Understanding the IBM z/OS Cloud Object Storage Solutions

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Session IBM_copy227

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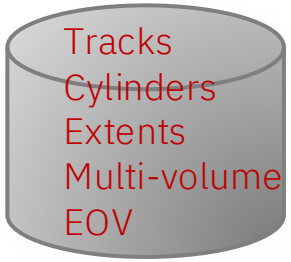
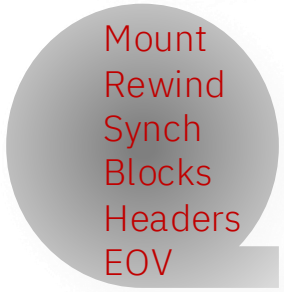
Agenda

- Hybrid Cloud Object Storage – The Basics
- Client Interest
- The Foundational Technology
- The Big Picture
- Use Cases

The Basics of Hybrid Cloud Object Storage

Traditional storage requires extensive media awareness





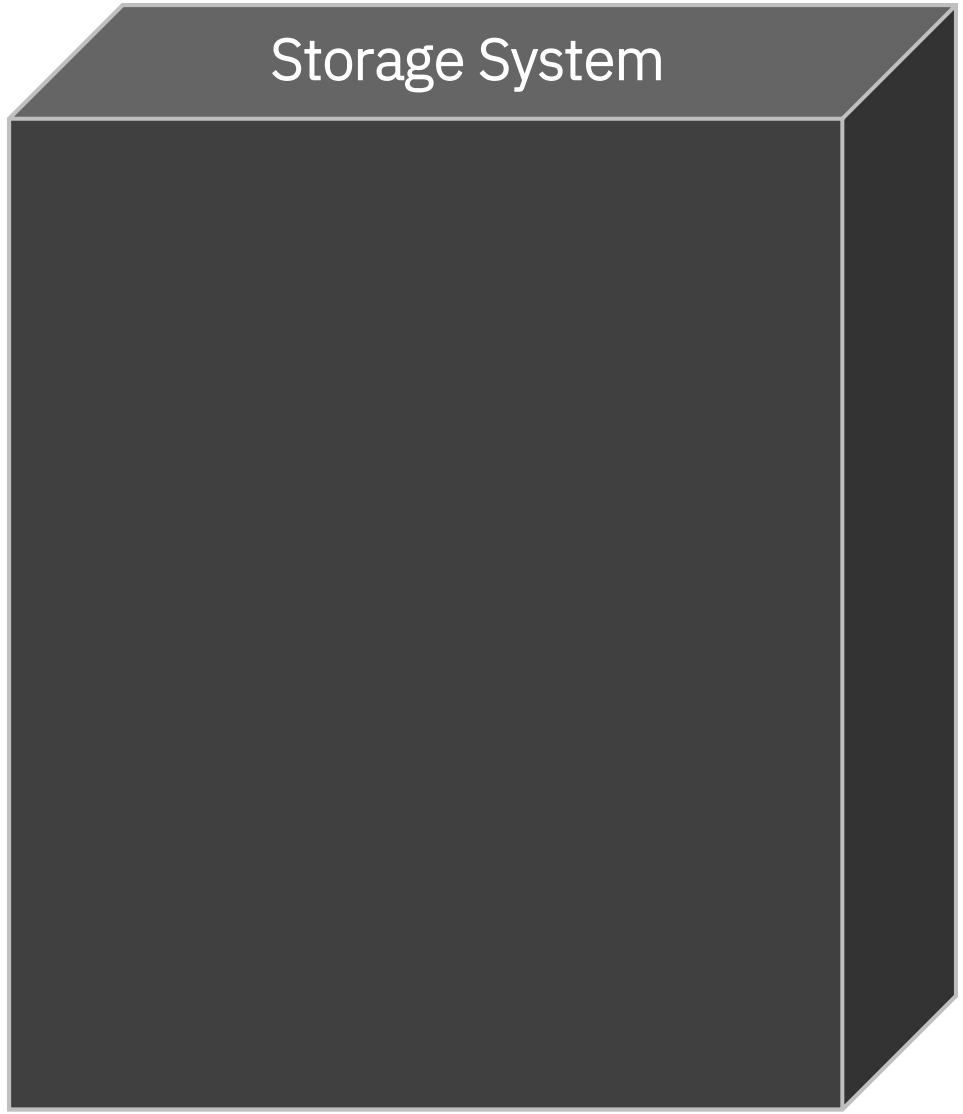
Transactional, Record-level, Performance critical

Complex WRITE, READ, ERASE APIs

Object Storage requires NO media awareness

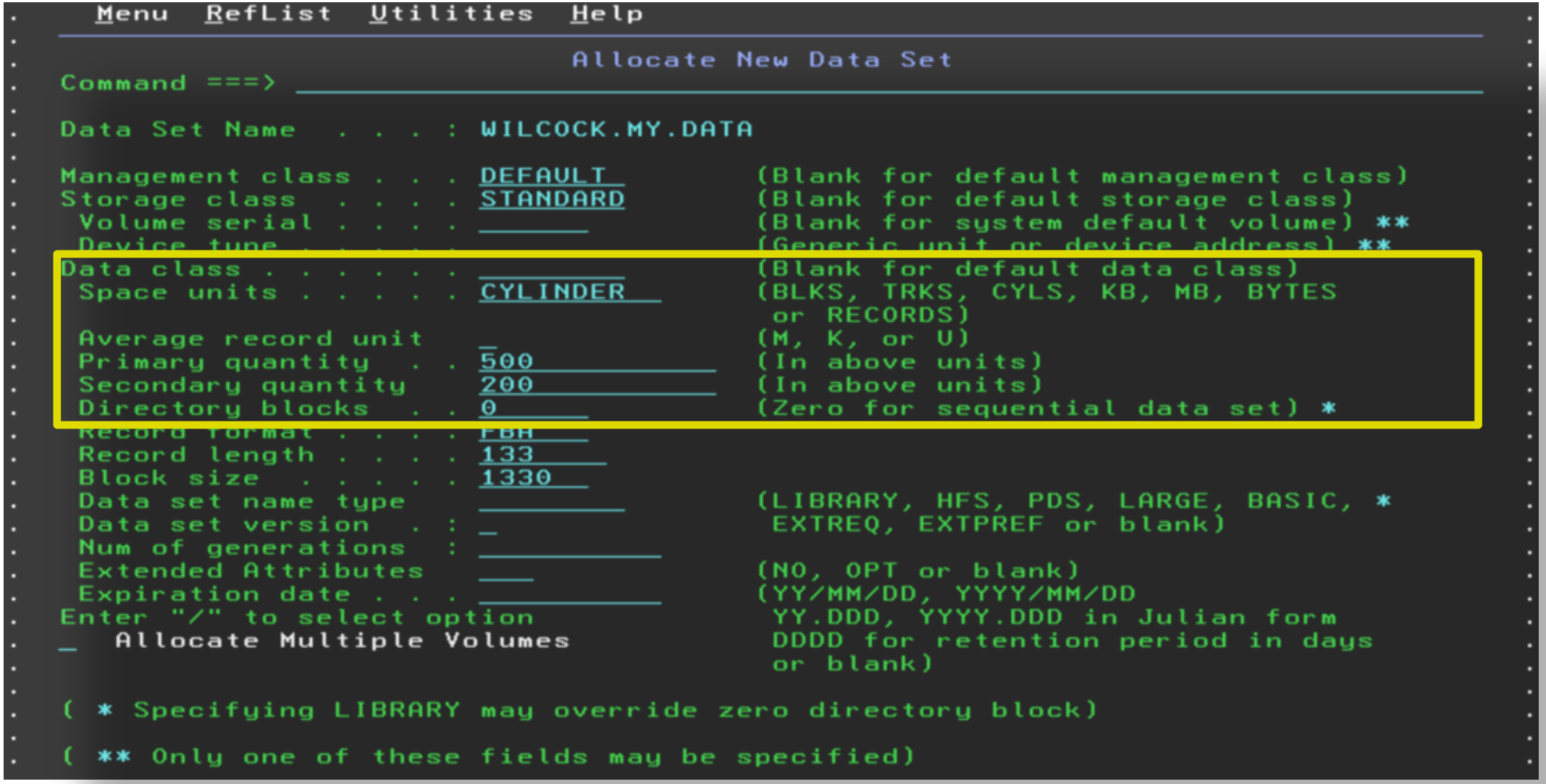
Sequential, WORM, WORN

Simple, industry standard PUT, GET, DELETE APIs



Data Set Allocation...

