SUSEcon '20

HPC + AI for everyone – with Microsoft Azure

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SUSE

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?

Why High Performance Computing (HPC)?

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

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

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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]

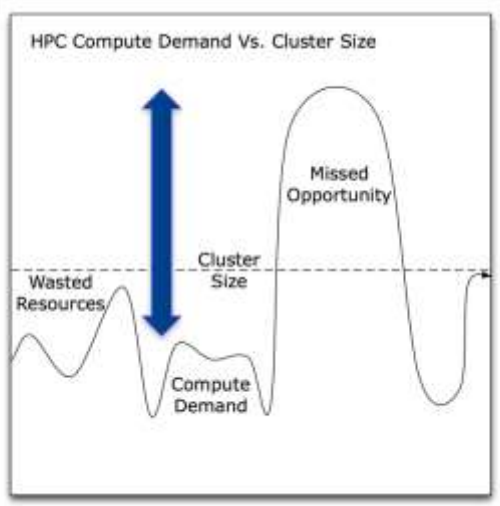
Autonomous vehicles will generate and consume roughly **4,000 gigabytes of data** a day by 2020.[2]

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 (EODSIS) 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

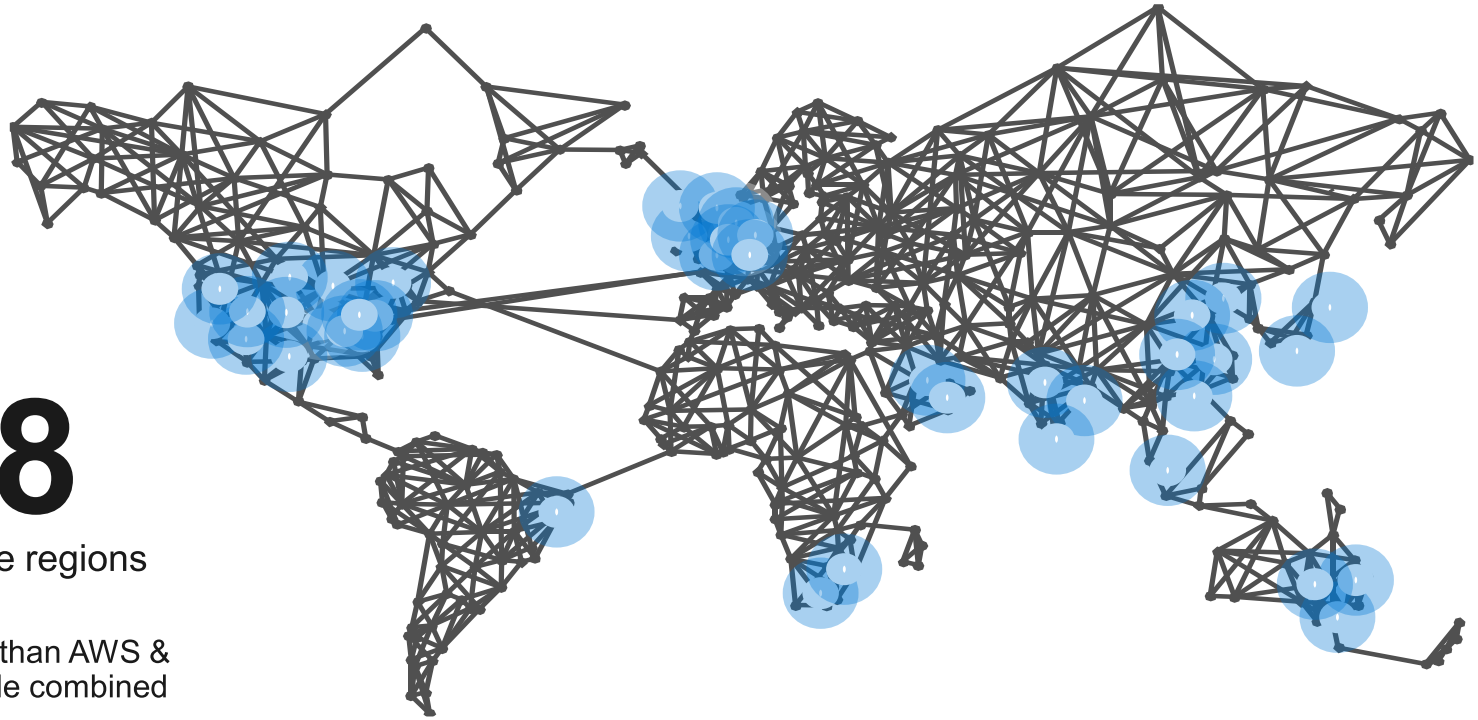
RDMA support

VPN & Express Route (MPLS) networking

Broad partner ecosystem

Azure HPC Attributes

Microsoft Azure: Built for scale



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Azure regions

More than AWS & Google combined

