HPC·AI
ADVISORY COUNCIL
NETWORK OF EXPERTISE

ANSYS Fluent 19.0
Performance Benchmarking

Aug 2018

ANSYS Fluent

- **Computational Fluid Dynamics (CFD)**
  - Enables the study of the dynamics of things that flow
  - Enable better understanding of qualitative and quantitative physical phenomena
  - Enable to improve engineering designs
- **CFD brings together a number of different disciplines**
  - Fluid dynamics
  - Mathematical theory of partial differential systems
  - Computational geometry
  - Numerical analysis
  - Computer science
- **ANSYS FLUENT is a leading CFD application from ANSYS**
  - Widely used in almost every industry sector and manufactured product

Objectives

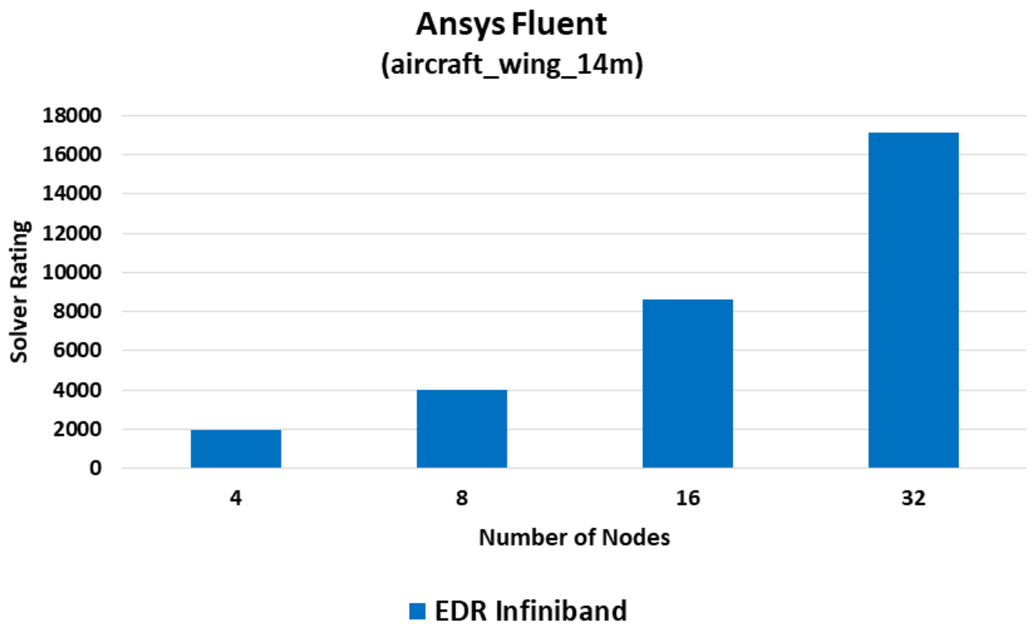
- **The research was done to provide best practices for ANSYS Fluent**
  - MPI library performance comparison
  - Interconnect (Network) performance comparison
  - Scalability

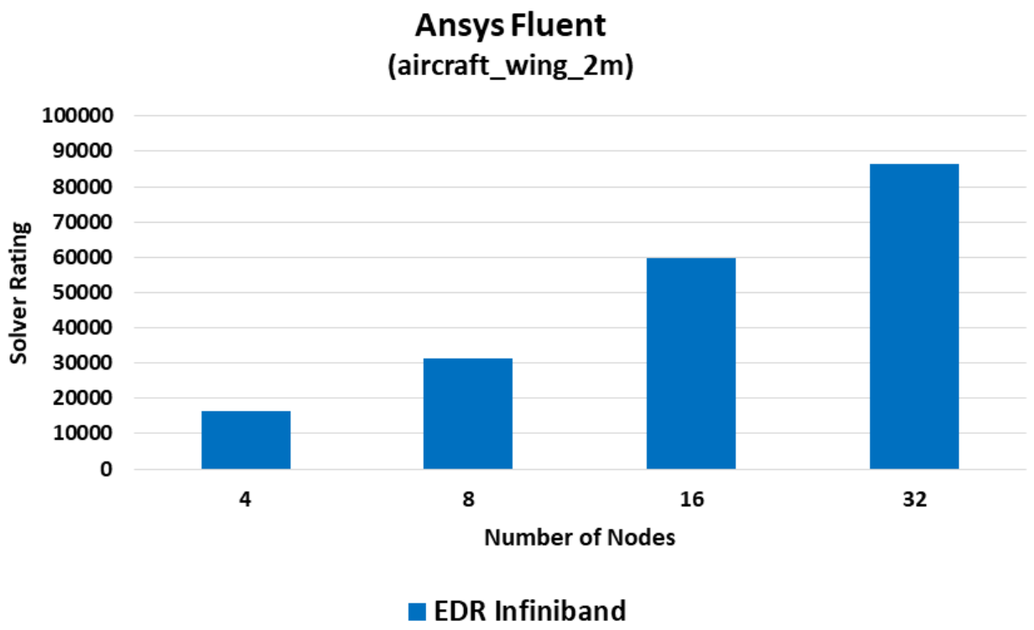
- **The presentation will present considerations for higher productivity and efficiency**