Close your eyes and hope for the best!!



z/OS Client Interest in Hybrid Cloud Object Storage

60% of Infrastructure and Operations leaders will implement hybrid cloud file deployments, up from 20% in early 2023*

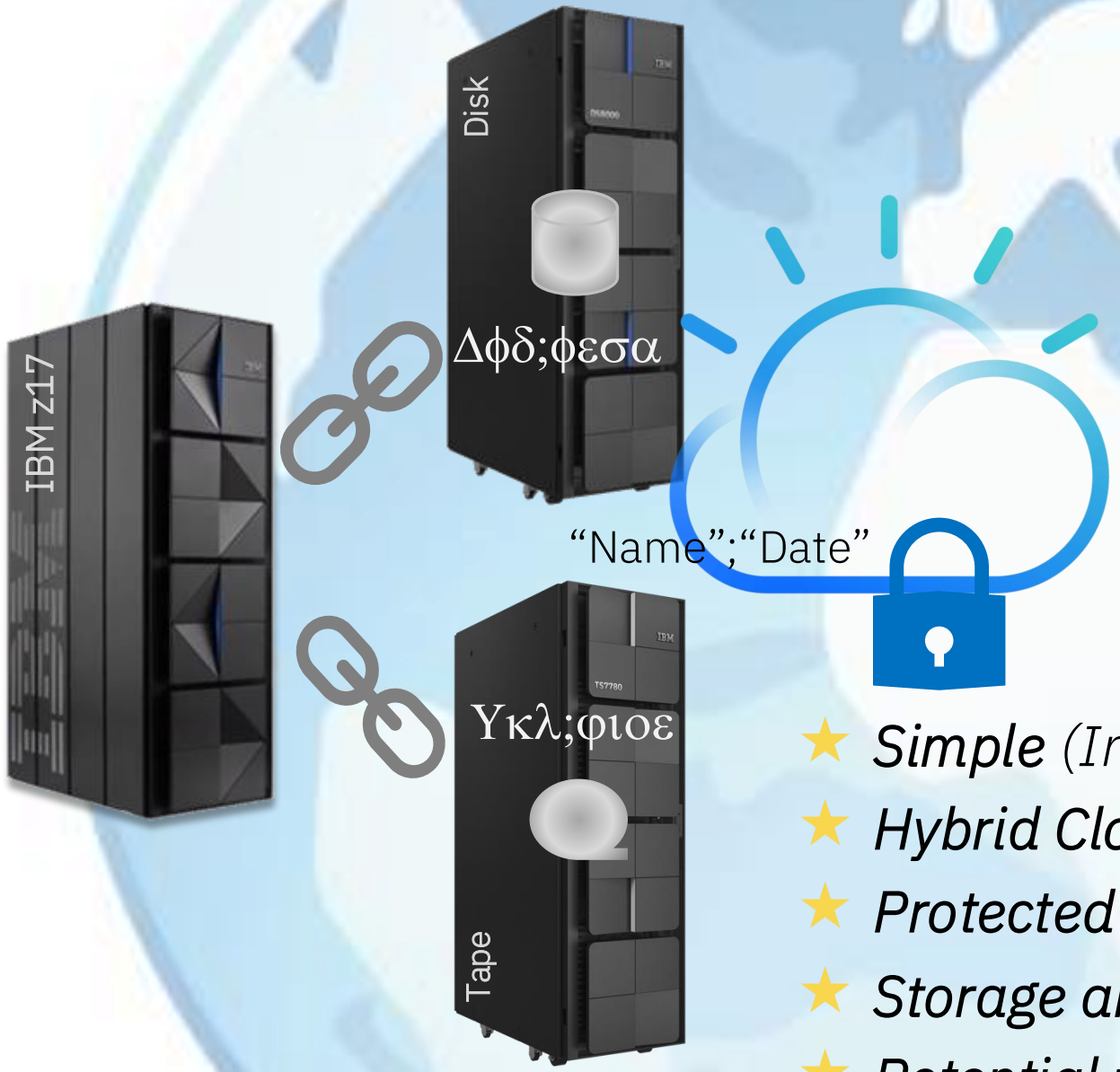
Clients want a simplified z/OS platform that leverages industry standard interfaces

Clients want a cohesive view of all data across their enterprise *and* all their platforms to leverage the enterprise investment in hybrid cloud object storage

Clients want protected, off-prem copies of their data

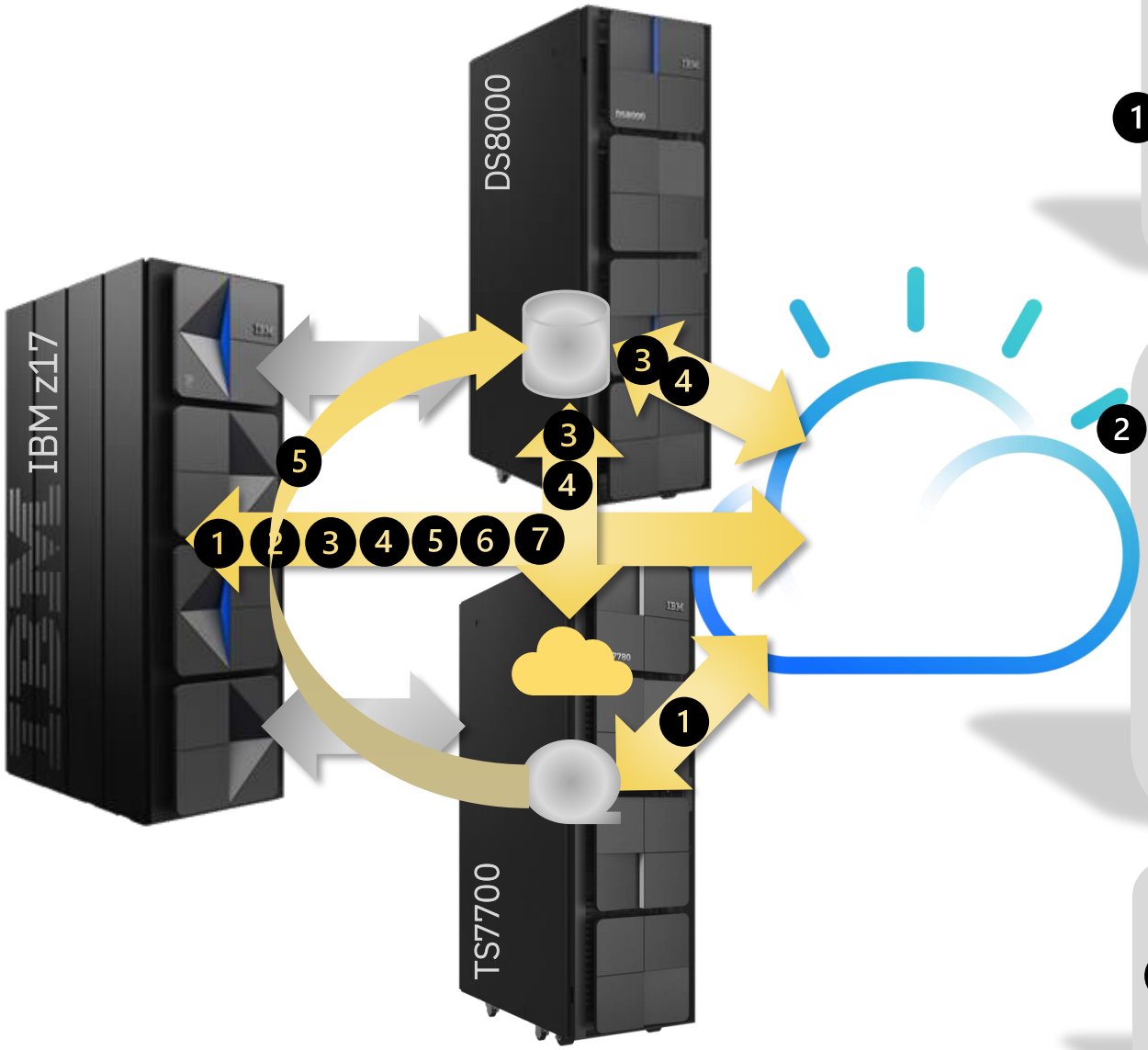
*Source: Gartner, Top Trends in Enterprise Data Storage 2023, 29 June 2023

The z/OS Perspective



- ★ *Simple (Industry Standard)*
- ★ *Hybrid Cloud: On/Off-prem; Private/Public*
- ★ *Protected*
- ★ *Storage and Data sharable across platforms*
- ★ *Potential to lower costs*

Where to Begin? Determine your Use Case(s)



Solutions Transparent to z/OS

1 TS7700 Cloud Storage Tier enables a seamless extension of the TS7700.

<OR>

IBM Cloud Tape Connector for z/OS enables a software only solution.

