

IBM® TS7760 Virtual Tape Library

Enhance data protection and
business continuity for mainframe
environments in the cloud era

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4.x Code Update

Cyber criminal attacks have become increasingly common

“It’s no longer a matter of if, but when ...”

Of the **9 Billion**

records breached since 2013 only

4% were encrypted²



27.7%



Likelihood of an organization having a data breach in the next 24 months ¹

1.9 Billion

Records breached in the first half of 2017²



\$3.62M

Average cost of a data breach in 2017¹

A material data breach is one that involves a minimum of 1,000 lost or stolen records containing personal information about consumers or customers.

¹ Source: 2017 Ponemon Cost of Data Breach Study <https://www-01.ibm.com/common/ssi/cgi-bin/ssialias?htmlfid=SEL03130WWEN&>

² Source: Breach Level Index -- <http://breachlevelindex.com/>

The world's most valuable resource is no longer oil, but data.

Pervasive encryption makes data the new perimeter

It offers a transparent and easily consumable approach to enable extensive encryption of data in-flight and at-rest to substantially simplify & reduce the costs associated with protecting data & achieving compliance mandates



Not only is existing data protected, but new data is also protected throughout its lifecycle

Many compliance standards require data protection. Pervasive encryption helps meet compliance standards like:

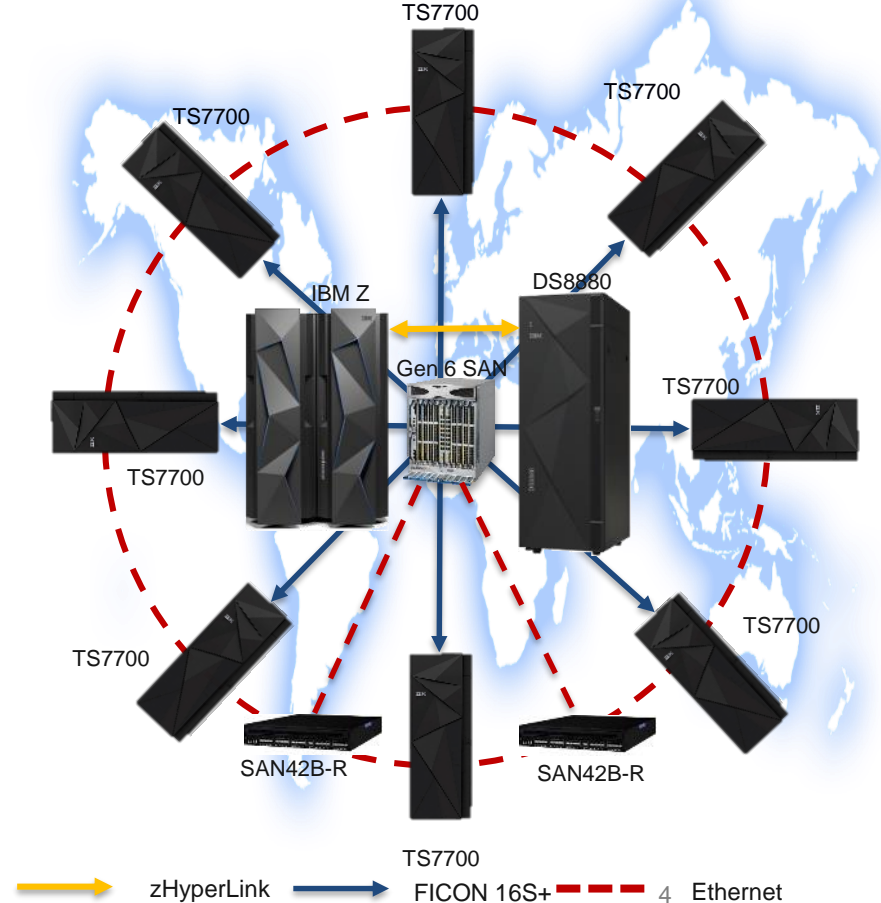
- PCI-DSS
- GDPR
- Others...

IBM Z®, DS8880 and TS7700 have been integrated by design to provide data security capabilities

IBM TS7760 + IBM DS8000: Designed for IBM Z

Improved security, availability and scalability

- Protect all application and database data according to enterprise security policy
- Encryption of data encryption in-flight and at-rest without application changes and no impact to SLAs.
- The best Disaster Recovery solution in the industry with more than “six-nines” availability and unique 2, 3 & 4 site replication with industry-leading RPO and RTO
- Up to eight TS7700 systems provide a flexible grid for high-availability and disaster recovery
- Ensure the availability and security of encrypted data with robust, centralized full-lifecycle encryption key management



Enable your infrastructure for systems of insight with next-generation enterprise storage

Only IBM!



IBM continues to uniquely provide higher value, long before competitors

Extreme performance

Process transactions faster with 4x better performance

Deep integration with z Systems

Accelerate z Systems® performance by offloading data tiering to tape

24/7 availability

Achieve near-zero downtime with advanced business continuity, full redundancy, and 6-way Grid Cloud configurations that automatically switch over

Self-tuning agility

Optimize economics and maximize performance with self-tuning data tiering, automated quality-of-service and easy to use GUI

Advanced security capabilities

Protect information with standard full disk and tape encryption and advanced capabilities to keep sensitive data secure

What is the IBM TS7760?

The IBM TS7700 family is virtual tape storage for z Systems 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 hierarchal storage management.

IBM TS7760 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 2.45 PB Disk Cache Per System
 - Over 12 PB with 5:1 compression
- Up to 100PB Tape 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



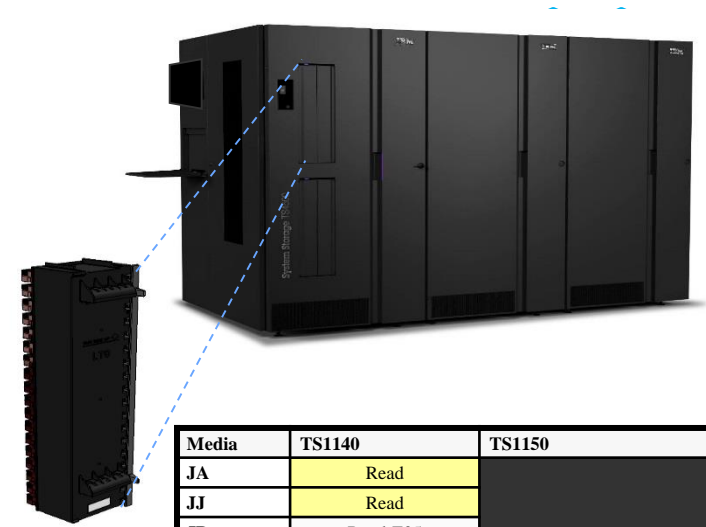
TS7760: Next Generation Controller

- Built with DS8880 Synergy
 - Common Rack, Power hardware, I/O bays and adapters
- Built on New Power8[®] Platform
 - Two 10 core, 3.42GHz processors
- New I/O Bay Interconnect
 - PCIe Gen3 for increased bandwidth performance and HW support
- Integrated Power System
 - 30amp single phase power
- Exclusive Features
 - 4X10GB long wave Ethernet network links for Grid Cloud replication
 - 16Gb FC attachment to disk cache and TS1100 tape drives



TS7760: TS4500 Attachment

- Next Generation Enterprise Automation
 - Dual accessor for high availability
 - Integrated service bay
 - Dynamic partitioning
 - Transparent Capacity on Demand
 - Virtual I/O (VIO)
 - Up to 128 - TS1150 / TS1140
 - Single cartridge support up to 10 TB native
 - 16Gb FC switch support for TS7760T attach
 - 100 PB native usable capacity when attached to TS7760T
- Improved Performance
 - Up to 2.7x the slot density over TS3500 for TS1100
- Improved Management
 - Magazine I/O
 - Native LDAP support
 - Improved ease of use



Media	TS1140	TS1150
JA	Read	
JJ	Read	
JB	Read-E05 1.0TB-E06* 1.6TB-E07	
JC	4TB	4TB-E07* 7TB-E08
JK	500GB	500GB-E07* 900GB-E08
JD		10TB
JL		2TB

Model TS7760 Components (slide 1 of 3)

- The Frame

- Up to 36u of rack space dedicated to TS7760 components
 - A TS7760 system¹
 - One TS7760 cache controller
 - Up to nine TS7760 cache drawers
 - Redundant power supplies for improved availability
 - Two power feeds for improved availability

- The “Cluster”

- High performance IBM Power8 server
 - Two 10-way processor card
 - Over 2 GBps of data throughput
 - Redundant I/O drawers for improved availability
- Performance enablement features
 - Up to 24 additional 100MBps increments (FC5268)
 - First increment is enabled with the server (FC9268)
- Hardware for continuous availability
 - 2x1Gb, 4x1Gb (SW optical or Copper) or 4x10Gb LW Optical Grid Ports
 - Up to 8-way grid configurations



¹ Machine Type 3957 Model VEC

Model TS7760 Components (slide 2 of 3)

