Industrialising Expertise for
more economic value from HPC

SC13, Denver
November 2013
Fujitsu leading in HPC for >30 years

**Vector Supercomputer Series**
- **F230-75APU**
  - Japan’s First Vector (Array) Supercomputer (1977)
- **VP Series**
  - VPP500
  - VPP300/700
- **NWT**
  - Developed with NAL
  - No.1 in Top500 (Nov. 1993)
  - Gordon Bell Prize (1994, 95, 96)
- **World’s Fastest Vector Processor (1999)**
  - VPP5000

**Scalar MPP Series**
- **AP Series**
  - AP1000
  - AP3000

**Scalar Supercomputer Series**
- **HPC2500**
- **PRIMEPOWER**
  - PRIMEQUEST
  - Most Efficient Performance in Top500 (Nov. 2008)
- **FX1**
  - No.1 in Top500 (June and November 2011)
- **K computer**
  - Most Efficient Performance in Top500 (Nov. 2008)
- **AP1000**
- **SPARC Enterprise**
  - World’s Fastest Vector Processor (1999)

**Exascale**
- **FX10**
  - Trans-Exascale
  - Next x86 Generation
- **PRIMERGY BX900 / CX400**
  - Cluster node
- **PRIMERGY RX200**
  - Cluster node
- **HX600**
  - Cluster node

**Japan’s Largest Cluster in Top500**
- (July 2004)

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Fujitsu HPC solutions for each problem size

Principles

- **Best** in class performance and efficiency
- **Leverage** technology and expertise across segments. Examples:
  + FEFS
  + HPC Gateway
  + Volume effects
- **Integrated solution** approach
  + SW / Application know how impacts HW design
  + Ready-to-Use
Select Best Fitting Server Technology

Flexibility to address all kinds of customer requirements

- CELSIUS workstations
- PRIMERGY rack server
- PRIMERGY CX400 skinless server
  - Massive scale-out due to ultra dense server
  - HPC GPGPU / coprocessor support
- PRIMERGY blade server
  - Industry leading blade server density
Small and Medium Deals

Kolbenschmidt Pierburg
- Integrated Solution selected CAE applications
  - Computational Fluid Dynamics
- Application optimized adapted to specific application requirements
  - Thin nodes for CFD
- Ready-to-Go 1+6 Ansys CFX
  - 6 x RX200 + 1 x RX300 Management Headnode

Porsche
- Integrated solution for selected CAE applications
  - Computational Fluid Dynamics
  - Structural Analysis
- Application optimized and adapted to specific application requirements
  - Fat nodes for structural analysis (main memory, I/O)
  - Thin nodes for CFD
- 6 x RX300

Siemens CT
- Integrated HPC infrastructure for optimal purchase decisions (BX900)
  “Thanks to Fujitsu, we have a stable, predictable and scalable HPC solution that is helping us make more precise simulations of the copper and energy markets. We now know how accurate our forecasts will be and can put a percentage probability on various outcomes. This allows us to make the best decisions in a rapidly changing market.”
  Dr. Christoph Tietz, Senior Key Expert Engineer, Siemens AG, Corporate Technology
- Meanwhile second order received by Siemens CT, Configuration doubled
Medium and Large Deals

Maruti Suzuki

Integrated CAE Infrastructure
- Fujitsu qualification by
  - Integrated solution stack (server, storage, interconnect, middleware)
  - Application optimized sizing based on benchmark results
  - Competence and solution stack quality was weighted higher than possible cheapest offer (replacement of sgi)
  - Successful against SGI, HP, IBM, Dell
- Infrastructure based on BX900 (98 nodes) and Eternus storage

HPC Wales

Distributed HPC infrastructure
- Sophisticated tier model
  - Efficient, transparent access of users to the resources by means of Fujitsu HPC solution stack (HPC Gateway)
- Comprehensive joint engagement
  - Consulting and research collaboration
  - Joint business promotion (econo. growth)
- Infrastructure based on CX400 and BX900,
  - More that 1400 nodes
  - Eternus and 3rd party storage (DDN)

