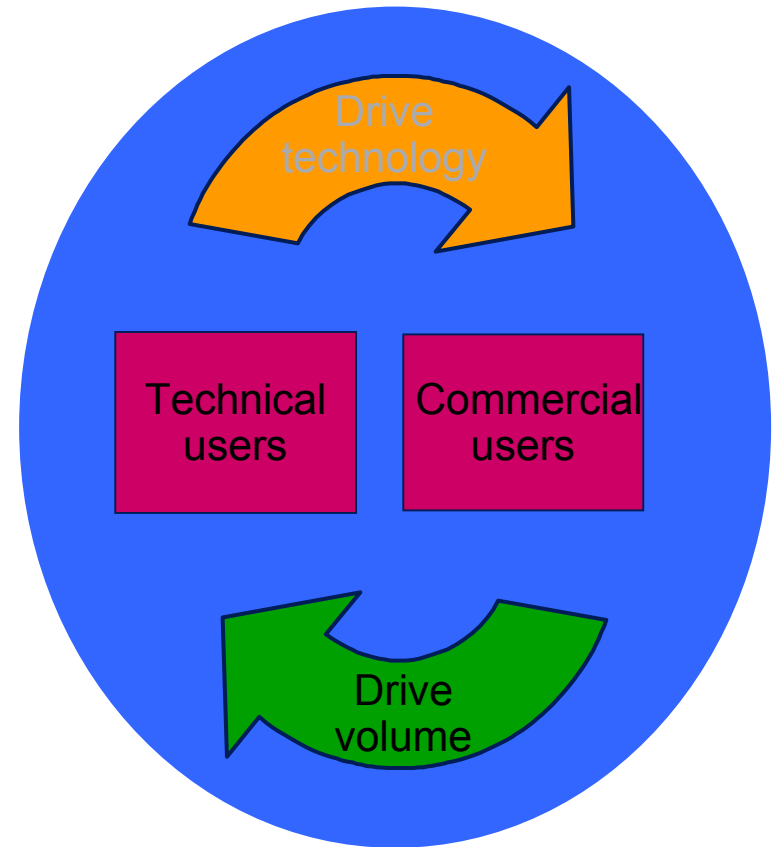Hewlett-Packard

Axceleon Enfuzion for LC Series – Topics

* HP HPTC Portfolio and LC Series Partner Driven Software Solutions
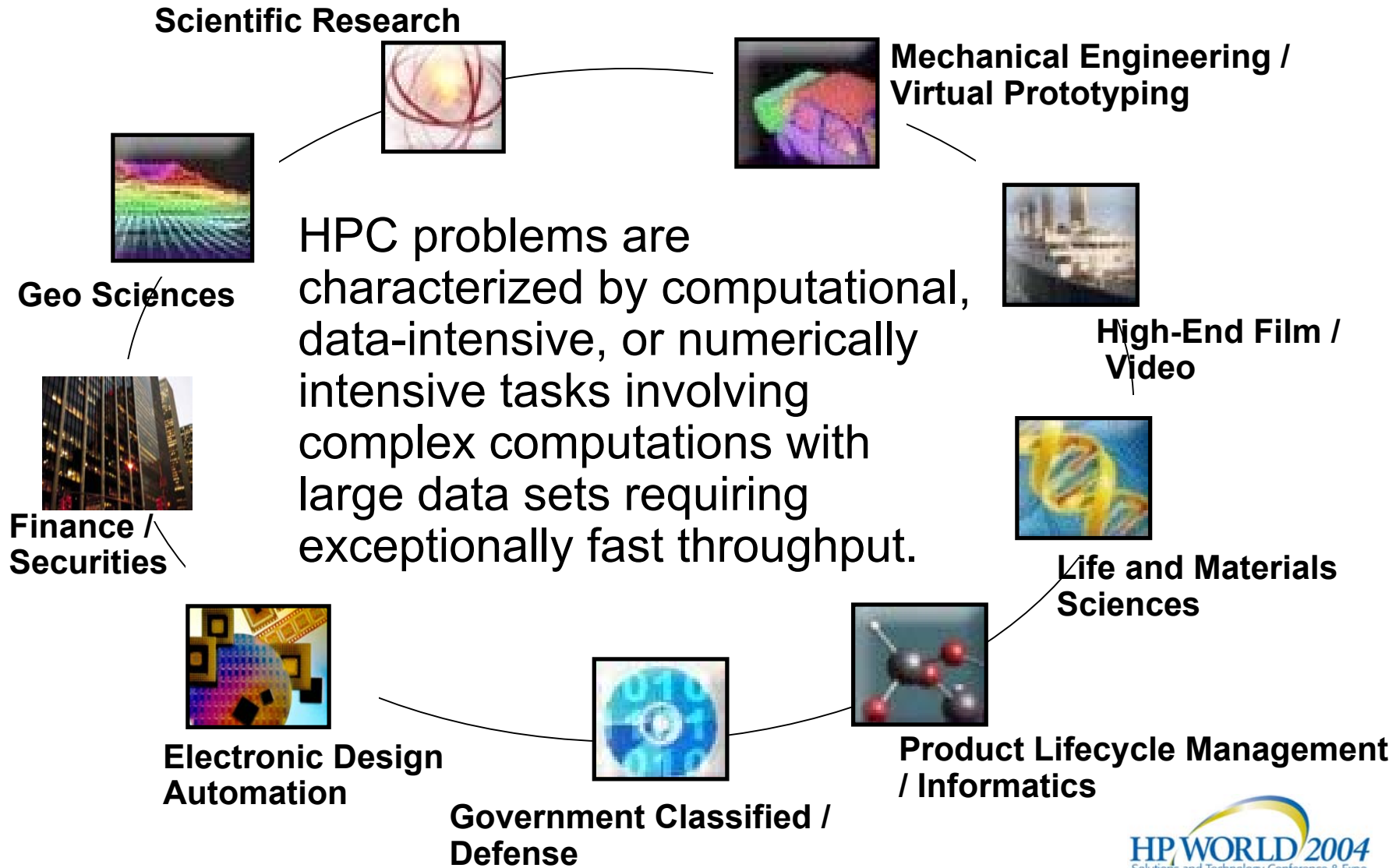
* Enfuzion Overview

* Q&A's

HPTC and new technologies at HP

"High performance technical computing is a strategic focus for HP. It is here that new computing paradigms are created and the applications they enable become early indicators of the general commercial applications that will follow."