Microsoft Azure: Built for trust

Global

- ☑ ISO 27001:2013
- ☑ ISO 27017:2015
- ☑ ISO 27018:2014
- ☑ ISO 22301:2012
- ☑ ISO 9001:2015
- ☑ ISO 20000-1:2011
- ☑ SOC 1 Type 2
- ☑ SOC 2 Type 2
- ☑ SOC 3
- ☑ CSA STAR Certification
- ☑ CSA STAR Attestation
- ☑ CSA STAR Self-Assessment
- ☑ WCAG 2.0

US Gov

- ☑ FedRAMP High
- ☑ FedRAMP Moderate
- ☑ EAR
- ☑ DoD DISA SRG Level 5
- ☑ DoD DISA SRG Level 4
- ☑ DoD DISA SRG Level 2
- ☑ DFARS
- ☑ DoE 10 CFR Part 810
- ☑ NIST SP 800-171
- ☑ NIST CSF
- ☑ Section 508 VPATs
- ☑ FIPS 140-2
- ☑ ITAR
- ☑ CJIS
- ☑ IRS 1075

Industry

- ☑ PCI DSS Level 1
- ☑ GLBA
- ☑ FFIEC
- ☑ Shared Assessments
- ☑ FISC (Japan)
- ☑ APRA (Australia)
- ☑ OSFI (Canada
- ☑ FCA + PRA (UK)
- ☑ MAS + ABS (Singapore)
- ☑ 23 NYCRR 500
- ☑ SEC 17a-4
- ☑ CFTC 1.31
- ☑ FINRA 4511
- ☑ SOX
- ☑ HIPAA BAA
- ☑ HITRUST
- ☑ 21 CFR Part 11 (GxP)
- ☑ MARS-E
- ☑ NHS IG Toolkit (UK)
- ☑ NEN 7510:2011 (Netherlands)
- ☑ FERPA
- ☑ CDSA
- ☑ MPAA
- ☑ FACT (UK)
- ☑ DPP (UK)

