AMPERE.

HPC Performance and Efficiency of Ampere Altra and Altra Max Cloud-Native Processors

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Ampere Altra is the World's First Cloud-Native Processor

Ampere's Architecture is Optimized for the Cloud

Ampere® Altra®
7nm
80 Cores

Ampere® Altra® Max
7nm
128 Cores

Predictable High Performance

+

Elastic and Scalable

+

Power Efficient and Sustainable

Multi-Threaded Client Core
Inconsistent Operating Frequency

Limited Core Counts
Power and Area-Inefficient

Smaller Private Caches

Legacy Architectures

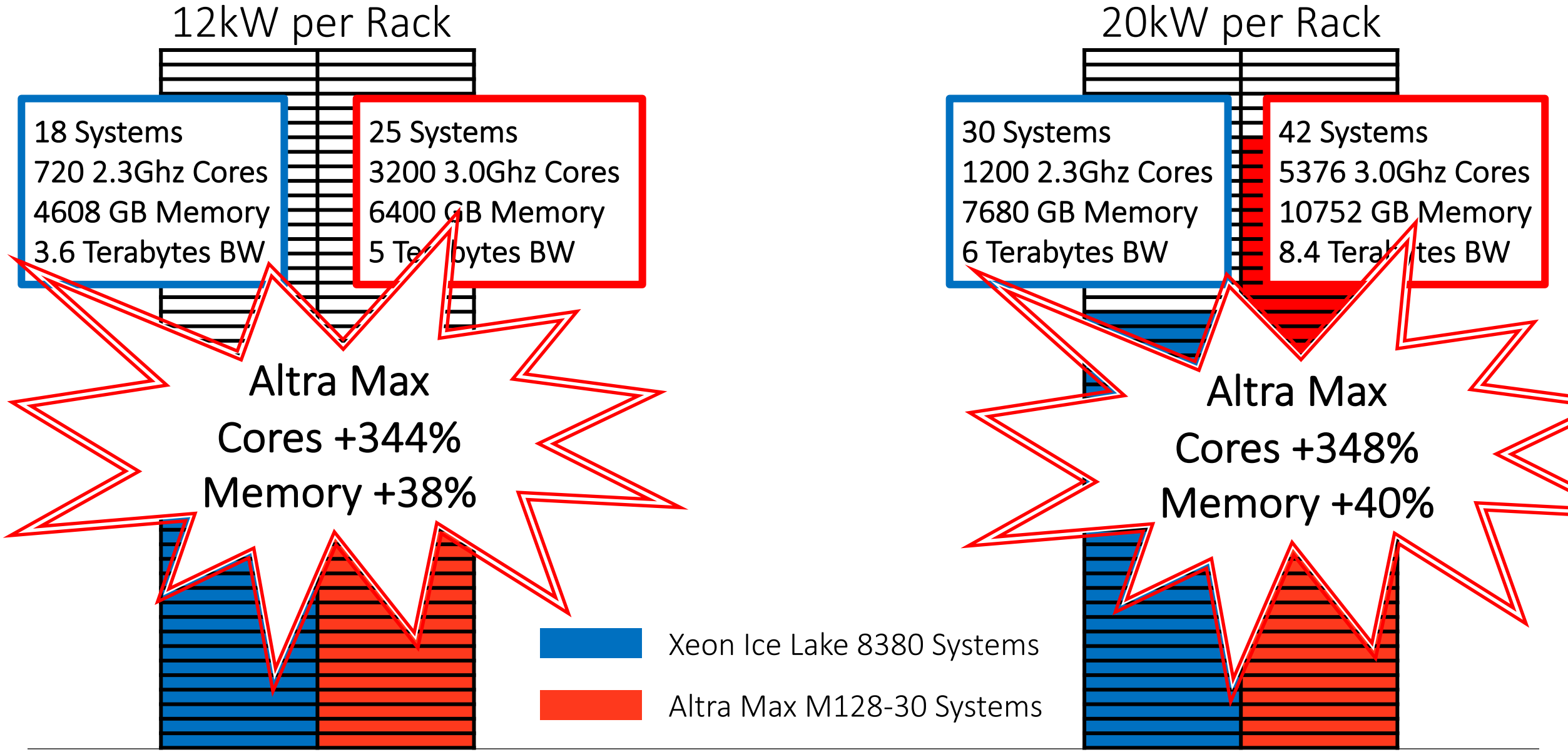
Ampere Architecture

Single-Threaded Cloud Core
Consistent Operating Frequency

Maximum Core Counts
Power and Area-Efficient

Larger Low Latency Private Caches

Server Rack Density



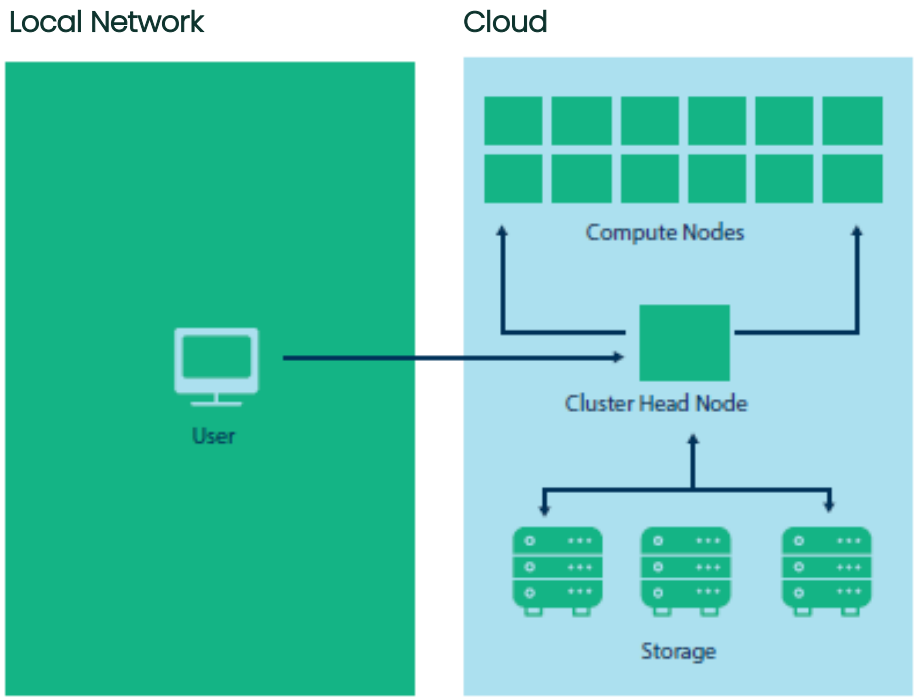
SUSE Linux Enterprise High Performance Computing

- Includes popular HPC tools & libraries for scheduling & performance monitor
- Tools supported by SUSE as part of subscription
- Adaptable across hybrid infrastructures
- Common code base for seamless workload migration - 100% binary match with openSUSE Leap
- X86-64, Arm64, GPUs, Azure, GCP, AWS
- CC EAL 4+ provides confidence to critical service providers - Certification is essential for a secure software supply chain

Base OS & Architecture	SLE HPC 15 (HPC Module w/subscription) supports x86 & Arm64
Management Tools	SLURM (a highly scalable workload manager) conman (the console manager) genders (static cluster configuration database) lua-lmod (environment module system) munge (authentication service for user credentials) mrsh (set of remote shell programs using munge) pdsh (high performance, parallel remote shell utility) prun (script-based wrapper for launching parallel jobs) clustduct (script glues the genders database to dnsmasq) powerman (cluster power control) cpuid (obtain CPU details)
I/O Services	Memkind (heap manager for memory control) RASDaemon (RAS reports via kernel tracing)
Parallel Libraries	boost (portable C++ source library) gsl (GNU Scientific Library) FFTW3 (Fourier transforms computing library) PETSc (data structures for partial differentiated equations) ScaLAPACK (scalable linear algebra package) hypre (parallel solvers for sparse linear systems) mumps (multifrontal massively parallel sparse direct solver) Scotch (graph & mesh/hypergraph partitioning, clustering) trilinos (large-scale complex physics & scientific problems)
Serial Libraries	OpenBLAS (optimized BLAS library) Superlu (super nodal sparse direct solver)
Compilers	GCC (GNU Compiler Collection includes C++ & Fortran)

