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100G iSCSI - A Bright Future for Ethernet Storage

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Presentation Outline

- Company Overview
- iSCSI Overview
- iSCSI and iSER
- Innovations
- Summary

iSCSI Timeline

- RFC 3720 in 2004
  - Latest RFC 7143 in April 2014
- Designed for Ethernet-based Storage Area Networks
  - Data protection
  - Performance
  - Latency
  - Flow control
- Leading Ethernet-based SAN technology
  - In-boxed Initiators
  - Plug-and-play
  - Closely tracks Ethernet speeds
    - Increasingly high bandwidth

- 10 GbE, IEEE 802ae 2002
  - First 10 Gbps hardware iSCSI in 2004 (Chelsio)
- 40/100 GbE, IEEE 802.3ba 2010
  - First 40Gbps hardware iSCSI in 2014 (Chelsio)
  - First 100Gbps hardware available in Q3/Q4 2016

iSCSI Trends

- iSCSI Growth
  - FC in secular decline
  - FCoE struggles with limitations
- Ethernet flexibility
  - iSCSI for both front and back end networks
- Convergence
  - Block-level and file-level access in one device using a single Ethernet controller
  - Converged adapters with RDMA over Ethernet and iSCSI consolidate front and back end storage fabrics
- Hardware offloaded 40Gb/s (soon to be 50Gb/s & 100 Gb/s) aligns with migration from spindles to NVRAM
  - Unlocks potential of new low latency, high speed SSDs
- Virtualization
  - Native iSCSI initiator support in all major OS/hypervisors
  - Simplifies storage virtualization

iSCSI Overview

- High performance
  - Zero copy DMA on both ends
  - Hardware TCP/IP offload
  - Hardware iSCSI processing
- Data protection
  - CRC-32 for header
  - CRC-32 for payload
  - No overhead with hardware offload

- Why Use TCP?
  - Reliable Protection Protocol
    - retransmit of load/corrupted packets
    - guaranteed in-order delivery
    - congestion control
    - automatic acknowledgment

iSER Overview

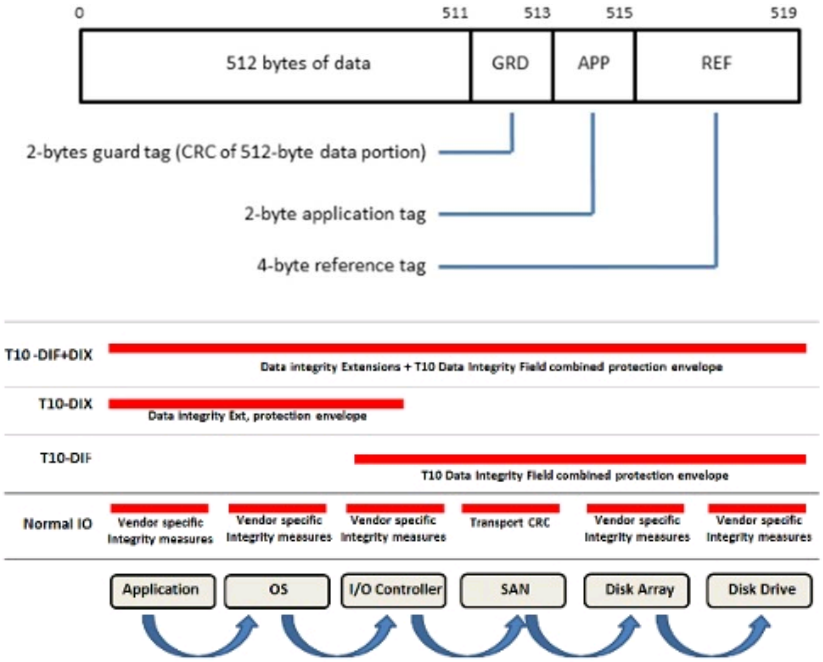
- iSER - iSCSI Extensions for RDMA
- Used to operate iSCSI over RDMA transports such as iWARP/Ethernet or Infiniband
- iSER reach options
  - SCSI over iWARP over TCP/IP
  - SCSI over RoCEv2/IB over UDP/IP
- Requires RDMA NICs (RNICs) on both sides

Introduction: Speeds and Feeds

	Bandwidth (Gbps)	Reach
Ethernet		
iWARP	1, 2.5, 5,10,25,40,50,100	Rack, Data Center, LAN, MAN, WAN
iSCSI		Rack, Data Center, LAN, MAN, WAN
RoCEvn		Rack, Data Center
Infiniband	8, 16, 32, 56, 112	Rack, Data Center