Cluster Configuration

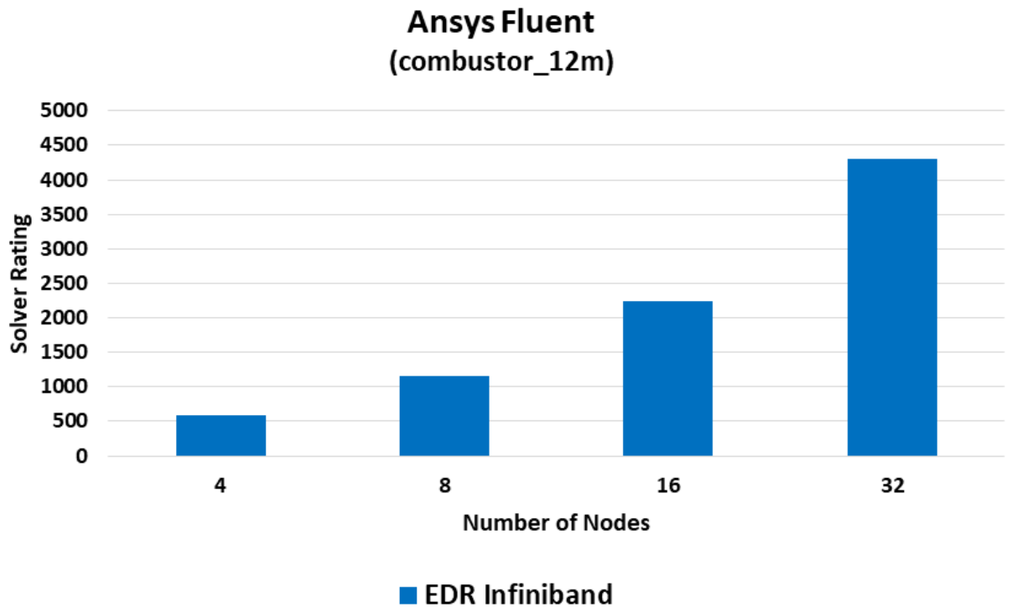
- **HPE ProLiant DL360 Gen9 128-node (4096-core) “Hercules” cluster**
  - Dual-Socket 16-Core Intel E5-2697A v4 @ 2.60 GHz CPUs
  - Memory: 256GB memory, DDR4 2400 MHz
  - Mellanox ConnectX-5 EDR 100Gb/s InfiniBand Adapters
  - Mellanox Switch-IB2 SB7800 36-port EDR 100Gb/s InfiniBand Switch
  - OS: RHEL 7.4, MLNX_OFED 4.3
- **Dell PowerEdge R730 36-node cluster “Thor” cluster**
  - Dual-Socket 16-Core Intel E5-2697A v4 @ 2.60 GHz CPUs
  - Memory: 256GB memory, DDR4 2400 MHz, Memory Snoop Mode in BIOS sets to Home Snoop
  - InfiniBand EDR Fabric (ConnectX-5 and Switch-IB2 36-ports)
  - Intel Omnipath fabric Operating System and MPI
  - OS: RHEL 7.4, MLNX_OFED 4.3, IFS 10.6.1.0.2
  - Intel MPI 2018.1.163
  - HPC-X 2.1

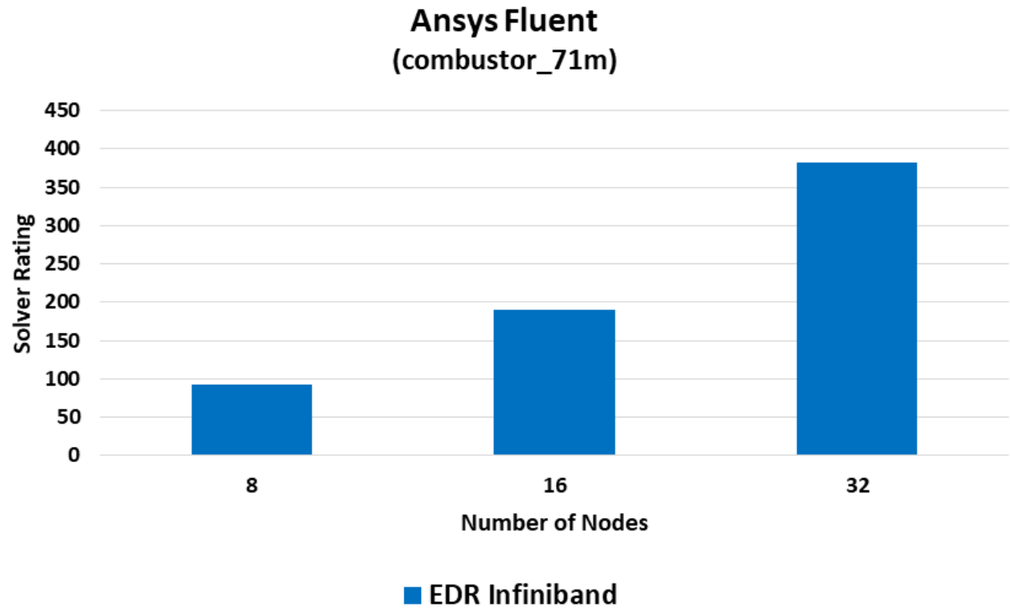
Fluent Performance (Aircraft Wing 2M and 14M)



