



Fujifilm 2015 Conference

Into Tomorrow with Tape Technology

Investing in the Future

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DEEP STORAGE EXPERTS

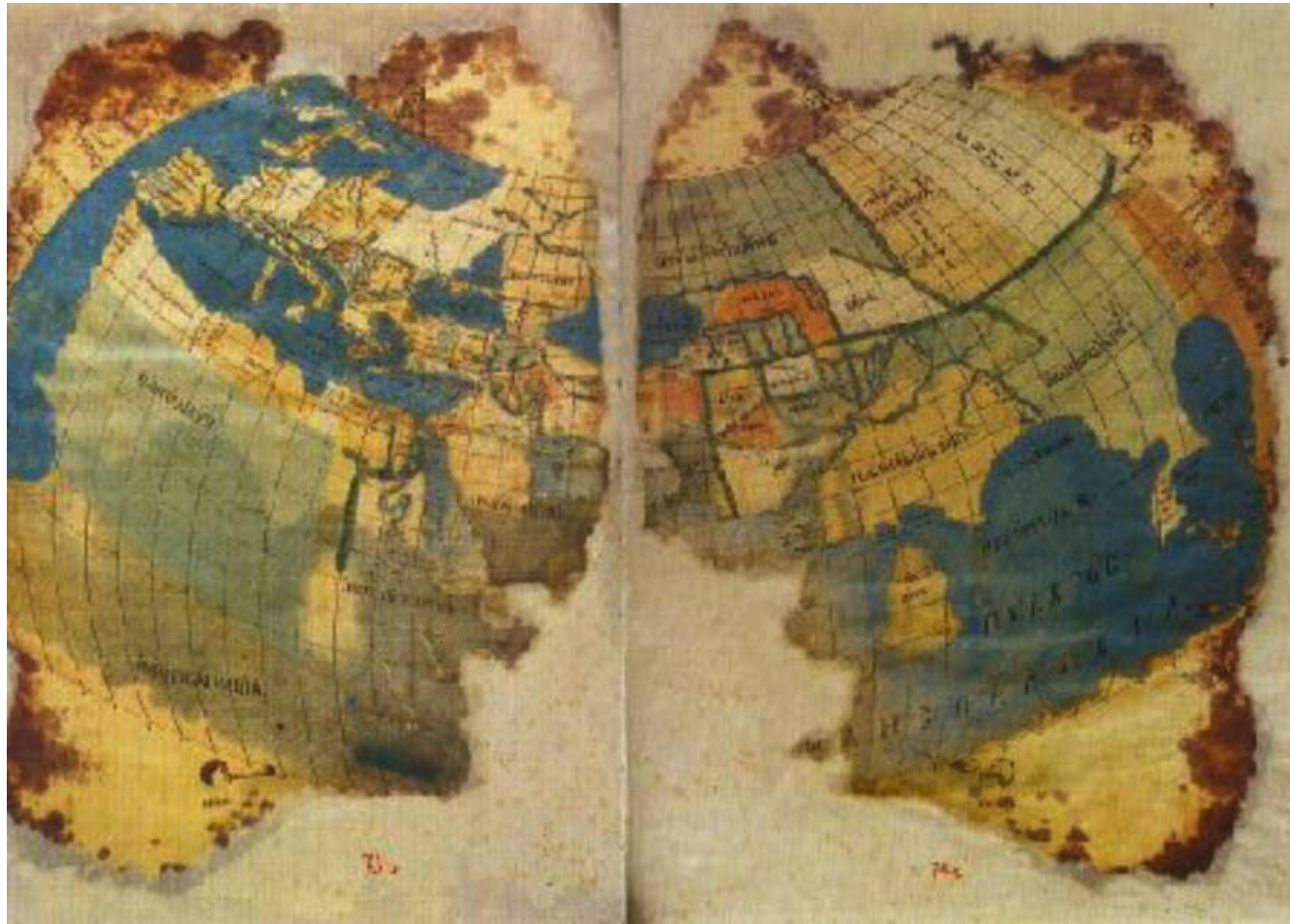
16th Century Illustration Of Claudius Ptolemaeus (Ptolemy)

AD 100 – c. 170



- Greek heritage, Roman citizen and resident of Alexandria, Egypt
- Work included Astronomy, Astrology & Cartography
- Scholarly work “Geography” of ~150 AD, mapped the then current extent of the Roman Empire
- His intellectual contribution was lost during Dark Ages, re-discovered 1,000 years later

Known World Map from Ptolemy's Second Projection circa 1300



World Map In 1482, Johannes Schnitzer, Engraver



World Data Storage and Population in 2020

- IDC projects the “Digital Universe” produce 40 Zettabytes by 2020. Not all of this will be stored.
- Spectra has been studying this and are writing a whitepaper based on storage demand & production capacity, and we believes the actual storage will be 15ZB-25ZB by 2020
 - By 2030 Spectra projects that “stored portion” of Digital Universe to grow to between 150ZB and 250ZB
- World population is expected to reach 7.7B by 2020 (UN 2012)
- All these predictions are tightly connected as we move into a full digital era.