Carly Fiorina
Chairman and CEO, HP

Drive technology

Technical users

Commercial users

Drive volume

HPC @ HP

Scientific Research

Mechanical Engineering / Virtual Prototyping

Geo Sciences

HPC problems are characterized by computational, data-intensive, or numerically intensive tasks involving complex computations with large data sets requiring exceptionally fast throughput.

High-End Film / Video

Finance / Securities

Life and Materials Sciences

Electronic Design Automation

Government Classified / Defense

Product Lifecycle Management / Informatics

HP's HPC Platforms

XC6000 HPTC cluster

XC3000 HPTC cluster

LC Series 3000 HPTC cluster

LC Series 1000/2000 HPTC clusters

HP Integrity Superdome

HP Integrity rx8620

HP Integrity rx7620

HP Integrity rx4640

HP Integrity rx2600

HP Integrity rx1600

HP ProLiant DL585

HP ProLiant BL20p/BL30p

HP ProLiant DL360/DL380

HP ProLiant DL140/DL145
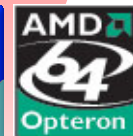
HP's HPC Software Architecture Portfolio

Scalable Cluster Services

HPTC Application and Development/Grid Portfolio

HP Scalable File Share

HP Scalable Visualization

Scalable Cluster Management

Partner software

Partner SW

XC Cluster SW

ClusterPack

Common Operating Environments

Windows

Linux

HP-UX

HPTC Cluster Platforms ProLiant & Integrity/Multiple Interconnects

Common products available for multiple OS (OS specific implementation)

Linux   HP-UX   Windows
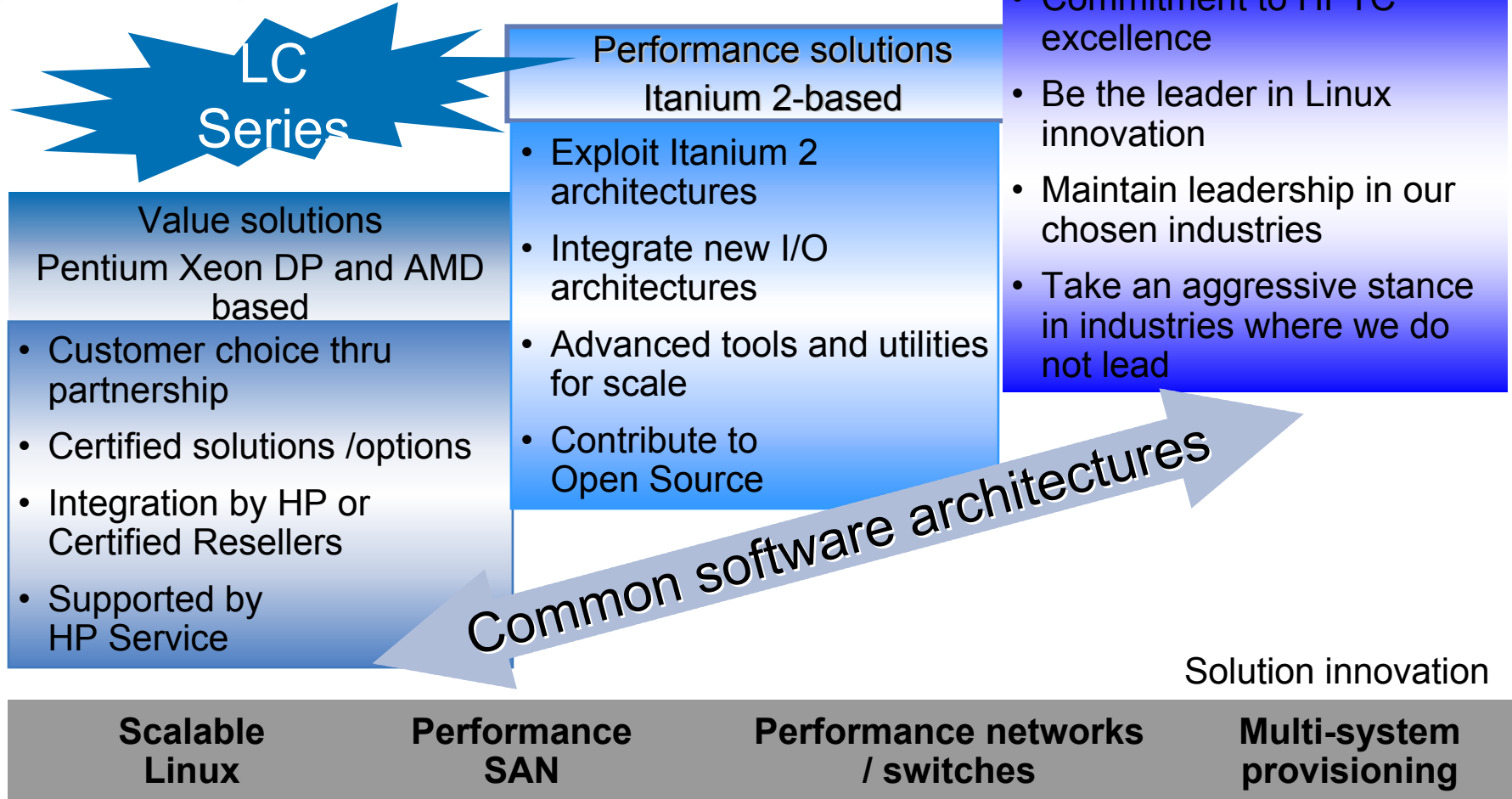
HP's HPC solution strategy –

