IBM Synergy and TS7700 Release Update

Joe Swingler
STSM, Enterprise Client Solutions Architect

January 2023

IBM Synergy

- Full access to all IBM proprietary command sets from IBM Storage products
  - OAM management, TMS Integration, Scratch Allocation Assist, 3,968 shared devices per composite library, PLF (Perform Library Function) commands for TS7700

- CUIR automated device online/offline processing
- User Commands (e.g. LI REQ) and Tools support for TS7700
- End to end FICON CRC protection

- DS8000 zSynergy Bundle
- TS7700 Object Store Support
- TS7700 Grid Technology
- DS8000 and TS7700 common code stack
- DS8000 and TS7700 in the same rack
- IBM Spectrum Scale

- DS8000 Transparent Cloud Tiering
- Exclusive knowledge of tape block and buffering for zero RPO synchronous copy
- Integrated DFSMS policy management in TS7700
- IBM Spectrum Scale

- IBM Power Systems integration in DS8000 and TS7700

- IBM Flash Systems integration in TS7700

- IBM TS4500 library integration with TS7700
- IBM TS4300 library integration with TS7700

TS7700 Grid - Flexible, Scalable and Resilient

Select the right solution for your business

- Geographically Dispersed
- Active-Active Grid Technology with zero RPO
- Optional Tape or Cloud Tiering
- Optional DS8K Transparent Cloud Tiering target

TS7700 stand-alone
20TB rack mounted

Optional

500PB+ potential storage (5:1)

IBM DS8000
TCT Target

IBM TS4500

IBM TS4300
Rack Mount

IBM Cloud Object Storage
IBM Cloud
RStor
amazon web services

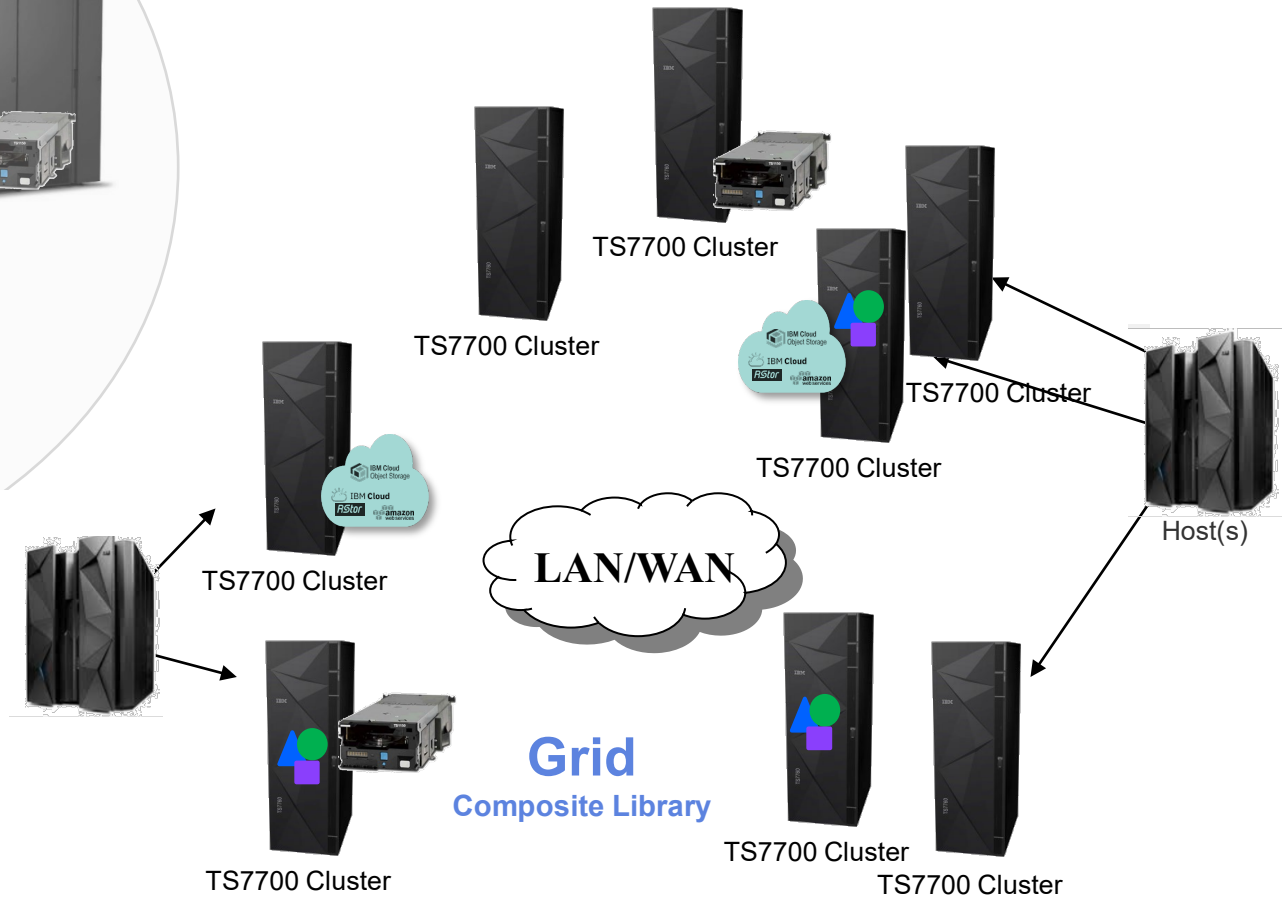
S3 Cloud Tiering

…or any configuration in between

8-way TS7700 Grid

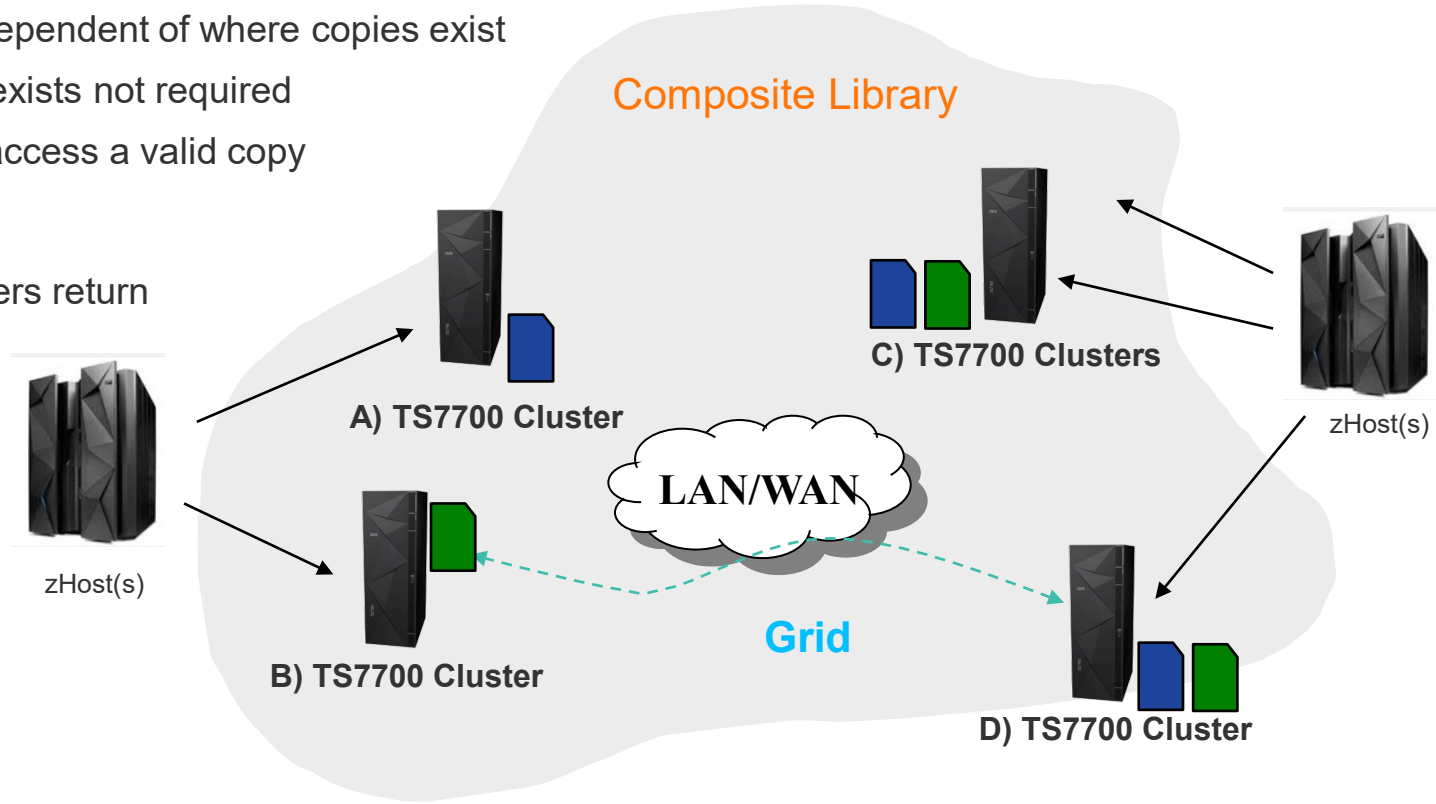
Each TS7700 cluster:

- 3.94PB * 8 uncompressed, 19PB * 8 with 5:1 compression
- 4.3GB/s * 8 @ 16Gb FICON
- 496 * 8 virtual devices (3968 max)



TS7700 Grid Solutions – More than just replication

- IBM Z hosts views the entire grid as one large composite library
  - Up to 496 devices per TS7700 cluster; maximum 3968 common devices
- All clusters are equal players
  - No concept of primary, secondary, or standby nodes
  - Each cluster's devices within an entire grid always has access to all volumes
  - Volume is accessible from any cluster's devices independent of where copies exist
  - User intervention or host knowledge of where data exists not required
  - If a local copy isn't present, IP is used as remotely access a valid copy
- Post outage
  - All updates are automatically reconciled when clusters return
  - Failback can occur immediately



TS7700 Cyber Security Building Blocks

Auditing & Compliancy
Flash Copy DR Testing
Events & Task logging (MI/SNMP)
Rsyslog tamperproof logging
Upload SSL Certificates or use default
SP800-131a Compliancy Settings

Management Interface Security
Granular Roles & Permissions
Local or LDAP Login w/Tivoli RACF
Dual Control Sensitive Settings

HTTPS

Cloud Tier
Cloud Storage Tier
Cloud Export
Cloud Export Recovery
Cloud Export Recovery Testing
Logical Volume Version Retention
Single Logical Volume Version Recovery
PIT snapshots for airgap
Multi-cloud support (public, private, multi-tenancy)
Cloud device encryption

Secure Data Transfer AES256 (IKM)

DS8K to TS7700 TCT Objects — Object Store
Copies between TS7700s — Ethernet
Exports to cloud storage devices

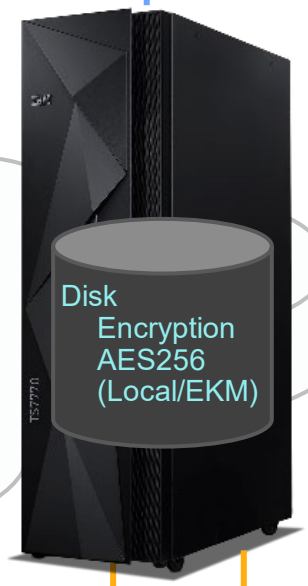
IBM Cloud Object Storage | amazon web services S3 | RStor

IBM z/OS

DS8900

GRID
TS7700 Grid technology to store multiple copies of data anywhere in the world (up to 8 clusters)
Fast migrate/recall at disk speeds
Active/Active…
Each cluster is an access point
Grid Resiliency

TS7700 Grid



Physical Tape Tier
Tape Encryption AES256 (EKM)
Copy Export Secondary Copy
Copy Export Offsite Airgap
Copy Export Recovery
Copy Export Recovery Testing
zTape Air Gap

TS4300 Rack Mount

TS4500

FICON
Virtual Tape
Fibre Channel
Physical Tape

Extended Retention and Access
Selective Device Access Control (SDAC)
Category Retention w/Expire Hold
LWORM
LWORM Retention

R5.21 & R5.3 TS7770 – All Flash Cache System

IBM Synergy: Leveraging Flash Systems 5030

High IOPS Enabled Capacity

- **Performance equal to and exceeding larger NL-SAS configurations**
- **3.84 TB SAS SSD Drives**, RAID6 Distributed RAID Pools
- **60 TB** usable capacity for single drawer
- Maximum of 4 drawers for a total of **260 TB** usable capacity as of R5.3
- Concurrent disk cache drawer expansion

Capacity On Demand

- Any combination of **20TB and 100TB**

Full AES256 Encryption

- Both Local and External Key Management supported
- ISKLM KMIP with TLS 1.2 support (distributed ISKLM only)
- Encryption must be enabled at time of purchase

Use Cases:

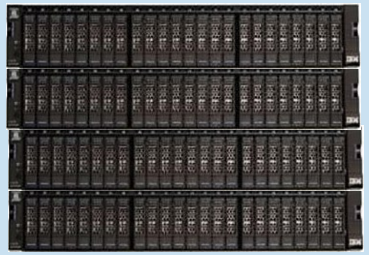
- Applications that need high IOPS (TPF)
- Users with smaller capacity needs but want the best performance
- C07 end of life users
- Systems that require heavy workload

Need capacity, speed or both?

