

IBM Tape Portfolio Overview

Client Presentation

IBM's data retention infrastructure

Shawn Brume
Hypergrowth Storage Offering Manager
Shawn.Brume@ibm.com

Roger Didio
Worldwide Sales Enablement Leader, IBM Storage
rjdidio@us.ibm.com

Agenda

- Why tape
- History
- Physical tape
- Tape software defined storage
- Virtual tape

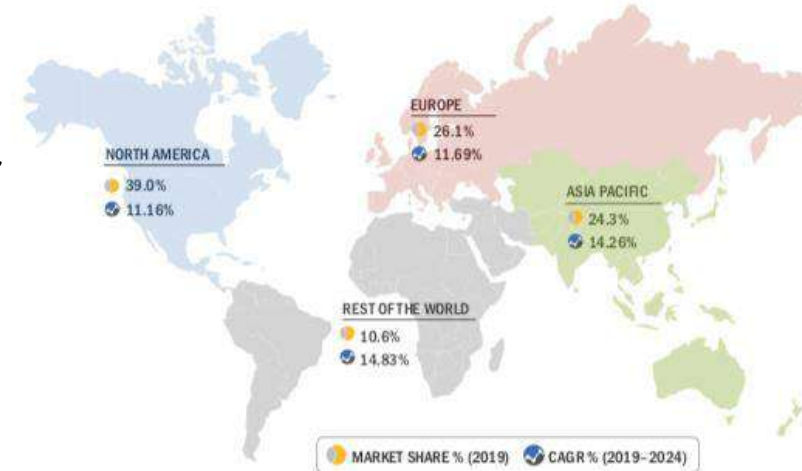
How is the data universe growing?

- Stored data growing at an average of 16.5%
 - 21% faster than the global storage growth
- Over 7ZB of long-term data storage by 2024
- File and object store growing 60% faster than structured data
- North America will continue to be the global leader in total stored data
- Data growth is on everyone's mind

NEXT-GENERATION DATA STORAGE MARKET, BY STORAGE ARCHITECTURE

Storage Architecture	2016	2017	2018	2019	2020	2022	2024	CAGR (2019-2024)
File & Object-Based Storage	31.12	34.49	38.44	42.99	48.46	62.49	81.79	13.73%
Block Storage	11.39	12.09	12.81	13.80	14.92	17.50	20.45	8.19%
Total	42.51	46.58	51.25	56.79	63.37	79.99	102.23	12.48%

Region Market Share and CAGR, 2016–2024



What tape does best

Long term storage: Infrequently accessed data

Multiple copies: Near-line and offline data

Protection: Security and compliance

Cost Reduction: Reduce space and power consumption

Archive: Often only refreshed once a decade

Cloud: Scalability and TCO benefits

Tiered Storage: Data / Cost optimization for inactive data

Defensibility: Unaffected by viral attacks



Agenda

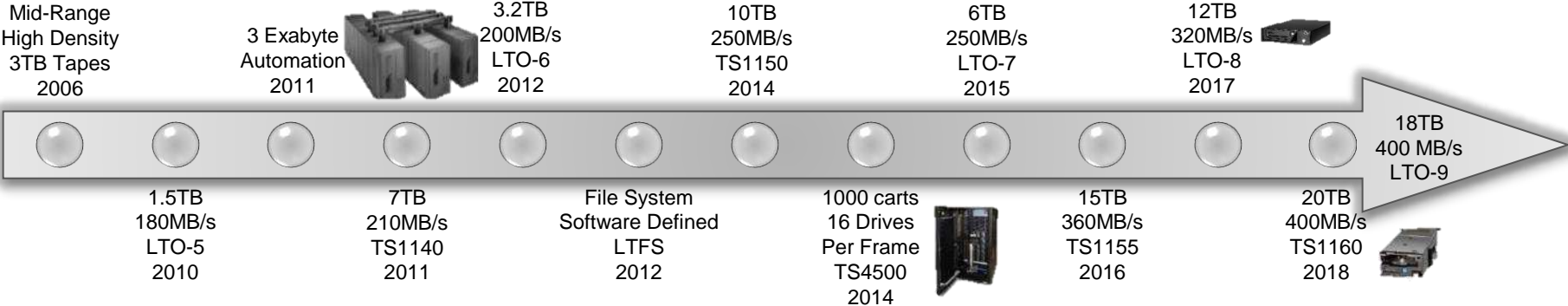
- Physical Tape
- Tape Software Defined Storage
- Virtual Tape