ANU NCI

National Research Facility
- Capacity and Capability System to address fundamental problems in
  - Climate change, Ocean modeling
  - National water management research
  - Medicine, material sciences, astronomy
- Research collaborations with Fujitsu
  - Open Petascale Libraries
- Infrastructure based on CX400
  - Most powerful system in Australia
  - More that 3500 nodes,
  - non-blocking interconnect

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Fujitsu’s HPC competency network

**Fujitsu** Technology Solutions
- PRIMERGY based HPC Ecosystem
- Services and Support

**Fujitsu** Systems Europe, ict GmbH - a Fujitsu company
- HPC certified expert partner program
- HPC application champions
- Benchmarking

**Fujitsu** Laboratories
- Research & Development
e.g. Open PetaScale Libraries Network
Take advantage from a complete HPC offering

PRIMERGY Server

Cluster Management & Operation
- Fujitsu HPC Cluster Suite
  - Gateway
  - FEFS

ETERNUS Storage

ISV and Research Partnerships
- PreDICT Initiative
- Open Petascale Libraries Network

Consulting and Integration Services
- Sizing, design
- Proof of concept
- Integration into customer environment

Certified system and production environment

Complete assembly, pre-installation and quality assurance

Ready to Operate at delivery

Ready-to-Go
Fujitsu HCS – the total solution approach

Make IT Dynamic – Business Efficiency for HPC Solutions

- Optimal system configuration based on application needs, immediate system readiness and faster deployment
- Simplifies HPC usage and management for both current and potential users of HPC (“out-of-the-box” operation)

HPC Cluster Suite
- Deployment (based on Fujitsu SVIM and Fujitsu CDM)
  - Integrates ServerView supplied drivers to the CDM repository
- Cluster Management
  - Node configuration
  - Monitoring and Alerting
- Comprehensive software coverage
  - Flexible choice of Workload Manager
  - Libraries, Compilers
  - Support for Parallel File Systems

Value Add / Differentiation by Fujitsu

HPC Gateway - Integrated intuitive interface
- Provides simplicity in using the HPC Cluster and Application
- Use resources more effectively
- Broaden HPC and process reuse
- Share and exchange data more widely

FEFS - optional Parallel File System
- Single file namespace across all nodes
- Increases Storage performance
- Required in large or high load I/O configurations
- Fujitsu Exabyte File System – FJJ developed (Lustre based)
The Fujitsu HPC Cluster Suite (HCS)

- Comprehensive software stack for managing Fujitsu PRIMERGY HPC clusters
  - Easy-to-use cluster management
  - Popular workload managers
  - General HPC Open Source Software
  - Highly scalable parallel file system
  - Graphical end-user interface for simplified usage
- Alliance with leading ISVs
- Fully validated HPC solution
Leveraging expertise

Only 8% of manufacturers with under 100 employees are using HPC.

Source: Intersect360 Research

Small manufacturers need lower cost, lower risk, and more expertise.
Case Study

Company

- Provide structural design and simulation services to automotive suppliers
- Small company (15 employees) designs tools to form (stamp) car parts
- Compute-intensive process demanding highly precise modeling (<1mm)

Challenges

- Low precision single run already takes 24 hours on 8-core workstations
- Results further refined by customer using LS-DYNA software, increasing overall project time
- Not feasible to obtain same customer resolution internally; would take up to 1 week elapsed per run
Re-structure end-to-end process

Objective
Provide better quality, more accurate, results to reduce/eliminate time for subsequent detailed simulations by customer

Solution
Running LS-DYNA code on HPC clusters reduces overall job elapsed time and creates a new more valuable and sustainable overall process

