STORAGE 101:

PAST, PRESENT, FUTURE OF STORAGE.

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HARD DRIVE TECHNOLOGIES

- ## PATA DRIVES   Parallel ATA (Parallel Advanced Technology Attachment or **PATA**)

- ## SATA DRIVES   Serial ATA (Serial Advanced Technology Attachment or **SATA**)

- ## SAS DRIVES   Serial Attached SCSI (**SAS**)

- ## FATA DRIVES   Fibre Attached Technology Adapted (**FATA**)

- ## SSD   Solid-State Drive (**SSD**)

- ## NVMe   Non-Volatile Memory Express (**NVMe**)

GETTING VIDEO TO THE DESKTOP

- In the 90's Lockheed Martin was looking to bring video to the desktop.

- What technology did they use?

  -Fibre Channel

- What went wrong?

  -File churn that created lots of extents

- What evolved from the project?

  -Stornext
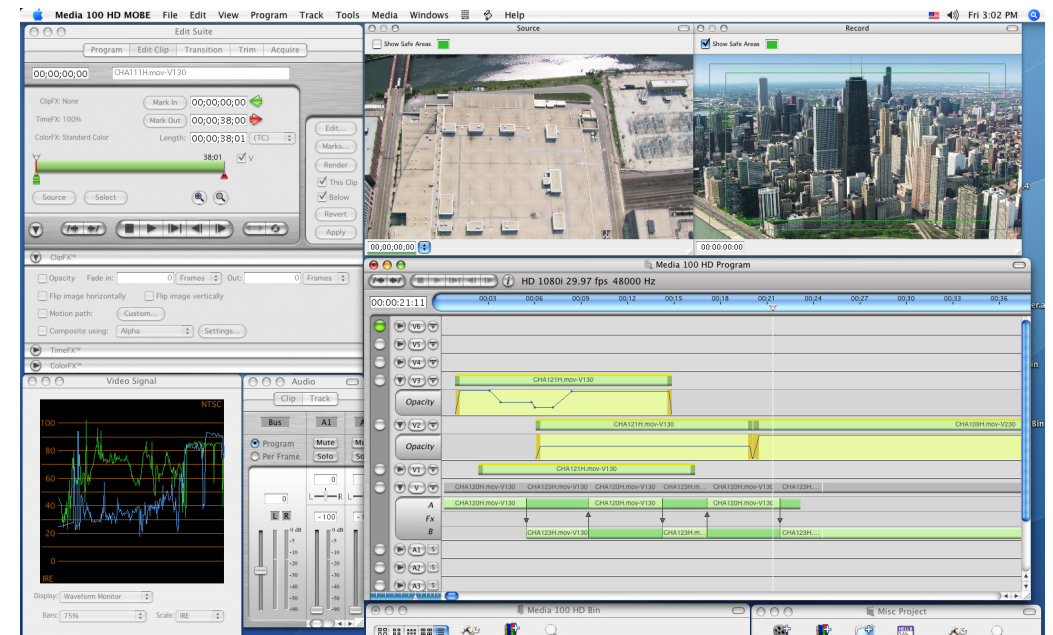
KEEPING VIDEO TO THE DESKTOP NAS OR SAN

- Starting around the year 2007
  post productions
  - studios needed to make a decision NAS or SAN

- Why did we need to use a SAN?
  - Many decided with the SAN as it offered
    speeds around 400 MB/sec

- Why not use a NAS?
  - Ethernet only offered 1GbE

- What are the disadvantages of a SAN?
  - Difficult to DPX, Fragmentation,
    many failure points

Storage Area Network
Multiple storage devices in a Fibre Channel network
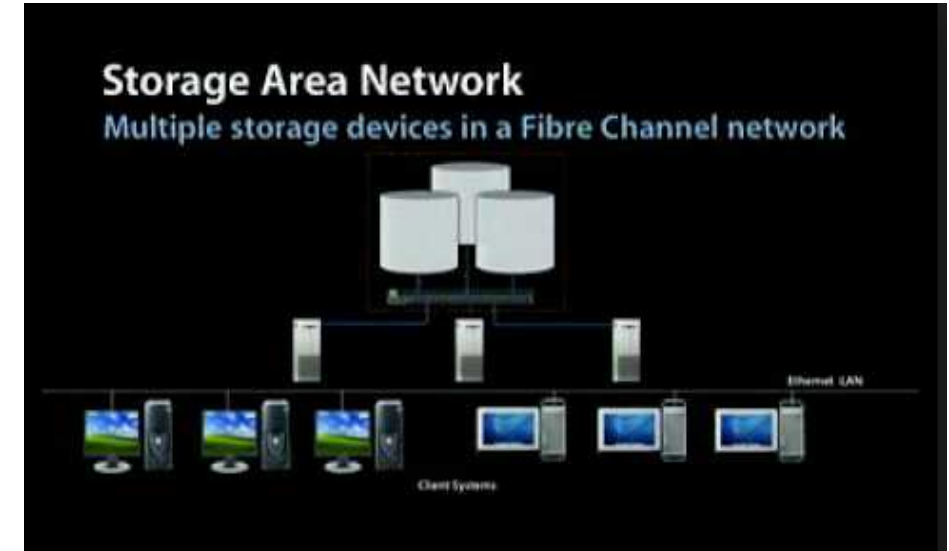
NVMe vs. SSD

- SSD debuted in 2009

- What's held SSD back?
  - 6 Gb/SATA (550MB) cable or 12Gb/SAS (1,100MB)

- Why is NVMe so much faster?
  - Connects directly to the PCIe3 X4 bus

- How will we use NVMe in M&E?
  - 2TB delivering 3,000 MB/sec

- Will NVMe be the future?
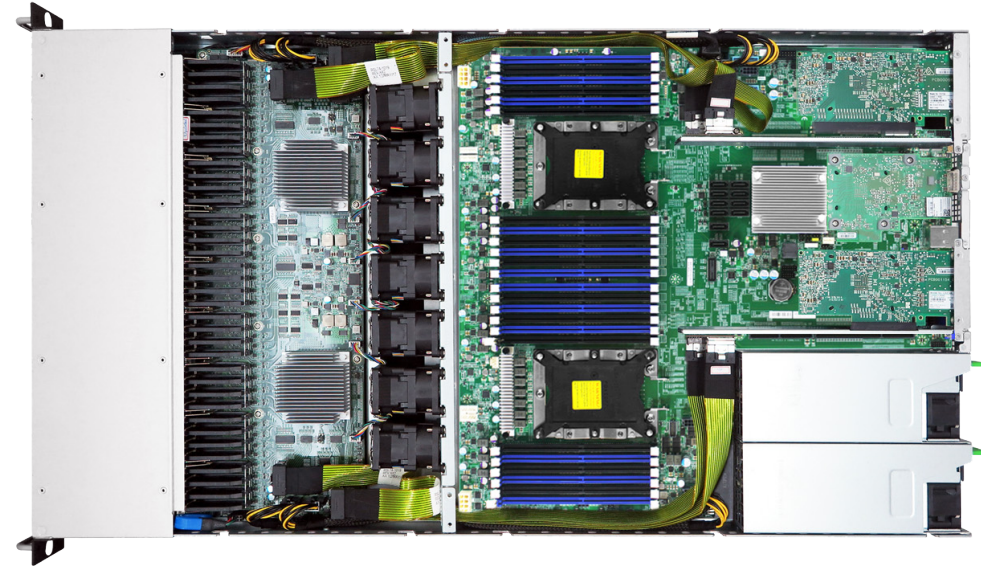 - No, it's the present

