WELCOME TO NVMe™ Developer Days
We put the iWARP in NVMe-oF
NVMe-oF with iWARP

• NVMe/iWARP RDMA over Ethernet
• Extend storage fabric beyond PCIe reach
• High Performance, scalable low latency API
• RDMA performance and efficiency across standard Ethernet without the DCB tax and complexity
Why is this important?

• iWARP is....
  • Easier to deploy
  • Uses legacy infrastructure
  • Performance
  • Price
  • Stable
  • Scalable
Supported across the Chelsio product line

• 10 Gb/sec to 100 Gb/sec
• Kernel mode part of the Linux kernel today!
• SPDK mode coming soon
• Supported on multiple platforms
  • x86_x64/EPYC
  • ARM
NVMe-oF Kernel Mode Bandwidth

Chelsio T62100-CR 100Gb/sec
1 Target
2 Initiators
1GB RAM DISK
8 Total Connections
2 Target devices per initiator

Complete set of Benchmark results including competitive comparison available upon request
NVMe-oF SPDK Bandwidth

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NVMe-oF Kernel Mode IOPs

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IOPs in Millions

- **4K**: Read 1.41, Write 2.55
- **8K**: Read 1.48, Write 2.17
- **64K**: Read 0.19, Write 0.19
- **256K**: Read 0.05, Write 0.05

- **Read**
- **Write**
NVMe-oF SPDK IOPs

- **Chelsio T62100-CR 100Gb/sec**
  - 1 Target
  - 2 Initiators
  - 1GB RAM DISK
  - 8 Total Connections
  - 2 Target devices per initiator

Complete set of Benchmark results including competitive comparison available upon request.
NVMe kernel mode over 100GbE iWARP Fabric

RamDisk and SSD IOPs & Throughput vs I/O size
NVMe kernel mode over 100GbE iWARP Fabric

Latency vs # of connections
Benchmark: 100G NVMe/TCP
Host Stack vs TOE

**Test Setup**

- **The target machine**
  - 2 Intel Xeon E5-2687W v4
    - 12-core @ 3.00GHz (HT disabled)
  - 128GB of RAM
  - Chelsio T62100-CR (2 x 100Gbps)
  - RHEL 7.3 (4.18.0-rc6 kernel)

- **The initiator machines**
  - 1 Intel Xeon E5-1620 v4
    - 4-core processor @ 3.50GHz (HT enabled)
  - 32GB of RAM
  - Chelsio T62100-CR (2x100 Gbps)
  - RHEL 7.3 (4.18.0-rc6 kernel)
Benchmark: 100G NVMe/TCP
Host Stack vs TOE

Summary
• Read throughput is line rate for TOE
• Write throughput near line rate for TOE
• 2.6M IOPS at 4K I/O size for TOE
• ~12 µSec delta latency between local and remote storage
What’s New? SoftiWARP!

• NVMe/iWARP RDMA over Ethernet in Software
• Can run on any L2 NIC (No RNIC Required)
• High Performance, scalable API
• RDMA performance and efficiency across standard Ethernet without the DCB tax and complexity
• Get the Benefits of RDMA across your cluster without having to equip all nodes with RNICs
More on SoftiWARP

- Builds in an automatic second source to any offloaded solution
- Unlike RoCE, this solution interoperates with ALL iWARP Cards
- Enables NVMe-oF and iSER to benefit from ubiquity of a software solution
- SoftiWARP is available under GPL and BSD Licenses
- Surprisingly Good Performance
Test Setup

- **The target machine**
  - 2 Intel Xeon E5-2687W v3
    - 8-core @ 3.00GHz (HT enabled)
    - 64 GB of RAM
    - Chelsio T62100-CR (2 x 100Gbps)
    - CentOS 7.6 (4.14.85 kernel)

- **The initiator machines**
  - 2 Intel Xeon E5-2687W v3
    - 8-core processor @ 3.00GHz (HT enabled)
    - 64GB of RAM
    - Chelsio T62100-CR (2x100 Gbps)
    - CentOS 7.6 (5.0 rc5 kernel)
Chelsio T6 ASIC

- 2 ports - 1/10/25/40/50/100 Gbit
- PCI Gen 3 x16
- On-Board TLS/SSL/IPsec Co-processor
- 264 Port Embedded Ethernet Switch
- On-NIC Filtering, Traffic Management, Traffic Pacing
- Single processor data-flow pipelined architecture
- Up to 1M connections
- Concurrent Multi-protocol Operation
# Chelsio Adapters

