

HPC + AI for everyone – with Microsoft Azure

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Agenda

1. Why HPC on Azure?

- Why High Performance Computing?
- Why Microsoft Azure?
- Industry, Customer, and Partner Ecosystem

2. How could you do it?

- Architectures & Orchestration Tools
- Compute, Storage, Networking
- More Information



Why HPC on Azure?



Microsoft mission:

To enable every person & organisation on the planet to achieve more.

- Enabling Scientists, Engineers, Researchers
- Faster Simulations
- Cheaper Simulations
- More Simulations

Why High Performance Computing (HPC)?



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Why Cloud for HPC?

Transformation requires a new level of compute power



Total autonomy will only be 100% accident-free by testing a minimum of **8.8 billion miles**.¹



Autonomous vehicles will generate and consume roughly **4,000 gigabytes of data** a day by 2020.²



20.4 billion things will be connected by 2020.³



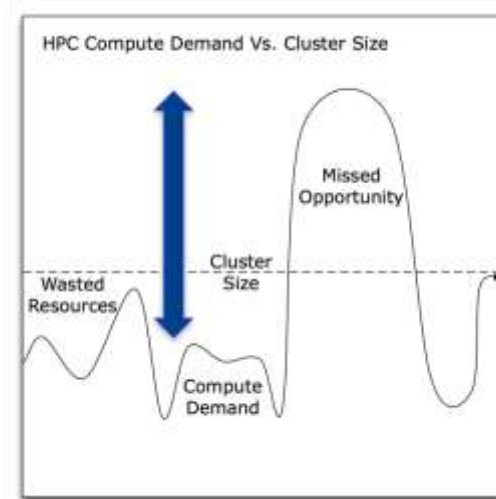
An animated film might render as much as **65 million hours** of footage to come up with 90 minutes of worthwhile materials.⁴



NASA's Earth Observing System Data and Information System (EOSDIS) distributes almost **28 terabytes of data** a day.⁵



An airplane will generate **40 terabytes of data** a day by 2020.⁶



Why Microsoft Azure for HPC?

On-demand

Access on-demand compute resources that enable you to run large parallel and batch compute jobs in the cloud, right when you need to

Extensible

Extend on-premises HPC cluster to the cloud when you need more capacity, or choose to run simulations entirely in the cloud

Scalable

Scale up and down easily, and take advantage of advanced networking features such as RDMA to run true HPC applications using MPI