THE NUMBERS

- How many drives to fill a 100GbE pipe?
  - SATA HDDs – 250
  - SATA SSDs – 24
  - SAS SSDs – 10
  - NVMe – 4
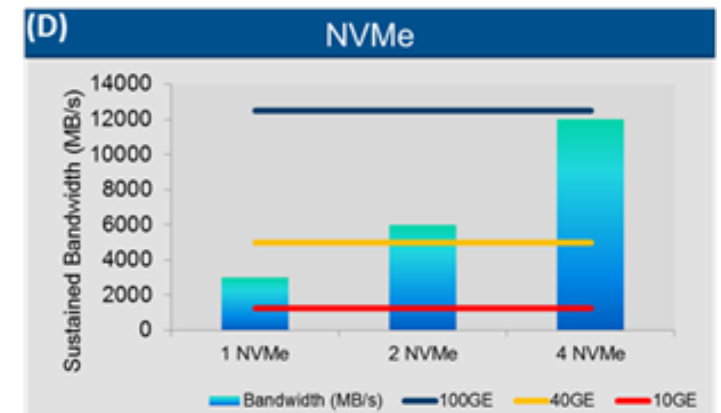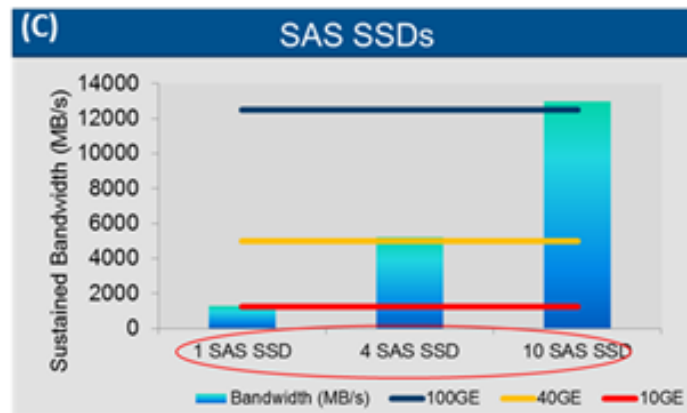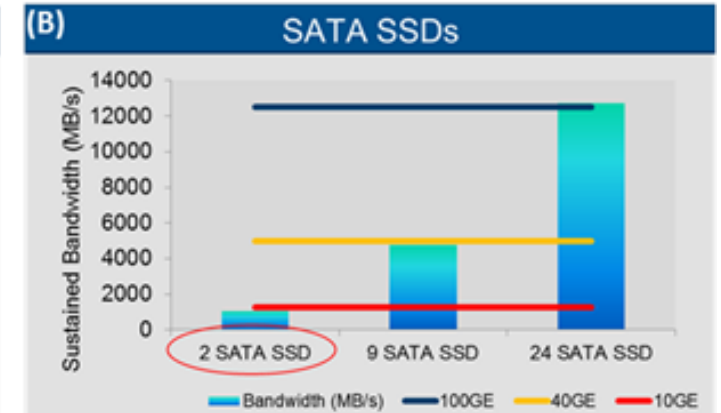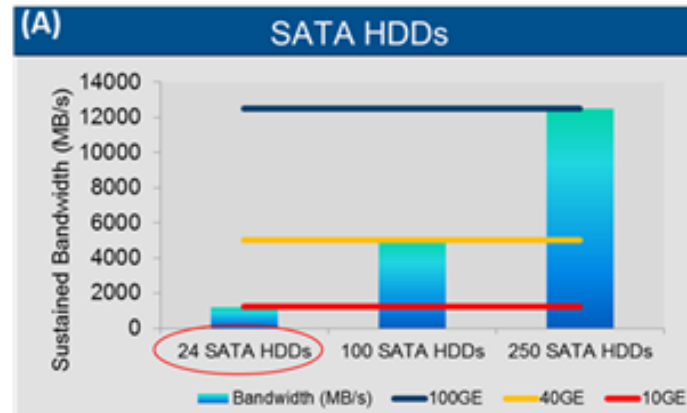
WHAT IF SOMEONE WENT EXTREME?

- 36 NVMe Drives in 1 RU

- 10 Millions IOPS

- 576 TB

HOW DO WE LEVEREDGE NVMe?

- The technology was first defined by the IEEE 802.3ba-2010 standard

- 40GbE and 100GbE made their debut

- What can we do with this technology

  - 100GbE from NAS to 10GbE Switch

  - Support Image Sequences (DPX, TIFF, OpenEXR) and demanding bitrate(s)

THANK YOU

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Mellanox – Ethernet Storage Fabric

Presented by Bill Webb, Director - Ethernet Switching - Americas
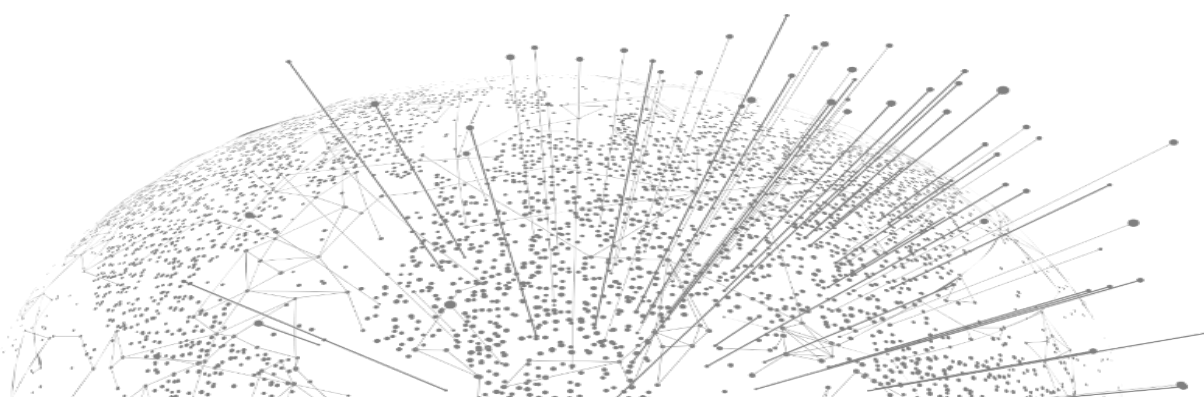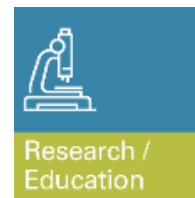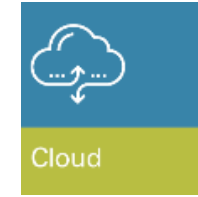
September 17, 2018

Mellanox Ethernet Switches Power All Platforms

3,000+ unique customers worldwide

Over 1M ports deployed

OEM'd by global server OEMs

Open Network Operating Systems

Web 2.0   Cloud   Big Data   Machine Learning

Enterprize Storage   Business Intelligence   Entertainment   Financial

Research / Education   Oil & Gas   Government   Defense

Mellanox Accelerates Businesses' Success!

Reducing CPU Usage Drastically with Advanced Network Offloads
IP-Broadcasting Applications and Many More on 25/100GbE!

BBC

100K subscribers from a Single Caching Server!
Netflix Open Connect Appliance with Mellanox ConnectX-4

NETFLIX

Mellanox 40GbE-based Network to Support Clustered File Systems
Live Broadcast Video Editing

svt1
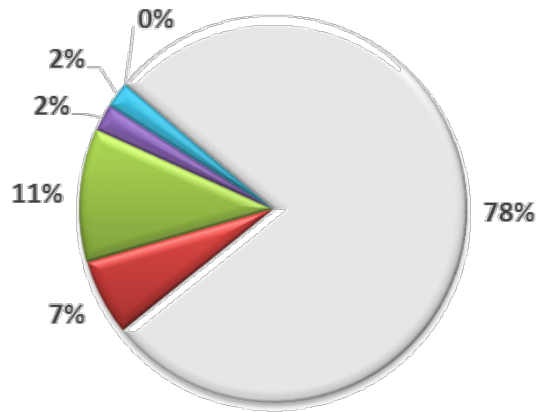
Mellanox 10/40GbE-based Storage Network
Offline Broadcast Editing

CBC Radio-Canada

Only End-to-End 100GbE Network to Support Maximum of 32 Tiles
Enabling IP-Broadcast Multiviewer & Signal Analytics

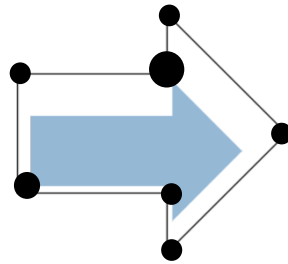**sky 1**

25G & Above is Fastest Growing Ethernet Segment

Mellanox is #1 with 67% share in the Nx25G segment
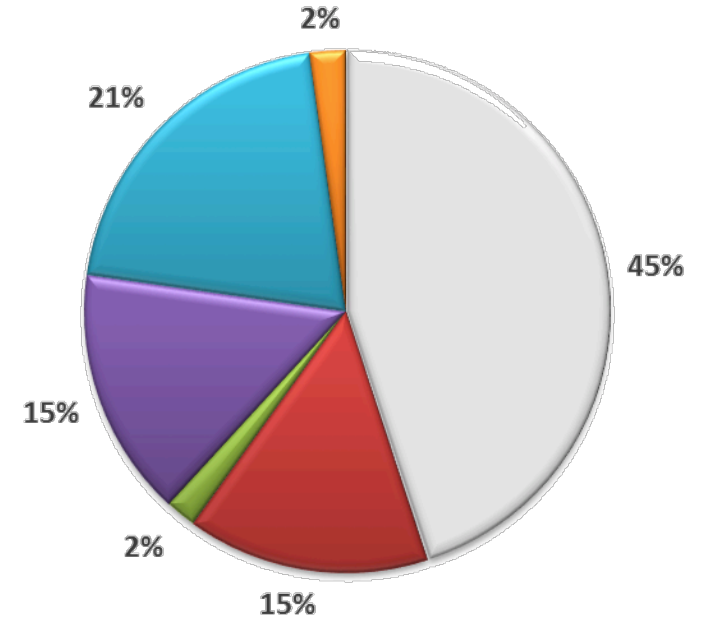
**High Speed Adapter Forecast
2021 TAM ($2.3B)**