- Goal:
  - Deliver complete turn-key integrated solutions that are designed specifically for customer needs
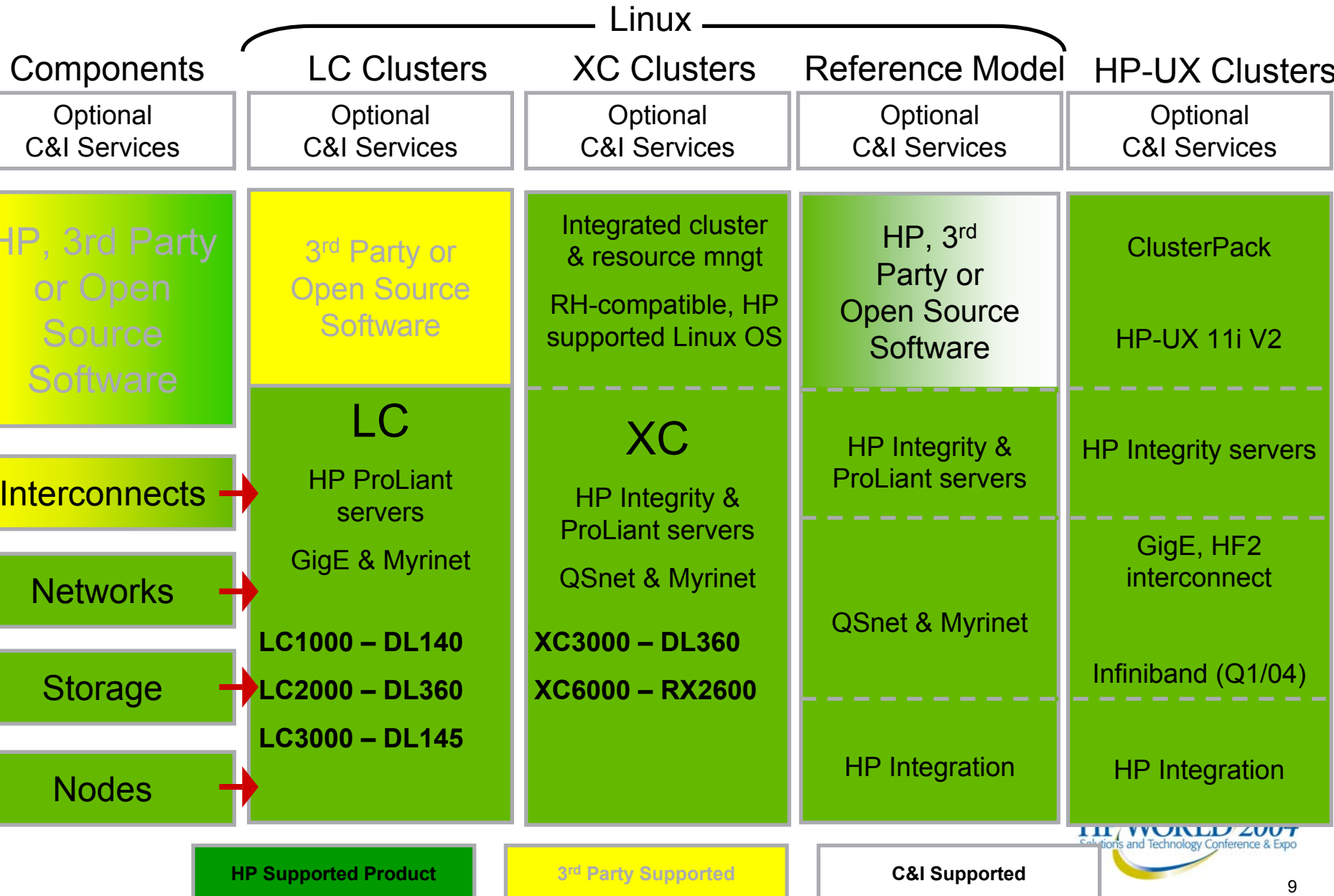
- Challenge:
  - The key is tight linkages with application partners and a process for design, build, delivery, and support
    - Application codes are complex to integrate as hardware components, maybe more so!
    - Software partners and hardware companies have not been taking ownership for this!
  - A viable production cluster solution requires a unique set of skills and products only available through a partnership with leaders in their respective fields and Professional Services trained and aware of HP solutions and alternatives

HP's HPC product delivery

Deliver unprecedented capabilities through pervasive technologies and partnerships

LC Series

Value solutions
Pentium Xeon DP and AMD based

- Customer choice thru partnership
- Certified solutions /options
- Integration by HP or Certified Resellers
- Supported by HP Service

Performance solutions
Itanium 2-based

- Exploit Itanium 2 architectures
- Integrate new I/O architectures
- Advanced tools and utilities for scale
- Contribute to Open Source

Specialty solutions

- Commitment to HPTC excellence
- Be the leader in Linux innovation
- Maintain leadership in our chosen industries
- Take an aggressive stance in industries where we do not lead

Common software architectures

Solution innovation

Scalable Linux	Performance SAN	Performance networks / switches	Multi-system provisioning

HP's High Performance Cluster Choices

	Linux			
Components	**LC Clusters**	**XC Clusters**	**Reference Model**	**HP-UX Clusters**
Optional C&I Services	Optional C&I Services	Optional C&I Services	Optional C&I Services	Optional C&I Services
HP, 3rd Party or Open Source Software	3rd Party or Open Source Software	Integrated cluster & resource mngt RH-compatible, HP supported Linux OS	HP, 3rd Party or Open Source Software	ClusterPack HP-UX 11i V2
Interconnects →	**LC** HP ProLiant servers GigE & Myrinet **LC1000 – DL140**	**XC** HP Integrity & ProLiant servers QSnet & Myrinet **XC3000 – DL360**	HP Integrity & ProLiant servers QSnet & Myrinet	HP Integrity servers GigE, HF2 interconnect
Networks →				
Storage →	**LC2000 – DL360** **LC3000 – DL145**	**XC6000 – RX2600**		Infiniband (Q1/04)
Nodes →			HP Integration	HP Integration

HP Supported Product	3rd Party Supported	C&I Supported

LC Series Overview

- LC for 'loosely coupled'
- Three new orderable 32-node SKU solutions
  - LC1000 Series — ProLiant DL380 Control node and 32 ProLiant DL140 Compute nodes
  - LC2000 Series — ProLiant DL380 Control node and 32 ProLiant DL360 Compute nodes
  - LC3000 Series — ProLiant DL380 Control node and 32 ProLiant DL145 Compute nodes
- Common Packaging for ease of ordering, manufacturing and support
  - Out of Band unique due each platform device, IMPI 1.0, 1.5, and iLO

– Optional software from HP and ISV partners
  - Linux and Windows 2003 HPC
  - Checkpoint Restart
  - HPTC Cluster and GRID Mgmt
  - Development ToolKits
  - Job Management

