SNIA DEVELOPER CONFERENCE
SDC 25
By Developers FOR Developers

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What you need to know about the future of Fibre Channel

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Fibre Channel Industry Association - President Emeritus

www.sniadeveloper.org

Agenda

- FC Health, industry numbers
- 128/256 roadmap
- FC-RDMA completion
- FC-SP3 - Security - Autonomous in-flight encryption
- Enterprise AI - FC's role in AI
- FCIA resources - training library, YouTube, engage with us.

2025 Fibre Channel Market Milestones

$50B+ FC Revenue

Total Revenue of Adapter and Switch products

35M+ FC Ports In Service

Adapter and switch ports estimated in service

160M+ FC Total Ports Shipped

Adapter and switch ports

*Market research analyst reports

Why Fibre Channel?

- **Designed for Enterprise Storage Networking**
  - Nearly all all-flash and majority of hybrid block storage arrays use FC
- **Security**
  - Not Ethernet, Hardened Zoning, Fabric Services
  - New FC-SP-3, Auto-Encryption Everywhere!
- **High Performance**
  - Low Latency, Low CPU utilization, High IOPs
  - Highest fabric utilization without packet retransmission, deterministic
- **Reliable and Resilient**
  - Lossless, credit based transmission
  - Low BER (Bit Error Rate) network design
- **Investment Protection**
  - 2 Generation backward/forward compatibility by design. Speed even more!
  - Cable plug compatibility – cable length/loss standardization

Fibre Channel Speeds

Product Naming	Throughput (Mbytes/s)*	Line Rate (Gbaud)	T11 Specification Technically Complete (Year) †	Market Availability (Year) †
8GFC	1,600	8.5 NRZ	2006	2008
16GFC	3,200	14.025 NRZ	2009	2011
32GFC	6,400	28.05 NRZ	2013	2016
64GFC	12,800	28.9 PAM-4	2017	2020
128GFC	24,850	56.1 PAM-4	2022	2025
256GFC	49,700	112.2 PAM-4	2025	Market Demand
512GFC	TBD	TBD	2029	Market Demand
1TFC	TBD	TBD	2033	Market Demand

"FC" used throughout all applications for Fibre Channel infrastructure and devices, including edge and ISL interconnects. Each speed maintains backward compatibility at least two previous generations (I.e., 32GFC backward compatible to 16GFC and 8GFC)

*These numbers are representative throughput values for the line rate and are payload dependent

† Dates: Future dates estimated

Fibre Channel 128GFC Requirements

- Throughput
  - 128GFC doubles the throughput of 64GFC
- Error correction
  - Corrected bit-error-rate (BER) target of **1e-15**
- Compatibility
  - 128GFC had to be backward compatible to 64GFC and 32GFC
  - Backward compatibility and "plug and play" to utilize existing infrastructure with new speeds is always a "**must have**" for FC development
- Distance
  - 100 meters
    - Multi-mode short reach optical variant using OM4/OM5 cable plants
  - 10 kilometers
    - Single mode optical variant
- Reuse
  - Existing cable assemblies must plug into 128GFC capable products
  - LC (connector) and SFP+ (form factor)

128GFC Milestones

- FC-PI-8
  - 128 GFC single lane specification
  - INCITS Fibre Channel/T11 complete October 2022
  - ANSI accepted October 2023
- FC-FS-6
  - 128 GFC single lane framing and signaling specification
  - INCITS Fibre Channel/T11 complete October 2023
  - ANSI accepted June 2024
- FC-PI-9 project
  - 256 GFC single lane specification
  - INCITS Fibre Channel/T11 TC work started December 2022