TS7770
HDD cache

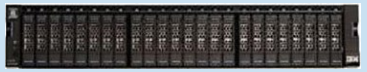
*Potential Full frame support via RPQ
640TB (3.2PB @ 5:1 compressions)

*New TS7770
Flash cache



New
**FC5999

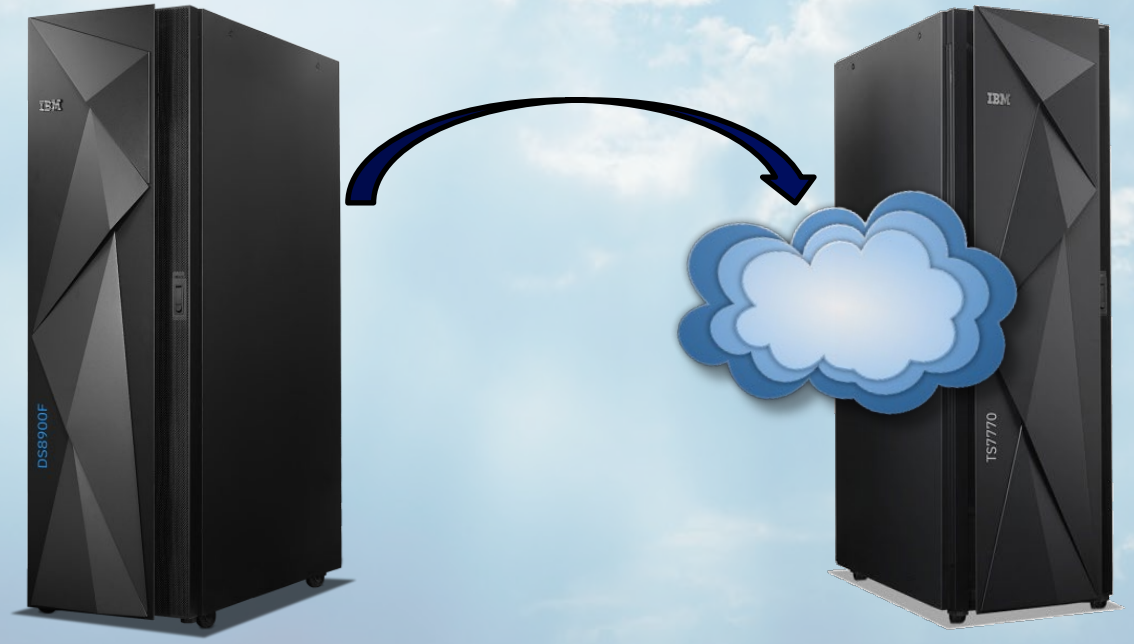
TS7770
Flash cache
controller



System	IBM TS7770 Capacity Model	IBM TS7770 Performance Model	IBM TS7770 High-Performance Tape/Cloud Controller
Cache Drives	10 TB NL-SAS HDD	3.84 TB SSD	3.84 TB SSD
Minimum Configuration usable capacity	157 TB	60 TB	60 TB
Usable capacity per drawer pair on base frame	157 TB	120 TB	60 TB
Cache Drawers on base frame (min / max)	2,4,6,8,10	1, 2,3,4	1
Usable capacity per system frame	789 TB	260 TB	60 TB
Usable capacity per system	3.94 PB	260 TB	60 TB
Optional Expansion frames	2	-	-
Cache Compression 5:1	19 PB	1.3 PB	300 TB
Added Tape attach support with 5:1 compression*	500 PB	500 PB	500 PB
Added Cloud Storage Tier with 5:1 compression*	500 PB	500 PB	500 PB
Standalone Throughput+ (32Kb, 8x16Gb FICON)	4.1 GB/sec	4.3 GB/sec	4.3 GB/sec
Bi-Directional Copy Throughput+	2.8 GB/sec	4.4 GB/sec	4.4 GB/sec
Minimum Rack Space	18 U	16 U	16 U

**Feature restrictions apply

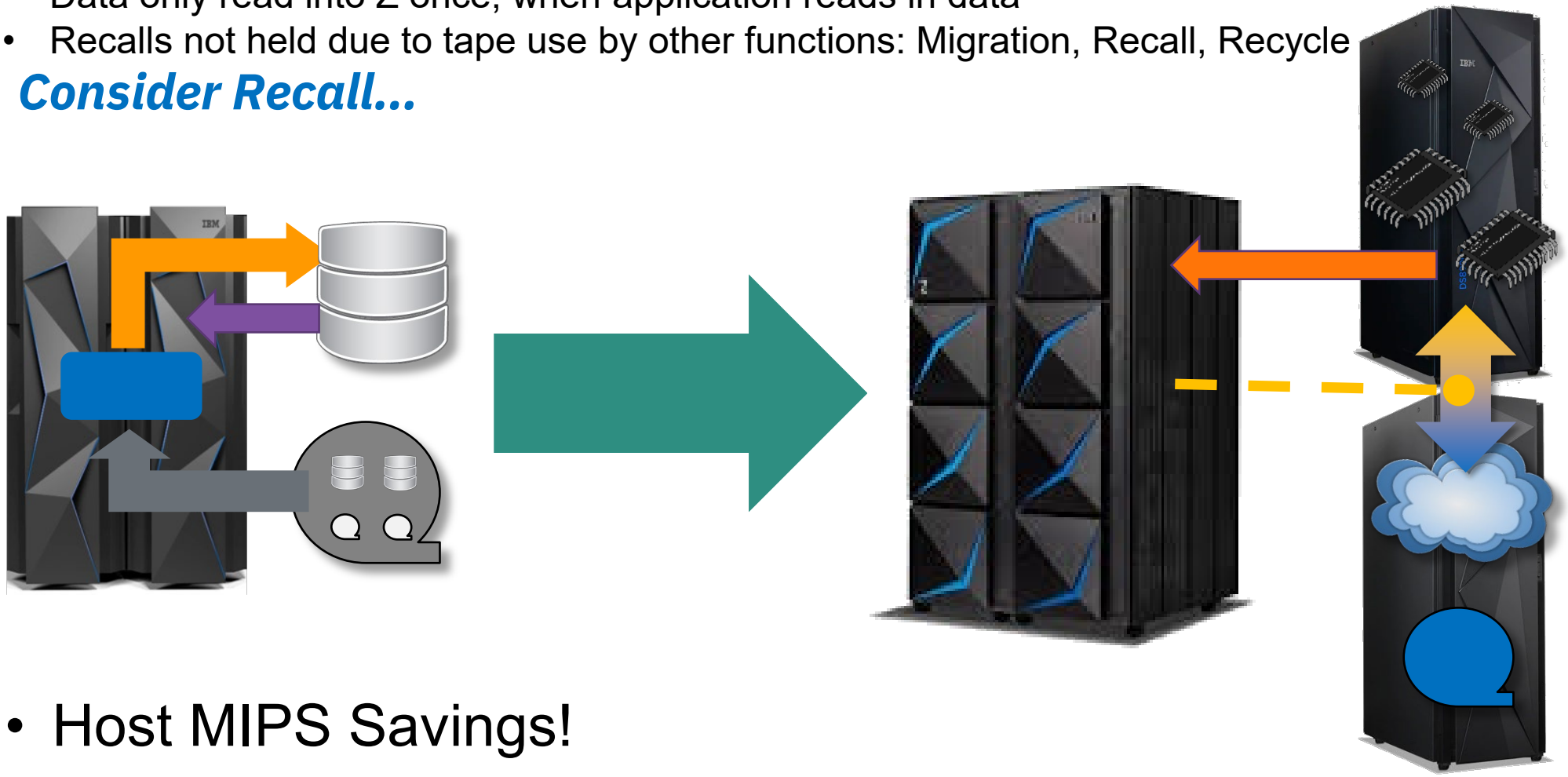
DS8000 Transparent Cloud Tiering With TS7700 Advanced Object Store



The TCT Advantage

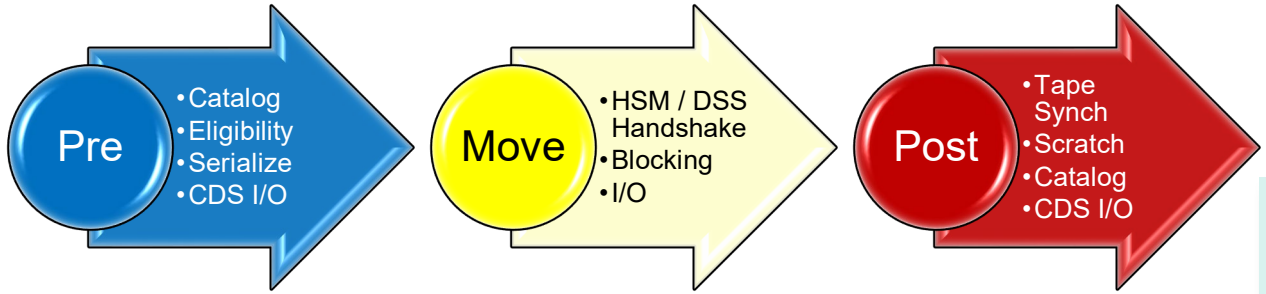
- Eliminates serial access from a tape
- Recycles eliminated
- Uses TCP/IP route so could run throughout the day
- Data only read into Z once, when application reads in data
- Recalls not held due to tape use by other functions: Migration, Recall, Recycle