Leverage Products that are Object Aware

2 OAM for unstructured data

DFSMS support for DS8900 Transparent Cloud Tiering (TCT), TS7700 DS8000 Object Store and Direct to Cloud

3 DFSMShsm Migration for cold data

4 DFSMSdss Full Volume Dump for cyber resiliency

DFSMScdm for object storage data management

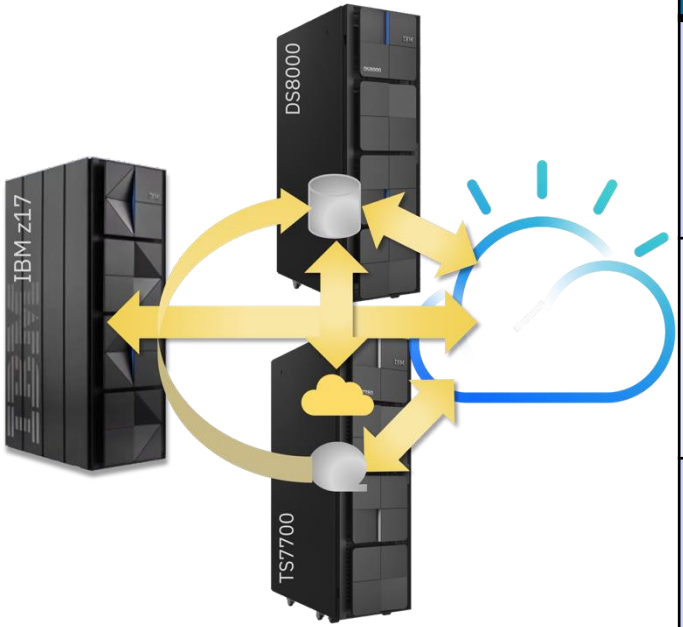
5 Convert ML2 to MLC for 'deep archive'

6 Object data management at scale

Update Applications & Processes directly

7 DFSMS Cloud Data Access (CDA), GDKUTIL and DFSMScdm for data sharing across sysplexes and platforms

Leveraging Object Storage in z/OS …



	Maintain SLAs	Application Transparent	Leverage specific cloud capabilities *(object lock, versioning, etc)*	Sharable Data
TS7700 CST				
Product Aware – nonSharable Data (DSS, HSM, OAM, CTC)				
Product Aware – Sharable Data (OAM, CDM)				
CDA: Application & Process changes				

Solutions that are
Transparent to z/OS

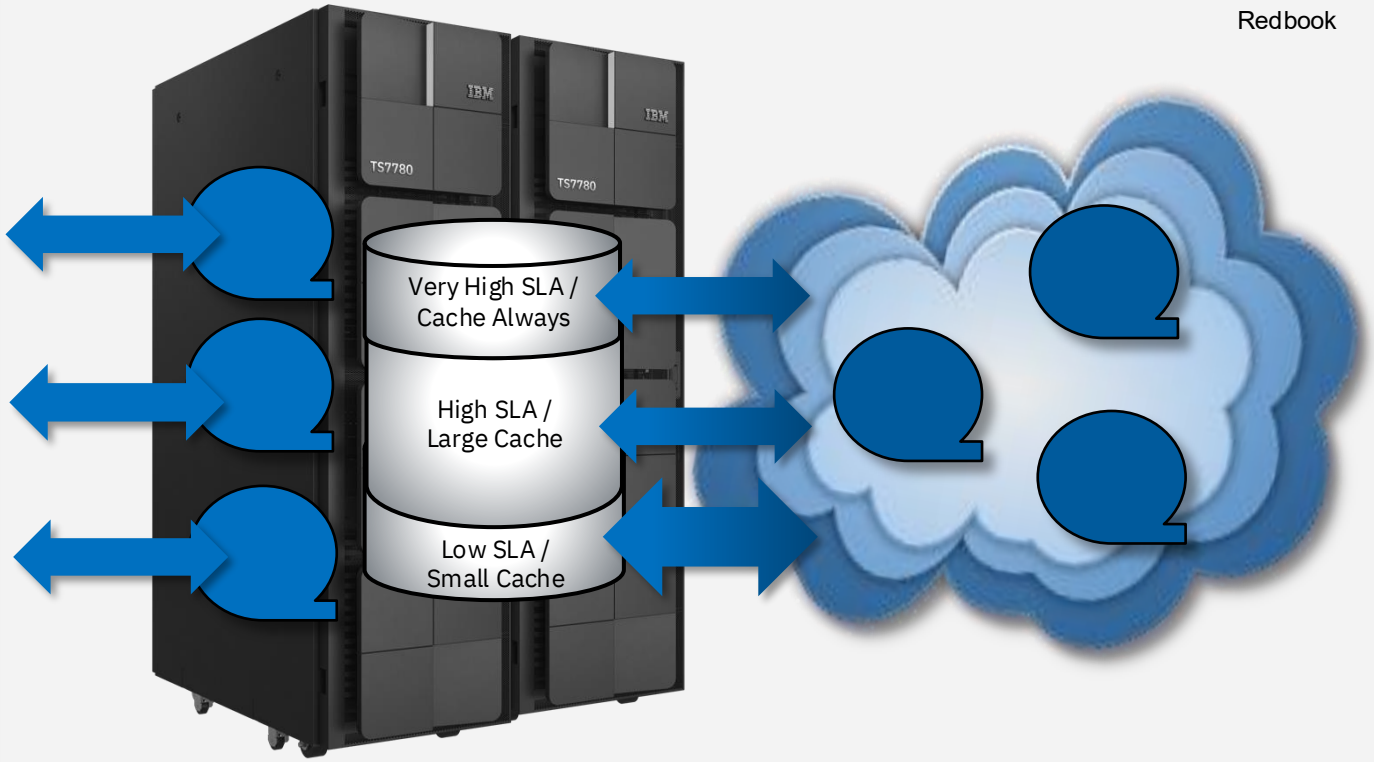
Integrate Cloud Object Storage
into your *Virtual Tape Environment*

TS7700 Cloud Storage Tier

Redbook

Cloud object storage as an *extension* of the tape grid

- Transparent to Applications
- Using Management Class policies, virtual volumes are replicated among peers in the grid and can be offloaded to an object store
- Other clusters in the grid have access to the cloud object storage copy
- Tune cache residency through Cache Partitions
  - Cache always partition, for data with very high SLA
  - Large partitions, for workloads that require a high cache hit ratio
  - Small partitions, for workloads that should primarily exist in the cloud



	Maintain SLAs	Application Transparent	Leverage cloud capabilities	Sharable
TS7700 CST				

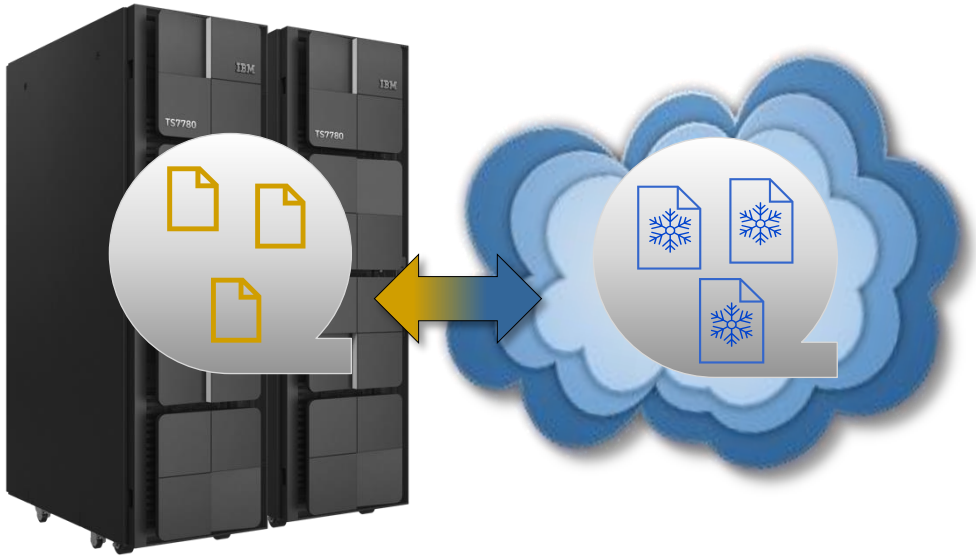
TS7700 Cloud Storage Tier

Application Data

Best Case: WORN – Write Once, Read Never

Backup Data

Data that is generally not referenced and expires collectively



TS7700 CST Use Case: DFSMShsm Recycle

Virtual tapes must be read into TS7700 cache to be processed

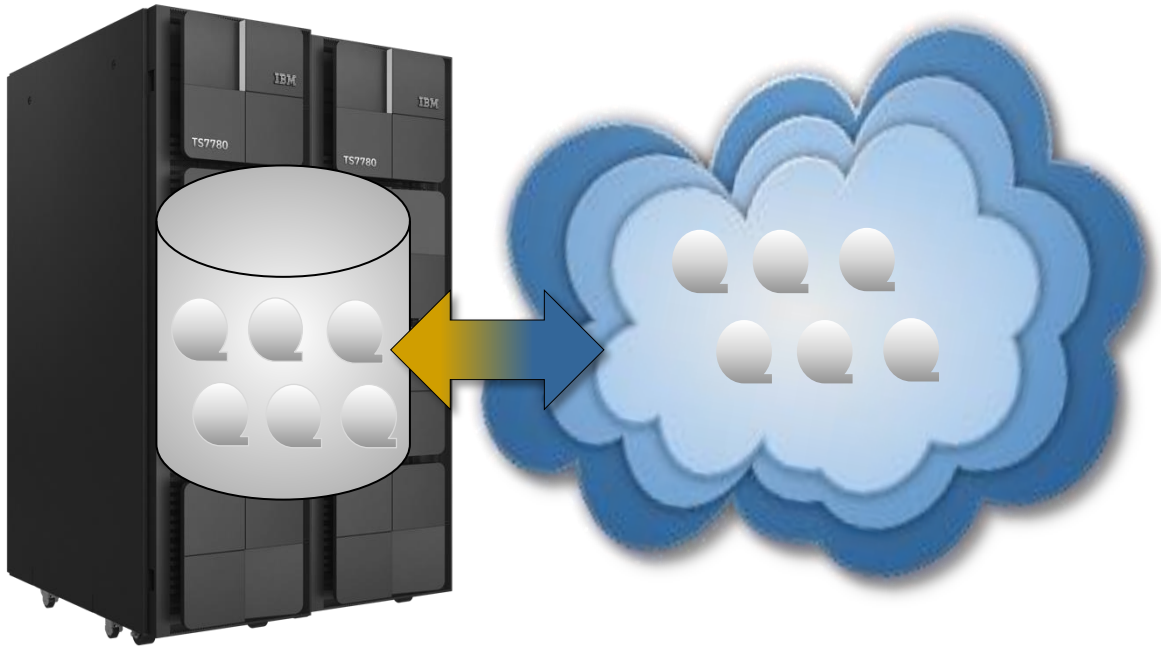
SETSYS RECYCLETAPERESIDENCE(...)