Society is Dependent on the “Digital Universe”

- Healthcare
- Drug development
- Property definitions and rights
- Agriculture genetics
- Food processing and distribution
- Energy development, production & distribution
- Communications
- Transportation
- Semiconductors design & production
- Software design
- All levels of government
- Education
- Social safety nets
- Law enforcement
- Security
- Agriculture production

Society's Genome?

- Digital Universe should be considered to be society's DNA—it carries us forward
- Organizations are like organisms—they must preserve their DNA—their most important asset. How much DNA is there? And just with our DNA we never know what is needed, so we have to keep it all
- Maintaining and moving this information forward, “Digital Preservation” may be our most important mission
 - Geographic Dispersal
 - Genetic Diversity
 - Accuracy of Replication—we have this one in T10, S3, Hash Codes (SHA256, MD5)
- At this time there is no high-capacity permanent storage medium. All data must be made “moveable” to another medium. Same with organisms. Same with Ptolemy
- Again, society may only make multiple copies if those copies are cost effective



Wikipedia Article On Digital Preservation

Article [Talk](#)

Digital preservation

From Wikipedia, the free encyclopedia

In [library](#) and [archival science](#), **digital preservation** is a formal endeavor to ensure and it combines policies, strategies and actions to ensure access to [reformatted](#) and over time.^[3] According to the *Harrod's Librarian Glossary*, digital preservation is the i

[Contents](#) [\[hide\]](#)

- 1 Preservation Fundamentals
 - 1.1 Appraisal
 - 1.2 Identification (identifiers and descriptive metadata)
 - 1.3 Integrity
 - 1.3.1 Fixity
 - 1.4 Characterization
 - 1.5 Sustainability
 - 1.5.1 Renderability
 - 1.5.2 Physical Media Obsolescence
 - 1.5.3 Format Obsolescence
 - 1.5.4 Significant Properties
 - 1.6 Authenticity
 - 1.7 Access
 - 1.8 Preservation Metadata
- 2 Intellectual foundations of digital preservation
 - 2.1 *Preserving Digital Information* (1996)
 - 2.2 OAIS
 - 2.3 Trusted Digital Repository Model
 - 2.4 InterPARES
- 3 Challenges of digital preservation
- 4 Outcomes

The Digital Universe: Risks and Threats

- Internal Data Loss
- Cyber Attack
- Scarcity of Media

The New Nation-State Attack on Saudi Aramco
Main Wave of the attack on Saudi Aramco
30,000 hard drives were scrapped and replaced
Large quantities of data were destroyed
Remained cyber for 15 years of operations and data
by 2020?

- Simple computer viruses
- Environmental lost (fire, flood, earthquake)