IBM tape – performance priced storage



- **#1** in market share*, **17** years running
- **11- Nines** of durability**
- Files System Enabled
- Industry Standardized Strong Encryption
- **5 Generations** Forward Demonstrated
- Commitment - ~7% R&D to Revenue Investment
- Investment protection for over 60 years

51%
market share

4X
market share
of nearest competitor



IBM available tape drives

<p>TS1100/3592</p> <p>Enterprise Open Tape Format</p> 	<p>TS1140</p> <p>4 TB 250 MB/s Downward R/W* compatible WORM and Encryption LTFS</p>	<p>TS1150</p> <p>10 TB 360 MB/s Downward R/W* compatible WORM and Encryption LTFS</p>	<p>TS1160</p> <p>20 TB 400 MB/s Downward R/W* compatible WORM and Encryption LTFS</p>
<p>LTO Tape</p> <p>Industry Interoperable Tape Format</p> 	<p>LTO-7</p> <p>6 TB Up to 300 MB/s Downward R/W* compatible WORM and Encryption LTFS</p>	<p>LTO-8</p> <p>12 TB Up to 360 MB/s Downward R/W* compatible WORM and Encryption LTFS</p>	<p>LTO-9</p> <p>18 TB Up to 400 MB/s Downward R/W* compatible WORM and Encryption LTFS</p>

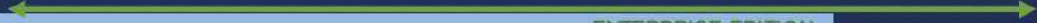
*LTO-8 and LTO-9 are downward read and write compatible 1 generation only

The physical tape portfolio

TS1160 Tape Drive
Up to 400 MB/s uncompressed Data Rate
20TB uncompressed Cartridge Capacity
Media Capacity Uplift
Enterprise Open Data Format



Spectrum Archive SDS



STAND ALONE

LIBRARY EDITION

ENTERPRISE EDITION

**Desktop
TS2280
"Bridge Box"**



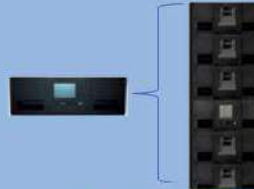
Stand Alone Drive
Single Cartridge
AC Power

**Desktop/Rack
TS2900**



Single Drive
Orchestrated Media Changer
Up to 162TB

**Rack mount
TS4300**



Up to 21 drives
Up to 30.24 TB per Hour
3U Modular Expansion
Orchestrated Media Changer
Up to 5.04 PB

**Enterprise Automation
TS4500**



Up to 128 Drives
up to 184TB per hour
Intelligent Media Changer
Up to 417 PB



LTO-9 Tape Drives
Up to 400 MB/s uncompressed Data Rate
18TB uncompressed Cartridge Capacity
Industry interoperable format

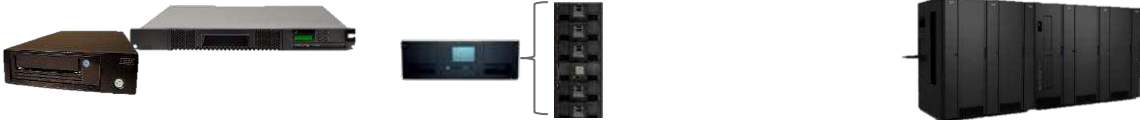
IBM tape - when to consider LTO

- Need interoperability with other organizations
 - Media exchange
 - Single cartridge price is important
- Flexible infrastructure internally
 - Small, medium and large facilities and needs
 - Independent infrastructure globally requires interoperability
- Common infrastructure between multiple vendors

IBM LTO-9 tape drives



	LTO-9 Half High	LTO-9 Full High
Native Capacity	18 TB	18 TB
Native Data Rate	250* MB/s	400 MB/s
Compression	2.5:1	2.5:1
Downward Compatibility	R/W LTO-8	R/W LTO-8
Interface	12Gb SAS or 8Gb Fibre Channel	12Gb SAS (reintroduced) or 8Gb Fibre Channel
Load/Thread Reliability	100,000	100,000
Encryption	AES-256	AES-256
WORM	Yes - Physical	Yes - Physical
Partitioning	Yes	Yes
LTFS	Yes	Yes



The LTO tape portfolio



Spectrum Archive SDS



STAND ALONE

LIBRARY EDITION

ENTERPRISE EDITION

**Desktop
TS2280**
"Bridge Box"



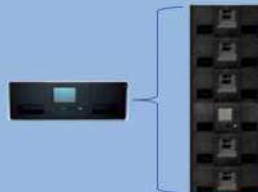
Stand Alone Drive
Single Cartridge
AC Power