RECYCLE SELECT(TAPERESIDENCE(...))

- BOTH
- INCACHE
- NOTINCACHE

Use SETSYS to only process INCACHE

Use a very low (or zero) PercentValid value for NOTINCACHE processing



PERCENTVALID(**40**)

PERCENTVALID(**0**)

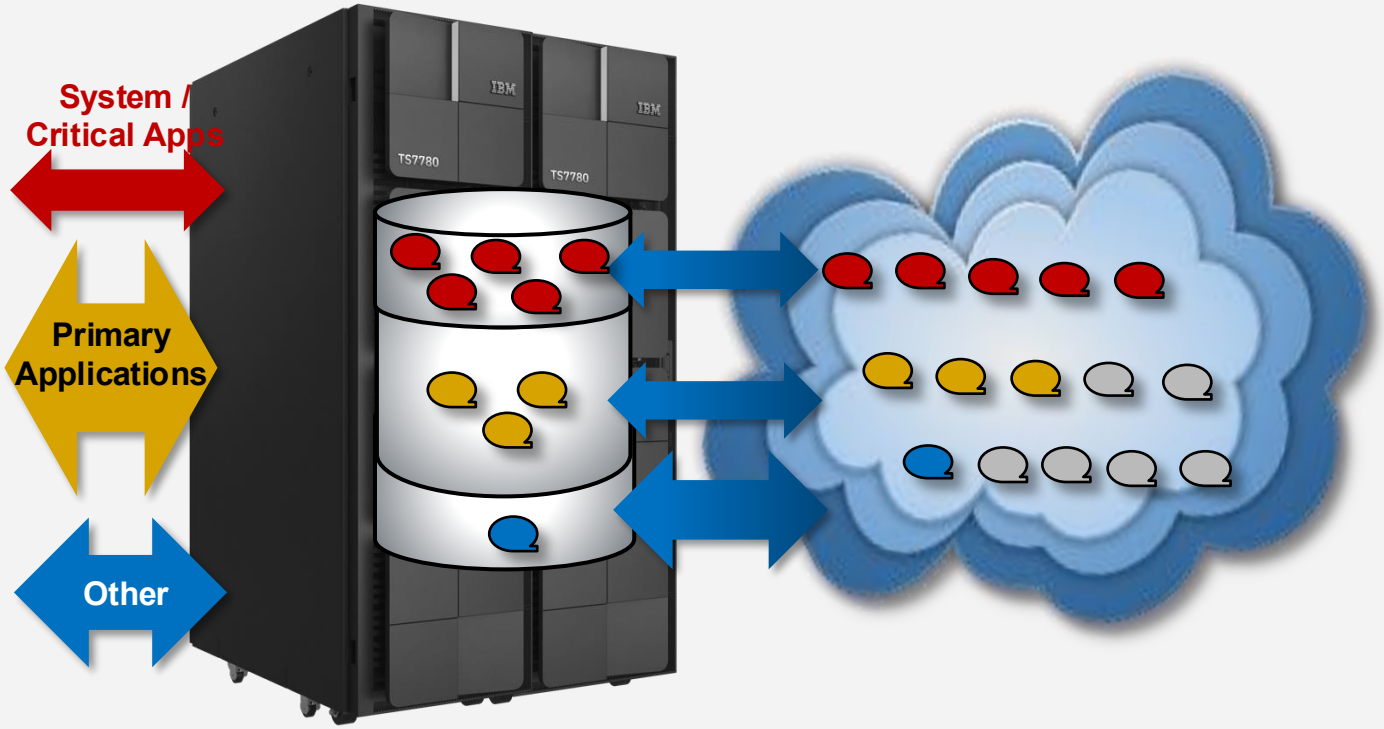
Use Case:
Large Scale Recovery

Data is assigned a Recovery priority from P0 to P*n*. For Example: Priority0, 1 and 2

- P0 backup copies target the 'Cache Always' cluster
  Recovery is Always from Cache
  (Also is Cloud for multiple copies)

- P1 backup copies target Large Cache where
  3 days backup copies are kept in cache
  Odds are that recovery will be from Cache

- P2 backup copies target Small Cache where
  1 day of backup copies are kept in cache
  Older backup copies will be read in from COS, but they have an acceptably lower SLA