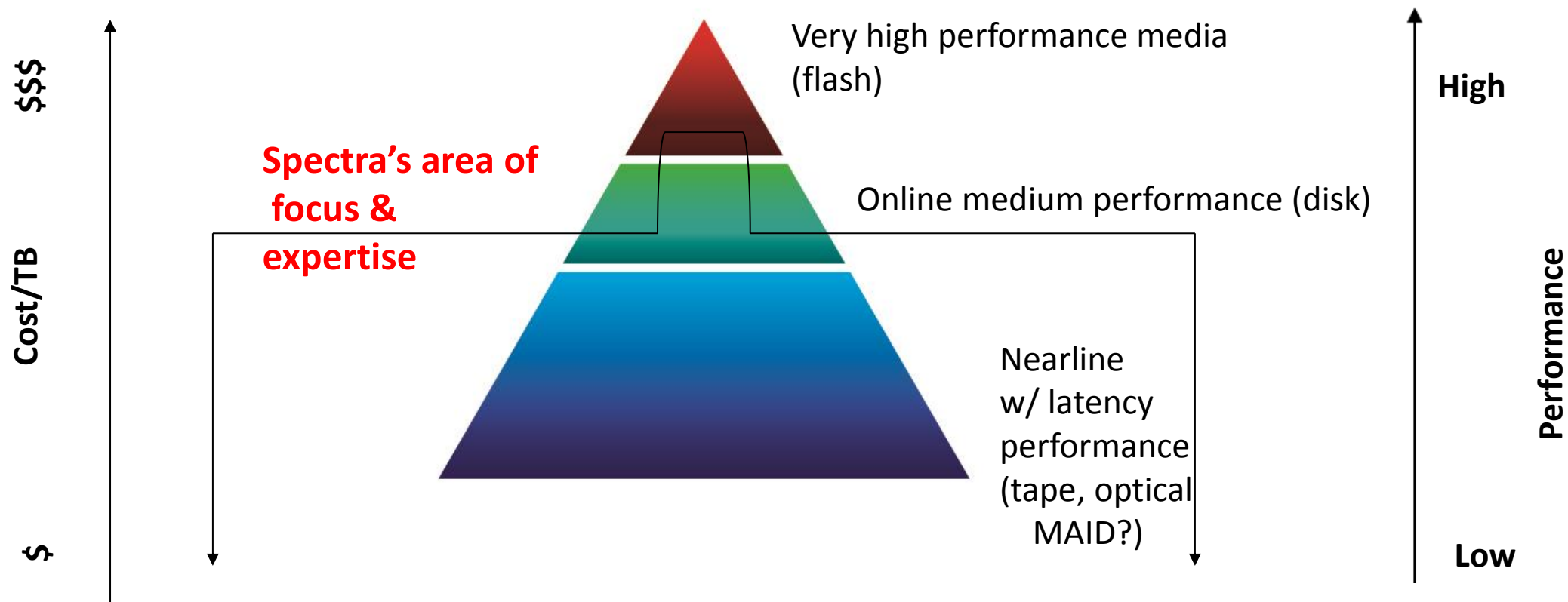
How Does 15-25ZB Digital Universe Survive?

- 15ZB is 15,000,000,000,000,000,000,000 bytes
- Geographic Disbursal: Preferably removable media, not susceptible to common mode failures
- Genetic Diversity: Two or more copies of information on genetically different media to reject common failure modes.
- Accuracy Of Replication: Additional copies must be identical
 - Additional copies must be cost effective



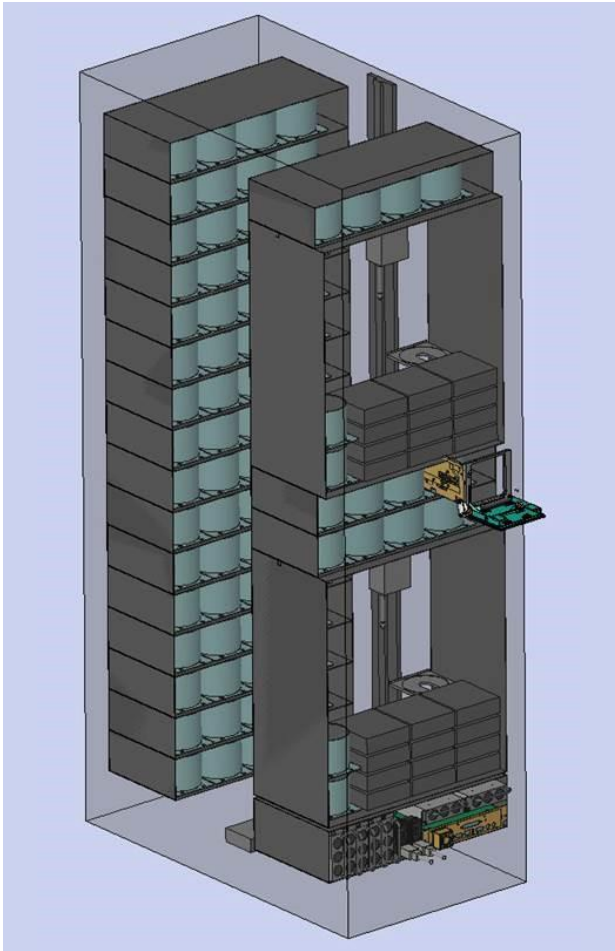
Spectra's Market is the Bottom 80% Of Storage

Most of the storage world is interested in the high performance, segments of storage. At Spectra we are interested in the “bottom 80%” —whether is it delivered via partner apps, NAS or Private Cloud. You will hear us refer to this as “deep storage.”



