Industrialising Expertise for more economic value from HPC

SC13, Denver
November 2013

FUJITSU
shaping tomorrow with you

Fujitsu leading in HPC for >30 years

FUJITSU

Exascale

FX10

Trans-Exascale

World's Fastest Vector Processor (1999)

VPP5000

No.1 in Top500 (June and November 2011)

Vector Supercomputer Series

K computer

FX1

NWT*
Developed with NAL

VPP300/700

No.1 in Top500 (Nov. 1993) Gordon Bell Prize (1994, 95, 96)

SPARC Enterprise

Most Efficient Performance in Top500 (Nov. 2008)

next x86 generation

PRIMEQUEST

VPP500

PRIMEPOWER HPC2500

World's Most Scalable Supercomputer (2003)

PRIMERGY CX400

VP Series

Scalar Supercomputer Series

PRIMERGY BX900 / BX400
Cluster node

F230-75APU

AP3000

HX600
Cluster node

Scalar MPP Series

AP1000

PRIMERGY RX200
Cluster node

x86 Cluster Series

Japan's First Vector (Array) Supercomputer(1977)

Japan's Largest Cluster in Top500 (July 2004)

| 1980 | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 |

*NWT: Numerical Wind Tunnel

Fujitsu HPC solutions for each problem size

PRIMEHPC FX10

Super Computer
>500K$

Divisional
>250K$

Departmental
>100K$

Workgroup
< 100K$

PRIMERGY HPC solutions

Power Workstation

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
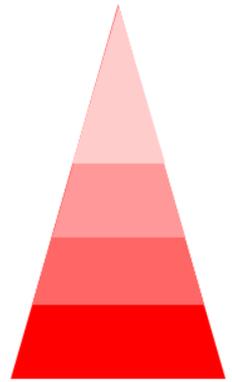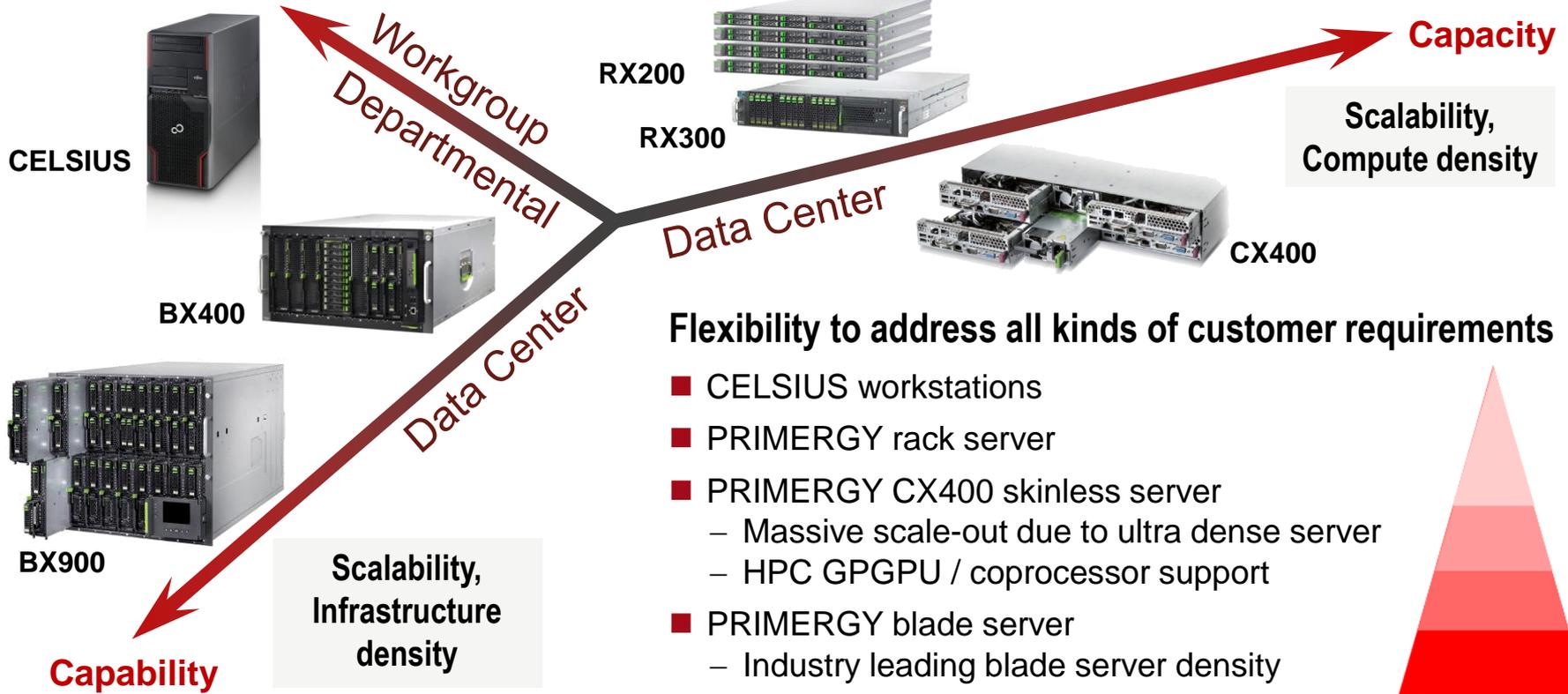
Capacity

