Fibre Channel vs. iSCSI

January 31, 2018
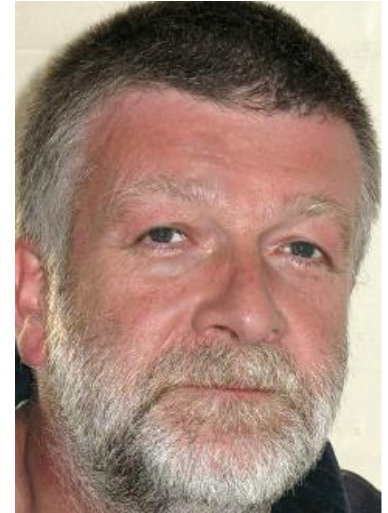
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Agenda

- ◆ **A Brief History**
  - ◆ Fibre Channel
  - ◆ iSCSI

- ◆ **Similarities and Differences**

- ◆ **Is one better than the other? Challenge Topics**
  - ◆ Performance, manageability, security, cost, etc.
  - ◆ The future

What is Fibre Channel?

- **Block storage network technology**
    - Upper level protocols (SCSI, FICON, NVMe, etc.)
    - Protocol mapping (FCP, FC-SB, FC-NVMe, etc.)
    - Lower/signaling protocols and Physical network
- **Standardized by ANSI/INCITS T11**
    - First standardized 1994
    - First available 1997
- **"Fibre Channel" usually means SCSI on FCP over FC**

Fibre Channel Network Model

- ◆ 5-Layer Model
- ◆ 2x wire speed every ~4 years (4/8/16/32 Gb/s, etc.)

ULPs	SCSI	FICON	NVMe
Mapping FC-4	FCP-4	FC-SB	FC-NVMe
Services FC-3	FC		
Signaling FC-2	FC		
Transmission FC-1	FC		
Physical FC-0	FC		

Fibre Channel

◆ **FC: Purpose-Built for Storage**

  ◆ Optimized out of the box

    › Fire it up and Forget it

◆ **Uses Different Adapters & Switches**

  ◆ Dedicated Network with one job to do – storage

  ◆ Familiar configurations and topologies

    › Point to Point or Switched Fabric

Switched Fabric

Fibre Channel
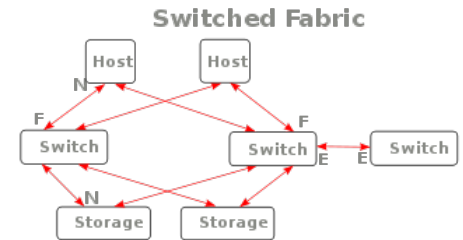
◆ **FC: Purpose-built for Storage**

- ◆ Centrally Managed (in the network/switch)
- ◆ Lossless in-order delivery
- ◆ Reusable protocol
  - › SCSI (traditional LUNs)
  - › FICON (Mainframe block storage)
  - › NVMe (Namespaces)
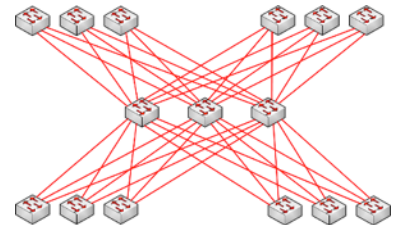 - › Even Aircraft (FC-AE/FC-AV)

Fibre Channel

◆ **Reliability**

- ◆ Strong CRC
- ◆ Fewer retransmissions

◆ **Redundancy**

- ◆ Built using duplicate SANs
- ◆ Simplifies network protocol
- ◆ Complexity in Host S/W and Storage device
  - › Not in the network

Fibre Channel

◆ FC Services

- ◆ Zoning
  - › Manual zoning
  - › Peer zoning (automatic)

- ◆ Name Server
  - › Registration / Discovery
  - › Notifications of network state changes