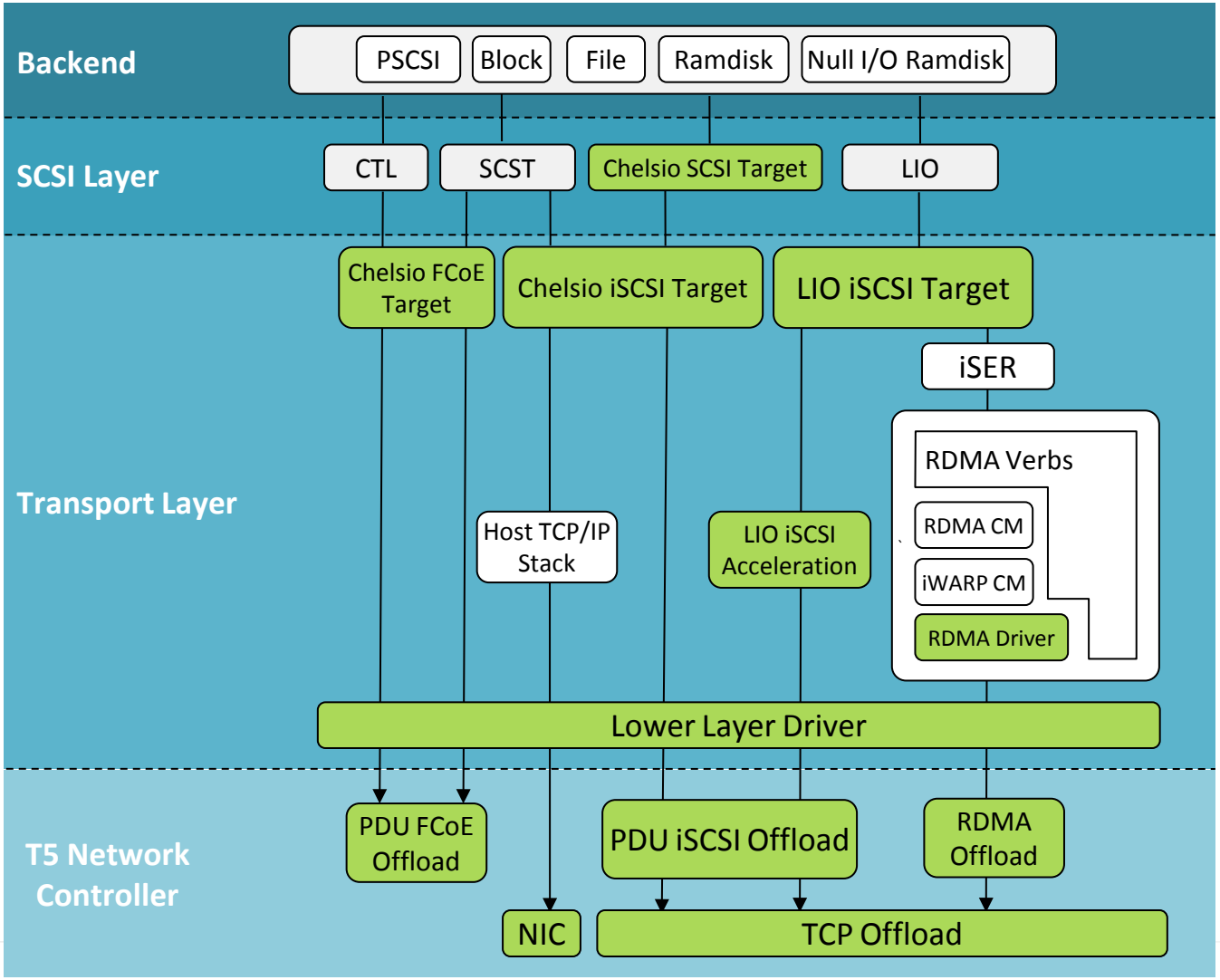
Advanced Data Integrity Protection

- Above and beyond iSCSI CRC-32
- Data Integrity Field (DIF) protects against silent data corruption with 16b CRC
  - Adds 8-bytes of Protection Information (PI) per block
- Data Integrity Extension (DIX) allows this check to be done between application and HBA
- T10-DIF+DIX provide a full end-to-end data integrity check
  - iSCSI CRC-32 handoff possible
- T5 supports hardware offloaded T10-DIF+DIX for iSCSI (and FCoE)