Revving up for Fibre Channel 256GFC

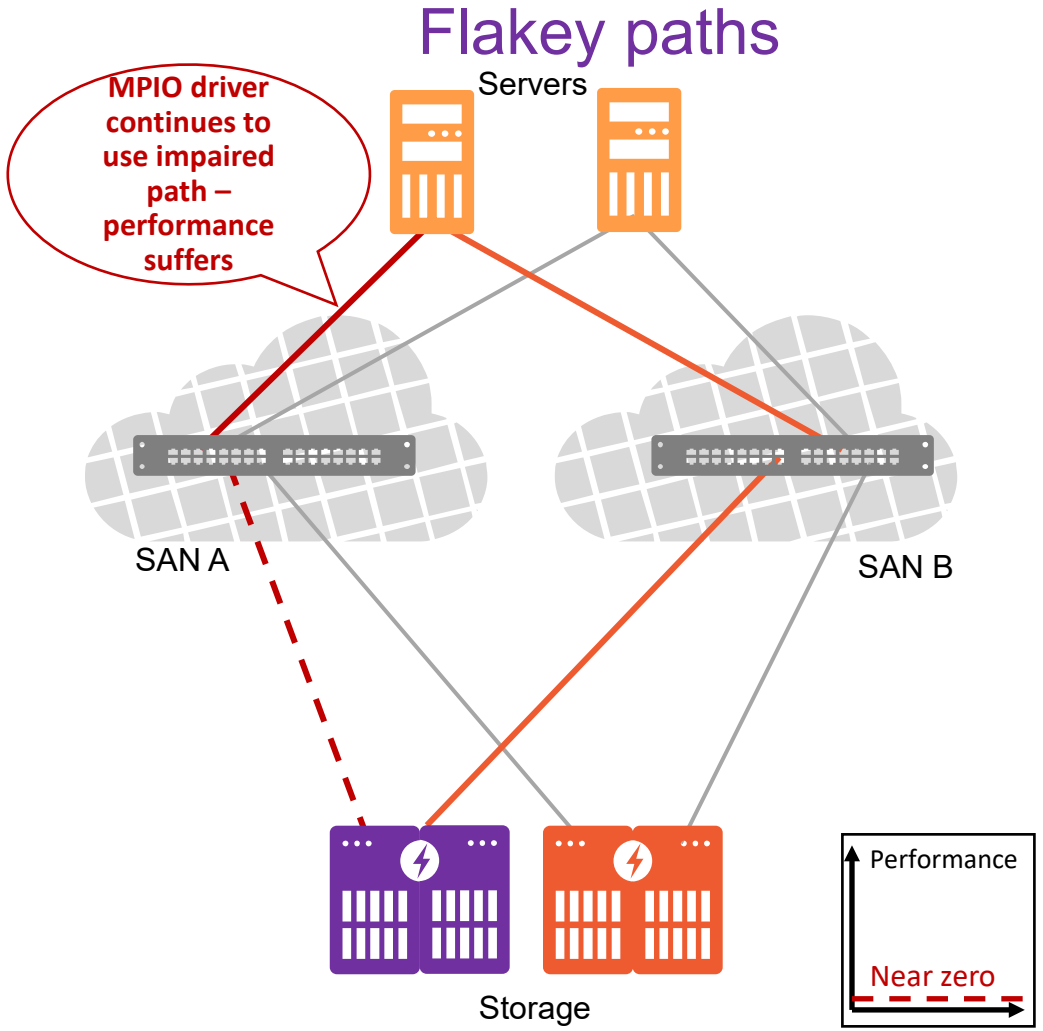
- Throughput
  - 256GFC doubles the throughput of 128GFC
    Fastest Single lane
- Error correction
  - Corrected bit-error-rate (BER) target of **1e-15**
- Compatibility
  - 256GFC backward compatibility with 128GFC and 64GFC
- Distance
  - 100 meters (watch this space)
    - Multi-mode short reach optical variant using OM4/OM5 cable plants
  - 10 kilometers
    - Single mode optical variant
- Reuse
  - Existing cable assemblies must plug into 256GFC capable products
  - LC (connector) and SFP+ (form factor)
- FC-PI-9 project is underway!

NVMe® over Fibre Channel

- Strong Industry-wide development support
  - 2014 T11 began work on FC-NVMe
  - Industry milestones: Demos, Plugfests, first product shipments
  - 2020 FC-NVMe-2 complete, 2025 FC-NVMe-3 in progress
- 2025: FC - Leading Fully Supported NVMe-oF™ Transport Solution
  - FC-NVMe solutions shipping from all major FC component/array storage vendors
  - Support for all major operating systems
  - Significant application performance improvements over traditional SCSI
- Future of NVMe/FC
  - Continued performance improvements as OS's refine NVMe-oF transport
  - Broadened vendor and OS adoption