- ◆ Security
  - › FC-SP-2 authentication
  - › FC-FS-4 encryption
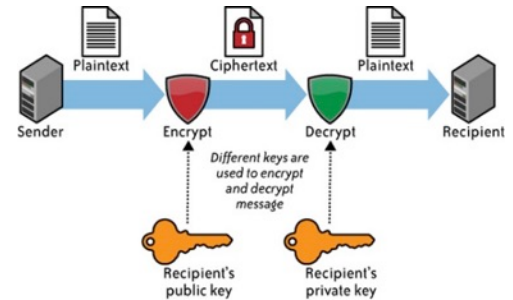
Fibre Channel

◆ **Speeds and Feeds**

  ◆ 1G / 2G / 4G / 8G / 16G / 32G / 64GFC / 128GFC (x4)

◆ **Futures**

  ◆ In Development: 256GFC (x4) / 128GFC (x1)

  ◆ Roadmap: 256GFC (TBD), 512GFC (TBD) / 1TFC (TBD)

  ◆ FC-NVMe runs NVMe protocol over existing FC networks

Agenda Revisited

- ### A Brief History
  - Fibre Channel
  - iSCSI

- ### Similarities and Differences
- ### Is one better than the other? Challenge Topics
  - Performance, manageability, security, cost, etc.
  - The future

What is iSCSI?

- **Block storage network technology**
  - SCSI protocol running (usually) on TCP/IP
  - Can run on RDMA: InfiniBand, iWARP, RoCE
  - Almost always over Ethernet
- **Standardized by IETF**
  - RFCs 3721, 3722, 4018, 4056, 7143, etc.
  - First available in 2003/2005/2006 (Windows/Linux/VMware)
- **"iSCSI" usually means SCSI on TCP/IP over Ethernet**

iSCSI Network Model

- ◆ **OSI 7-layer model**
- ◆ **Was 10x wire speed every ~5 years**
  - ◆ 10Mb, 100Mb, 1/10/100GbE
  - ◆ Now 2x every 3-4 years (200/400GbE)
- ◆ **Ethernet supports NVMe-oF**
  - ◆ But not over iSCSI

L7	**Applications**		
L6	SCSI		
L5	iSCSI	iSER iWARP	iSER RoCE
L4	TCP		UDP
L3	IP (Network)		
L2	Ethernet (Link)		
L1	Ethernet (Physical)		

iSCSI

- ❖ **iSCSI: Protocol is purpose-built for storage**
  - ❖ Underlying Ethernet network is all-purpose
  - ❖ iSCSI just works out of the box
    - › But discovery requires configuration
    - › Optimization or tuning required for best performance
- ❖ **Can have dedicated or shared network**
  - ❖ Shared network for lower cost, maximum flexibility
  - ❖ Dedicated storage network for highest performance

iSCSI

- ◆ **Management**
  - ◆ Mostly distributed (in clients and targets)
- ◆ **Transport can be configured as lossless or lossy**
- ◆ **Underlying network is reusable**
  - ◆ Other storage protocols: NFS, SMB, NVMe-oF
  - ◆ Object storage or scale-out filesystems
  - ◆ Compute traffic or hyperconverged infrastructure

iSCSI

- **Reliability**
  - iSCSI digest (CRC)
  - Ethernet CRC, RoCE/InfiniBand CRC, TCP/IP checksums

- **Redundancy**
  - Protocol: Link aggregation (LACP) or iSCSI multipathing
  - Physical: Duplicate Ethernet networks (optional)

iSCSI

iSCSI Services

- Zoning or isolation options
  - Physically separate network
  - ACLs (access control lists), VLANs (virtual LAN), VPN (virtual private network)
- Internet Storage Name Service (iSNS)
- Ethernet QoS and monitoring tools
- Security
  - IPSEC for encryption
  - CHAP or RADIUS for authentication

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iSCSI
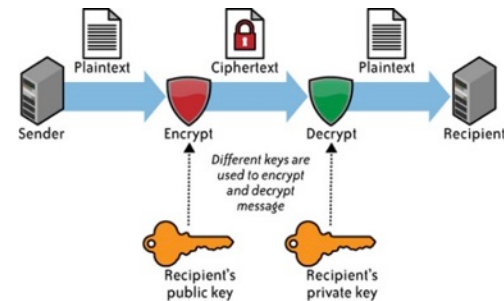
- ◆ **Speeds and Feeds Today**
  - ◆ 1G / 2.5G / 5G / 10G / 25G / 40G / 50G / 100G

