Lenovo & SUSE HPC

SUSECON 2019

Francois Corradino – Lenovo Sr Manager HPC, AI, SAP
Jose Betancourt – Director Global Alliances Lenovo
Agenda

- Lenovo overview
- Lenovo Value add for HPC
- A word on the future
- AI
- SUSE
  - SUSE Enterprise Linux Server for HPC
  - SUSE Storage
A global technology leader

- **52,000** Employees serving customers in 160+ countries
- **#226** Fortune 500 Company
- **$43B** Publicly traded on the Hong Kong Stock Exchange
- **$1.2B** AI & IOT investment
- **7** different nationalities in leadership executive council
- **5** nationalities represented on Board of Directors
- **36** manufacturing facilities, 7 research centers and 71 offices globally
- **100%** different nationalities in leadership executive council
- **7** nationalities represented on Board of Directors
- **36** manufacturing facilities, 7 research centers and 71 offices globally
DCG: TRANSFORMING THE CUSTOMER EXPERIENCE

#1 IN PERFORMANCE
129 WORLD RECORDS

#5 IN HIGH TECH SUPPLY CHAIN

#1 IN X86 SERVER RELIABILITY
5 YEARS RUNNING

2018 Gartner Supply Chain Top 25: High Tech

#1 IN CUSTOMER SATISFACTION

19 OF 22 ATTRIBUTES IN N. AMERICA
18 OF 22 ATTRIBUTES IN EMEA & APAC

***ITIC 2016/2017 & ITIC 2017/2018

>750 CXO / IT SURVEYED
IN >20 COUNTRIES
Unplanned downtime
>4 Hours

LENOVO SYSTEM X
CISCO UCS
DELL POWEREDGE
HPE PROLIANT

1% 1%
2 7%
7% 7%
14% 10%
16%

2016 2017
Lenovo users report spending average of 4.2% of their HPC budgets on services and personnel for maintenance and repair, compared to the population-wide average of 4.8%, implying 12.5% savings on spending in those categories.
#1 PROVIDER OF SUPERCOMPUTERS IN THE WORLD
MORE THAN 1 IN 4 RUN ON LENOVO

140+ systems  28% share

0  140

#1 in aggregate performance
Most diverse footprint 17 countries
Lenovo’s Track Record in HPC

✓ Lenovo has the highest performing servers in the industry:
  4 HPCWire Awards + Vendor Showdown Award at ISC in 2018
Lenovo’s Track Record in HPC

✓ 17 of the Top 25 Research Universities run Lenovo
## Lenovo Value Add for HPC

### Solution Exploration and Selection
- Vertical Expertise
- Innovation Centers
- Data Center Consulting
- Benchmarking Experts

### Solution Design
- Full system Installation and bring up
- LeSI Best Recipes
- Thermal profiling of components
- Solution Architecture

### Delivery, Support and Success
- White Glove Delivery
- Self-Maintainer Program
- Expansion Price Protection
- Personalized Partnerships

### Technology Differentiator
- SharedIO
- Direct Water
- Storage
  - DSS-G
  - SUSE CEPH
Press release yesterday

- We refreshed all our ThinkSystem and ThinkAgile datacenter portfolio aligned with the Intel’s launch of the 2nd Generation Intel® Xeon® Scalable processors (Cascade Lake) with Intel® Optane™ DC persistent memory modules.
With our new ThinkSystem servers, research teams will be able to generate results faster, enabling new discoveries and breakthroughs. These new systems deliver even faster processing speeds than previous generations. Lenovo’s reputation as a leader in high performance computing, and their ability to deliver the servers just days after the new Intel processors became commercially available were real differentiators to us in our selection process.

Ian Fisk– Scientific Computing Core Co-Director at Simons Foundation, January 2019
Higher input power will push us past the ability for traditional air removal of heat.
Thermal Transfer Module (TTM) New!

- 205W CPUs in a 2U4N system
- $2,100 / year per rack energy savings

Rear Door Heat Exchanger (RDHX)

- 3.5X more efficient than air only
- Heat removed could power 4,000 LED bulbs

Direct to Node Cooling (DTN)

- Run highest performance CPUs
- Up to 40% reduction in power costs
Leibniz SuperComputing Centre (LRZ)
- SuperMUC – NG
- 26.9 PetaFlops
- 6500 nodes
- Build date – March, 2018
- LRZ: Leibniz Supercomputing Centre

Barcelona SuperComputing Centre
- MareNostrum 4
- 11.1 PetaFlops
- 3400 nodes (48 Lenovo SD530 racks)
- Lenovo activates world's largest Intel-based SuperComputer in Barcelona
AI transforming enterprises
Reduce costs, make better decisions, gain competitive advantage and impact human lives

**AI Core Capabilities**
- Computer Vision
- Natural Language Processing (NLP)
- Predictive analytics
- Knowledge graphs

**Use cases**
- MFG Quality control
- Image diagnosis
- Automated retail checkout
- Training/document management
- Call Center / Chat Bots
- Machine maintenance,
  Commercial IoT & Fraud detection
- Knowledge management,
  document search
- Compliance checks

**Healthcare**
- Medical Image Diagnosis
  - Error rate reduction: 85%

**Manufacturing**
- Defect detection improvement: 90%
- Lost sales reduced by Supply-chain forecasting improvements: 65%
- Supply-chain forecasting improvements: 50%

**Finance**
- Time savings with credit decisions: 25-50%
- Global fraud savings: $60 Billion

Reduce costs, make better decisions, gain competitive advantage and impact human lives.
The complexity of AI
What it takes to build a custom solution.

