WHITE PAPER
Internet Wide Area RDMA Protocol (iWARP)
NetEffect 10 Gbps Ethernet
Server Cluster Adapters
Technical and High-Performance Computing

Intel® Ethernet 10 Gigabit iWARP LS-DYNA Performance Study

EXECUTIVE SUMMARY

The *Intel® iWARP Ethernet Performance Series* of test results intends to help close the gap between real user requirements and the micro-benchmarks promoted by other RDMA vendors. Each paper in the series demonstrates the real-world performance of Intel iWARP on an industry standard application.

This paper reports on LS-DYNA performance testing performed by the Research Computing and Cyberinfrastructure unit of Information Technology services at Penn State.

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Introduction

RDMA enables direct, zero-copy data transfer between RDMA-capable server adapters and application memory, removing the need in Ethernet networks for data to be copied multiple times to operating system data buffers. The mechanism is highly efficient and eliminates the associated processor-intensive context switching between kernel space and user space. HPC applications can therefore reduce latency and perform message transfer very rapidly and consistently by directly delivering data from application memory to the network.

Both iWARP and InfiniBand use RDMA and a common API for HPC applications, however iWARP enables the use of RDMA over the familiar Ethernet fabric. Because iWARP runs over Ethernet TCP/IP, it enables both application and management traffic to operate over a single wire.

This paper reports on LS-DYNA performance testing performed by the Research Computing and Cyberinfrastructure unit of Information Technology services at Penn State to identify how well iWARP fabrics support workloads on widely used high performance computing applications compared to InfiniBand.

iWARP Features

Unlike InfiniBand, iWARP is an extension of conventional Internet Protocol (IP), so standard IT management tools and processes can also be used to manage the traffic and resources associated with iWARP, which implements the following key performance features:

- **Kernel-Bypass:** Enabling applications to interface directly to the Ethernet adapter removes the latency of the OS and the expensive CPU context switches between kernel-space and user-space.
- **Direct Data Placement**: Writing the data directly into user space eliminates the need for wasteful, intermediate buffer copies, thus reducing processing latency and improving memory bandwidth.
- **Transport Acceleration:** The TCP/IP and iWARP protocols are accelerated in silicon vs. host software stacks, thereby freeing up valuable CPU cycles for application compute processing.

iWARP Benefits

HPC applications can use iWARP technology with NetEffect™ Ethernet Server Cluster Adapters from Intel to provide a high-performance, low-latency Ethernet-based solution. By making Ethernet networks suitable for these high-performance clustering implementations, iWARP provides a number of benefits:

- **Fabric consolidation.** With iWARP technology, LAN and RDMA traffic can pass over a single wire. Moreover, application and management traffic can be converged, reducing requirements for cables, ports, and switches.
- **IP-based management.** Network administrators can use standard IP tools to manage traffic in an iWARP network, taking advantage of existing skill sets and processes to reduce overall cost and complexity.
- **Native routing capabilities.** Because iWARP uses Ethernet and the standard IP stack, it can use standard equipment and be routed across IP subnets using existing network infrastructure.
- **Existing switches, appliances, and cabling.** The flexibility of using standard TCP/IP Ethernet to carry iWARP traffic means that no changes are required to Ethernet-based network equipment.

iWARP vs. Infiniband Performance: LS-DYNA

LS-DYNA, developed by Livermore Software Technology Corporation (LSTC), is a general-purpose, transient-dynamic finite-element program designed to simulate complex real-world problems. It is optimized for shared and distributed memory UNIX*, Linux, and Windows*-based platforms. Related products include LS-OPT, a standalone Design Optimization and Probabilistic Analysis package with an interface to LS-DYNA; and LS-PrePost, an advanced interactive program used for preparing input data for LS-DYNA and processing the results from LS-DYNA analyses. For more information, see the LS-DYNA website. [1]

Test Scenario

In the test case simulated here, a van crashes into the rear of a compact car, which in turn crashes into a midsize car. Vehicle models were created by the National Crash Analysis Center (NCAC) and assembled into the input file by Mike Berger, consultant to LSTC. For this study, the input files were downloaded from the Top Crunch Project. [2] This model has 794,780 elements with six contact surfaces and 1,052 materials. The simulation time of collision is 150 ms.