Native Linux &
Windows support



RDMA
support



VPN & Express Route
(MPLS) networking

Broad partner
ecosystem

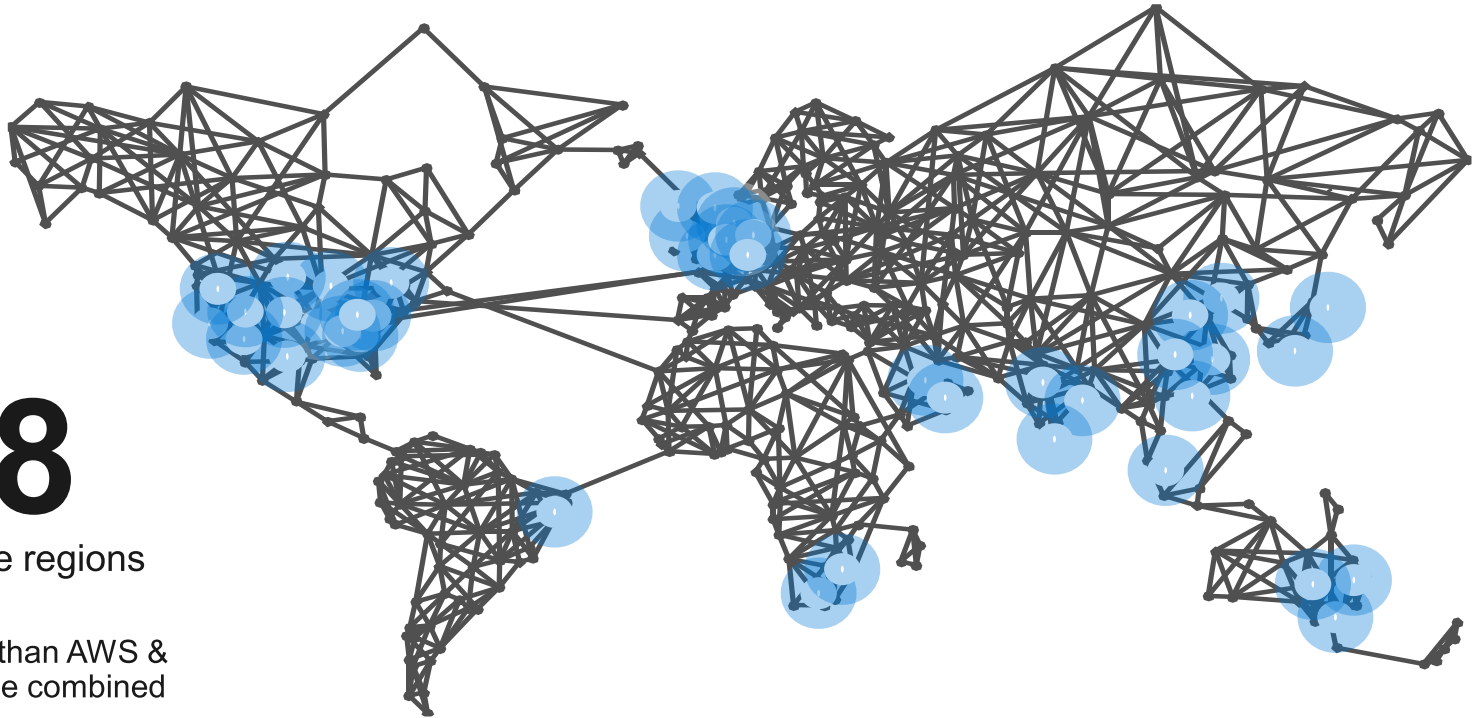
Azure HPC Attributes

Microsoft Azure: Built for scale

58

Azure regions

More than AWS &
Google combined



Microsoft Azure: Built for trust

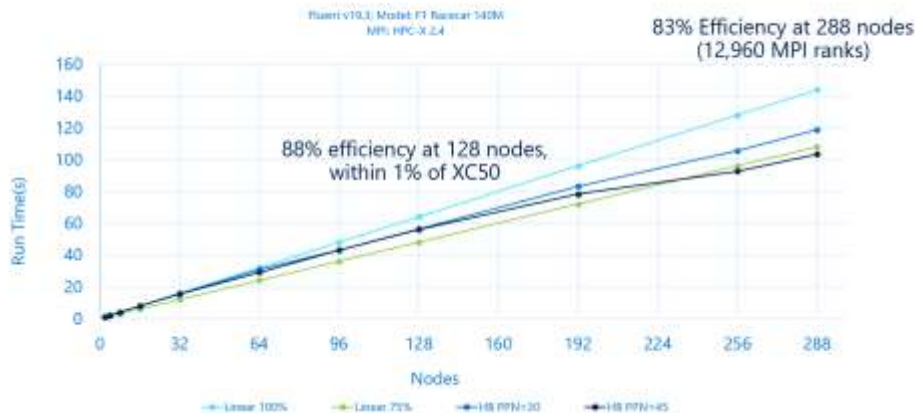
Global	<ul style="list-style-type: none"> ISO 27001:2013 ISO 27017:2015 ISO 27018:2014 	<ul style="list-style-type: none"> ISO 22301:2012 ISO 9001:2015 ISO 20000-1:2011 	<ul style="list-style-type: none"> SOC 1 Type 2 SOC 2 Type 2 SOC 3 	<ul style="list-style-type: none"> CSA STAR Certification CSA STAR Attestation CSA STAR Self-Assessment WCAG 2.0
US Gov	<ul style="list-style-type: none"> FedRAMP High FedRAMP Moderate EAR 	<ul style="list-style-type: none"> DoD DISA SRG Level 5 DoD DISA SRG Level 4 DoD DISA SRG Level 2 DFARS 	<ul style="list-style-type: none"> DoE 10 CFR Part 810 NIST SP 800-171 NIST CSF Section 508 VPATs 	<ul style="list-style-type: none"> FIPS 140-2 ITAR CJIS IRS 1075
Industry	<ul style="list-style-type: none"> PCI DSS Level 1 GLBA FFIEC Shared Assessments FISC (Japan) APRA (Australia) OSFI (Canada) 	<ul style="list-style-type: none"> FCA + PRA (UK) MAS + ABS (Singapore) 23 NYCRR 500 SEC 17a-4 CFTC 1.31 FINRA 4511 	<ul style="list-style-type: none"> SOX HIPAA BAA HITRUST 21 CFR Part 11 (GxP) MARS-E NHS IG Toolkit (UK) 	<ul style="list-style-type: none"> NEN 7510:2011 (Netherlands) FERPA CDSA MPAA FACT (UK) DPP (UK)
