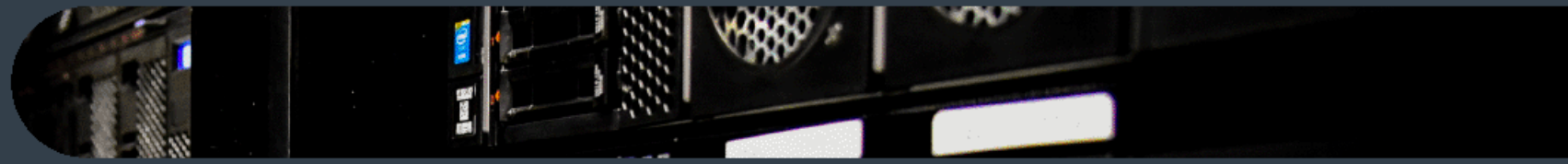
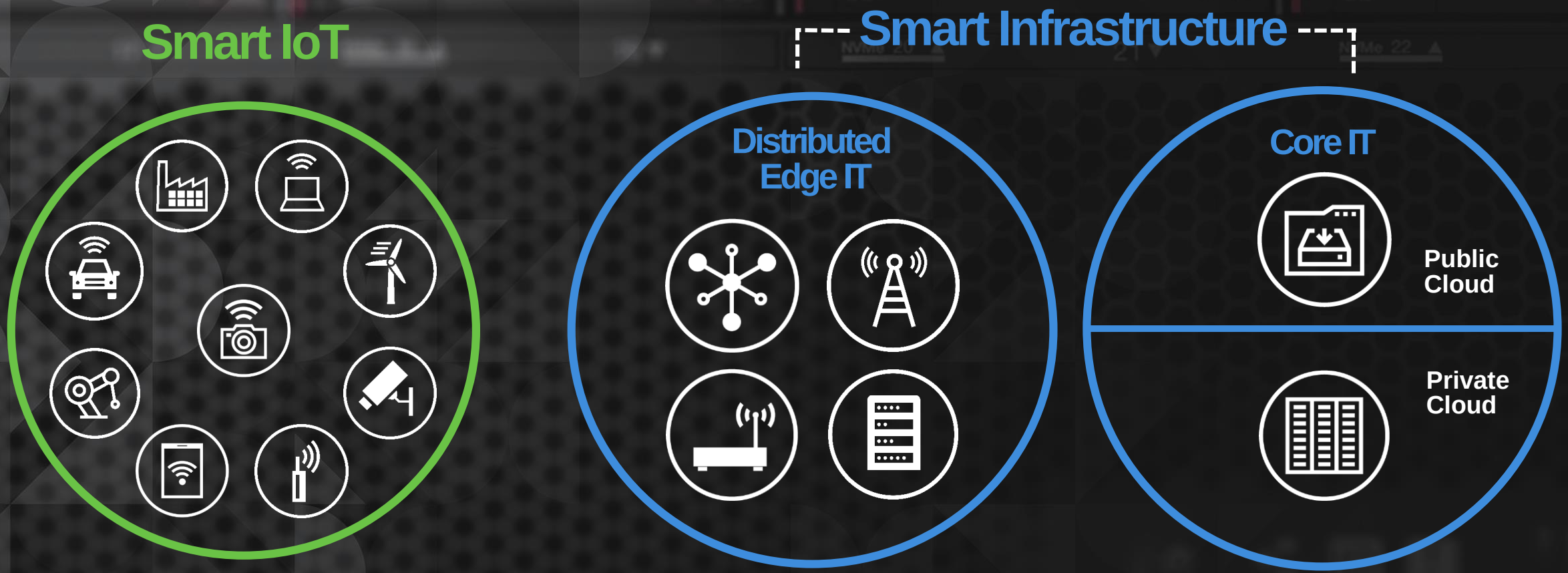


AI is hot. Here's how to cool it.

June 6, 2019 | Dave Weber, Director & CTO, Lenovo

Lenovo Smart Devices + Infrastructure



Lenovo – AI End-to-end Strategy

DATA CENTER & CLIENT SOLUTIONS

$1.2 Billion
AI Investment

"AI has changed everything and big data analysis is what large companies depend on."

Yang Yuanqing
CEO - Lenovo

AI Research
Providing tools and expertise to accelerate AI innovation.