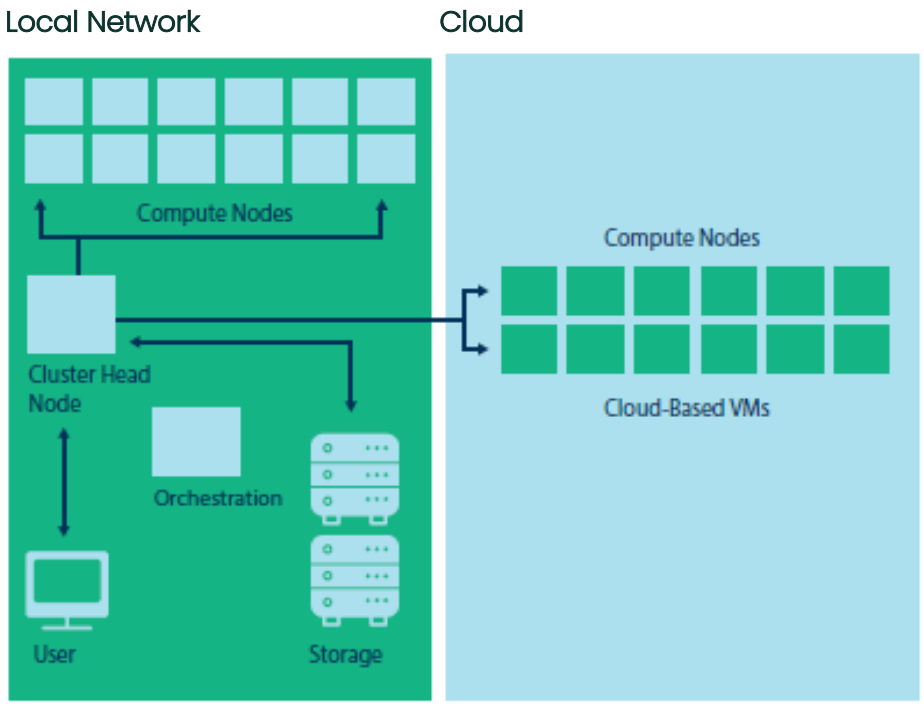
Monitoring Tools	ganglia (ganglia monitoring core) ganglia-web (ganglia web front-end) icinga2 (monitoring platform core) prometheus slurm exporter (Prometheus exporter for perf metrics)
I/O Libraries	adios (adaptable I/O system for exascale) hdf5 (data model, library and file format for managing data) netcdf (Unidata network Common Data Form) netcdf-cxx4 (C++ libraries and utilities) netcdf-fortran (netCDF Fortran libraries) pnetcdf (parallel I/O library for NetCDF file access)
Message Passing Interface	openmpi3/openmpi4 (Message Passing Interface implementation) mvapich2 (MPI over InfiniBand, Omni-Path, RoCE, iWARP) mpich (HP portable implementation of MPI) openPMIx (Process Management Interface Exascale standard)
Development Tools	metis (serial graph partitioning & matrix ordering) hwloc (hardware locality) python-numpy (scientific computing with Python) python-scipy (software for math, science and engineering)
Performance Tools	mpiP (lightweight MPI profiler) imb (Intel MPI benchmarks) papi (Performance Application Programming Interface)
SUSE Package Hub	robinhood (policy engine to monitor filesystem contents) singularity (HPC application containers) charliecloud (lightweight user-defined HPC stack) clustershell (scalable cluster admin Python framework) warewulf (scalable systems mgmt suite for HP clusters)

All-in vs. Bursting



HPC "all-in" the cloud

- Includes the head, compute and storage nodes, with no hardware infrastructure to maintain
- Optimized cost and performance for scale-out applications



HPC bursting to hybrid/public clouds

- Address changing capacity needs
- Extend HPC jobs to the Cloud for on-demand scale and flexibility