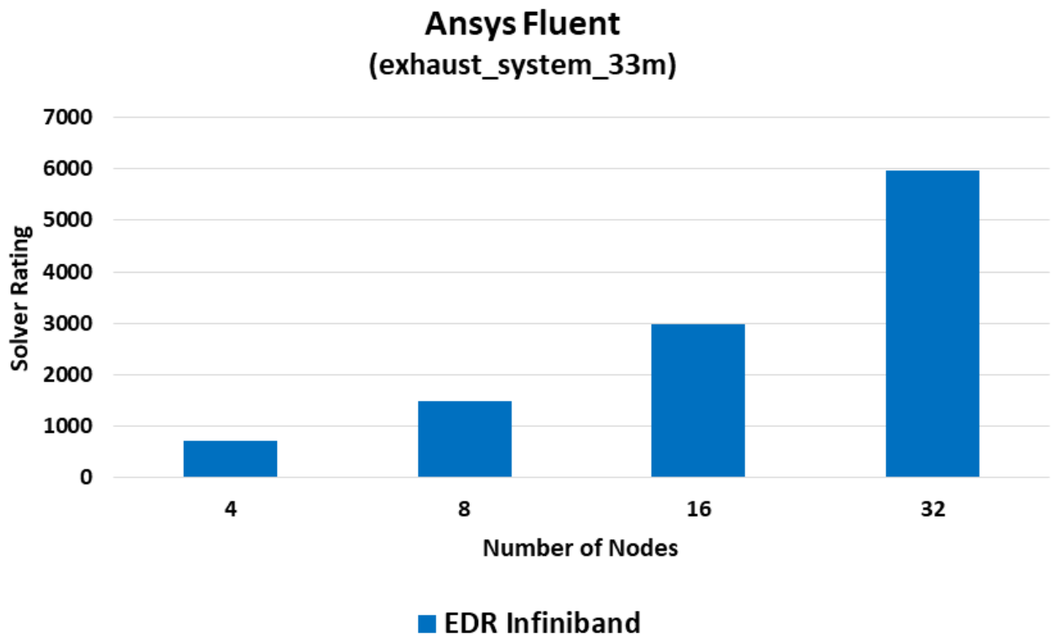


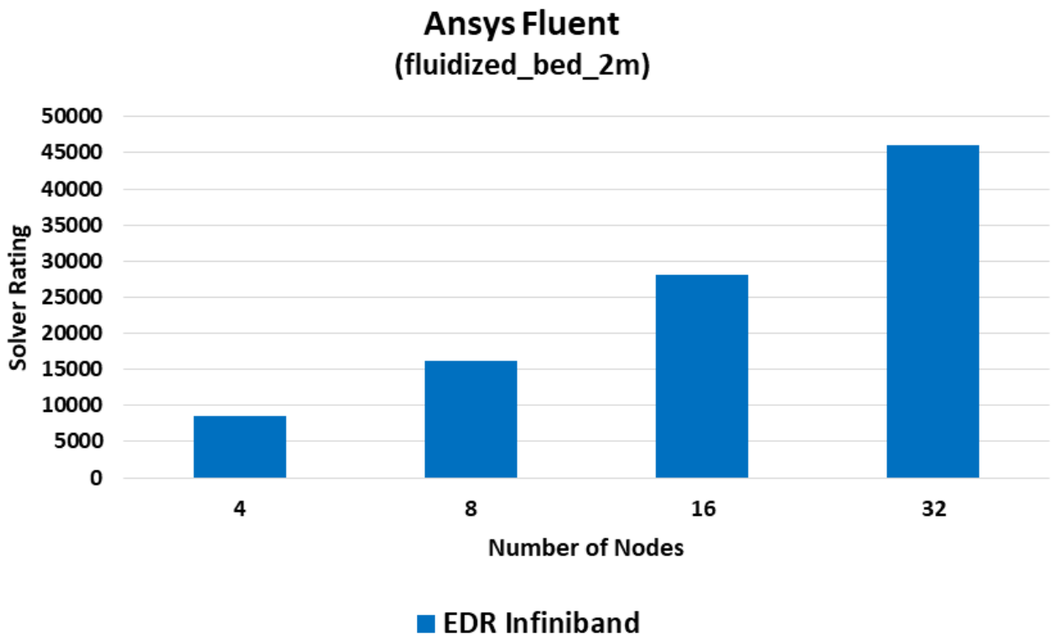
Fluent Performance (Combustor 12M and 71M)



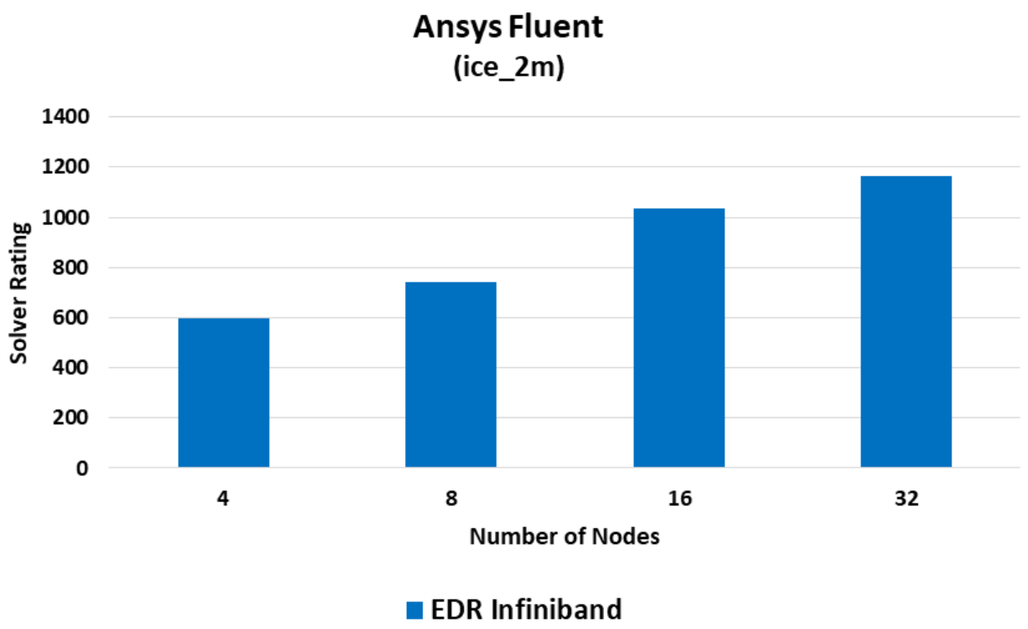


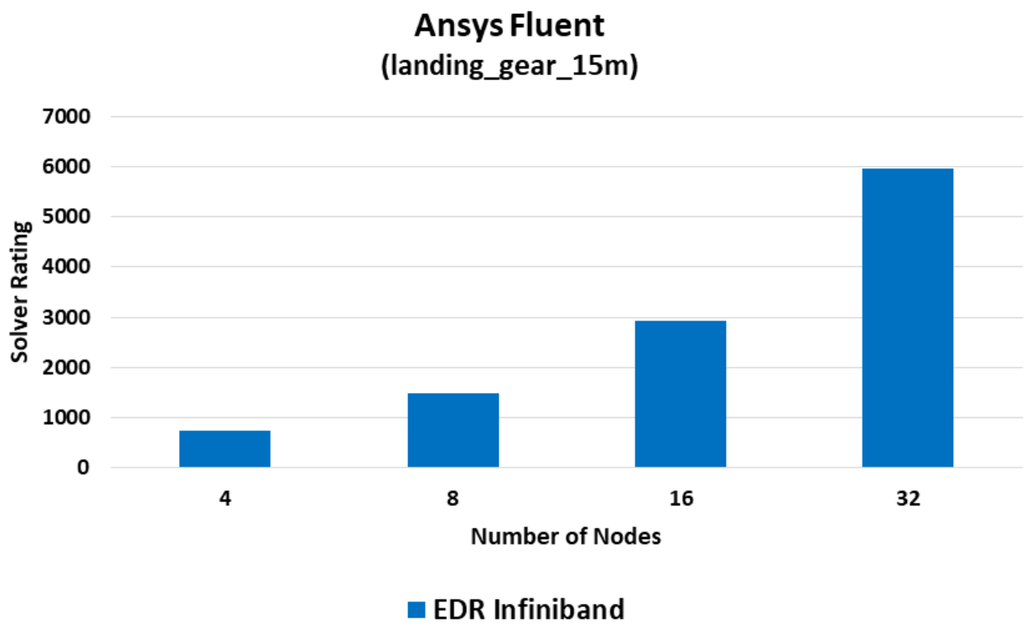
Fluent Performance (Exhaust 33M, Fluidized_Bed 2M)