- Base frame supports up to 9 additional XSA cache drawers¹
 - Provide high performance Dynamic Disk arrays
 - Maximum base frame capacity over 600 TB (pre-compression)
- Up to two optional expansion frames
 - Each with CSA disk controller and up to 15 model XSA disk expansion modules
 - Maximum capacity of each TS7760 Encryption Capable Expansion frame is over 925 TB
- Each TS7760 cache drawer
 - High performance Dynamic Disk Pool
 - Attaches to the TS7760 cache controller
 - Provides ~ 61 TB of usable cache capacity
 - Includes 8 TB SAS HDDs
 - Supports high availability
 - Dual power
 - Automatic rebuild leveraging reserved capacity
 - Redundant hot-swap components
 - AES 256 bit encryption



¹ Machine Type 3956 Model XSA

Model TS7760 Components (slide 3 of 3)

- TS7760T
 - Physical tape support
 - 16Gb Fibre Channel connectivity
 - Minimum of 4 and a maximum of 16 tape drives
- Flexible cache configuration
 - Balance performance and cost
- Each TS7760T
 - Supports
 - TS1150, TS1140, TS1130 tape drives
 - TS4500 and TS3500 tape libraries
 - Supports high availability
 - Dual power
 - Automatic hot sparing/rebuild
 - Redundant hot-swap components
 - Dual active accessors
 - AES 256 bit encryption



TS7760 value based enhancements

- Up to 60% VTL Cache Throughput
 - Reduced drawer count for the same performance
- Up to 27% faster replication
 - Near 0 downtime
- 2X higher Redundancy in grid connectivity
- Up to 2X higher bandwidth to Physical tape
 - Reduce data retrieval times
- 60% Higher Disk capacity
 - Reduced infrastructure costs
- Up to 68% faster Rebuild times
 - Reduced impact to performance
- Reduce update times by up to 80%
 - Concurrent Disk Firmware updates eliminate impacts to operations

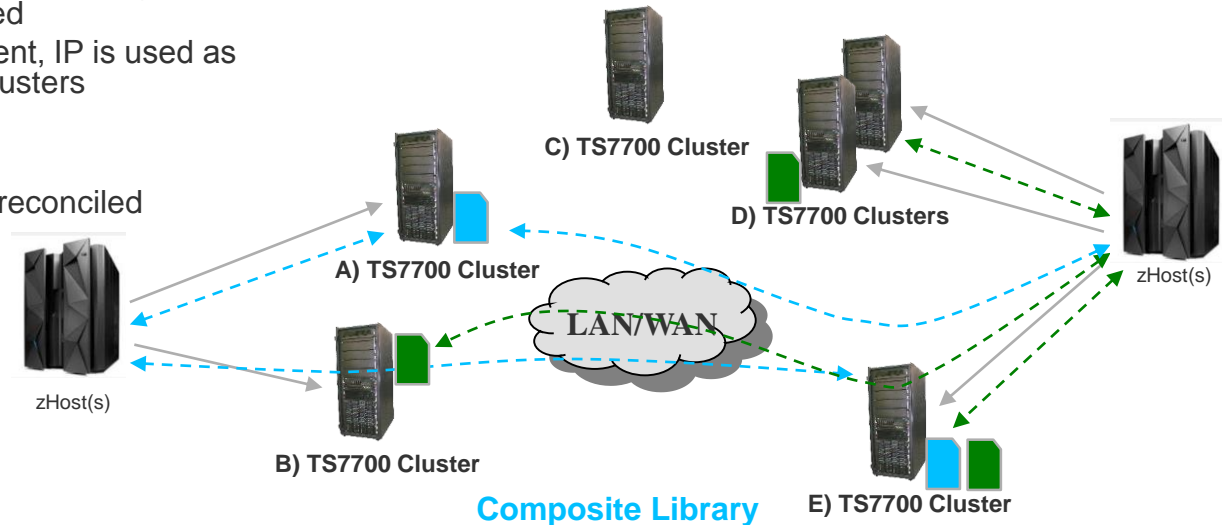


IBM TS7760 Advantages

- Flexible copy consistency points
 - Only VTL solution with functional equivalent to Metro/Global Mirror
 - Only VTL solution with functional equivalent of GDPS Hyperswap built in
 - Tailorable from as granular as a single dataset to as broad as all production data based on RTO/RPO requirement
- Tiered storage solution with multiple media type
 - Data placement based on policy (e.g. archive/retention data placement on physical tape; active data on Disk Cache)
 - Advanced outboard policy management; DFSMS integration to provide SMS constructs' names
 - Provides considerable economic advantage (TCA, TCP, OpEX) by mixing tape media into VTL, with full VTL functionality to the host
- Integration with z/OS host processing
 - Scratch Allocation Assist, Device Allocation Assist, Sync Mode Copy Assist for mount preferencing for performance
 - Workload balancing
 - GDPS integration
 - DFSMS integration for all key functions (media placement, copy consistency, etc); easily modified as needed
 - Integrated “green screen” reporting for a single VTL image
- Resilient DR solution
 - Fully automated failover/failback capabilities
 - Proven out with CAT360 migration
 - Policy based copy consistency point
 - Integration with GDPS automation for “freeze and go” type recovery

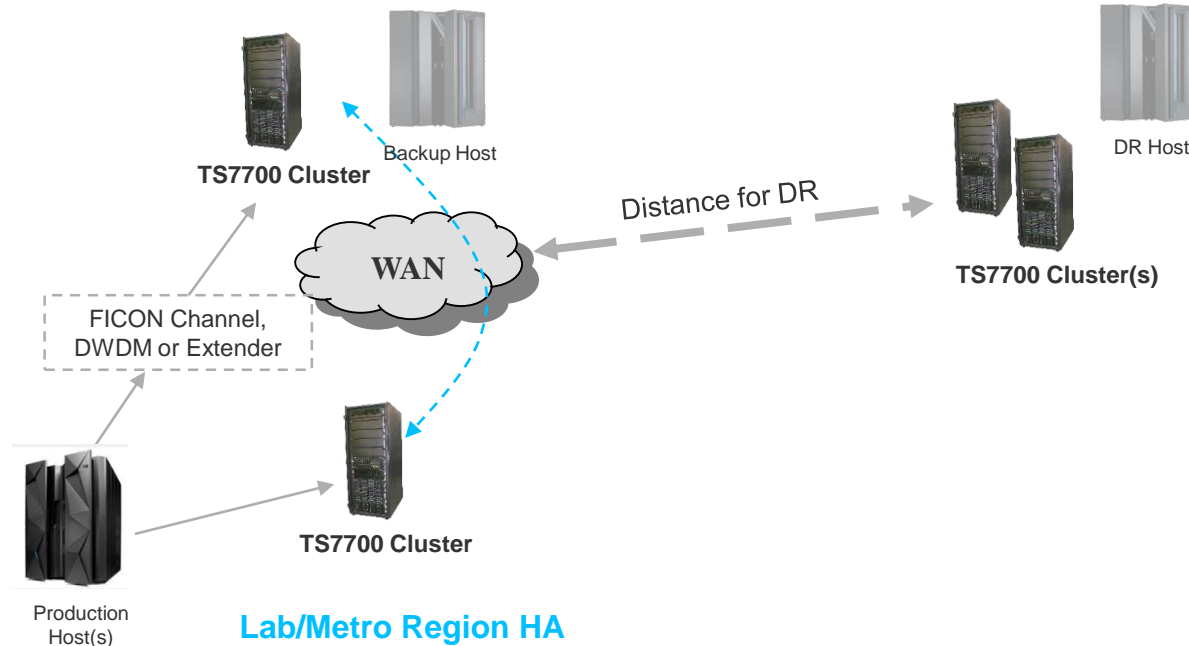
TS7700 Grid Solutions – More than just replication

- All clusters are equal players – Cloud Storage, before it was a popular!
 - No concept of primary, secondary, or standby nodes
 - Each cluster's devices within an entire grid always have access to all volumes
 - System z hosts views the entire grid as one large composite library with up 3968 common devices
 - Volume data is accessible from any cluster's devices independent of where copies exist
 - User intervention or host knowledge of where data exists is not required
 - If a local copy isn't present, IP is used as a channel extender to clusters containing a valid copy
- Post outage
 - All updates are automatically reconciled when clusters return
 - Failback can occur immediately



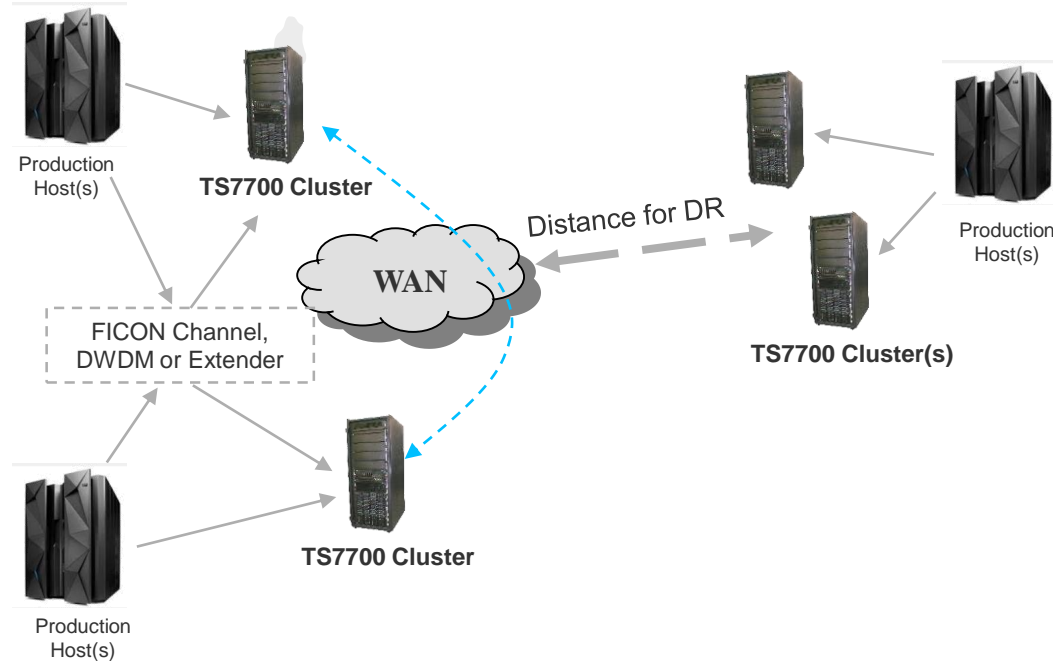
Is distance for DR also a requirement?