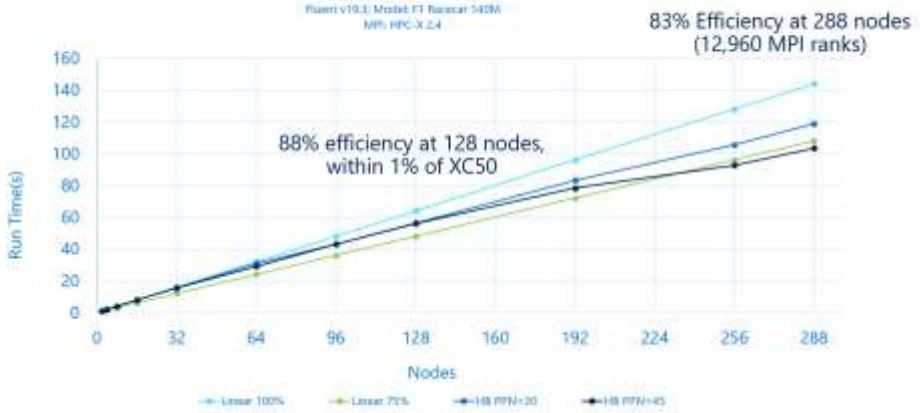
Regional

- ☑ Argentina PDPA
- ☑ Australia IRAP Unclassified
- ☑ Australia IRAP Protected
- ☑ Canada Privacy Laws
- ☑ China GB 18030:2005
- ☑ China DJCP (MLPS) Level 3
- ☑ China TRUCS / CCCPPF
- ☑ EN 301 549
- ☑ EU ENISA IAF
- ☑ EU Model Clauses
- ☑ EU – US Privacy Shield
- ☑ GDPR
- ☑ Germany C5
- ☑ Germany IT-Grundschutz workbook
- ☑ India MeitY
- ☑ Japan CS Mark Gold
- ☑ Japan My Number Act
- ☑ Netherlands BIR 2012
- ☑ New Zealand Gov CIO Fwk
- ☑ Singapore MTCS Level 3
- ☑ Spain ENS
- ☑ Spain DPA
- ☑ UK Cyber Essentials Plus
- ☑ UK G-Cloud
- ☑ UK PASF

Microsoft Azure: Built for HPC Performance

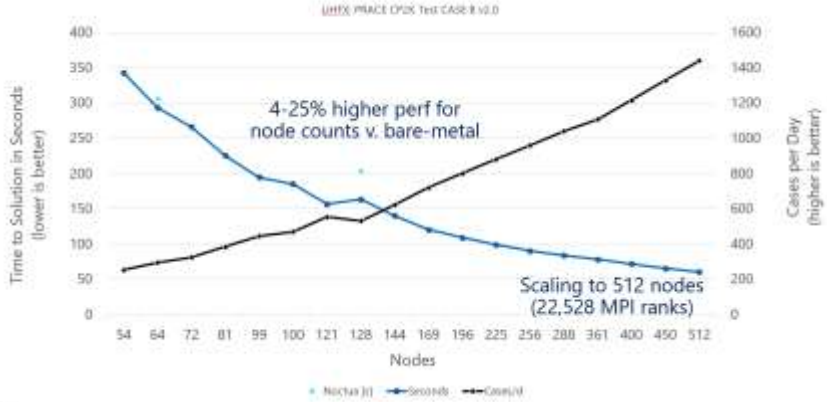
ANSYS Fluent on Azure HB VMs

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:

Workspot, intel, teradici, CITRIX, NVIDIA

Deep Learning and AI Training:

Mellanox, NVIDIA, Caffe, Chainer, SCSK, CNTK, torch, intel

Cloud Rendering:

AUTODESK MAYA, SOLIDANGLE arnold, intel, V-ray, 3DS MAX, NVIDIA

Supported OS:

SUSE, CentOS, ubuntu, Windows

HPC Simulation and Analysis:

d3View, Altair, rescale, NVIDIA, CONVERGE, Uber Cloud, Bright Computing, esi, Atos, FUJITSU, SIEMENS, SIMULIA, MSC Software, intel, Mellanox, LSTC, TotalCAE, ANSYS, SCSK

How could you do it?

A Cloud HPC Adoption Lifecycle

Existing apps

Clone to cloud

Start using the benefits of a cloud platform without rewriting or rearchitecting your application

Hybrid workflows

Optimize your application workflows to benefit from both on and off premises resources