**Desktop/Rack
TS2900**



Single Drive
Orchestrated Media Changer
Up to 162TB

**Rack mount
TS4300**



Up to 21 drives
Up to 30.24 TB per Hour
3U Modular Expansion
Orchestrated Media Changer
Up to 5.04 PB

**Enterprise Automation
TS4500**



Up to 128 Drives
up to 184TB per hour
Intelligent Media Changer
Up to 417 PB



LTO-9 Tape Drives

Up to 400 MB/s uncompressed Data Rate
18TB uncompressed Cartridge Capacity
Industry interoperable format

LTO Tape
Industry Interoperable Tape Format

LTO-7
6 TB
Up to 300 MB/s
Downward R/W* compatible
WORM and Encryption
LTFS

LTO-8
12 TB
Up to 360 MB/s
Downward R/W* compatible
WORM and Encryption
LTFS

LTO-9
18 TB
Up to 400 MB/s
Downward R/W* compatible
WORM and Encryption
LTFS

IBM tape - when to consider TS1100

- TCO is critical
- Enterprise critical data
- Maximum performance
- Floor space is limited
- Secure infrastructure required
- Integration with IBM Z storage
- Standardized infrastructure

The TS1100 tape portfolio

TS1160 Tape Drive
Up to 400 MB/s uncompressed Data Rate
20TB uncompressed Cartridge Capacity
Media Capacity Uplift
Enterprise Open Data Format



Spectrum Archive SDS

ENTERPRISE EDITION

TS1140	TS1150	TS1160
<p>4TB 250 MB/s 2.5:1 Compression</p> <p>Fibre Channel Host interface Downward R/W* compatible JC Media Support JB Media Support WORM Encryption LTFS</p>	<p>10TB 360 MB/s 2.5:1 Compression</p> <p>Fibre Channel Host interface Downward R/W* compatible JD Media Support JC Media Support WORM Encryption LTFS</p>	<p>20TB 400 MB/s 2.5:1 Compression</p> <p>Fibre Channel Host interface ROCE Host interface SAS Host interface Downward R/W* compatible JD Media Support JC Media Support WORM Encryption LTFS</p>