- ◆ **Futures**
  - ◆ Coming in 2018: 200GbE (4x50) and 400GbE (8x50)
  - ◆ In the plan: 800G, 1.6T, 3.2T (dates TBD)
  - ◆ NVMe-oF: Ethernet network also supports NVMe

Other Block Protocols

- **FCoE**
  - SCSI on FCP over lossless Ethernet
  - Often used for blade servers
- **SRP – SCSI RDMA Protocol**
  - Only runs on InfiniBand—usually for HPC customers
- **NVMe over Fabrics**
  - New kid on the (protocol) block
  - NVMe running over RDMA (Ethernet) or Fibre Channel

Important to Remember

◆ Applications can use either FC or iSCSI
- Both deliver SCSI commands to LUNS
- Most OSes and Hypervisors support both

◆ Most arrays support both FC and iSCSI
- Both protocols have initiator and target
- The optical cabling is often the same

Key Differences

◆ **Underlying Network**

◆ **Adapter Offload Options**

- ◆ FC almost completely offloaded
- ◆ iSCSI can be offloaded or S/W based

◆ **Connection Management Model**

◆ **Security & Cost**

- ◆ We'll explore shortly

Fibre Channel vs. iSCSI

Challenge Questions
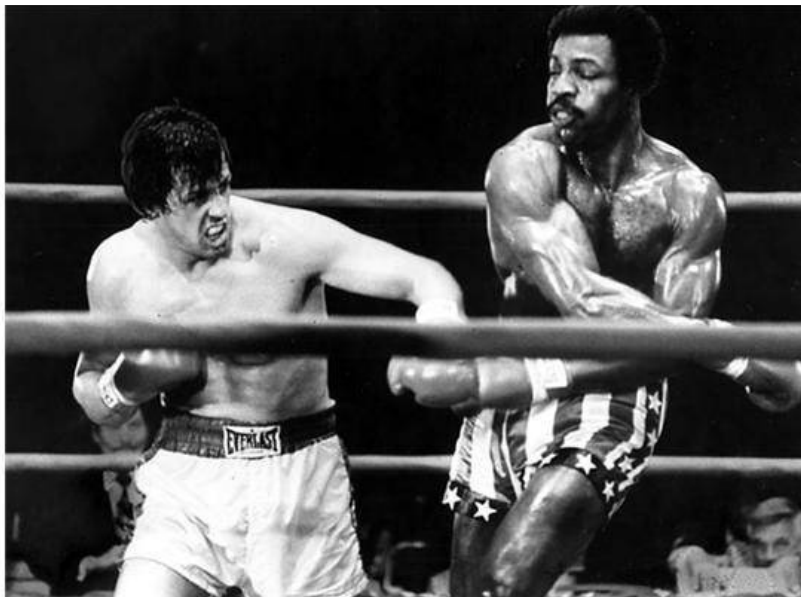
Challenge Question #1 — Performance

◆ **Which offers better performance?**

- Bandwidth?
- Latency? Deterministic latency?

◆ **Who is winning the speed race?**

- Does it matter? Who needs that kind of speed anyway?
- What about distance?
- How can a server support 100/128/200 Gb/s?
- In reality, both use the same groups for their "speed" work
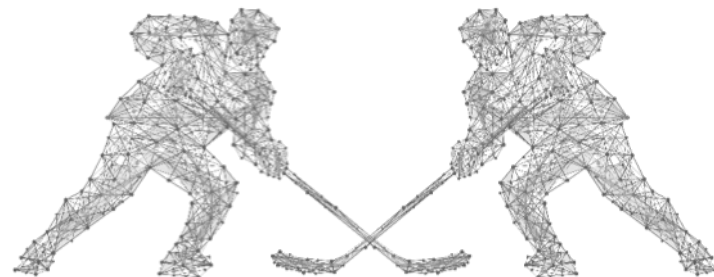
Challenge Question #2 — Reliability & Manageability

◆ Which is More Reliable?

◆ Which is Easier to Manage?