100+ Data Scientist & Developers

Enterprise AI Solutions
Empowering organizations to launch their AI initiatives.

AI Research & Innovation Centers

AI Exploration
Democratizing AI for all.

AI HW & SW Platforms

End-to-end Solutions

Lenovo in AI/ML

Driving focus verticals

Healthcare & Life Science

Health Screening & Early Diagnosis

Academia & Research

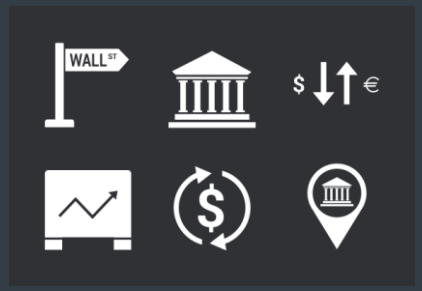
AI Powered Research

Manufacturing

Quality control & Predictive Maintenance

Energy / O&G

Improving uptime & Efficiency



Financial Services

Risk Monitoring, Anomaly Detection, Augmented Trading Strategies

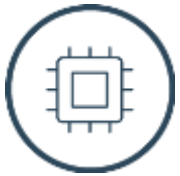
Other Use Cases

Lenovo™

Neptune™

ThinkSystem

What's The Future Look Like?



Higher Power Processors

Data Center limitations

Increasing Electricity Costs

Thermals Capping Performance

Waste Heat Reuse

CPU/GPU TDP Wattage

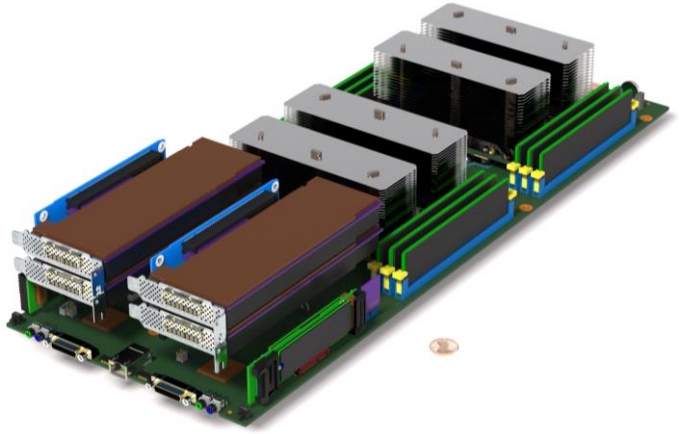
Server Form Factor

	<=205W	>205W-250W	250W – 500W
1U Half Wide	Air/Hybrid	Liquid	Liquid
1U Full Wide	Air	Air/Hybrid	Liquid
2U Half Wide	Air	Air/Hybrid	Liquid
2U Full Wide	Air	Air	Air/Hybrid

Lenovo Approaches to Thermal Challenges

HIGHER

- Grow Heat-Sinks
- Reduce Density
- Why not go wider?

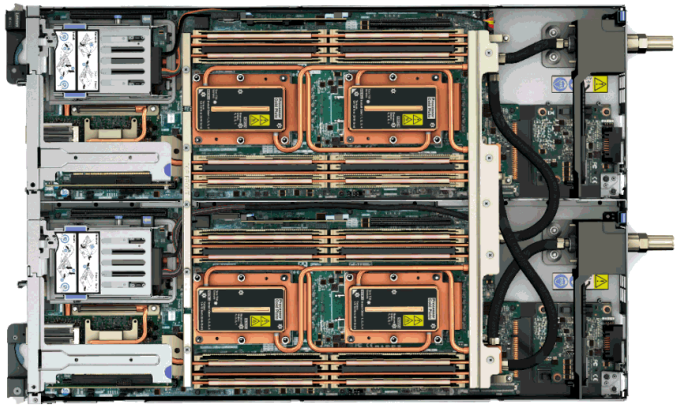


WIDER

- Back to Spread-Core
- Reduce Density
- Ok for „Technical Computing“

LIQUID

- Liquid within the node
- Increase density
- New Supercomputing standard

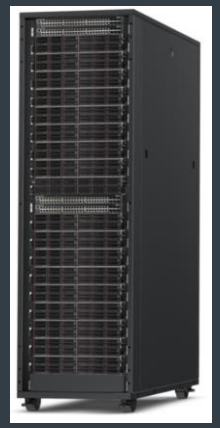


Lenovo HPC System Evolution 2006 - 2018

Eli Lilly and Company
(#75, Nov 2006)
Blade Center HS21 w/ Xeon 5160 2C 3.0GHz 80W