- Introduce 3rd distant site for DR
 - In the event the entire production environment is lost, recovery can occur at a remote DR location
 - Once the zSeries environment is recovered, continuing operation is as easy as varying on devices.



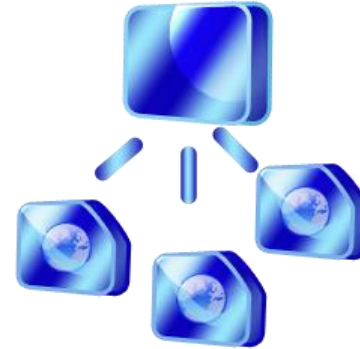
Does each site play a role in production and DR?

- **How about using each site for dual purpose? No problem!**
 - Though a site may be labeled as an HA pair or DR site, the technology views each site as an equal player in a grid. Any site can concurrently play the roll of all of the above by design.
 - Run production to all sites at the same time and use adjacent/remote peers for HA and/or DR.
 - The same volume ranges and scratch pools can even be used at all locations!



TS7700 z/OS Policy Management

- **Integrated DFSMS support**
 - Automatic Class Selection (ACS) Routines
 - Storage construct names assigned to logical volumes
 - Construct names passed to TS7700 during mount request
- **Volume granular policy management**
 - No dependency on Tape Management System pools
- **Dynamic policy updates**
 - Simply redefine the name or rules and a simple mount/demount enforces it
- **Most TS7700 features are policy managed**
 - Volume capacities, media types, replication policies, physical tape pooling, allocation assistance, tier to tape behavior and many others



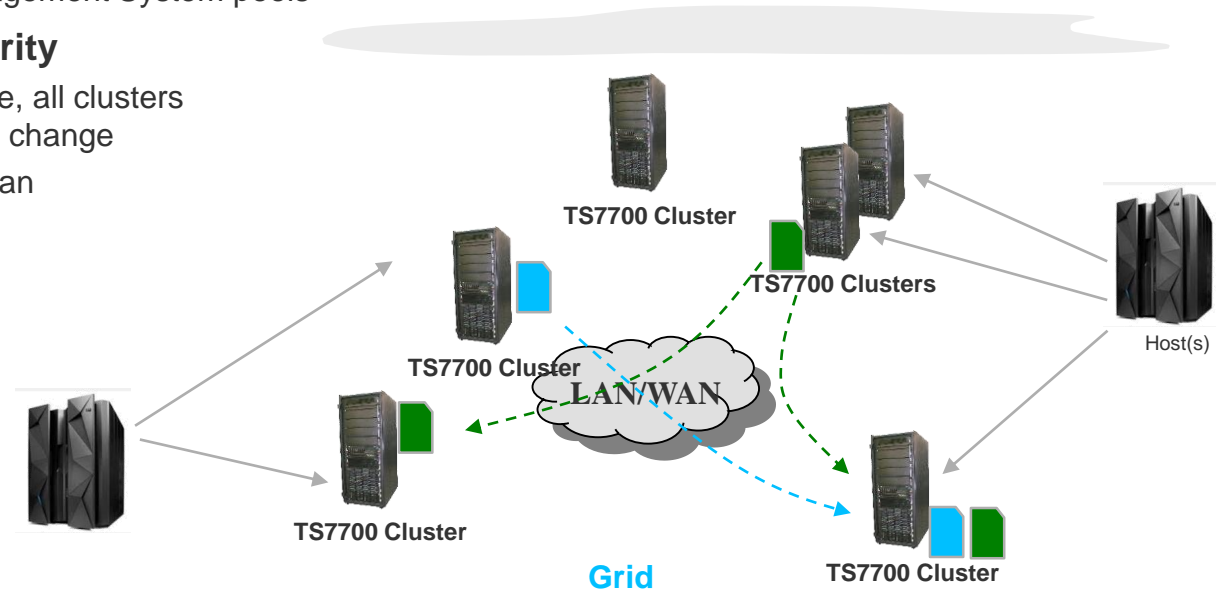
Volume Granular Replication

- **DFSMS policy managed replication**

- Each volume, independent of where it is created, can have one to eight copies within a grid
- Replication can occur synchronously, immediately or asynchronously or any mixture of the three
- Simply use your SMS ACS routines to determine which method is used at volume granularity
- No dependency on Tape Management System pools

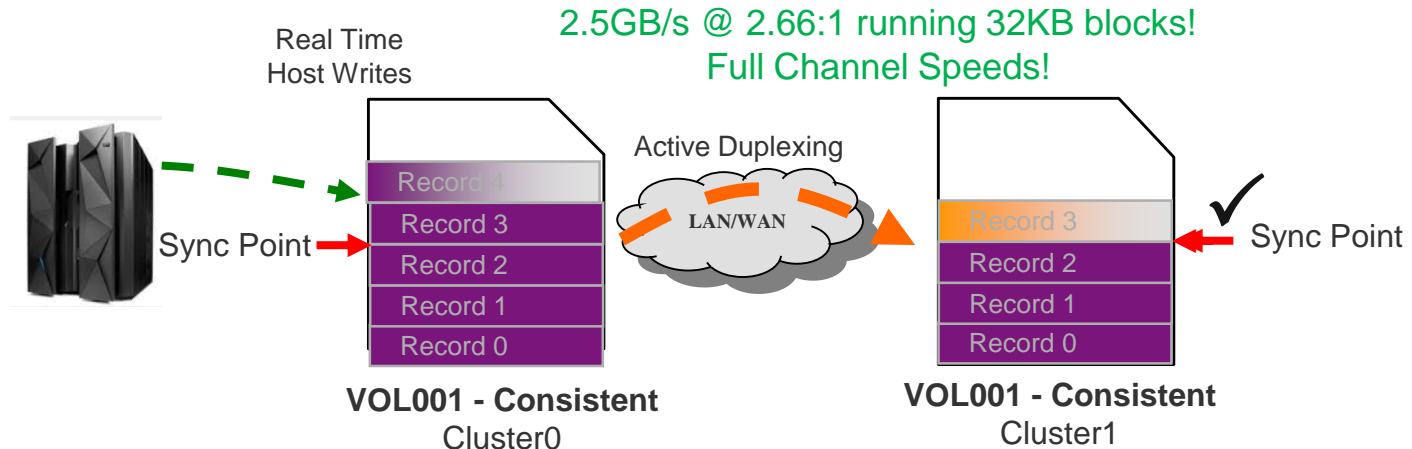
- **Volume granular data integrity**

- Prior to any host write first write, all clusters are made aware of the coming change
- No ambiguity of whether you can trust additional copies after any failover event
- Full audit lists of any inconsistent volumes



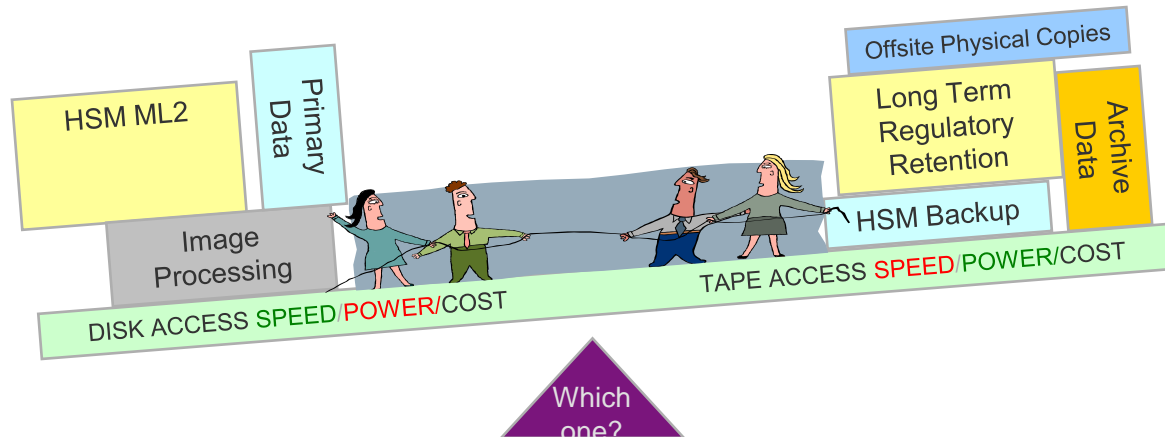
True Sync Mode Copy

- **Volume End Guaranteed/Immediate mode copy does not provide a Zero RPO**
 - Applications which stack datasets to tape such as DFSMSHsm ML2 migrations can remove previously stacked datasets from DASD prior to end of volume processing
 - Content not yet replicated up to that point on tape is exposed to a single datacenter copy on tape
- **TS7700 provides the first Zero RPO synchronous copy method**
 - Up to two sites will be kept consistent after each implicit or explicit tape SYNC operation
 - Provides applications, such as DFSMSHsm, dataset level replication (Zero RPO!)
 - Additional Deferred and/or Immediate copies can occur once RUN is received
 - Eliminates the need to run host duplexing for equivalent RPO



