UNDERSTANDING STORAGE PERFORMANCE FOR VIDEO PRODUCTION

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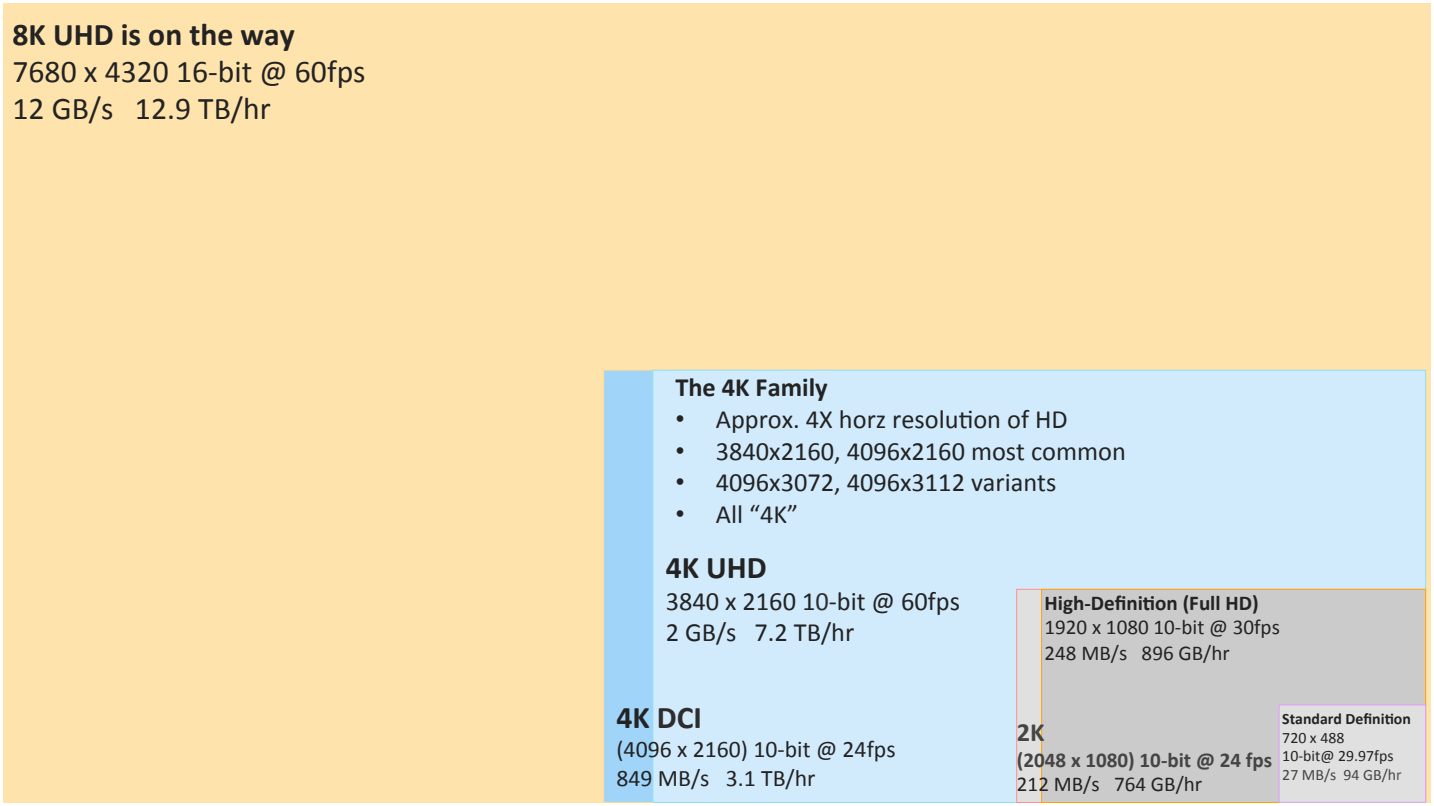
Collaborative 4K Post Is Not Easy