- ◆ Setup and Expansion
- ◆ Monitoring
- ◆ Troubleshooting
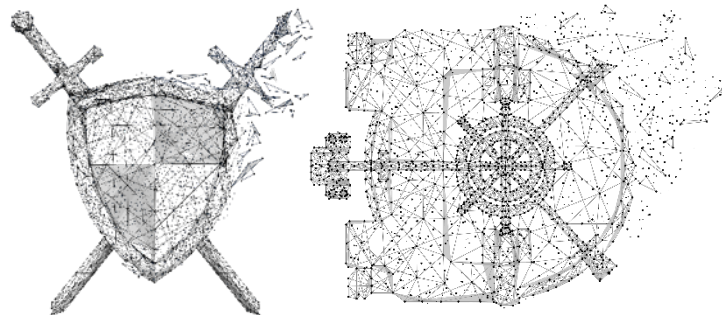
Challenge Question #3 — Cost & Vendors

◆ What about price?
  - Acquisition cost
  - Operational cost

◆ Is it better to have 2 vendors or 6?
  - Competition
  - Innovation
  - Interoperability

Challenge Question #4 — Security

◆ **Which is More Secure?**

　◆ Zoning vs. ACLs and VLANs

　◆ How does iSCSI do LUN masking?

　◆ How about encryption on the wire?

◆ **Should storage always use a separate network?**

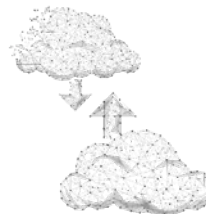　◆ Does a network "air gap" guarantee storage security?

◆ **What are the Best Applications for Each?**

  - Where is Fibre Channel used most?
  - Where is iSCSI used most

◆ **Industry/Vertical Preferences**

  - Who prefers Fibre Channel?
  - Who prefers iSCSI?

Challenge Question #6 — The Future

◆ **What Will Happen with NVMe and NVMe-oF?**

  - How will NVMe SSDs affect block storage networking?

  - Will NVMe-oF replace one more than the other?

◆ **What about Hyperconverged Infrastructure?**

  - Does HCI make both FC and iSCSI SANs obsolete?

Fibre Channel Advantages

◆ **Fast, Dedicated Hardware**

  • Always lossless with credit-based flow control

  • HBA offloads; High-bandwidth switches

◆ **Mature Ecosystem**

  • Proven interoperability, Simple setup

  • Integration with storage and management software

◆ **Storage Services**

  • Name services, zoning, monitoring, diagnostics

iSCSI Advantages

◆ **Ubiquity of Ethernet**

  ◆ Lower price alternatives, many vendors, popularity in the Cloud

  ◆ Same network can support other storage/compute traffic

◆ **Flexible Feature-vs.-cost Tradeoffs**

  ◆ Hardware acceleration: iSCSI offload, TOE, RDMA

  ◆ Lossless, flow control, congestion management

◆ **Higher Bandwidth, Lower Latency**

  ◆ 100GbE now, 200GbE soon

Decision time...

◆ How do you decide?

◆ Compare apples to apples

  ◆ Don't compare 1GE iSCSI to 32GFC

◆ Do you want an isolated dedicated storage network?

◆ Do you want a converged shared network?

◆ How big / complex is your environment?

◆ What is your inhouse expertise?

More Webcasts

- **Next Live Webcast: Storage Performance Benchmarking: Workloads**
  - February 14th 10:00 am PT
  - Register at: https://www.brighttalk.com/webcast/663/297859
- **On-Demand "Everything You Wanted To Know About Storage But Were Too Proud To Ask" Series**
  - https://www.snia.org/forums/esf/knowledge/webcasts-topics
- **FCIA webcast: Fibre Channel Performance: Congestion, Slow Drain, and Over-Utilization, Oh My!**
  - February 6th 10:00 am PT
  - Register at: https://www.brighttalk.com/webcast/14967/295141
- **SNIA resources on iSCSI**
  - Evolution of iSCSI: https://www.brighttalk.com/webcast/663/197361
  - Comparing iSCSI and NVMe-oF blog: http://sniaesfblog.org/?p=647

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