4 weeks
Design stamping form/tool  Optimize form/tool  Finalize design

Intel® Xeon® processor E5 PRIMERGY CX 8 nodes

5 – 6 hours

6 – 7 days
## Case Study

### Company
- Specialists in CAD and CAE services to automotive vendors (15 employees)
- Use a variety of application software – depends on customer requirements
- Focus on car body impact behavior – highly compute-intensive activities

### Challenges
- Want to offer automatic design optimization – shape, weight, variants
- Turnaround of 16-18 hours per job on current workstations make optimization studies impractical
- Now more competitors for the current basic engineering services
Innovate with new optimization studies

**Objective**
Design a weight-optimized rollover protection system, respecting FMVSS 216 crush test

**Solution**
Calculation time for multiple simultaneous load cases cut by 75% on multi-node cluster

Intel® Xeon® processor E5
PRIMERGY CX 8 nodes

Source: U.S. Department Of Transportation (TP-216-05)
Economic value

<table>
<thead>
<tr>
<th>Precision upstream design increases service value and status</th>
<th>Differentiating services through technology leadership</th>
</tr>
</thead>
<tbody>
<tr>
<td>D+B customers no longer refining results, saving them time and cost</td>
<td>OK Engineering service quality and speed raised above competition</td>
</tr>
<tr>
<td>New process is the basis for D+B to obtain preferred supplier status</td>
<td>Service portfolio is broadened with new competences</td>
</tr>
</tbody>
</table>
# Patterns of Expertise

<table>
<thead>
<tr>
<th>Democratization</th>
<th>Process-oriented</th>
</tr>
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<tbody>
<tr>
<td>Systematic methods</td>
<td>Service approach</td>
</tr>
<tr>
<td>Organized activity</td>
<td>Multi-application</td>
</tr>
<tr>
<td>Dynamic scale</td>
<td>Network neutral</td>
</tr>
</tbody>
</table>

Common needs for individual and team approach to HPC application **methods and usage.**
Industrialising Expertise

Simplify HPC access to lower cost and risk

Application processes to extend the value of HPC
Capturing process expertise

<table>
<thead>
<tr>
<th>Structure and encode business processes as automated transferable workflows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allows users to focus on research and analysis – eliminates low-level actions, increases productivity</td>
</tr>
<tr>
<td>Systematic deployment of best practice and expert methods, to non-experts and other experts</td>
</tr>
</tbody>
</table>
PRIMERGY HPC Gateway and Application Catalogue

Pre-built workflow packages from Fujitsu Application Catalogue site

Import into your own HPC Gateway system

Productivity from first login with HPC expert processes

Industrializing Expertise with scalable methods and tuned processes.
Deploying Expertise: Built Environment

Architect, Bureau
- Small to medium businesses, mostly local
- Graphical design workstations, potentially no HPC data centre
- Contracted to constructors, local/state government

Constructor
- Large organizations, potentially multinational
- HPC can be distributed among departments
- Constructing offices, stadia, airports, stations, retail
Reference model for Solution Design

HVAC Model – Same dimensions and physics as current production workloads

<table>
<thead>
<tr>
<th>Model setup</th>
<th>The basis of this study was a heating, ventilation and air-conditioning (HVAC) model for simulation with the ANSYS Fluent CFD code. Geometry based on a large meeting room or office floorplan. Radiators and fans are placed within the building, and a variable external load was applied.</th>
</tr>
</thead>
</table>
| Mesh                        | Cells: 7,897,612  
                              | Nodes: 9,679,421                                                                                                                           |
| Physics                     | Transient simulation with explicit time stepping for 12 hours. Full solar load model.                                                                                                                   |
## Target workloads

