

STAR-CCM+ Performance Benchmark

August 2010

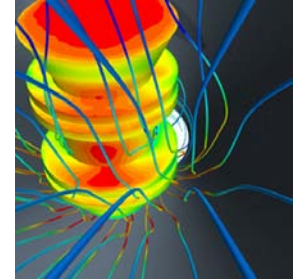


- **The following research was performed under the HPC Advisory Council activities**
 - Participating members: CD-adapco, Dell, Intel, Mellanox
 - Compute resource - HPC Advisory Council Cluster Center

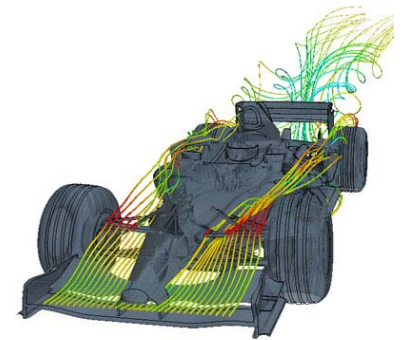
- **For more info please refer to**
 - <http://www.cd-adapco.com>
 - <http://www.dell.com>
 - <http://www.intel.com>
 - <http://www.mellanox.com>

- **STAR-CCM+**

- An engineering process-oriented CFD tool
- Client-server architecture, object-oriented programming
- Delivers the entire CFD process in a single integrated software environment



- **Developed by CD-adapco**



- **The presented research was done to provide best practices**
 - CD-adapco performance benchmarking
 - Interconnect performance comparisons
 - Ways to increase CD-adapco productivity
 - Power-efficient simulations

- **The presented results will demonstrate**
 - The scalability of the compute environment
 - Considerations for power saving through balanced system configuration

- **Dell™ PowerEdge™ M610 14-node cluster**
 - Six-Core Intel X5670 @ 2.93 GHz CPUs
 - Memory: 24GB per node
 - OS: CentOS5U4, OFED 1.5.1 InfiniBand SW stack
- **Intel Cluster Ready certified cluster**
- **Mellanox ConnectX-2 40Gb/s InfiniBand adapters and 40Gb/s switches**
- **MPI: HP-MPI 2.3.1**
- **Application: STAR-CCM+ version 5.04.006**
- **Benchmark Workloads**
 - Lemans_Poly_17M (Epsilon Euskadi Le Mans car external aerodynamics)
 - Civil_Trim_20M (Civil Airliner External Aerodynamics)

- **Intel® Cluster Ready systems make it practical to use a cluster to increase your simulation and modeling productivity**
 - Simplifies selection, deployment, and operation of a cluster
- **A single architecture platform supported by many OEMs, ISVs, cluster provisioning vendors, and interconnect providers**
 - Focus on your work productivity, spend less management time on the cluster
- **Select Intel Cluster Ready**
 - Where the cluster is delivered ready to run
 - Hardware and software are integrated and configured together
 - Applications are registered, validating execution on the Intel Cluster Ready architecture
 - Includes Intel® Cluster Checker tool, to verify functionality and periodically check cluster health