– Optional Storage Bundles for NFS and GFS Storage support
  - Red hat Sistina
  - PolyServe Matrix Server

– Factory integrated and tested in Houston and Erskine

– Complete suite of service and services offerings

HP LC Series Family Overview
LC Series Design and Configuration Guide

Reference Models for flexibility:

- ✓ Any server model (2.8, 3.06, 3.2…)
- ✓ Any compute node count up to 128
- ✓ More than one control node
- ✓ Storage options
- ✓ Change switch types/size
- ✓ Modified cabling
- ✓ Customized software installs
- ✓ Component location changes

Reference Models require:

- ✓ Purchase of the Configuration Resource Kit
- ✓ Factory presets of servers and switches
- ✓ Cabling consistent with the LC cluster specification
- ✓ Use of components certified for use in LC clusters
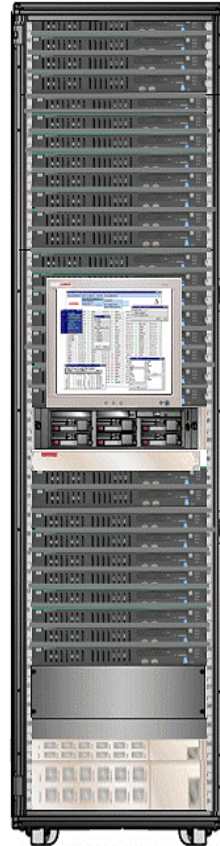
Reference Model Benefits:

- ❖ Speed flexibility
- ❖ 8 to128 node reference design
- ❖ Supports HA Control Node
- ❖ NFS to 48TB GFS options
- ❖ Flexibility and choice
- ❖ Meet specific site need
- ❖ Add infrastructure products
- ❖ Meet specific site need

Reference Model benefits:

- ❖ Fully documented configuration for ease of growth or service
- ❖ Geared to application performance
- ❖ Ease of growth for scale out and serviceability
- ❖ Ease of serviceability and scale out

Over 180 Tested Configuration Options

LC Series Partner Driven Software Portfolio

Applications	Bioscience, Engineering, GeoScience, etc
GRID Mgmt	Axceleon , United Devices
HPTC	Scali
Cluster Reliability	Meiosys– Checkpoint Restart
Job Management	Altair
Development	Engineered Intelligence
Data Mgmt	Red Hat Sistina, PolyServe
Operating System	Red Hat / SUSE Linux, Windows

Certified Partner Based Solutions - Linux

- Multiple Linux cluster management choices allow customers to find the 'best fit' based on
  - experience with Linux and open source
  - on-site capabilities
  - ISV application focus
  - ISV support for target hardware
- Service programs in place, or in roll-out, for these partners
- Available as integrated solutions from each region

Certified Partner Based Solutions - Windows

- Microsoft support is beginning thru Microsoft and limited partner approaches
- Multiple application choices can be adapted to Windows 2003 Server High Performance Computing Edition
  - Special Windows 2003 HPC pricing for Compute Nodes
- Partner solutions based on end user needs that HP is partnering with
  - Utilities
  - Bio Life and Materials Science
  - Financial Services Modeling

" HP is the unchallenged leader in delivering HPC solutions and provides the most competitive breadth of Linux and Windows cluster solutions offered. LC Series clusters are available to meet just about any customers' needs. They are configured, tested, and shipped ready to run out of the box. No special ordering process is required, regardless of the node architecture."

Robert de Sautel

Principal, Harvard Research Group

Harvard Research Group, Inc.
P.O. Box 297
Harvard, MA 01451 - 0297 USA
 Tel. (978) 263-3399

Axcelon Enfuzion Overview

Customer Needs

- Need for real time analysis (financial)
- Need to shorten time to market (manufacturing)
- Time pressure, deliver fast (digital media)
- Need to have high work quality (energy)
- Need for parametric studies (government, R&D)
- Need for enormous managed compute power (life sciences)
- Increased/optimized resource use (all)

Customer Business Challenges

- Most job scheduling (JS) solutions do not work well in Heterogeneous environments.

  - Tuned usually to single System/Cluster

- Current JS solutions can be expensive

- Current JS solutions can be hard to deploy and maintain, concerns about cost

- Current JS solutions can lack features and are not optimized for parametric execution

- Ease of use very, very, very important

- Need for automation of "run-submission" process

What is EnFuzion?

- An Enterprise Resource Manager™ that combines HP Clusters and Servers and creates an affordable supercomputer, allowing users to do more
- Simplifies job generation, eases the task of distributing applications across many servers
- Enables faster execution through distribution of jobs
- Reduces complexity of distributed computing involving many machines in heterogeneous environments
- Maximizes utilization of compute resources with minimum user involvement
- Manages files, machines and network, freeing users to do problem solving

EnFuzion History

- Nov'93 – The first Linux Beowulf Cluster?
  - Griffith University, Brisbane, Australia