Workgroup

Departmental

Data Center

Data Center

CELSIUS

RX200

RX300

CX400

BX400

BX900

Capability

Scalability, Compute density

Scalability, Infrastructure density

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
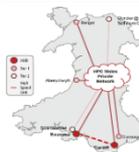
- Sophisticated tier model
  - Efficient, transparent access of users to the resources by means of **Fujitsu HPC solution stack** (HPC Gateway)
- **Comprehensive joint engagement**
  - Consulting and research collaboration
  - Joint business promotion (econo. growth)
- Infrastructure based on **CX400** 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

Fujitsu's HPC competency network

FUJITSU Japan
- Global lead in High Performance Computing
- Strategy, Development, Services and Support

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
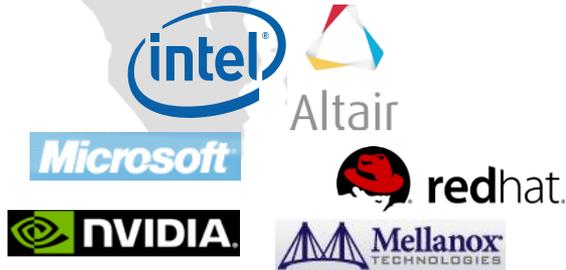
Take advantage from a complete HPC offering

FUJITSU

PRIMERGY Server

ETERNUS Storage

Cluster Management & Operation

Fujitsu HPC Cluster Suite

| Gateway | FEFS |

redhat. CentOS

ISV and Research Partnerships

ANSYS DS SIMULIA MSC Software
CD-adapco LSTC Altair
Exa MAGMA

PreDiCT Initiative

Open Petascale Libraries Network

Consulting and Integration Services

STAR-CD, C-CLASS, X5670, 12 cores/node
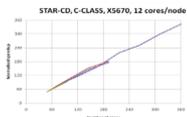
Sizing, design

Proof of concept
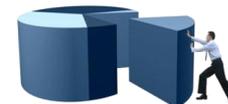
Integration into customer environment

intel Cluster Ready

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

FUJITSU

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)

FUJITSU

- **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**

Application programs			

Fujitsu HPC Cluster Suite

Graphical end-user interface			
Parallel Middleware	Scientific Libraries	Compilers, performance and profiling tools	Parallel File System

Workload manager

Management of cluster resources	Manage serial and parallel jobs	Fair share usage between users

Cluster deployment and management

Automated installation and configuration	Administrator interface Operation and monitoring	User environment management	Cluster checker