- Large formats and data rates challenge standard file systems
  - Reading, writing, tracking, sharing and protecting
- NAS-based systems struggle with 4K workflows
  - Latency from packetization is real
  - Ethernet based system saturate quickly
- Every additional user multiplies the problem
  - Teams frequently read from the same file during production

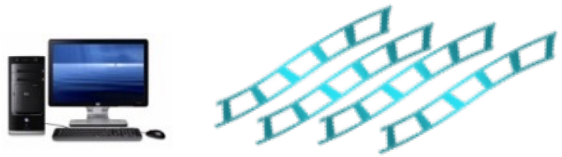
Uncompressed Resolutions



What Impacts Performance

- Host (client) machine
- Data Rate
  - Compressed or Uncompressed
  - Resolution and Frame Rate

- Stream Count
  - Number of cameras used in acquisition, composition layers, workstation requirements
  - Mezzanine or proxy workflows

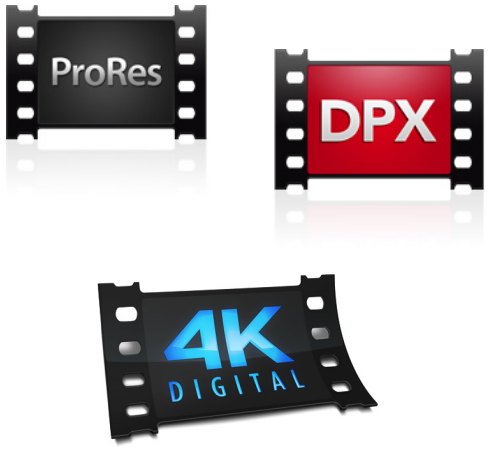


- Drive type

But All 4K Is Not Equal

Tested formats and frame rates

4K Format	Resolution (W x H)	Frame Rate (fps)	Data Rates (MB/s)	Storage Capacity (GB/Hr)
UHD ProRes 422 HQ	3840 X 2160	30	111	400
		60	221	796
UHD ProRes 4444 XQ	3840 X 2160	30	249	896
UHD (10 bit)	3840 x 2160	24	807	2,905
		60	1990	7,164
4K Full App (10 bit)	4096 x 3112	24	1224	4,406

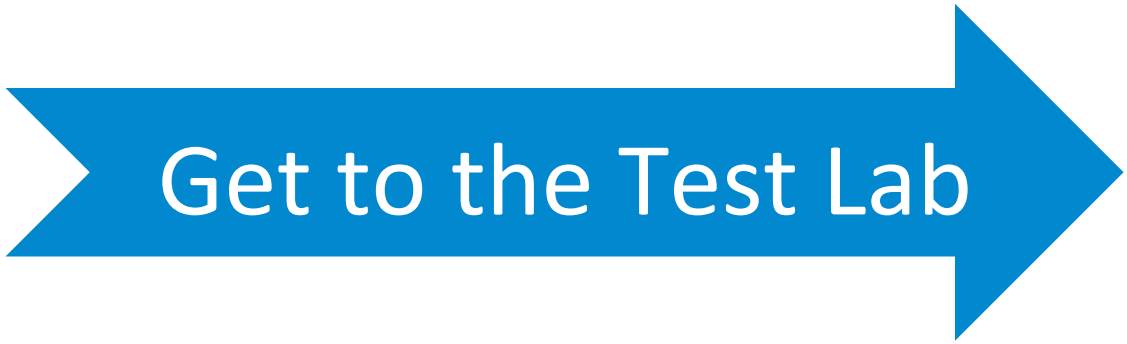


4K Format Guide

- 4K is horizontal resolution of approx. 4,000 pixels
- There are several resolutions that qualify as 4K
- UHD or “Quad HD” is 4x HD resolution (TV)
- Full App 4K is Super 35mm resolution (Film)