Let's Look At Archive Disk Optical Media

Spectra's 15,000 Disk Robot Design



Strengths / Weaknesses

Derivative of BluRay & DVD

Developed by Sony & Panasonic

Write once, 50 year media life

Roadmap: 300GB (2016), 500GB (2019), 1TB (unknown)

Unknowns

Media format interchange between drives

Optical drive longevity (may be a consumer grade design)

Media costs (needs to be \$2.50 per disk to compete)

Market acceptance

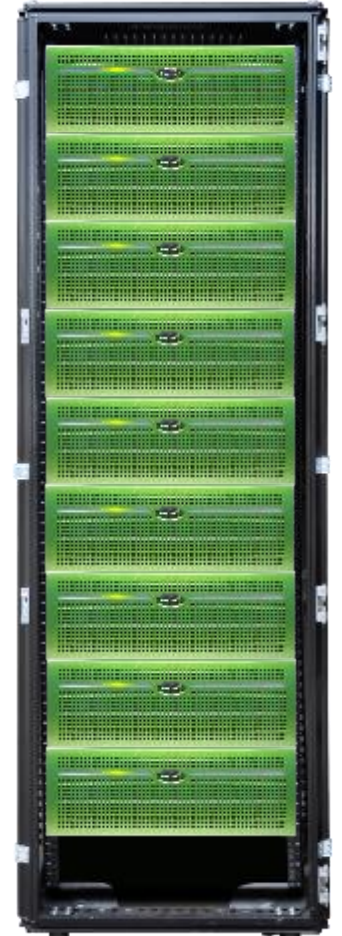
Currently on hold at Spectra due to market uncertainty



Let's Look At Shingled Magnetic Recording (SMR) Disk

- Spectra has launched SMR disk product called Spectra Verde DPE (Digital Protection / Enterprise)
 - As low at 9c/Gigabyte at 2PB. Built in data compression
 - NAS (CIFS, NFS, ftp) Bulk Storage for Archive, Backup, Unstructured Data, Large Files. Not for databases
- Spectra has invented “Very Wide RAID” of 20 + 3 for efficiency of use
 - Massive error detection/correction using Galois Field mathematics & continuous checksums
 - Tape-like, but allows typically 1 GB/s random read/write in bulk storage applications
- Good media growth potential.