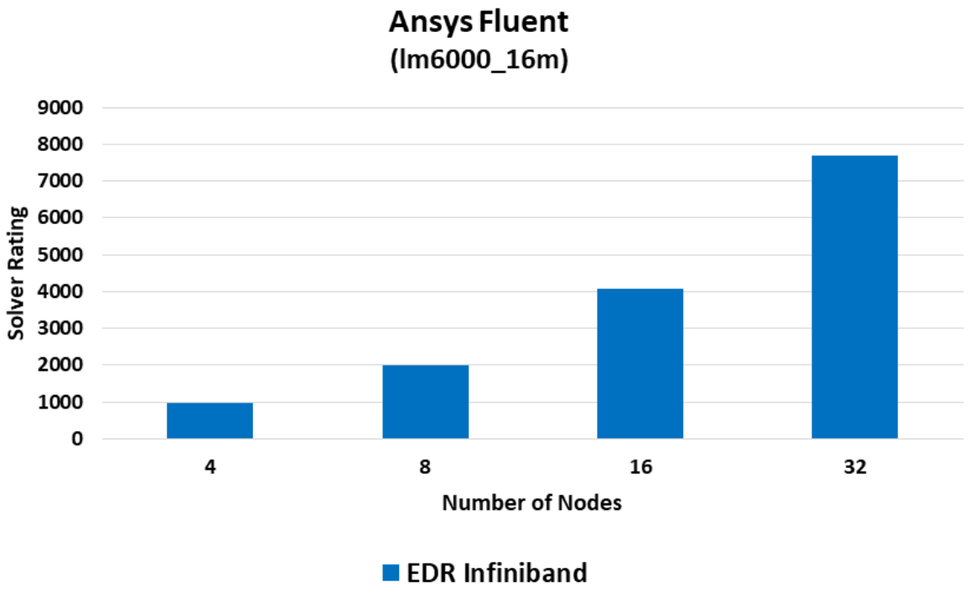


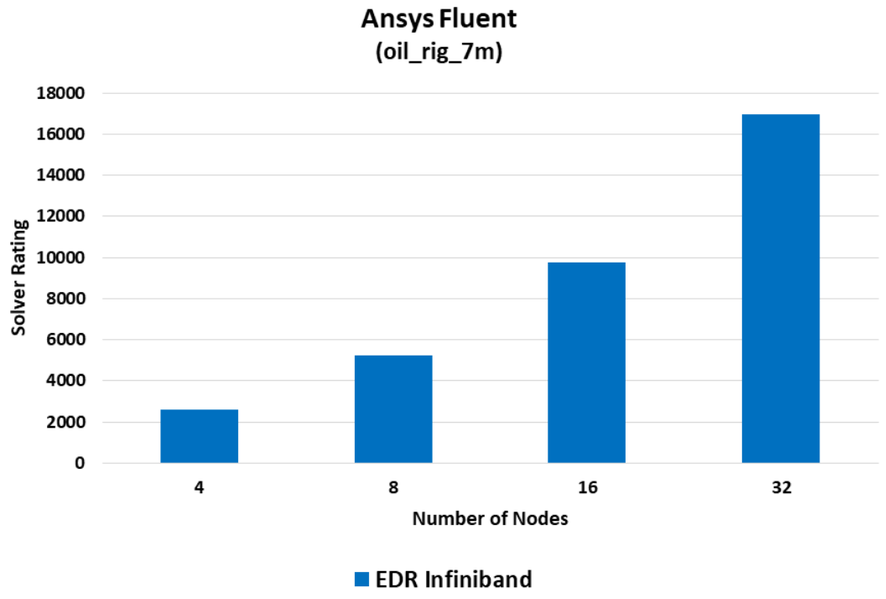
Fluent Performance (Ice 2M, Landing Gear 14M)



