

Leveraging EESSI for WRF simulations at scale on Azure HPC

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Why do we like EESSI



Working with dozens of customers running HPC on Azure



To help success of the customer by lowering adoption curve and



To learn and improve Azure for HPC



We help set up HPC on Azure, but do not run day-to-day admin tasks



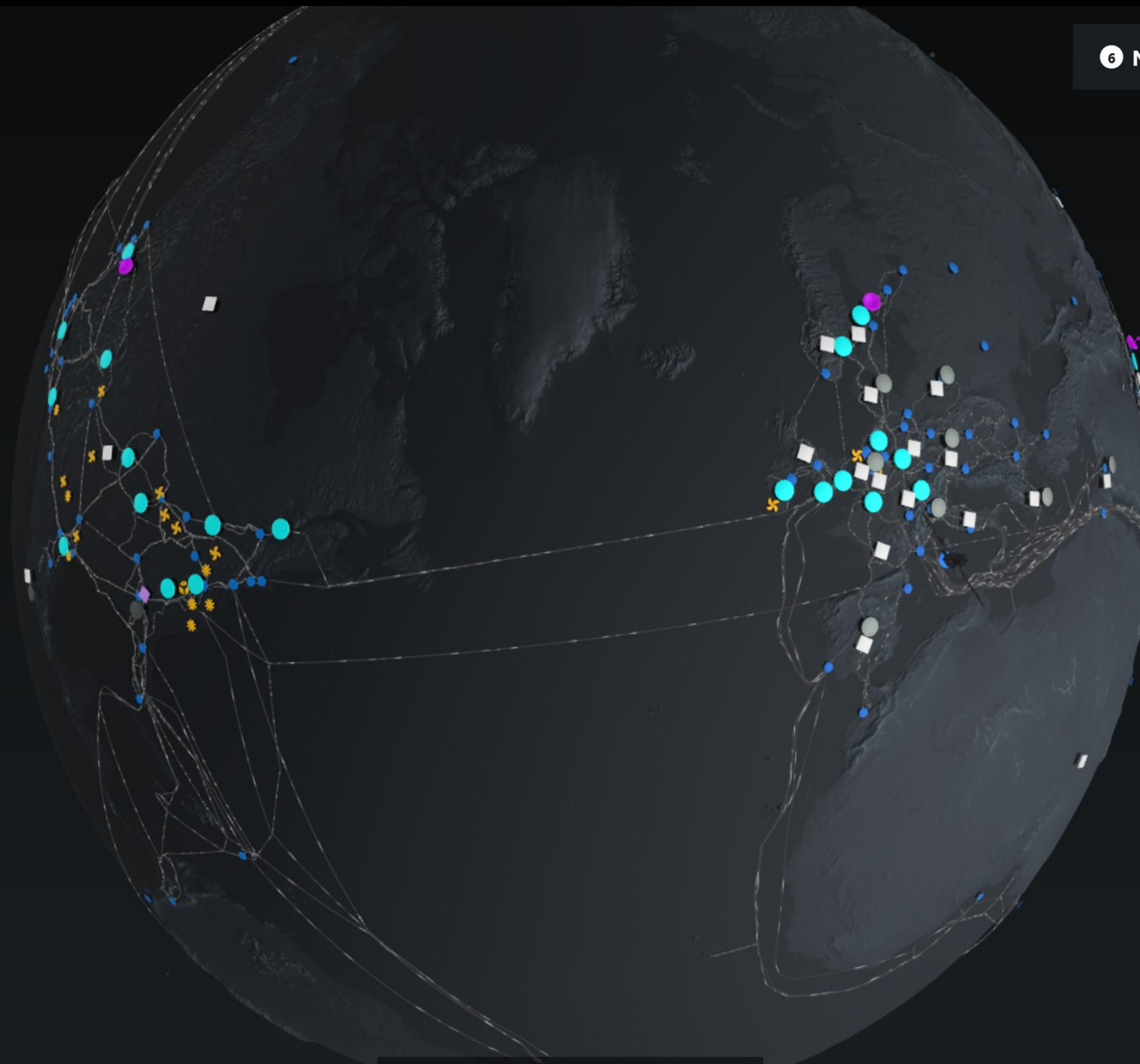
We are feeling the same application delivery pains as you do ;)

