

SC16

Salt Lake City

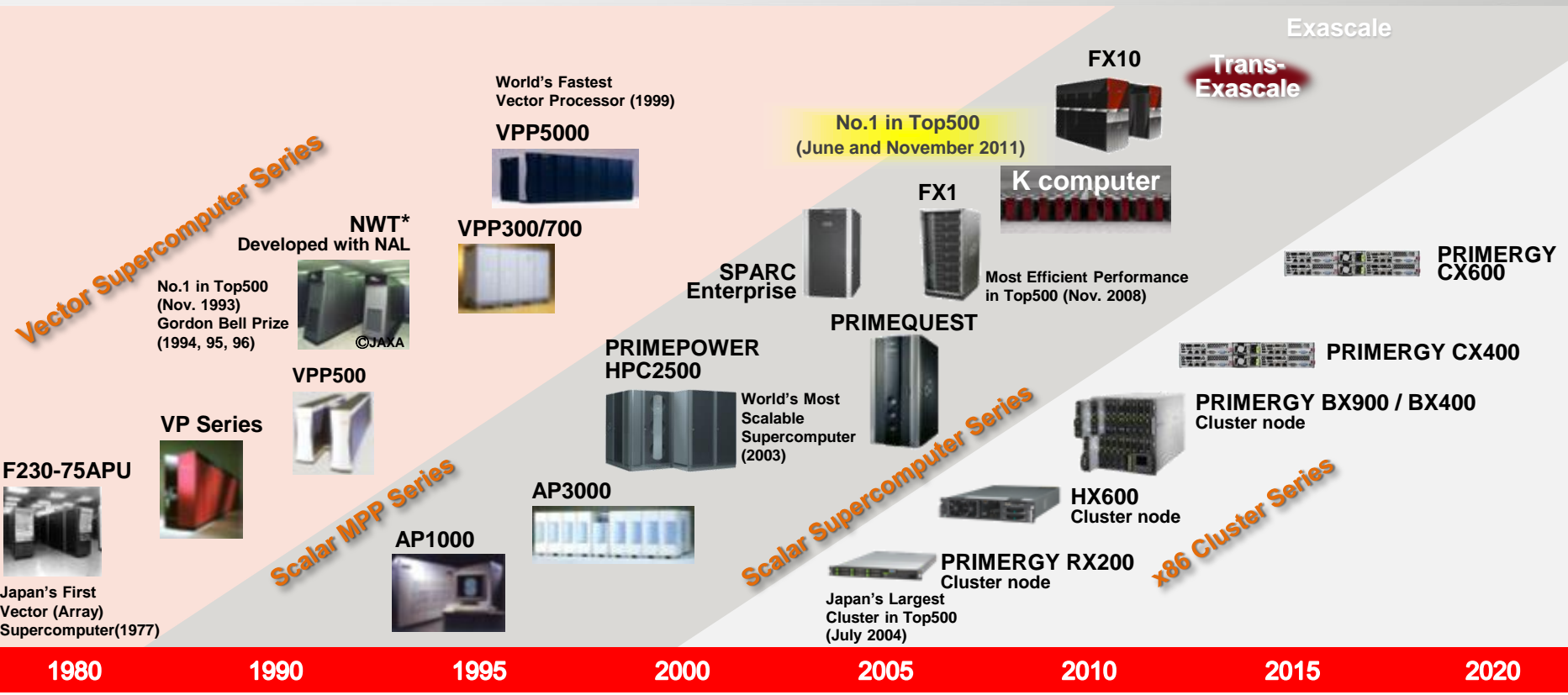
November 14<sup>th</sup>, 2016



shaping tomorrow with you

**New Fujitsu  
PRIMERGY CX600 M1**  
Your platform for highly parallel computing

# Fujitsu's Has Had a Leading Role in HPC for >30 Years



\*NWT: Numerical Wind Tunnel

# Fujitsu's Worldwide HPC Competency Network



## FUJITSU Japan

- Global leader in High Performance Computing
- Strategy, Development, Services and Support

## FUJITSU Technology Solutions

- PRIMERGY-based HPC Ecosystem
- Services and Support

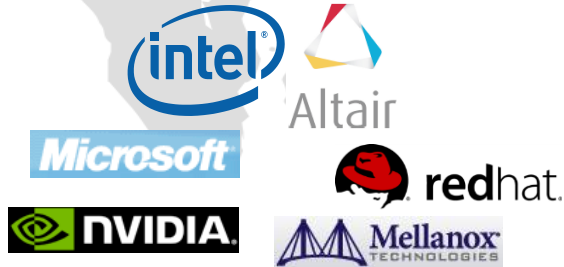
## FUJITSU Systems Europe, ict GmbH - a FUJITSU company