- Mature, field-proven software since 1996
  - 1996 - Deployed in life sciences
  - 1997 - First commercial release
  - 1998 - Deployed in engineering
    - analysis
  - 1999 - First technology of this type on Wall Street
  - 2002 - Acquired by Axceleon
  - 2003 - EnFuzion 8.0 released
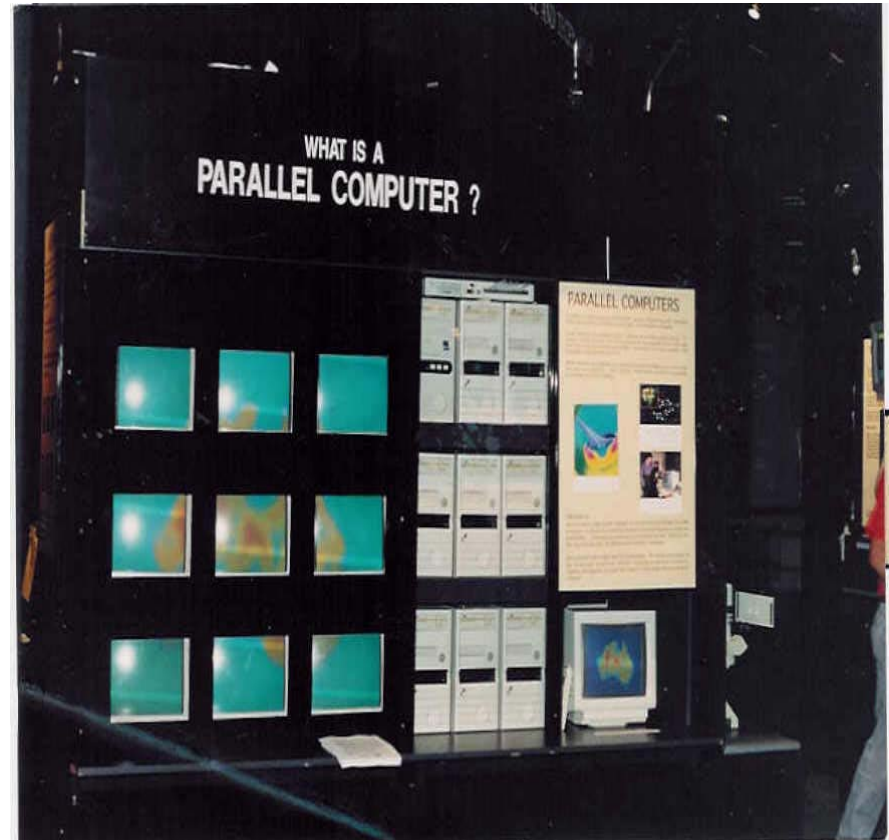
Courtesy of David Abramson, Monash University

Why EnFuzion on LC Series

- Clusters are a growing market in the Enterprise
- Each Cluster needs management tools
- EnFuzion does Enterprise Resource Management
- Why EnFuzion
  - ➢ EnFuzion makes your customer's business & technical applications high performance
  - ➢ Increase compute power, reduce IT costs
  - ➢ Simple to install, easy to use
  - ➢ Grid enables applications

Why EnFuzion the Product

- Optimized for Parametric Execution
  - Same algorithm large number of different inputs or scenarios
- High throughput with low latency
  - Large number of jobs in a very short time
  - Equivalent to a "real time" response
- Application Specific user interface
  - Easy to use GUI
  - Full API
- Works in heterogeneous operating environments, including; IRIX, Unix, Linux, Windows 2000, NT, and XP
- No need to modify existing applications
- Speeds up job's / simulations / rendering up to 1000 times depending on grid size
- Harness the power of every CPU in existing racks/networks
- Easy to deploy, ease to use

Core Technology

- EnFuzion is software for computational grids

- EnFuzion allows applications to use the combined power of multiple computers.
  - based on parametric job execution, same application, numerous sets of different parameters and scenarios
  - very high performance up to 1,000,000 jobs/minute
  - real time capability down to 0.01s response time
  - easy to deploy and manage, scalable
  - Web based user interface/GUI
  - extensive management and monitoring capabilities
  - automatic load balancing, resource sharing and fault tolerance

- EnFuzion has a wide range of options to integrate with applications from no programming to complete API

How does EnFuzion work?

LC Windows Clusters

LC Linux Clusters

Worker Machines

3. EnFuzion reports results and cleans up the worker machines

User Computer

EnFuzion Head Node Computer

2. EnFuzion distributes, manages and executes jobs on worker machines until completion

1. User submits jobs

HP WORLD 2004
Solutions and Technology Conference & Expo
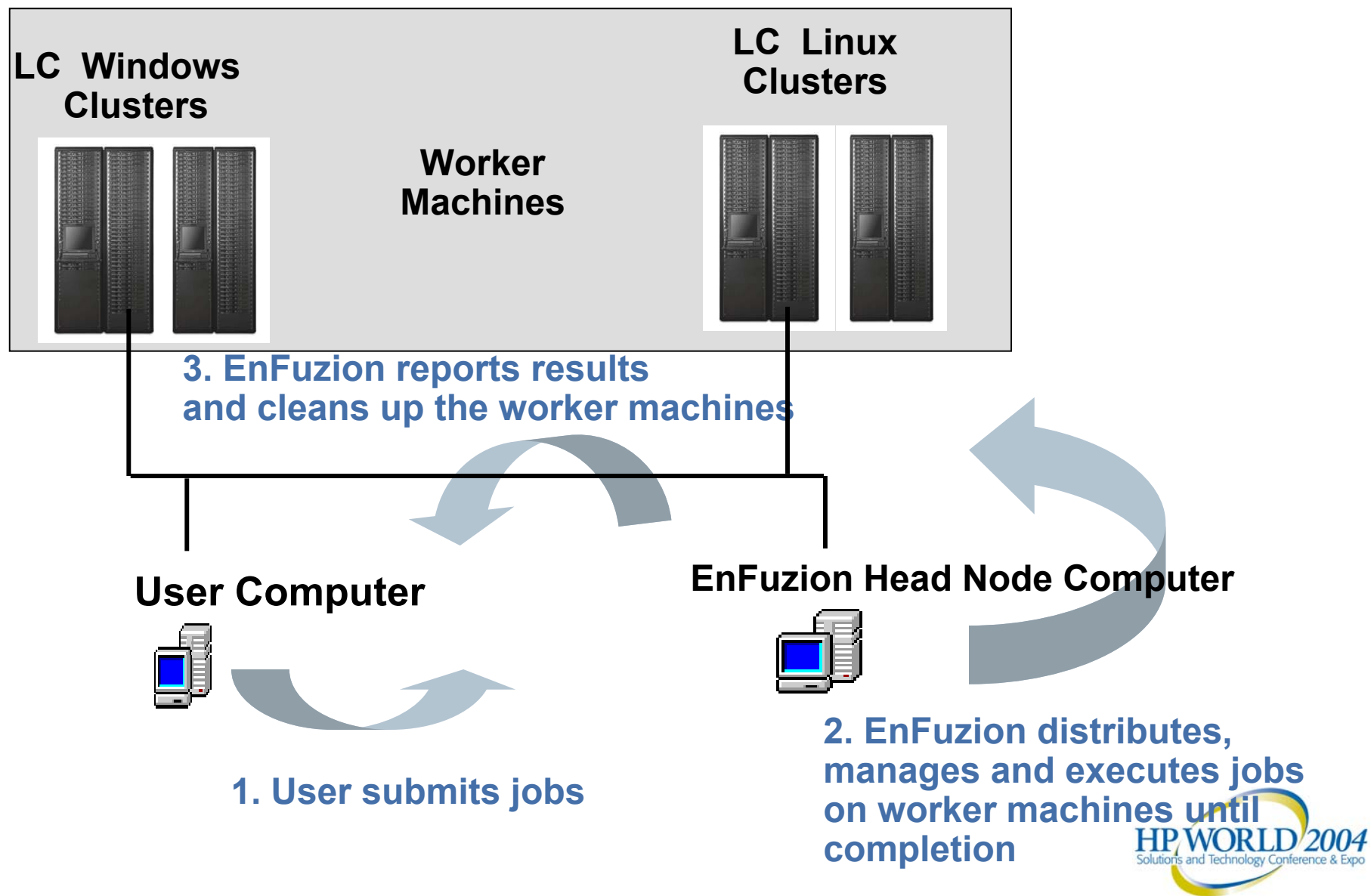
EnFuzion: the Computational Workbench