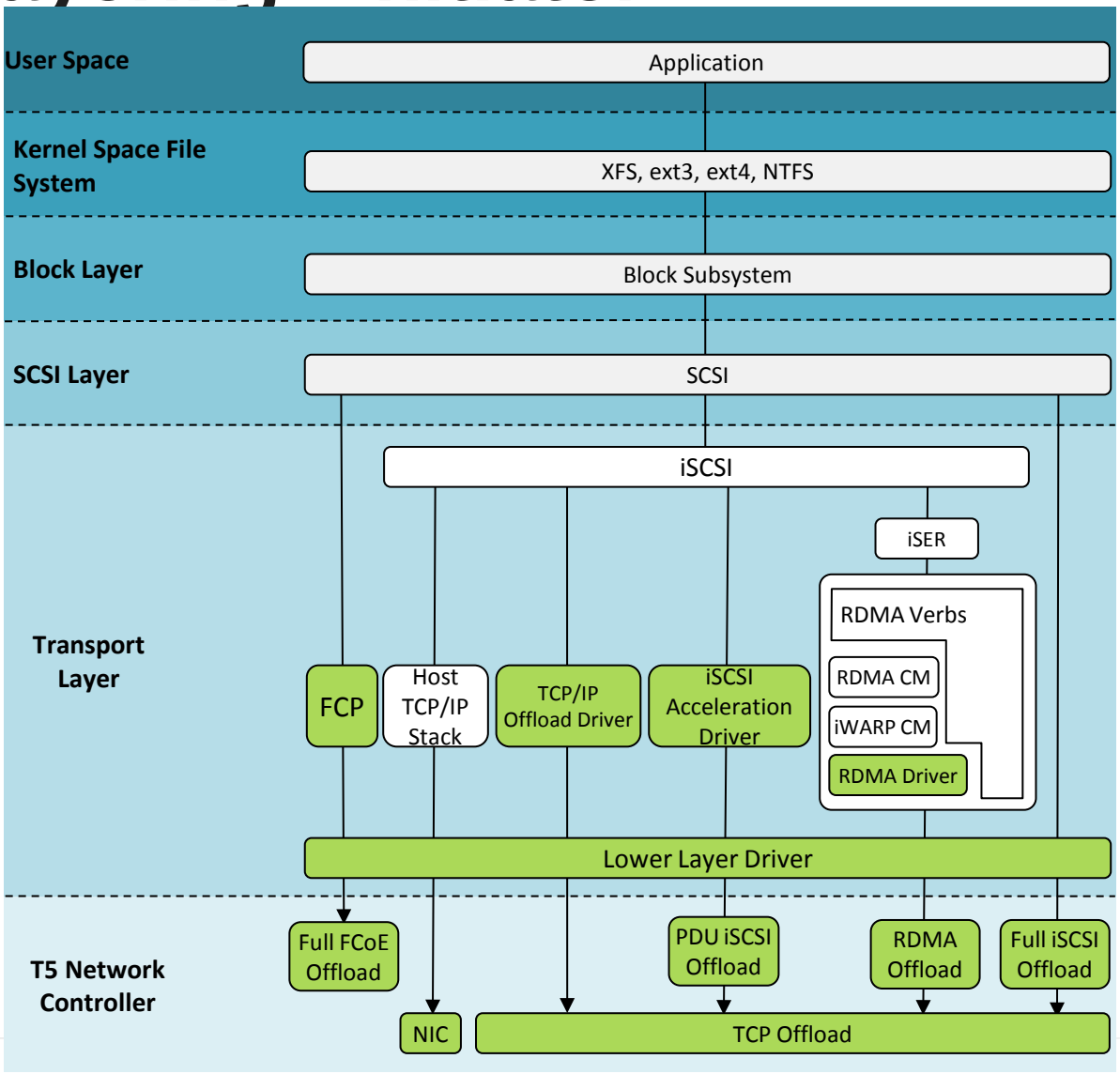


Martin Petersen, Oracle, https://oss.oracle.com/~mkp/docs/dix.pdf

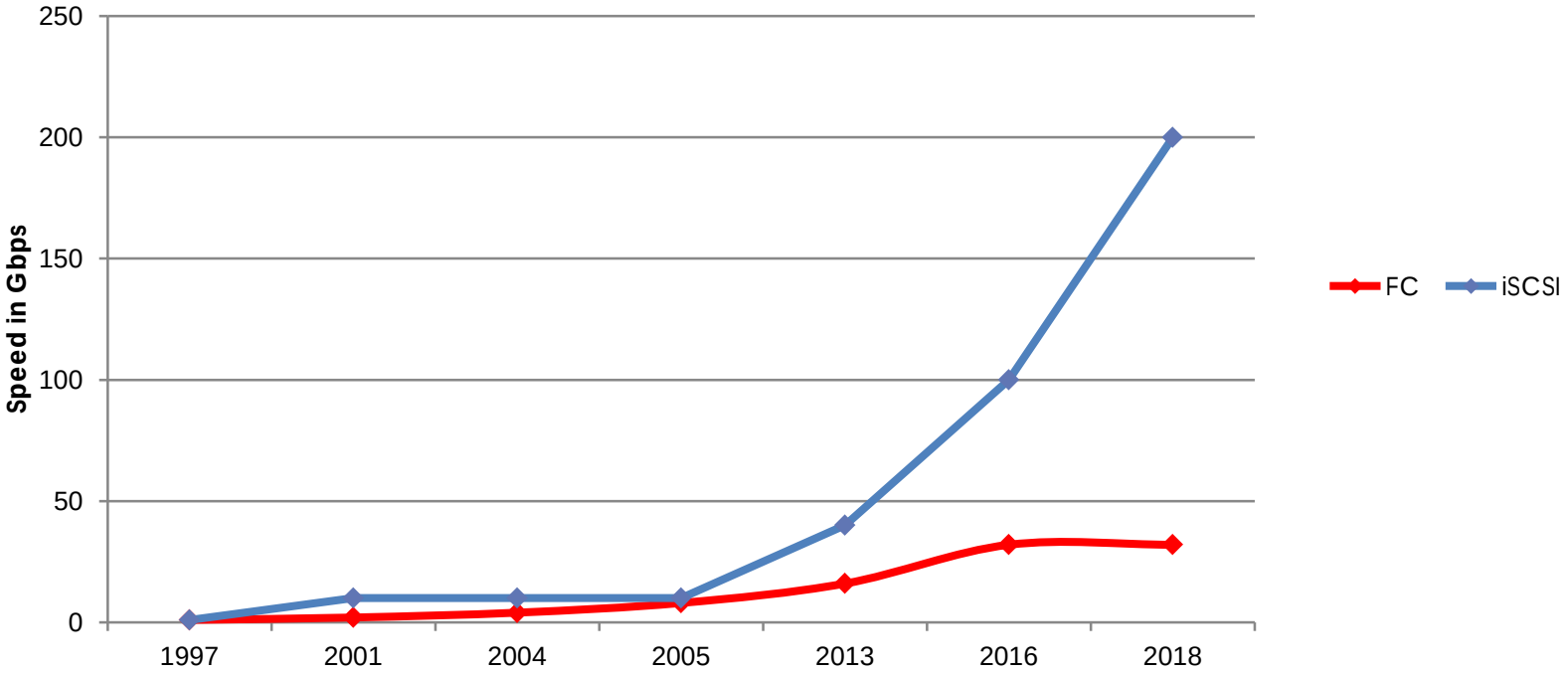
iSCSI Layering - Target



iSCSI Layering - Initiator

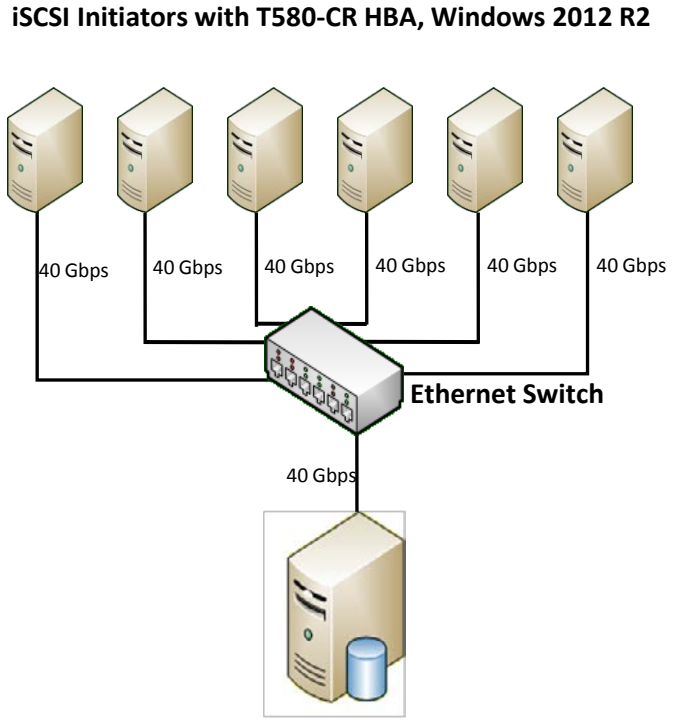


iSCSI Bandwidth Roadmap



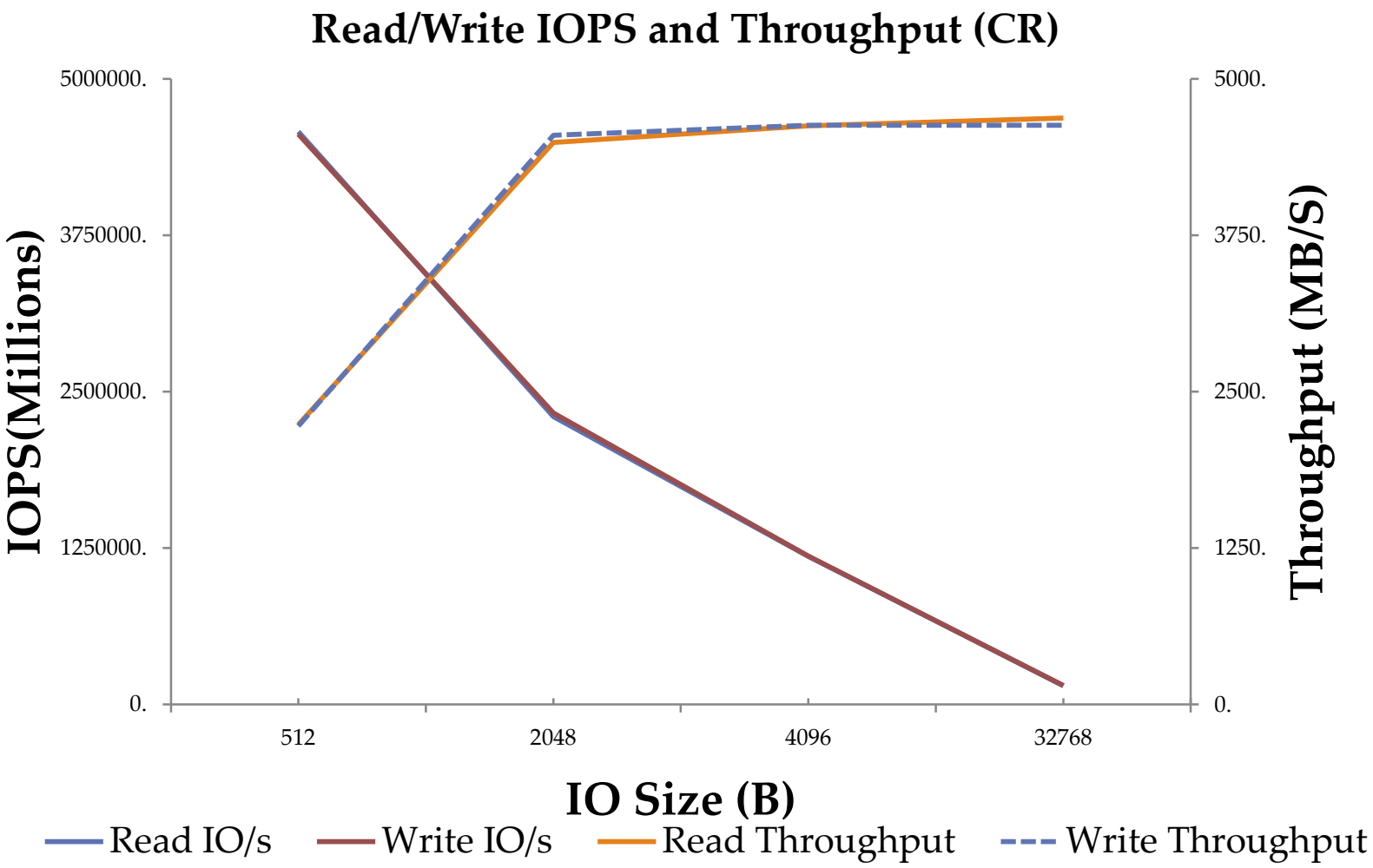
Quick succession of Ethernet speeds requires no SW API modifications for the networking controller

iSCSI Performance at 40Gbps



- Storage array with 64 targets connected to 6 initiator machines through 40 Gbps switch
  - Targets are ramdisk null-rw