- HPC-certified expert partner program
- HPC application champions
- Benchmarking

## FUJITSU Laboratories

- Research & Development

e.g. Open PetaScale Libraries Network



# Fujitsu PRIMERGY for HPC Workload Demands



## RX Family



Versatile and scalable rack-optimized servers with leading efficiency and performance

## CX Family, based on Xeon and Xeon Phi



Density-optimized cloud server infrastructures for HPC, cloud and hyper-converged computing



High density platform for smart HPC computing based on highly parallel applications

# FUJITSU Server PRIMERGY Scale-out Systems



Platform for HPC, cloud and hyper-converged stacks

- More computing power in less space
- Lower energy costs due to shared power & cooling
- Optional liquid cooling for lower cooling costs and higher density



**CX400**

Compact server nodes with high power efficiency to realize large scale-out solutions for HPC, hosting, and hyper-converged computing at lower overall costs

Chassis



**CX2550**

Dual socket server node in a highly condensed half-wide, 1U form factor

Server Nodes



**CX2570**

Dual socket server node for ambitious HPC, analytics and visualization solutions



**CX600**

HPC optimized scale-out server platform based on Intel Xeon Phi x200 (“Knights Landing”) technology

Chassis



**CX1640**

Single socket Xeon Phi server node for significant performance boost in parallel-processing

Server Node

# Intel® Xeon Phi™ “Knights Landing” Ecosystem

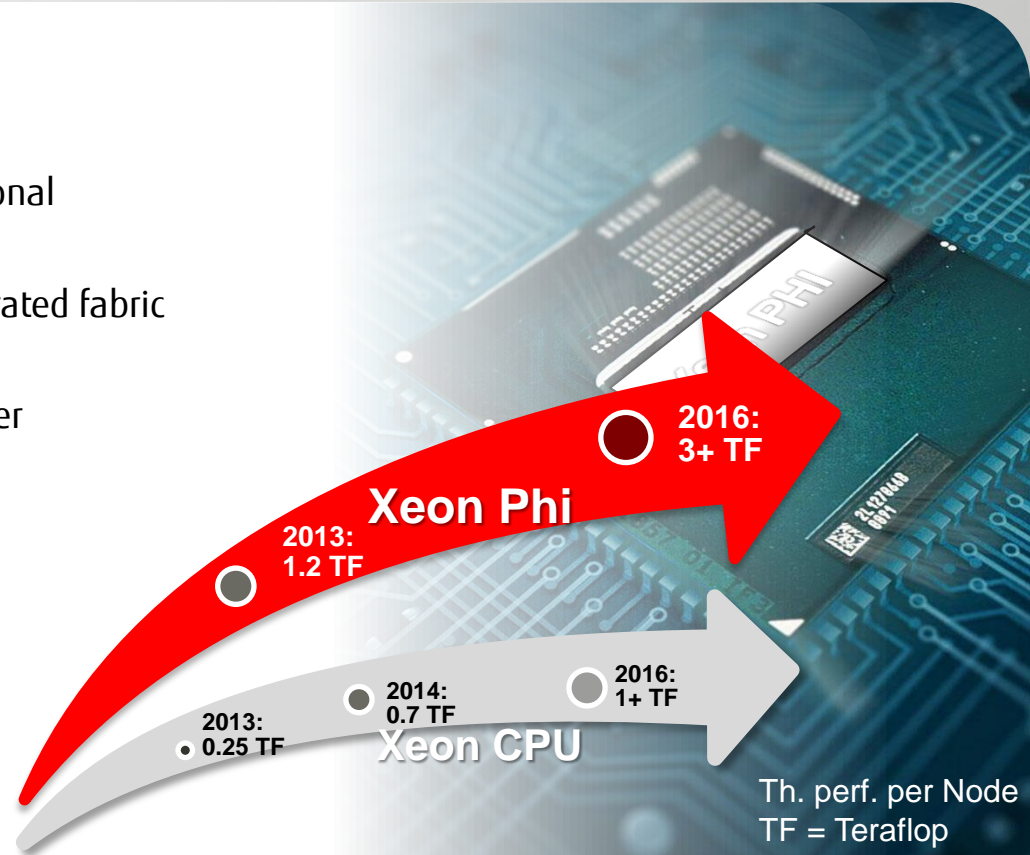


## ■ Intel Xeon Phi (Second Generation)

- Single socket compute node
- Significant performance boost versus conventional Xeon CPU
- Integrated high bandwidth memory and integrated fabric increases price/performance and density
- Eliminates cost overhead by Xeon CPU and other components