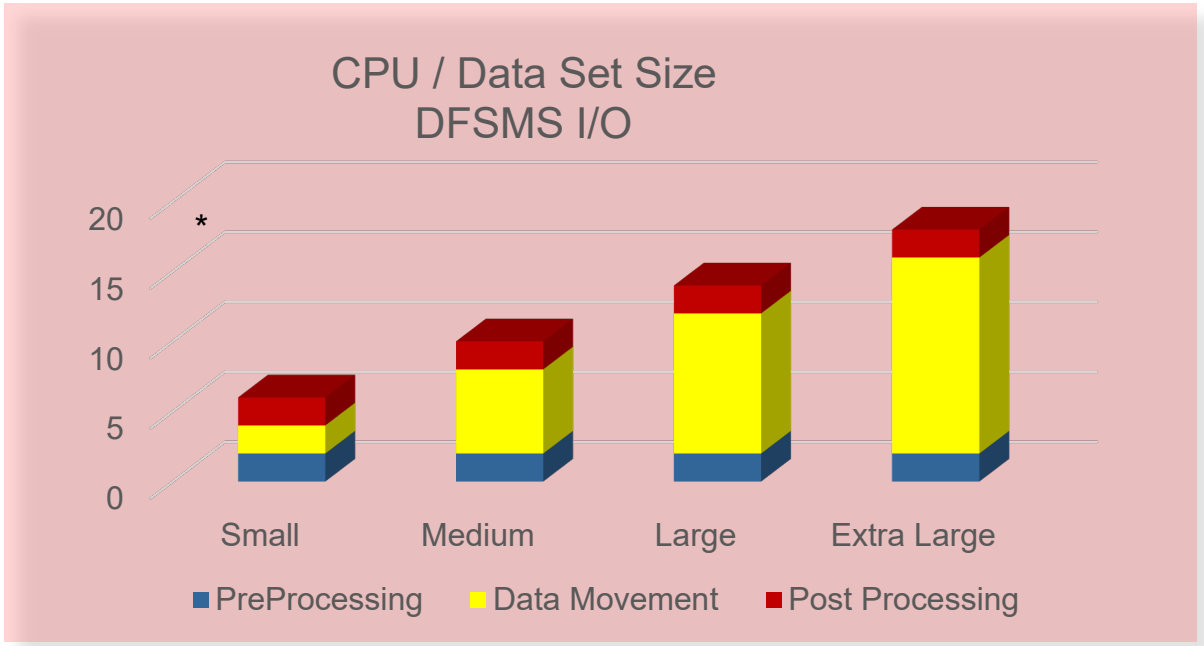
Consider Recall…

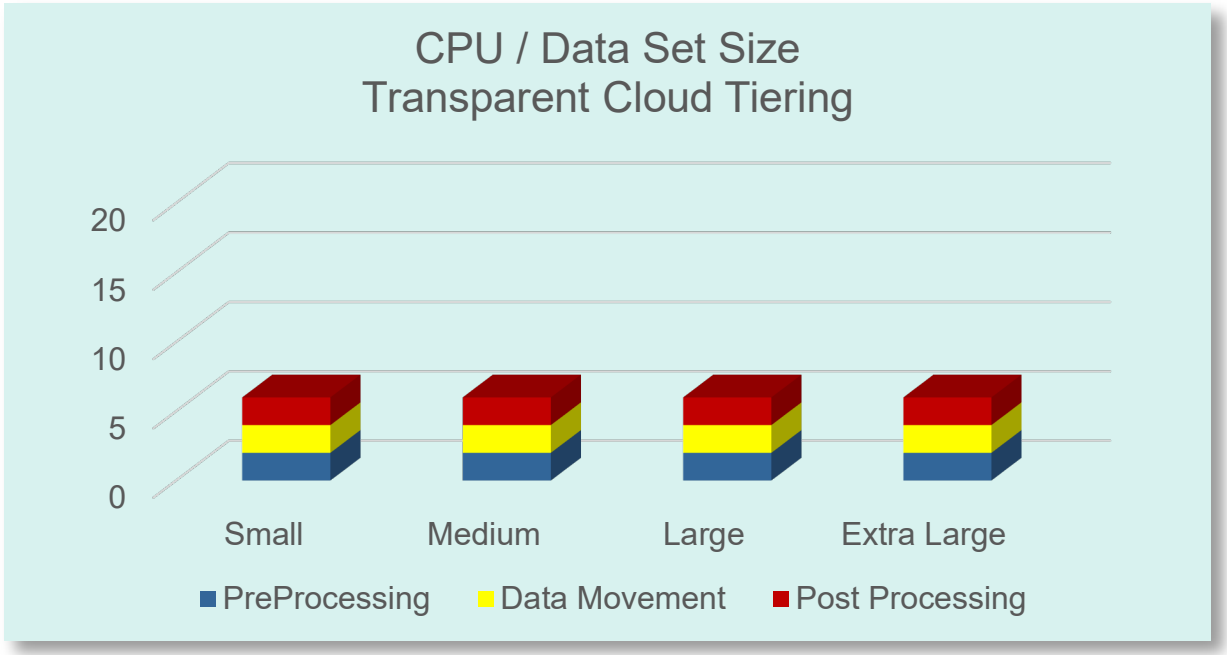


- Host MIPS Savings!

Just How Much CPU Savings?



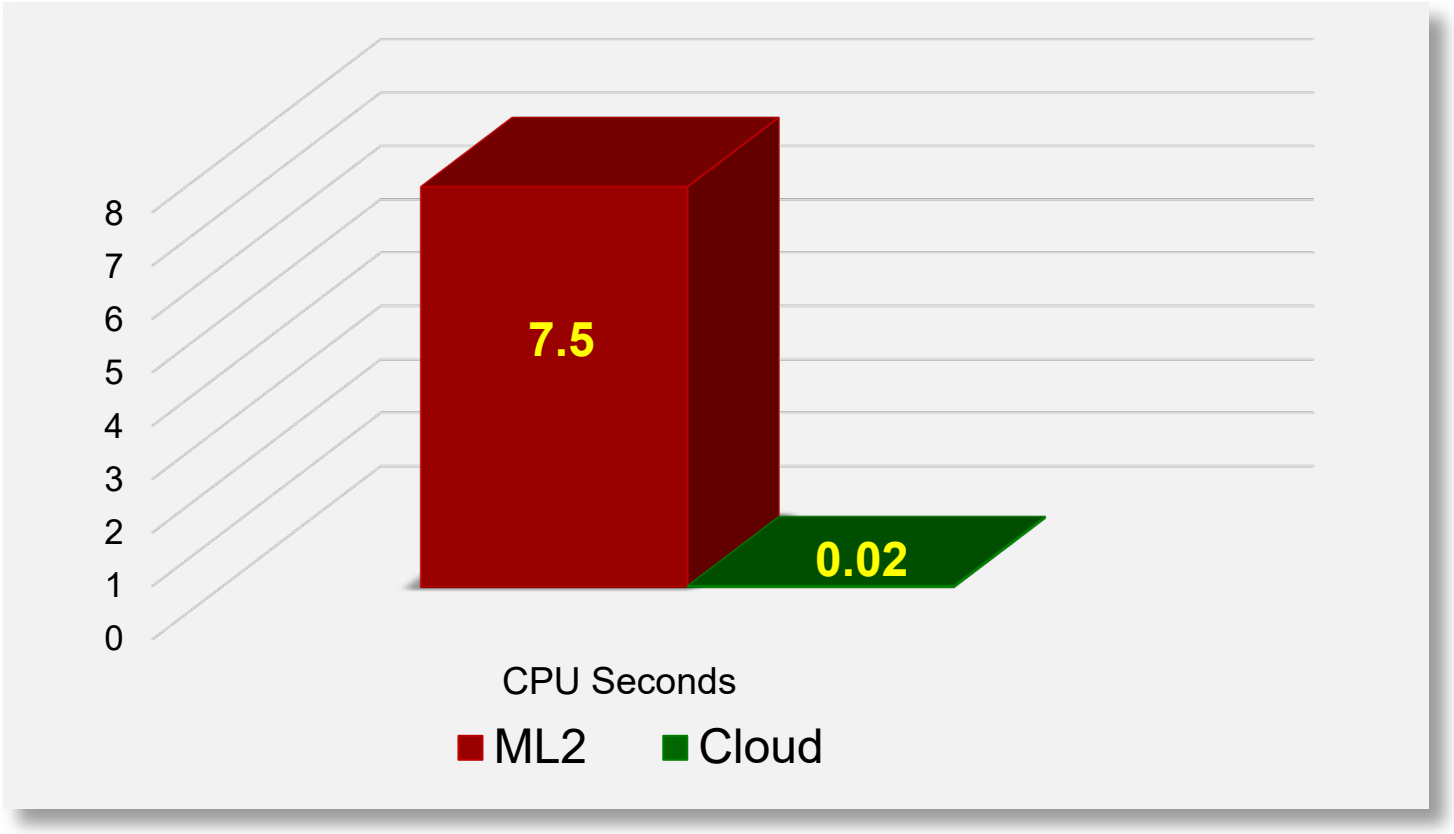




* Values in graphs are not from actual tests, but rather just represent a relative comparison

Just How Much CPU for Migration?

CPU consumed to migrate a 5 GB data set



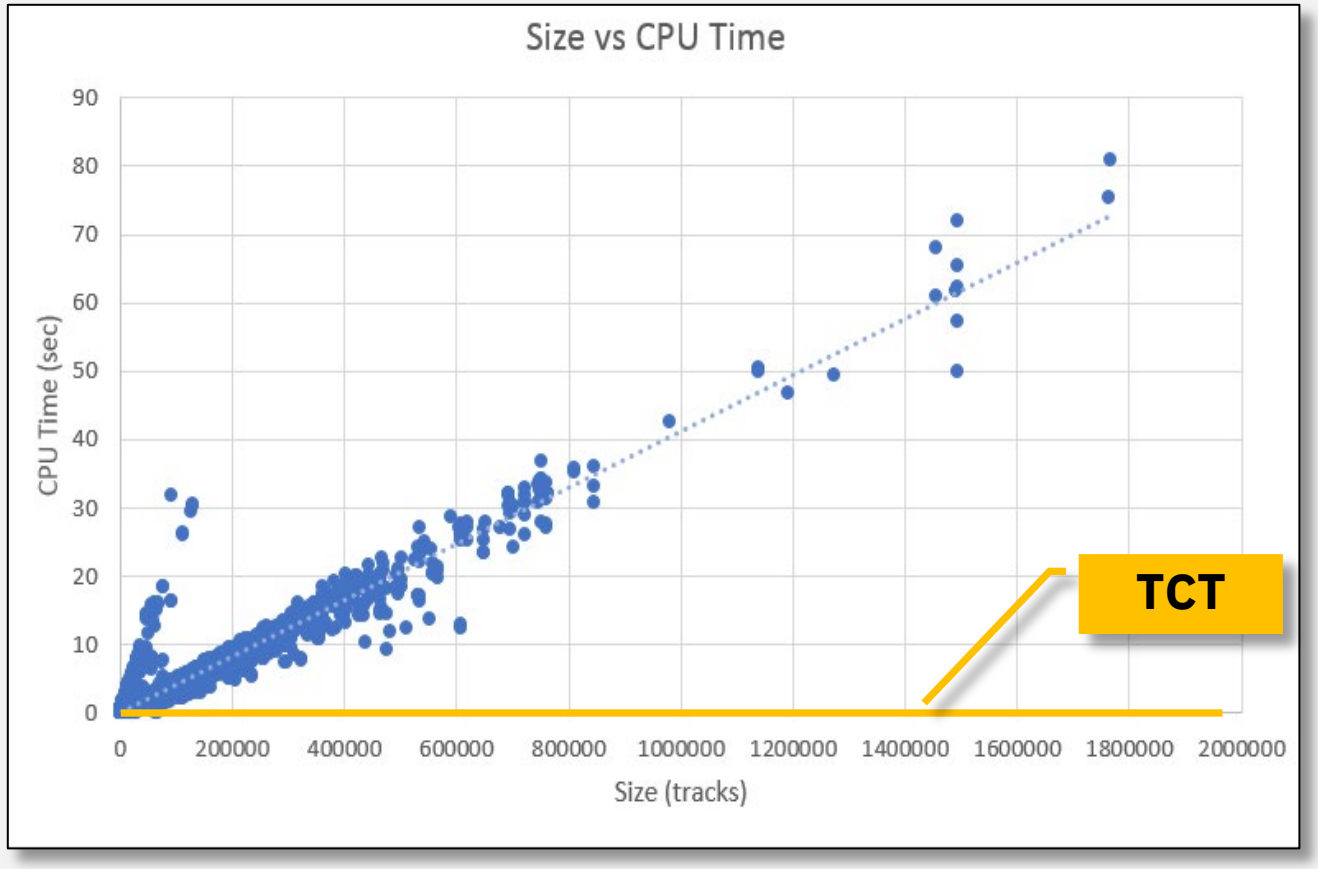
*** Disclaimer:** ***Based on projections and/or measurements completed in a controlled z15 environment. Results will vary by customer based on individual workload, configuration and software levels.***

Client ‘X’ Data Scatterplot

CPU Estimator

Scatterplot of CPU / Tracks for Primary Space Management

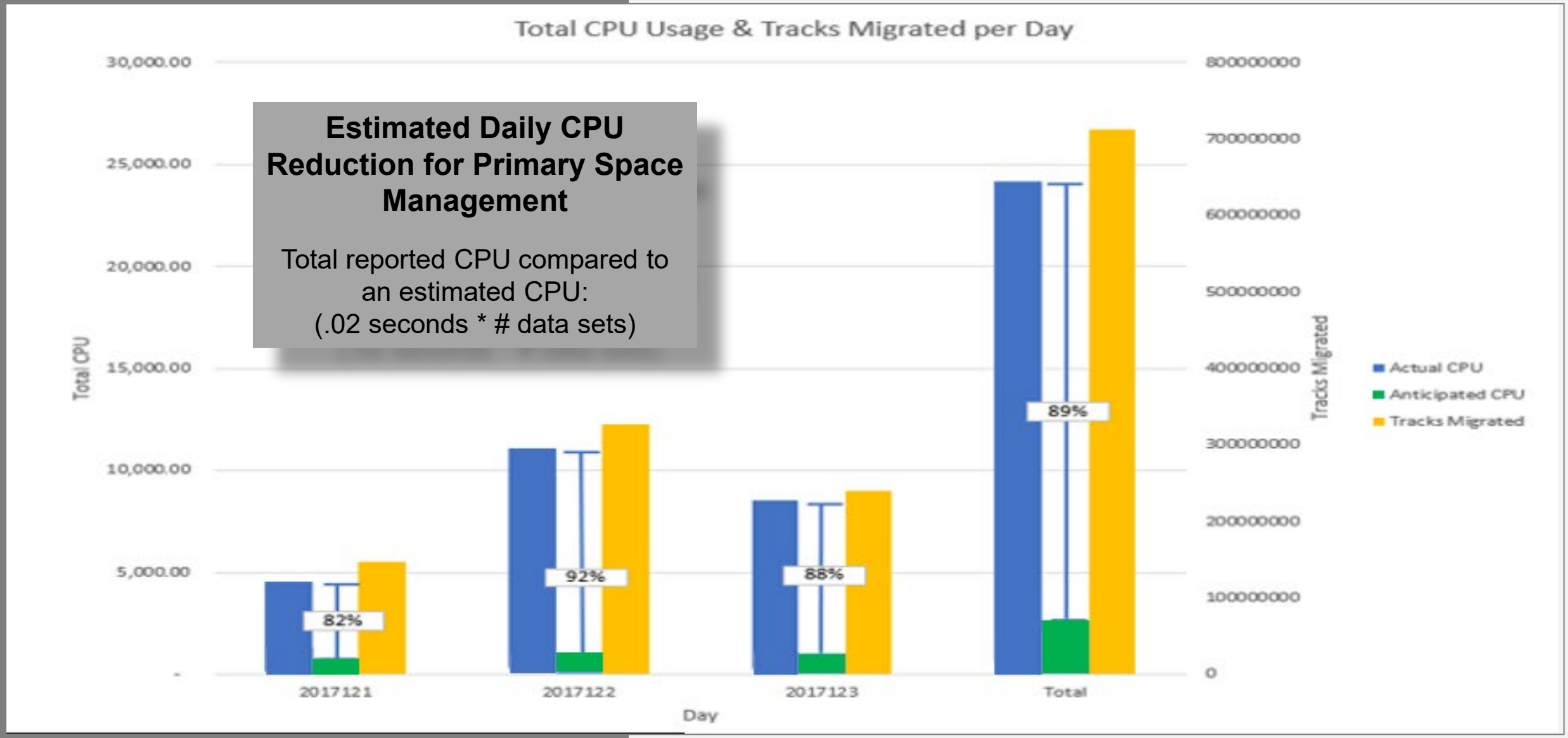
Excluded FSRs that didn’t move data:
RC > 0, Migration Reconnects