What do we want to bring to EESSI

Run	<p>Run well on Azure HPC VM's with InfiniBand RDMA</p> <ul style="list-style-type: none">• Intel Skylake with EDR InfiniBand (HC44rs)• AMD Rome / Milan(-X) with HDR InfiniBand (HB120rs_v2 and HB120rs_v3)
Contribute	<p>Contribute to EESSI by adding applications</p> <ul style="list-style-type: none">• That are useful for us and for our direct customers• To verify regression of our fleet
Make	<p>Make EESSI available</p> <ul style="list-style-type: none">• Through Azure open projects like Az-HOP:<ul style="list-style-type: none">• https://github.com/Azure/az-hop• And public projects like Cluster-in-the-Cloud



6 News updates



How our global infrastructure works



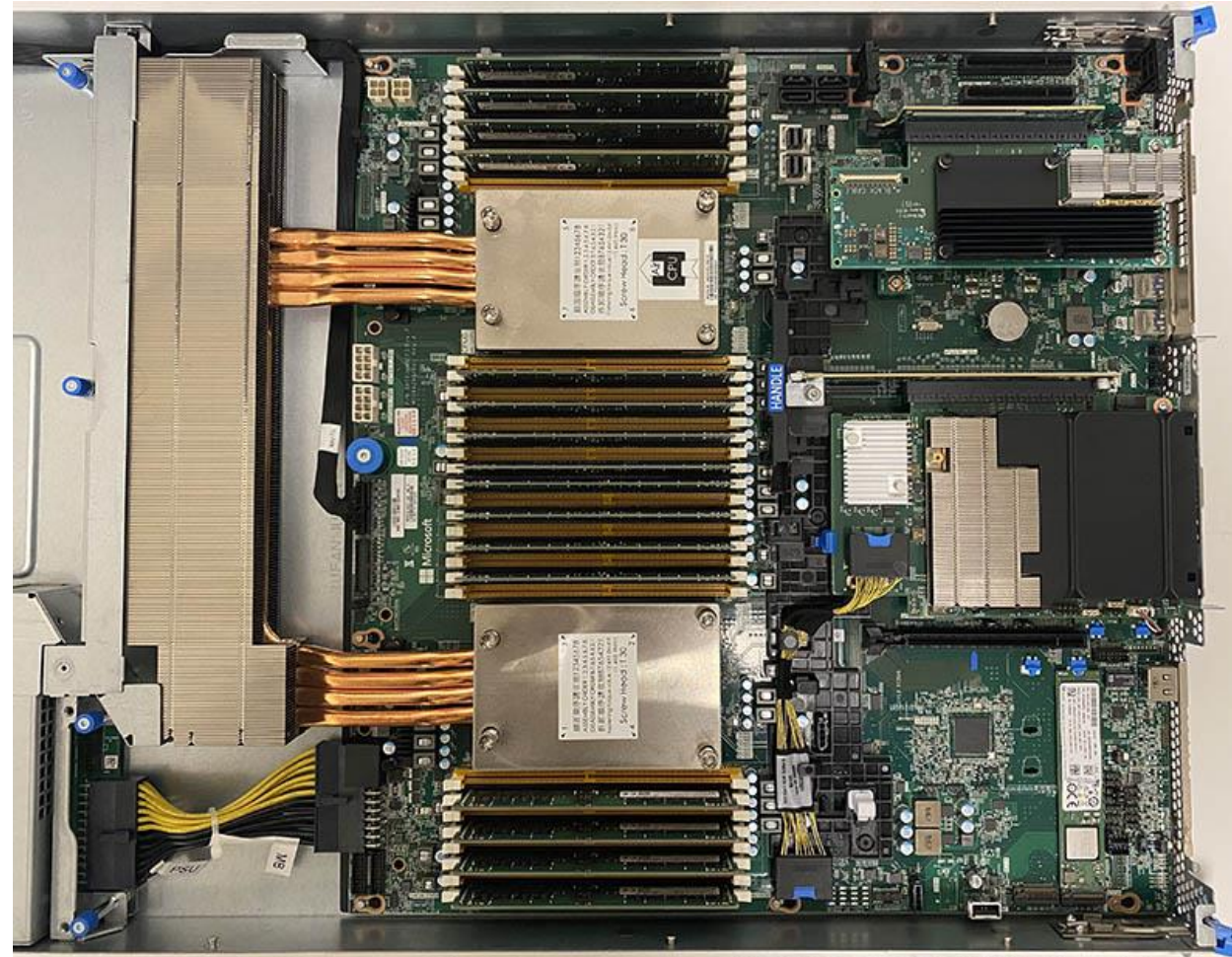
HPC vm fleet (InfiniBand enabled only...)