It's complex and it requires
• Investment
• Time
• Diverse skills
Lenovo AI offerings
Reducing uncertainty and complexity

Launch:AI workshop
Discover
We are just getting started on AI but don’t know how to / didn’t identify a use case

AI innovation center
PoC
Discover
We already selected a use case but want to test technical feasibility and prove business value

AI starter kits
+ LiCO
Develop
We are hiring some talent (1-2 persons) and looking for HW and SW tools to get started

AI Ref architectures
+ LiCO
Deploy
We have multiple projects in the pipeline with teams and are in the process of scaling AI for better ROI

AI infrastructure (servers, storage, networking)
We are simply looking for infrastructure solutions
ANNOUNCING LAUNCH:AI WORKSHOPS AT SC18

Transforming Your Business With Artificial Intelligence

Making AI A Reality For Business Transformation

Transforming Your Business With Artificial Intelligence

Our team of AI experts including Data Scientists and AI Engineers will be sharing their knowledge to help you understand how AI can help transform your business.

Data Center Group

LAUNCH:AI

WHAT WE’LL COVER

- Common use cases within your specific industry
- Cloud services vs. on-prem AI, Hybrid Cloud & AI
- How to build your data pipeline
- Building an end-to-end AI solution
- Custom report with guidance on next steps

INDUSTRY SPECIFIC SOLUTIONS

- Energy
- Healthcare & Life Sciences
- Financial Services
- Manufacturing
What is LiCO?

LiCO = Lenovo Intelligent Computing Orchestration

• Lenovo-developed software
  – that brings together a number of open-source tools into a single GUI
    - to make the use and management of distributed computing resources easier
      - for HPC and AI workloads

• LiCO leverages an open-source base
  – OpenHPC project software distro for cluster management tools
    - augmented with Lenovo value-add open source components
      - extended with open AI frameworks, workflows and job management
        - to orchestrate and manage HPC and AI workloads
LiCO validated software component stack

**Web GUI (LiCO)**
- LiCO user portal
- LiCO operator portal (monitoring)
- LiCO administrator portal

**AI Frameworks**
- Caffe (CPU, GPU)
- TensorFlow (CPU, GPU)
- MXNet (CPU, GPU)
- Intel-Caffe (CPU)
- Neon (CPU)

**Cluster Management Software Stack**
- xCAT (Lenovo)
- Confluent (Lenovo)
- HPC Energy-Aware Runtime (Lenovo)
- Slurm/Munge (OpenHPC)
- Ganglia (OpenHPC)
- Singularity (OpenHPC)
- gmond (OpenHPC)
- CUDA (NVIDIA)
- CUDNN (NVIDIA)
- RabbitMQ
- PostgreSQL
- Nginx
- Influxdb
- OpenLDAP
- OpenMPI
- MPICH
- MVAPICH2

**Operating System**
- SUSE SLES12 SP3
LiCO “abstracts the stack”

User Portal to deploy, monitor and manage HPC and AI workloads

Administrator Portal to manage and monitor cluster resources
AI for better quality control
Innovation in Manufacturing with Lenovo

**Current State of Manufacturing:**
Quality Control directly related to:
- More yield at higher speed
- Lower production costs by faster adjustments to process

**Where AI can help:**
- Better manage quality through product age of customizations using computer vision

**McKinsey Predictions**

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<th>Metric</th>
<th>Improvement</th>
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<tr>
<td>Defect detection</td>
<td>90%</td>
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<tr>
<td>Lost sales reduced by</td>
<td>65%</td>
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<tr>
<td>Supply-chain forcasting errors</td>
<td>50%</td>
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<tr>
<td>Scrap rate reduced</td>
<td>30%</td>
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Lenovo’s liver tumor segmentation

The Challenge:
• Develop automatic segmentation algorithms to detect liver lesions in CT scans

AI technology (named leHealth):
• Analyzes CAT images of patients to detect and classify tumors
• Enables easier and accurate diagnosis by highlighting the locations and status of tumors

<table>
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<tr>
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<th>Image classification accuracy*</th>
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<td>AI</td>
<td>92.5%</td>
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<tr>
<td>Pathologist</td>
<td>96.6%</td>
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<td>Pathologist assisted by AI</td>
<td>99.5%</td>
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85% reduction in human error rate*

Next Steps?
Interested to learn more?