Note: CPU times *will* vary:
https://www.ibm.com/support/knowledgecenter/SSLTBW_2.2.0/com.ibm.zos.v2r2.ieag200/cputvari.htm

https://public.dhe.ibm.com/eserver/zseries/zos/DFSMS/HSM/zTCT/

Client ‘X’ Reduction Approximation

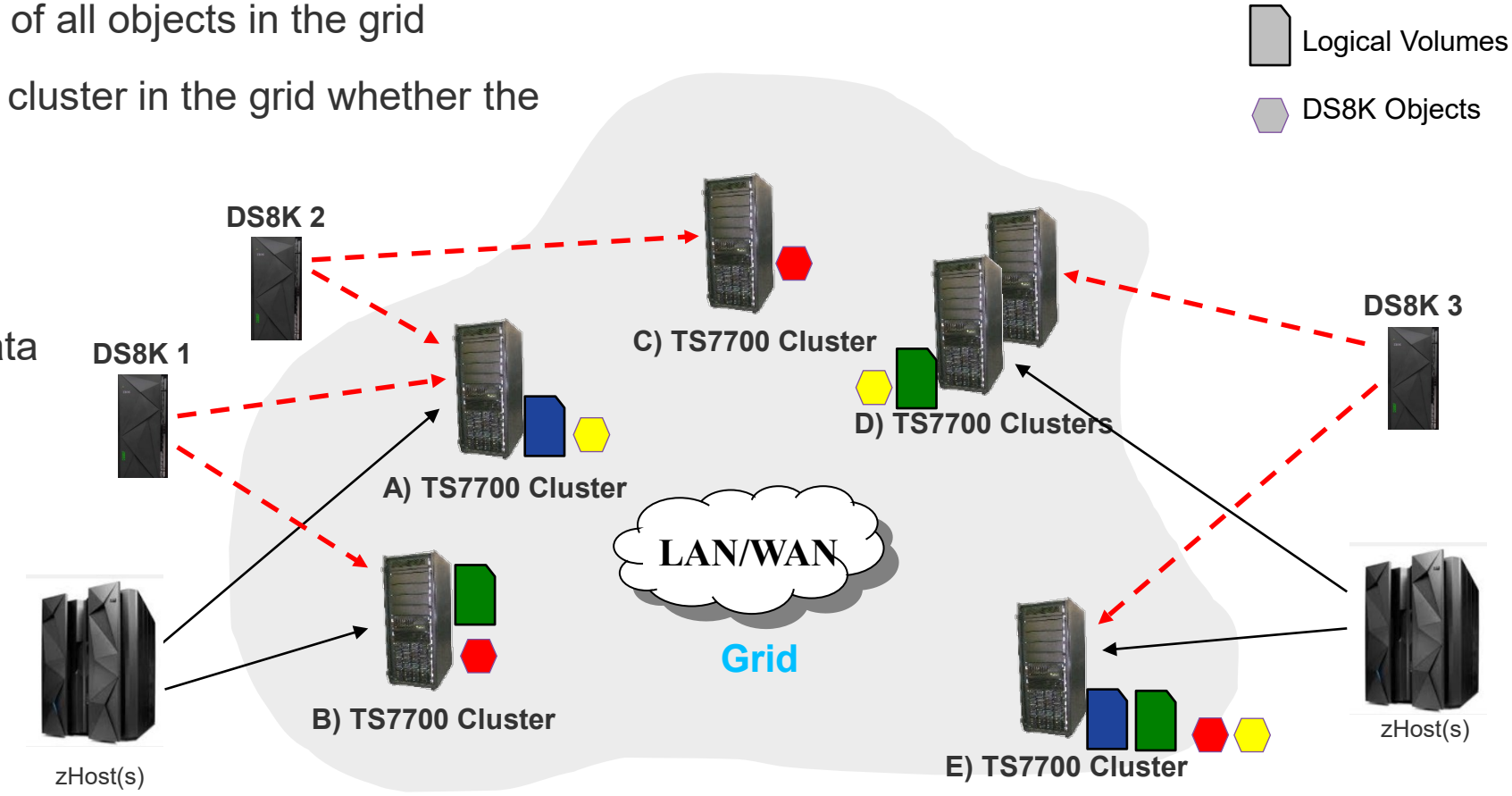


Based on approximations from internal IBM data measurements on an z15. Results will vary by customer based on particular workloads, configurations, software levels and the quantity and size of data sets being migrated.

TS7700 Advanced Object Store

(FC5283)

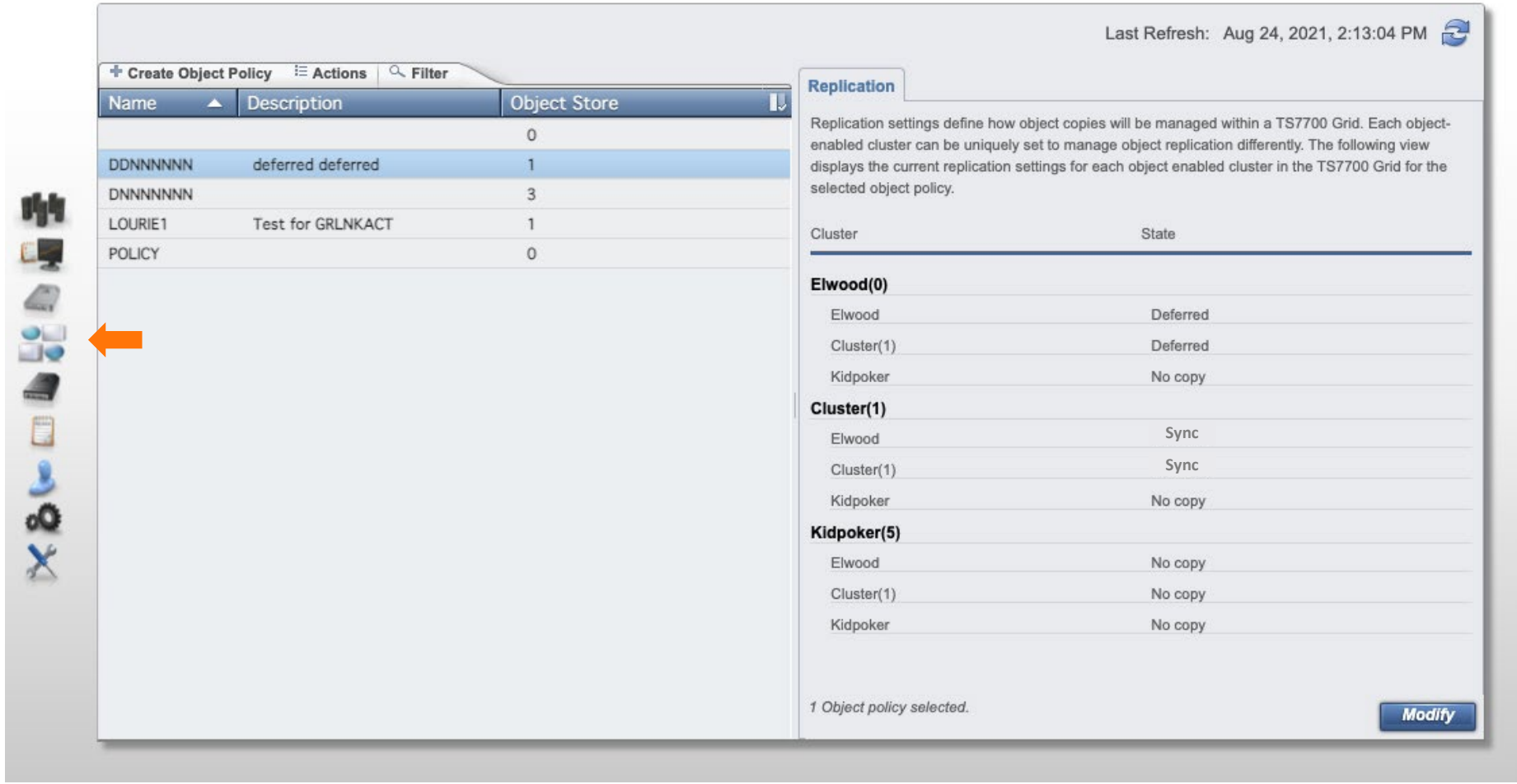
- Originally delivered in R5.0. Major enhancements in R5.22
- Support Grid Architecture for DS8K Objects
  - All TS7700 clusters are aware of all objects in the grid
  - Access to all objects from any cluster in the grid whether the cluster has a local copy or not
  - Tape Logical volumes and Object data in one system
  - Cache Partitioning of object data
  - DFSMS Cloud Network Connection construct used for policy management
  - Uses existing grid links and cache storage
  - R5.3 introduced migration services for Objects
  - Secure Data Transfer of Objects between TS7700 clusters (FC 5281 required)



R5.22 Object Policies

Object Policies

- New GUI page under the “Object” navigational icon
- Replication Policy: select copy mode type of Synchronous, deferred or no copy for each cluster in the grid
- Default policy automatically generated
- Grid scope page. Object policy changes will be sent to all DS8k Object Store clusters in the grid
- Changes to policies affect future PUT operations and not existing objects.

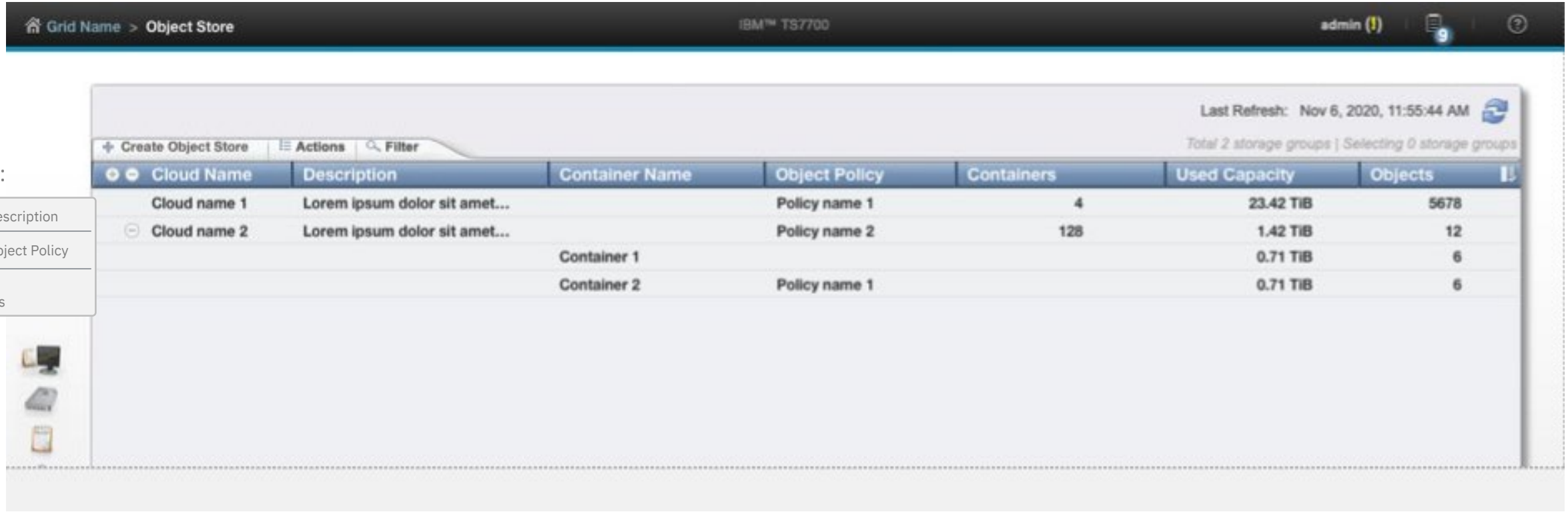


Actions:

- Modify Description
- Modify Replication
- Delete Properties

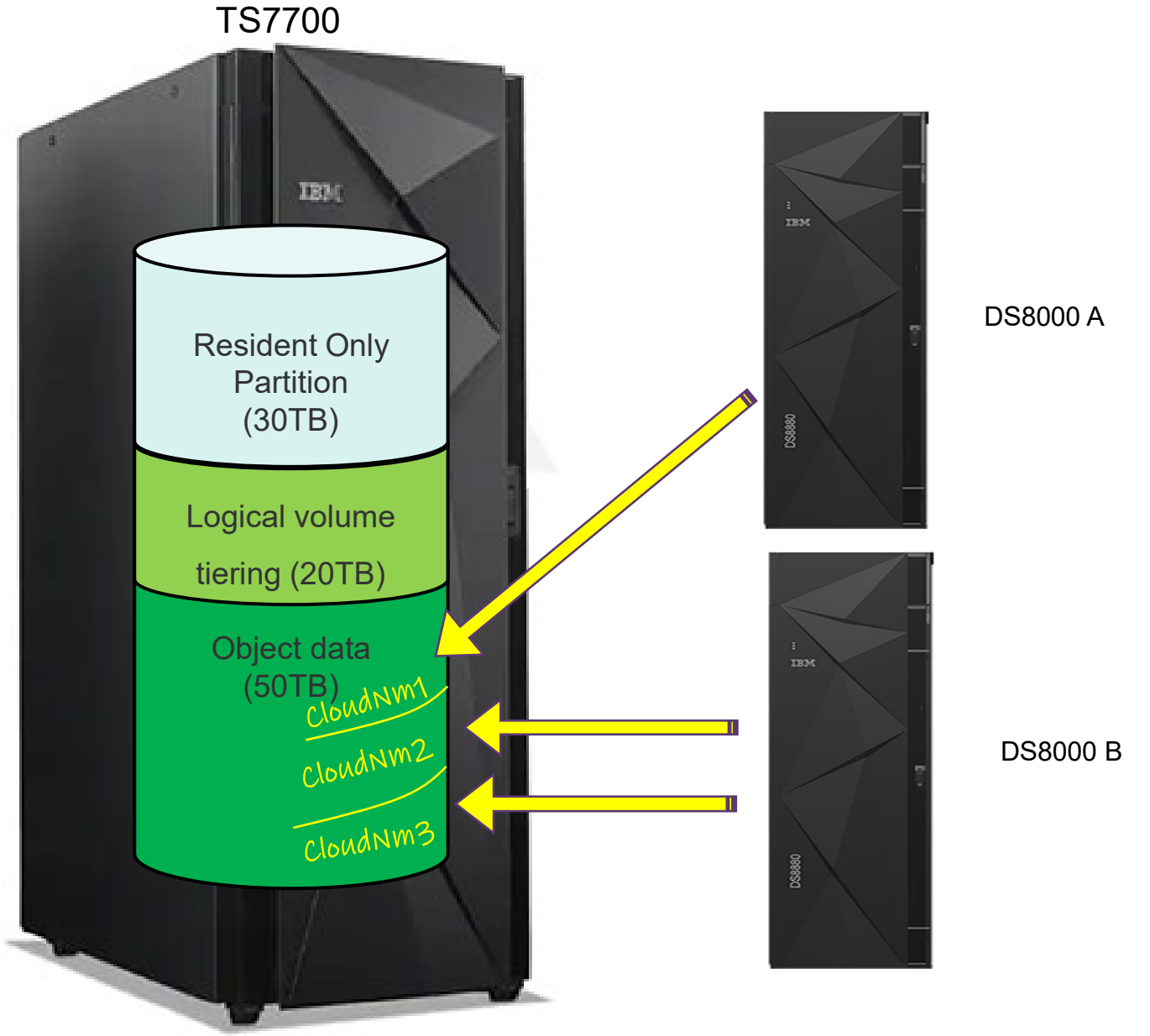
R5.22 Object Stores

- Must match the Cloud Network Connection Construct in DFSMS
- Grid scope page. Object Store changes will be sent to all DS8k Object Store clusters in the grid
- Creates a “Cloud Name” bucket under the object Cache Partition specified in the policy
- Host PUT commands contain Cloud Name and are matched to the associated object policy. This policy will be used to provide copy mode instructions in this release.



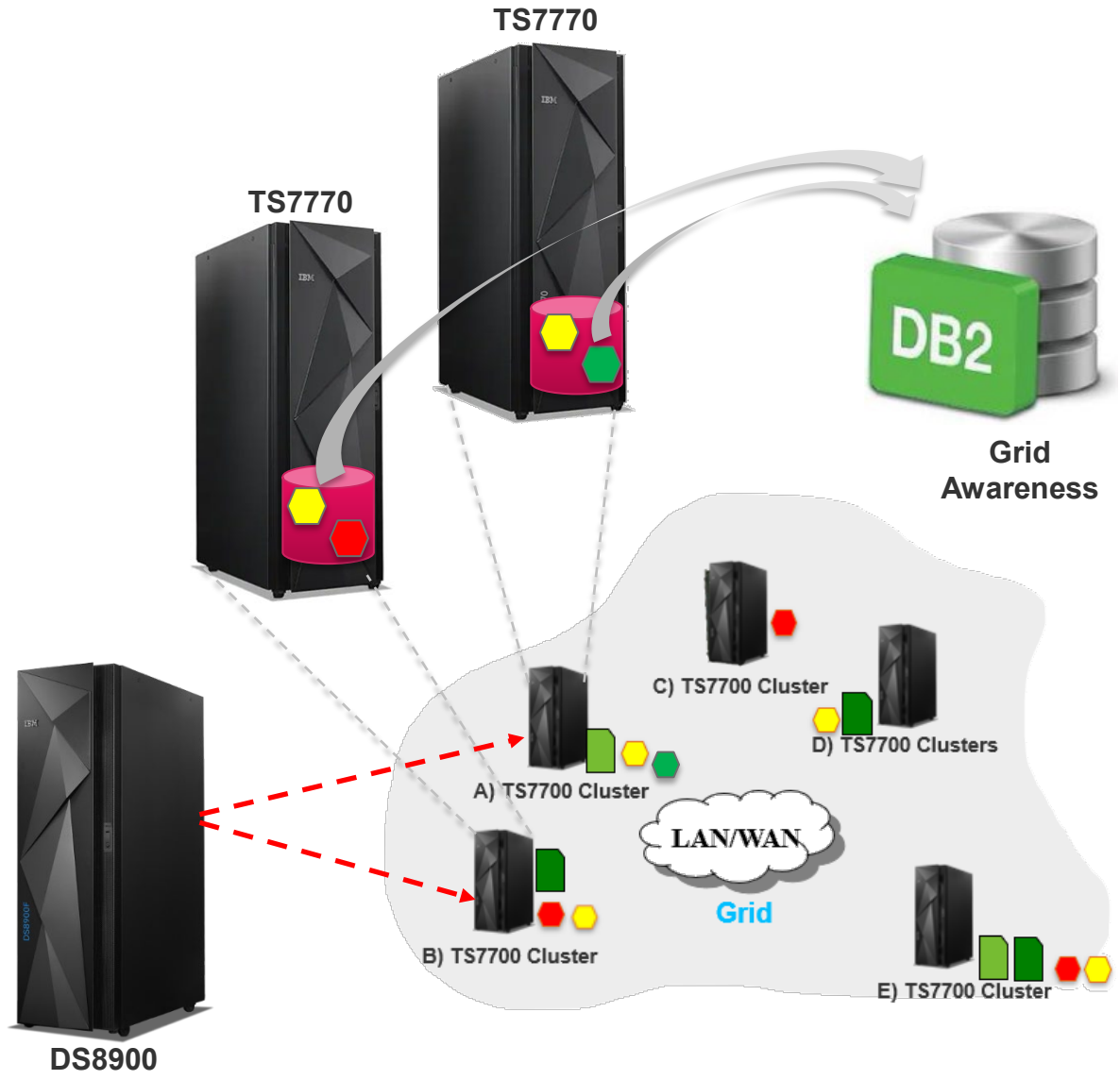
R5.0 TS7700 Object Cache Partition and Cloud Buckets

- Utilizes TS7700 Logical Cache Partitioning functionality with one partition for objects
- Within a grid, up to 256 “Cloud Name Virtual Object Stores” can be defined corresponding to Cloud Name configured in the customer DFSMS ISMF Cloud panel.
- Each DS8000 supports up to 8 object stores (R9.2x multi-cloud support required 3Q 2021).
- A cloud name virtual object store within a grid can be targeted by one or more DS8ks configured with the same cloud name.
- The sum of cache utilization of all defined cloud names in an object partition must stay within the allocated size of the partition (e.g. 50TB)



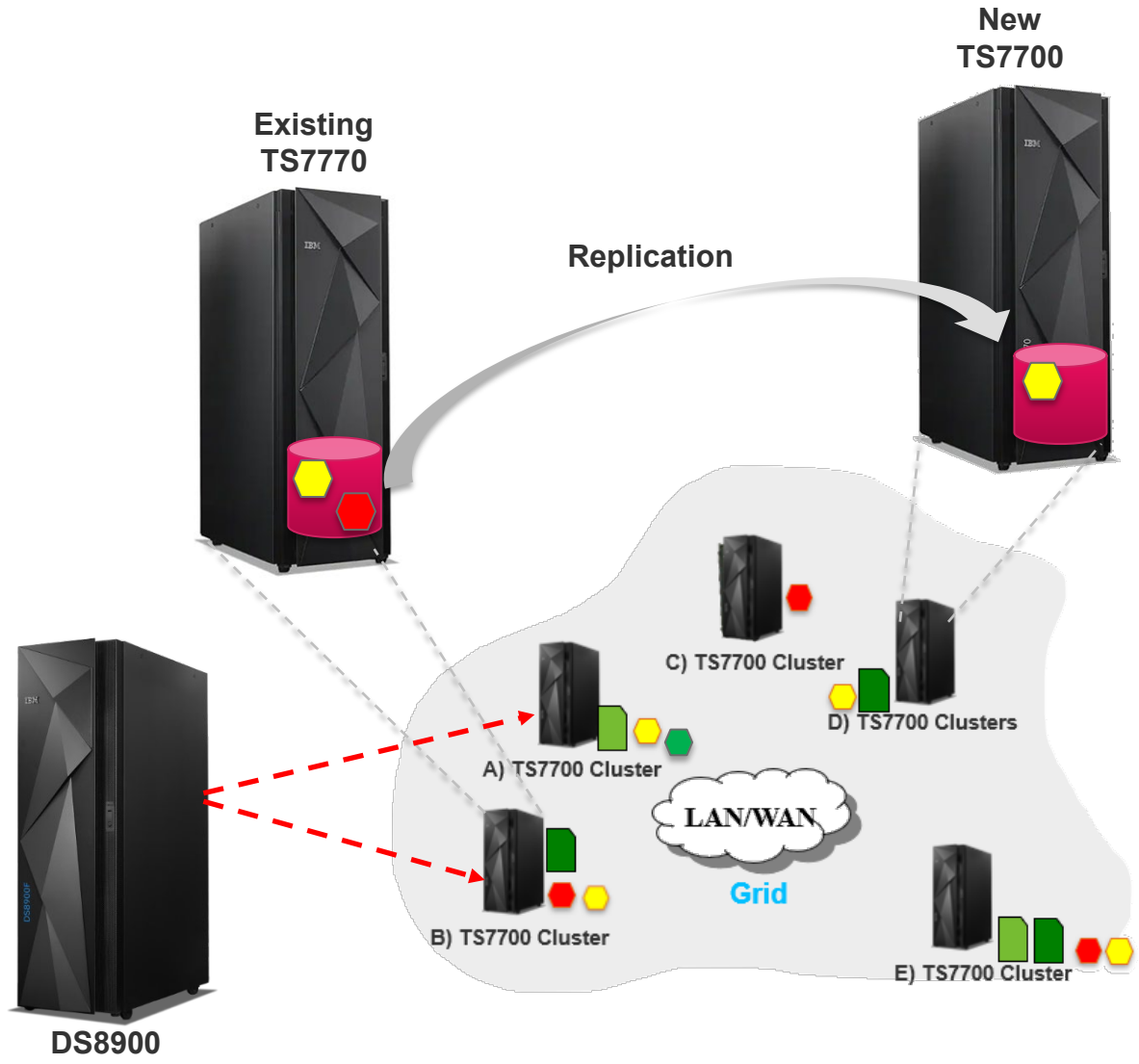
R5.3 FC5282 to FC5283 Migration

- Existing FC5282 Grids can migrate to FC5283
- Each TS7770 containing FC5282 will analyze all DS8K created objects and export them into the Grid DB2 instances
- Once completed, all objects previously created while under FC5282 will have full Grid awareness as if they were created under FC5283
- DS8900 will rely on the Grid for both synchronous and asynchronous replication and will no longer support writing to two TS7700s simultaneously



R5.3 FC5283 Migration Service

- FC5283 Enabled clusters can join existing grids
- Service provided to replicate objects from existing FC5283 enabled cluster to the newly joined cluster
- Filter criteria supported such as:
  - By cloudname
  - By container
  - By consistency
  - Custom object list



TS7700 Object Store Features

TS7770 with R5.22 or higher

Virtual Tape & Object Store

Co-existence of virtual tape and object data in the same TS7700. Uses existing grid links and cache storage

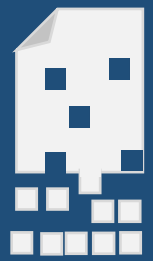
Logical Cache Partitions

Separation of tape and object data using logical cache partitioning

256 DS8000 Connections

Supports up up to 256 cloud network connections to a TS7700 Grid

Secure Data Transfer



Data in flight AES 256-bit encryption for object between DS8000 and TS7700 as well as clusters in the grid

Grid Awareness

New!