## ■ Fujitsu's Offering:

- PRIMERGY CX600 based on Xeon Phi KNL
- Rollout including
  - Parallel application enablement and optimization program by Intel, Fujitsu and Partners
  - Enhanced HPC Software Stack



# PRIMERGY CX600 M1 – Usage Scenarios



Business Processing	Analytics	Scientific	Cloud Services	Visualization & Audio	Comms	Storage
OLTP	Data Analysis & Mining	Simulation/CAE & CFD	Front End Web	Media Delivery and Transcode	Wired Networking	Analytics
File & Print	Big Data Analytics	CAD	Data Caching	Remote Visualization	Packet Processing	Business Processing
Email	Machine/Deep Learning - Training	Life Sciences – Genomics/ Sequencing	Search	Remote Gaming	Virtual Switching	Cloud Storage Object Storage Active-Archive
ERP	Machine/Deep Learning - Evaluation	Life Science - Molecular Dynamics		VDI (Clients)	Network Security	Archive/ Regulatory Compliance
CRM		Financial - Trading		Image & Video Analytics	Wireless Access	Backup/ Recovery
Application Servers		Financial - Risk		Speech & Audio	Wireless Core	Disaster Recovery
		Energy – Seismic/Reservoir		Scientific Visualization		
		Weather		Professional Rendering		
		Defense/Security				

Very Applicable
Applicable
Less Common

\* Source: Intel

## ■ Positioning

### Usage

Usage	HPC Market		
	SMALL	MID	HIGH
General purpose HPC solution	Xeon CPU		
Hybrid parallel / throughput-oriented solution		Xeon Phi	

## ■ Target market

- University / Academic for scientific research
- Market expansion
- Business intelligence / Analytics (BA)
- Graphics analysis (rendering)
- HPC expertise leverage
- Highly parallel workloads, such as weather forecasting, molecular dynamics, genomics, financial engineering, machine learning and deep learning,...

# What will your next HPC cluster be based on?

- The **NEW**  
PRIMERGY **CX600 M1**  
PRIMERGY **CX1640 M1**



# CX1640: KNL CPU (Choose from 4 Options)



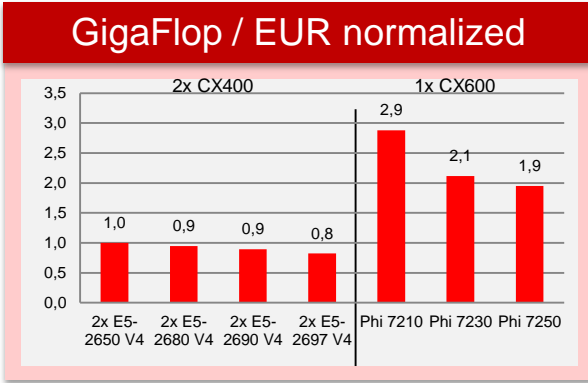
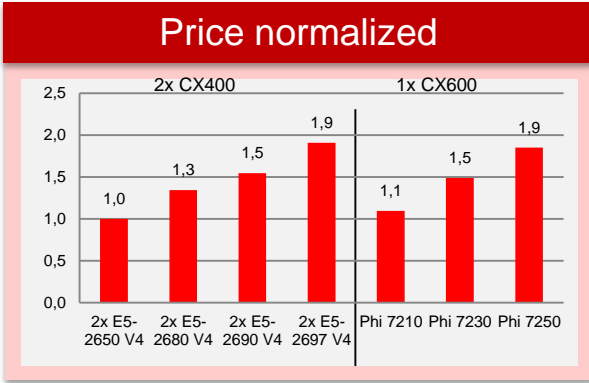
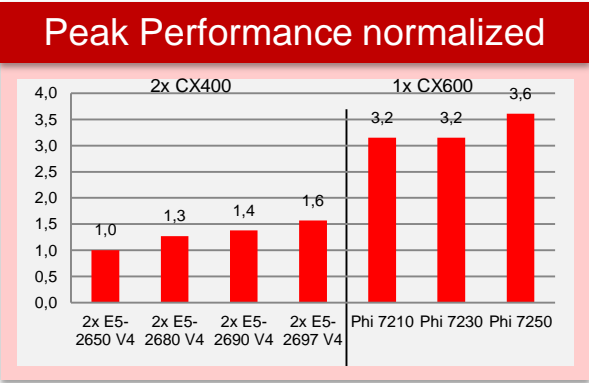
	Xeon PHI	Cores	Ghz	Integrated Memory	Fabric*	DDR4	power
LC only	<b>7290</b> Best Performance	72	1.5	16GB 7.2 GT/s	Yes	384GB 2400 MHz	245W Fabric +15W
	<b>7250</b> Best Performance/Watt	68	1.4	16GB 7.2 GT/s	Yes	384GB 2400 MHz	215W Fabric +15W
Air and LC	<b>7230</b> Best Memory BW per Core	64	1.3	16GB 7.2 GT/s	Yes	384GB 2400 MHz	215W Fabric +15W
	<b>7210</b> Best Value	64	1.3	16GB 6.4 GT/s	Yes	384GB 2133 MHz	215W Fabric +15W