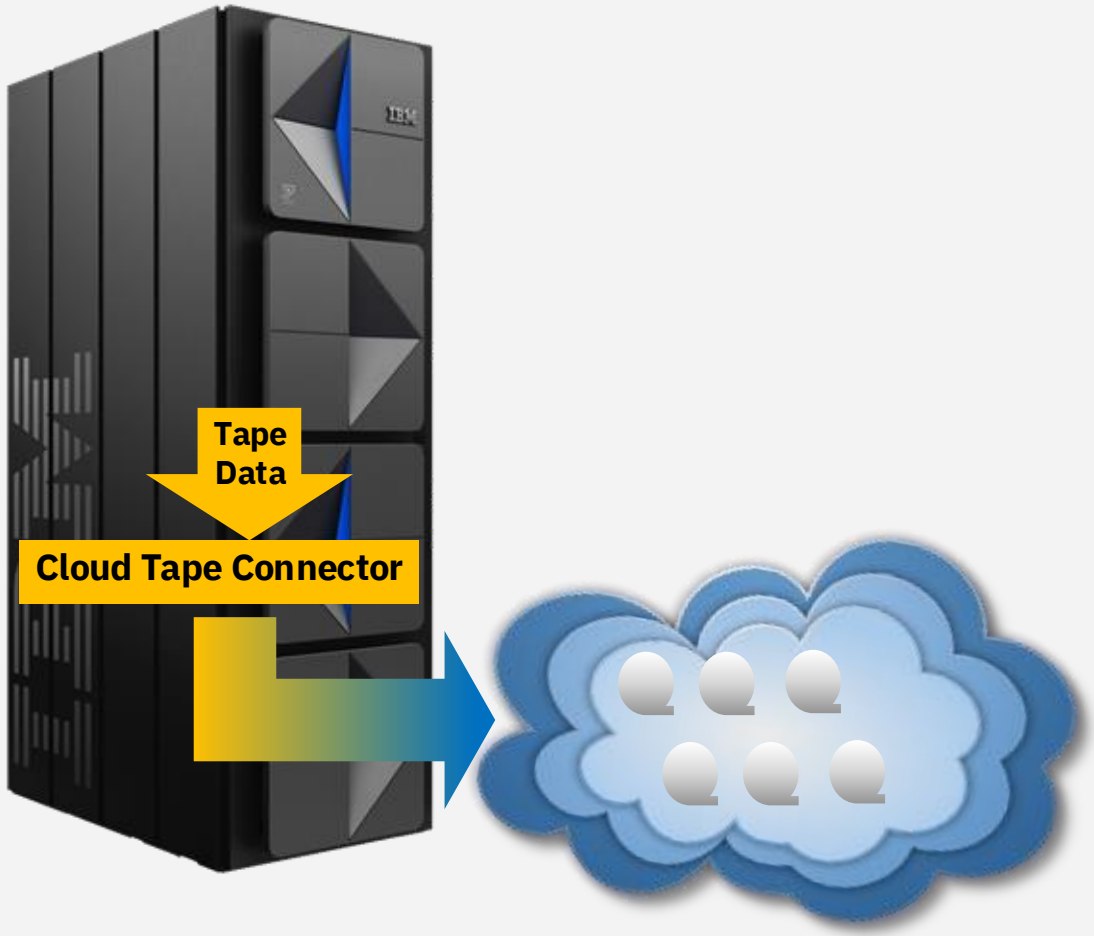


Cloud Tape Connector

CTC Website

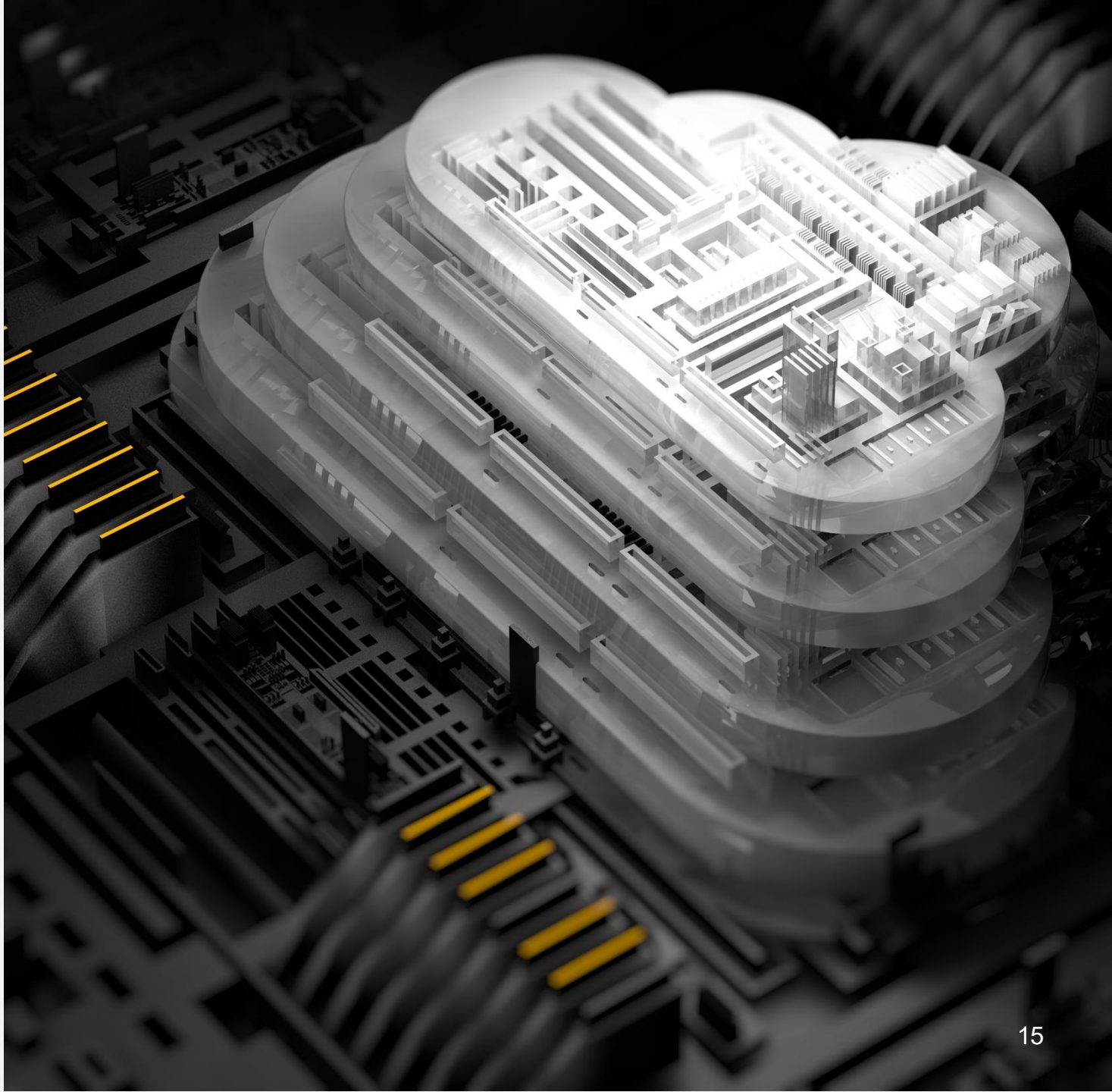
zIIP enabled, *software only* solution

- Full emulation of z/OS tape, transparent to applications
- Clone active tape
- Host side compression and encryption
- Upload existing tape and sequential disk data sets directly to the cloud
- Easily maintain a common inventory image amongst multiple z/OS systems



	Maintain SLAs	Application Transparent	Leverage cloud capabilities	Sharable
CTC				

Leverage Products that Utilize Object Storage

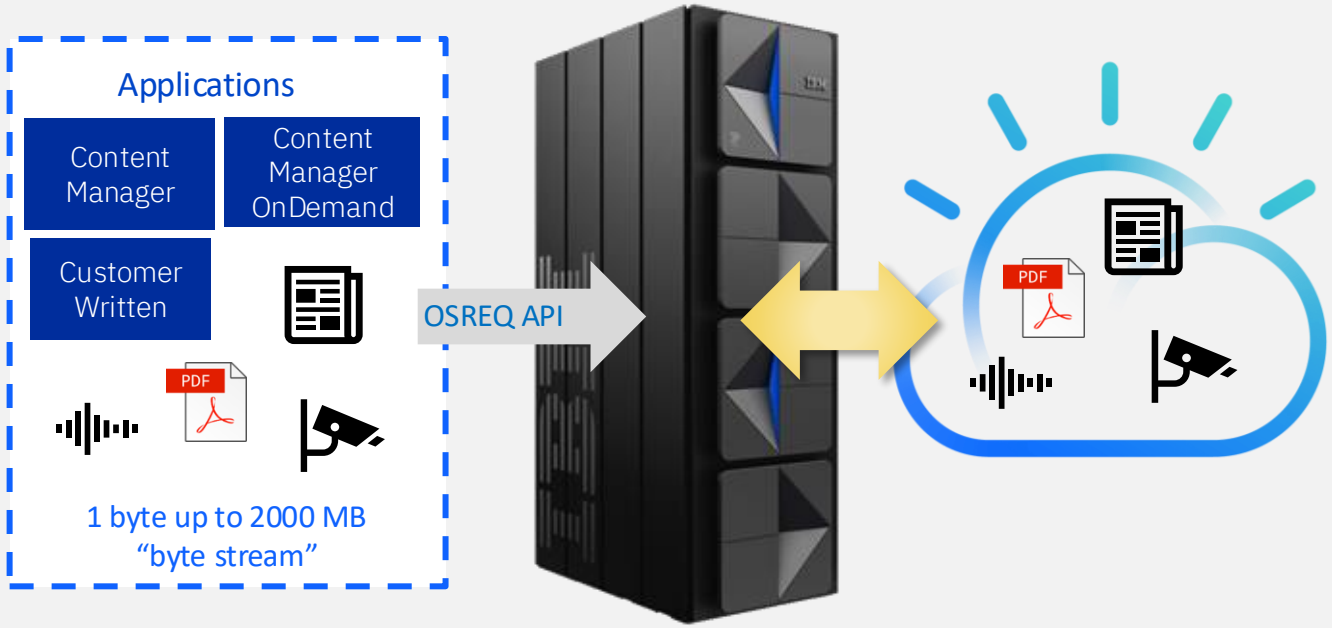


OAM - Unstructured Data

Many clients store unstructured data directly to z/OS. (Scanned images, legal records, video files, PDFs, etc). z/OS DFSMS Object Access Method (OAM) supports writing this data to cloud object storage.

This data can be written directly to cloud object storage or transition there from disk or tape as it ages.

OAM is included with the base z/OS license

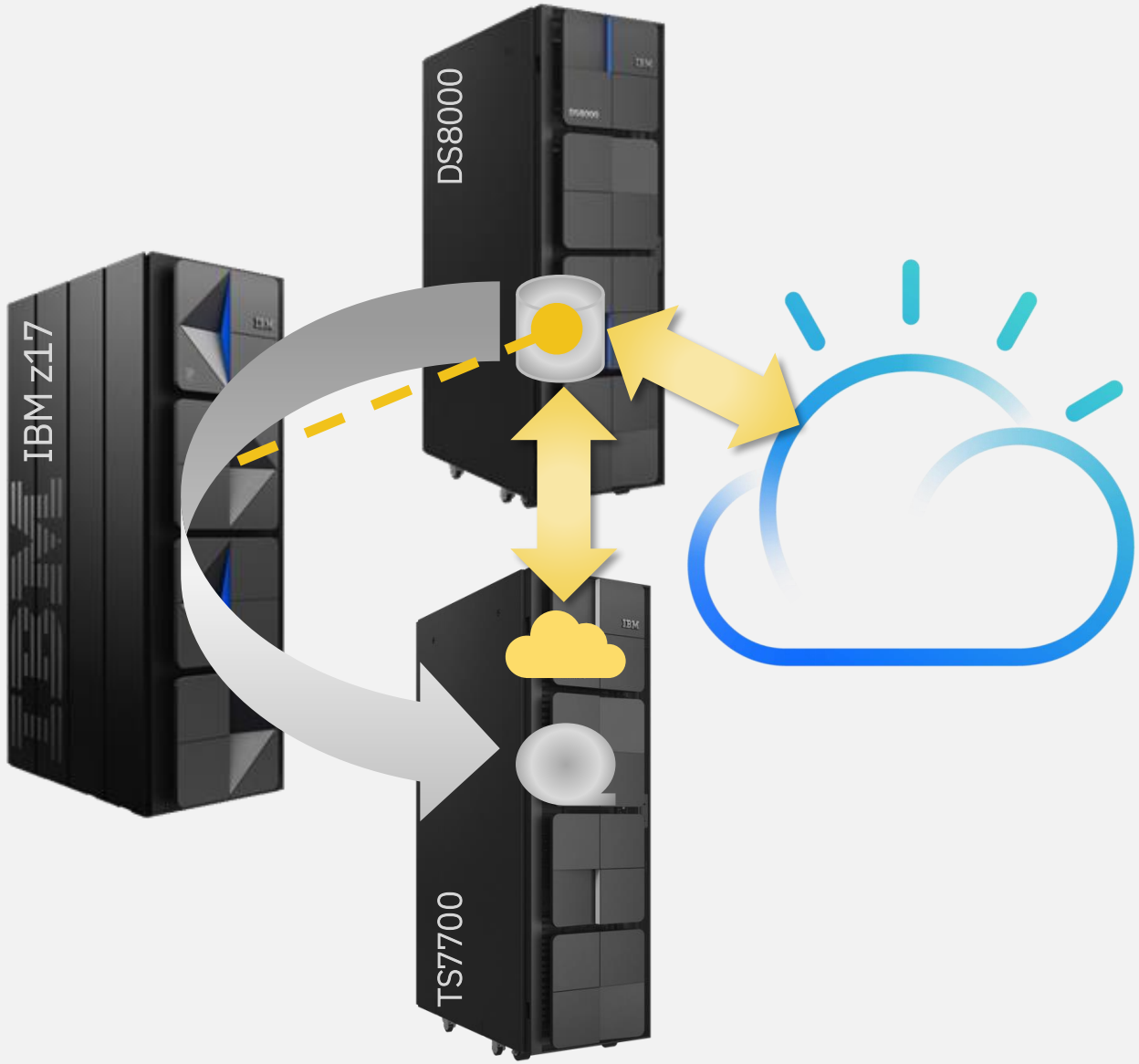


	Maintain SLAs	Application Transparent	Leverage cloud capabilities	Sharable
OAM				

DFSMS Data Management DS8900 Transparent Cloud Tiering TS7700 DS8000 Object Store