**Enterprise Automation
 TS4500**



Up to 128 Drives
 up to 184TB per hour
 Intelligent Media Changer
 Up to 351 PB

3592 cartridge media – higher capacity on same media

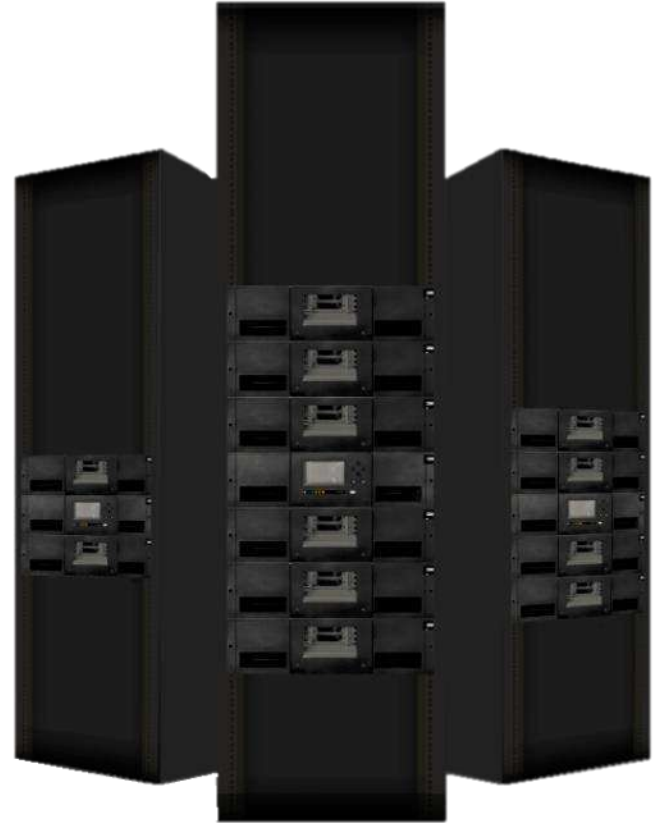
Native performance

Drive marketing Name >> Models Name		TS1160 drive 3592 60F(FC), 60E (eth), 60S (SAS)		TS1155 drive 3592 55F(FC) 3592 55E (eth)		TS1150 drive 3592 E08(FC)		TS1140 drive 3592 E07 (FC)	
Tape Cartridge Name	Format	Capacity	Data Rate	Capacity	Data Rate	Capacity	Data Rate	Capacity	Data Rate
JE (data) JV(WORM)	JE J6 20TB	20 TB	Up to 400 MBps						
JM (short JE)	JE J6 20TB	5 TB	Up to 400 MBps						
JD (Data) JZ (WORM)	JD J5A 15TB	15 TB	Up to 360 MBps	15 TB	Up to 360 MBps				
JL (short JD)	JD J5A 15TB	3 TB	Up to 360 MBps	3 TB	Up to 360 MBps				
JD (Data) JZ (WORM)	JD J5 10TB	10 TB	Up to 360 MBps	10 TB	Up to 360 MBps	10 TB	Up to 360 MBps		
JL (short JD)	JD J5 10TB	2 TB	Up to 360 MBps	2 TB	Up to 360 MBps	2 TB	Up to 360 MBps		
JC (Data) JY (WORM)	JC J5 7TB	7 TB	Up to 300 MBps	7 TB	Up to 300 MBps	7 TB	Up to 300 MBps		
JK (short JC)	JC J5 7TB	900 GB	Up to 300 MBps	900 GB	Up to 300 MBps	900 GB	Up to 300 MBps		
JC (Data) JY (WORM)	JC J4 4TB	4 TB (R/O)	Up to 250 MBps	4 TB (R/O)	Up to 250 MBps	4 TB	Up to 250 MBps	4 TB	Up to 250 MBps
JK (short JC)	JC J4 4TB	500 GB (R/O)	Up to 250 MBps	500 GB (R/O)	Up to 250 MBps	500 GB	Up to 250 MBps	500 GB	Up to 250 MBps

TS4300 tape library – modular expandability

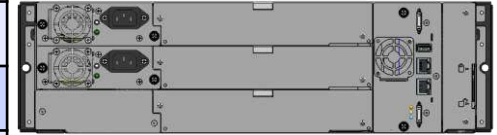
Modular Automation

- Up to **5.04 PB** native capacity
- Up to **30.24 TB** per hour data rate
- **40 to 280** LTO storage slots
- Up to 35 I/O slots
- Up to **21 LTO** 9, 8, 7 & 6 hot-swappable tape drives
 - Combination of HH & FH drives
- Access Modes:
 - Support for random and sequential modes



IBM TS4300 - modular flexibility

	Per Base Module (One 3U)	Per Expansion (up to Six 3U)
Cartridge count	40	40
Capacity	720 TB	720 TB
I/O slots	Zero or 5	Zero or 5
Drive profile combinations	HH(3) or FH(1) HH(1) and FH(1)	HH(3) or FH(1) HH(1) and FH(1)
Drive generations	LTO-9,8,7,6	LTO-9,8,7,6
Drive interface	SAS or Fibre Channel	SAS or Fibre Channel
USB and ethernet 10/100/1000	Yes	No
Power supply (s)	Yes*	Optional*
Encryption	AES-256	AES-256
Rack mount	Optional	Required



* Additional power supply for continuity and when drives located in expansion

IBM TS4500 high density (HD) tape automation

Benefits

- Reduced floor space requirements and energy consumption
 - High density library and drive frames (HD2)
 - 10U “top rack” option
- Reduced operator training and management time with simplified GUI
 - Integrated management with built in LDAP, and analytic tools
 - Improved library management with control system that integrates built-in and external tools
- Scalability with support for up to 18 frames and 128 drives
- Improved availability and performance with dual active accessors