- **Input Dataset**

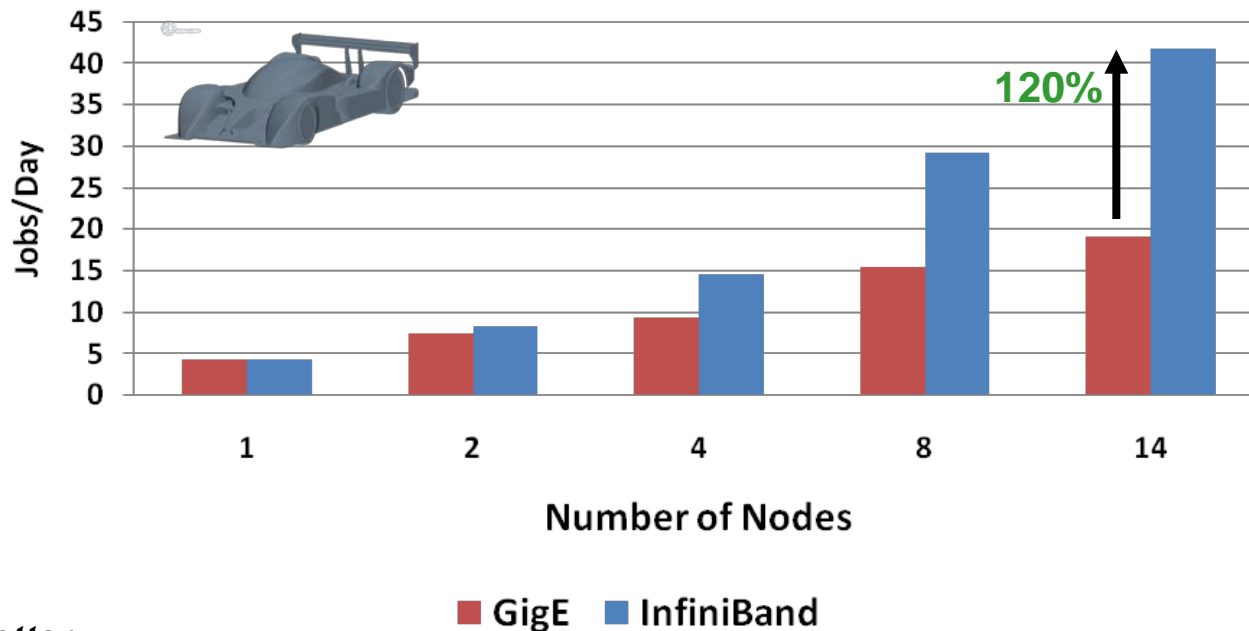
- Lemans_Poly_17M

- **InfiniBand enables higher scalability**

- Up to 120% higher performance than GigE at 14 nodes
- At 8 nodes, InfiniBand allows 2x power efficiency versus Ethernet



STAR-CCM+ Benchmark
(lemans_poly_17m)



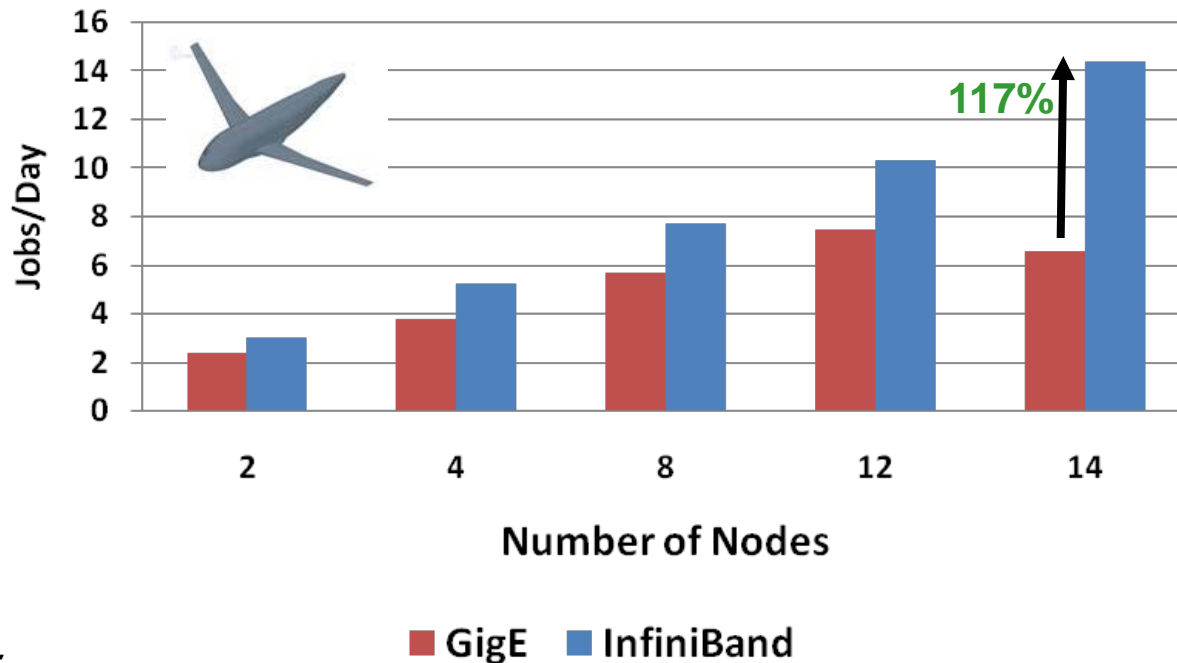
12 Cores/Node

STAR-CCM+ Performance Result - Interconnect

- **Input Dataset**
 - Civil_Trim_20M
- **InfiniBand enables higher scalability**
 - Up to 117% higher performance than GigE at 14 nodes



STAR-CCM+ Benchmark (civil_trim_20m)