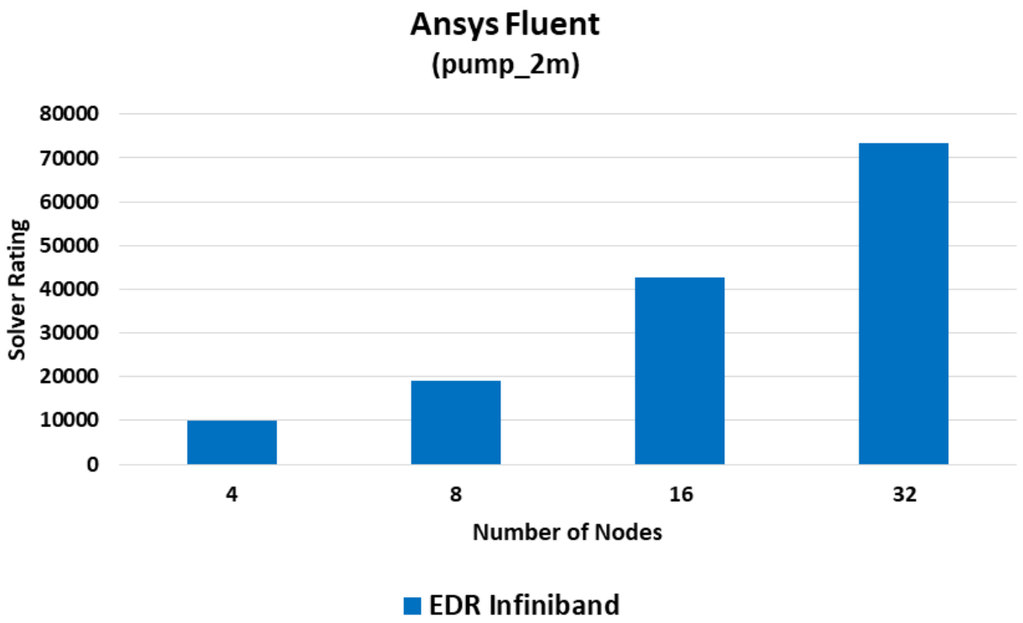


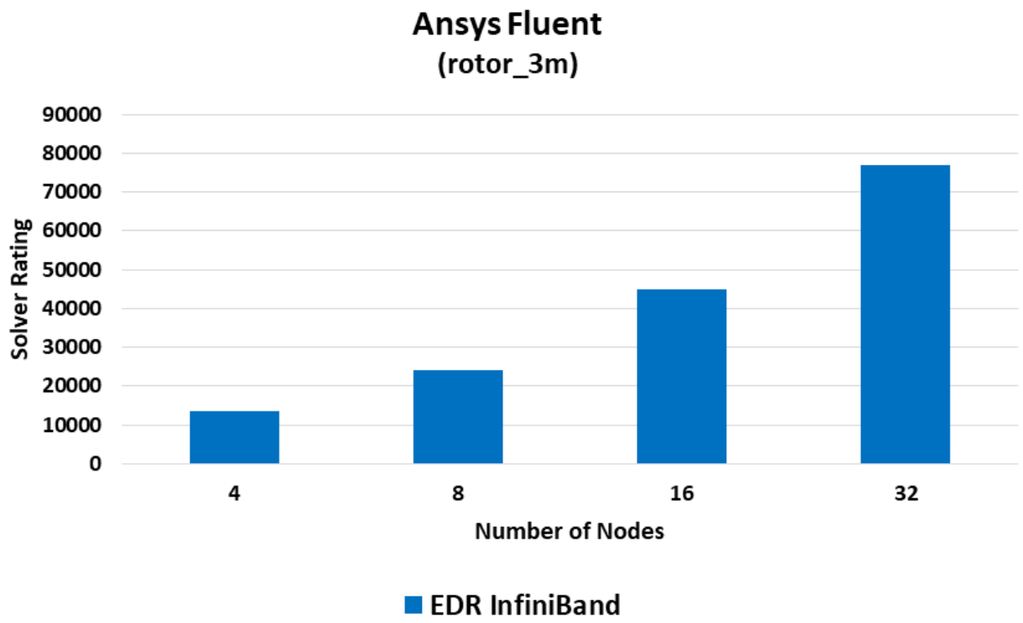
Fluent Performance (Lm6000 16M, Oil Rig 7M)



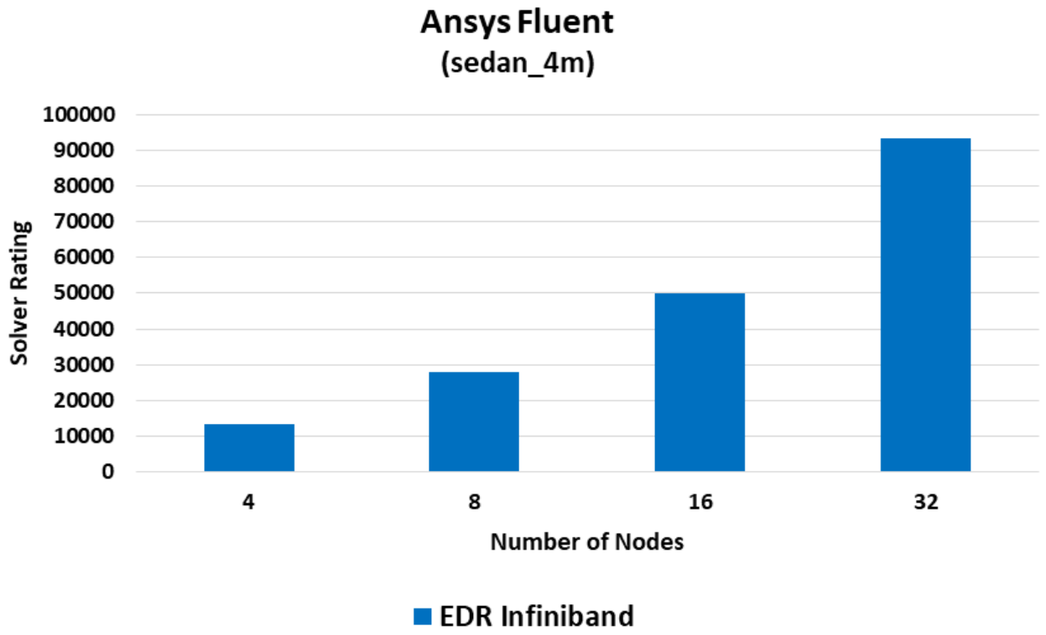


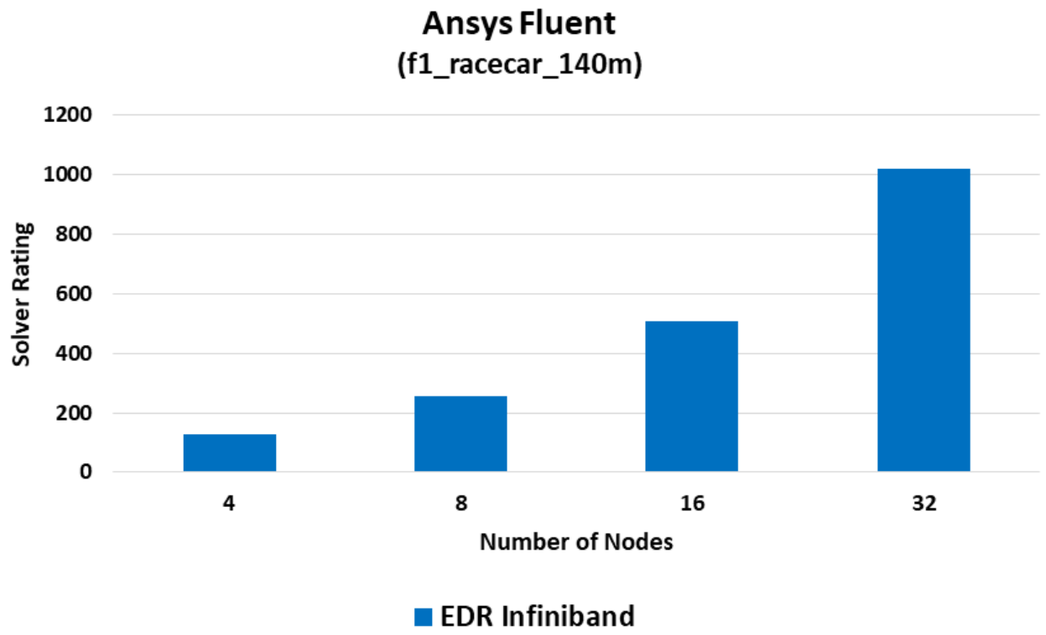
Fluent Performance (Pump 2M, Rotor 3M)