TS4500 specifications overview

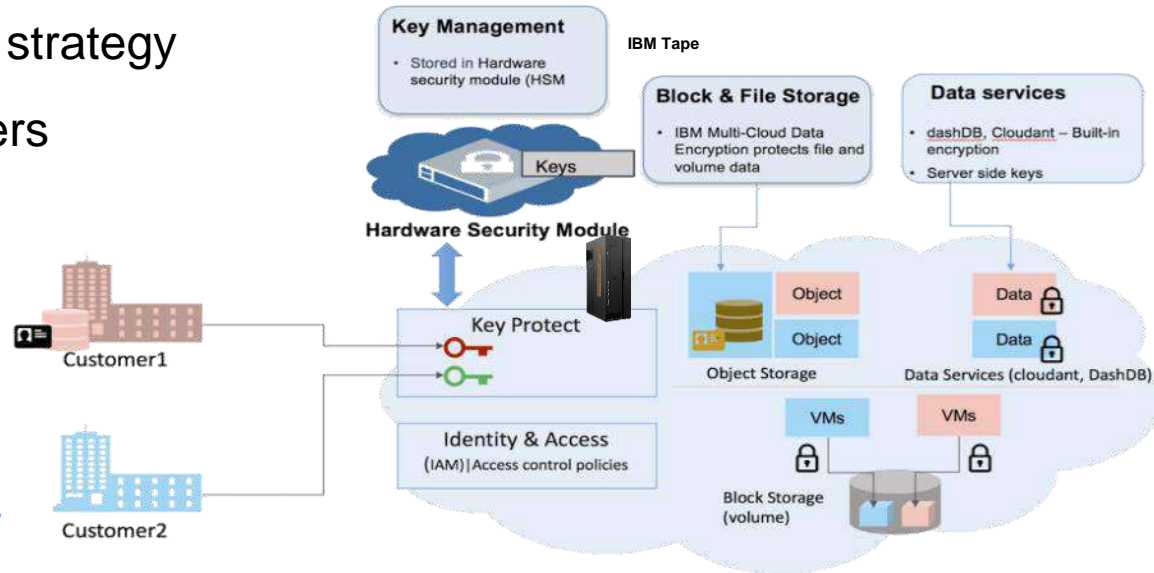
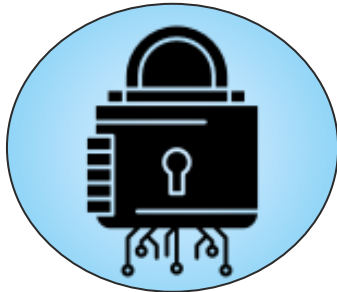
Feature	TS1100/3592	TS10x0/LTO
Base frames	1	
Expansion frames	Up to 17	
Tape drives	Up to 128	
Data Rate per hour	Up to 184.3	Up to 184.3
Supported tape drives*	TS1150, TS1160	LTO-9,8,7
Supported Media	SAS, ROCE or Fibre Channel	SAS or Fibre Channel
Storage slot configuration	Up to 17,550	Up to 23,170
Native maximum capacity	Up to 351 PB	Up to 417 PB
Native compressed capacity	Up to 1.05 Exabytes**	Up to 1.04 Exabytes
I/O Stations	2 min, 8 max	
I/O Slots	Up to 128	Up to 144
High Availability robots	Up to 2	
Distributed systems attach	AIX®, IBM I®, MS Windows®, Linux®, Unix®	
Storage for IBM Z attach	Via TS7700	

* Only currently marketed drives listed.

**3:1 compression

IBM tape – leading encryption solutions

- First to market with hardware-based encryption
- Over 14 years leadership in tape and encryption key management
- Encryption – solutions for secure infrastructure
- Part of broad infrastructure strategy
- Inevitable for most customers

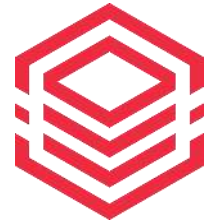
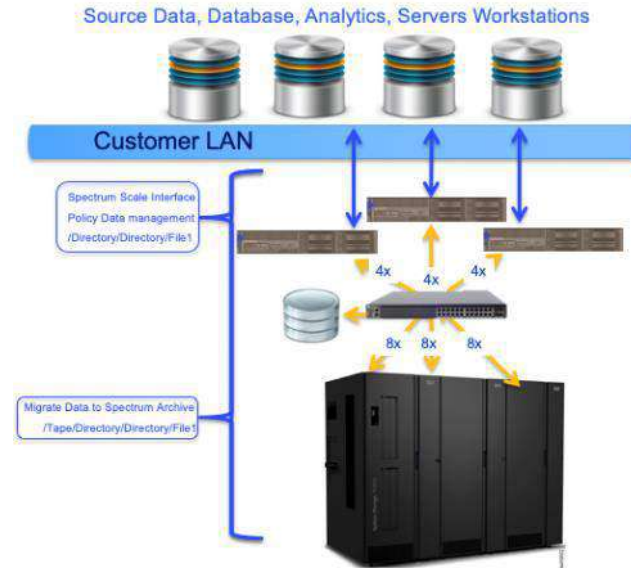