Conclusion

By providing realistic application performance instead of micro-benchmark test results, this report illustrates the danger of relying solely on synthetic benchmarking when evaluating networking options. HPC workloads behave much differently than, for example, a half round-trip latency test: using multiple connections in a switched environment with non-uniform I/O patterns.

The real-world application results shown in this report show the viability of iWARP Ethernet as an alternative to discrete, proprietary fabrics for HPC workloads. The fundamental advantages of a converged Ethernet network combined with easier IP-based management and native routing capability make iWARP a compelling solution for HPC use cases.

References

[1] http://www.ls-dyna.com/.

[2] http://www.topcrunch.org/.

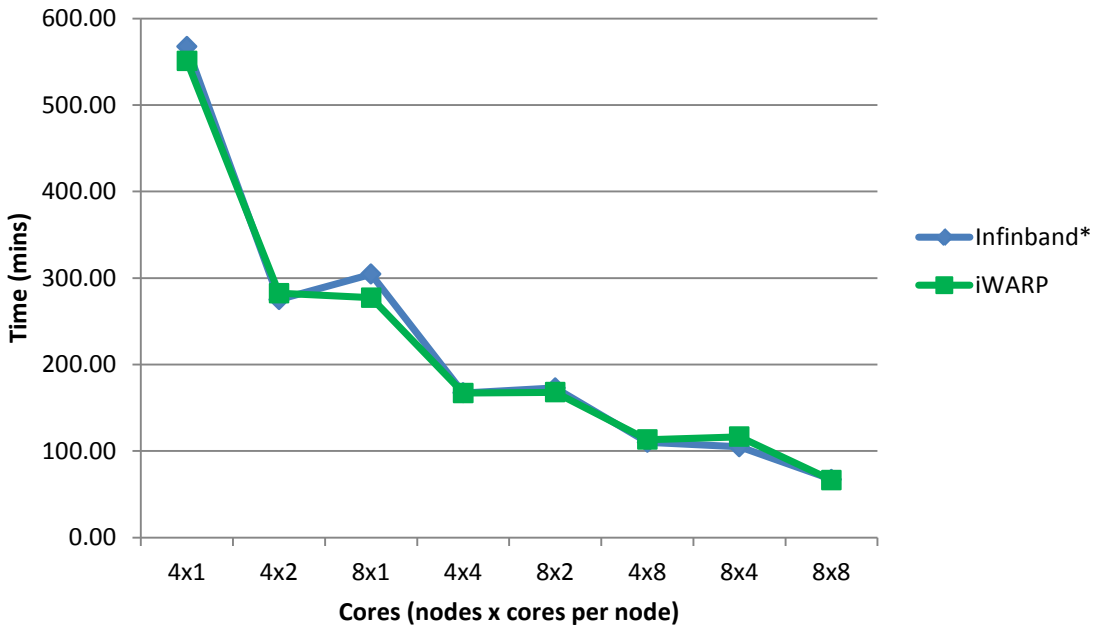

Figure 1. LS-DYNA iWARP versus InfiniBand* Performance-Testing Results (lower y-axis figures are better)

TEST ENVIRONMENT

All tests were performed by the Research Computing and Cyberinfrastructure unit of Information Technology services at Penn State.

The application software under test was MPPdyna. (Results are shown in Figure 1.)

The test environment consisted of the following:

Servers

- Dell PowerEdge* R710 Server
- Two Intel® Xeon® processors X5560
- 48 GB RAM

Network Adapters

- 10 Gbps iWARP-enabled NetEffect Ethernet Server Cluster Adapter from Intel
- Mellanox Connect-X MT26428 QDR InfiniBand* Host Channel Adapter

System Software

- Red Hat Enterprise Linux* 5.6
- OpenFabrics Enterprise Distribution* 1.5.2
- OpenMPI 1.4.2

Switches

- iWARP: Arista 7148SX* with Jumbo Frames enabled
- InfiniBand: Mellanox MTS3600*

For more information on Intel® iWARP, please visit:

www.intel.com/go/ethernet

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