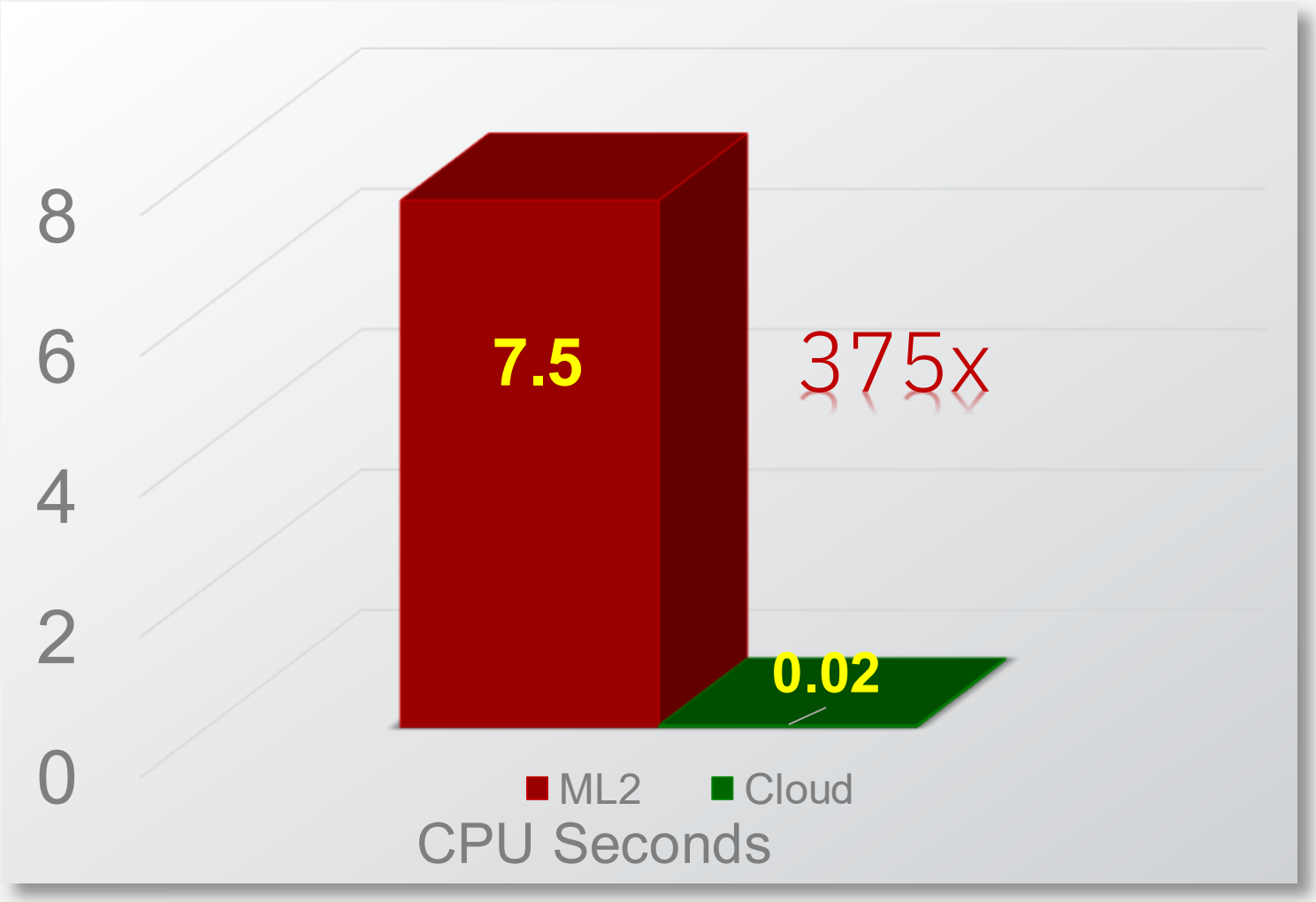
- DFSMShsm/dss Data Movement directly between DS8900 and object storage!
  - No Host CPU for data movement!
- Eliminate DFSMShsm Recycle Processing
- Eliminates serial access to ML2

	Maintain SLAs	Application Transparent	Leverage cloud capabilities	Sharable
DSS TCT				
HSM TCT				



Just how much CPU?

CPU consumed Migrating a 5GB Data Set

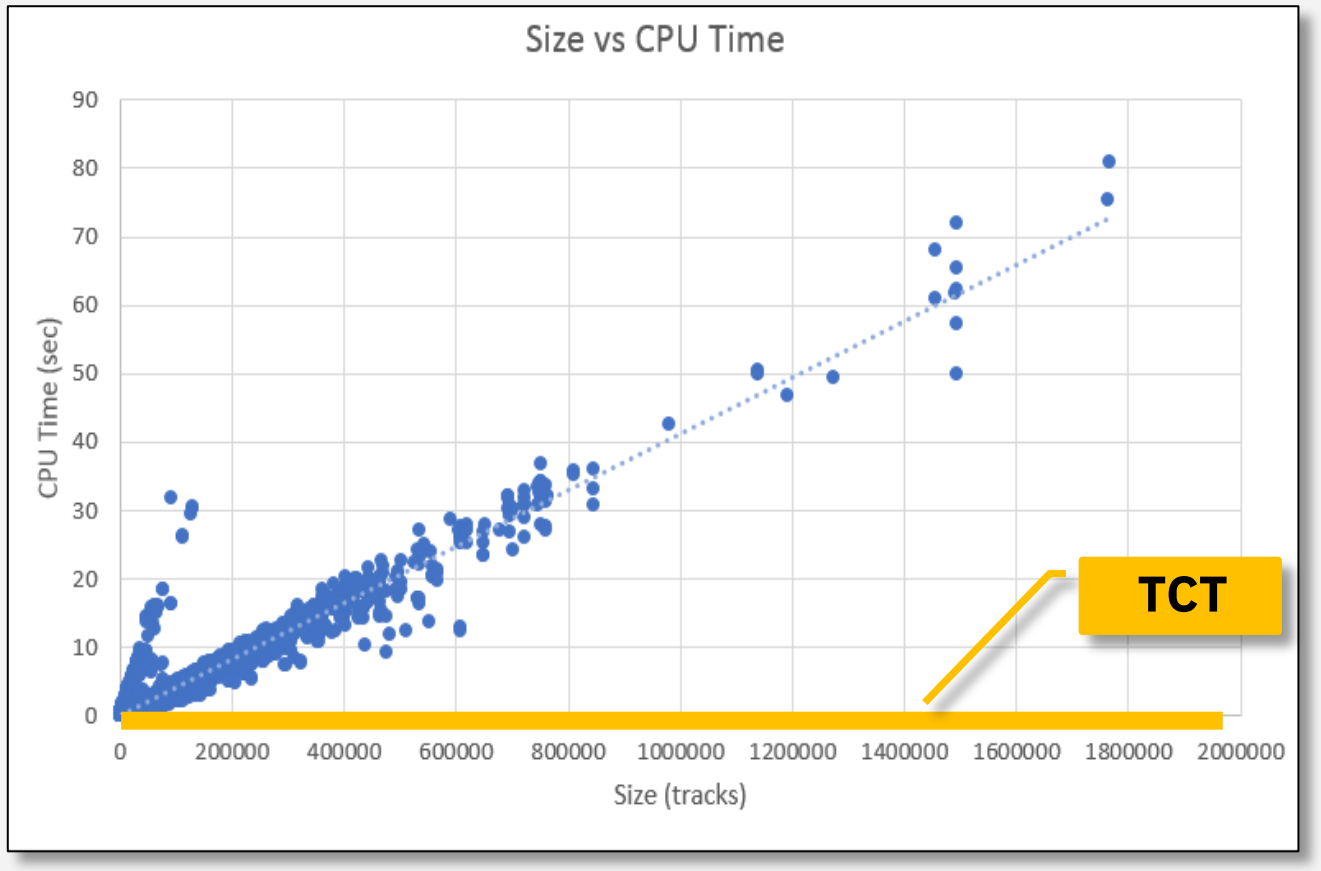


* Disclaimer: *Based on projections and/or measurements completed in a controlled z15 environment. Results will vary by customer based on individual workload, configuration and software levels.*