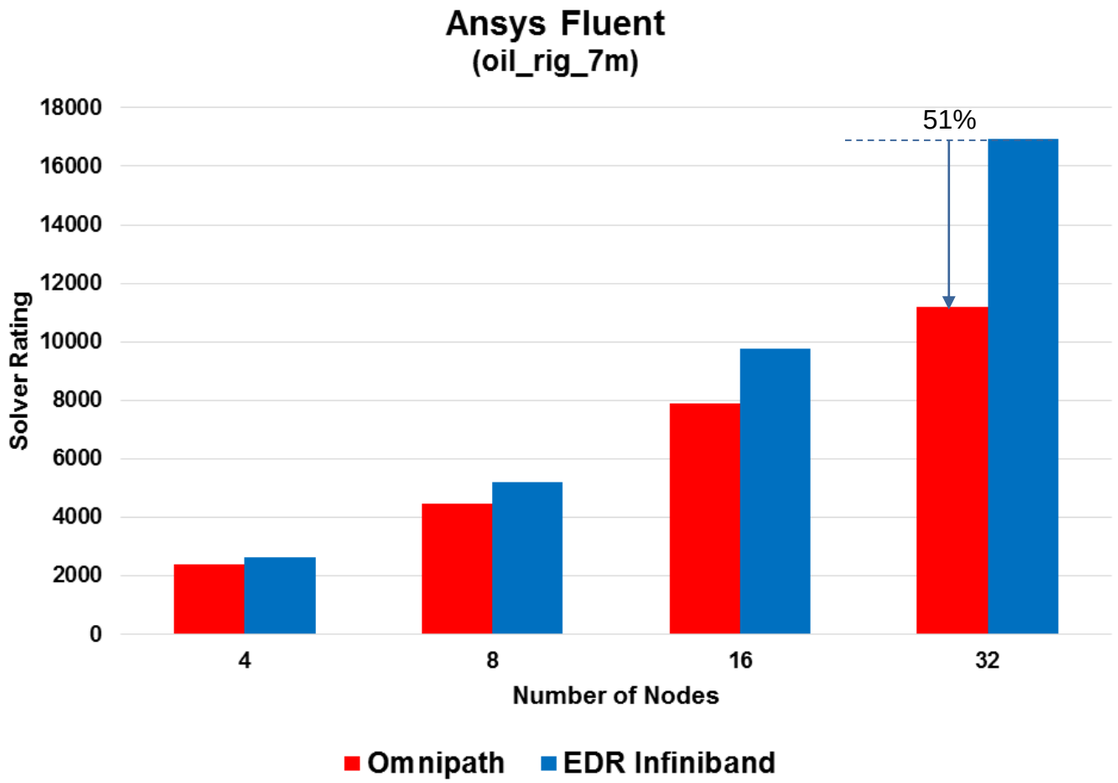


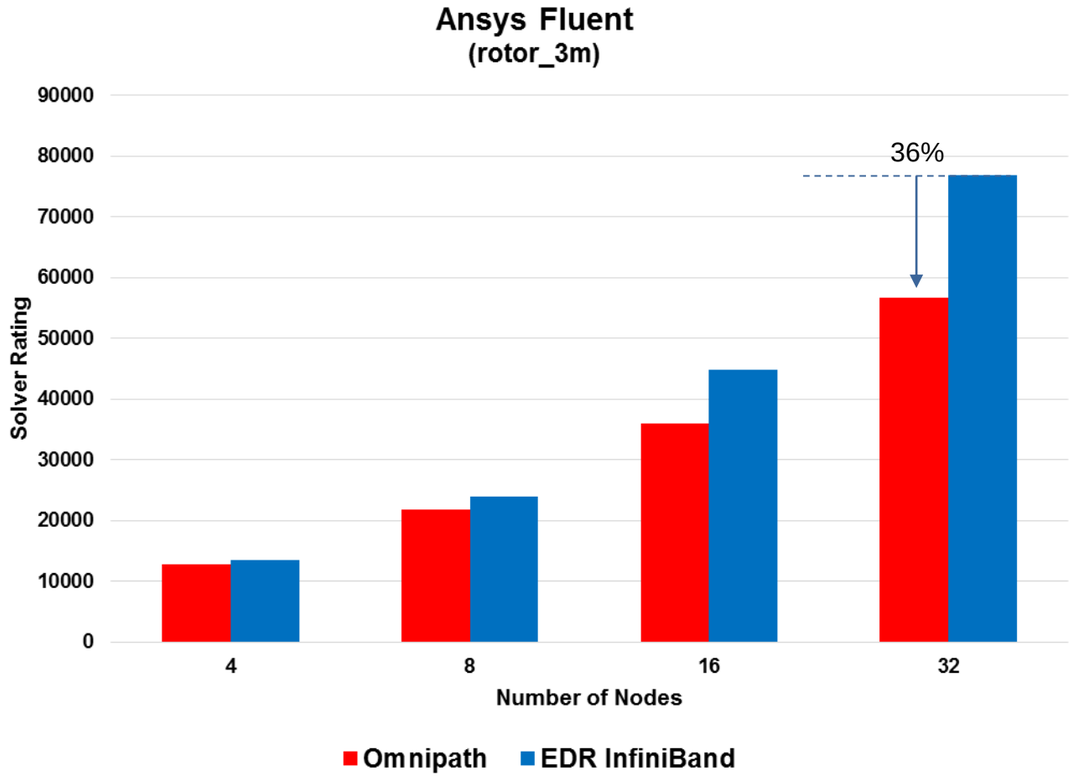
Fluent Performance (Sedan 4M, F1_Racecar 140M)





Performance – Network Comparison (InfiniBand, OmniPath)

