



# Update on LRZ

## Leibniz Supercomputing Centre

of the Bavarian Academy of Sciences and Humanities

2 Oct 2018 | Prof. Dr. Dieter Kranzlmüller

## IT Service Backbone for the Advancement of Research Science



250  
employees  
approx.



56  
years of  
IT support



Computer Centre  
for all Munich Universities

Regional Computer Centre  
for all Bavarian Universities

National Supercomputing Centre  
(GCS)

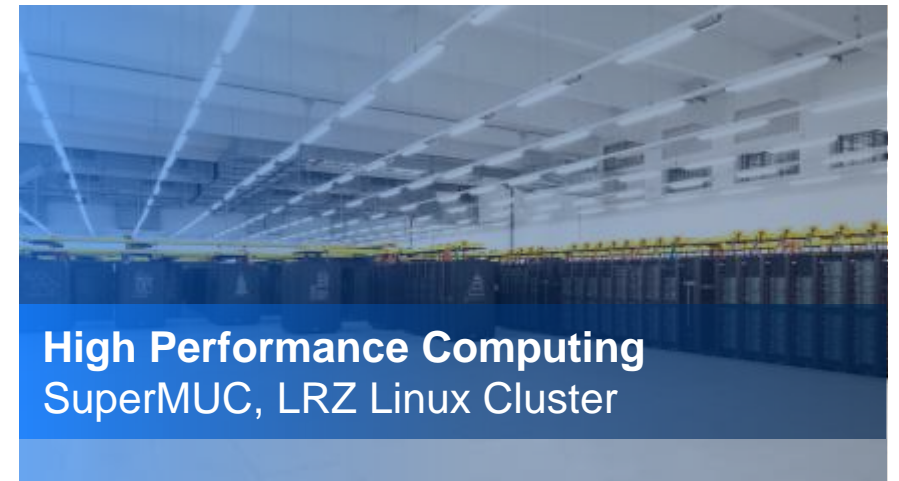
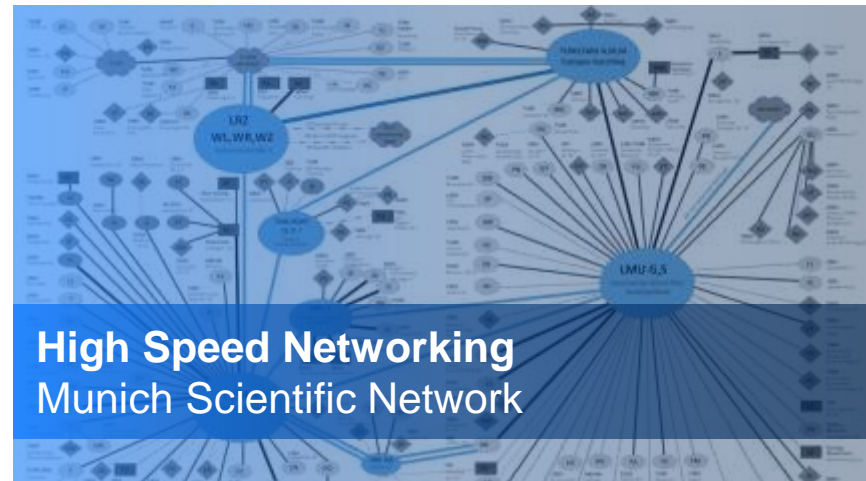
European Supercomputing Centre  
(PRACE)