Operating System

RedHat Linux	CentOS	GPGPU and XEON Phi software support
OS Drivers		

Fujitsu PRIMERGY HPC Clusters

Leveraging expertise

High performance computing in digital manufacturing

Only 8% of manufacturers with under 100 employees are using HPC.
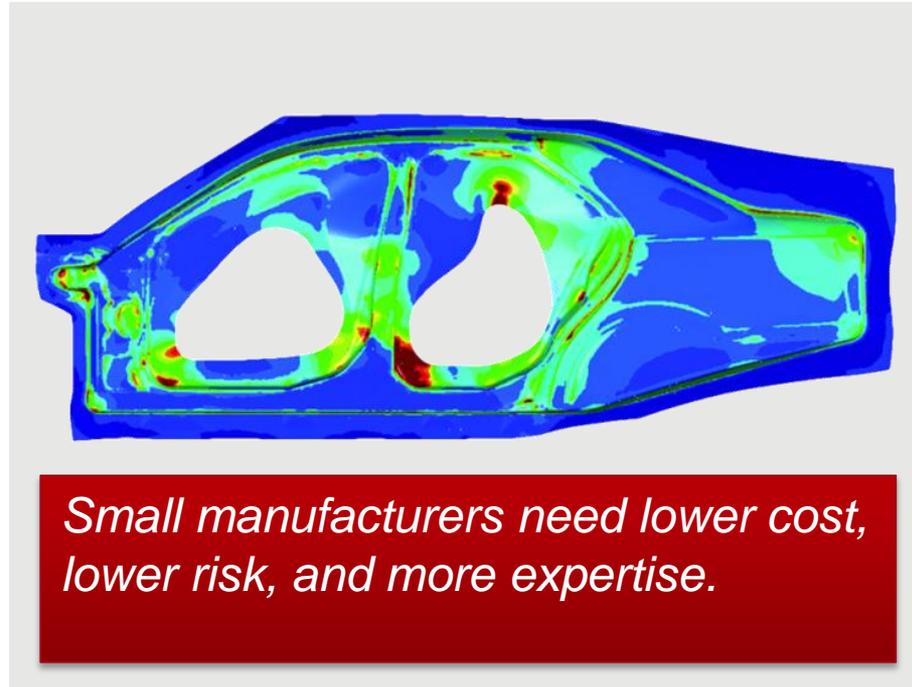
Small manufacturers need lower cost, lower risk, and more expertise.

Source: Intersect360 Research

Case Study

FUJITSU

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	Solution	6 – 7 days
Provide better quality, more accurate, results to reduce/eliminate time for subsequent detailed simulations by customer	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
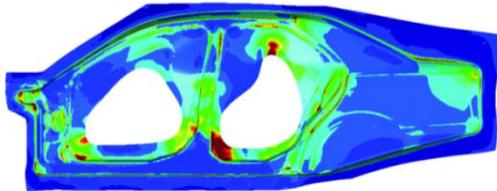
Detailed simulation

Intel® Xeon® processor E5
PRIMERGY CX 8 nodes

5 – 6 hours

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

18 hours

FORCE

254mm
1,829mm
5°
ANGLED LOADING DEVICE

RIGID HORIZONTAL SURFACE

LEFT SIDE VIEW

ANGLED LOADING DEVICE

FORCE

762mm

25°

RIGID HORIZONTAL SURFACE

FRONT VIEW
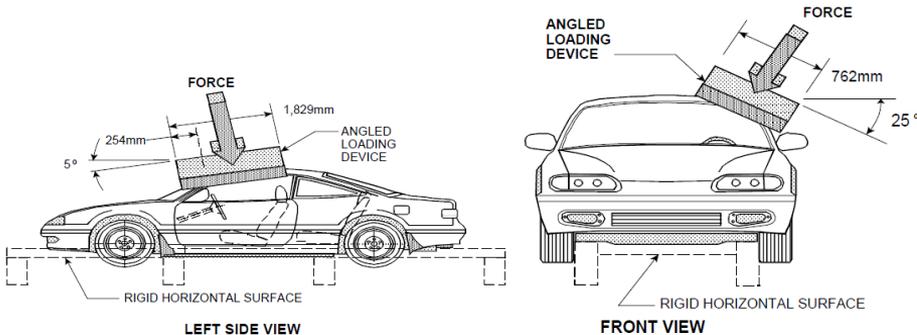
Intel® Xeon® processor E5
PRIMERGY CX 8 nodes