**High Speed Adapters
2017 ($1.3B)**

25G+ Segment Growing at 38% CAGR

22% Of Total Market

Pie chart 2017: 0%, 2%, 2%, 11%, 7%, 78%

Pie chart 2021: 2%, 21%, 15%, 2%, 15%, 45%

Legend: ▨ 10G ■ 25G ■ 40G ■ 50G ■ 100G ■ 200G

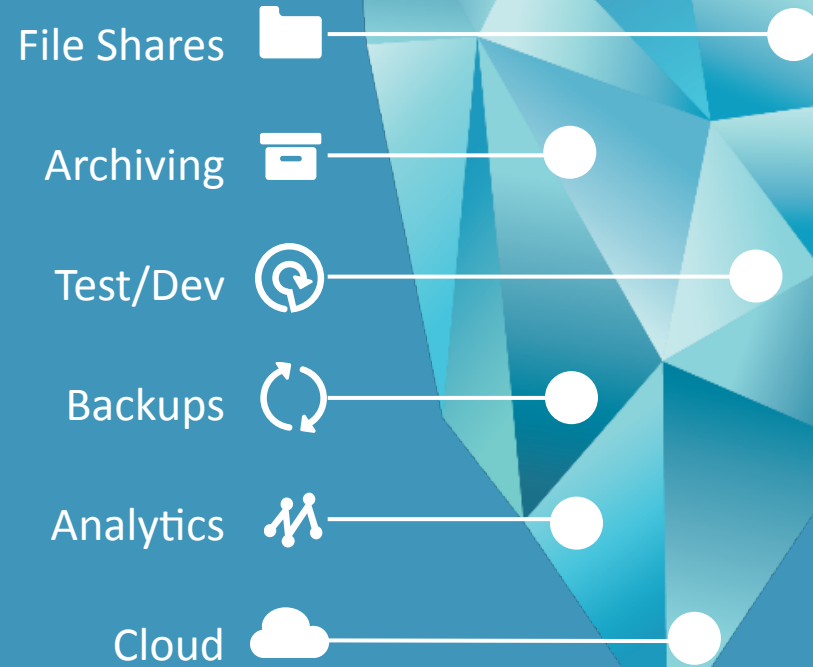- Key Drivers of 25G+ Networking:
  - Cloud, Big Data, Faster Storage, Virtualization, AI & Machine Learning
- 25G+ Adoption Cycle:
  - #1: US Hyperscalers #2: BAT in China #3: Third wave of cloud, telco, and storage in US, ASIA, and Japan

Source: Crehan Long Range Forecast Server-Class Adapter & Lom Controller (10G and greater), Jan '18

Storage Landscape

STORAGE ICEBERG

PRIMARY STORAGE
– Traditional SAN
– Only 20% of capacity

File Shares

Archiving

Test/Dev

Backups

Analytics

Cloud

SECONDARY STORAGE

– 80% of capacity
– Rapid growth
– Diverse data types
– Scale-out, Ethernet-based
– Tiered data

NVMe Growth Projection – $60B by 2021

- NVMe-oF adapter shipments will exceed 1.5M units by 2021
  - $750M @ $500/per

- This does not include ASICs, Custom mezz. cards, etc. inside AFAs and other storage appliances

Storage Networking Background: Fibre Channel & Ethernet

1997

Feature	Fibre Channel	Ethernet
Bandwidth	1 G	100 M
Supports	Block	Block, file
Lossless	Yes	No
Cost	High $$$$	Medium $$
Cloud / HCI	No / No	No / No
Vendors	Several	Many
SDS / Scale-out	No / No	No / No

2017

Feature	Fibre Channel	Ethernet
Bandwidth	8/16/32 G	10/25/40/100 G
Supports	Block	Block, file, object
Lossless	Yes	Yes
Cost	Medium $$	Low $
Cloud / HCI	No / No	Yes / Yes
Vendors	2 / 2	Many / Many
SDS / Scale-out	Rare / No	Yes / Yes

Yesterday: Storage Network = FC

- Fibre Channel offered best performance
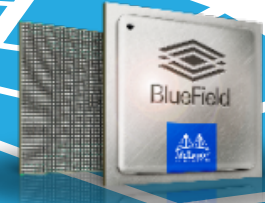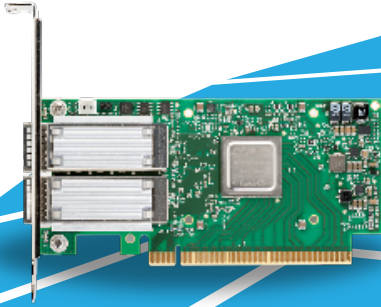- All interesting storage was tier-1 block
- No cloud or hyperconverged

Today: Both FC & Ethernet for storage networks

- FC option for Primary Block Storage
- Ethernet only option for all Primary & Secondary Storage

(Block, Object, NAS, Cloud, Hyperconverged, Big Data)

Problem Solved With an Ethernet Storage Fabric

Ethernet Storage Fabric

Everything a Traditional SAN Offers but ...
Faster, Smarter, & Less Expensive

FAST
- Highest Bandwidth
- Lowest latency
- RDMA and storage offloads
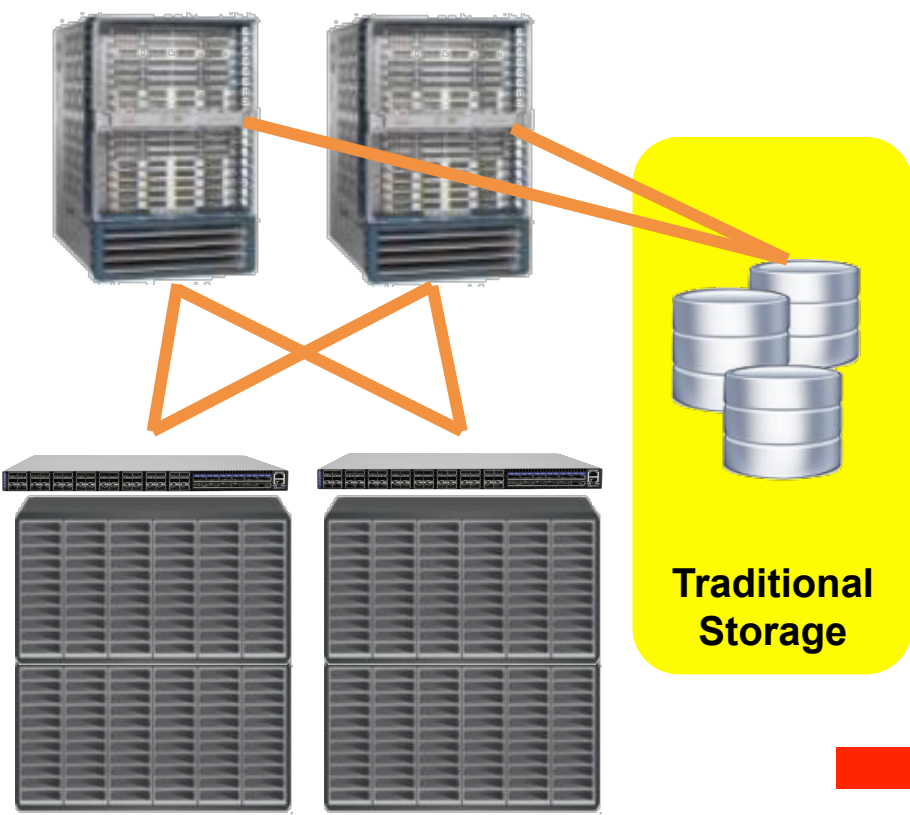- Native NVMe-oF Acceleration