Test Configuration

Cluster Element	QTY	System	Components/Configuration
Headnode / NFS	1	Mt Collins 1S 2U	1x Ampere Altra 80 Core 3.0Ghz CPU
			128G RAM 8x32 DIMM 3200
			2x 240GB M.2 Micron 5300 (OS) 8x 3.84TB Micron 7300 PRO NVMe U.2
			1x Mellanox ConnectX6 Single Port 100GbE
			SUSE Linux Enterprise High Performance Computing 15.4
Network Switch	1	Switch 1U	32x100G MLNX Spectrum2 MSN2700
Altra Compute nodes	1	Mt Snow 1U	1x Ampere Altra 80 Core 3.0Ghz CPU
			512G RAM 16x32 DIMM 3200
			1x 960GB M.2 (OS)
			1x Mellanox ConnectX6 Single Port 100GbE
			SUSE Linux Enterprise High Performance Computing 15.4
Altra Max Compute nodes	1	Mt Collins 1S 2U	1x Ampere Altra Max 128 Core 3.0Ghz CPU
			256G RAM 8x32 DIMM 3200
			1x 960GB M.2 (OS)
			1x Broadcom 25GbE NIC
			SUSE Linux Enterprise High Performance Computing 15.4
Equinix n3.xlarge.x86 Compute & Head node	2	Mt Collins 2S 2U	1x Xeon Gold 6314U
			512G 8x64 DIMM 3200
			2x 240GB M.2 (OS)
			4x 25GbE
			Price $4.50/hr
Equinix c3.large.arm64 Compute & Head node	2	Mt Collins 2S 2U	1x Ampere Altra Q80
			256GB 8x 64 DIMM 3200
			2x 240GB M.2 (OS)
			4x 25GbE
			Price $2.50/hr

aarch64

WRF 4.4.1 CONUS 12km

gcc-11.2.0

GROMAC 2022.03

armclang 22.1 (gcc 11.2)

arm performance libraries

x86_64

WRF 4.4.1 CONUS 12km

gcc-11.3.0

GROMAC 2022.03

gcc-11.3.0

Performance and Power Utilization

GROMACS	Score(hib) ns/day	Avg Power	Peak Pwr
Altra	75.86	217W	275W
Altra Max	105.83	314W	392W
WRF	Score (lib) s/ts	Avg Power	
Altra	1.1	242W	300W
Altra Max	1.06	298W	352W