• Lenovo has…
  – Solution Briefs
  – Vertical Experts
  – Reference Architectures
    - DSS-G
    - Genomics @ Scale: DSS-G for Genomics
    - Big Data
  – AI
    - Launch:AI workshop
    - Innovation Center collaboration
    - Use Case PoC
  – Briefing
    - June 6 – AI/Big Data Customer Briefing
SUSE Linux Enterprise HPC Module

- Simplifying access to supported HPC software
  - All packages supported by SUSE (Base OS + Module)
    - SLE HP includes popular HPC software such as slurm and OpenMPI
  - Enterprise Linux with Enterprise support
    - Incidents such as Spectre/Meltdown highlight the need for quick response to address system vulnerabilities
  - Support included in SLES for HPC subscription
  - Easy installation via yzypper or YaST
  - Available for x86 and ARM platform beginning with SLES 12 SP2
  - Flexible release schedule
    - Releases are independent of Service Pack schedule
  - Aggressively priced subscriptions
- Proven track record in HPC

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Positioning SUSE Linux Enterprise for HPC

• Enterprise Linux with Enterprise support
  – Incidents such as Spectre and Meltdown highlight the need for quick response to address system vulnerabilities
• More than just the OS – HPC software included and supported
  – SUSE Linux Enterprise for HPC includes popular HPC software such as *slurm* and *OpenMPI*
• Additional open-source packages via PackageHub
• Aggressively priced subscriptions
  – SUSE Linux Enterprise for HPC priced for large and small HPC configurations
• Multiple service life options
  – Extended Service Pack Overlap Support (ESPOS) built-in
    - 18 months of total Service Pack Support *after* the release of a newer Service Pack
    - Long-Term Service Support (LTSS) available in one-year increments after ESPOS for additional coverage within the same SP
• Proven track record in HPC
  – 50% of the Top 100 are running SUSE Linux or SLES-based OS
Storage
Lenovo Distributed Storage Solution for IBM Spectrum Scale (DSS-G)

- Scalable storage solution for HPC, BigData, and Cloud
  - Building-block approach to easily deploy and scale capacity and performance

- Leverages the latest Lenovo technology, along with IBM Spectrum Scale and Linux
  - Cost-effective approach to meet the storage performance, capacity, and uptime demands in scale-out environments

- Validated, engineered solution delivered through Lenovo Scalable Infrastructure (LeSI)
  - Ensures interoperability, support and smooth deployment
  - Onsite installation and configuration provided through Lenovo or approved business partner
  - Available in 1410 rack, or can be installed in customer rack
Introducing IBM Spectrum Scale

Highly scalable high-performance unified storage for files and objects with integrated analytics

• Remove data-related bottlenecks
  – Demonstrated 400GB/s throughput

• Enable global collaboration
  – Data Lake serving HDFS, files & object across sites

• Optimize cost and performance
  – Up to 90% cost savings & 6X flash acceleration

• Ensure data availability, integrity and security
  – End-to-end checksum, Spectrum Scale RAID, NIST/FIPS certification
SUSE Enterprise Storage
Unlimited Scalability with self-managing Technology

Management Node

Object Storage
Block Storage
File System

Monitor Nodes

Storage Nodes

Highly Scalable
Reduces Cost

SUSE Development Focus Areas

Manageability
Interoperability
Efficiency
Availability
How is SUSE Enterprise Storage used in HPC

• Block storage for VMs
  – Sites deploying HPCaaS with virtual machines acting as nodes
  – Dev/test environments
  – Mixed usage nodes (ex: SR650) using a combination of fast HDDs and fast SSDs

• Primary storage
  – High-speed, high-performance cache layer leveraging NVME or fast, enterprise-class SSDs

• Scratch storage/Tier-2 storage
  – All HDD OSD nodes
  – IBM Spectrum Scale (GPFS – Lenovo DSS-G) as primary tier
  – Leverage Spectrum Scale Transparent Client Tiering
Tiered HPC Storage Solution
Common Use Case – Tier 2 Storage/Active Archive

- Low Latency Storage
- IBM Spectrum Scale

Transparent Cloud Tiering → SUSE Enterprise Storage
Architecture for Primary HPC Storage
Ideal for small clusters (Ex: <= 250 nodes)

CephFS:
- Is a distributed file system with POSIX semantics
- Offers Scale Out Load Balanced Active Metadata servers and Direct Access to OSD nodes

Design Considerations:
- Cache Tier sized to working data set allows acceptable latency
- CephFS throughput scales with additional nodes
Positioning SUSE Enterprise Storage

• Block, file, and object storage through one solution.
  – Configure OSD, Gateways, and network depending on the requirements of the environment.
  – Lenovo’s server, network, and DASD portfolio allows multiple configurations with a common set of building blocks.

• As active archival component when tied to an IBM Spectrum Scale (DSS-G)
  – New installation.
  – As supplemental platform for existing Spectrum Scale/GPFS installations.

• As primary storage solution for HPC solutions:
  – For installations with <=250 compute nodes.
  – Leveraging the ability to deliver several file options (CephFS, NFS).

• Note: SUSE Enterprise Storage is priced per 2-socket node
  – **NOT by GB/TB/PB**
  – **NO additional client licenses required**
Different is better

thanks.