Client ‘X’ Data Scatterplot

Scatterplot of CPU / Tracks for Primary Space Management

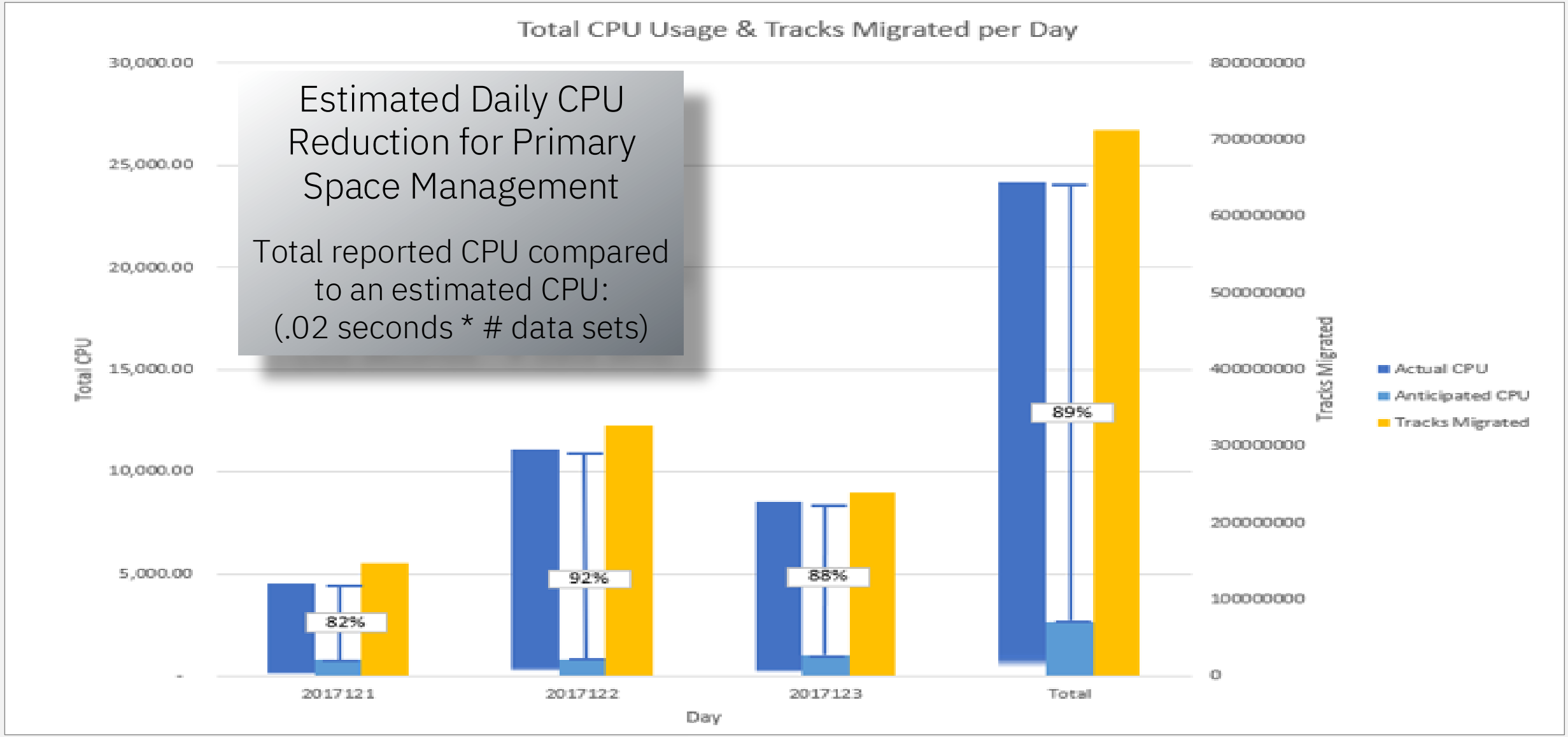
Excluded FSRs that didn’t move data:
RC > 0, Migration Reconnects



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

Client ‘X’ CPU Reduction Approximation

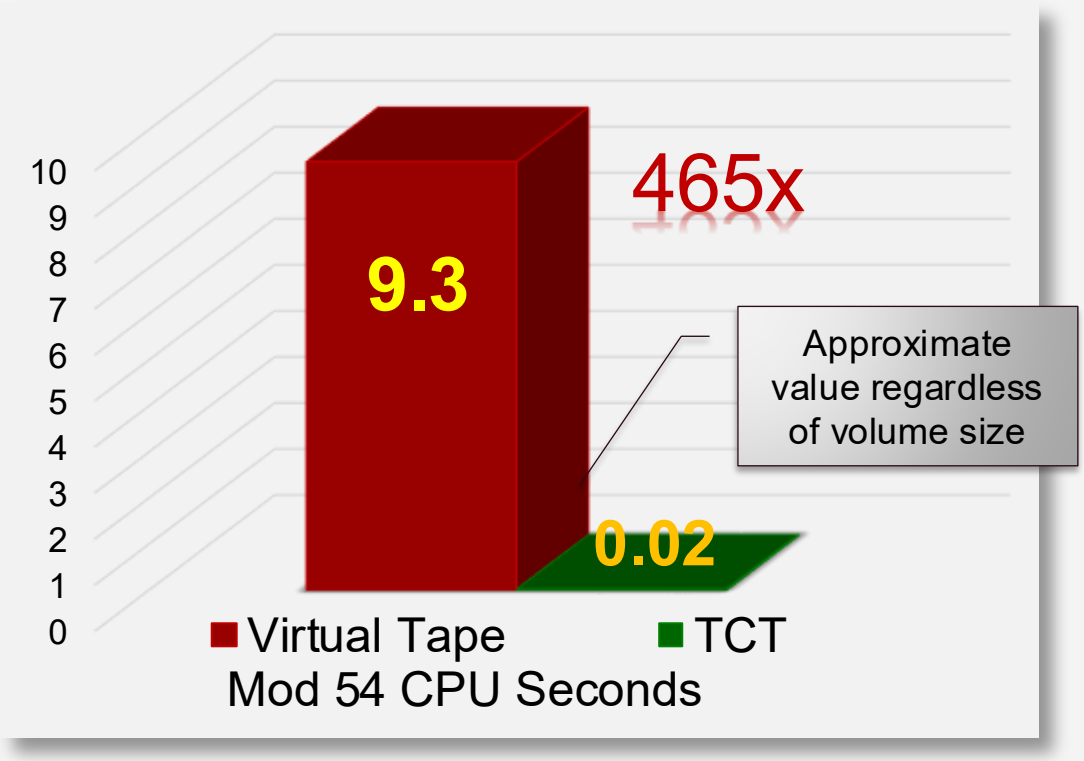
CPU Estimator

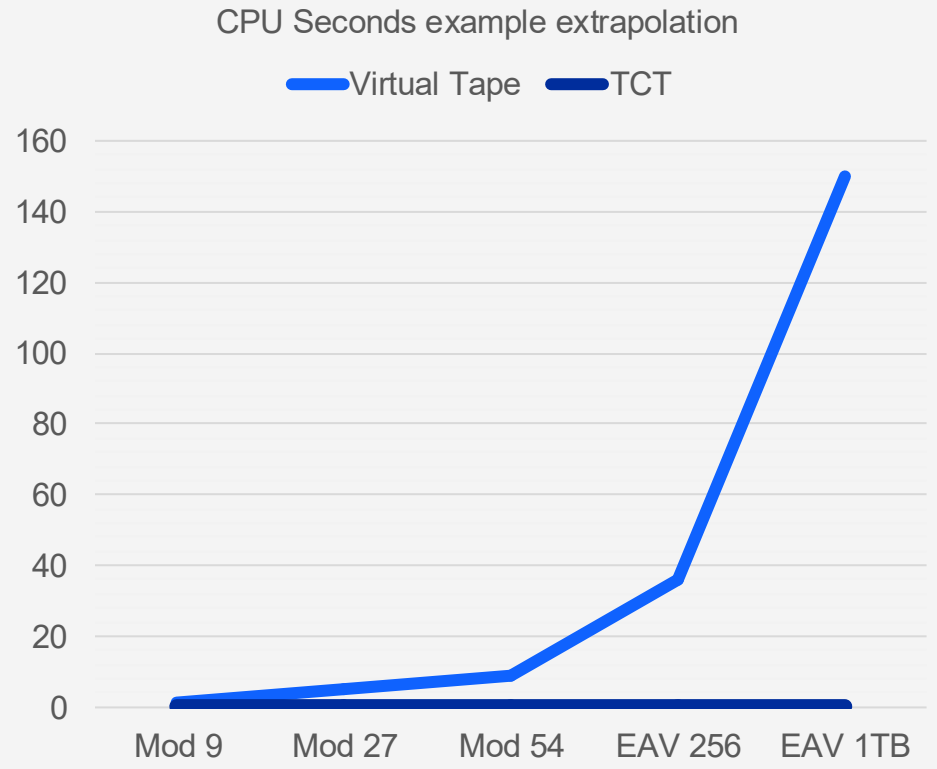


Based on approximations from internal IBM data measurements on an z15. Results will vary by customer based on particular workloads, configurations, software levels and the quantity and size of data sets being migrated.