7.4 PB Verde
DPE NAS in
Rack

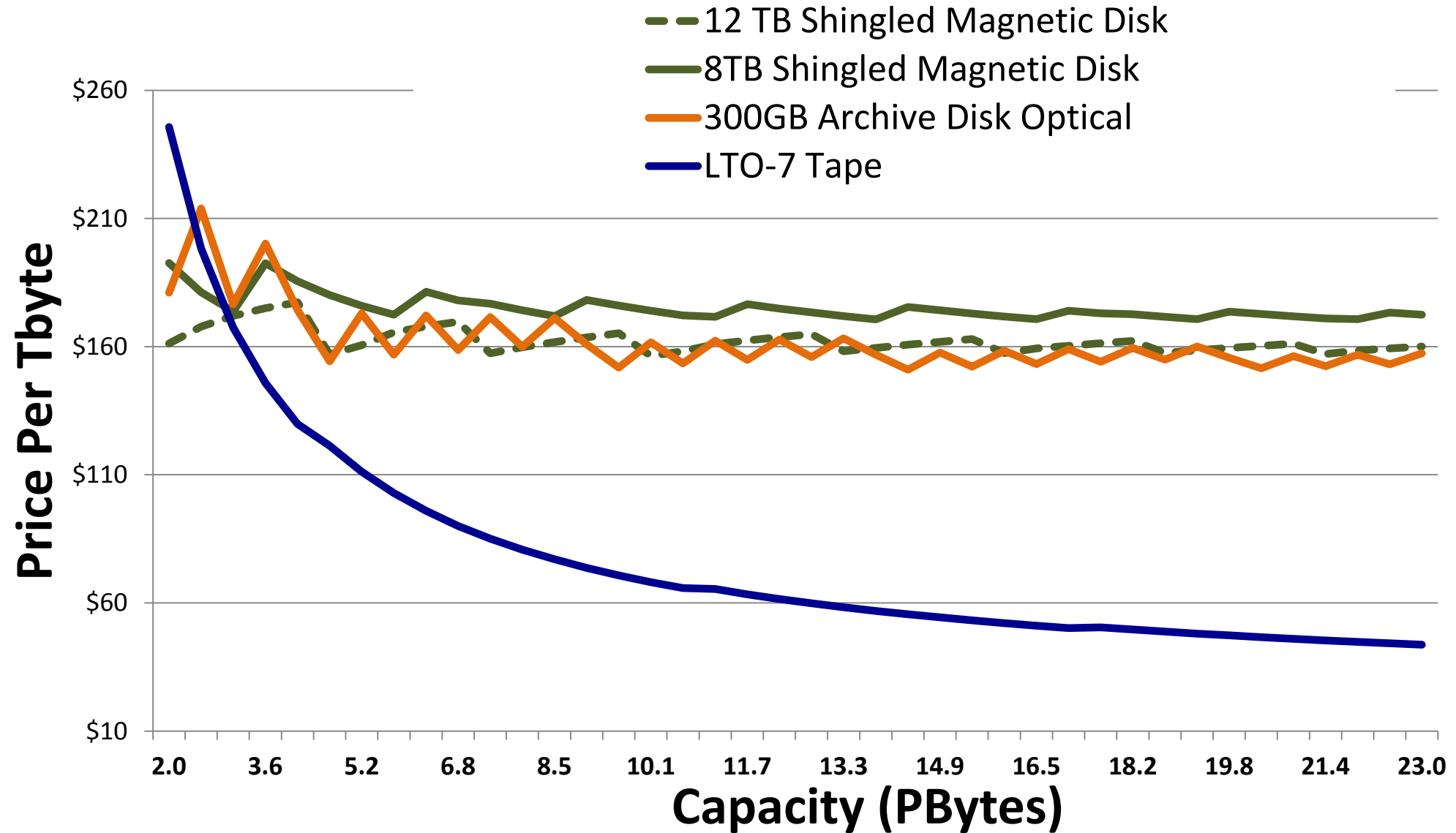


Spectra Continues to Develop the World's Largest Capacity Tape Libraries



- Tape Is A Growth Market For Spectra
 - Continued library innovation and commitment to R&D
 - Increasing reliability and performance
 - Significant new product in 2016

2017 Robotic Tape/Optical & Disk At List Price



What is Needed is a Way Make These Technologies Useful...

- Allow customers to seamlessly use Disk, Flash, Tape and possibly in the future, Archive Disk (optical)
- Enable Digital Preservation including Geographic Dispersion, Genetic Diversity, Accuracy Of Replication
- Lower the cost of storage, such that multiple copies can be created on different media or cloud storage
- Dramatically reduce the cost of developing tape storage applications. Ease application development by use of cloud and web methods
- Support our partner infrastructure across multiple industry segments

Independent Software Vendor Partners



marquis



DEEP STORAGE EXPERTS

The diagram illustrates the Black Pearl architecture. On the left, a blue box labeled "Spectra S3 Enabled Applications" points via an orange arrow to a central Spectra storage unit. From this unit, two orange arrows branch out: one points to a rack of tape drives labeled "LTFS" (Linear Tape File System), and the other points to a server rack connected to a cloud icon. A blue disc icon is also shown near the cloud. The text "†TBD" is located at the bottom right of the diagram.

Black Pearl

- Data Flow – Single Copy to Tape
- Data Flow – One Copy Disk and One Copy Tape
- Data Flow – Replication with two copies
- All media is written in LTFS Open Format
- Tape media migration is seamless[†]
- Future data migration to new technologies is equally seamless[†]