\* Integrated fabric is an optional feature

# PRIMERGY CX400 vs. CX600: Price Performance



**CX600 provides significantly better price performance ratio, based on theoretical peak performance.  
Final performance depends on application parallelization.**



\* Comparison on complete node configuration

**CX600 based on Xeon Phi (KNL):  
your cost optimized platform for highly parallel computing**

# Performance Comparison of KNL vs. Xeon



Over 30 applications optimized for Intel® Xeon Phi™ Processor family are available at launch with up to 6.5x performance improvement.

## MODELING & SIMULATION



AND MANY MORE...

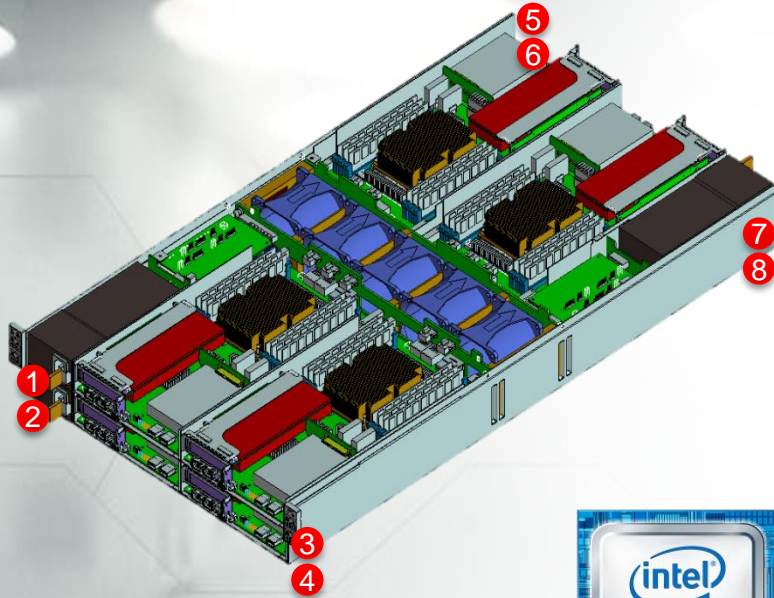
MANUFACTURING, ENGINEERING,  
WEATHER, OIL & GAS,  
APPLIED SCIENCE, DEFENSE...

Fueling Breakthroughs in Science and Industry

\* Relative Performance

(Intel® Xeon Phi™ Processor 7250 compared to Intel® Xeon® processor E5-2697 v4)

# New HPC Platform: PRIMERGY CX600



## PRIMERGY CX600 M1

- Leveraging Intel Xeon Phi x200 “Knights Landing” multicore platform
- Up to 8x compute nodes in 2U (4x front / 4x rear)
- Fujitsu parallel application enabling program to support application adoption, porting and tuning
- Significant performance boost for parallel-processing
- Cool-Central Liquid Cooling support

### Target markets

- University / academic for scientific research
- Business intelligence / Analytics (BA)
- Graphic analysis (rendering)
- Product development / optimization

# New PRIMERGY CX600 – specifications



- ✓ High-density server with air or liquid-cooling for HPC market
- ✓ Up to 12K cores & 64TB memory in a rack \*
- ✓ Up to 0.5 PF in a rack \*