## Chelsio Unified Wire Adapter Product Selection Guide

**Single Adapter with concurrent Multi-Protocol Operation**

<table>
<thead>
<tr>
<th>Chelsio P/N</th>
<th>Ports</th>
<th>Connector Type</th>
<th>Host Interface</th>
<th>Form Factor</th>
<th>Concurr. Conn.</th>
<th>Power (Typical)</th>
<th>Airflow</th>
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</thead>
<tbody>
<tr>
<td>T62100-CR</td>
<td>2x4/8G</td>
<td>QSFP28</td>
<td>PCIe Gen3 x16</td>
<td>High</td>
<td>256 1k</td>
<td>22W</td>
<td>200 LF/F</td>
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<td>32k</td>
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<td>1x4/8G</td>
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<td>32k</td>
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<td>15W</td>
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<tr>
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<td>4x1G</td>
<td>QSFP+ Cage</td>
<td>PCIe Gen3 x8</td>
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### Features
- Windows Server 2012-R2 / 2016
- Windows Storage Spaces Direct (S2D)
- Windows Azure Stack Private Cloud
- Windows Network Direct
- Windows SMB Direct
- Windows Name Server
- Windows Client RDMA
- Low Latency L2 NIC
- TCP Offload Engine (TOE)
- TLS/SSL, DTLS, IPsec, SMB 3.X crypto
- iSCSI Offload (Initiator and Target)
- FC Offload
- NFA ROMA Offload
- NVMe Over Fabrics
- NVMe IODF (Just a Bunch of Flash)
- GPUDirect ROMA
- Wire Direct Low Latency Suite
- SDN / Virtualization
- DPDK / PacketDirect / Netmap
- OVS / OpenFlow Offload
- NVGRE / VLAN/ Geneve
- Media StreamEngine
- Traffic Management / DCB
- Packet Classification
- Sniffer / Tracer
- Mult / Single adapter Failover

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1. Supported only on Nx family of adapters
2. Not supported by 3D (Server Offload) adapters

**LL:** Low Latency  **LP:** Low Profile  **SD:** Server Offload
# Software Ecosystem

## Chelsio Software Suite

### Linux
- **Networking**
  - L2 NIC, PTP TOE
  - SAFO/MAFO SRIOV (VF)
  - DPDK Filtering/OVS
- **iSCSI**
  - Initiator
  - LIO Target
- **FCoE**
  - Initiator
  - LIO Target
- **QoS**
  - Traffic Mgmt
- **Security**
  - Coprocessor
  - Inline TLS
- **Analytics**
  - Sniffer/Tracer
- **Boot**
  - PXE
  - iSCSI
  - FCoE
  - uEFI
- **Mem Free**
  - TOE
  - iWARP
  - iSER
  - NVMe-oF
- **Ring Backbone**
  - L2 NIC, TOE
  - iWARP, iSER
  - iSCSI Initiator/Target
  - NVMe-oF

### Linux P8/ARM
- **Networking**
  - RDMA
  - iWARP
  - NFOsRDMA ISER
  - NVMe-oF
  - RoCE v2
- **RDMA**
  - iWARP
- **iSCSI**
  - Initiator
  - LIO Target
- **Security**
  - Coprocessor
  - Inline TLS
- **QoS**
  - Traffic Mgmt
- **VF Rate Limit**
- **Traffic Mgmt**

### k.org
- **Networking**
  - RDMA
  - iWARP
  - NFOsRDMA ISER
  - NVMe-oF
- **RDMA**
  - iWARP
- **iSCSI**
  - Initiator
  - LIO Target
- **Security**
  - Coprocessor
- **QoS**
  - Traffic Mgmt
  - VF Rate Limit

### Windows
- **Networking**
  - RDMA
  - iWARP
  - NFOsRDMA ISER
  - NVMe-oF
- **RDMA**
  - iWARP
- **iSCSI**
  - Initiator
- **QoS**
  - Traffic Mgmt
- **DCB**

### ESX
- **Networking**
  - RDMA
  - SMBDirect
  - Network Direct
  - S2D, SR
  - Client RDMA
  - Guest RDMA
  - ISER
- **Boot**
  - PXE
  - iSCSI
  - uEFI

### MacOS
- **Networking**
  - L2 NIC

### Solaris
- **Networking**
  - L2 NIC
  - netmap Filtering

### FreeBSD
- **Networking**
  - L2 NIC
  - netmap Filtering
  - RDMA
  - iWARP
Check out the Chelsio Webstore - store.chelsio.com
sales@chelsio.com
www.chelsio.com

For support and other information
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