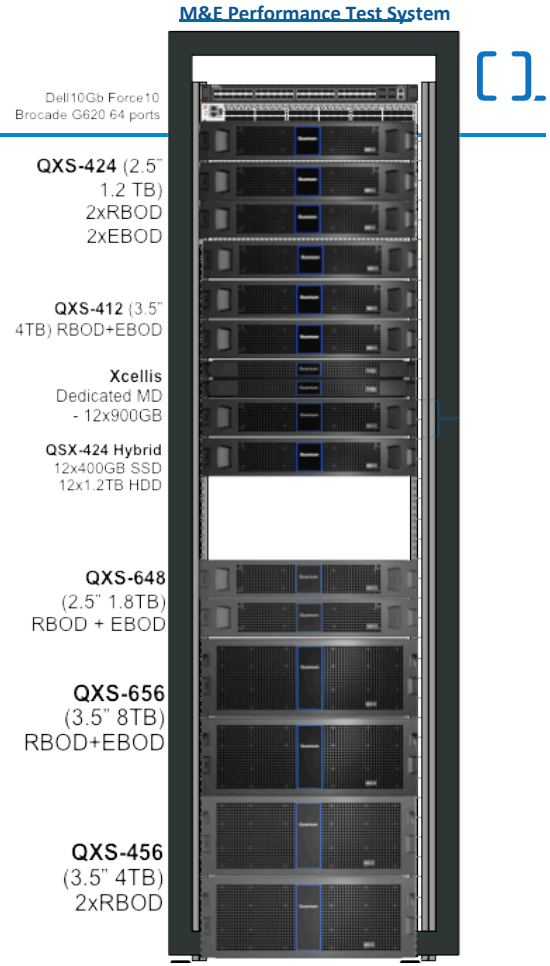
Flash For 4K In The Real World

- Customers struggling to move to 4K workflows on existing storage
- Compounded by multiple users sharing content and workloads
- Flash might be the answer, but at what cost?



Test Methodology

- Define the Test Metrics
  - Identified optimal StorNext variables for M&E workflows
  - 6 4K Formats, 3 Drive types, 5 Arrays, 2 Capacities, 3 Clients OS
  - Over 500 separate tests
- Invent the Ruler
  - Calibrate Application stream counts for Autodesk Flame and Blackmagic Resolve with Vid I/O numbers
- I/O Test Files
  - Uncompressed: created frames to match published resolutions and data rates
  - Compressed: created individual files that mirrored published codec bitrates
- Capacity and Color
  - Tested all configuration at 0% and 85% capacity
  - All tests on RGB rather than YUV



How Operating Systems Differ

- Linux is the optimal performer
  - Most efficient HBA drivers

- Windows drivers have more CPU overhead, less efficient
  - Windows is 15% less efficient than Linux

- macOS is similarly less efficient than Linux in multi-client environments
  - macOS is overly aggressive with I/O requests
  - HBA manufacturers must be diligent with drivers

Scalability and Growth

- Xcellis Workflow Director HA Pair
- Metadata Array
- RBOD (controller & storage)
- JBOD
- JBOD
- JBOD

1+3

“Scale-up”

Adding JBOD storage to an existing RBOD chassis

- Capacity upgrade with slight increase in performance from additional spindles
- Too many spindles can saturate the controller

- Xcellis Workflow Director HA Pair
- Metadata Array
- RBOD
- JBOD
- RBOD
- JBOD

2+2

“Scale-Out”

Adding RBOD chassis to existing RBOD chassis
(with or without JBODs)

- Simultaneous performance and capacity upgrade
- Performance virtually doubles
- Pract