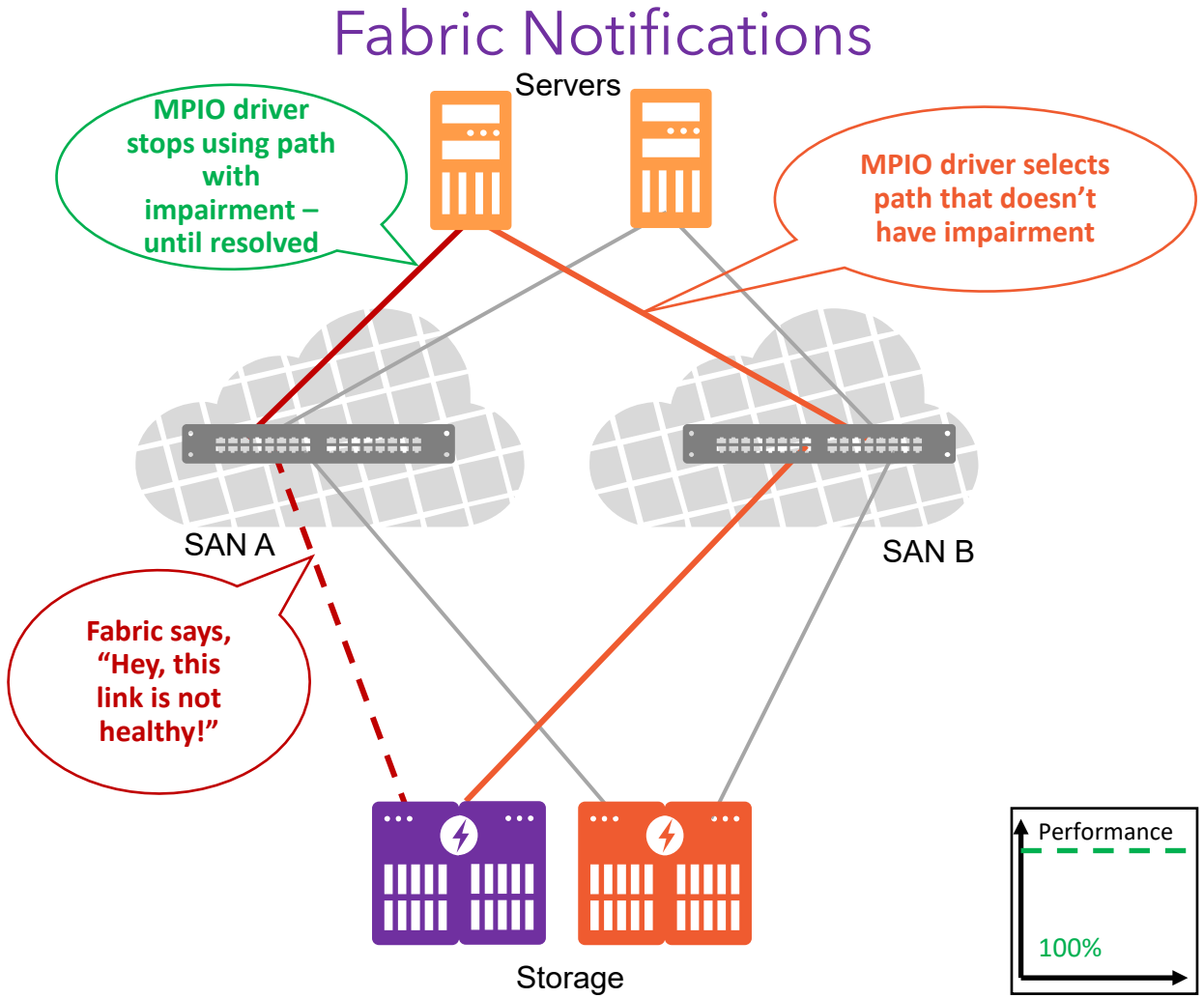
Fabric Resiliency

- Persistent, intermittent errors
  - Significant role in customer escalations
  - Difficult for traditional solutions to resolve
  - Required manual intervention increases mitigation costs
  - MPIO solutions struggle with resolution, which impacts the dual fabric paradigm
- Causes
  - Marginal cables, SFPs, connections, etc
  - Congestion due to lost credit, credit stall, or oversubscription
- Why now?
  - Fibre Channel solutions are mature and diversified
  - Identification and mitigation tools have evolved
  - Customers are demanding more automation



Fabric Notifications

- Fabric Notifications
  - Notifications and signals
    - Generated by the fabric
    - Inform devices of impairments
- Notifications
  - Reporting: Events sent to registered devices
  - Diagnostics: Helps efficiently evaluate errors
  - Operation: Extended Link Services (ELS)
- Signals
  - Signaling: Report resource depletion to registered devices
  - Diagnostics: Transmitter indicates resource usage
  - Operation: Link level Primitive Signal



2025 FC-RDMA Update

S Fibre Channel – FC-RDMA

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WHATS NEW?

- Goal – Establish RDMA semantics over Fibre Channel to address emerging technologies (e.g. Persistent Memory)
- Project Started Aug 2018

HOW

- Uses the services defined by the FC-FS specification
- Enables the transmission of RDMA operation code formats, data and control, and operation status across the Fibre Channel transport
- Operates using Fibre Channel Class 3 across Fibre Channel Fabrics

WHEN

- Tech Defined Jun 2024 – Publication Dec 2025
- Market availability – 2026 est.