Native Tape, Less Tape or No Tape

- **Not one size fits all**
 - Disk only solutions are optimal for primary data applications or applications which need fast access times
 - Solutions tightly integrated with physical tape are best for archive and backup data
 - Total cost of ownership also factors into a customer's choice which doesn't always agree with usage case
- **TS7760 Tape Attach and Hybrid Grid is the best of both worlds**
 - Using TS7760T disk cache partitioning, users can direct specific workloads by policy to physical tape
 - Using Grid architecture, intermix TS7760 solutions with disk/tape TS7760T/TS7720T/TS7740 solutions
 - Allows customer to configure how their data is managed in order to fully benefit from physical tape
 - Allows IBM to be flexible in its offerings while also differentiating itself with smarter options



Flash Copy for DR Testing

- **Full support of concurrent testing**

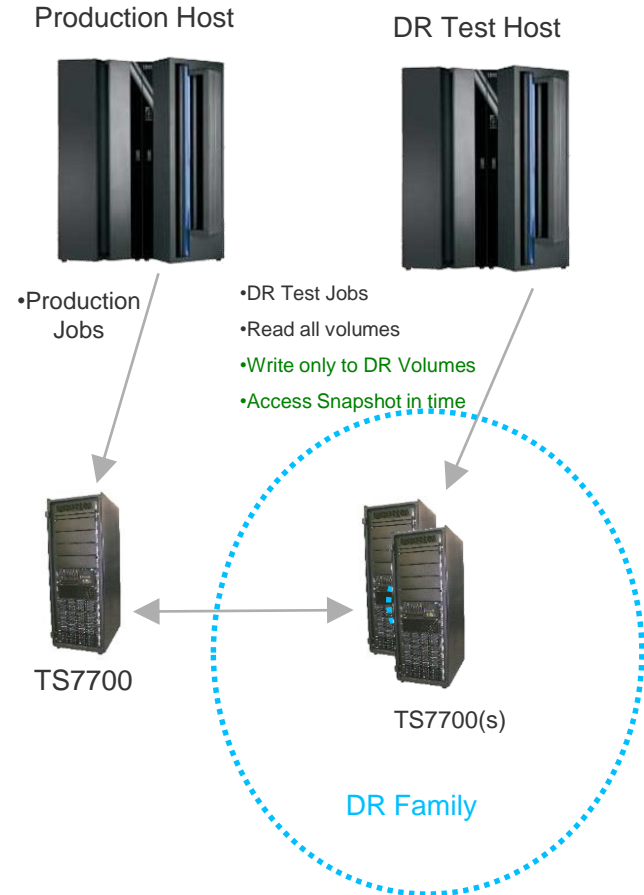
- DR test host can run while production continues
- Production data continues to replicate during the entire test
- Mount volumes at both production and DR at the same time.
- Data contained within any TS7720 DR cluster is accessible for DR testing and the content at time zero is provided.
- Through selective write protect, DR host can create new content to segregated volume ranges.

- **Production data protection**

- Use TS7700 selective write protect to isolate DR test volumes by category for full read/write access while only allowing read access to production volumes
- All access to write protected volumes will actually access a snapshot in time flash.
- Access production volumes which have been returned to scratch as private volumes within DR location
- No need to disable return to scratch processing

- **Enablement**

- Configure “DR Families” via LI REQ
- Enable Write Protect and/or Flash from the LI REQ command against all clusters in a DR Family



Dynamic Disk Pool Overview

- **Dynamic Disk Pool vs RAID**

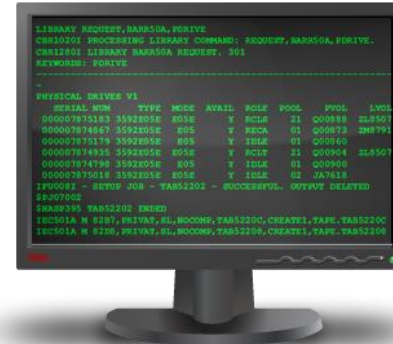
- RAID reads from all drives and writes to a single spare during rebuild (when a disk fails). This results in parallel reads but a single write. Thus the single spare drive causes bottleneck
- Dynamic disk pools (DDP) do not have spares. They have reserved space
- In DDP when a drive fails all drives are read and multiple writes are executed. This results in parallel reads and writes improving rebuild times.

- **Dynamic Disk Pool Requirements**

- Up to two drives can fail in a pool at any given time (a 3rd drive failure will fail the pool)
- Pool needs free space reserved but **THERE ARE NO GLOBAL SPARE DRIVES**
- Faster rebuilds
 - When a drive fails the pool will rebalance in 10 to 20 hours depending on host IO (no more waiting 3 days for a rebuild!)

TS7700 Monitoring/Management

- **Web-based Management Interface**
 - Configuration/health/performance status/statistics
 - Unification between IBM solutions
- **z/OS operator console**
 - 'Green Screen'
 - For operator monitoring of TS7700 status and changing of many settings
- **Operational statistical data**
 - Captured every 15 minutes, 90 rolling days kept outboard
 - IBM provided report formatting tools (VEHSTATS, MI Graphical Output)



TS7700 Encryption Support

- TS7700 Disk Encryption (zero performance impact)
 - Internal key AES 256 bit encryption
 - All R3.0+ and later hardware is encryption ready (CS9/CC9, CSA/XSA)
 - Retroactive enablement in the field
 - External key AES 256 bit encryption
 - All R3.0+ cache hardware is encryption ready
 - TKLM/ISKLM compatible at cluster granularity
 - Retroactive enablement in the field for all R3.0+ cache 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
 - Policy based tape pool granularity
 - Each pool of tapes enabled/disabled individually
 - Unique key usage when encryption is enabled
 - External key management through TKLM/ISKLM
 - AES 256bit



IBM Synergy: Leveraging DS3000



Why choose the IBM TS7760?

- IBM provides technology that matters
 - The 1st generation Virtual Tape Servers (VTS) completely changed tape processing
 - The 2nd, 3rd and 4th generation VTS increased performance and capacity
 - Business continuance leader with PtP VTS and followed with Grid Cloud replication
 - Single model, agile solutions offering high performance cache, hybrid disk to tape automated tiering or tape only configurations
 - Systems synergy: z Systems, DS8880, SAN
- IBM continues leading the industry in tape technology investment
 - Acknowledged in the industry as a leader in tape drive technology
 - Offers a full range of tape drives, libraries and virtual tape subsystems
 - Offers the full complement of software and services to maximize your ROI
 - Offers data protection via tape drive encryption support
- The TS7700 supports a further reduction in cost
 - Virtualizing more of your data at a lower cost on fewer resources
 - Automating storage management through full DFSMS support
 - Reducing configuration complexity and environmental requirements
 - Providing high performance and cache capacity

IBM Tape

IBM continues to make investments on Tape, with a strong roadmap ahead

Full line of tape solutions with advanced features

Industry leader in tape and data protection technologies and solutions

IBM is #1 Branded Tape in the market



Recent enhancements

TS7760: Enterprise Feature Evolution

B16 - Industry First VTS (1997)	R1.4 11/23/07 Copy export (Grid)
B18 - Next Gen VTA	R1.5 12/05/08
P2P VTS - First DR VTS	TS7720 Introduction (disk only)
B10/B20 - Next Gen VTS	LM Convergence
TS7700 R1.0 9/29/06	Disk Cache refresh
2-way grid	TS1130 Support
TS3500 Support	TS3500 HD support
16 3592 J1A drives	
R1.1 1/25/07	R1.6 12/04/09
Autonomic Ownership	4-wqy grid
Take over	TS7720/TS7740 Hybrid
TS1120 Drive Support	Logical WORM
Larger Disk Cace	Network Load Balancing
SW 1Gb Fibre Grid replication	Cluster Families
256 virtual devices	R1.7 6/04/10
R1.2 3/09/07	Disk Cache Refresh
First Tape drive AES256 encryption	Selective Write Protect
Broadband Call home	Additional Memory FC
	600MB Logical Volumes
	LDAP support
R1.3 8/31/07	
3-way grid	
LI REQ Support	
Copy Export (standalone)	
1M logical volumes	
Secure data erase	
ROR recovery	