Comparing SSDs and HDDs

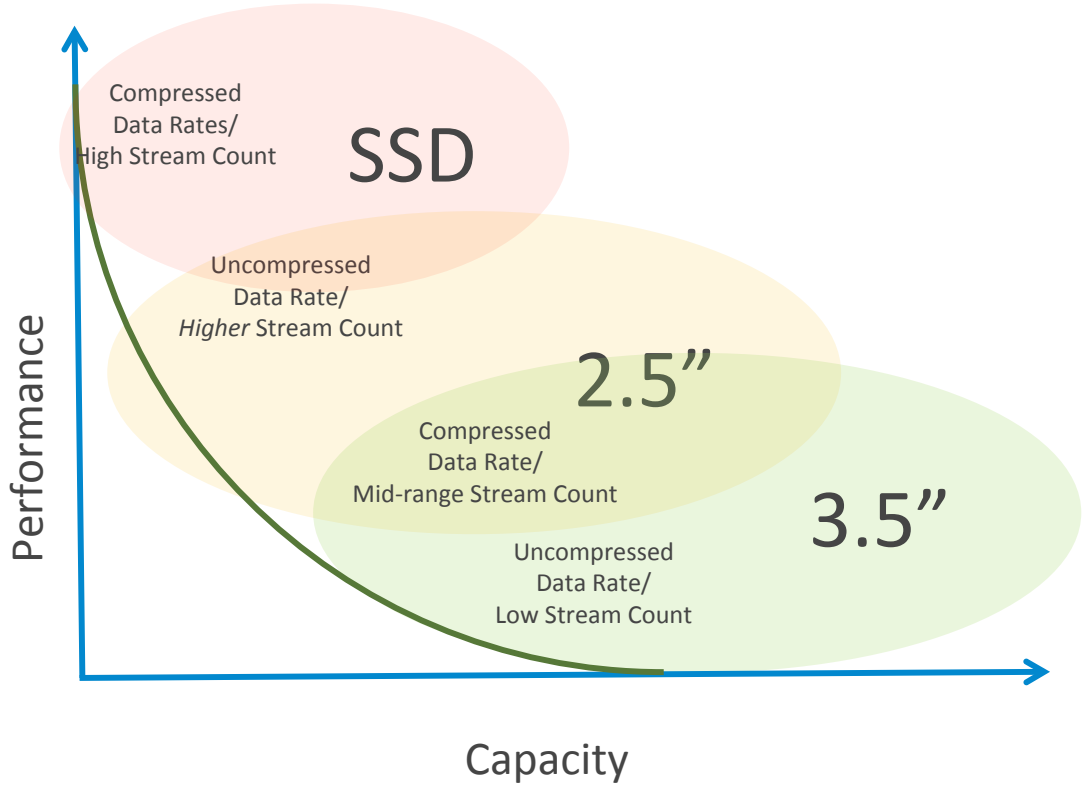
- Ideal for high stream count and low capacity requirements

		Stream Count		Cost Per Stream (Relative)		Useable Capacity (TB)
Drive From Factor	**Configuration**	**Compressed ProRes 422 HQ**	**Uncompressed UHD 24 fps (10-bit)**	**Compressed ProRes 422 HQ**	**Uncompressed UHD 24 fps (10-bit)**	
3.5 HDDs 4 TB	QXS-412	6	0	$1.7 X	N/A	40
	QXS-412 1+3	15	2	$1.6 X	$1.7 Z	160
	QXS-456 RAID	14	2	$1.8 X	$1.4 Z	384
2.5 HDDs 1.2 TB	QXS-424 RAID	13	2	$ X	$ Z	24
	QXS-424 RAID 2+2	28	5	$1.5 X	$1.6 Z	96
2.5” SSDs 400 GB	QXS-424 RAID All-SSDs	49	3	$0.52 X	$3.9 Z	8
	QXS-648 RAID All-SSD	66	6	$0.74 X	$1.2 Z	16