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2025 FC-RDMA Update

NCITS Fibre Channel - FC-SP-3

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WHATS NEW?

- Updated Standards for Fibre Channel Security
- Stay Ahead of government security guidelines for 2025-2030
- Eliminate outdated security algorithms
- Clarification of implementation profiles

HOW

- Add definitions for CNSA 1 and 2 Algorithms
- Removed MD5, SHA1 and others
- Automatic in-flight FC encryption profile

WHEN

- Technical Definitions Underway
- Technical definition by Dec 2024, Est standard completion by 2025
- Products pervasive in marketplace in 2025

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Fibre Channel SecureHBA Solution

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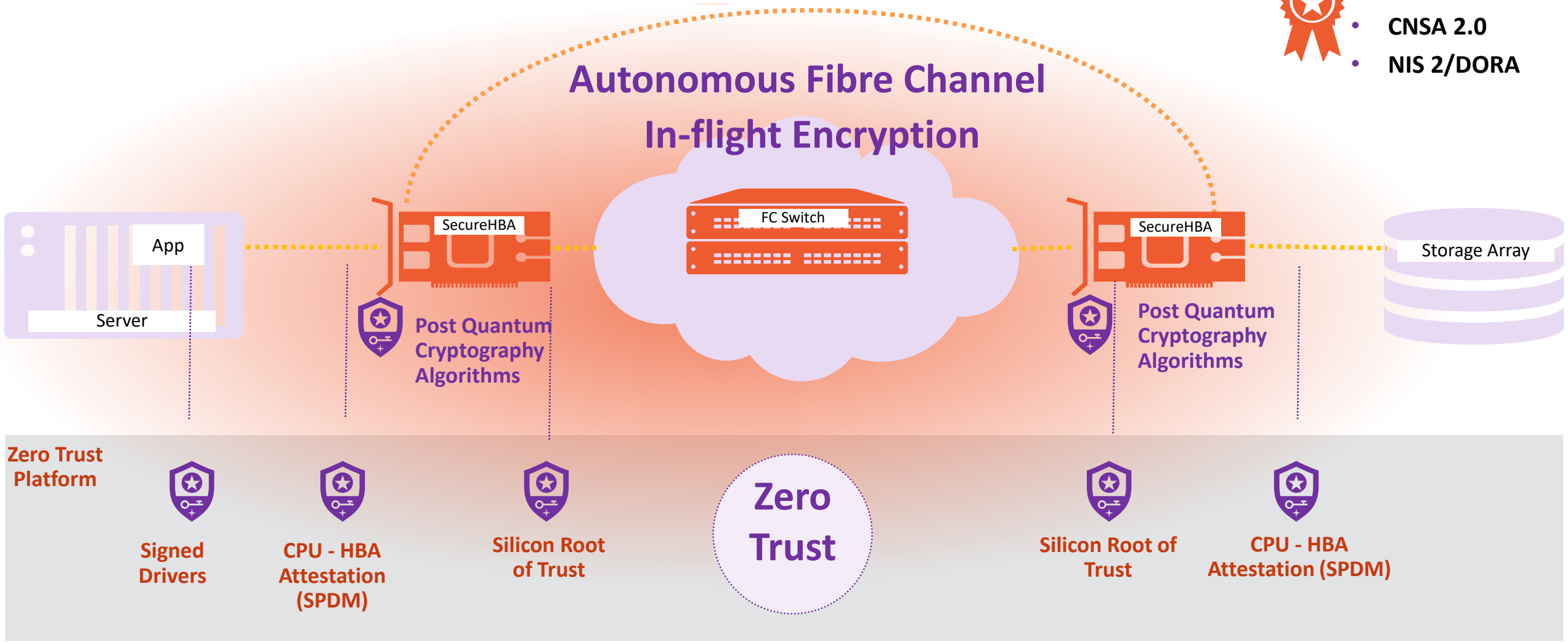
Compliant