Description of Parameters and Commands

Job 1   Job 2   Job 3
Job 4   Job 5   Job 6
Job 7   Job 8   Job 9
Job 10   Job 11   Job 12
Job 13   Job 14   Job 15
Job 16   Job 17   Job 18
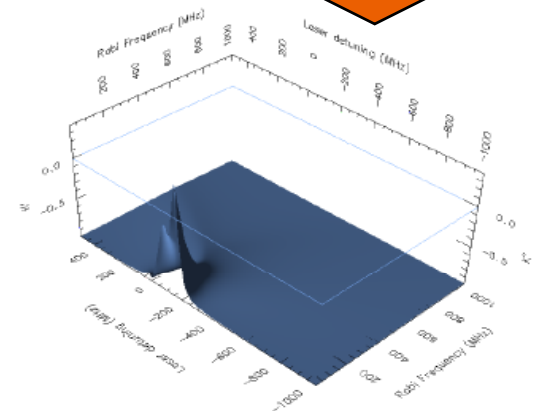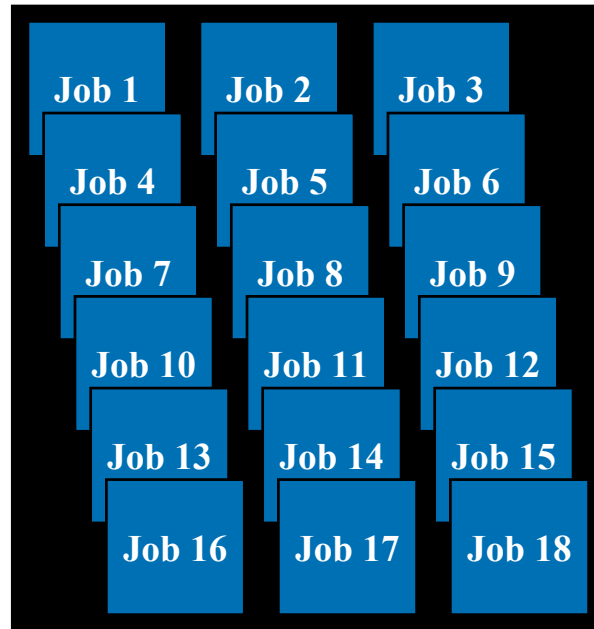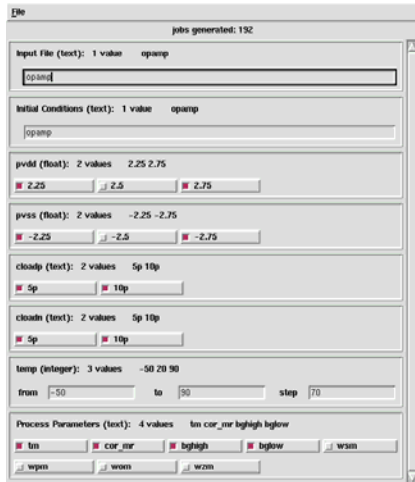
K' (Rabi Frequency, Laser Detuning)
Rubidium I=5/2 isotope : Zero Doppler width

"Deploying EnFuzion allowed us to harness the power of hundreds of powerful desktop workstations and servers during times when they would otherwise be sitting idle.."

Michael Liberman,

head of Global Swaps and Derivatives Technology

J.P. Morgan.

Cost savings – more than $7 million a year at project launch

Install and Configure

- **Installation – No Special Requirements**
  - Hardware/software pre-requisites – none
  - Fully self contained, no other applications required
  - Low footprint on the root and node machines

- **Flexible Configuration Options**
  - Can be adapted to any IT infrastructure policies, no need to do anything special to get EnFuzion running
  - Dynamic EnFuzion reconfiguration w/o bringing the system down

- **Heterogeneous Environment Supported**
  - Windows, Linux, all major Unix HP-UX, Tru64
  - 64-bit platforms - Itanium, AMD64, Alpha
  - Can mix and match different platforms

Distributed Resource Management - I

- **Job Management**
  - Automated job scheduling and execution management
  - Transparent restart of jobs from failed machines
  - Differentiated handling of system and job errors

- **File Management**
  - Creation of separated job work areas on worker machines
  - Automated copying of input files to worker machines and output results to the root or the submit computer
  - Automatic clean-up of worker machines

- **Workload Management**
  - Support for multiple users
  - Prioritizing jobs from multiple users/applications according to their priorities
  - User access permissions

