Agenda

• Market and business context
• Customer SAN requirements
• What is Fibre Channel?
  – FC protocol features refresher
• NVMe over FC
  – Fabric advantages
  – Latency
• Summary
What are we going to discuss today?

• We will discuss
  – What is Fibre Channel?
  – What are customer requirements from a SAN?
  – What makes FC so reliable?
  – What makes FC different?
  – What are the best practices for designing FC solutions?

• We will NOT discuss
  – N-port, E-port, etc
  – Classes of service
  – FC Frame, Exchanges, Sequences, etc
  – FC detailed addressing
  – 8B/10B, 64B/66B encoding
  – Blah blah blah
  (Geeks, so sorry to disappoint you)
Connecting Businesses to Important Data

Fibre Channel fabrics are the common thread

Reliability
Keep running no matter what

Performance
Unleash application performance

Scalability
Adapt to your business

Security
Secure your data and mitigate risk

Critical applications and data require purpose-built networking for storage
What are SAN Requirements?

• Reliable network
  – Minimal to zero packet loss

• Deterministic network behavior
  – Robust error recovery mechanisms
  – NSPF / redundancy

• Security and Authentication

• Predictive performance, ability to handle –
  – Bursty storage traffic
  – Unbalanced network flows
  – Bad/Degraded or Greedy N nodes and slow legacy devices

• Manageability
  – Rich in error detection and reporting

• Seamless scalability
# The future of storage protocols

Fibre Channel is data center storage protocol of choice for the next decade

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### Figure 1. Comparison of Storage Protocols

<table>
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<tr>
<th>Protocol</th>
<th>Performance</th>
<th>Cost</th>
<th>Reliability, Availability and Serviceability</th>
<th>Ease of Administration</th>
<th>Future Upgrade Path</th>
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<td>Throughput and Latency</td>
<td>Purchase</td>
<td>Operational</td>
<td>Choice</td>
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Source: Gartner (June 2016)
• Foundational Fabric Services
  • FC-CT protocol
• Fabric Controller
  • Principal switch, FSPF (Fabric Shortest Path First) Routing, ISL initialization
• Name Server
  – Fabric, Distributed, Phone Book Addressing
• Zoning
  – Security and Access controls, Distributed
• High Performance
  – Flow Control with Buffer Credits, 2K packets, In order Delivery, Congestion Control Algorithms that actually work
• Low Latency
  – Highly optimized (ASIC does I/O transfer, very little software overhead)
• Multi generational Interoperability
  • Current and two back (3 speeds)
• High Availability
  – Extensibility over long distances to different data centers or NSPF with redundant fabrics with MPIO
• Scalability
  – Easy scalability with up to 1000s of nodes per fabric
Foundational Fabric Services

• FC Generic services protocol
  – For practical purposes, all fabric services exist in the switch (embedded)
  – Provides the control plane for information transfer between devices
  – Technical name is FC-CT protocol
  – Distributed services

• Principal switch and Domain ID assignment
• FSPF routing protocol
Name and Event Server

• FC Name server is like the telephone exchange or post office in every town
  – Distributed database in every switch/fabric
  – Devices in a fabric login and logout of the fabric
  – Provides the foundation of a reliable network

• All members, devices register with the event server
  – Updates name server, change registrations and notifications

• Can invoke fabric readjustments if required to maintain proper access between servers and storage
  – Fabric reconfigurations
  – Path failovers and failbacks
  – Fast convergence
  – Etc.
Zoning

• Zone: Consists of one or more members allowed to access each other
  – Storage is unique as we’re dealing with file systems, data access, etc
  – This feature was required as data stores (LUNs) can get corrupted
• Has a unique alphanumeric name
• Devices can be part of single or multiple zones
• Two types of zoning – Soft and Hard
  • Soft Zoning
    – Lightly enforced
    – Access map to each device is tailored to its zone membership assignment
    – Can be implemented by the name server
  • Hard Zoning
    – Physical access is restricted by the hardware
    – More like access key card, more secure
• Redundant and distributed in a fabric (all switch members)
• Latest development is TDPZ - Auto zoning
High Performance

• Flow control with BB Credits
  – Difference between highway and air traffic systems
• ASIC driven, high performance DMA engines
• 2K packets, no jumbo frames required
• Virtual Channels for differentiating and prioritizing traffic
• FC fabrics can guaranty In-order delivery even during path failovers, etc
• MPIO, adds redundancy and high performance load balancing algorithms to take advantage of multiple paths to storage arrays
• Easier to design long distance replication solutions
NVMe: The Future of Storage Networking

• Improves performance and value of solid state storage by an order of magnitude
• Increases scalability, while reducing latency and CPU overhead
• Standards-based technology, connected over a fabric
NVMe and the Data Center

Next Generation Flash Networks

Latency
- No translations between protocols
- Native for NAND
- Lowest in industry

Lower TCO
- Native protocol designed for flash
- Increased density
- Lower system power

Scale
- Massive parallel I/O capabilities
- Broad industry support including, HW, OS and NAND vendors

Fabrics
- Can be transported on different interconnects for best performance
- FC is ideal choice (80% networked flash deployed on FC)
Why Fibre Channel for NVMe?

Industry Leading Low Latency

Scalability Beyond the Rack

Low Risk Deployment

Faster than 25Gb Ethernet

NVMe over Fibre Channel yields 55% latency reduction

Optimized for heavy storage workloads

Leverages existing FC infrastructure and Concurrently run NVMe

Speeds matched to the PCIe bus for maximum performance

Gen 5 and Gen 6 Fibre Channel is NVMe Ready Today
Why NVMe over Fibre Channel Fabrics?

• NVMe is native to flash
  – Low latency
  – Low overhead
  – High performance

• Natural extension to run it over fabrics
  – Fibre Channel is the predominant fabric for storage
    • Will run on existing Gen 5/Gen 6 fabrics
    • Networked storage is a must for large customers
    • Makes clustering, VM mobility etc a reality i.e. requires networked storage
    • Direct Attached SSD (PCI-E based) doesn’t scale

• Fibre Channel is key, as the vast majority of “all flash storage” is deployed on FC
  • Ethernet will also be supported but still some unknowns (new move away from RDMA etc..)
Fibre Channel is data center storage protocol of choice for the next decade

- **Orders of magnitude performance improvement**, low latency requires higher-throughput protocols
- **Bottlenecks exist**: 10GbE, 8 Gbps Fibre Channel
- **16 Gbps Fibre Channel will be too slow** for the next generation of storage arrays
- **Plan for higher throughput**, e.g. 32 Gbps Fibre Channel
Summary

• The world’s most mission critical applications run on Fibre Channel
  – Healthcare, Finance, Retail, Airlines

• Fibre Channel is purpose built for storage traffic
  – Deterministic reliable network optimized for performance and utilization
  – Network efficiency with multipath load balancing

• Future proof investment protection
  – GEN 6 Fibre Channel supports 4/8/16/32/128G
  – Most All Flash Arrays are attached to Fibre Channel
  – NVMe ready while supporting existing FCP SCSI investments and legacy FICON
Q&A
After this Webcast

• Please rate this event – we value your feedback
• We will post a Q&A blog at http://fibrechannel.org/ with answers to all the great questions we received today
• Follow us on Twitter @FCIAnews
• Join us for our next live FCIA webcast:
  Deep Dive into NVMe over Fibre Channel
  August 29, 2017
  10:00 am PT
  Register at https://www.brighttalk.com/webcast/14967/265459
Thank you!