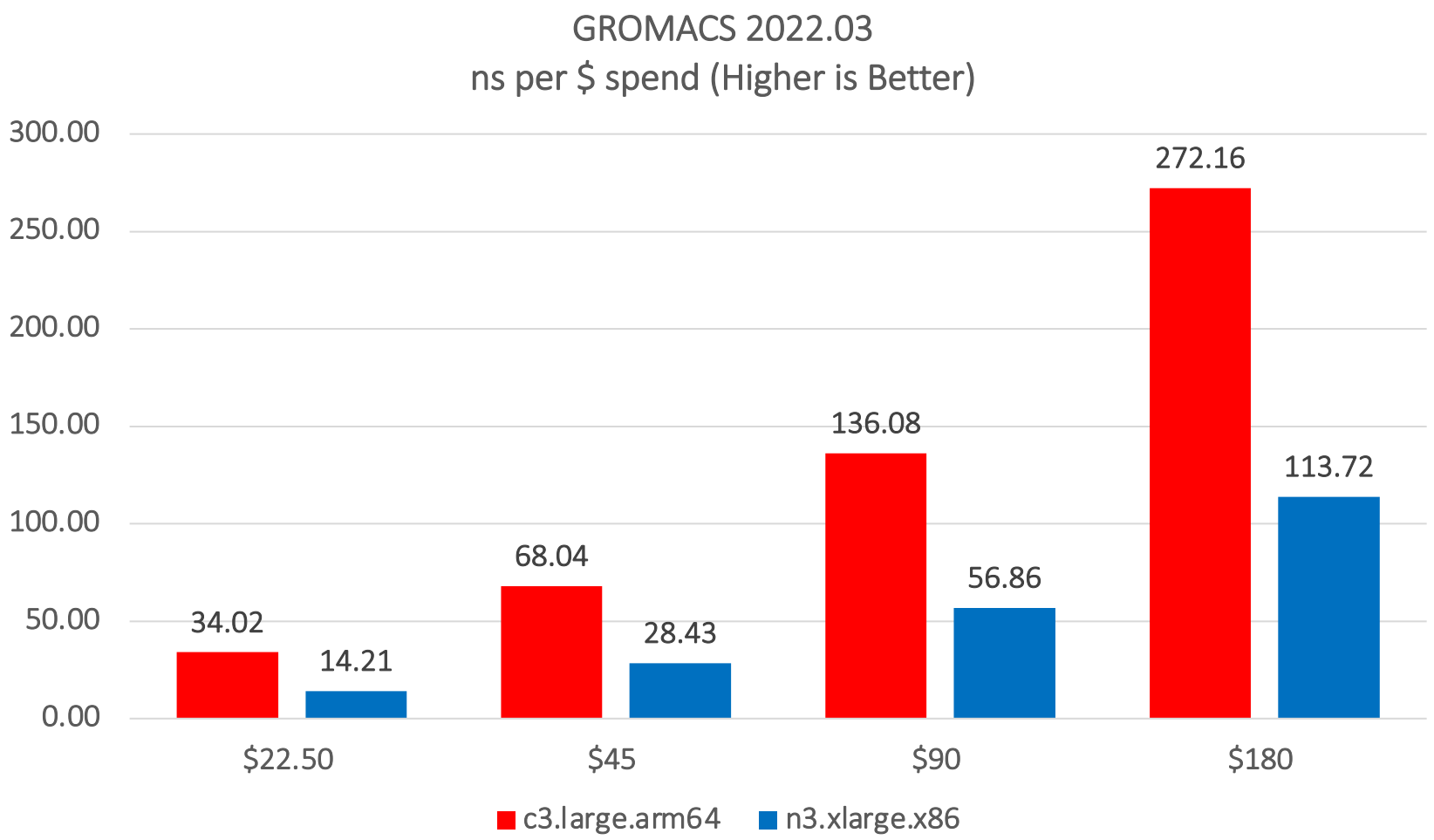
Cloud Performance per Dollar - GROMACS

c3.xlarge.arm64
Altra Q80
80 cores @ 2.8Ghz
8x64GB DDR4-3200

$2.50/hr

n3.xlarge.x86
Xeon Gold 6134U