SMART
- Automated Discovery & Provisioning
- Security & Isolation
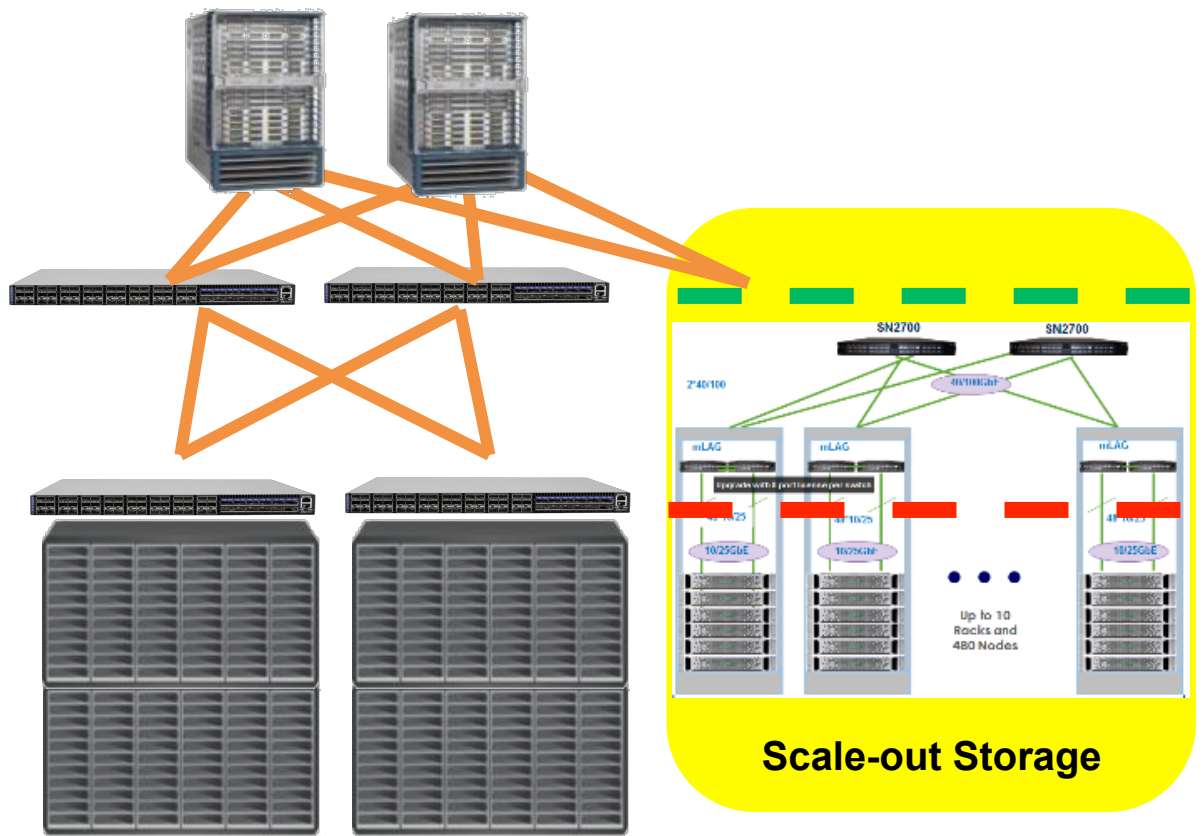- Monitoring, Management, & Visualization
- Storage-aware QoS

EFFICIENT
- Optimized Form Factors
- Just Works Out of the Box
- Flexible: Block, File, Object, HCI
- Affordable: SAN without the $$

Traditional vs. ESF—Where to Draw the Line?

Traditional Storage

Scale-out Storage
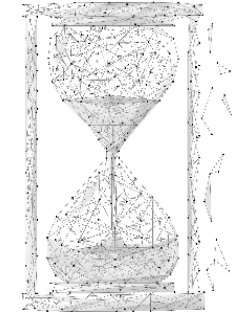
Legacy DC – FC SAN

Modern DC – Ethernet Storage Fabric

Why Not Just Use Your Existing Switches?
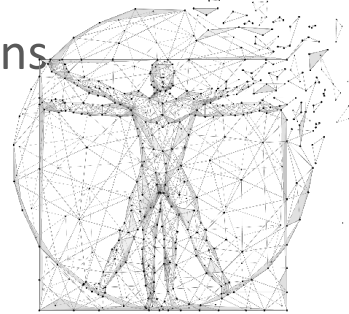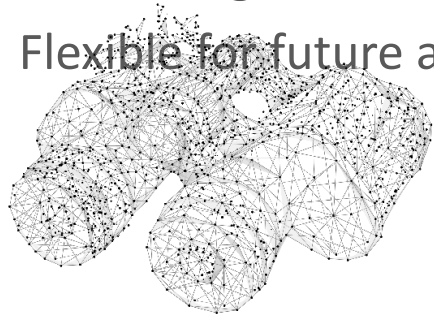
Existing switches might not be designed for storage

- Are there enough available ports?

- Will the switches support new speeds – 25, 40, 50, 100GbE?

- Blocking? How many hops? How much latency?

- Are switches too big for storage or HCI clusters?

Need to Look To the Future

- Today's network purchases must last 3-5 years

- Fast enough for flash

- Flexible for future applications
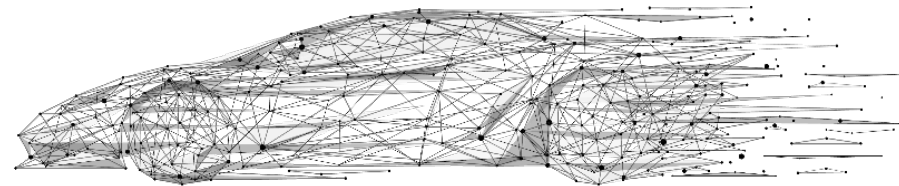
How to Enable an Ethernet Storage Fabric

Ethernet Storage Fabric needs dedicated ESF switches

Performance

High Availability

Simple

Automated

Scalable

Cost Efficient

Spectrum™

- ✓ **2 Switches in 1RU**
- ✓ **Storage/HCI port count**
- ✓ **Zero Packet Loss**
- ✓ **Low Latency**
- ✓ **RoCE optimized switches (NVMe-oF)**
- ✓ **NEO for Network automation/visibility**
- ✓ **Native SDK on a container**
- ✓ **Cost optimized**
- ✓ **NOS alternatives**

Open Ethernet 100/50/40/25/10G Switch Portfolio

SN2700 – 32x100/40GbE (64x50GbE)
Ideal ToR / Aggregation

SN2410 – 8x100GbE + 48x25GbE
25GbE ➜ 100GbE ToR

SN2100 – 16x100GbE ports (64x25GbE)
Ideal storage/Database Switch
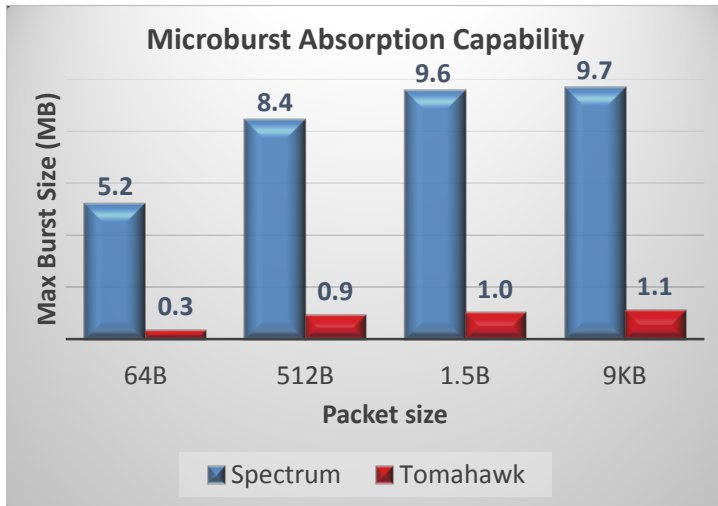Highest 25GbE Density Per Rack

SN2010 – 4x100GbE + 18x25GbE
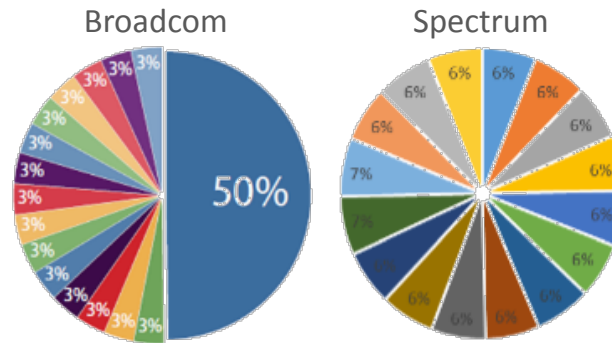Ideal HCI ToR Switch