Regional	<ul style="list-style-type: none"> Argentina PDPA Australia IRAP Unclassified Australia IRAP Protected Canada Privacy Laws China GB 18030:2005 China DJCP (MLPS) Level 3 	<ul style="list-style-type: none"> China TRUCS / CCCPPF EN 301 549 EU ENISA IAF EU Model Clauses EU – US Privacy Shield GDPR Germany CS 	<ul style="list-style-type: none"> Germany IT-Grundschutz workbook India MeitY Japan CS Mark Gold Japan My Number Act Netherlands BIR 2012 New Zealand Gov CIO Fwk 	<ul style="list-style-type: none"> Singapore MTCS Level 3 Spain ENS Spain DPA UK Cyber Essentials Plus UK G-Cloud UK PASF

Microsoft Azure: Built for HPC Performance

ANSYS Fluent on Azure HB VMs

Computational Fluid Dynamics (CFD)

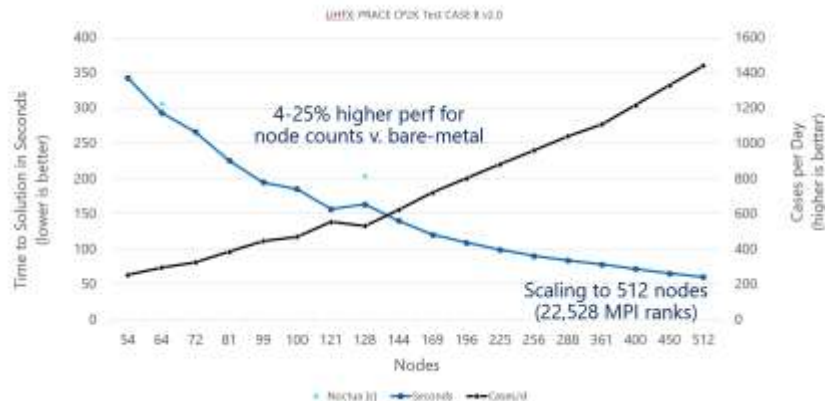
Scaled to 12,960 cores in a single job



CP2K on Azure HC VMs

Quantum Chemistry & Solid State Physics

Scaled to 22,528 cores in a single job



Broad HPC Partner Ecosystem

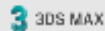
Cloud Workstation:



Deep Learning and AI Training:



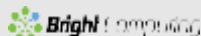
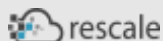
Cloud Rendering:



Supported OS:



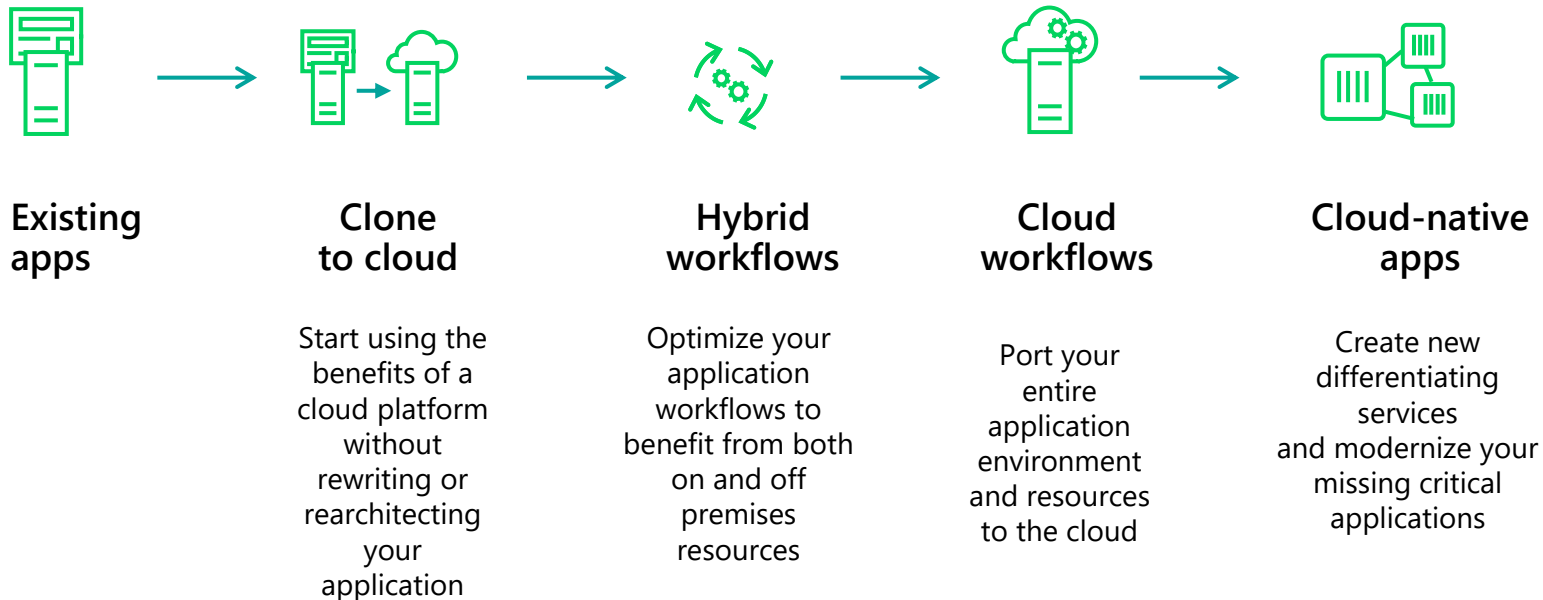
HPC Simulation and Analysis:





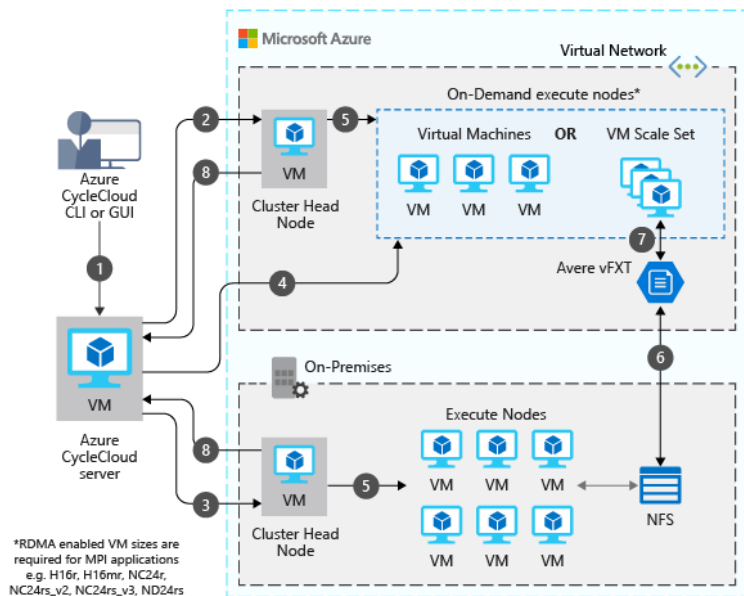
*How could you
do it?*

A Cloud HPC Adoption Lifecycle



HPC Architectures: Classic, & Cloud Enabled

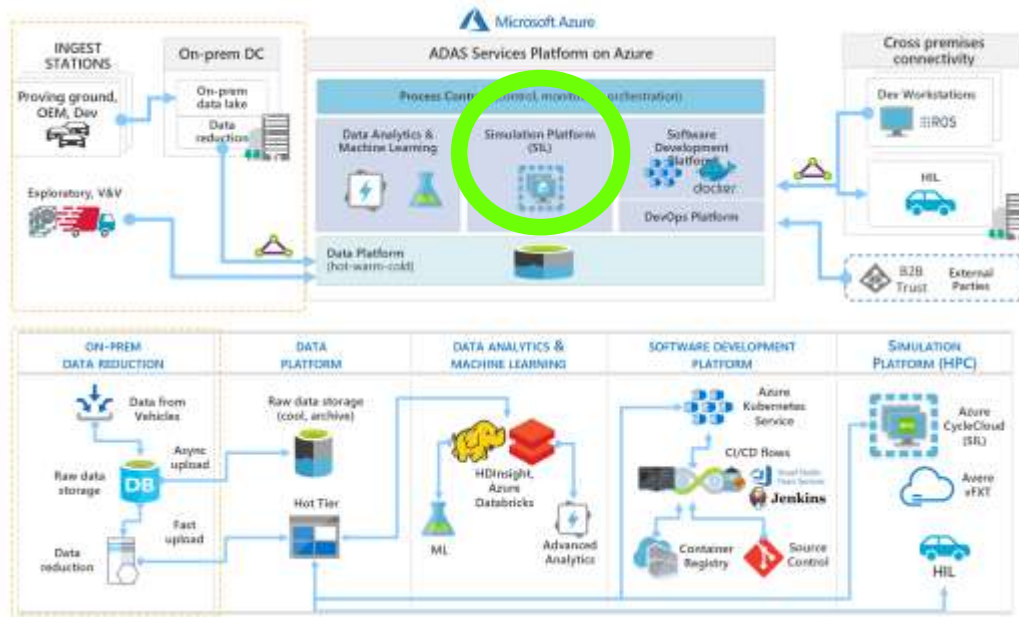
Classic HPC architecture & workflow



1. Connect to the Azure CycleCloud server to configure the cluster.
2. Configure and create the cluster head node, using RDMA enabled machines for MPI.
3. Add and configure the on-premises head node.
4. If there are insufficient resources, Azure CycleCloud will scale up (or down) compute resources in Azure. A predetermined limit can be defined to prevent over allocation.
5. Tasks allocated to the execute nodes.
6. Data cached in Azure from on-premises NFS server.
7. Data read in from the Avere vFXT for Azure cache.
8. Job and task information relayed to the Azure CycleCloud server.