64 threads @ 2.3Ghz
8x64GB DDR4-3200

$4.50/hr



Cloud Performance per Dollar - GROMACS

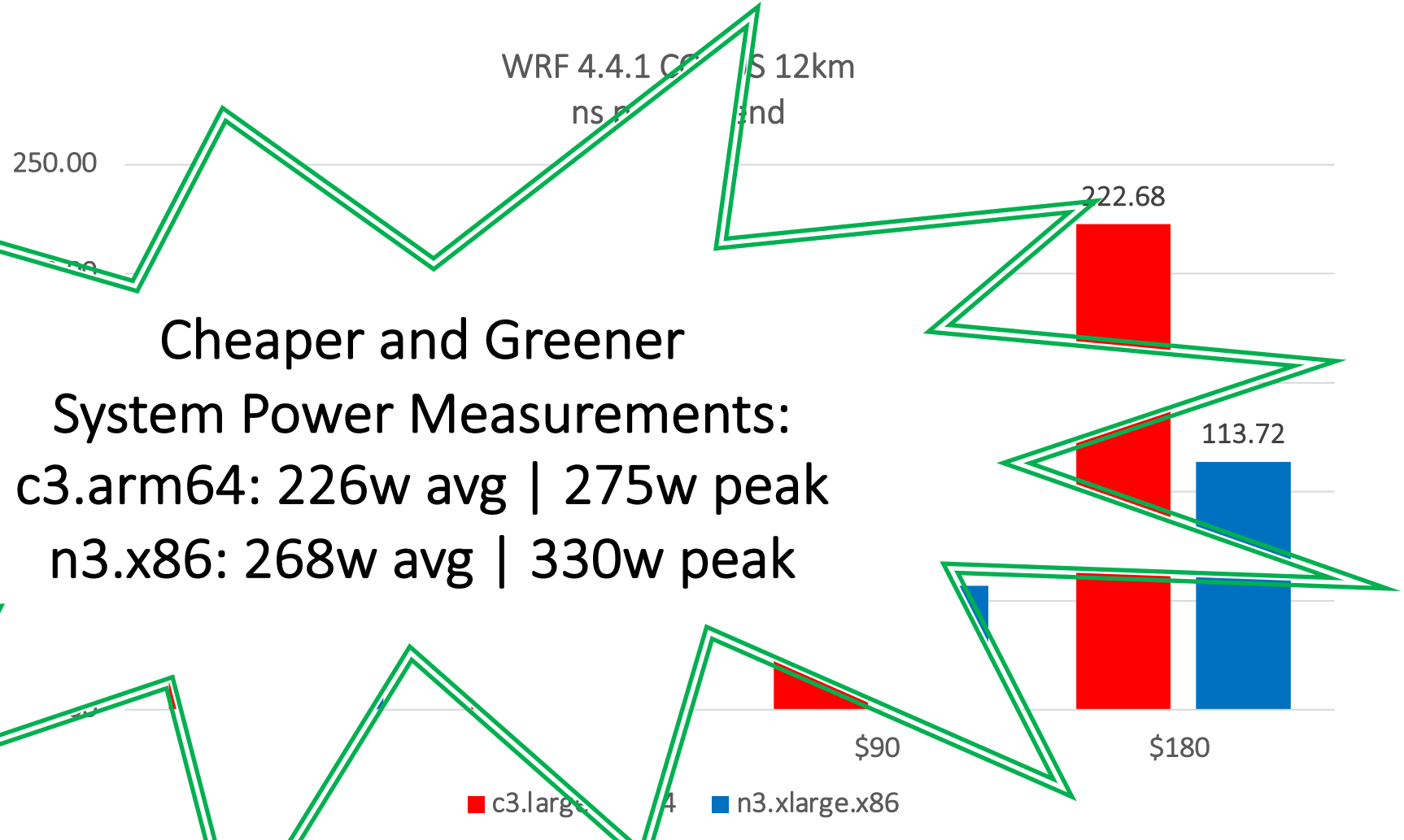
c3.xlarge.arm64
Altra Q8
80 cores @ 2.
8x64GB DDR4-320