Spectrum™

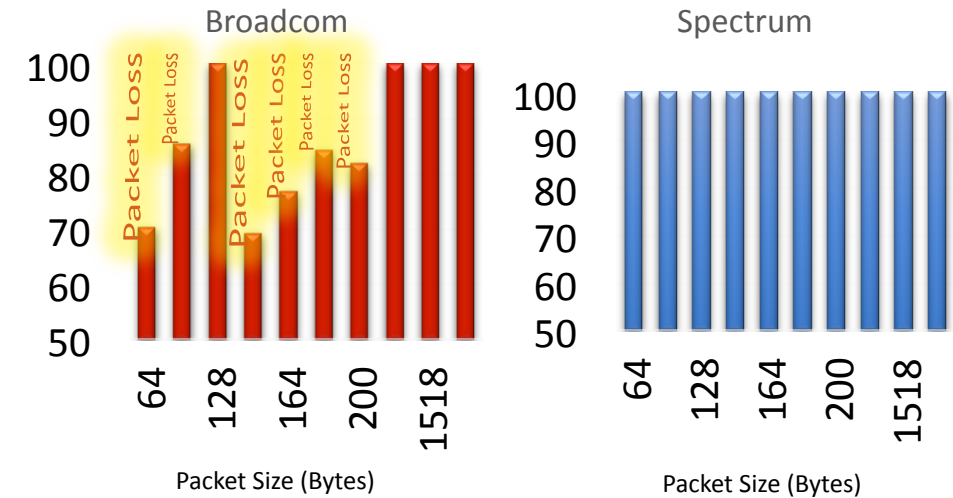**High performance, Multi-Tenant, Scalable Data Centers**

Spectrum is Built for ESF

Congestion Management

Microburst Absorption Capability

Fairness

Broadcom   Spectrum

Avoidable Packet Loss

Broadcom   Spectrum

Guaranteed Low Latency
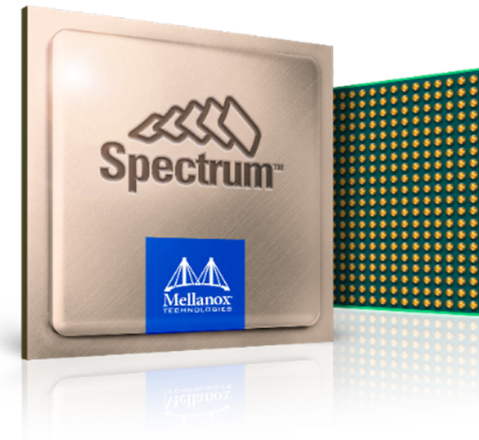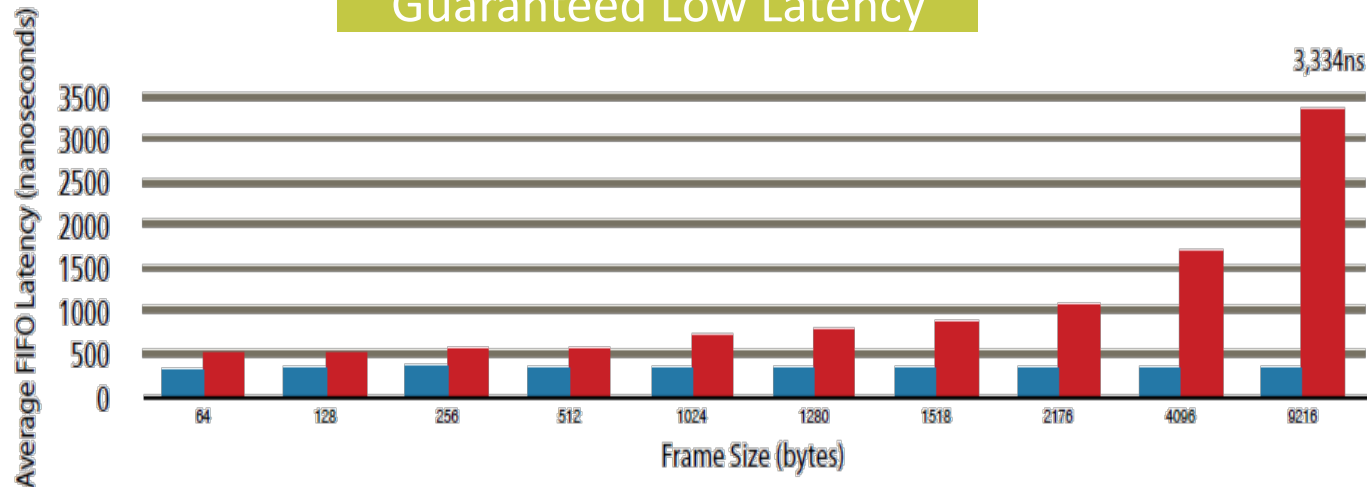
www.zeropacketloss.com

Ethernet Storage Fabric Must Support RoCE

- RoCE is RDMA over Ethernet
  - Bypass CPU
  - Increase efficiency

- RoCE has growing support
  - All Operating Systems
  - Many Applications
  - More Storage Arrays

- Common Use Cases
  - Storage (incl. NVMe over Fabrics)
  - Big Data
  - Video processing
  - Machine Learning / AI

Low Latency	DCB / PFC
Easy Configuration	Fast-response ECN
Guaranteed QoS	Strong Telemetry
Automated Mgmt.	High bandwidth

RoCE Support Done Right!

Application Blocked by the Switch

Other Switches

(Pause time (Microseconds) vs Time/Seconds)

Application Blocked by the Switch

Application runs Smoothly

(Pause time (Microseconds) vs Time/Seconds)
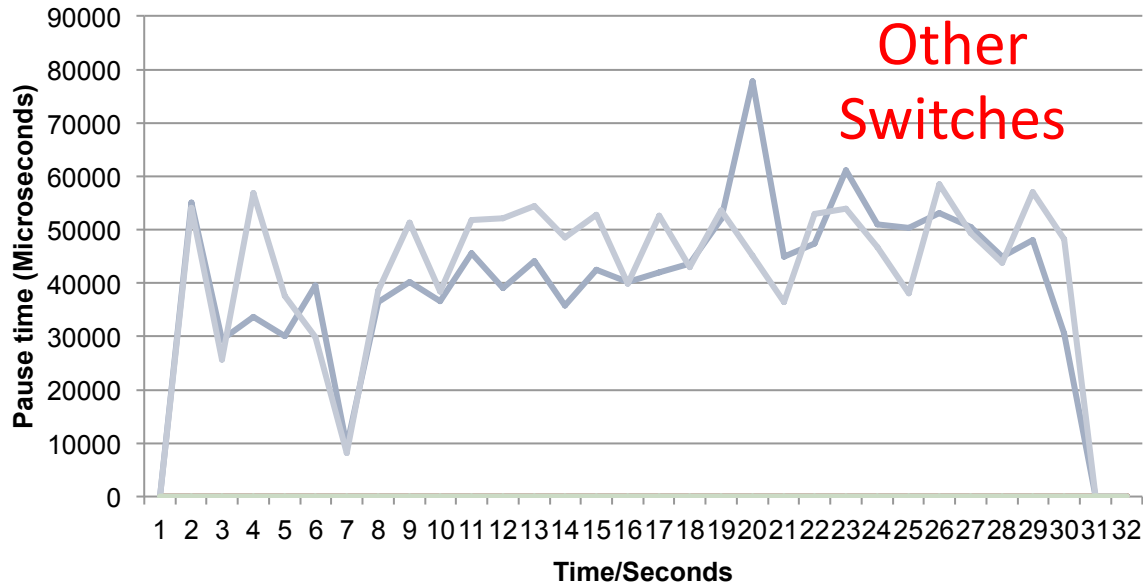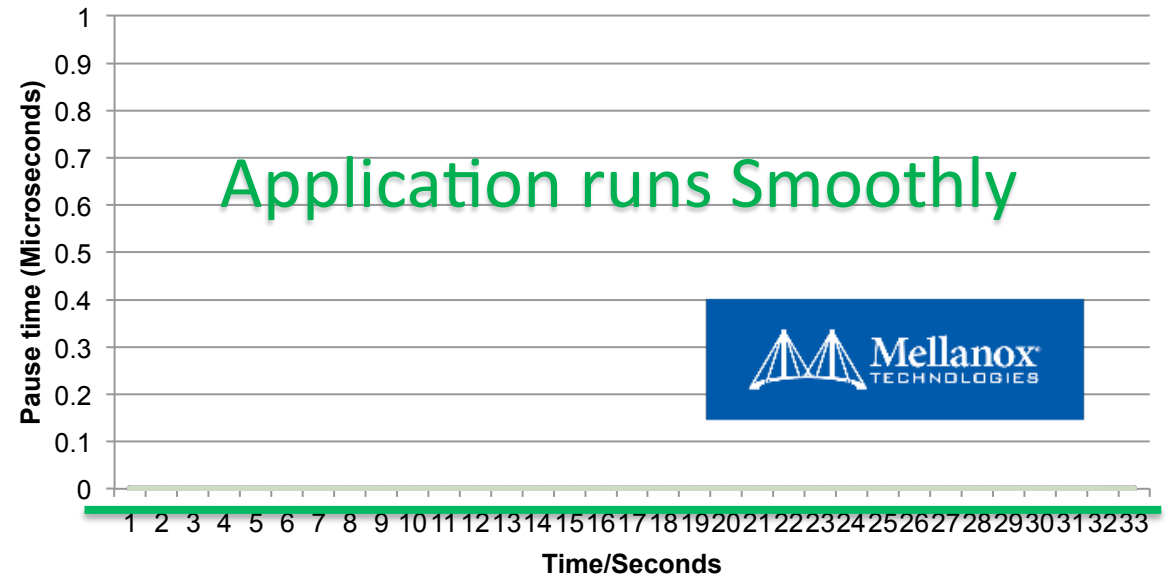
Summary: Choosing an ESF Switch

Better Performance ✓

Right Form Factors ✓

Easy Setup ✓

Better Visibility ✓

Tested End-2-End ✓

Mellanox

Rivermax VMA Tech.