Agenda

- Tape Software Defined Storage
- Virtual Tape

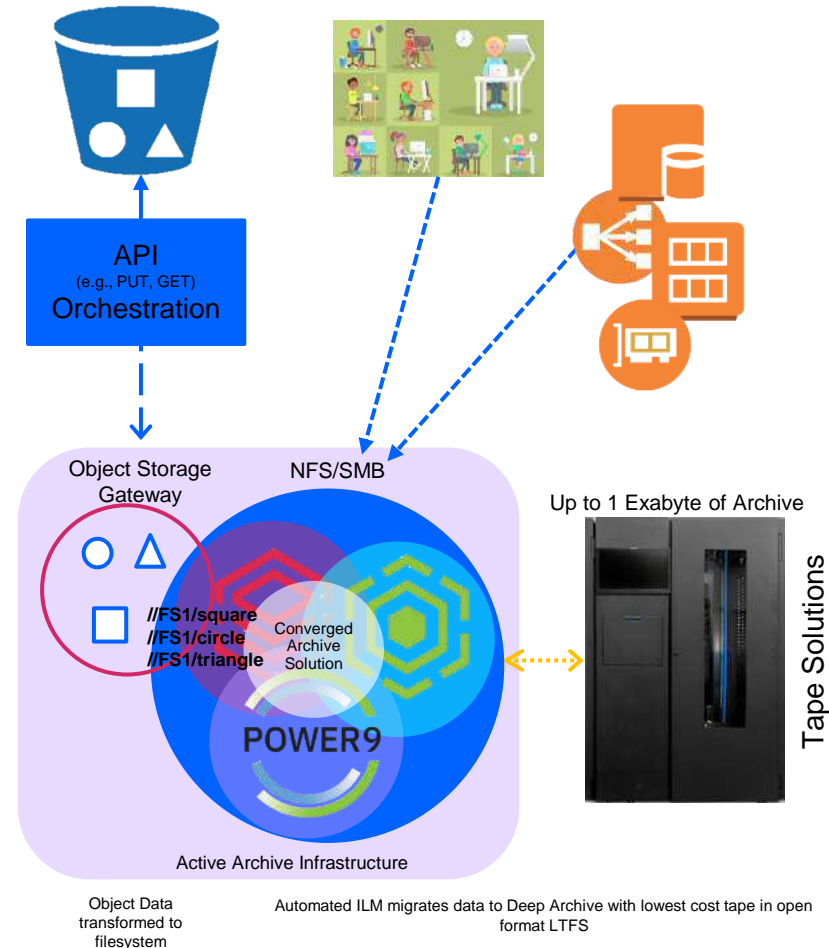
IBM Spectrum Archive – Tape SDS

- Graphical user interface
- IBM Spectrum Scale™ and ESS integration
- Creation of operational storage tiers
- Policy-based migration
- Flexible data sharing
- Easy data access
- Data storage efficiencies
- Application interface utilization
- LTFS format
- Simple access
- Easy data access
- Improve efficiency



An active archive for the rest of us

- NAS storage continues to grow
- Object Storage out of control
- Silos of data include Analytics
- Embrace the economics of scale
 - Start with data archiving
 - Migrate to unified data store
 - Shift analytics for performance



Agenda

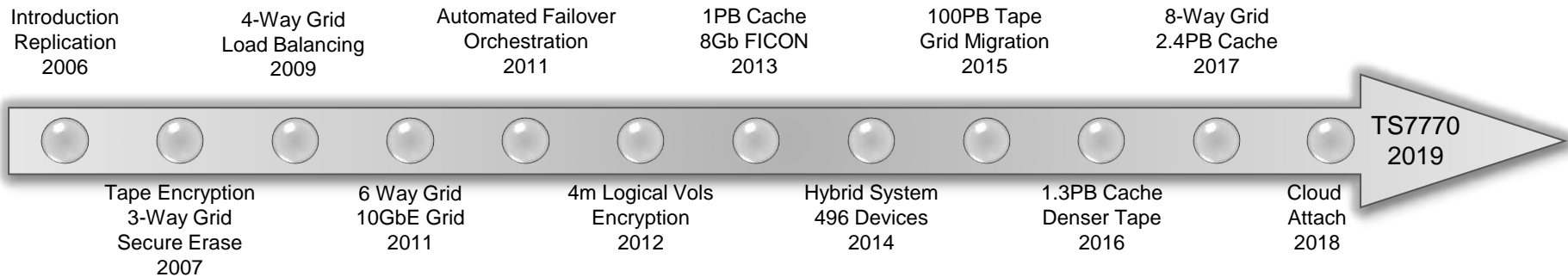
- Virtual Tape

TS7700 – Z data protection made easy

- **#1** in market share, **13** years running
- **99.9996%** availability
- Hybrid reduces TCO by up to 75%
- Industry standard strong encryption
- Near **99.9999%** data durability
- Commitment – 7% R&D to revenue investment
- Investment protection –flexible growth with hybrid tape & cloud

~70% +
enterprise market share

1st
with on-prem Cloud
based resiliency



What is the IBM TS7700?

The IBM TS7700 family is virtual tape storage for IBM Z data with interconnection for up to 8 geographically placed systems called “clusters” in a redundant network configuration called a *Grid*, which provides enhanced data availability and simplified business continuance.