$2.50/hr

n3.xlarge.x86
Xeon Gold 6
64 Threads @ 2.3Ghz
8x64GB DDR4-3200

$4.50/hr

Cheaper and Greener
System Power Measurements:
c3.arm64: 226w avg | 275w peak
n3.x86: 268w avg | 330w peak



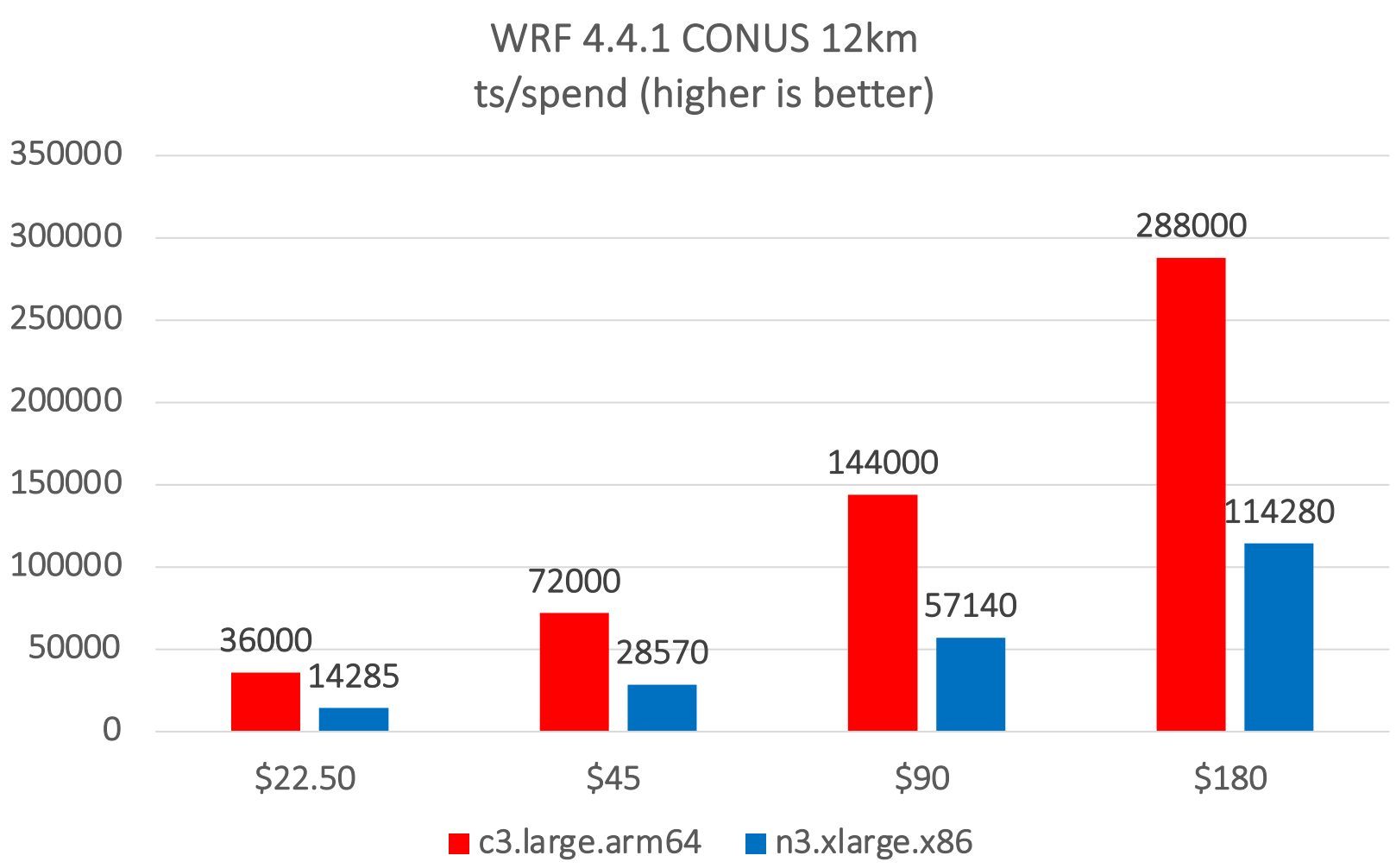
Cloud Performance per Dollar - WRF

c3.xlarge.arm64
Altra Q80
80 cores @ 2.8Ghz
8x64GB DDR4-3200

$2.50/hr
1.1s/ts

n3.xlarge.x86
Xeon Gold 6134U
64 threads @ 2.3Ghz
8x64GB DDR4-3200

$4.50/hr
1.26s/ts



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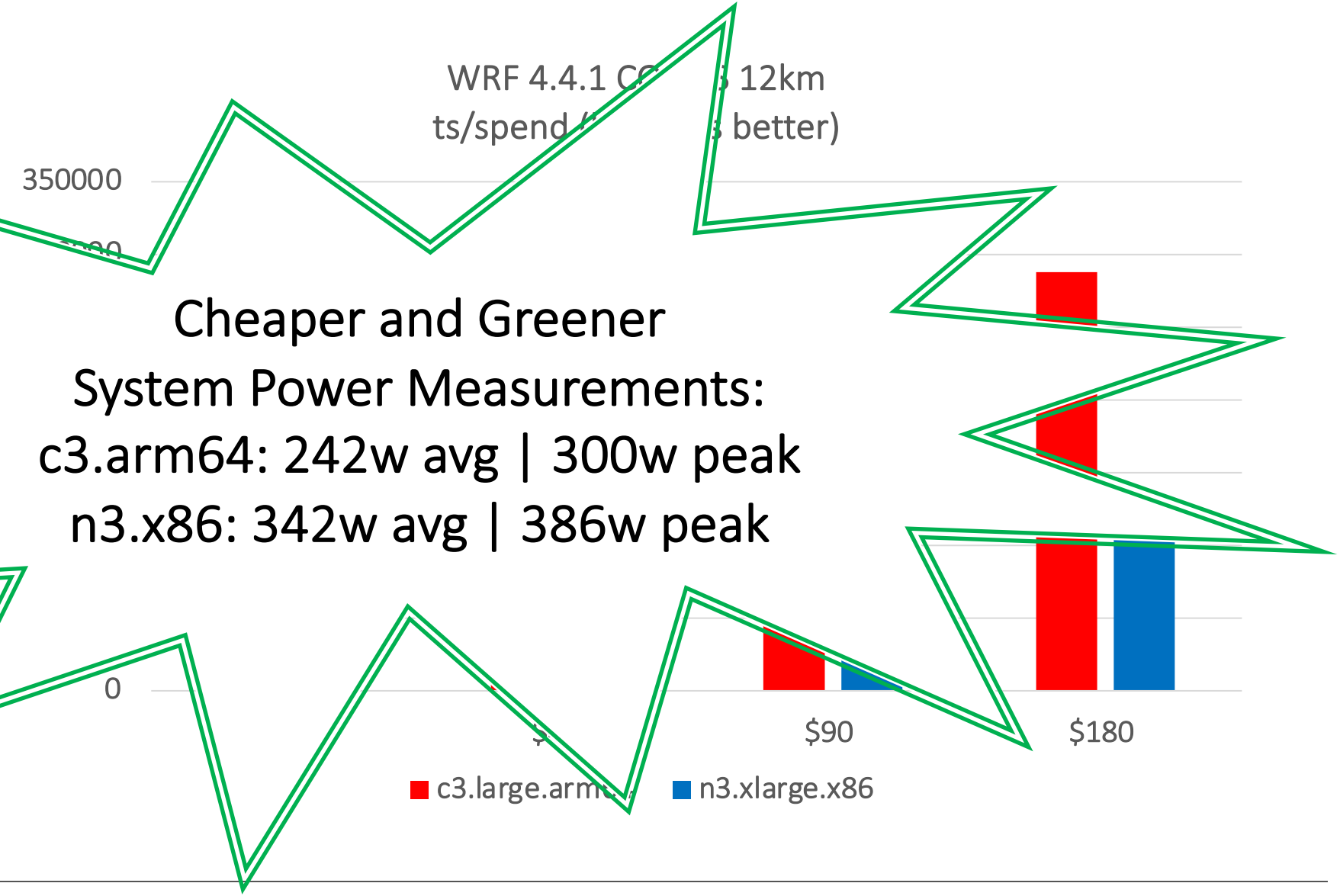

Cheaper and Greener

System Power Measurements:

c3.arm64: 242w avg | 300w peak

n3.x86: 342w avg | 386w peak

Access Programs - Where to Try

Home / Developer Access Programs

DEVELOPER ACCESS PROGRAMS

Get Trial Access to Ampere Systems

Ampere's Developer Access Programs provide a collection of free, easily accessible trial platforms for developers, customers, and Ampere partners. The programs offer compute resources using our Ampere® Altra® and Ampere® Altra® Max Cloud Native processors and provide remote access to a variety of systems managed by Ampere and our Cloud Partners.