TS7700 R2.0 6/3/11
Power7 technology
Server Swap support
2x10Gb LW optical Grid Ports
4x1Gb Grid Ports
6-way grid
Scratch Allocation Assist
TS1140 Support
R2.1 12/19/11
Synch Mode Copy
Remote Mount iP link
Failover
Grid Merge
Copy Export Merge
Parallel Copies and Pre-Migration
Copy Export Acceleration

TS7700 R3.0 Dec 2012
Disk Cache Refresh
Disk Cache AES 256
Encryption
Unified GUI
4Million Logical Volumes
Native LDAP
Limited IPv6 support
R3.1 Dec 2013
1PB TS7720
8x8Gb FICON Support (2.5GB/s)
512 paths per port
Flash Copy for DR Testing
Time Delayed Replication
R3.2 Dec 2014
Tape Attached TS7720 (TS7720T)
25GB Volume Support
496 UCB/Devices
RACF LDAP Support
R3.3 Sept 2015
TS1150 Support
100PB TS7720T
External key management for Disk
Grid to Grid Migration

TS7700 R4.0 June 2016
TS7760 introduction
Consolidated Model
Power8 Technology
TS4500 Support
Disk cache Reresh
1.3PB TS7760
Dynamic Disk Pools
4x10Gb Grid replication
TS7700 R4.1 Feb 2017
7/8-way Grids
Library Request command for grid status
TS7700 R4.1 May 2017
8 TB drives (2.45 PB)
TS7700 R4.1.2 Feb 2018
16 Gbps FICON support
Enhanced data compression
TS7700 R4.2 Sep 2018
Cloud Storage Tier



IBM TS7700

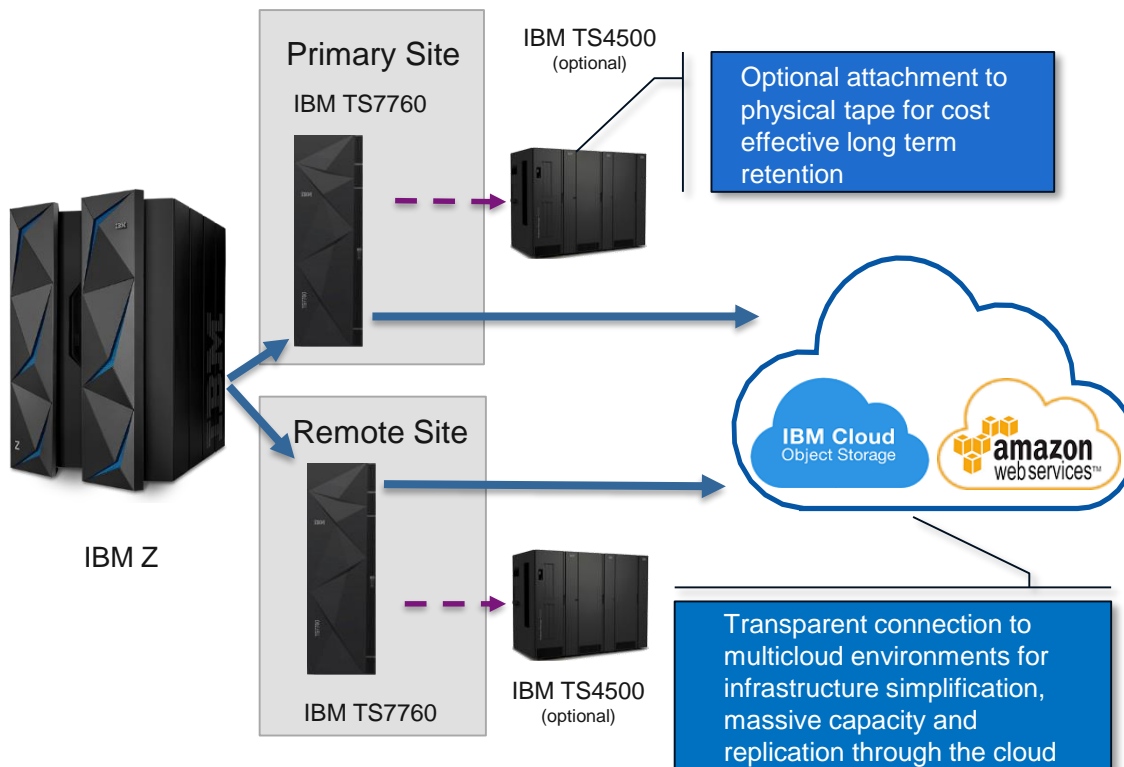
*Release R4.2 Major Line Items
Availability Sep 12th 2018*

- **Tier to cloud**

- Cloud Tiering
- TS7760C
- IBM COS or AWS Public

TS7760 – Cloud Tiering

Cloud as a storage tier for TS7700 R4.2



Transparent Cloud Tiering (TCT) for IBM TS7700 provides direct data transfer to cloud environments for long term data retention.

Five compelling reasons to use TCT:

1. It does not require an additional server or gateway
2. Provides great flexibility by supporting a variety of cloud options
3. Enables an additional storage tier with very little capital investment
4. Enables massive storage capacity
5. Enables replication through the cloud

IBM TS7700 System Z Virtualization Engine

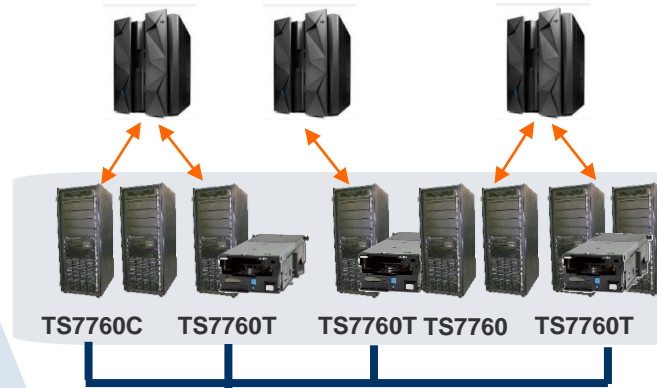
IBM Storage & SDI

Leveraging Object Stores as an Extension of Grid Cloud

Grid Cloud TCT Support

8-way consisting of any generation of TS7700

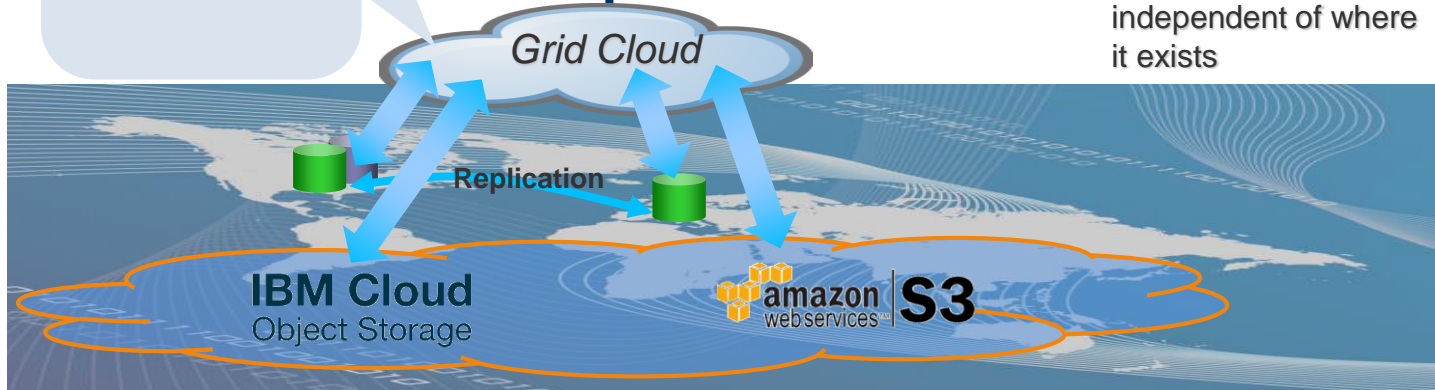
- Extension of Grid Cloud
- Uses 20 years of tape tier expertise and applies it to object stores
- On premise or off premise
- IBM COS, AWS S3



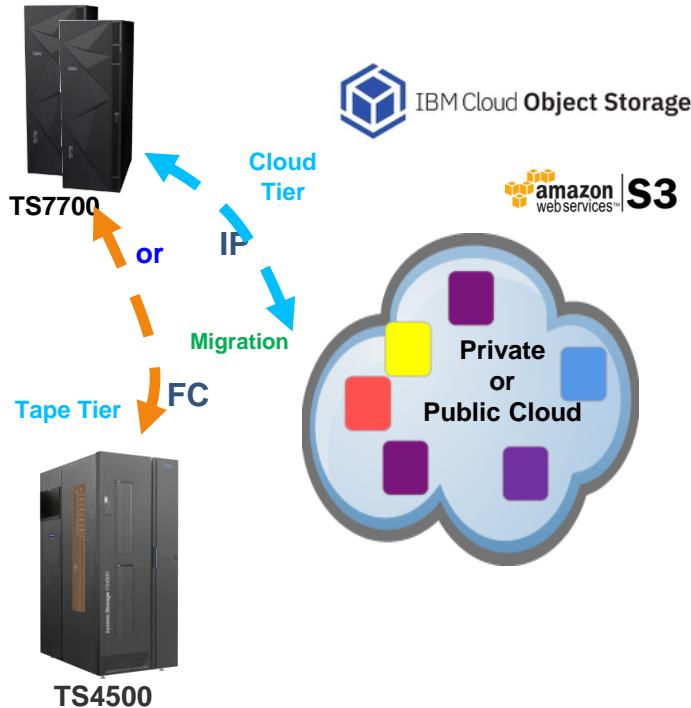
Cumulative FICON throughput of over 5GB/s * 8