\*: depends on DC environment

8x per 2U



## PRIMERGY CX600 M1

## PRIMERGY CX1640 M1

Type	Chassis for KNL Node	KNL Node
Chassis PSU / cooling	2 U / up to 8 nodes (4x front / 4x rear) 4x 1.200W PSU red, 5x fans, non hot-plug / red	1U, half-width air or liquid cooling support
Processor / performance		1x Intel® Xeon® Phi™ x200 Product Family, up to 72 Cores, +3TF/Node
Memory		16GB high-bandwidth on-package MCDRAM memory ~465GB/sec Additionally 6x memory slots, up to 384GB DDR4 2400 MHz
Storage		At air cooling: 1x SATADOM or 1x 2.5" non hotplug SATA HDD or 2x SSD At liquid cooling: 1x SATADOM only
Networking / Interconnect	Node individual LAN	2x GbE Onboard (1x shared service from iRMC), Integrated Intel Omnipath or Mellanox EDR (PCIe) interconnect
I/O expansion slots	Node individual expansion	1x PCIe Gen3 x16 for interconnect

# Fujitsu PRIMERGY CX600 M1 at a glance



## Your platform for highly parallel computing

**Maximum density  
with  
8 nodes in 2U**

6x the performance  
per U in comparison  
with standard rack  
servers for extremely  
high density

**Specialized for  
parallel  
workloads**

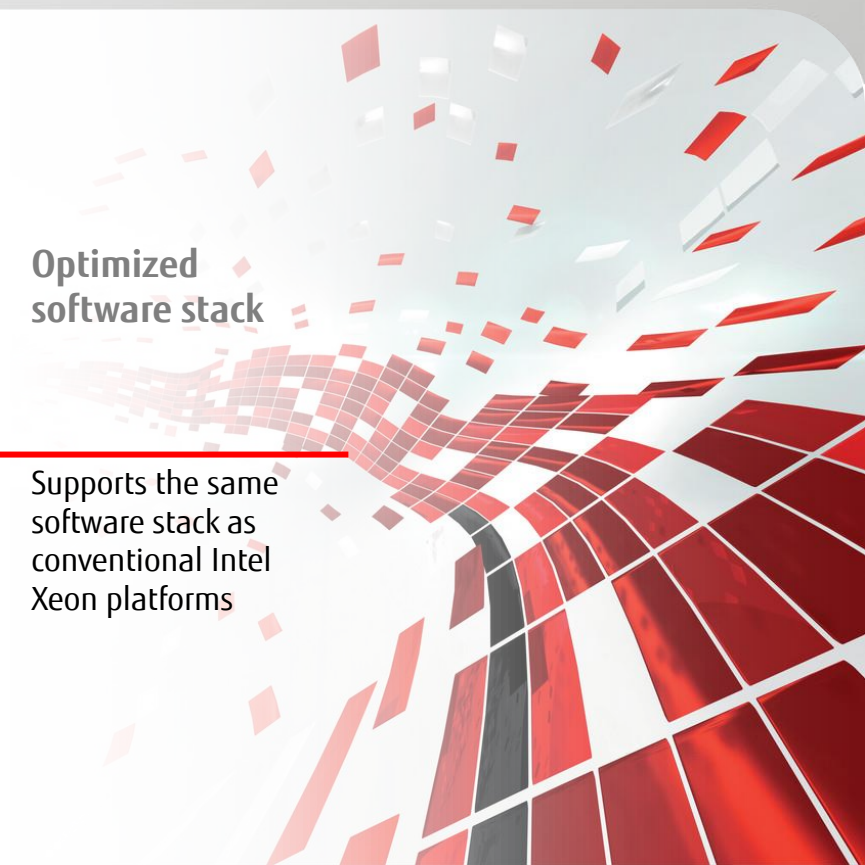
Significant  
performance boost for  
parallel-processing  
versus Intel Xeon  
platforms

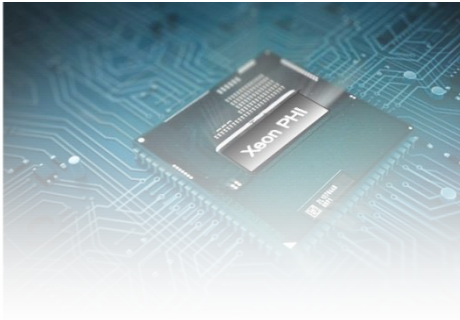
**Compliant to  
conventional  
datacenter  
environment**