These programs require users to adhere to Ampere's NDA and Technology Trial policies. We encourage our developers, partners, and customers to explore Ampere products by using our access programs to begin innovating on Ampere's leading Cloud Native platforms.

Program	Primary Usages	Current Platform(s)	Form	~Duration	
Early Access Program	Early access to platforms with forthcoming processors in a cloud configuration	Dec 2021: Altra Max Available 1. Mt. Snow 1P 2. Mt. Collins 2P	Bare Metal Instance	2-4 Weeks	Apply
Partner Cloud Program	Access to current and previous generation platforms in a cloud configuration	1. Altra Mt. Jade 2P	Bare Metal Instance	2-4 Weeks	Apply
Specialized Platforms	Special Case Configurations hosted by Ampere	1. Altra Mt. Snow 1P with NVIDIA T4 GPU 2. Altra Mt. Snow 1P with AMD GPU	Bare Metal Instance	4-8 Weeks	Apply
Cluster	Cluster access for scale-out use cases and application enabling	1. Altra Mt. Snow 1P with 200GbE, 24 TB Drive Capacity	Cluster: 2-10 Nodes	4-8 Weeks	Apply
CSP Partners	Trial access to Ampere Cloud VM shapes in China	1. Tencent CVM SR1	VM Shapes	2-6 Weeks	Apply
CSP Partners	Cloud Partner Access Programs	1. OCI A1: Free Tier 2. OCI A1: Accelerator Program	VM Shapes	Free Trial: 1 month Accelerator: Variable	Try out on OCI

Thank You!

Questions?

Contact Information

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