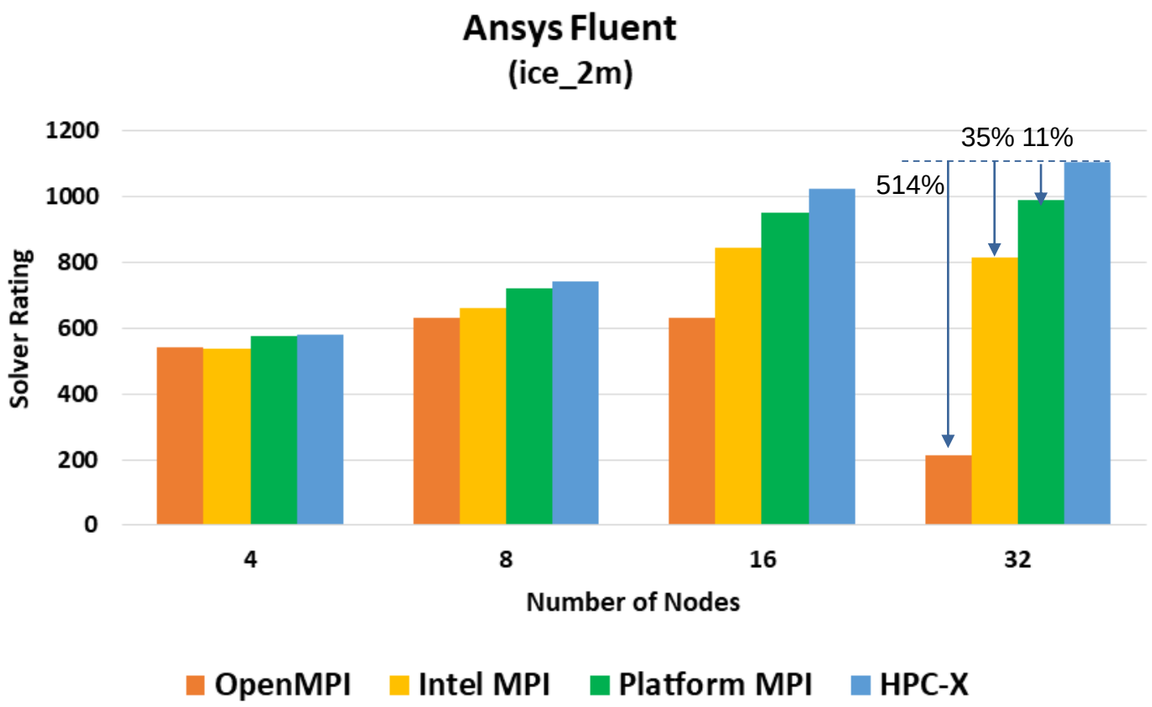


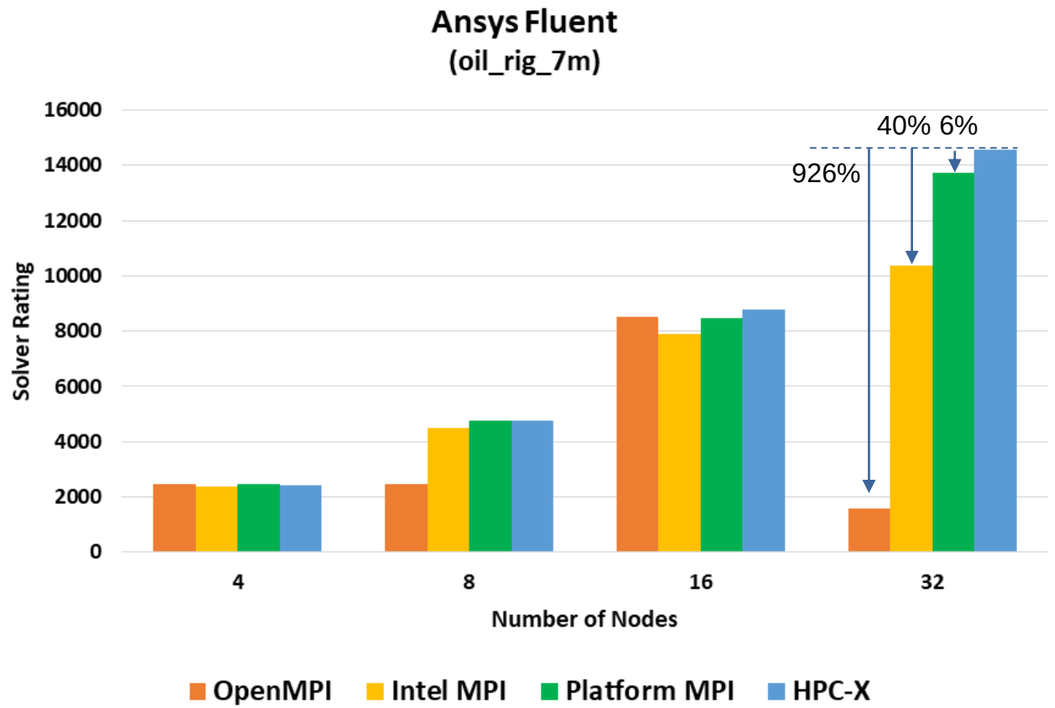


Performance – MPI Comparison

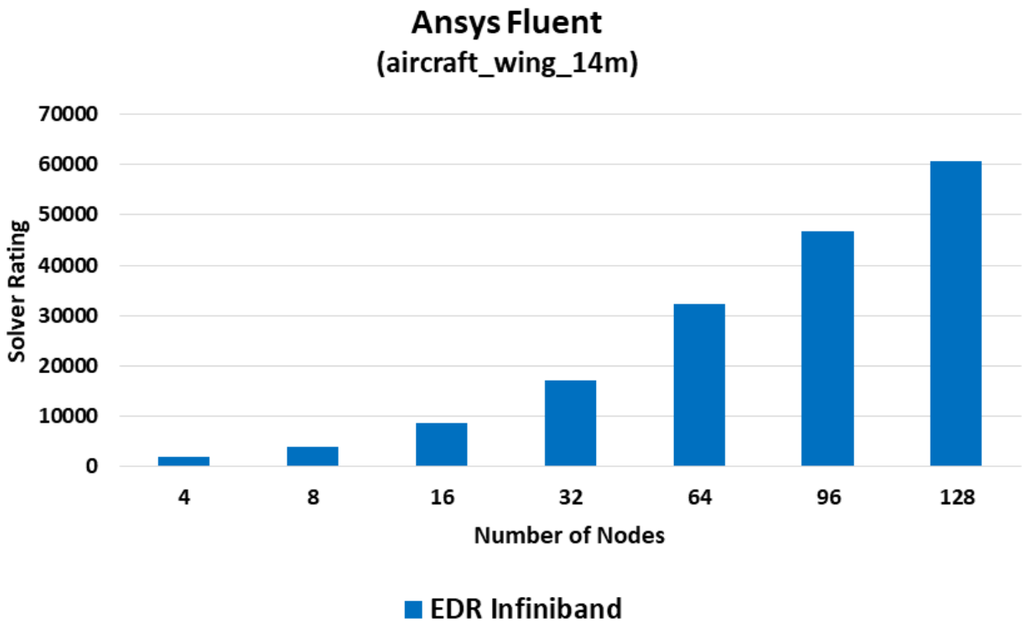
- **The following tests were done on Thor cluster (InfiniBand network), on the same cases using the following MPIs**
  - Open MPI
  - Intel MPI
  - Platform MPI
  - HPC-X MPI