The TS7700 and its Grid architecture is unique, offering automated (hands-off) failover, replication, and automated hierarchical storage management.

Note: throughout this presentation, when “TS7700” is used, it implies the model used can be a TS7770 virtual tape server

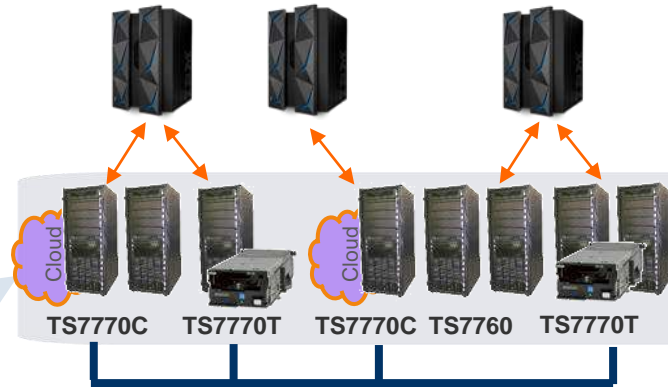
IBM TS7700 IBM Z Virtual Tape

Leveraging Grid as Cloud Tape Storage for IBM Z

Grid Cloud

8-way consisting of any generation of TS7700

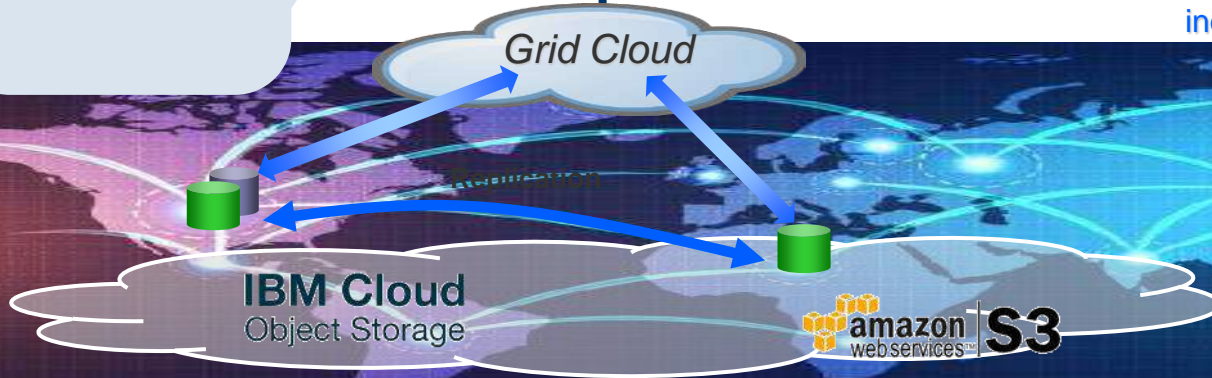
- Synchronous and asynchronous replication
- AES256 Encryption
- Tight integration with IBM Z and DFSMS policy managed
- Optional Transparent Cloud Tiering
- Optional integration with physical tape



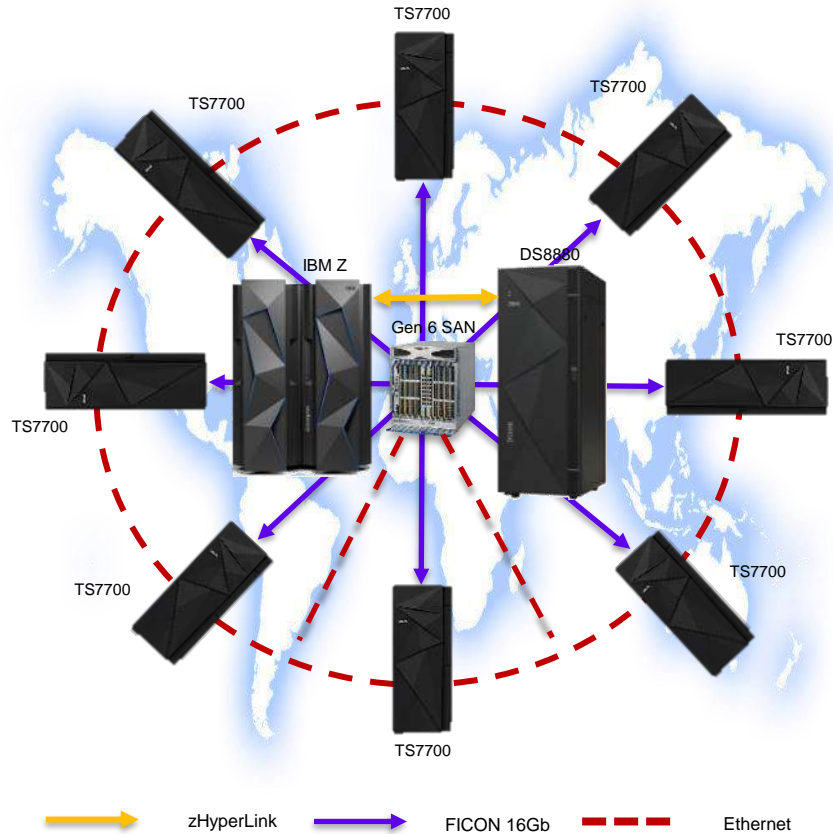
Cumulative 16Gb FICON throughput up to 4.8GB/s * 8