TS7700 Grid technology for objects. Access to any object in the grid regardless of where it exists. Automatic cluster self awareness of objects

Policy Management

New!

Synchronous and asynchronous policy managed replication for objects. Automatic handling of object copy queues

Utilities

New!

Object migrations, BVIR, Library Request command, and historical statistics support for objects

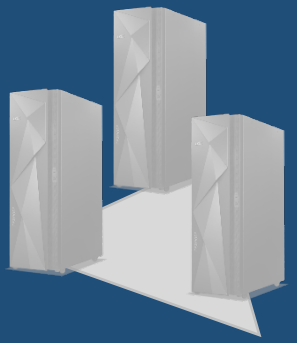
DS8000 TCT Features

DS8900 with V9.2 or higher

Clouds

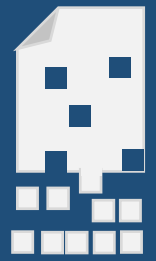
IBM Cloud Object Store, Amazon S3, Openstack Swift, **TS7700**

Environments



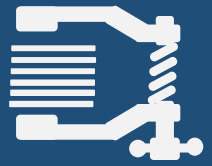
Simplex, Metro Mirror, Global Mirror, MGM Environments, with Hyperswap and Flashcopy

Encryption



Data in flight AES 256-bit encryption support to object store using Power9 crypto acceleration engine

Compression

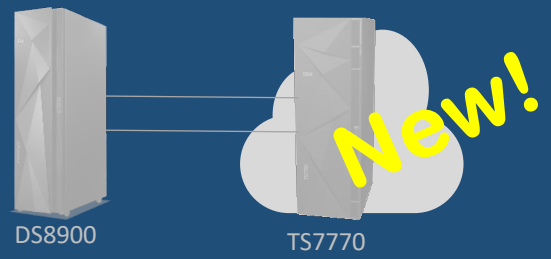


Power9 hardware accelerated NX842 compression to TS7700 object store if zEDC compression not used

Multi-Cloud

Configure up to 8 object store targets from the same DS8k. Mix of TS7700, public or private cloud

TS7700 Advanced Object Store



Support of the new TS7700 Advanced Object Store feature with enhanced bulk object processing

System Z TCT Applications

z/OS V2R3 or V2R4
+APARs as required

Targeted DFSMShsm Automatic Dataset Migration

IBM

Set Management Class policies to automatically migrate datasets

DB2 Image Copies

IBM

DB2 offline point-in-time copies using DSS FlashCopy, then MIGRATE STORAGEGROUP

DSS Dataset Disk Backups

IBM

Create DSS data set backups to HSM managed storage groups

Native DSS Full Volume Dump

IBM

DSS native full volume dumps. Create DSS FVD via FlashCopy and use DSS to move to the cloud. Restore directly to the source

DB2 System Level Backup

New!

IBM

Db2 invokes DFSMShsm to create flash copies then dumps the data to object store at Db2 level

DFSMShsm Full Volume Dump

New!

IBM

Create DSS FVD and use HSM to move to the cloud. Restore directly to the source

FDR and FDRABR

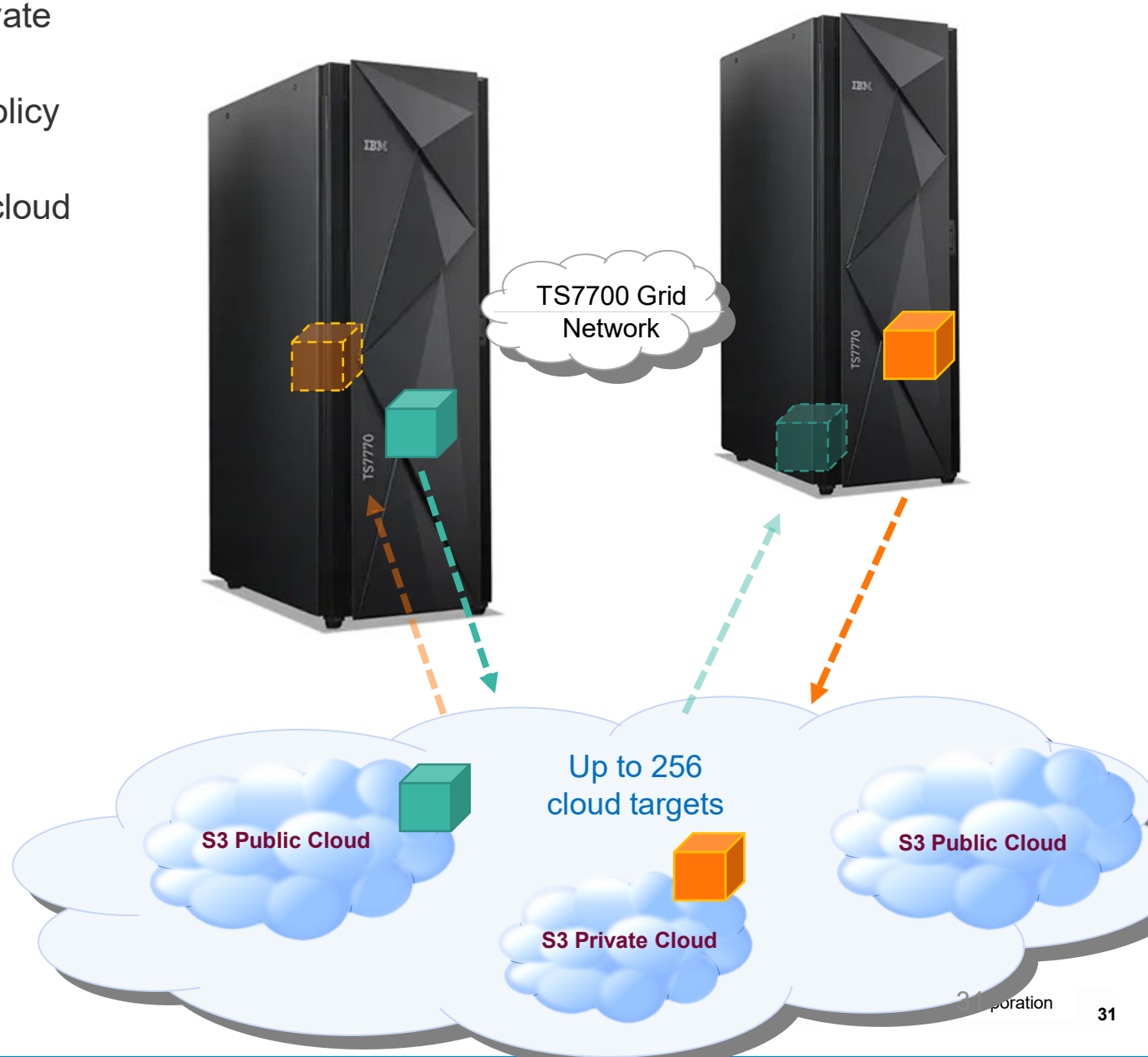
bmc

Move FDR and FDRABR backup and archive data to the cloud

TS7700 Cloud Storage Tier

TS7700 Cloud Storage Tier

- Leverage Cloud Storage Tier for off load to public or private cloud
- Put copies of logical volumes into an object store thru policy management
- Once one cluster puts a logical volume in the cloud, all cloud clusters have access to the copy in the cloud
  - Regardless of a cluster having a copy
  - Ghost copy to skip copy if a copy is verified in the cloud
  - Once a TS7700C is joined into the grid
  - If an existing non-cloud cluster is upgraded to a TS7700C
- Uses existing Grid network for cloud connectivity
- Supports TLS1.2 for data in-flight encryption



Supported Clouds:

IBM Cloud

IBM Cloud Public (iRPQ)

IBM Cloud Object Storage

IBM COS Private

amazon web services

Amazon AWS S3 Public

RStor

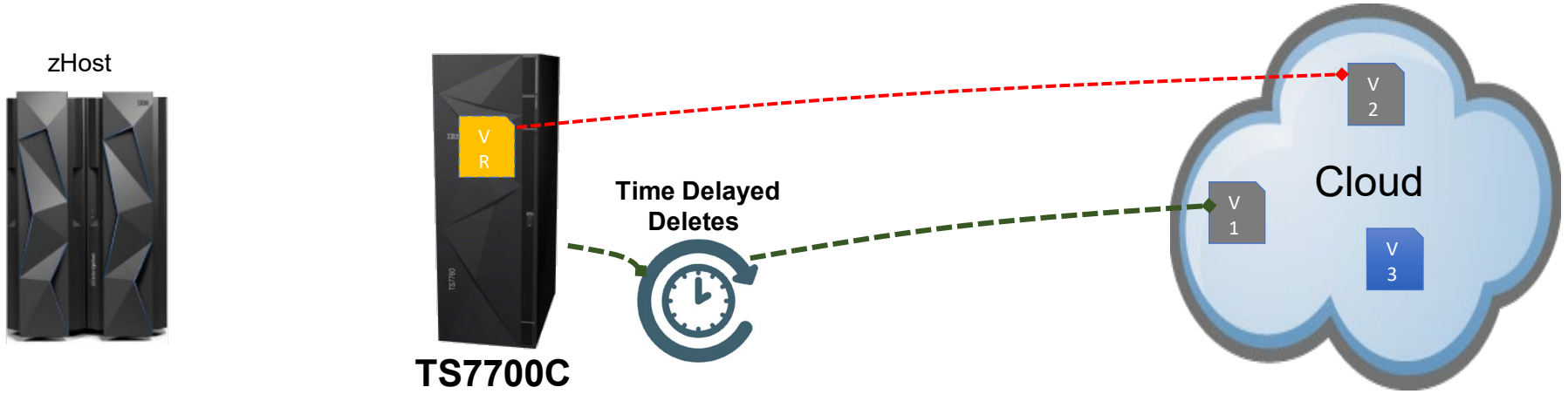
Rstor private and public (iRPQ)

R5.1pga1 TS7700C Volume Retention Recovery

- With natural TS7700 usage, volumes are modified, scratched, data-deleted and reused
  - Cloud Pool Retention allows previous versions to be retained in the cloud for either Cloud Export Restore or specific volume recovery
- Volume Retention Recovery (VRR)
  - Enable version retention within one or more Cloud Pools (Dual Control Protected)
  - In the event a previous version of a logical volume needs to be restored, it can be recovered into a new scratch volume
  - New volume will automatically map to previously retained volume in the cloud (no recall required)
  - The recovered volume is marked “live” and the retained version in the cloud is no longer a candidate for deletion
  - Any future access will re-label the recalled version on-demand allowing recoveries to keep the cloud version read-only
  - Unless modified once recalled, the retained version in the cloud remains immutable indefinitely and is only accessed if a volume is requested
  - The recovered volume can also be retained when it expires or is modified allowing future retention recovery
  - All recoveries are initiated through LI REQ allowing for batch style recovery