12 Cores/Node

- **Input Dataset**

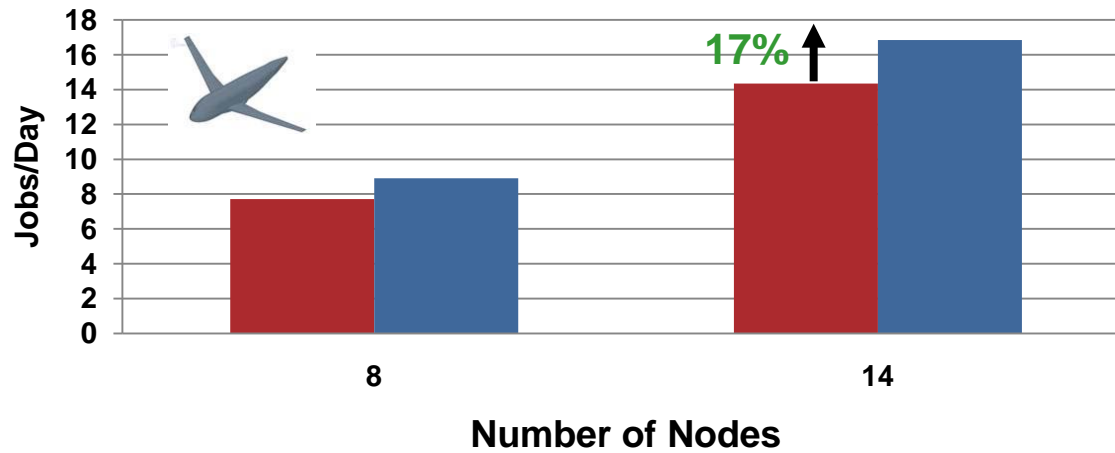
- Civil_Trim_20M

- **Running 2 jobs concurrently enables higher productivity**

- Using 6 cores/node (instead of 12 cores/node) to provide higher performance
- Up to 17% higher performance when 2 jobs running concurrently
- In perfect scaling, single job per system or multiple jobs execution in parallel will result in the same number of jobs per day
- In non perfect scaling, running multiple jobs concurrently can result in higher productivity



STAR-CCM+ Benchmark
(civil_trim_20m)



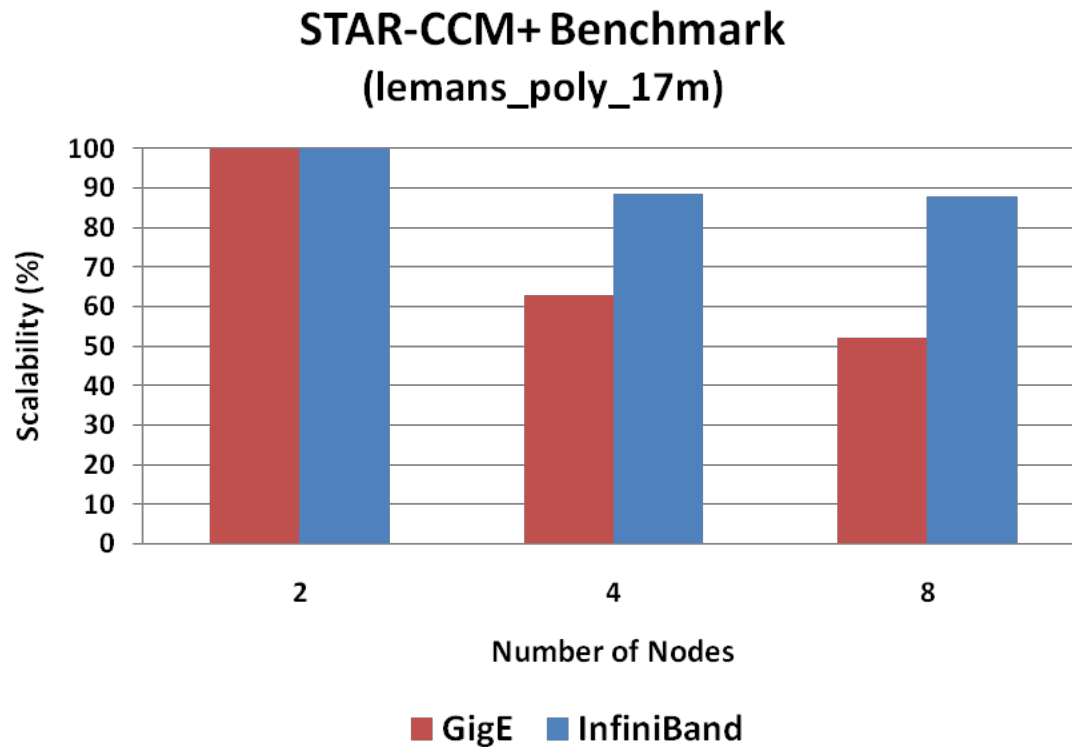
Higher is better

■ 1 Job Per Node ■ 2 Jobs Per Node

InfiniBand

12 Cores/Node

- **InfiniBand maintains scalability at ~90%**
- **Ethernet scalability drops to 50% at 8 nodes**
 - 50% of the system capability is not being utilized



Higher is better

InfiniBand
12 Cores/Node

- **Interconnect comparison shows**
 - InfiniBand delivers superior performance in every cluster size
 - InfiniBand Nearly 90% scalability versus 50% with Ethernet
- **Job Productivity**
 - Running 2 jobs can enable can yield the better performance
 - Up to 17% increase in number of jobs per day
- **InfiniBand QDR saves power**
 - InfiniBand reduces power consumption/job by 57% or more compared to GigE

Thank You

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