Easy rack-wide team  
play with already  
existing datacenter  
infrastructure –  
including Cool-Central  
Liquid Cooling

**Optimized  
software stack**

Supports the same  
software stack as  
conventional Intel  
Xeon platforms





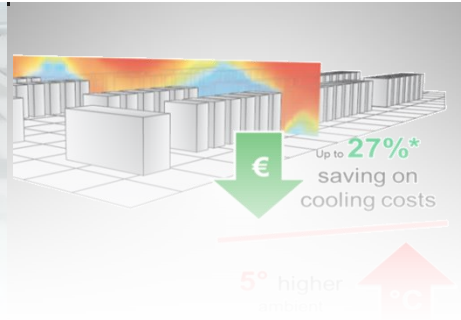
## Performance <sup>1)</sup>

- 2.3x DP Peak Performance (TF/s)
- 3.9x Memory Bandwidth (GB/s)



## Density / Scalability / Reliability

- 2x Density / Rack Height Unit, up to 168 Nodes / Rack <sup>2)</sup>
- Support of Intel OmniPath and Mellanox IB EDR Technology
- Power Supply and Fan redundancy



## Cooling

- Air Cooling with up to 40°C ambient
- or
- Hot water (45°C) Liquid cooling ensures reduced TCO by higher density and OPEX reduction

1) vs. CX2550, based on E5-2697 v4

2) Physical density per 42U Rack / air cooling

# CX400 or CX600: When to choose what?

## PRIMERGY CX400

Parallel, Fast Serial Multicore + Vector applications

Diverse workloads

Excellent single and Multi-Thread Performance requirements

CX400



## PRIMERGY CX600

Highly parallel and highly vectorized application profile

Applications requiring improved performance that achieves maximum FLOPs

Applications requesting highest sustaining memory bandwidth

CX600



# Our value – your benefit

Compared to today's Xeon technology, KNL will provide significant improvements in the following areas

High density platform



Reduces DataCenter OPEX



Better price / Performance ratio



Reduce TCO, improved ROI



Higher Performance per density / watt\*



Reduces simulation time, higher productivity



Leveraging Liquid Technology



Improved reliability, higher energy efficiency reduces DC OPEX and carbon foot print