  - Each initiator connects to 6 targets
- Iometer configuration on initiators
  - Random access pattern
  - 50 outstanding IO per target
  - 8 worker threads, one per target
  - IO size ranges from 512B to 32KB

T5 40Gb iSCSI Performance



iSCSI vs iSER scaling

- Chelsio T5 supports iSCSI and iSER concurrently
  - 2x40GE/4x10GE support
  - A storage target using T5 can connect to iSCSI and iSER initiators concurrently
  - The iSCSI hardware can support hardware initiators and software initiators concurrently
  - Full TCP/IP offload
  - Full iSCSI offload or iSCSI PDU offload

iSCSI vs iSER scaling

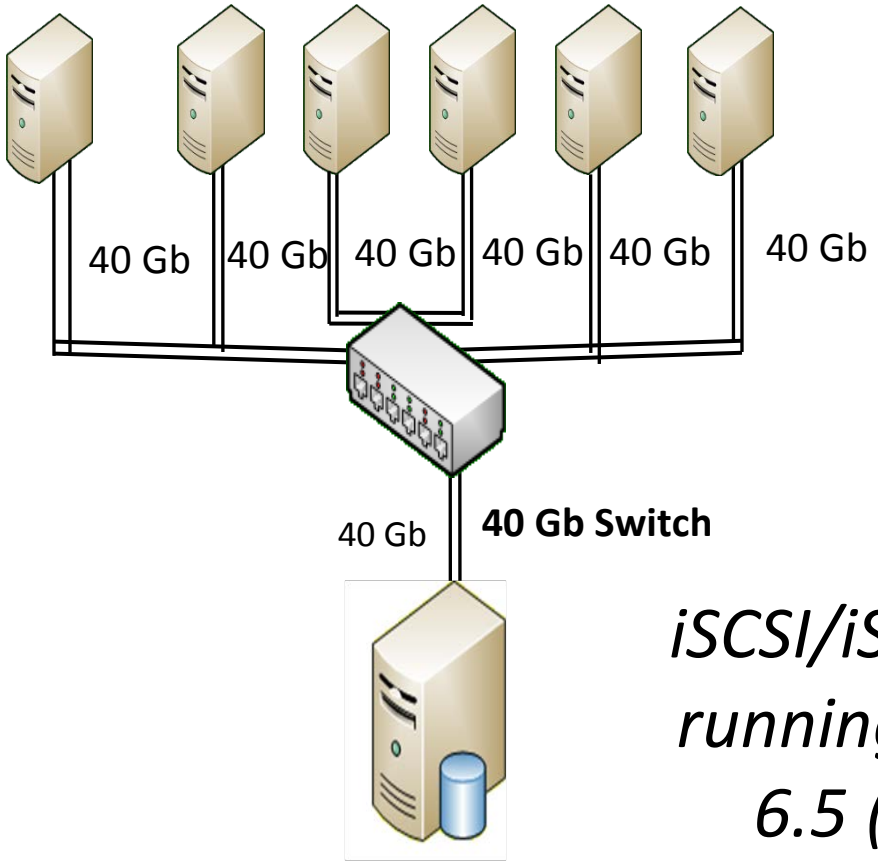
- Chelsio's iSCSI and iSER implementations scale equally well
  - iSCSI and iSER share the same hardware pipeline
    - Protocols interleave at packet granularity
    - Same hardware is used to implement DDP for iSCSI and iSER
    - Same hardware is used to segment iSCSI and iSER payload
    - Same hardware is used to insert/check CRC for iSCSI and iSER
    - Same hardware TCP/IP implementation
    - Same end-to-end latency for iSCSI and iSER
  - Operation mode is dynamically selected on a per-flow basis