Maximizing Efficiency of Software Video Streaming

Lower CPU Utilization

80% Less CORES*

Less Servers & Network

40% Less*

Lower Power, Cooling & Space

30% Less*

Highest Throughput & Quality

100 Gb/s PER PORT

0% Packet LOSS

2110-21 Compliance

SMPTE®

Packet Paced in NIC hardware

* Comparing to Kernel based application performan

Ultra HD Resolution Demands Hardware Performance

- Raw uncompressed video bandwidth requirement exceeds 100Gb/s
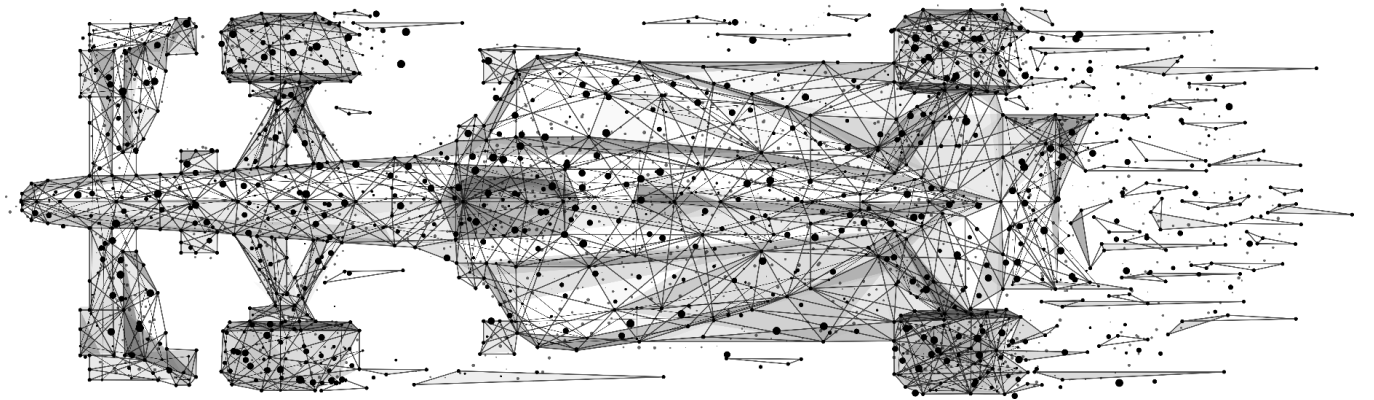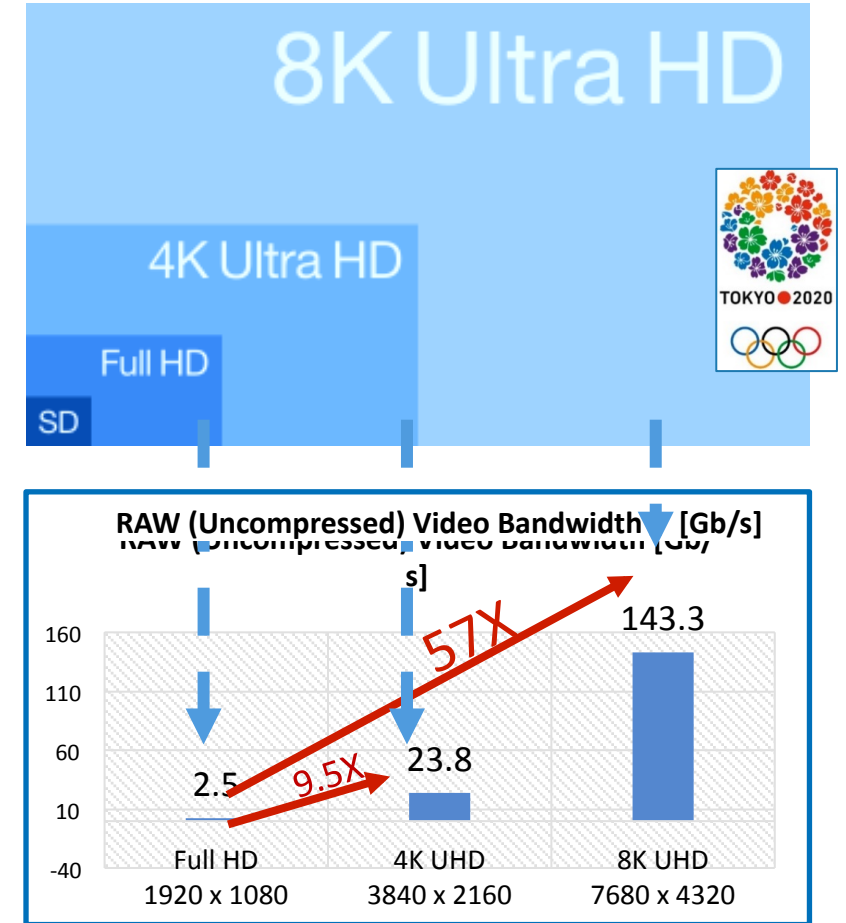 - Bandwidth for 1 video stream with 8K UHD high frame rate
- Packet pacing in software is not SMPTE 2110-21 compliant
  - Sub 1us Inter Packet Gap (IPG) is not achievable with software based solutions

Full HD	20bpp	25fps	IPG 11,000 nSec	Can be achieved with software packet pacing
4K UHD	20bpp	60fps	IPG 1,150 nSec	Cannot be achieved with Software packet pacing
4K UHD	24bpp	120fps	IPG 469 nSec	Cannot be achieved with Software packet pacing
8K UHD	36bpp	60fps	IPG 156 nSec	Cannot be achieved with Software packet pacing

Inter Packet Gap (IPG) Requirements for UHD

RAW (Uncompressed) Video Bandwidth [Gb/s]

	Full HD 1920 x 1080	4K UHD 3840 x 2160	8K UHD 7680 x 4320
	2.5	23.8	143.3

9.5X   57X

Bandwidth Requirements for UHD

Rivermax Key Features

Packet Pacing

- Leverages ConnectX-5 hardware based Packet Pacing
- SMPTE ST 2110-21 compliance at any bit rate
- No dependency on CPU Strength, OS interrupt level or Application