System z hosts view up to 496 * 8 equivalent devices

Grid access to all data independent of where it exists



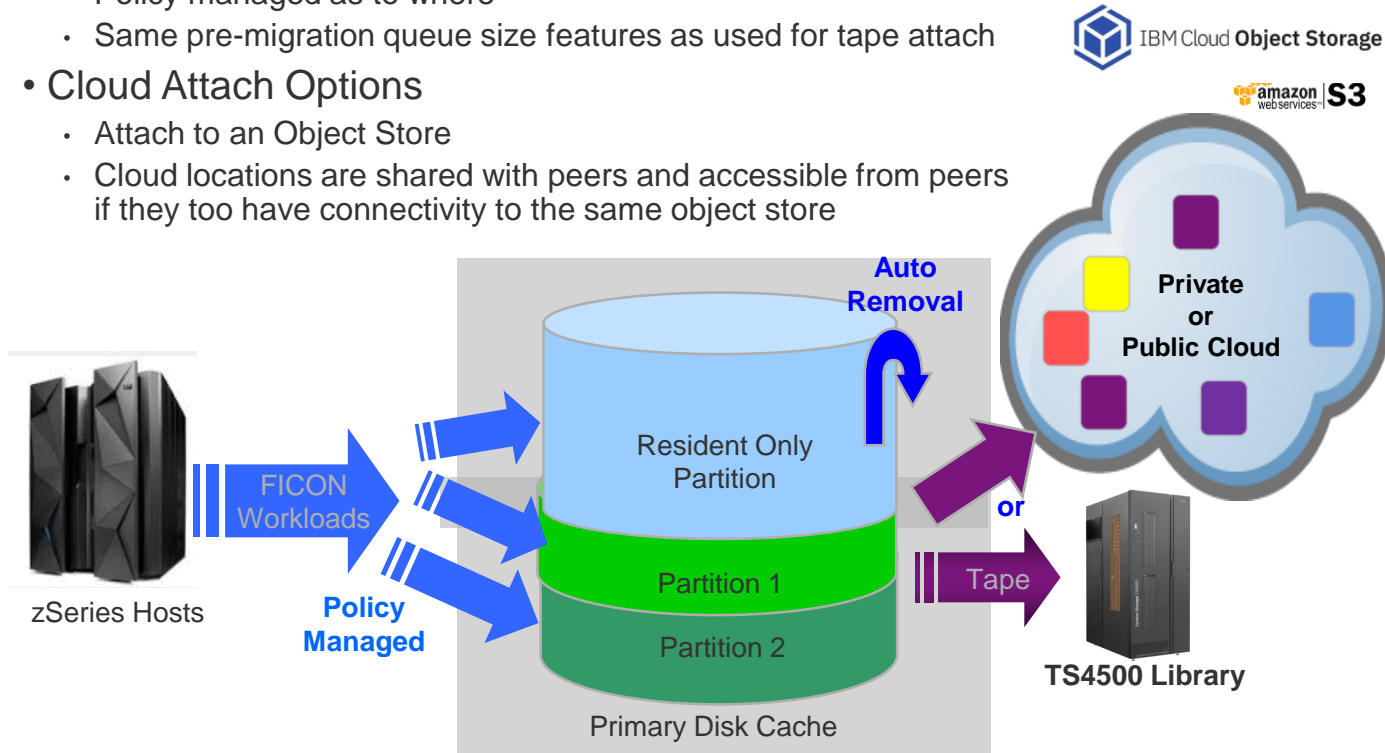
R4.2 TS7700 Transparent Cloud Tier



- Leverage TCT for off load to public or private cloud
- Physical tape and cloud tier are both policy managed options
 - One or the other in 4.2
- Once one cluster puts a copy in the cloud, all replicated peer clusters have access to the object store instance
- 4.2 will support IBM COS and AWS S3
 - IBM COS On Prem
 - AWS S3 Public
- Local and cross regional AWS S3 support

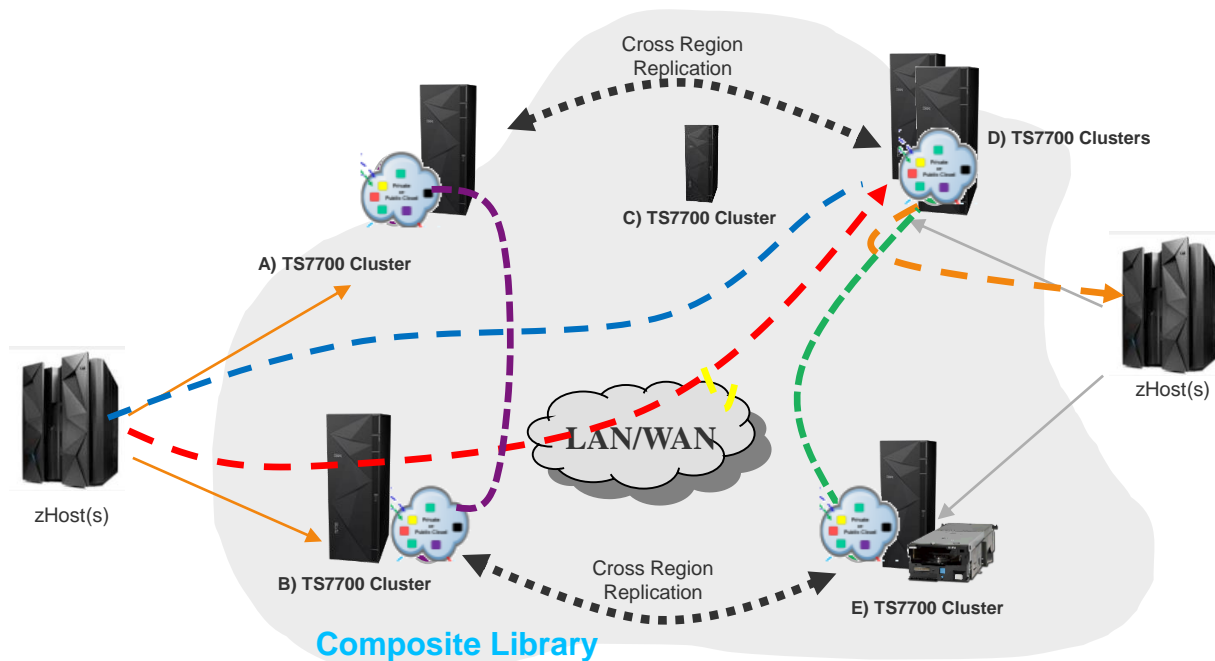
TS760 R4.2 Storage Partitions

- Define partitions
 - Same partition concepts of traditional tape attach
 - Content can go to Cloud via TCT just like it can go to tape
 - Policy managed as to where
 - Same pre-migration queue size features as used for tape attach
- Cloud Attach Options
 - Attach to an Object Store
 - Cloud locations are shared with peers and accessible from peers if they too have connectivity to the same object store



R4.2 Expanded Cloud Use Case

- Each cluster has optional connectivity to a single cloud
 - Not all clusters require the same setup
- Common clouds have full read/write access of common content from any location
 - TS7700 can help keep the “write access” mutually exclusive
 - Once content is written into cloud, it should be accessible from any other grid location which had a grid copy and has connection to same cloud domain, locally or cross regionally*
- TS7700 Grid remote access can be leveraged to access another peers cloud content



*The cluster has to have attempted a premigration of the volume in order to access the information at later date. Refer to the white paper for grid details

R4.2 Tier to Cloud Features

- All clusters must be at 4.2 before cloud can be enabled
- All cloud enabled clusters must be TS7760s
- A stand alone cluster can support cloud attach
- FC5278 – Cloud Enablement
 - Required on each TS7760 which will need access to an object store
 - Can be installed in manufacturing or in the field
 - Field installs (MES) require an offline/online event when activating
 - First time installs need SSR activation at the time of install
- FC5274 – 1TB Active Premigration Queue
 - At least one FC5274 feature required
 - Limits the total amount of premigration to the cloud content which can be queued at any given time
 - Up to 10 features supported
 - Same feature code for TS7700T configurations
- FC5279 – 5TB Active Premigration Queue
 - Additional premigration queue size after the initial 10 1TB FC5274 features are installed
 - Up to 10 FC4279 features supported
 - If all 10 are installed, the premigration queue is no longer limited
 - Up to the size of physical disk cache minus 12TB
 - Applicable to TS7700T configurations too