HPC Architectures: Classic, & Cloud Embedded

Wider Cloud Workflow: e.g. Autonomous Driving



Simulation Platform (HPC cluster) sits in the middle of wider workflow:

1. Ingest Data
2. Store Data
3. **Simulate**
4. Model/Learn/Analyse
5. Test
6. Deploy & Reiterate

Azure Machine Learning

Sophisticated pretrained models

To simplify solution development



Vision



Speech



Language



Search

Popular frameworks

To build advanced deep learning solutions



Pytorch



TensorFlow



Keras



Onnx

Productive services

To empower data science and development teams



Azure Databricks



Azure Machine Learning



Machine Learning VMs

Powerful infrastructure

To accelerate deep learning



CPU



GPU



FPGA

Flexible deployment

To deploy, manage models on intelligent cloud & edge



On-premises



Cloud



Edge

Azure Orchestration & Tools for HPC

Azure CycleCloud

- Lift & Shift HPC cluster workloads
- Empower users, IT, business & manage whole lifecycle: provision, config, monitor, optimize
- *Great for: IT admins, End users, Linux HPC clusters, auto-scale*



Azure Batch

- “HPC as a Service” – abstract to pools, jobs, tasks
- Autoscale workloads (10s to 1000s of VMs) and auto-recover from failures
- *Great for: Developers & end users, auto-scaled and managed workloads*



Cloud Native HPC

- Choose from 100s of Azure Services (IaaS, PaaS, SaaS), including IoT, AI, ML, Data
- Best Practice Architectures, docs, and templates available online
- *Great for: “Next Generation” HPC apps and app development*



Partner Solutions

- Third-party, Partner/ISV solutions for every industry/scenario
- Integrated or available through Marketplace
- *Great for: integrated & managed solutions from trusted names*



SLES HPC in Azure Portal

The image displays the Microsoft Azure Marketplace interface. On the left, a search for 'SLES HPC' yields 48 results. The main pane shows the details for 'SUSE Enterprise Linux HPC 15 SP1 + 24x7 Support' by SUSE. The product page includes a 'Create' button, a 'Start with a pre-set configuration' button, and a link to 'Deploy with Resource Manager (change to Classic)'. The 'Overview' tab is active, showing a description of the operating system for high-performance computing, highlighting its Azure-tuned kernel for up to 25% faster network throughput and 23% reduction in average latency. It also lists key benefits: realizing faster time-to-value, increasing scalability, efficiency, and performance, and adapting the growing HPC environment on-demand and stay in budget. A note states that this image includes an Azure-tuned kernel for up to 25% faster network throughput and 23% reduction in average latency, while BYOS images do not. It is a 'Pay as You Go' subscription of SLE HPC, including 24 x 7 integrated support from Microsoft and SUSE. Useful links are provided at the bottom, including 'Learn more', 'Documentation', 'Forum', 'SLE HPC Datasheet', 'Cloud Ready High-Performance Computing', and 'SUSE Linux Enterprise High Performance Computing'.

SUSE Enterprise Linux HPC 15 SP1 + 24x7 Support

Operating system for high-performance computing with an Azure-tuned kernel for up to 25% faster network throughput and 23% reduction in average latency.

SUSE Linux Enterprise High Performance Computing harnesses the power, speed and scale of parallel computing in the cloud and provides the infrastructure to solve your most demanding computational and data-intensive problems through modeling, simulation and advanced analytics.

- **Realize faster time-to-value with an accelerated HPC environment** with intelligent workload management and monitoring designed to support applications like AI/ML, while leveraging accelerator options.
- **Increase scalability, efficiency and performance** with an HPC platform that runs on a wide range of hardware from the edge to the core to choose the optimal place to run your workloads.
- **Adapt your growing HPC environment** on-demand and stay in budget by extending your on-premise HPC clusters to the cloud when you need it.