Job Management by EnFuzion
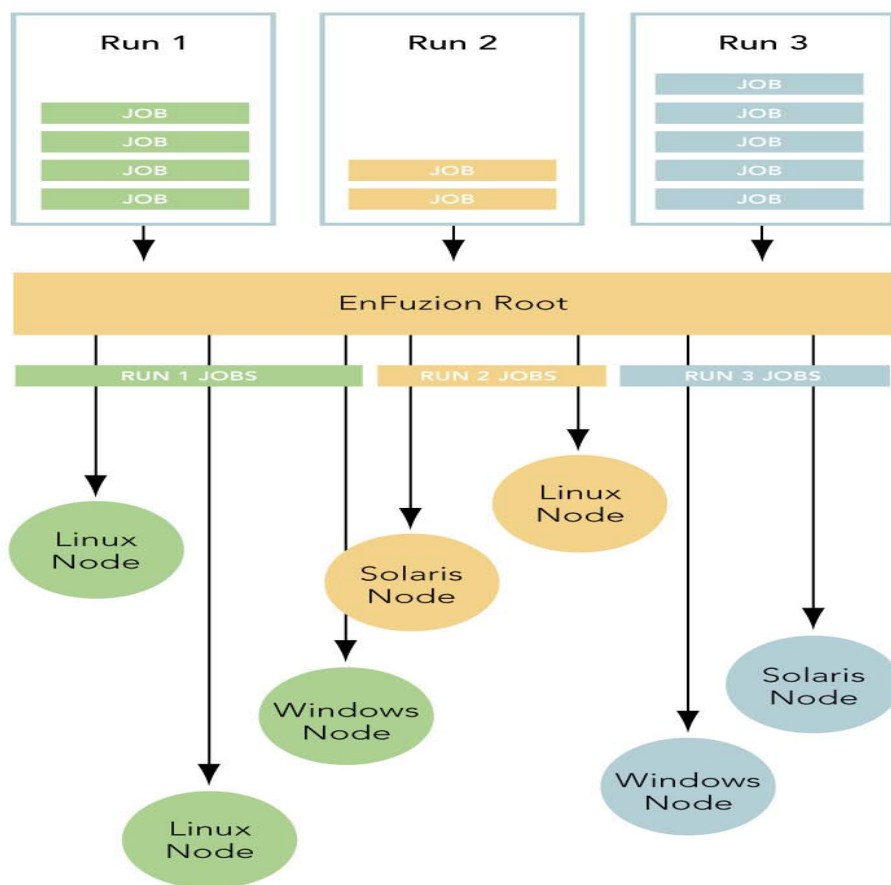
- **Parametric execution**

- **Real-time processing 0.01 sec**

- **Million jobs a minute**

- **Multi user support with priority**

- **Easy to use & deploy, user GUI**

- **Resource management**

- **Resource monitoring**

- **Automatic load balancing**

- **Full API**

Intuitive Web Based Dashboard

Distributed Resource Management - II

- **Resource Management**
  - Matching of job requirements with node properties:
    - Application releases
    - OS platforms
    - Application availability

- **Node Management**
  - Restart of EnFuzion software on recovered nodes
  - Dynamic addition and removal of nodes

- **Load Monitoring**
  - Peaceful co-existence with other computer uses, non-EnFuzion applications
    - Configurable to maximize use of dedicated machines or minimize impact to shared machines
    - Use idle machine cycles

- **Application Management**
  - Installation of required applications on remote nodes:
   - Use the latest application version

Easy to Manage, Fully Secure

- **Extensive Accounting/Reporting Services**
  - Run and node (job and worker machine) specific reports
  - Hourly, daily, monthly reports
  - Report formats - text, html, cvs or customized
- **Flexibility without Compromise to Security**
  - Extended OS-provided security
  - Network based security
  - Host based security
- **Comprehensive Logging and Debugging Functionality:**
  - Logging of all major events on the root and nodes
  - Additional diagnostic logs and tools
  - Saving application error environment for inspection and analysis

Customer Benefits

- Increased Productivity Leads to Increased Revenue, Top Line ROI
  - Faster time to results
    - Reduce time to market
    - Increase quality
  - Automate repetitive steps
    - Eliminate manual errors
    - Focus on innovation

Courtesy of Andrew Lewis, Queensland Parallel Supercomputing Facility
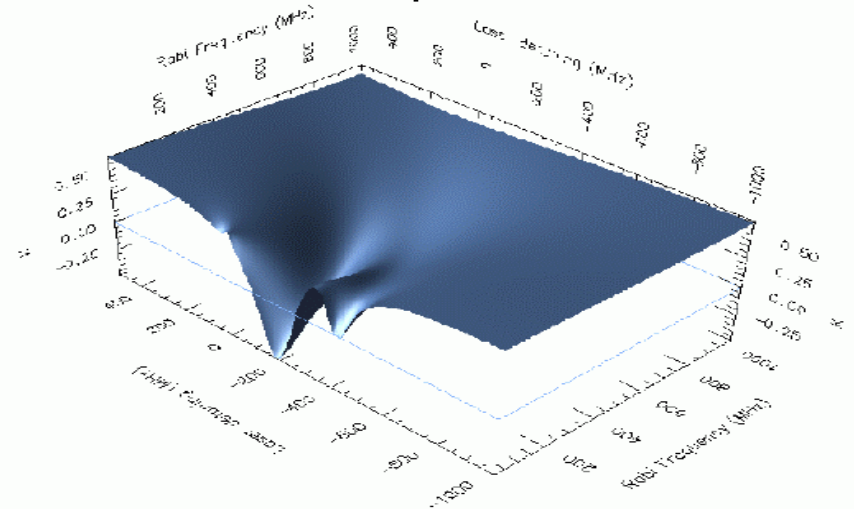
- Increased Resource Utilization Leads to Reduced IT Capital and Operational Expenditures, Bottom Line ROI
  - Unite computing resources, share machines and applications
    - Maximize use of existing hardware
    - Optimize use of existing software licenses
  - Reduce tedious IT maintenance tasks
    - Improve IT productivity
    - Focus IT on business applications
- Easy to Set up and Run