Kernel Bypass

- Reduced Kernel overhead with direct network adapter access
- Selective bypass – enables to select traffic bypasses and which flows to kernel
- Reduced latency
- Reduced CPU utilization
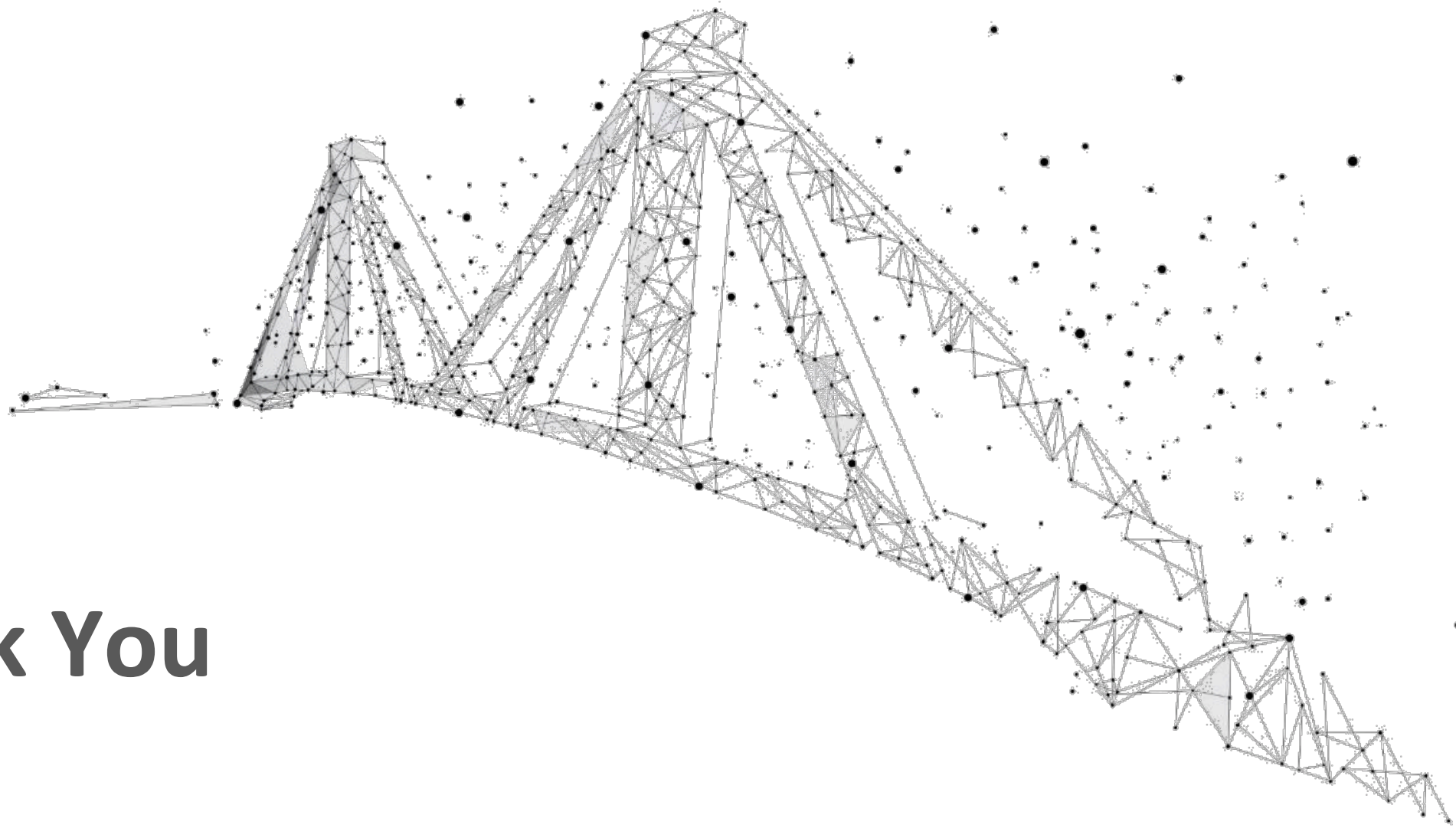- Increased throughput

Packet Aggregation

- Application at Frame/Line(s) level
- Receive: fully assembled frame/lines(s) in memory
- Transmit: synchronously transmit packet paced full frames/lines (/chunks)

Packets vs Frames

Based on ConnectX-5 Technology

Thank You

NEXT-GEN CREATIVITY: BEYOND THE TECH

PRESENTED BY NICK ANDERSON

creative.space

powered by DigitalGlue

MAKING 4K WITH HD TECH

STORAGE LIMITATIONS

• 1 & 10 GbE

• Non-realtime Image Sequences

• Compressed RAW for real-time

WORKSTATION LIMITATIONS

• Intermediate & Proxy Codecs

• Prores, Cineform, and DNx

• Optimized hardware acceleration

THE GREAT PLATEU
HOW FAR IS ENOUGH?

- 2K-8K Resolution (based on viewing distance)

- Physiological Color Gamut

- 21 Stops of Dynamic Range
  7 stops visible at one time

- 12-bit

— Physiological Color Gamut (average human eye)
— Pointer's Gamut
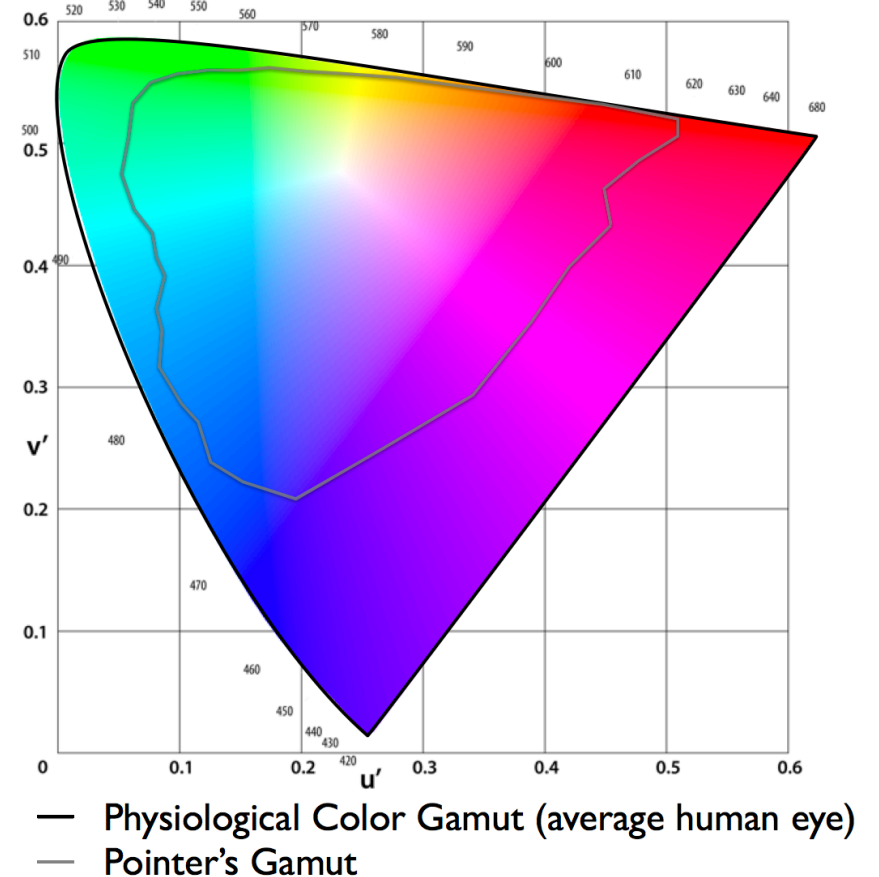
SO... WHAT CAN WE DO NOW?

- End-to-end Online Workflows
- Seamless Collaboration
- Artificial Intelligent Tools

- Masters as Deliverables
- …and then it gets spooky

END-TO-END ONLINE

- No waiting for transcodes for source workflows

- Source to master quality instead of proxy (16-bit OpenEXR)