Cloud workflows

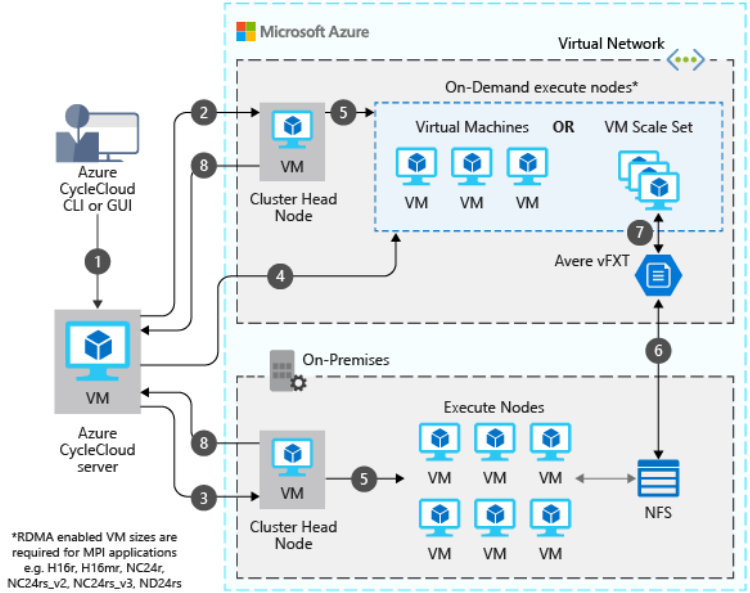
Port your entire application environment and resources to the cloud

Cloud-native apps

Create new differentiating services and modernize your missing critical applications