R4.2 Cloud Storage Tier – things to know

- **All clusters must be at 4.2 before cloud can be enabled**
 - Peers not at 4.2 or later will prevent the use of cloud within the Grid PIT - comes later
- **All cloud enabled clusters must be TS7760s**
 - VEB/V07 can exist in grid too, but can't attach to the cloud
- **TS7760C and TS7760T are mutually exclusive**
- **64GB Total Memory required on the TS7760 wanting to become a TS7760C**
- **A stand alone cluster can support cloud attach**
 - Grid adapters will be used
- **Enabling Cloud Storage Tier is non-concurrent**
 - Requires offline/online and reboot if memory upgrade is required
- **DNS server must be able to resolve *amazonaws.com addresses when using Amazon S3**
- **Port 80 (HTTP) or 443 (HTTPS) must be open on customer firewall**
 - TS7760C does not support using custom port values for HTTP or HTTPS
- **Customer must create vault or bucket before configuring the TS7760C**
- **90 day stats for TS7760C are stored in the same place holders as TS7760T**
 - Future STATS will add new fields.
Until then, the fields are shared given TS7760C and TS7760T are mutually exclusive

TS7760 R4.1.2

- **Enhanced compression**
- **16 Gbps FICON adapters**
- **RAS improvements**
 - Grid resiliency
 - Event Redesign and SYSLOG support
 - Code load improvements



R4.1.2: Enhanced Compression

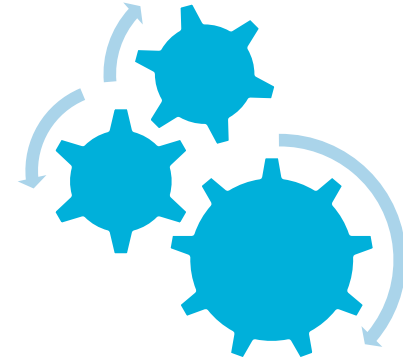
- **New compression options – LZ4, ZSTD**

- DATACLASS – determines which compression method is used for a given logical volume
- Software based (no new hardware required)
- Benefits on average of up to 80% with some workloads getting a 2x improvement
- Much higher compression ratios for highly compressible data
- Improved performance in most use cases
- Reduced network bandwidth because as less physical data is moved

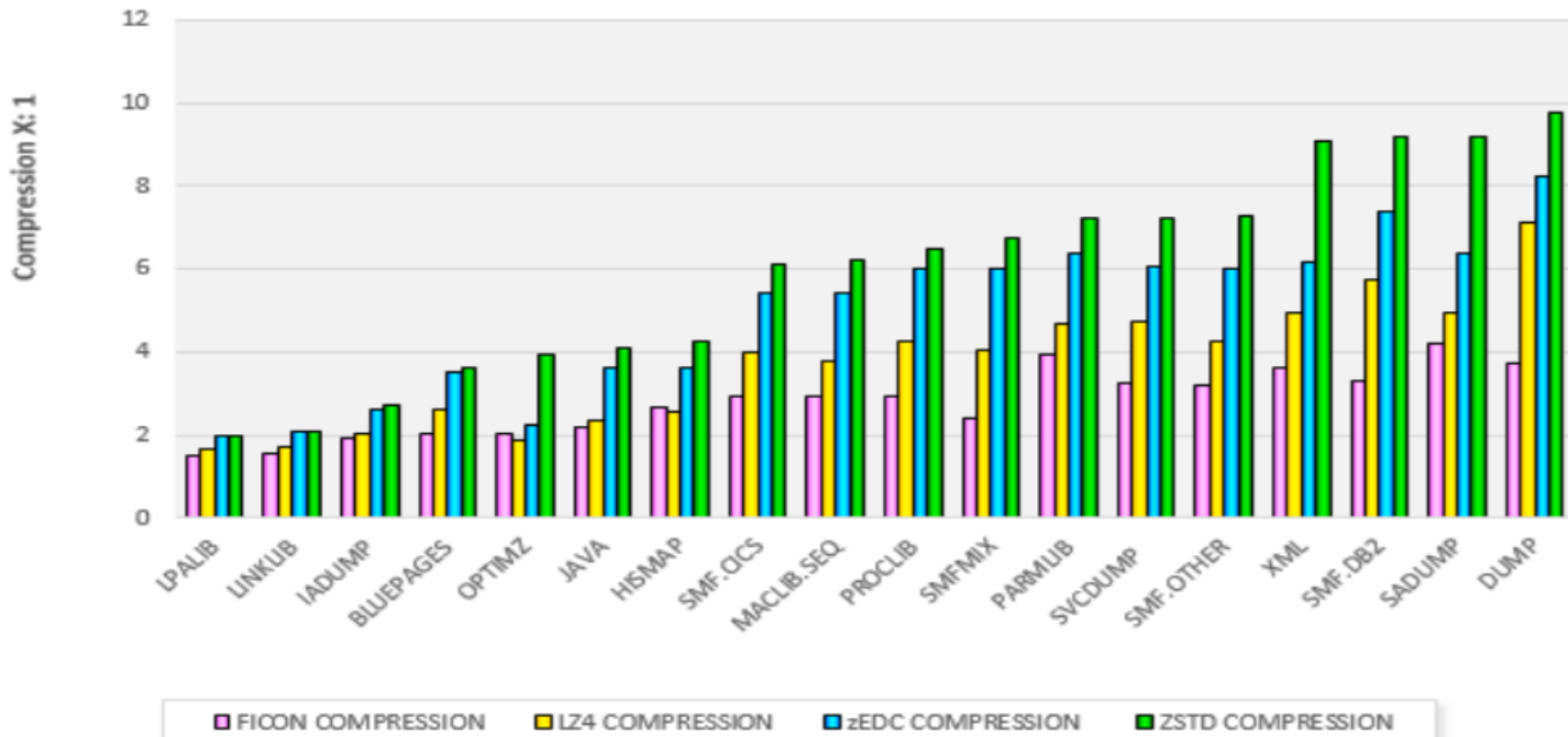
- **Mixed compatibility**

- Existing compression and enhanced compression supported at the same time
- All existing compression content is accessible
- Existing content will not benefit from new compression until logical volumes are re-written from beginning of tape

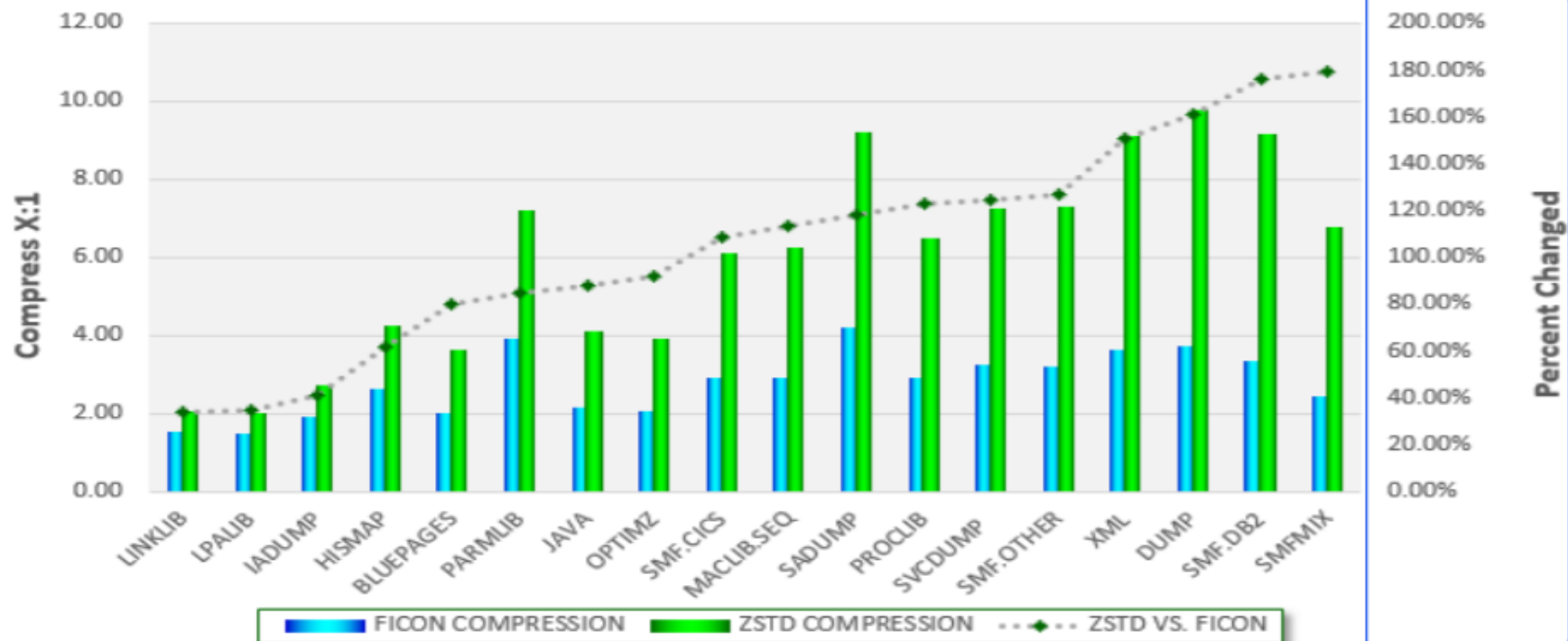
- **All clusters in the grid must be running R4.1.2 or later for the new DATACLASS values to be available**



TS7700 Compression Schemes vs. zEDC Compression (4 concurrent jobs - full datasets)



ZSTD Compression vs. FICON Compression



Based on the different workloads, our tests show that ZSTD compresses data more efficiently than FICON with improvements from +33% to +179%. ZSTD delivers high compression ratio at the expense of higher CPU utilization. As a result, ZSTD is generally not recommended for TS7700 with Power 7 server (models VEB/V07).