†TBD

- SPECTRA** **DEEP STORAGE EXPERTS**



BlackPearl User Implementation Examples

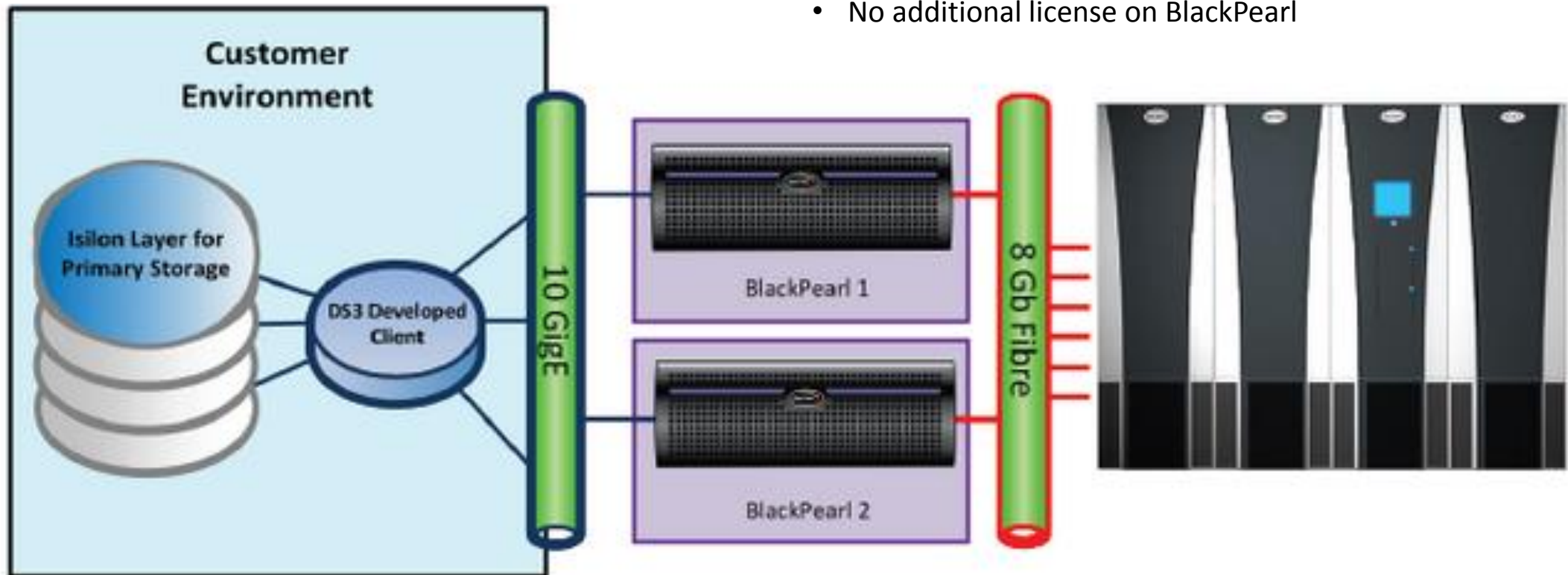
Premiere Digital Services

Challenges:

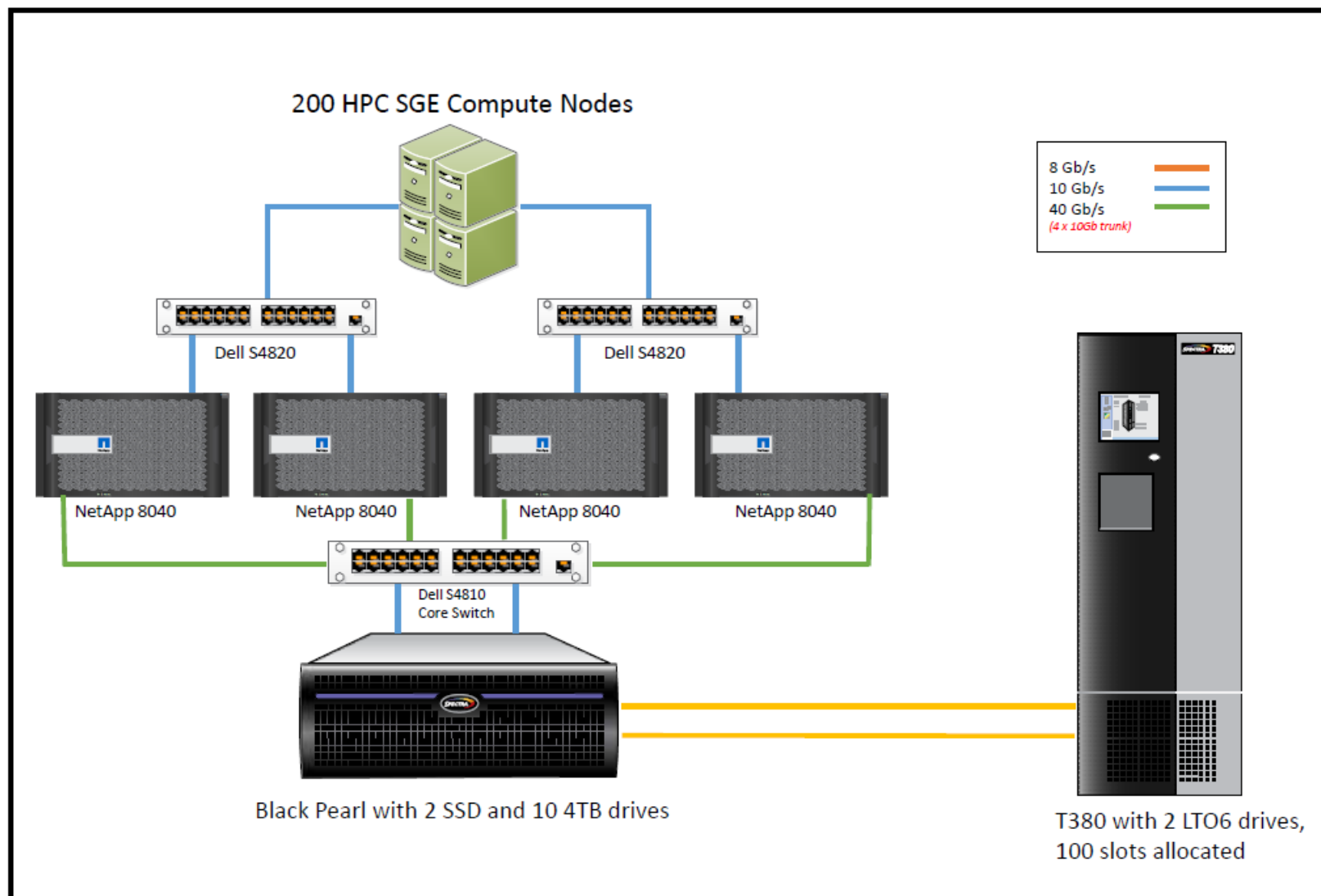
- All assets on expensive disk storage
 - Unmanageable cost structure
- No archive in place to protect assets long term