- **CNSA 2.0**
- **NIS 2/DORA**



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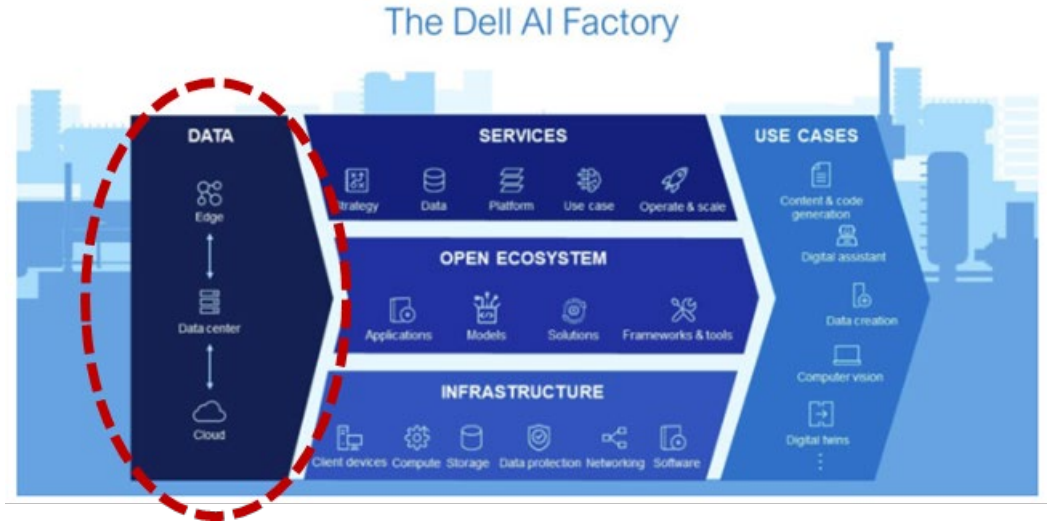
Taking Your AI To Your Data – Fibre Channel

- Initial use of AI focused on CSPs and others where large amounts of unstructured data is fed into inferencing models
- Enterprise usage will rely on in-house data
  - Databases are likely the source of this data, and **structured data** is predominantly stored on **Fibre Channel** arrays due to **reliability**, **scalability**, and **security**



USE CASES

Finance

- Credit card/ banking fraud detection

Healthcare

- Payment eligibility
- Improve patient outcomes

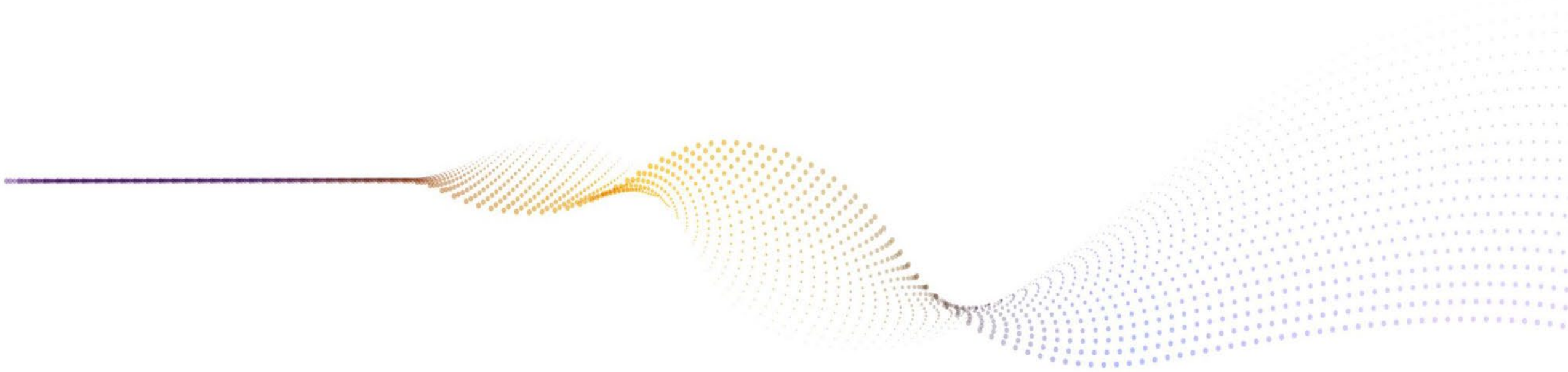
Transportation

- Delivery sequencing
- Package sorting

Fibre Channel Education

- **Changes in IT Education Trends:**
  - Fewer specialists – more generalists
  - Survey results*: 62% of new IT positions are being filled by generalists
  - Seasoned FC storage/SAN specialists are entering retirement age
- **FCIA Education Initiative**
  - Bi-monthly BrightTALK Expert webinars: https://www.brighttalk.com/channel/14967/
  - FCIA YouTube Channel: https://www.youtube.com/channel/UCeSb0O94Ot-RfZSDg2ykRBA
  - YouTube Playlists: Basics, Fibre Channel Expert Courses, FC-NVMe
  - www.Fibrechannel.org/fcia-blog

*ESG storage trend survey 62% of new IT positions are being filled by generalists



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