- More eyes looking at content to catch issues

- Non-destructive processing throughout the pipeline

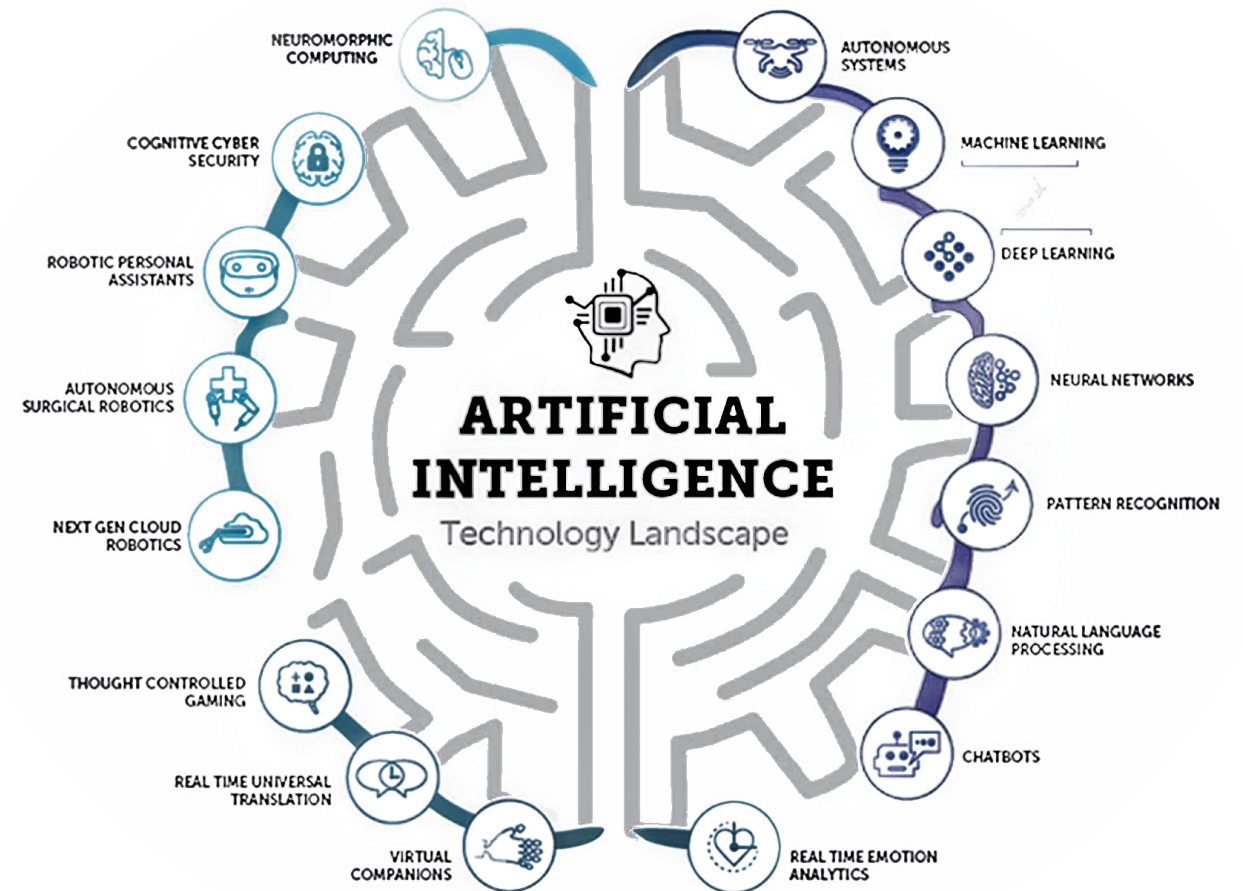- ACES Color Transforms

SEAMLESS COLLABORATION

- ## NLEs with collaboration

  - ❖ DaVinci Resolve – Edit, Color, Audio, and VFX in one application

  - ❖ Adobe – Dynamic Linking with Premiere, After Effects, and Audition

  - ❖ AVID – Bin Sharing and Fusion Connect to DaVinci Resolve
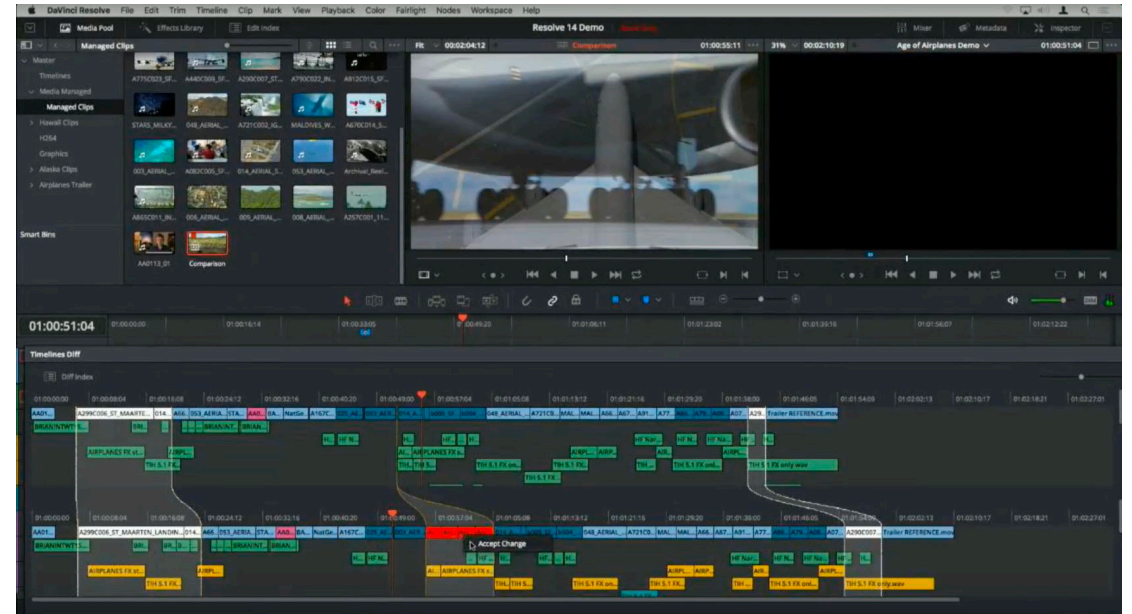
- Entire team working in Parallel with the same assets

- No conforms, relinking, or project version tracking

ARTIFICIAL INTELLIGENCE FOR POST

- ## AI-friendly storage enables new workflows

    1. AI-based auto-tagging and transcription
    2. Creating new pixels and bits (Nvidia)
    3. Machine learning for automation

- ## AI designed to enable non-technical creatives

ARTIFICIAL INTELLIGENCE
Technology Landscape

NEUROMORPHIC COMPUTING
AUTONOMOUS SYSTEMS
COGNITIVE CYBER SECURITY
MACHINE LEARNING
ROBOTIC PERSONAL ASSISTANTS
DEEP LEARNING
AUTONOMOUS SURGICAL ROBOTICS
NEURAL NETWORKS
NEXT GEN CLOUD ROBOTICS
PATTERN RECOGNITION
THOUGHT CONTROLLED GAMING
NATURAL LANGUAGE PROCESSING
REAL TIME UNIVERSAL TRANSLATION
CHATBOTS
VIRTUAL COMPANIONS
REAL TIME EMOTION ANALYTICS

MASTERS
AS DELIVERABLES

- High-bandwidth Fibre and 5G for content delivery

- IMF with encoding on the fly

- Metadata driven decode
  - Display transforms

IMF

INTEROPERABLE
MASTER FORMAT

THE COMING CREATIVE REVOLUTION

- Brain to computer interfaces

- P2P streaming

- Integrated AI creative tools

- Blockchain asset management

- Augmented, virtual, and mixed reality

- Femto-photography
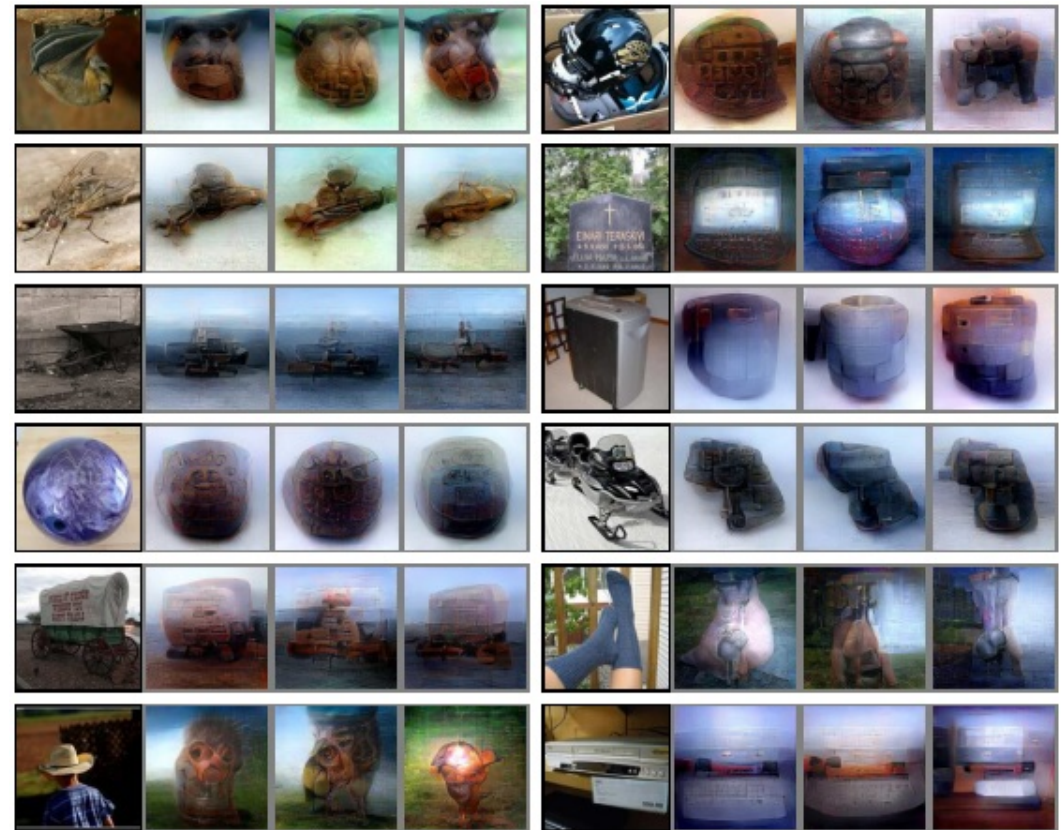
THANK YOU

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PRODUCT MANAGER, DIGITALGLUE
nick.anderson@digitalglue.com

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