iSCSI vs iSER Performance Comparison

- Use performance numbers for the Chelsio T5 that is a 4x10GE/2x40GE device that supports iSCSI offload, and iSER concurrently
  - 2x40GE performance limited by PCIe 8x Gen3
- In addition supports concurrently FCoE offload, NVMe over iWARP RDMA fabric, and regular NIC operation

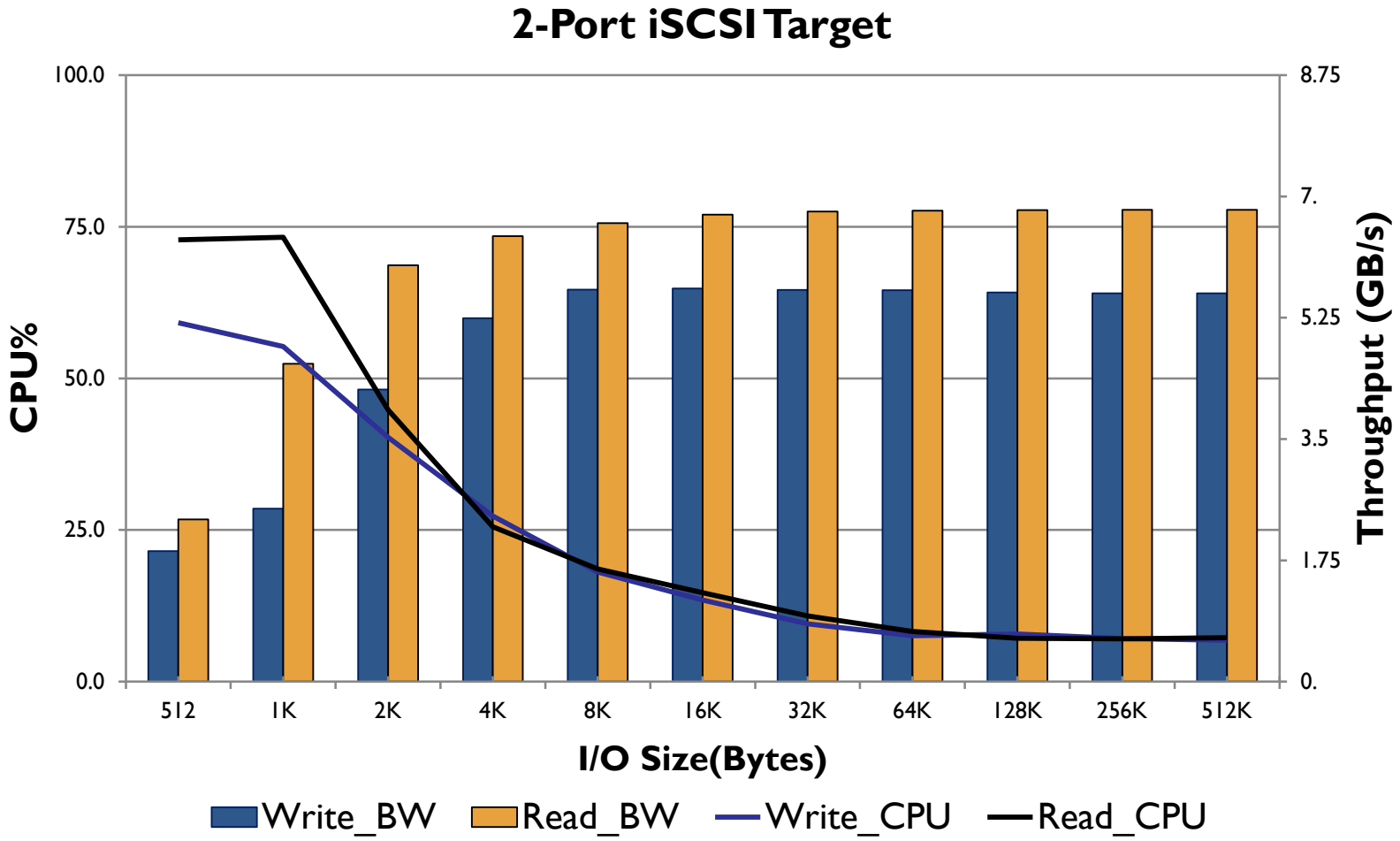
Performance iSCSI/iSER Offload

iSCSI Initiators with T580-CR adapters

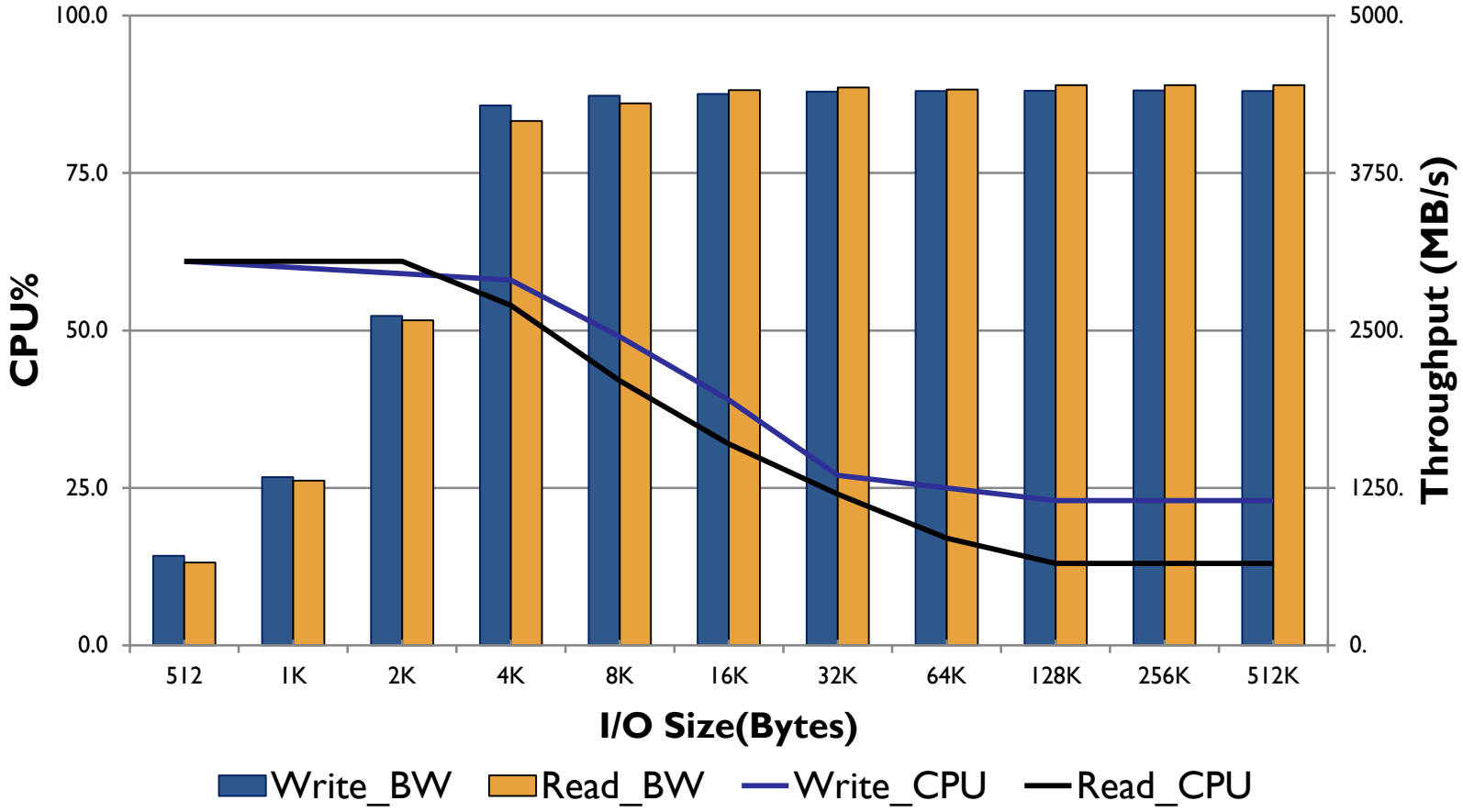


iSCSI/iSER Target running on RHEL 6.5 (3.6.11)