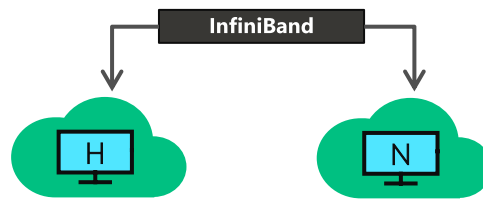
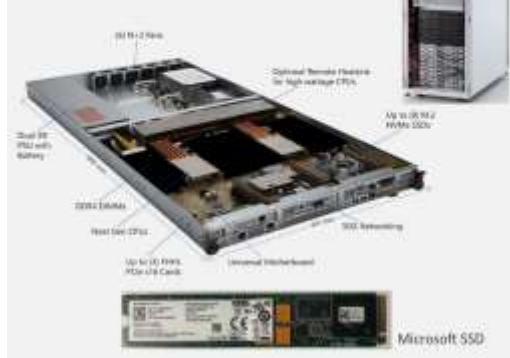
This image includes an **Azure-tuned kernel for up to 25% faster network throughput and 23% reduction in average latency**. The Azure-tuned kernel is only available on certain SUSE Linux images purchased through the Azure Marketplace. BYOS images do not contain the Azure-tuned kernel.

This is a "Pay as You Go" subscription of SLE HPC, which includes 24 x 7 integrated support from Microsoft and SUSE.

Useful Links

- [Learn more](#)
- [Documentation](#)
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- [SUSE Linux Enterprise High Performance Computing](#)

Azure Compute for HPC, AI, and Visualisation



CPU VMs

HB—Memory bandwidth

HC—Dense compute

GPU & FPGA-enabled VMs

NV—Graphics applications

NC—GP-GPU compute

ND—Deep Learning

NP—Programmable FPGA



Cray in Azure

Managed, Custom bare-metal

Large to extreme-scale HPC

Azure Network integration



>80,000 IOPS
Premium Storage

Low latency, high
throughput apps



Burstable VMs



General Purpose VMs

F—Compute-optimized

D—Standard workloads

E—Higher Memory



Storage & Highest Memory VMs

M—Extreme memory

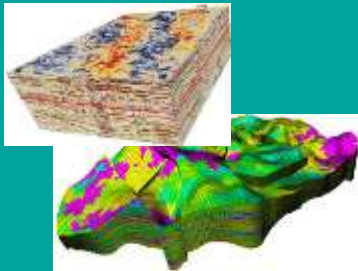
L—High SSD & IOPS

Azure Compute for HPC, AI, and Visualization

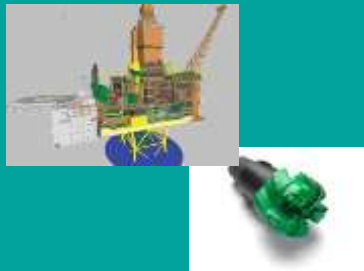
	HBv2	HB	HC	H
Workload Optimized	Memory Bandwidth	Memory Bandwidth	Dense Compute	Large-Memory HPC
CPU	AMD EPYC 2 nd Gen "Rome"	AMD EPYC 1 st Gen "Naples"	Intel Xeon Platinum 1 st Gen "Skylake"	Intel Xeon E5 v3 "Haswell"
Cores/VM	120	60	44	16
TeraFLOPS/VM (FP64)	4 TF	0.9 TF	2.6 TF	0.7 TF
Memory Bandwidth	353 GB/s	263 GB/sec	191 GB/sec	82 GB/s
Memory	4 GB/core, 480 total	4 GB/core, 240 total	8 GB/core, 352 GB	14 GB/core, 224 GB
Local Disk	900 GB NVMe	700 GB NVMe		2 TB SATA
InfiniBand	200 Gb HDR	100 Gb EDR		56 Gb FDR
Network	32 GbE	32 GbE		16 GbE

Azure Compute for HPC, AI, and Visualization

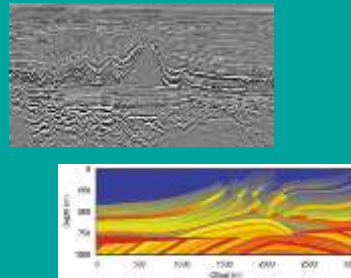
Visualization



Rendering



HPC/Simulation



Deep-Learning/AI



NV

- Workload centric PCs & Workstations
- Variable configuration for GPU workstations for content consumption
- Modern workspace for interactive collaboration