Fully integrated in SW stack



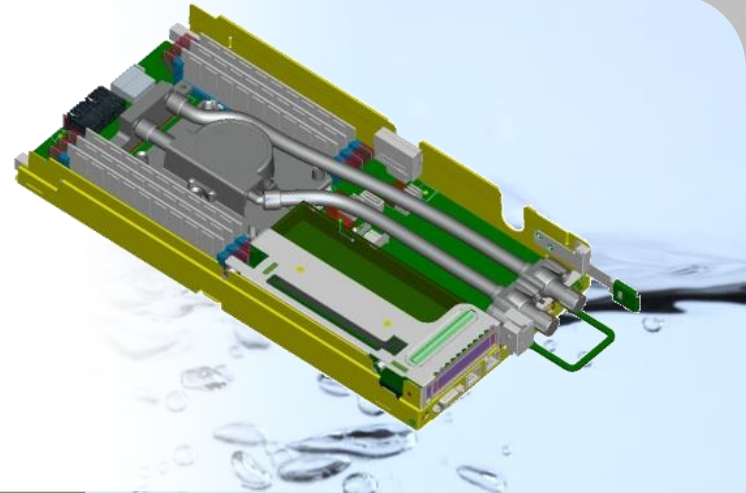
Stable, validated, ready for production



\*) For applications which are highly vectorised

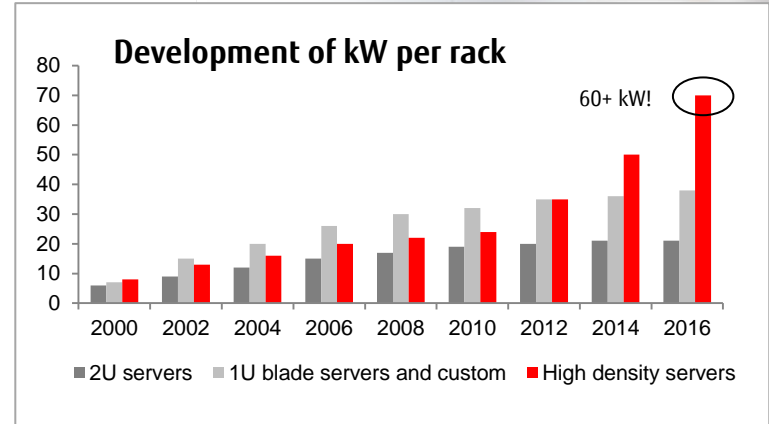
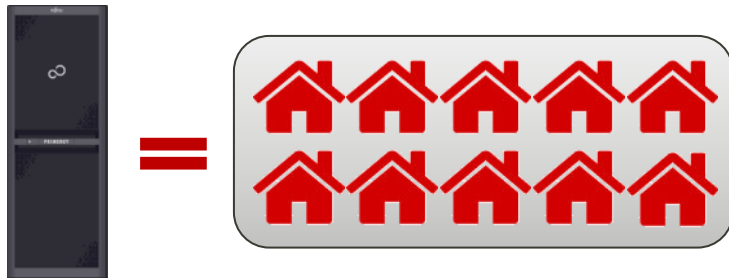
# Cool-Central<sup>®</sup> Liquid Cooling Technology

- Direct / on chip Liquid Cooling
- PRIMERGY **CX600 M1**
- PRIMERGY **CX1640 M1**



# Data Center = Thermal Power Station

- Future-proofing the PRIMERGY portfolio
  - Today: 35+ kW per rack
  - Future: >60 kW by 2016
  - kW per rack will further rise and traditional air cooling will not be sufficient
- Putting things into perspective
  - One 30 kW rack could supply ten houses with heating and warm water



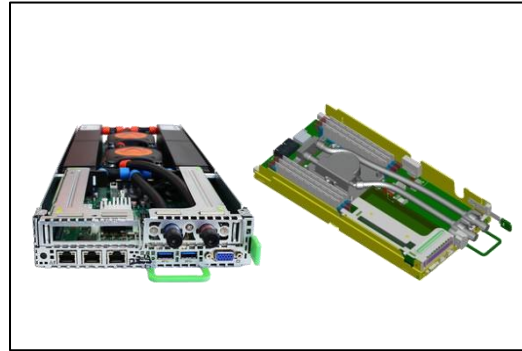
**High density servers will reach up to 70 kW per rack by 2016**

# Fujitsu's hot water (in 45°C – out 60°C) Liquid Cooling Offering



**Consulting**

- Professional services to evaluate the customers cooling infrastructure
- Sizing of (liquid) cooling installation
- TCO calculations



**Servers & Infrastructure**

- Tested and designed for PRIMERGY CX400 / CX600
- Rack Coolant Distribution Unit (CDU)
- Integration in ServerView Management



**Out of one hand**

- Pre-installed ex factory
- Full warranty and support

# Cool-Central<sup>®</sup> Liquid Cooling Technology



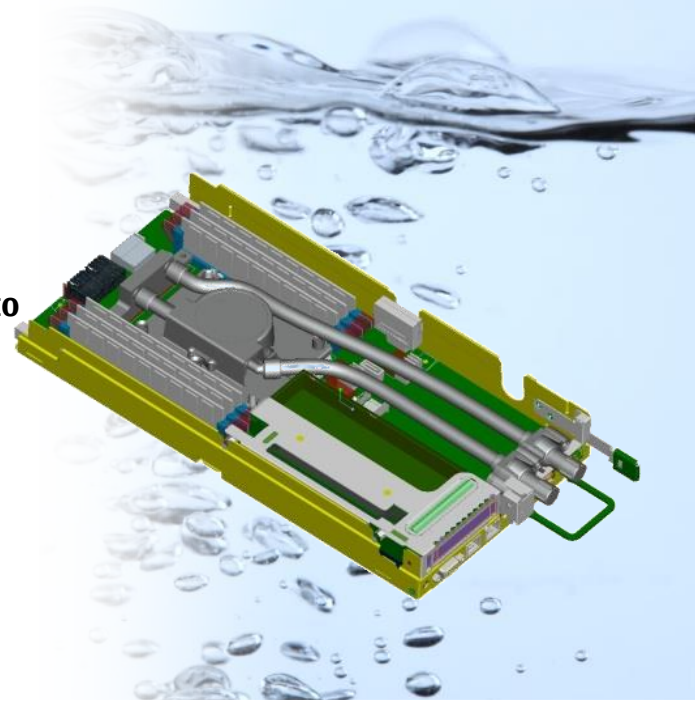
## Efficient cooling

- The liquid cooling is a direct-to-chip hot water (45 °C / 113 °F), based cooling solution that captures up to **75 %** of the PRIMERGY CX600 server heat
- Removes heat from Xeon Phi CPU and voltage-regulator-module (VRM) within the server, eliminating the need for chilling to cool these components