HPC Architectures: Classic, & Cloud Enabled

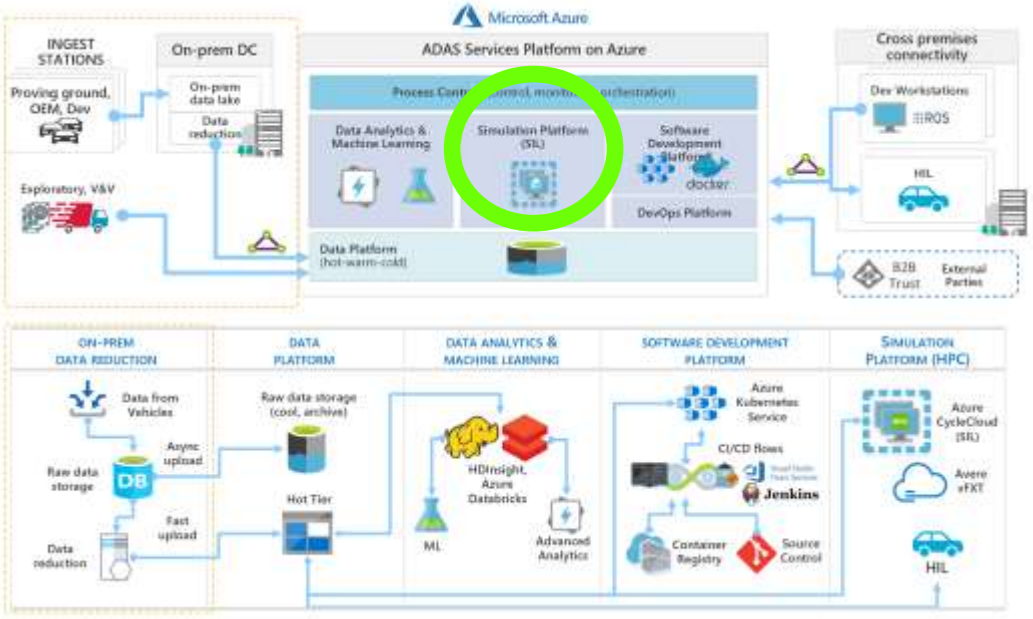
Classic HPC architecture & workflow



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

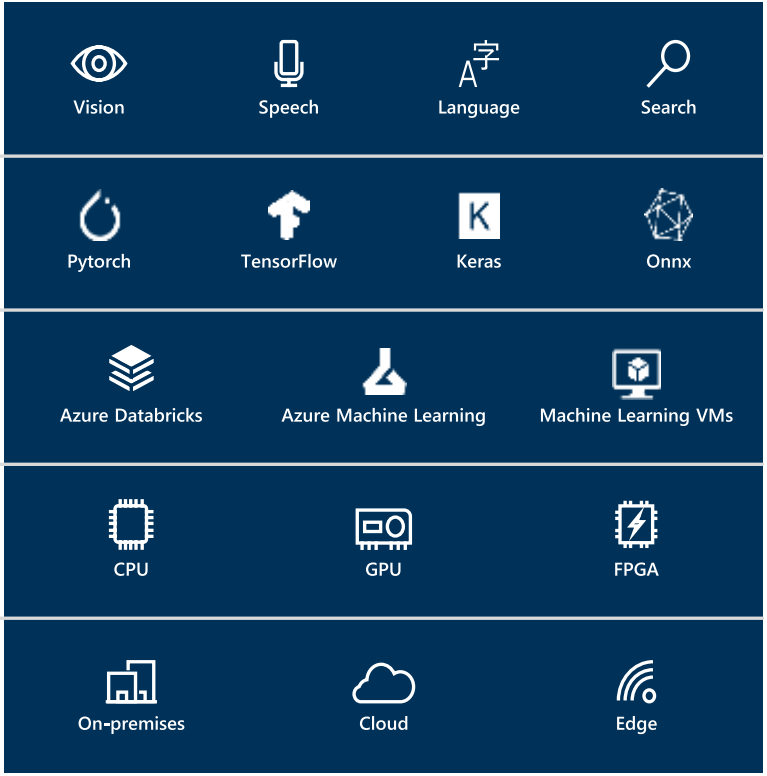
Sophisticated pretrained models
To simplify solution development

Popular frameworks
To build advanced deep learning solutions

Productive services
To empower data science and development teams

Powerful infrastructure
To accelerate deep learning

Flexible deployment
To deploy, manage models on intelligent 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*