4 hours

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

Economic value

Precision upstream design increases service value and status

Differentiating services through technology leadership

D+B customers no longer refining results, saving them time and cost

OK Engineering service quality and speed raised above competition

New process is the basis for D+B to obtain preferred supplier status

Service portfolio is broadened with new competences

Patterns of Expertise

Democratization	Process-oriented
Systematic methods	Service approach
Organized activity	Multi-application
Dynamic scale	Network neutral

▶ 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

Structure and encode business processes as automated transferable workflows

Allows users to focus on research and analysis – eliminates low-level actions, increases productivity

Systematic deployment of best practice and expert methods, to non-experts and other experts
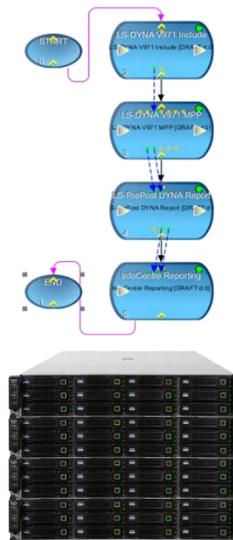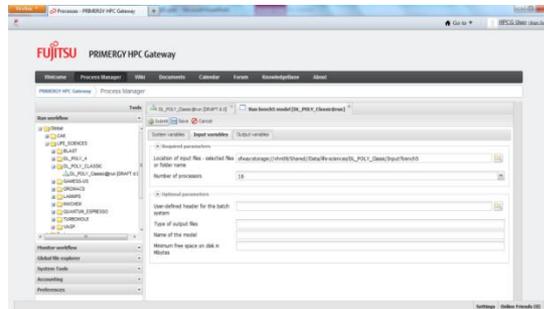
PRIMERGY HPC Gateway and Application Catalogue

Pre-built workflow packages from Fujitsu Application Catalogue site

Import into your own HPC Gateway system

Productivity from first login with HPC expert processes

Fujitsu site
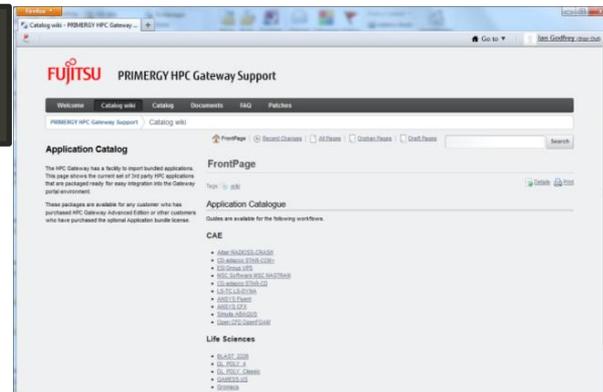
User site

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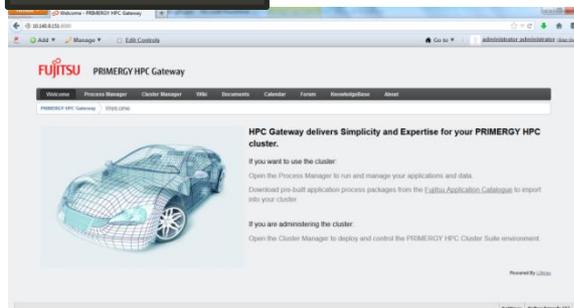
Industrializing Expertise with scalable methods and tuned processes.