## Cool-Central<sup>®</sup> Liquid Cooling Technology is a reliable and effective solution to relieve the burden on data center cooling

- Helps to reduce data center cooling costs by over 50 %
  - Less air needs to be cooled and moved
  - Liquid cooled systems need less airflow
- Allows for 2.5-5x higher data center server density
- Low pressure in rack circuit eliminates leakage risks
- Returning water is warm enough to enable waste heat recycling



# Why hot-water On-Chip Liquid Cooling?



**Maximum rack density**

**Extreme dense** HPC and cluster installations with more than 50 kW per rack are only possible with liquid cooling

**Less cooling power and costs**

Liquid cooling allows for up to **50% less cooling power and costs** through high efficient coolers with low operating costs

**Lower investment needed for building new data centers**

A hot water based liquid cooling infrastructure requires a **way lower investment** than traditional air cooled infrastructure

**Lower overall energy consumption**

Hot water based liquid cooling enables the easy **usage of waste heat** for heating homes, green houses, or swimming pools



# JCAHPC "Many-Core" Fujitsu Supercomputer Project (2016)



## PRIMERGY Server-based x86 Cluster System



### Outline

Will be the Japan's **highest-performance supercomputer** at **25 PFLOPS**.  
System will contain over **8,200 Intel® Xeon Phi™ processors** and begin operations starting December, 2016.

### About JCAHPC

In 2013, the University of Tokyo's Information Technology Center (ITC) and the University of Tsukuba's Center for Computational Sciences (CCS) founded the Joint Center for Advanced High Performance Computing (JCAHPC) where both universities would collaborate to build and operate a single supercomputer system.

# JCAHPC "Many-Core" Fujitsu Supercomputer Breakdown



This supercomputer will contribute to science, technology and academia through the promotion of cutting-edge computational science

## #1 Supercomputer in Japan: Performance of **25 PFLOPS**

### Compute Nodes

FUJITSU PRIMERGY x86 servers  
Intel® Xeon Phi™ processors  
(code name: Knights Landing)

**8,208 nodes**  
Peak Performance: 25 PFLOPS



Compute Node Network (Intel® Omni-Path)

Parallel File System

High-speed File Cache System

Life/Management Network (Ethernet)

Project | Oakforest-PACS Supercomputer

Client | JCAHPC

### Technology & Solution

- x86 Fujitsu PRIMERGY cluster system, combination of 8,208 of the latest PRIMERGY models as computation nodes, additional 51 PRIMERGY units, including 20 PRIMERGY RX2530 M2 models as login nodes
- Eight nodes per 2U rackmount chassis
- Advanced "hot water" cooling technology is used to supply cooling water to all system's components
- Intel® "Omni-Path" interconnect for high performance parallelization
- Fujitsu will also supply an HPC middleware, the FUJITSU Software Technical Computing Suite, to ensure the efficient job scheduling and overall system management.

# JCAHPC Oakforest-PACS #1 in Japan (Top 500)



- Announced on November 15, 2016, Oakforest-PACS, built by Fujitsu and operated by JCAHPC, achieved a LINPACK performance of **13.55 PF**, and is ranked in the November TOP500 list as the highest-performing supercomputer in Japan. With a top performance of **25 PF**, this system surpasses the K computer by roughly 2.2 times.
- Oakforest-PACS is an Intel® Xeon Phi™-based cluster supercomputer, comprised of 8,208 nodes, used cooperatively by the University of Tokyo and the University of Tsukuba.
- Oakforest-PACS will be primarily used under Japan's "High Performance Computing Infrastructure Initiative."

## Quantum chromodynamics research with HPC

- ✓ Dedicated to research field in QCD
- ✓ One of early installations of KNL projects Germany / Europe
- ✓ 1PF with great efficiency on Linpack



### Key Facts




High Ranking in Green TOP500 expected



High Performance combined with on-chip liquid cooling technology



Leveraging Intel OmniPath Interconnect technology



**FUJITSU**

shaping tomorrow with you