EnFuzion helped to discover new science in laser physics

"Suddenly there was an enormous growth spurt in the amount or work we were able to perform. (EnFuzion) made it possible to multiply the amount of work done by a factor of almost 100."
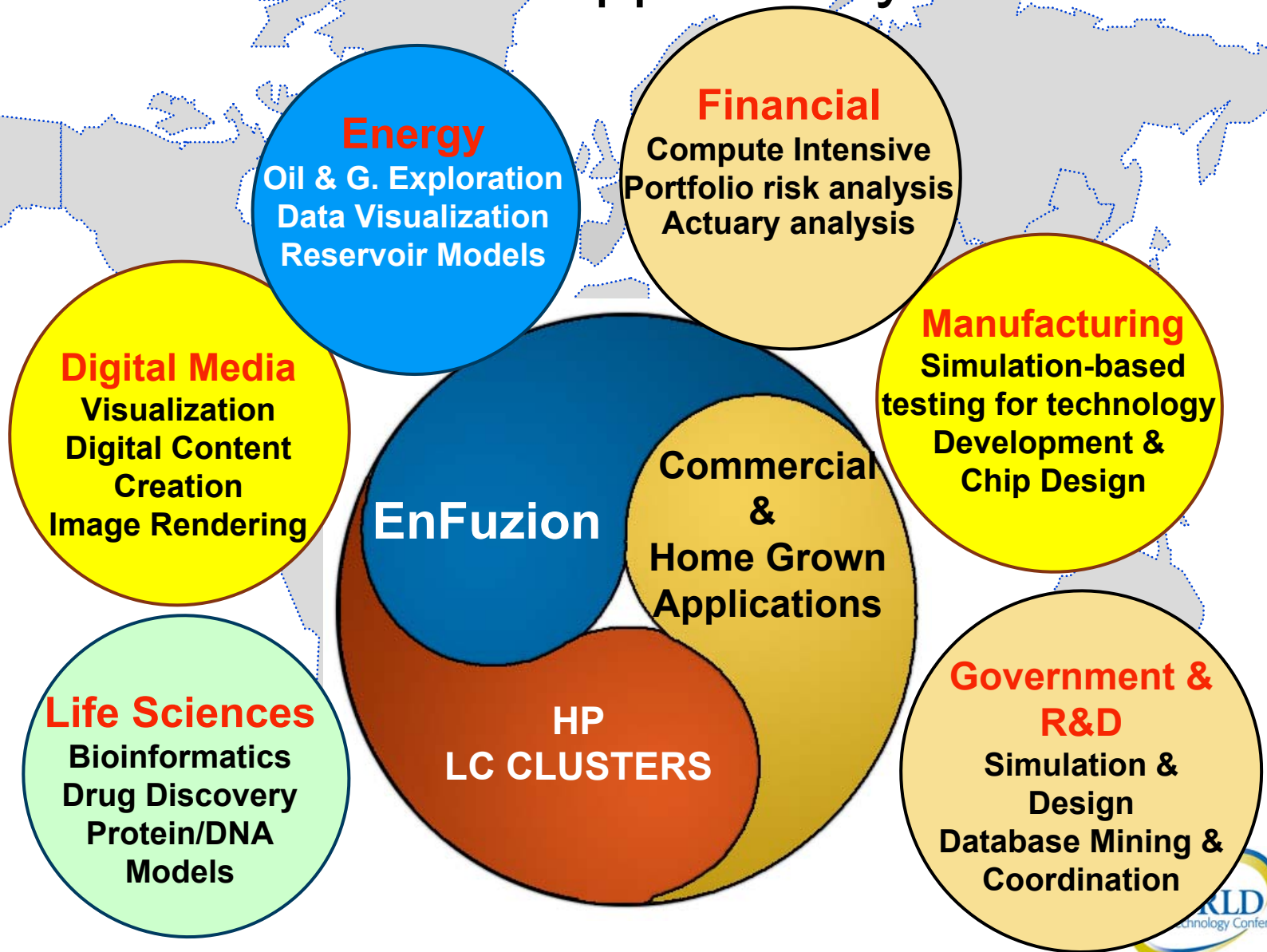
Dr. Alen Varsek

AMP

Australia's largest insurance firm and one of that country's leading banks.

EnFuzion's Applicability

Energy
Oil & G. Exploration
Data Visualization
Reservoir Models

Financial
Compute Intensive
Portfolio risk analysis
Actuary analysis

Manufacturing
Simulation-based
testing for technology
Development &
Chip Design

Digital Media
Visualization
Digital Content
Creation
Image Rendering

EnFuzion

**Commercial &
Home Grown
Applications**

**HP
LC CLUSTERS**

Life Sciences
Bioinformatics
Drug Discovery
Protein/DNA
Models

**Government &
R&D**
Simulation &
Design
Database Mining &
Coordination

Case Studies

- **Ceres Inc. -** Genomic Research & Technology company
    - Use computational biology to provide accurate solutions for many biological problems
    - Use Blast, psi-blast, PSORT, and SignalP for analysis and mining of predicted three-dimensional protein structures
    - Need to process vast amounts of genomic information
    - Needed a cluster management solution
- **Solution**
    - Use EnFuzion to manage a 50 Node LC Series Cluster
- **Benefits to customer**
    - Automated task management and processing
    - Maximize hardware utilization, minimize IT expenditures
    - EnFuzion integrated easily into their environment

Case Studies

- **Powerlink Queensland -** a leading Energy Transmission Co.
    - required increased compute power
    - needed solution for commercial power systems simulation software application
- **Solution**
    - EnFuzion enabled LC Series Cluster deployment
- **Benefits to customer**
    - Reduced simulation time, automated task processing,
    - Turbo-Charged their Electrical Grid Analysis
    - EnFuzion allowed fast, seamless integration with their commercial and home grown software applications

- Contingency analysis in PSS/E normally takes 4 hours to complete – with EnFuzion takes 6 minutes, speedup = 40 times

- Transient stability analysis with different fault durations and scenarios take 7 hours to complete – with EnFuzion takes 46 minutes, speedup = 9.2 times.

"Powerlink's use of EnFuzion is a great example of a growing trend to consolidate IT costs by utilizing grid computing to manage and execute compute intensive jobs faster and more accurately."

Bill Claybrook,

Research Director - Aberdeen Group

Q&A

HP delivering choice in HPC
Scale-up, Scale-out, Scale-simply

ProLiant Servers with 64-bit extensions

- Price/performance leadership with 32/64-bit co-existence
- Highest clock speed, peak performance
- Extensive 32-bit, and emerging 64-bit ecosystems
- Scale-out for simple, highly parallel workloads (2p nodes)
- Linux & Windows

- Price/performance leadership with 32/64-bit co-existence
- 32-bit throughput performance leadership
- Highest bandwidth for sustained performance
- Extensive 32-bit, and emerging 64-bit ecosystems
- Scale-out for moderate workloads (2p/4p nodes)
- Linux & Windows

Integrity Servers

- Highest performance 64-bit processor core for sustained performance
- Highest SMP scalability (to 128p)
- HP-UX for mission-critical technical computing
- Extensive 64-bit ecosystem (and 32/64-bit on HP-UX)
- Scale-up and scale-out for complex workloads
- HP-UX, Linux & Windows