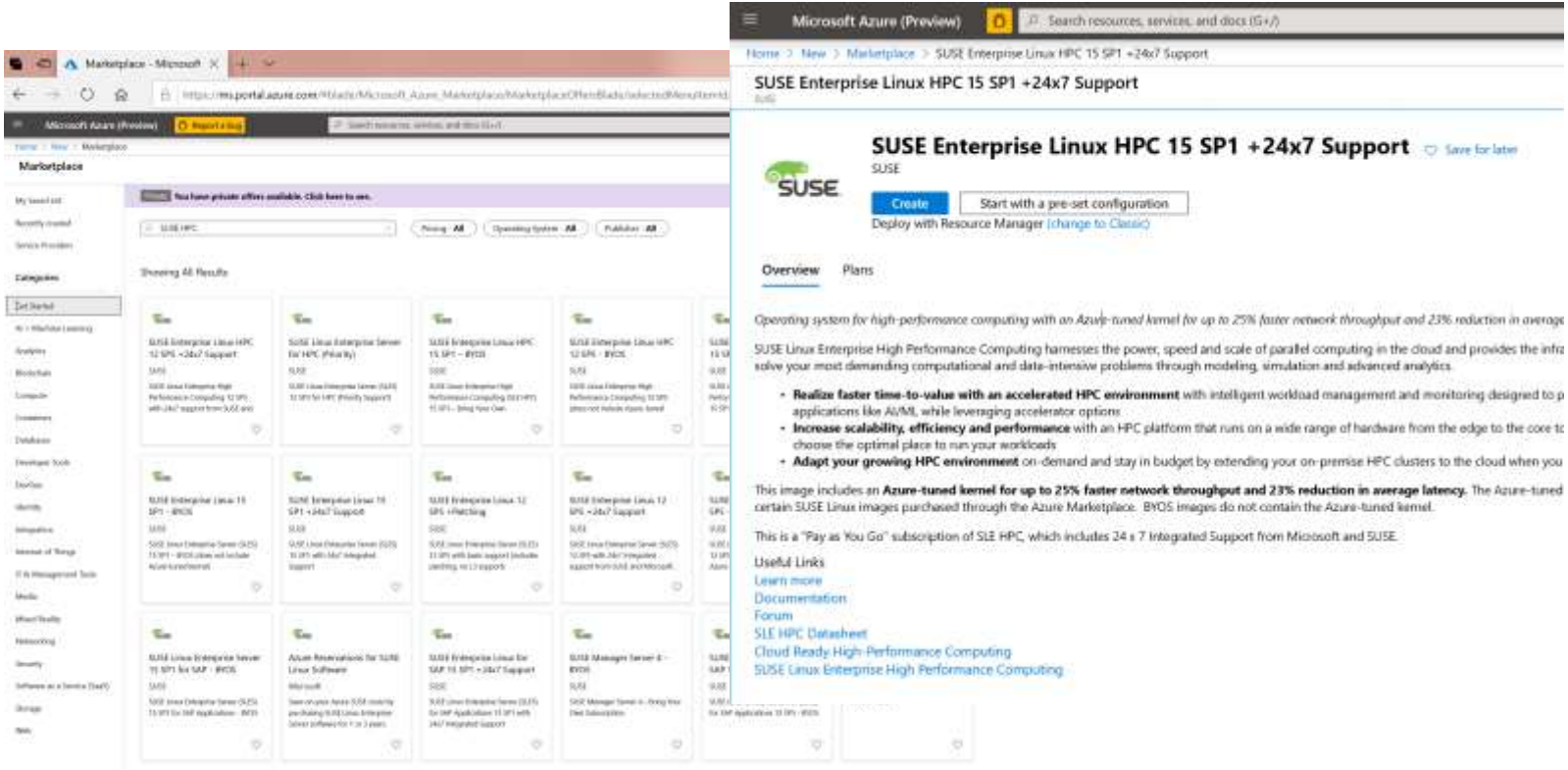
Cloud Native HPC

- 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



Azure Compute for HPC, AI, and Vizualisation

InfiniBand

H

N

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

A/B

Burstable VMs

F/D/E

General Purpose VMs

F—Compute-optimized

D—Standard workloads

E—Higher Memory

L/M

Storage & Highest Memory VMs

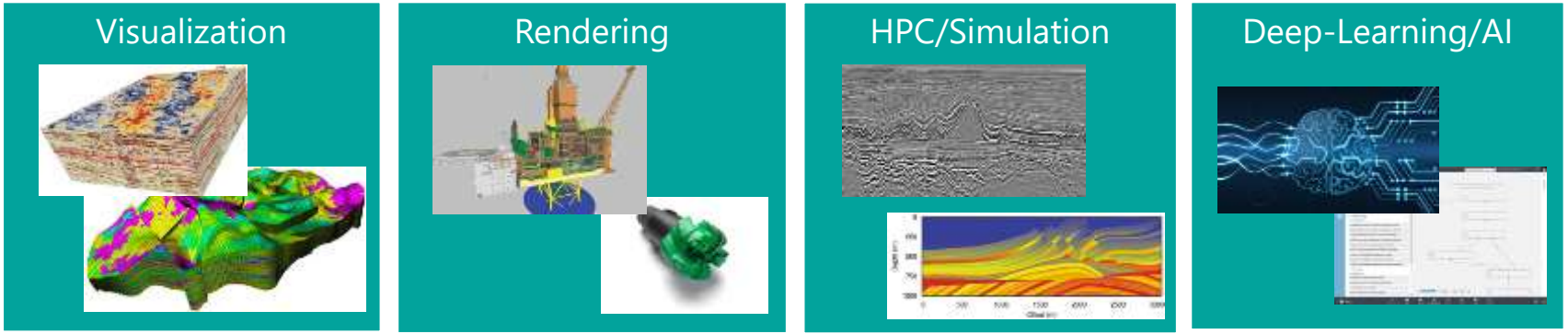
M—Extreme memory

L—High SSD & IOPS

Azure Compute for HPC, AI, and Vizualisation

	HBv2	HB	HC	H
Workload Optimized	Memory Bandwidth	Memory Bandwidth	Dense Compute	Large-Memory HPC
CPU	AMD EPYC 2nd Gen “Rome”	AMD EPYC 1st Gen “Naples”	Intel Xeon Platinum 1st 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 Vizualisation



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

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

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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