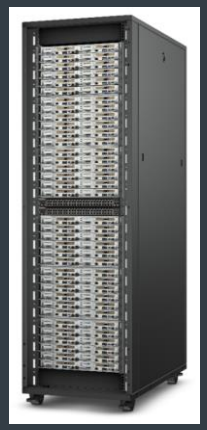
- **Rack: 56 Nodes, 224 Cores**
- **SPECfp2006 Rate: 2.548**
- **Rack Power: ~20kW**
- **Air Cooled**

BSC – Mare Nostrum
(#16, Nov 2017)
Lenovo SD530 w/ Xeon 8160 24C 2.1GHz 150W



- **Rack: 72 Nodes, 3.456 Cores**
- **SPECfp2006 Rate: 110.160**
- **Rack Power: ~33kW**
- **RDHx**

LRZ – SuperMUC-NG
(#8, Nov 2018)
Lenovo SD650 w/ Xeon 8174 24C 3.1GHz 240W



- **Rack: 72 Nodes, 3.456 Cores**
- **SPECfp2006 Rate: tbc**
- **Rack Power: ~45kW**
- **DTN Liquid**

90 Racks
6,480 Nodes
311,040 Cores
26.9 Pflop/s Peak

#8 on Top500

SuperMUC-NG
fastest general purpose
Supercomputer in the World

Liebert® XDU: 60 kW Water to Air HX – in row cooling without the CRAC

Key Features

- 42U, 600mm (24”) cabinet
- Redundant Pumps with VSD Control
- Closed Loop Fan Speed Control
- Designed to ASHRAE Liquid Cooling Class W4
- Designed to ASHRAE Air Cooling Class A2
- Top or Bottom Liquid Connection
- Integrated 50micron Filter
- iCOM 9” Color Touch Screen Display
- Adjacent or Remote Placement Options
- Intelligent Flow Monitoring with Alarm Features

Key Benefits

- Easy to Install and Service
- Eliminates Need for Facilities Water
- Installs in any data center environment
- In-Row or Perimeter Placement Options
- Reduces CAPEX for Liquid Cooling
- Localized liquid loop

Available Q3 2019

Enables Liquid Cooled Solutions in Any Data Center Environment

Lenovo SD650 – Enterprise-class HFT

Direct liquid cooling technology for a highly efficient data center

Maximum Performance

- ✓Constantly run CPUs in Turbo mode
- ✓Supports highest core/fastest* CPUs
- ✓Faster memory
- ✓6244 – 8 cores, 3.6 base, 4.3 max all-core turbo (non-AVX)
  - ✓With DLC, boost to 4.5 GHz!

Energy Efficiency

- ✔90% heat removal efficiency
- ✔Eliminates system fans – ultra quiet
- ✔Reduces power consumption and energy bills

Extreme Density

- ✓Dual Node Tray, 6 trays/enclosure, 6 enclosures/rack
- ✓72 nodes per rack with space left over for fabric & storage
- ✓Twice as dense as 1U servers, 1100+ cores/rack @8 cores/cpu

Lenovo Servers – STAC® Leadership Performance

- Kit & benchmarks:
  - SR950: 4x 8280L's, 1.5 TB DRAM
    - 12 TB (24x 512 GB) Intel Optane DC Persistent Memory (DCPMM) modules
    - SUT ID: KDB190322b STAC-M3™. Tested with STAC-M3 (Antuco).
  - SR650: 2x 8280L's, 768 GB DRAM
    - 6 TB (12x 512 GB) Intel Optane DCPMM's
    - SUT ID: KDB190320b STAC-M3™. Tested with STAC-M3 (Antuco)
  - kdb+ 3.6, RHEL 7.6
  - Security patches for the full range of Spectre/Meltdown vulnerabilities including 1, 2, 3 and L1TF
- April 2, 2019 records set:
  - Set 11 of 17 new records for 2S
    - Eleven were 2x faster, some were up to 9x faster
  - Set 9 of 17 new records for 4S
    - Six were more that 2x faster, some up to 3.7x faster

Different is better