IBM Z hosts view up to 496 * 8 equivalent devices

Grid access to all data independent of where it exists



TS7700 Synergy with z/OS Software



z/OS Synergy

- No additional z/OS software required
- Integrated with DFSMS support
- Full access to IBM proprietary tape library commands
- Full DFSMS volume granular policy management
- Dynamic policy updates
- CUIR automated device online/offline processing
- IBM Z intelligent, allowing efficiencies such as zero RPO synchronous copy speeds
- User commands (i.e. LI REQ) and tools support
- Can partition with z/VM, z/VSE, z/TPF
- End to end FICON CRC protection
- Replication, Logical WORM, Cloud, Physical Tape and many other features

IBM TS7770 Overview

- Agile Deployment
 - Access-centric applications (image data, report servers, critical backups, HSM ML2)
 - Cost-efficient applications (HSM, general backups, master-in, master-out, GDGs, archive)
- Over 3.9* PB Disk Cache Per System
 - Over 19 PB with 5:1 compression
- Up to 100PB Tape/Cloud Attach Support
 - 300 PB with 3:1 compression
 - TS1150, TS1140, TS1130 tape drives
 - TS4500 and TS3500 libraries
- Data Protected at All Levels
 - No performance impact
 - AES 256Bit Strong Encryption
- Dynamic Disk Pools
 - Distributed RAID
- 8-Way Grid Cloud Replication



TS7700 Data Resiliency

TS7700 disk encryption (zero performance impact)

- Internal key AES 256-bit encryption
- All R3.0+ and later CS9/CC9/CSA hardware is encryption ready
- Retroactive enablement in the field



External key AES 256-bit encryption

- All R3.0+ CS9/CC9/CSA hardware is encryption ready
- TKLM/ISKLM compatible at cluster granularity (excluding z/OS ISKLM)
- Retroactive enablement in the field for all CSA, CS9 and CC9 configurations
- Concurrent update from internal to external key management
- MI initiated key rotation supported

Ts1100 physical tape encryption


- Physical tape behind a TS7700 can be fully encrypted
- All encryption occurs at tape pool granularity allowing each pool of tapes to either enable/disable encryption & use unique keys when encryption is enabled
- All managed through policy management
- External key management through TKLM/ISKLM
- AES 256-bit



IBM Tape Storage Portfolio

Modern Data Protection & Cyber Resiliency

Storage for Z

Single Drive Edition	Library Edition	Enterprise Edition
		
Entry	Midrange	Enterprise
 TS2280 Bridge Box	 TS4300 Rack Mount	 TS4500
 7226 Multimedia Storage Enclosure	 TS4300 Expandable to 7 modules	 TS4500 Expandable to 18 frames
	 TS2900 Desktop/Rack Media Loader	 TS1160 / TS1150* Tape Drives
	 3592 Media *	
LTO	 LTO 8, 7, 6 HH Tape Drives	 LTO 8, 7, 6 FH Tape Drives
		 LTO Media

Enterprise Virtual Library


TS7770


TS7770
 Rack mounted

* Also supporting TS7700 environments

Tape offering management contacts

Carlos Sandoval, Global Physical Tape Offering Manager Ccarlossc@mx.ibm.com

Ricardo Clemente, Global Spectrum Archive Offering Manager ricardo.clemente@ibm.com

Jean-Pierre Lavigne, Global TS7700 Offering Manager jlavigne@us.ibm.com

Parker Wall, TS7700 Offering Manager parkerwall@ibm.com

Shawn Brume, Global Hypergrowth Storage Offering Manager shawn.brume@ibm.com

Roger Didio, Worldwide Sales Enablement, IBM Storage rjdidio@us.ibm.com

IBM