# LRZ as an IT Center of Excellence

## Operating Cutting-Edge IT Infrastructure



Email	
Network	
Storage	
Cloud Computing	
Cluster	
HPC	
Training	
Consultancy	





## World's largest general purpose supercomputer



**3.2 + 3.6**  
Pflop/s Peak Performance



**288 (Thin) + 52 (Fat) + 2.56 (Phi) + 194 (Phase 2)**  
TByte Memory

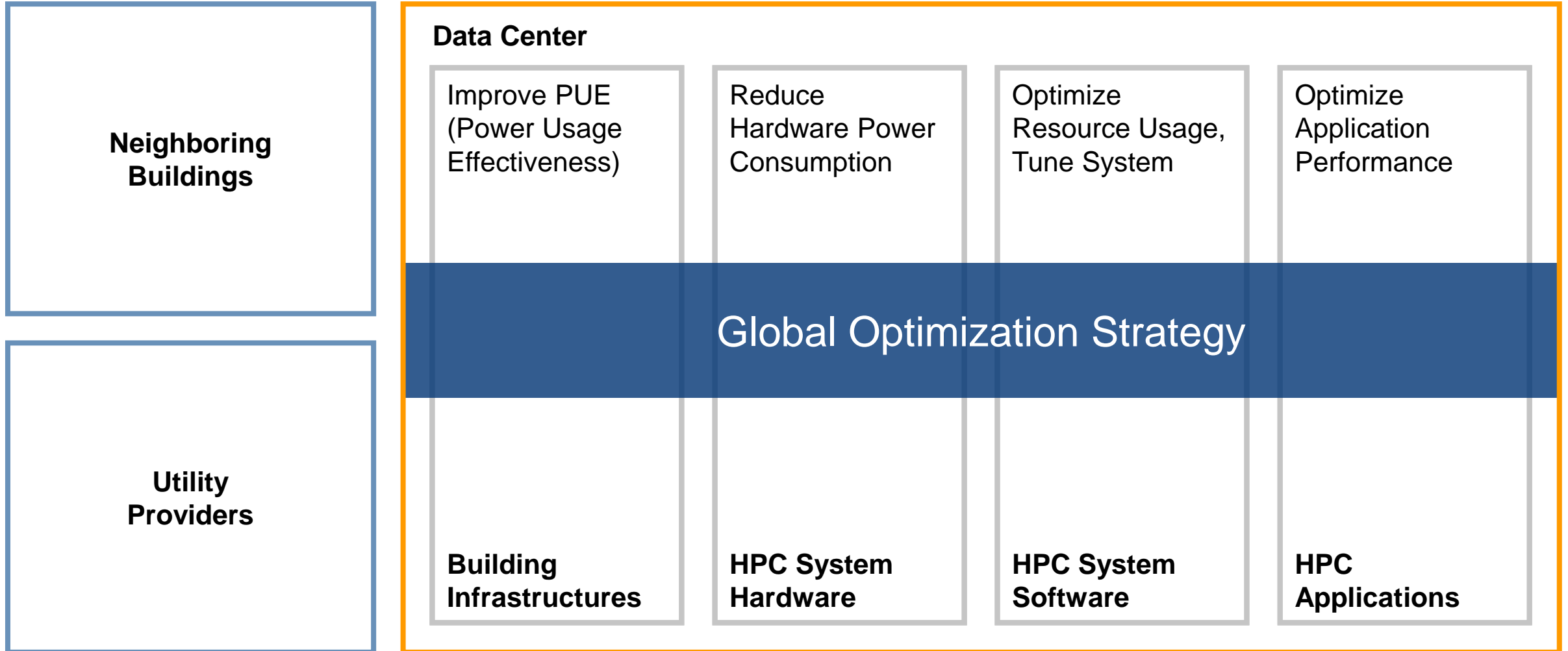


**2.3 + 1.1**  
MW Power Consumption



**147,456 (Thin) + 8,200 (Fat) + 3,840 (Phi) + 86,016 (Phase 2)**  
Cores

# The Four Pillar Model



# Pioneer in Hot Water Cooling



**2011**

**CoolMUC-1**

Megware

178 nodes, 22.7 Tflop/s, 40kW

SorTech ACS08, 6kW

**45 - 47 C year round**

**2015**

**CoolMUC-2**

Lenovo

384 nodes, 466 TFlop/s, 130kW

SorTech eCoo, 60kW

**45 - 47 C year round**

**2017**

**CoolMUC-3**

Megware

148 nodes, 394 TFlop/s, 60kW

**40 C summer / 30 C winter**



**2012**

**SuperMUC Phase 1**

IBM

9,216 nodes, 3.2 PFlop/s, 2.3MW

**40 C summer / 30 C winter**

**2015**

**SuperMUC Phase 2**

Lenovo

3,072 nodes, 3.6 PFlop/s, 1.1MW

**40 C summer / 30 C winter**

# Energy Efficiency at LRZ

## CoolMUC-3



3

Megaware  
SlideSX-LC Racks

- 100% warm water cooled
- 5 chassis per Rack
- 10 nodes per chassis

148

Compute nodes

- Intel Xeon Phi 7210-F
- 96GB DDR4
- 16GB HBM
- 2x100Gbit/s Omnipath



1

Air-cooled Rack

- <1% Power consumption
- 2x Management nodes
- Ethernet switches

Infrastructure

30 - 50°C

Inlet temperature range  
of the water cooling system

97

percent of waste heat  
transported in water

# Pioneer in Hot Water Cooling



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**2018**

**SuperMUC-NG Phase 1**

Intel/Lenovo

6,480 nodes, 26.9 PFlop/s, 2.8MW

Fahrenheit Zeo M, 600kW

**47 C w/adsorption chillers**

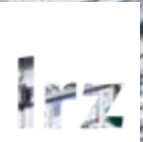


24 September 2018

The background of the slide is a photograph of a server room aisle. The aisle is formed by two long rows of black server racks. The racks are filled with server units, and their front panels are perforated, revealing green fiber optic cables. Yellow cable management trays are mounted on top of the racks, and the aisle is illuminated by overhead fluorescent lights.

# SuperMUC-NG

## Next Generation



# SuperMUC-NG

## Next Generation

# SuperMUC-NG (Next Generation)



## Specs

- Peak Performance: 26.7 Pflop/s
- 719 Tbyte main memory and
- 70 Pbyte disk storage
- 6,480 Lenovo ThinkSystem nodes with Intel Xeon processors (Skylake)
- 311,040 compute cores
- Intel Omni-Path interconnects
- Direct warm water cooled + Adsorption coolers

## HPC + Cloud

- Usage of own and individual virtual machines (integrated cloud)
- Pre- and post-processing with user's individual software
- Integrated development, ability to use familiar software and tools
- Remote visualization and integration to V2C

## Application Mix – General Purpose, Broad Use

### **Computational Fluid Dynamics**

Optimisation of turbines/wings, noise reduction

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### **Fusion**

Plasma in a future fusion reactor (ITER)

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### **Astrophysics**

Origin and evolution of stars and galaxies

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### **Solid State Physics**

Superconductivity, surface properties

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### **Geophysics**

Earth quake scenarios

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### **Material Science**

Semiconductors

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### **Chemistry**

Catalytic reactions

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### **Medicine and Medical Engineering**

Blood flow, aneurysms, air conditioning

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### **Biophysics**

Properties of viruses, genome analysis

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### **Climate research**

Currents in oceans

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# ORIGINS

Vom Ursprung des Universums  
bis zu den ersten Bausteinen des Lebens

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## Geophysics

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- > 7.6 billion compute hours consumed
- > 5.6 million jobs processed
- > 750 research projects carried out
- > 1,995 researchers as clients



High Performance  
Computing

in Science and Engineering  
Garching/Munich 2018

Get your digital copy  
of the results book on SuperMUC projects



# The LRZ as an IT service provider for science



Excellent research requires excellent tools

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High-performance computers provide  
computing power for scientific competition

.....

SuperMUC-NG offers the next generation of energy  
efficient HPC to a broad range of users

## Contact:

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