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

ANSYS | **FUJITSU**

HVAC Model – Same dimensions and physics as current production workloads

Model setup	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.
Mesh	Cells: 7,897,612 Nodes: 9,679,421
Physics	Transient simulation with explicit time stepping for 12 hours. Full solar load model.
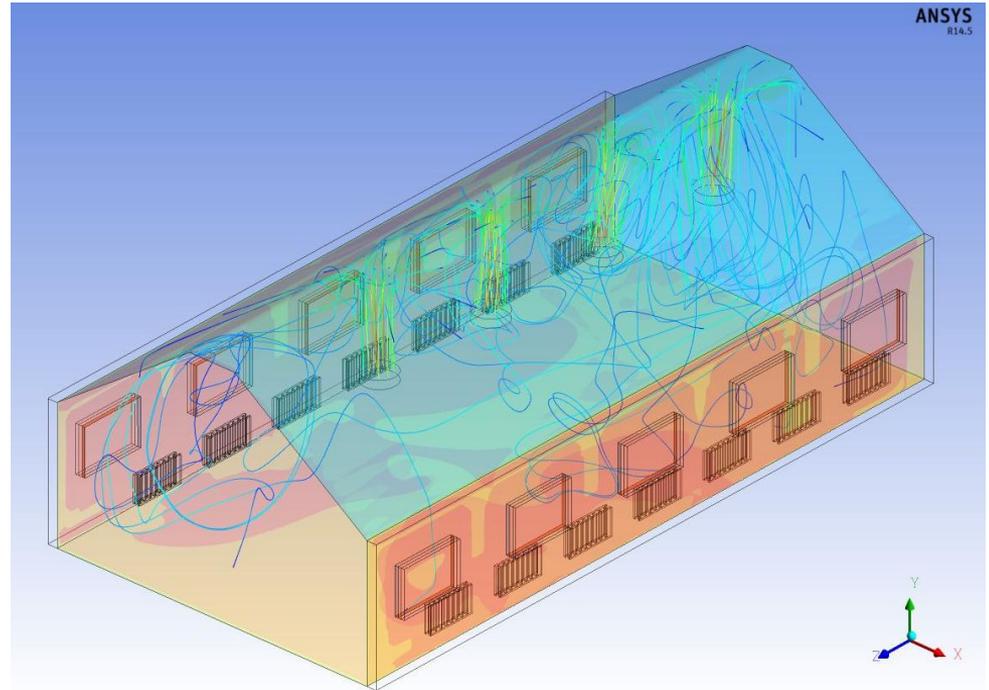
Target workloads

Construction type	Private House	Shopping Center	Stadium
Overall project duration	2 weeks	3 months	18 months
Model size (number of cells)	4 million	15 million	60 million
Ideal simulation phases	Effective number of jobs		
Problem set up (Steady state)	10	15	25
Design of Experiment (DoE), steady-state	80	150	200
Robust Design Optimization (RDO), steady-state	40	80	140
Transient scenarios	5	10	15
DoE (transient)	15	50	100
Estimated ideal project workload	150	305	480
Estimated Total Computational Time			
Hours on a single node	2,335	27,780	137,800
Months on a single node	3	39	191
Tuned cluster size – number of compute nodes	8	24	56
Total elapsed hours	294	1,158	2,461
	0.4 months	1.5 months	3.4 months

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

FUJITSU

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**
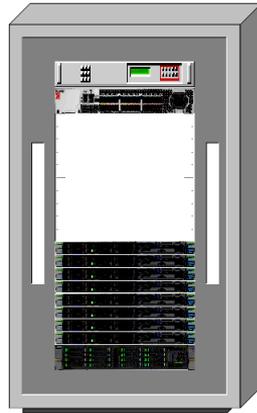
Configuration optimized for
ANSYS® Fluent software

ANSYS®

[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

FUJITSU

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**
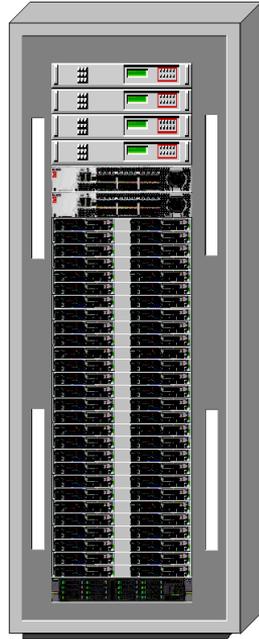
Configuration optimized for
ANSYS® Fluent software

ANSYS®

[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**