NC

- Scale out using IB for multimode HPC and ML workloads on any MPI stack
- Scale-up multi GPU VMs with fast NVLINK interconnect for high-density single box training and HPC workloads

ND

Scalable Storage Options

Azure has the global capacity for petabyte scale data sets common in many industries such as Energy, Media, and Life Sciences

→ 200 trillion
objects currently in storage

→ 160 trillion
storage transactions / month



Object Storage

Azure Blobs



Data Lake Storage

Azure Data Lake Storage Gen 2



File Storage

Azure Files

Avere vFXT for Azure

Azure NetApp Files



Hybrid Storage

Azure StorSimple

Azure File Sync

Azure FXT Edge Filer



Disk Storage

Azure Disk Storage



Data Transport

Azure Import/Export

Azure Data Box

Scalable Storage Options for Azure HPC



Blob

Object Storage
Filesystem Interfaces
Hot/Cool/Archive Tiers
Persistent/Staging



VM + Disk

Disk Storage
RAID partitions
SATA/SSD/NVMe
Small Scale



Parallel FS

Disk Storage
Lustre/BeeGFS/OND
SATA/SSD/NVMe
Med/Large Scale



Avere vFXT

Cache Storage
Great for NFS reads
Hybrid capability
Med/Large Scale



Netapp Files

Filesystem Storage
NFS/SMB
Familiar Filer 'aaS'
Med/Large Scale



Cray ClusterStor

Filesystem Storage
Large Parallel FS
Dedicated Hardware
Large Scale

101010 101010 101010 101010
010101 010101 010101 010101
101010 101010 101010 101010

Data Transfer

Native tools: AzCopy
Acceleration & Managed
Aspera/Signiant/FileCatalyst

Offline Data Transfer



Data Box

- Capacity: 100 TB
- Weight: ~50 lbs
- Secure, ruggedized appliance
- GA September 2018



Data Box Disk

- Capacity: 8TB ea.; 40TB/order
- Secure, ruggedized USB drives orderable in packs of 5 (up to 40TB).
- Currently in Preview



Data Box Heavy

- Capacity: 1000TB
- Weight 500+ lbs
- Secure, ruggedized appliance
- Preview September 2018

Online Data Transfer



Data Box Gateway

- Virtual device provisioned in your hypervisor
- Supports storage gateway: SMB, NFS, Azure blob, files
- Preview: September 2018



Data Box Edge

- Local Cache Capacity: ~12 TB
- Includes Data Box Gateway and Azure IoT Edge.
- Preview: September 2018

Microsoft Azure + SUSE : Built for HPC



Comprehensive portfolio

Only cloud vendor to offer IaaS, PaaS, hybrid and supercomputer solutions for HPC



Easy to Transition

Tools for hybrid infrastructure, cloud clusters, data staging, and cloud apps



Intelligent Cloud

Join HPC with AI and IOT for Digital Twins and building next generation models



Extensive partner ecosystem

Unique programs & industry leaders ready to collaborate with your business



Investment In HPC

Dedicated HPC engineering and customer engagement teams



More Information on Azure HPC

Azure HPC:

<https://azure.microsoft.com/en-us/solutions/high-performance-computing/>

Azure HPC Reference Architectures:

<https://docs.microsoft.com/en-us/azure/architecture/topics/high-performance-computing>

AZHPC (Azure Engineering Tool for easy HPC deployments):

<https://github.com/Azure/azurehpc>

Thanks!

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The logo for SUSEcon '20 is centered on a solid blue background. The word "SUSEcon" is in a white, bold, sans-serif font. To its right, the year "'20" is displayed in white inside a blue, rounded, pill-shaped container. A small "TM" trademark symbol is located at the bottom right of the "SUSEcon" text. The background features faint, white, wavy lines that create a mesh or honeycomb pattern, resembling a soccer ball, which curves around the central text.

SUSEconTM '20