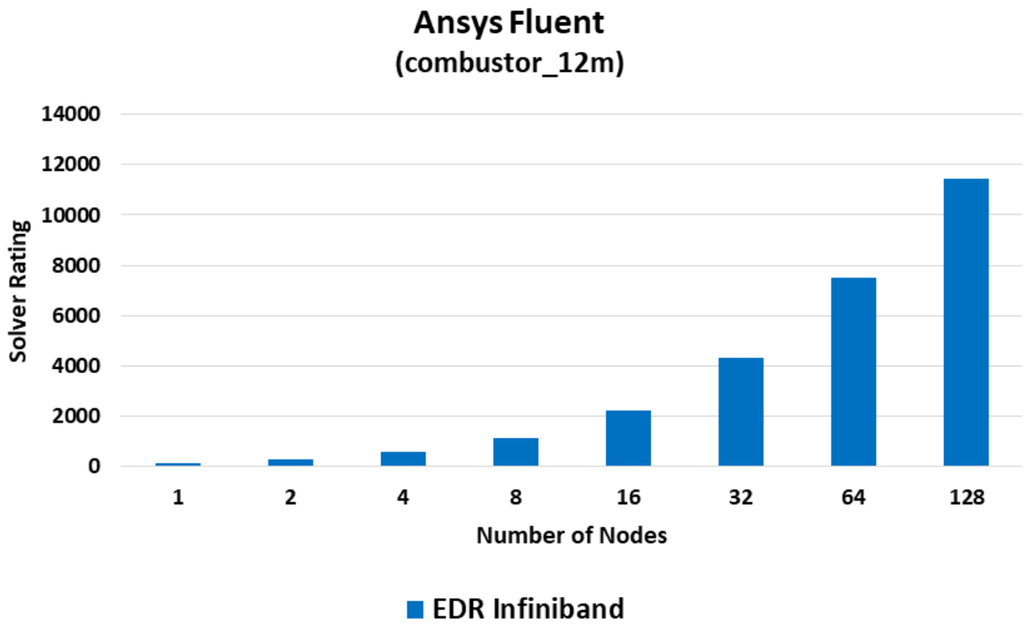
Performance – MPI Comparison



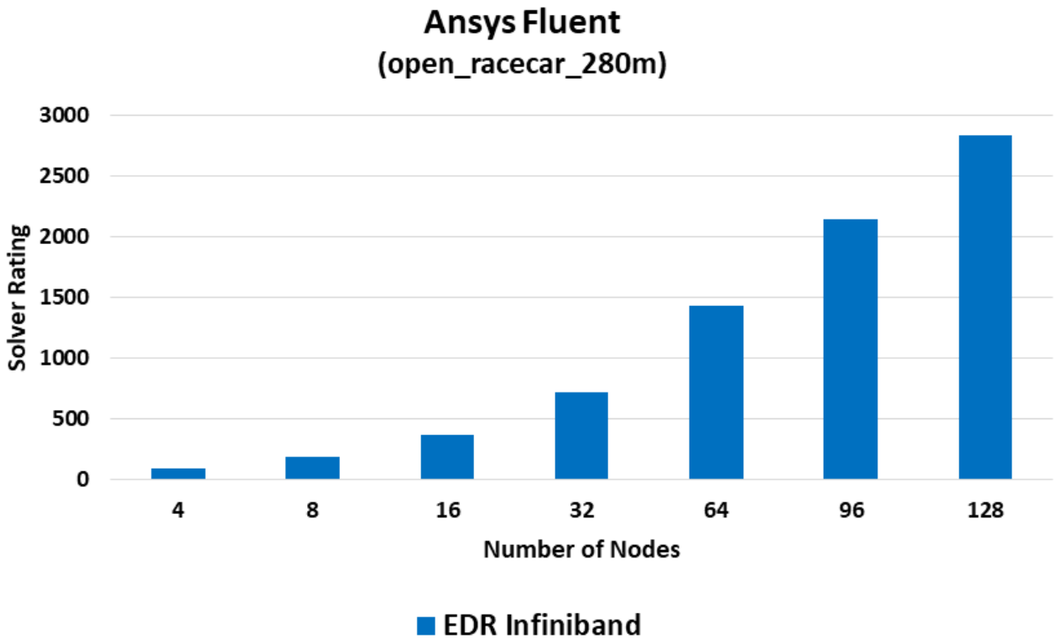


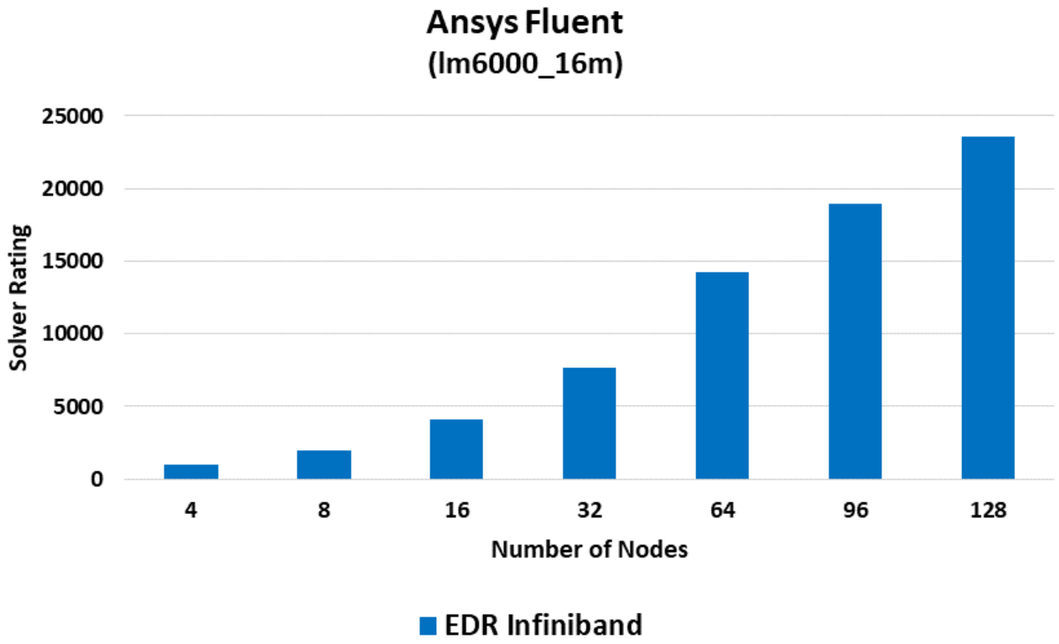
Performance at Scale (Wing, Combustor)





Performance at Scale (Open_Racecar, Lm6000)





Results Analysis

- **Network Comparison**
  - The result tests show the advantages of InfiniBand interconnect
- **MPI Comparison (InfiniBand)**
  - For the several benchmarks, HPC-X exhibits higher performance and better scalability
- **Scalability (InfiniBand)**
  - The Scalability tests show good scalability up to 128 nodes across all benchmarks

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Thank You