Since expired…
DATASET=DS12345
TAPE=**VOL002**
DATE=MM/DD/YY

Becomes…
DATASET=DS12345
TAPE=**VOL00R**
DATE=MM/DD/YY



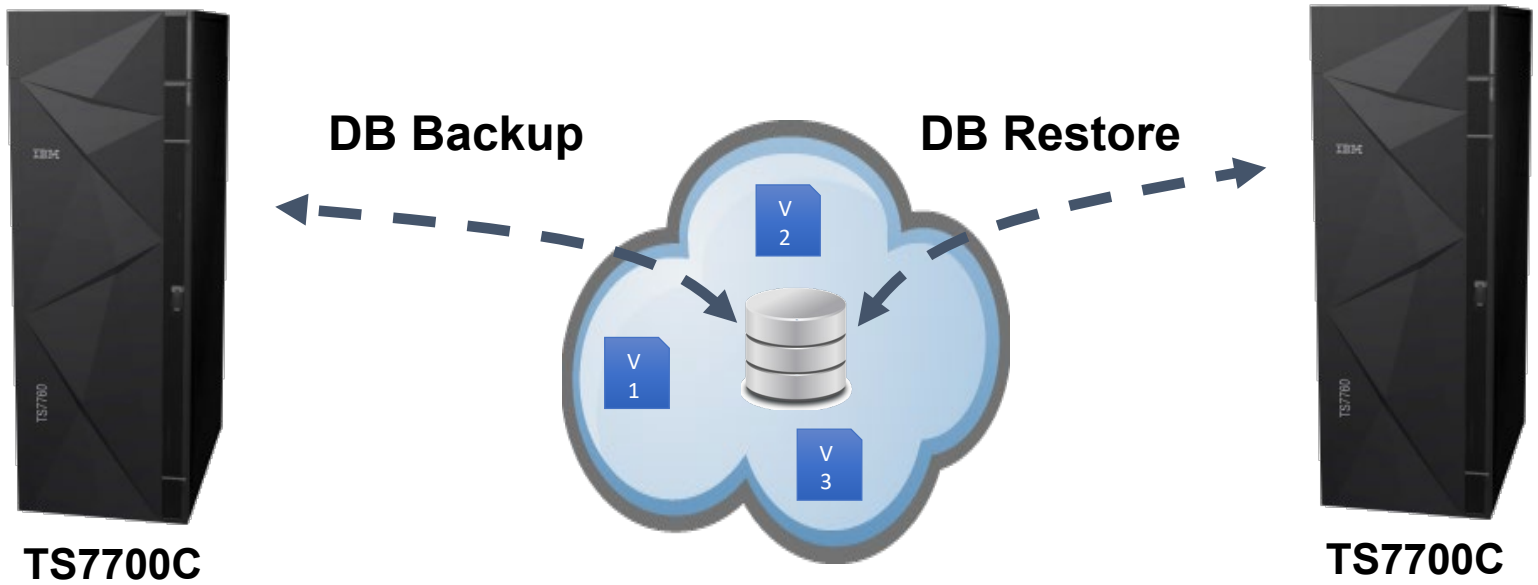
TS7700C Cloud Export and Recovery

Backup/Export

- Take **periodic point-in-time backup** of the TS7700C database and store it in the cloud using Z LIBRARY EXPORT command
- The TS7700C ensures **all queued objects are premigrated** before taking the backup
- **Backup is put into** one or more **cloud** containers specified by the user based on the cloud pool

Restore/Recovery

- **Full system recovery** - Recover into a TS7700 stand-alone using backup stored in the cloud
  - TS7700 now has full access to all cloud data
- **Single volume version recovery** – recover one or more older logical volume versions into new scratch volume using LI REQ
- **Import** of data back into TS7700 disk cache happens over time **as recall requests** are **received** in both cases



Logical WORM with Retention

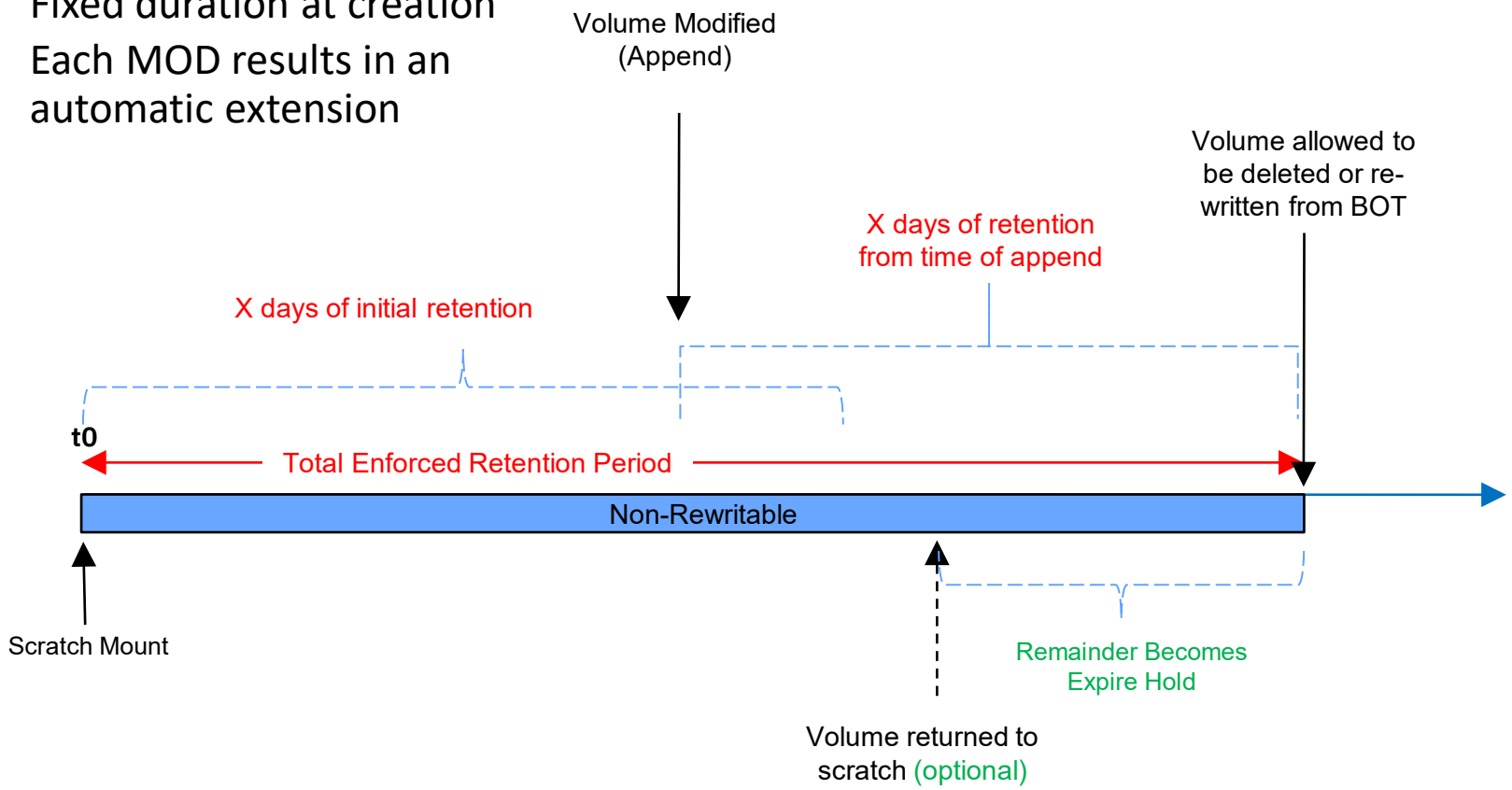
TS7700 R5.1pga1 LWORM Retention

Extension of LWORM

- Two retention types
  - Fixed duration
  - HDR1 expiration date
- Three choices for retention duration at volume creation
  - Fixed duration settings include days to retain with option to extend at mod time or “forever”
  - HDR1 Tape Management System provided expiration date
  - Fixed/Added Duration at return to scratch time (dynamic expire-hold)
- Numerous settings allow customized behaviors
  - How to handle TMS dates that imply “Application Managed”
  - How to handle cases where no HDR1 date is provided
  - Whether to allow return to scratch before retention period expires
    - If allowed, the volume will go into an expire-hold state until the retention period passes supporting move back to private if needed
    - Option to extend or introduce a retention period when returned to scratch providing a data class granular expire-hold capability

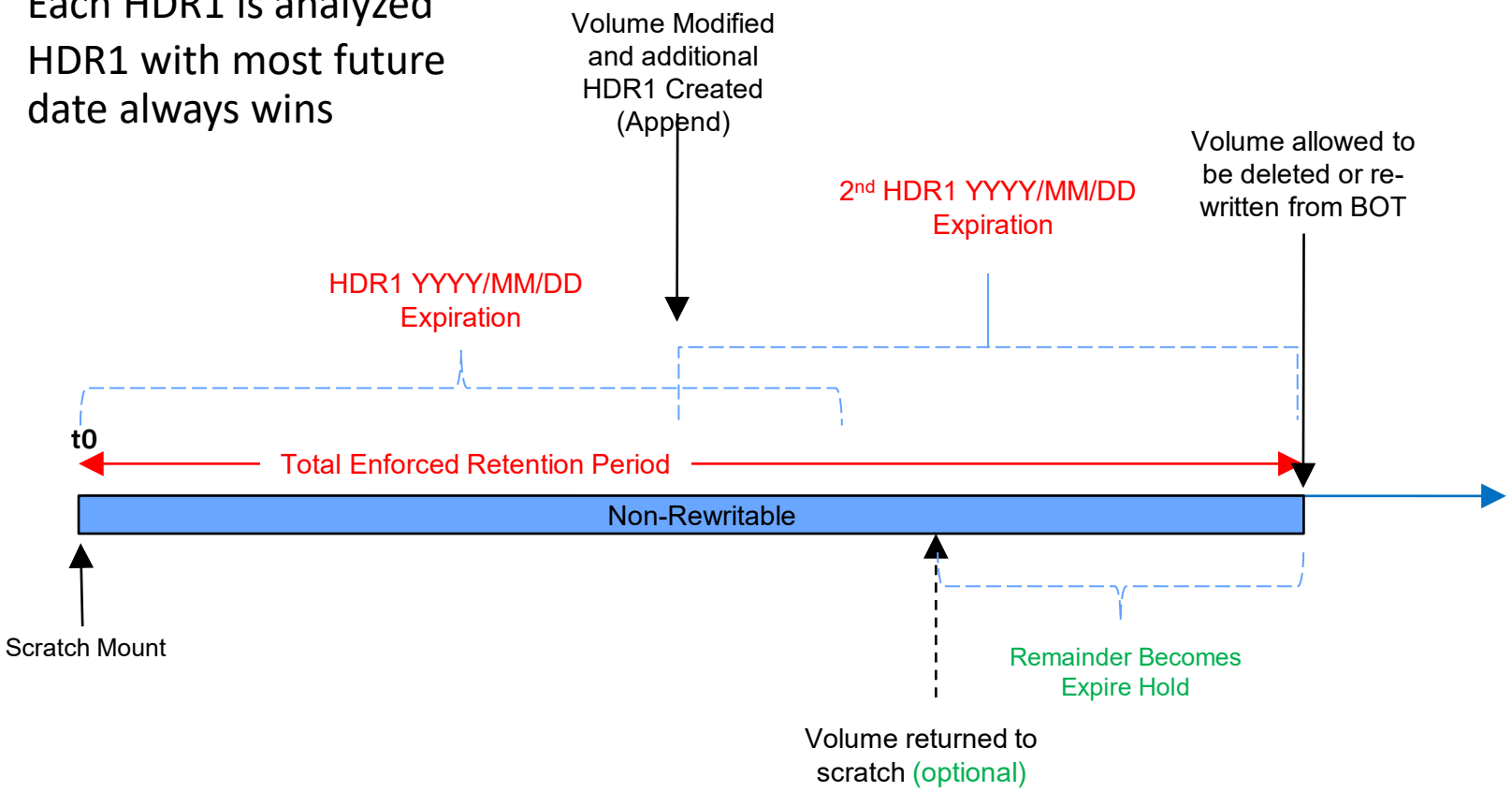
TS7700 R5.1pga1 LWORM Retention

- Fixed Duration
  - Fixed duration at creation
  - Each MOD results in an automatic extension



TS7700 R5.1pga1 LWORM Retention

- HDR1 Based Retention
  - Each HDR1 is analyzed
  - HDR1 with most future date always wins