R4.1.2: 16Gb FICON

- **Latest Generation 16Gb FICON Adapter**

- Two ports active per adapter (8 ports total per TS7700)
- 512 paths per port
- Built in ASIC providing real-time compression and end to end IBM Z CRC protection

- **Additional Enhancements**

- Forward Error Correction
 - Improve 16Gb error recovery
- Read Diagnostics Params
 - Improved link error isolation

- **Improved Performance**

- Up to 4.2GB/s for 32KB blocks @ 5:1 compression.
- 4.7GB/s to 4.8GB/s for large block (64KB to 256KB)



R4.1.2: 16Gbps FICON feature codes

•TS7760 Server 3957 model VEC features

- #3402 – 16 Gb SW FICON adapter
- #3403 – 16 Gb LW FICON adapter

- #3401 - Enable FICON second port
Same as with 8 Gb FICON – 1 instance of #3401 enables 2nd port on all installed FICON adapters

- #5268 – 100MB/s Throughput
Maximum quantity increased to 39 when 16 Gb FICON adapters are installed.
Forty (40) increments required (including 9268) before throughput is unconstrained.

Users achieving over 2,500 MB/s throughput with 8 Gb FICON should increase their quantity of #5268 when installed 16 Gb FICON adapters to avoid host throughput throttling.



R4.1.2: TS7700 resiliency improvements

More like IBM Z

- Improved self diagnostics sickness detection
- Improved grid diagnostics
 - Handshake timing and success analysis
 - Call out problem cluster and act based on customer provided settings and criteria
- Manual “you are sick” customer intervention (last resort)
 - Cluster is marked sick via WEB Management Interface
 - Cluster is marked sick via LIBRARY REQUEST OAM command in IBM Z

Virtual devices are not automatically varied offline
in R4.1.2

```
LIBRARY REQUEST,distlib,STATUS,GRID,DIAGTIME
CBR1280I Library,distlib,request.
Keywords: status,grid,diagtime
Grid Diagnostic Times V1 .0
```

Composite Library View

```
Current Time (UTC):                2016-02-28 03:33:02
scratch mounts      3400 #private mounts      303
  AF000 (CL0)      CL0  CL1  CL2  CL3  CL4  CL5  CL6  CL7
  SCRMNT-AVG      -----  2  1199  1  2  NA  NA  NA
  PRIMNT-AVG      -----  4  1033  3  3  NA  NA  NA
  HS-AVG          -----  2  2  2  1  NA  NA  NA
Diagnostic Times Last Reset (UTC): 2016-02-27 03:01:23
  AF001 (CL1)      CL0  CL1  CL2  CL3  CL4  CL5  CL6  CL7
  SCRMNT-AVG      3 -----  900  1  2  NA  NA  NA
  PRIMNT-AVG      2 -----  1300  1  2  NA  NA  NA
  HS-AVG          1 -----  3  1  1  NA  NA  NA
Diagnostic Times Last Reset (UTC): 2016-02-27 03:03:10
  AF002 (CL2)      CL0  CL1  CL2  CL3  CL4  CL5  CL6  CL7
  SCRMNT-AVG      2  2 -----  1  3  NA  NA  NA
  PRIMNT-AVG      5  3 -----  1  2  NA  NA  NA
  HS-AVG          7  2 -----  1  1  NA  NA  NA
Diagnostic Times Last Reset (UTC): 2016-02-27 03:03:57
  AF003 (CL3)      CL0  CL1  CL2  CL3  CL4  CL5  CL6  CL7
  SCRMNT-AVG      0  0  0 -----  1  NA  NA  NA
  PRIMNT-AVG      0  0  0 -----  1  NA  NA  NA
  HS-AVG          2  2  2 -----  2  NA  NA  NA
Diagnostic Times Last Reset (UTC): 2016-02-27 03:05:25
  AF004 (CL4)      CL0  CL1  CL2  CL3  CL4  CL5  CL6  CL7
  SCRMNT-AVG      0  0  0  0 -----  NA  NA  NA
  PRIMNT-AVG      0  0  0  0 -----  NA  NA  NA
  HS-AVG          3  2  3  2 -----  NA  NA  NA
Diagnostic Times Last Reset (UTC): 2016-02-27 03:06:02
```

R4.1.2: TS7700 Event Redesign

- **Introduce SYSLOG support**

- Common method to surface messages to a SYSLOG server
- Used primarily for audit trail for both customer and IBM activities, but can be used for all events if desired

- **Tunable Events**

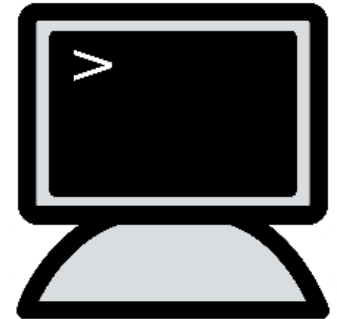
- Table of all supported events made available in the MI
- Customer picks and chooses which events go where
 - Email (Future)
 - Host messages
 - MI events
 - SYSLOG events
 - SNMP events

- **Customer can override severities**

- **Customer can backup configuration and restore to other grids**

- **Improved event descriptions and problem determination**

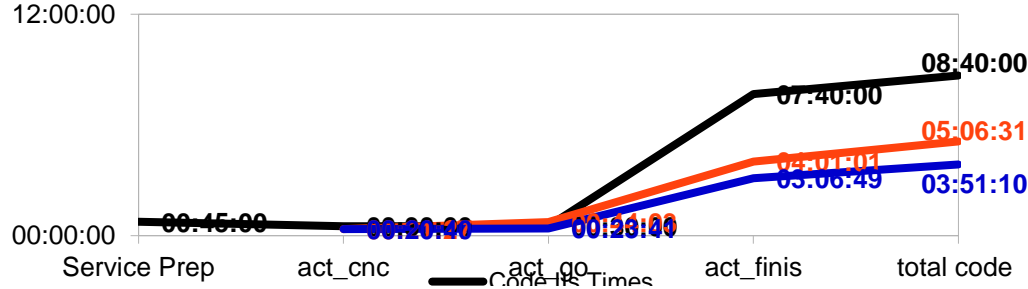
- [WSC Webinar - TS7700 Usability Enhancements in Release 4.1.2](#)



R4.1.2: TS7700 - code load time reduction

Development focused to reduce code load pain points with automation and time reduction.

VEB
Max Base + Max 2 Expansion frames
24% Improvement



Pre-Install Duration & Pain

- R3.3 – Adding TVC changes
 - R3.3 – z/OS cmd for issue devices
 - R4.1.2 – Automation to vary off devices and swap jobs
- Control Unit Initiated Recovery (CUIR)*

Install Duration

- More parallelization
- Incremental improvements
- PTF/VTD Exec Integration

Post-Install Duration & Pain

- R4.1.2 – Automation to vary device back online
- R4.1.2 – Token merge improvements

R4.1.2: TS7700 - what is CUIR?

CUIR (Control Unit Initiated Reconfiguration):

- is a software mechanism that automatically requests a supported zSeries hosts to vary device for a TS7700 distributed library offline and online automatically.
- eliminates the tedious task of varying (sometimes many) device ranges offline and online manually.

Note: For Release 4.1.2, this feature only supports CUIR during normal Service Prep and Service Cancel operations. CUIR function is not invoke during DDM swaps, grid resiliency operations, sudden outages or any other unhealthy cluster event where a cluster could become unavailable.

R4.1.2: TS7700 - CUIR Supported Configurations

- The CUIR function is supported in a TS7700 Grid configuration only (no stand-alone)
- The CUIR function will be introduced with the TS7700 microcode level release 8.41.2xx.xx.
All clusters in the grid must be at 8.41.2xx.xx or higher microcode level for CUIR functions to be available.
- Only natively running z/OS LPARS are supported.
IBM z operating systems such as zVM, zTPF, zVSE and z/OS as a zVM guest are not supported.
- The z/OS host must include APAR 0A52376 with code level V2R2 and above

- Support for 8 TB HDDs
 - 8 TB FIPS 140-2 validated, self encrypting 7,200 rpm hard disk drive
 - Fulfills the Product Preview statement published 28 February 2017
IBM plans to extend the capacity of the TS7760 base frame to over 600 TB, and to extend the capacity of a fully configured TS7760 system to over 2.45 PB, before compression, by supporting 8 TB disk drives.
 - Each 3956 model using 8 TB HDDs provides over 60 TB of usable capacity
 - Each TS7760 expansion frame using 8 TB HDDs provides over 925 TB
 - Assuming 3:1 compression, a TS7760 using 8 TB HDDs stores:
 - over 1.8 PB of user data in a base frame
 - over 2.775 PB of user data in an expansion frame
 - over 7.35 PB of user data in a full 3 frame system

TS7760 8 TB HDD new features

Description	Machine type	Model	Feature
Plant Instl CSA w 8TB DDM	3952	F06	5660
Plant Instl XSA w 8TB DDM	3952	F06	5661
Field Instl XSA w 8TB DDM	3952	F06	5662
96 TB SAS Storage	3956	CSA	7118
96 TB SAS Storage	3956	XSA	7118

Thank you

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