Solution:

- Two BlackPearl gateways & T950 Library
- 8 LTO6 drives
- 8PB capacity of tape library slots licensed
 - No additional license on BlackPearl



Pacific Biosciences Overview - Detailed

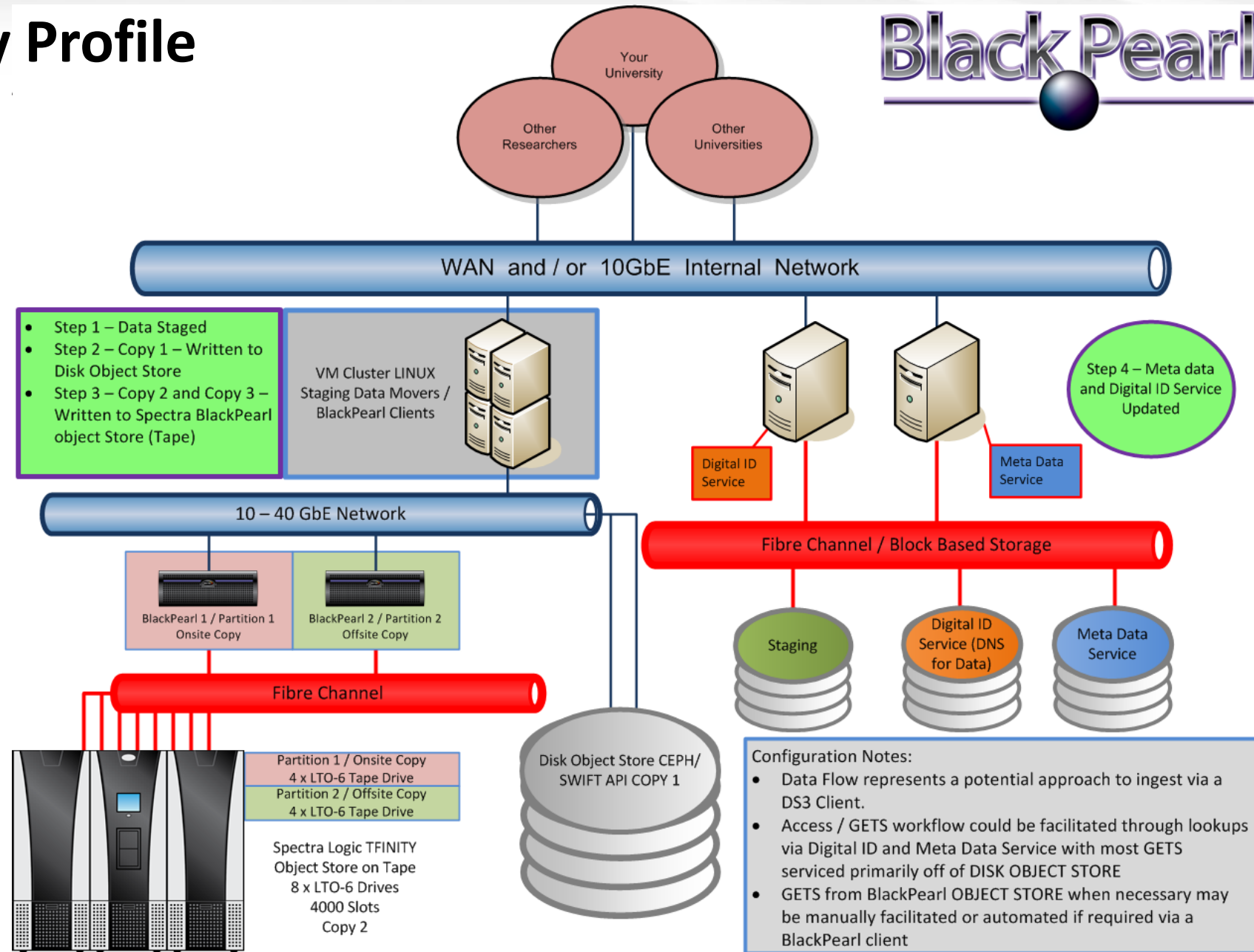


Research University Profile



Challenge:

- Build a large repository of genomic data
- Protect the massive Disk Object Storage systems data
- With a second and third offsite copy



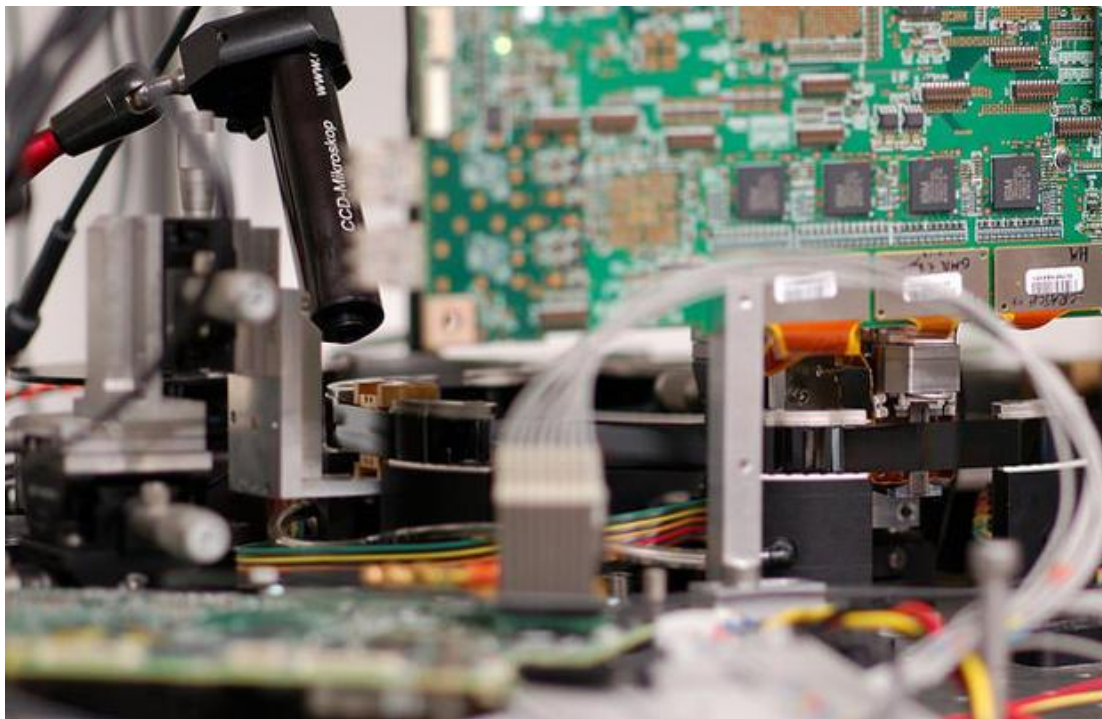


What We Are Excited About

IBM and Fujifilm 220TB tape demonstration

DEEP STORAGE EXPERTS

IBM & Fujifilm



IBM's Tale of the Tape

More than 60 years of tape innovation



	2006	2010	2014	2015
Aerial Density (bits per sq inch)	6.67 Billion	29.5 Billion	85.9 Billion	123 Billion
Cartridge Capacity	8 Terabytes	35 Terabytes	154 Terabytes	220 Terabytes
Number of Books Stored	8 Million	35 Million	154 Million	220 Million
Track Width (micrometers)	1.5	0.45	0.177	0.140
Linear Density (bits per inch)	400'000	518'000	600'000	680'000
Tape Material	Barium Ferrite	Barium Ferrite	Barium Ferrite	Barium Ferrite
Tape Thickness (micrometers)	6.1	5.9	4.3	4.3
Tape Length (meters)	890	917	1255	1255

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<http://www.zurich.ibm.com/news/10storage.html>
<http://www.cs.fsu.edu/~nkrishna/ibm/ibm10storage.html>
<http://www-02.ibm.com/press/us/2015/05/20150504>





What We Want To Avoid



Women, men, and children were tortured or killed by religion of the dark ages.
Maria van Beckum, en Urfel, haers Broeders Wif. 1544.





**Spectra Storage Forecast White Paper
will be published in October 2015**

**Spectra created book "Society's Genome"
will be published in early 2016**

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