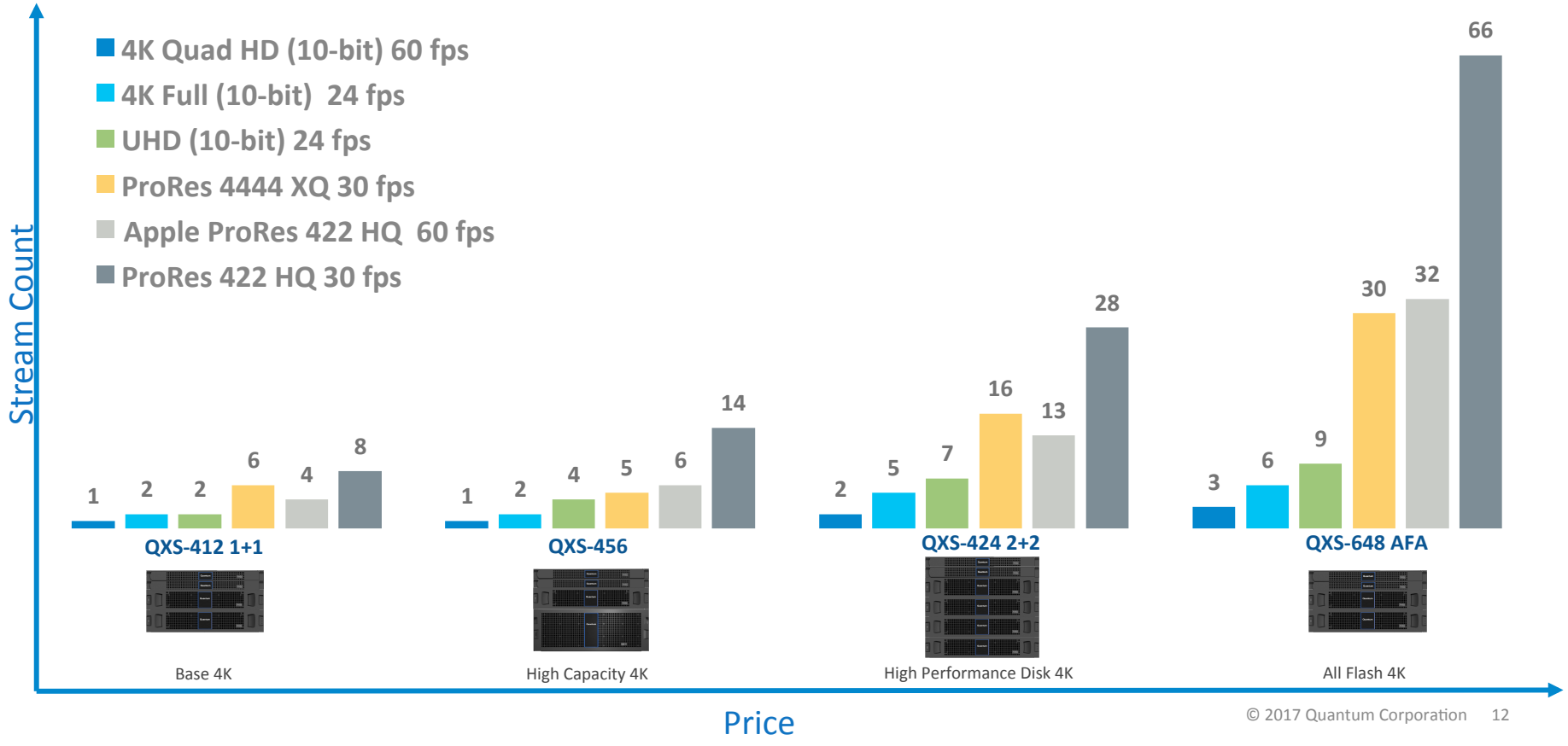
All connectivity via Fibre Channel – Ethernet significantly lower
Read streams at 85% capacity
Prices based on average street price of storage arrays only

The Right Drive for the Job

- **Solid State Drives (SSDs)**
  - Lowest capacity
  - Highest performance
  - Highest price
  - *SSDs for compressed? Yes, when stream count is high.*
  - *Uncompressed may not be worth the cost.*
- **2.5” HDDs**
  - Low capacity
  - High performance (10K RPM)
  - Higher priced
- **3.5” HDDs**
  - High-capacity
  - Low performance (7.2K RPM)
  - Affordable



4K Reference Architectures



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