<table>
<thead>
<tr>
<th>Construction type</th>
<th>Private House</th>
<th>Shopping Center</th>
<th>Stadium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall project duration</td>
<td>2 weeks</td>
<td>3 months</td>
<td>18 months</td>
</tr>
<tr>
<td>Model size (number of cells)</td>
<td>4 million</td>
<td>15 million</td>
<td>60 million</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ideal simulation phases</th>
<th>Effective number of jobs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem set up (Steady state)</td>
<td>10</td>
</tr>
<tr>
<td>Design of Experiment (DoE), steady-state</td>
<td>80</td>
</tr>
<tr>
<td>Robust Design Optimization (RDO), steady-state</td>
<td>40</td>
</tr>
<tr>
<td>Transient scenarios</td>
<td>5</td>
</tr>
<tr>
<td>DoE (transient)</td>
<td>15</td>
</tr>
<tr>
<td>Estimated ideal project workload</td>
<td>150</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Estimated Total Computational Time</th>
</tr>
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<tbody>
<tr>
<td>Hours on a single node</td>
</tr>
<tr>
<td>Months on a single node</td>
</tr>
<tr>
<td>Tuned cluster size – number of compute nodes</td>
</tr>
<tr>
<td>Total elapsed hours</td>
</tr>
</tbody>
</table>

<p>| |</p>
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<tr>
<td>0.4 months</td>
</tr>
<tr>
<td>1.5 months</td>
</tr>
<tr>
<td>3.4 months</td>
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</tbody>
</table>
Sector-Ready Solutions

Components selected for optimal price-performance matched to real models and sector workload

Higher user productivity from HPC Gateway pre-built workflow packages for ANSYS Fluent

Standardized methods to helps even new HPC users to run large simulation workloads

Integrated HPC architecture with user-ready middleware – lowers acquisition risk and reduces up-front effort

Factory-installed user environment for immediate project readiness and fast-start application usage
READY High Performance Computing with HVAC workload optimized HPC Solutions

Integrated HPC cluster solution optimized for HVAC\(^1\) applications using ANSYS® Fluent software

Configuration (1) based on

- Model size\(^2\) (typical)
  Number of cells: 4 million

- Estimated ideal project workload\(^2\): 165 jobs

Configuration optimized for ANSYS® Fluent software

\(^1\)Heating, Ventilation and Air-Conditioning
\(^2\)see White Paper for further details

At a glance

Configuration: 1HN 08CN ANSYS HVAC 04M cells

- 8x PRIMERGY RX200 S8 compute nodes, with 2x Intel Xeon processor E5-2670v2 2.5 GHz 10C/20T
  8x 8GB 1866MHz, 1x SATA250GB, IB HCA 40Gb 1 port QDR

- 1x PRIMERGY RX300 S8 head node with 10TB disks for storing data

- InfiniBand interconnect

- Fujitsu HPC Cluster Suite Basic Edition, including TORQUE batch resource manager and HPC Gateway Basic Edition; option for ANSYS® CFD components from the standard Gateway application catalogue

PRIMERGY x86 HPC. Industrializing Expertise
READY High Performance Computing with HVAC workload optimized HPC Solutions

Integrated HPC cluster solution optimized for HVAC\(^1\) applications using ANSYS® Fluent software

Configuration (3) based on

- Model size\(^2\) (typical)
  Number of cells: 60 million
- Estimated ideal project workload\(^2\): 480 jobs

Configuration optimized for ANSYS® Fluent software

\(^1\)Heating, Ventilation and Air-Conditioning

\(^2\)see White Paper for further details

At a glance

Configuration: 1HN 56CN ANSYS HVAC 60M cells

- 56x PRIMERGY CX250 S2 compute nodes, with 2x Intel Xeon processor E5-2670v2 2.5 GHz 10C/20T
  8x 8GB 1866MHz, 1x SATA250GB, IB HCA 40Gb 1 port QDR
- 1x PRIMERGY RX300 S8 head node with 10TB disks for storing data
- InfiniBand interconnect
- Fujitsu HPC Cluster Suite Advanced Edition with full-featured PBS Professional batch resource manager and Gateway workflow development tools

PRIMERGY x86 HPC. Industrializing Expertise