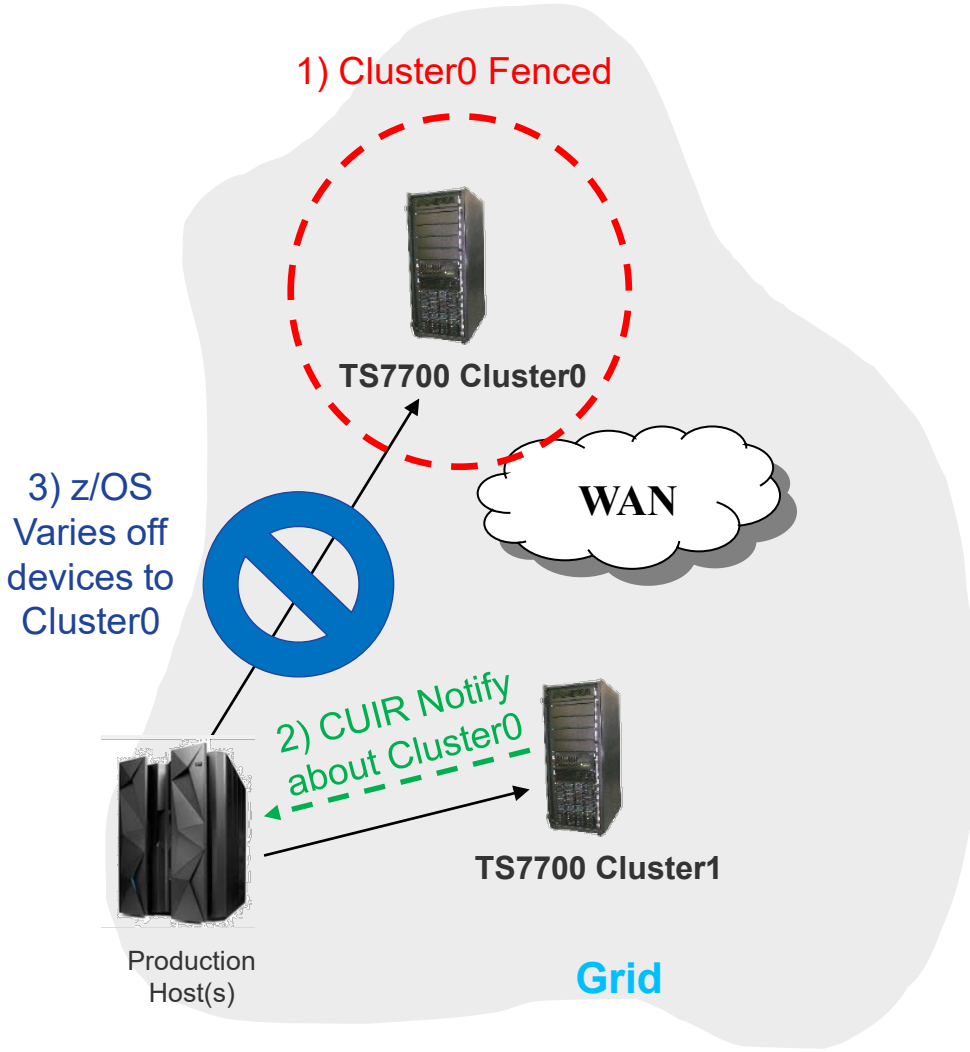
TS1160 (Jag6) R5.2.1 PGA1 1Q2022

- **Support previous gen JC/JD and new media JE**
  - All JA, JJ and JB media types will not be supported without previous gen (TS1140 or older) drives being present too.
  - New 20TB JE and a 50% capacity increase on previous gen JD to 15TB
  - Heterogeneous drive support in TS7760T and TS7770T for migration purposes
    - 4+ TS1160 “read-write” drives and 2+ “read only” drives from one previous TS1140 or older drive generation
    - Still limited to 16 total drives

TS1100 Generations 	**TS1140 (E07)**	**TS1150 (E08)**	*TS1155 (E55)*	**TS1160 (E09)**
Write Formats				✪ 20 TB (JE-E09)
		✪ 10 TB (JD-E08)	↗ *15 TB (JD-E55)* *10 TB (JD-E08)*	15 TB (JD-E55) 10 TB (JD-E08)
	✪ 4 TB (JC-E07)	↗ 7 TB (JC-E08) 4 TB (JC-E07)	*7TB (JC-E08)*	7 TB (JC-E08)
	1.6 TB (JB-E07) 1 TB (JB-E06)			
Read Formats	ALL (JC) ALL (JB) ALL (JA)	ALL (JD) ALL (JC)	*ALL (JD)* *ALL (JC)*	ALL (JE) ALL (JD) ALL (JC)
Native Data Rate	**250 MB/s**	**360 MB/s**	360 MB/s	**Up to 400 MB/s**
Attachment	**FC-8**	**FC-8**	FC-8, 10 GigE (RoCE)	**FC-16, 10 or 25 GigE (RoCE)**

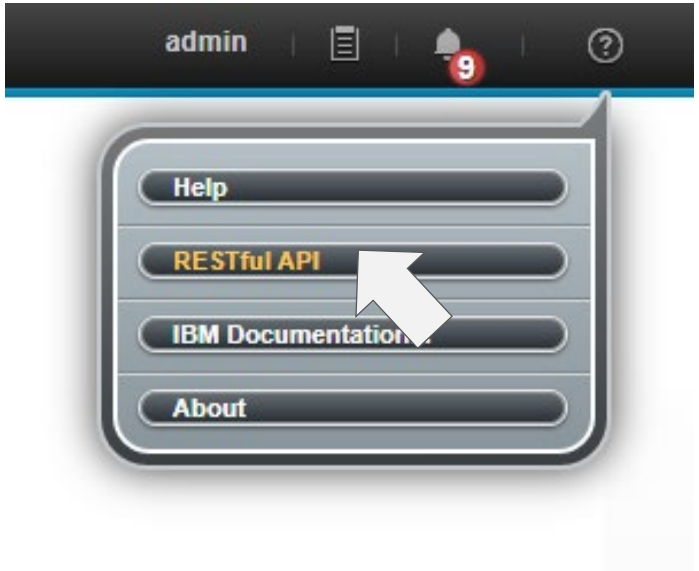
R5.2 CUIR Grid Resiliency Improvement

- Builds upon Grid Resiliency and CUIR
  - Functions previously introduced in R4.1.2
  - Grid resiliency uses thresholds and other methods to determine a TS7700 cluster in a grid is not healthy and will fence the cluster
  - CUIR provides a way for a cluster to notify attached z/OS hosts to automatically vary off devices ahead of a planned outage
- z/OS notified of unhealthy clusters (New)
  - When a cluster is fenced as part of Grid Resiliency, any cluster connected to the same hosts as the unhealthy cluster will be notify the attached hosts about the unhealthy cluster through CUIR
  - The hosts will then auto-vary offline the devices to the unhealthy cluster
  - A single sick cluster can also notify its own attached hosts that it's sick
- Post outage
  - The unhealthy cluster will then notify the host to auto vary the devices back online once it has recovered



R5.3 RESTful API

- Introducing the TS7700 REST API
- JSON style RESTful API for accessing different TS7700 settings traditionally available through the Management Interface
- Current RESTful API options
  - Grid Summary
  - Cluster Summary
  - Construct Settings
    - Management Class
    - Storage Group
    - Storage Class
    - Data Class
  - Categories
- Additional settings coming soon!



R5.3 RESTful API – Grid Summary

```
curl "https://168.127.0.11:443/api/v1/grid -H Authorization: Bearer ${MYKEY}“

{
    "metadata": {
        "responseSent": "2022-08-16T22:05:05.398Z",
        "request": "GET http://168.127.0.11/api/v1/grid",
        "resources": 1,
        "requestReceived": "2022-08-16T22:05:04.142Z"
    },
    "data": [
        {
            "insertedVirtualVolumes": 1031234,
            "compositeLibrarySeqNum": "BA025",
            "name": "BARR25",
            "description": "",
            "licensedVirtualVolumes": 4000000,
            "clusters": 2
        }
    ]
}
```

R5.3 RESTful API – Cluster Summary

```
curl "https://168.127.0.11:443/api/v1/clusters -H Authorization: Bearer ${MYKEY}"

 "data": [
        {
            "product": "TS7770",
            "fenced": "no",
            "clusterFamily": "Testing",
            "licensedThroughput": 100,
            "usedCapacity": 3688.0,
            "objectEnabled": false,
            "cloudEnabled": false,
            "mtm": "3957VED",
            "description": "",
            "licensedCapacity": 200.00014336,
            "physicalTapeEnabled": false,
            "installedCapacity": 307.958382592,
            "licensedPremigrationQueueSize": 0.0,
            "name": "Pine",
            "varyDevicesOnlineRequired": false,
            "id": 0,
            "sn": "78-99999",
            "state": "warning",
            "microcodeLevel": "8.53.0.00",
            "licensedVirtualDrives": 256,
            "gridEnabled": true,
            "distributedLibrarySeqNum": "BA025"
        },
```

R5.3 RESTful API – Management Class

```
curl "https://168.127.0.11:443/api/v1/managementClasses -H Authorization: Bearer ${MYKEY}"
 "data": [
        {
            "copyModes": [
                {
                    "fromCluster": 4,
                    "toCluster": 0,
                    "scratchMountCandidate": true,
                    "copyMode": "syncCopy"
                },
                {
                    "fromCluster": 4,
                    "toCluster": 4,
                    "scratchMountCandidate": true,
                    "copyMode": "deferredCopy"
                },
...
 "clusterSettings": [
                {
                    "timeDelayAfter": "volumeCreation",
                    "cluster": 4,
                    "syncDeferredOnWriteFailure": false,
                    "secondaryTapeVolumePool": 0,
                    "description": "The default Management Class",
                    "onPrivateMount": "openBothCopiesOnZosImpliedUpdate",
                    "timeDelay": 24,
                    "retainCopyMode": false
                },
```

Disclaimers and Trademarks 1 of 2

- Copyright© 2022 by International Business Machines Corporation.
- No part of this document may be reproduced or transmitted in any form without written permission from IBM Corporation.
- The performance data contained herein were obtained in a controlled, isolated environment. Results obtained in other operating environments may vary significantly. While IBM has reviewed each item for accuracy in a specific situation, there is no guarantee that the same or similar results will be obtained elsewhere. These values do not constitute a guarantee of performance. The use of this information or the implementation of any of the techniques discussed herein is a customer responsibility and depends on the customer's ability to evaluate and integrate them into their operating environment. Customers attempting to adapt these techniques to their own environments do so at their own risk.
- Product data has been reviewed for accuracy as of the date of initial publication. Product data is subject to change without notice. This information could include technical inaccuracies or typographical errors. IBM may make improvements and/or changes in the product(s) and/or programs(s) at any time without notice. Any statements regarding IBM's future direction and intent are subject to change or withdrawal without notice, and represent goals and objectives only
- References in this document to IBM products, programs, or services does not imply that IBM intends to make such products, programs or services available in all countries in which IBM operates or does business. Any reference to an IBM Program Product in this document is not intended to state or imply that only that program product may be used. Any functionally equivalent program, that does not infringe IBM's intellectually property rights, may be used instead. It is the user's responsibility to evaluate and verify the operation of any on-IBM product, program or service.

Disclaimers and Trademarks 2 of 2

- THE INFORMATION PROVIDED IN THIS DOCUMENT IS DISTRIBUTED "AS IS" WITHOUT ANY WARRANTY, EITHER EXPRESS OR IMPLIED. IBM EXPRESSLY DISCLAIMS ANY WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NONINFRINGEMENT.
- IBM shall have no responsibility to update this information. IBM products are warranted according to the terms and conditions of the agreements (e.g. IBM Customer Agreement, Statement of Limited Warranty, International Program License Agreement, etc.) under which they are provided. IBM is not responsible for the performance or interoperability of any non-IBM products discussed herein.
- Information concerning non-IBM products was obtained from the suppliers of those products, their published announcements or other publicly available sources. IBM has not tested those products in connection with this publication and cannot confirm the accuracy of performance, compatibility or any other claims related to non-IBM products. Questions on the capabilities of non-IBM products should be addressed to the suppliers of those products.
- The provision of the information contained herein is not intended to, and does not, grant any right or license under any IBM patents or copyrights. Inquiries regarding patent or copyright licenses should be made, in writing, to:

  IBM Director of Licensing
  IBM Corporation
  North Castle Drive
  Armonk, NY 10504-1785
  U.S.A.

- The following terms are trademarks or registered trademarks of the IBM Corporation in either the United States, other countries or both.
  - IBM, TotalStorage, zSeries, pSeries, xSeries, S/390, ES/9000, AS/400, RS/6000
  - z/OS, z/VM, VM/ESA, OS/390, AIX, DFSMS/MVS, OS/2, OS/400, ESCON, Tivoli
  - iSeries, ES/3090, VSE/ESA, TPF, DFSMSdfp, DFSMSdss, DFSMShsm, DFSMSrmm, FICON,
- Microsoft, Windows, Windows NT, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both. Other company, product, and service names mentioned may be trademarks or registered trademarks of their respective companies.

IBM Storage

Unleash the potential of your data.

thank you!