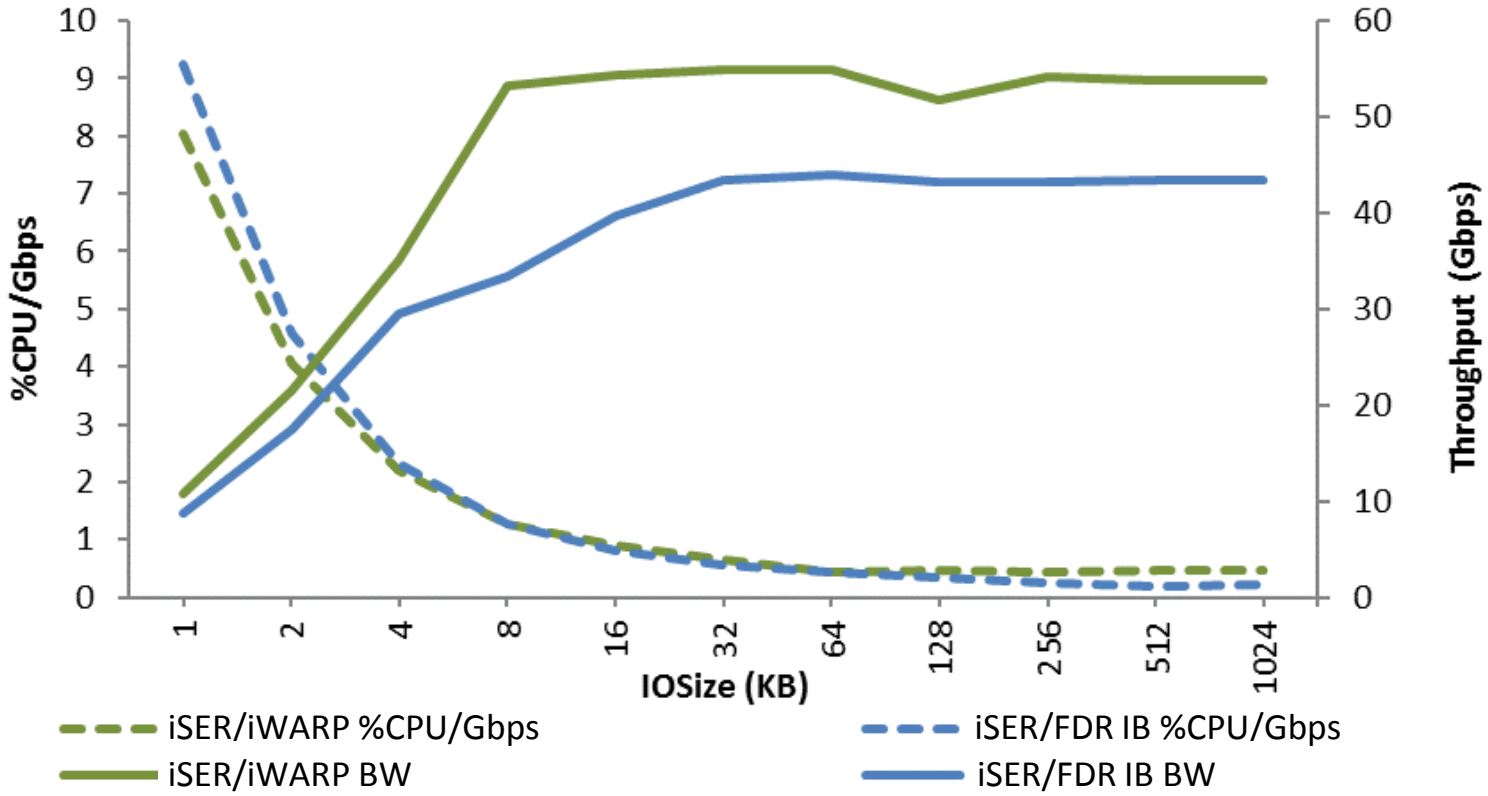
Performance iSCSI 2x40GE offload



Performance 1x40G iSER



iSER/iWARP vs iSER/FDR IB



http://www.chelsio.com/wp-content/uploads/resources/iSER-over-iWARP-vs-IB-FDR.pdf

100Gb - What does it bring to iSCSI?

- Support for 100 GbE iSCSI with LOW CPU Utilization
- 100 GbE will have Excellent Support for NVMe devices
- Chelsio iSCSI processing efficiency will be on-par with processing efficiency already achieved with iWARP

Summary

- iSCSI is a mature protocol with wide industry support
- iSCSI Native initiator in-boxed in all major operating systems/hypervisors
  - Back-end & front-end applicability, virtualization
- Hardware offloaded iSCSI shipping at 40 Gb and soon shipping at 25, 50, 100 Gb
  - High IOPs and throughput
  - Low Latency
  - At 100Gb on both the initiator and target side, we will be able to transmit and receive exactly ONE iSCSI PDU within one TCP segment
- An iSCSI SAN is cheaper and easier to deploy than an iSER SAN
  - iSCSI has a “built-in” second source
    - Software-only solution is CRITICAL for enterprise OEMs
    - iSER has interoperability issues
- For those customers who want it, Chelsio supports ISER (over iWARP) too

More information

www.chelsio.com

www.chelsio.com/whitepapers
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Questions

Thank You!