VM	Cpu arch	Mem	Mem bw	InfiniBand	Local Scratch	Remarks
H16(m)r	Intel Haswell	112/224		56 Gb/s FDR	2 TB	EOL August 2022
HC44rs	Intel Skylake	352 (8)		100 Gb/s EDR	700 GB	
HB60	AMD Naples	228 (4)	260 GB/s	100 Gb/s EDR	700 GB	
HB120_v2	AMD Rome	456 (4)	350 GB/s	200 Gb/s HDR	900 GB	
HB120_v3	AMD Milan(-X)	448 (4)	350 GB/s	200 Gb/s HDR	2.1 TB	Migrating to -X

VM	Cpu arch	Mem	GPU	InfiniBand	Local Scratch	Remarks
NC24r	Intel Broadwell	224	K80 (4x)	56 Gb/s FDR	1.44 TB	
NC24rs_v2	Intel Broadwell	448	P100 (4x)	56 Gb/s FDR	3 TB	
NC24rs_v3	Intel Broadwell	448	V100 (4x)	56 Gb/s FDR	3 TB	
ND24rs	Intel Broadwell	448	P40 (4x)	56 Gb/s FDR	3 TB	
ND40rs_v2	Intel Skylake	672	V100 (8x)	100 Gb/s EDR	2.9 TB	NVlink
ND96asr_A100_v4	AMD Rome	900	A100 (8x)	200 Gb/s HDR (8x)	6.5 TB	40 GB A100 + NV
ND96amsr_A100_v4	AMD Rome	1900	A100 (8x)	200 Gb/s HDR (8x)	6.5 TB	80 GB A100 + NV

Infiniband in Azure

- InfiniBand for MPI/NCCL
 - Not for storage / heterogenous
- Stamps == cluster == IB connectivity
- SR-IOV:
 - 387e:00:02.0 Infiniband controller: Mellanox Technologies MT27800 Family [ConnectX-5 Virtual Function]
- InfiniBand Partitions
 - Subnet manager is provided
 - No access to vlane 0
 - So no ibtracert and friends
- Use through Availability Zone or VMSS
 - Azure Cyclecloud for orchestration
 - we can combine multiple vmss in single cluster





Using InfiniBand on Azure

```
#!/bin/bash
module load OSU-Micro-Benchmarks/5.6.3-gompi-2020a
scontrol show hostname $SLURM_JOB_NODELIST > hostfile
export OMPI_MCA_pml=ucx
mpirun --hostfile hostfile -n 2 --map-by ppr:1:node osu_bw
```

OSU MPI Latency Test v5.6.3 using RDMA

# Size	Latency (us)
0	1.53
1	1.52
2	1.52
4	1.52
8	1.52
16	1.52
32	1.58
64	1.76
128	1.84

OSU MPI Latency Test v5.6.3 using TCP

# Size	Latency (us)
0	74.98
1	72.37
2	68.46
4	76.83
8	73.02
16	69.52
32	70.65
64	80.39
128	76.94

[EESSI pilot 2021.12] \$ cat slurm-39.out

OSU MPI Bandwidth Test v5.6.3

# Size	Bandwidth (MB/s)
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1	4.39
2	8.84
4	17.60
8	35.28
16	69.55
32	141.00
64	254.08
128	475.12
256	833.28
512	1505.10
1024	2603.79
2048	3944.87
4096	5403.71
8192	7621.57
16384	7533.24
32768	10164.94
65536	11419.85
131072	11607.19
262144	11511.06
524288	11538.26
1048576	11538.91
2097152	11408.83
4194304	11321.95

Running WRF3

Disclaimer: we are not
trying to benchmark
here,

just trying to verify
EESSI on Azure with
RDMA...

Running WRF3 on Zen3

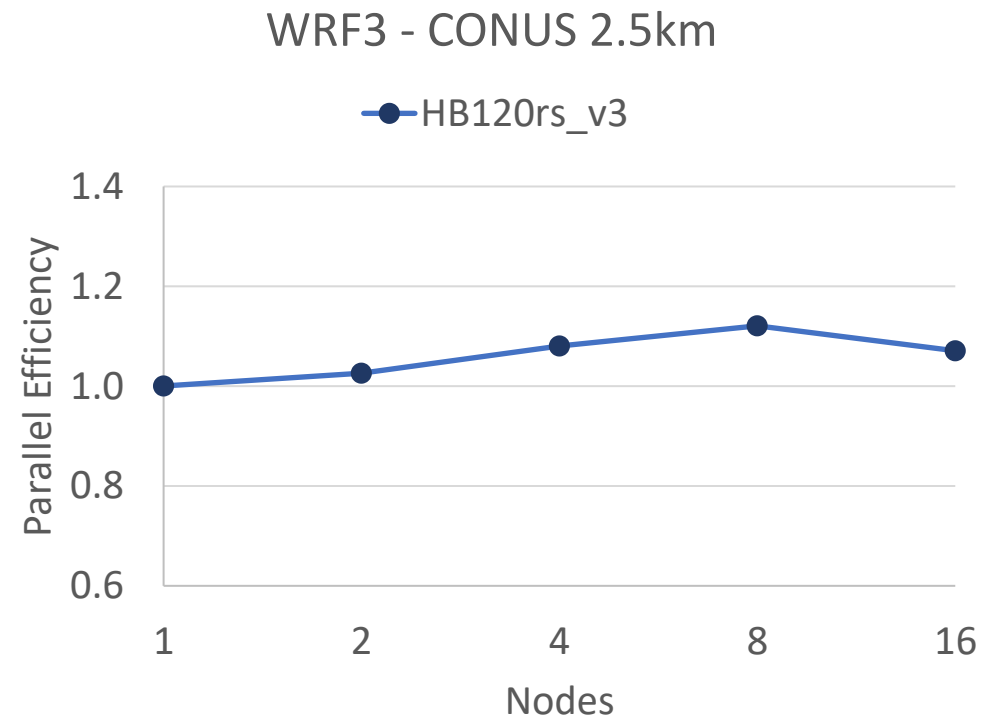
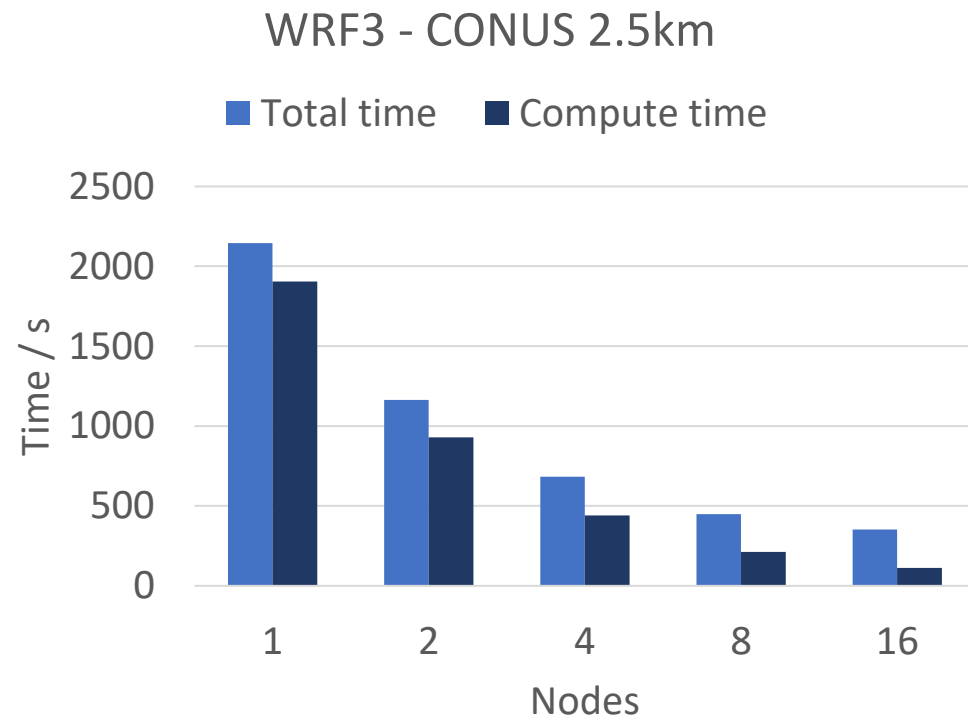
```
#!/bin/bash
#SBATCH --nodes=<N>
#SBATCH --tasks-per-node=120

export EESSI_SOFTWARE_SUBDIR_OVERRIDE=x86_64/amd/zen3      #archspec/pku
source /cvmfs/pilot.eessi-hpc.org/versions/2021.12/init/bash
module load WRF/3.9.1.1-foss-2020a-dmpar

mkdir wrf_job_2.5
cd wrf_job_2.5
ln -s `dirname $(which wrf.exe)`/../../run/* .
rm namelist.input
ln -s ~/WRF_test/bench_2.5km/* .

export OMPI_MCA_pml=ucx      #fixed in foss2021a/OpenMPI4.1.1
time mpirun wrf.exe
```

WRF3 Scaling on Zen3





Next steps



Getting the WRF3 runs
optimized

Tiles vs MPI processes vs
OpenMP vs I/O



Adding WRF4

And increasing scaling to ...
nodes



Automate ReFrame runs for regression testing



Stratum 1's in main Azure
regions

Based on VMs or directly on Blob
When do we need autoscaling
Squids?



What do you need from Azure to run HPC
better/easier?