DSS Full Volume Dump CPU Reduction

DS8900 transparent cloud tiering can reduce CPU by ***up to 98%*** for z/OS DFSMSdss full volume dump operations ***of mod54 volumes or larger*** by performing all the data movement directly between the DS8900 and a TS7700 DS8000 object store or cloud object storage.



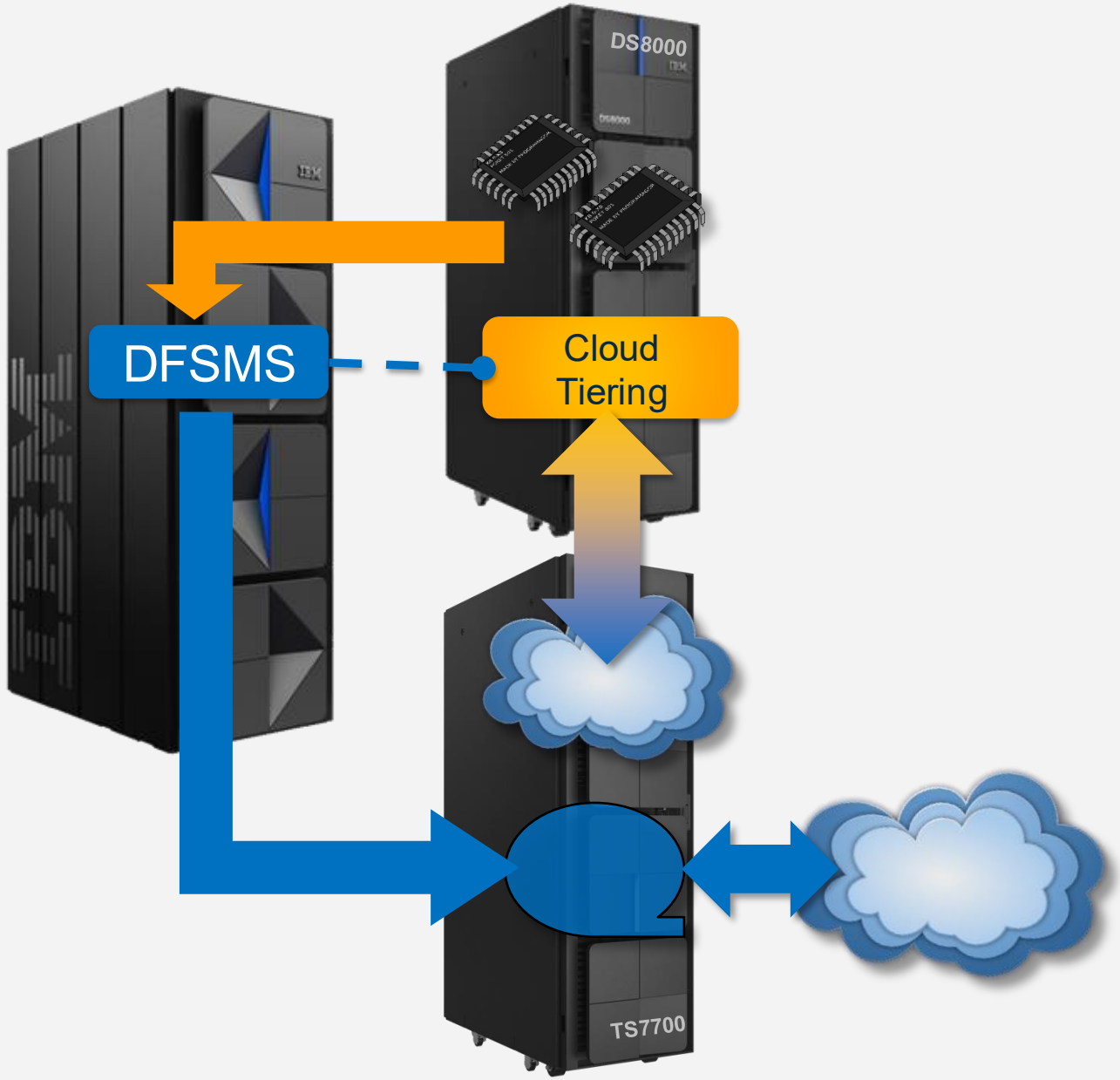


*** Disclaimer:** The DFSMSdss results are based on internal IBM data measurements on a z15 with Crypto Express7S* when performing full volume dumps and restores of MOD54s on a DS8900. Results will vary based on workload, configuration, software level and the quantity and size of disk volumes.

Use Case: Targeted DFSMShsm *Automatic Migration*

- ★ DFSMShsm Automatic Migration driven by *Management Class*
  - Target large data sets that most benefit from CPU reduction
  - Management Class can specify SIZE of data set that should target different tiers (ML1, ML2, MLC)
  - Data sets that still require a high SLA, as guaranteed by TS7700 cache, can still target Virtual Tape and seamlessly migrate to object storage through the VTS

	Maintain SLAs	Application Transparent	Leverage cloud capabilities	Sharable
HSM TCT				



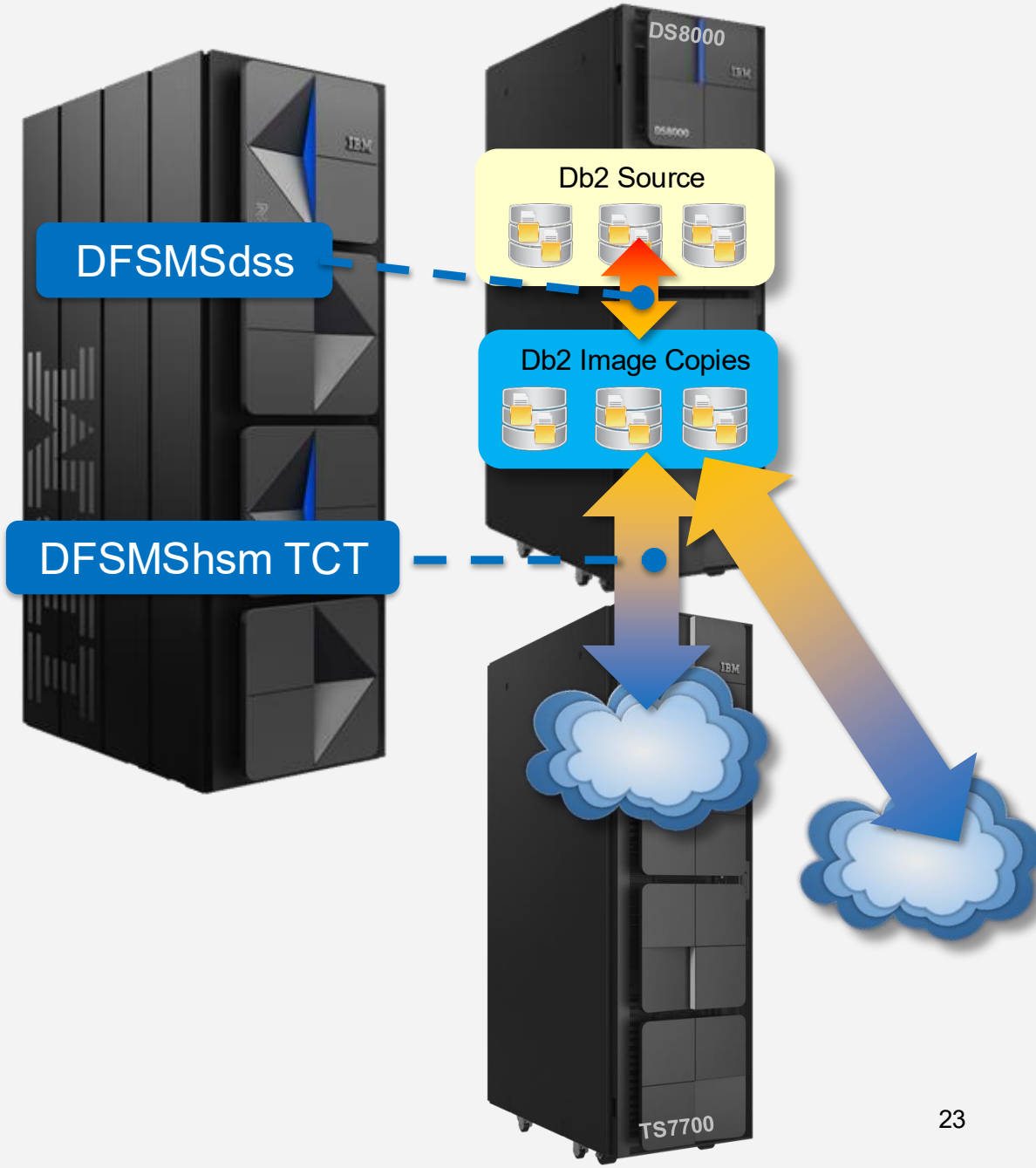
Use Case: Db2 Image Copies

Offline Db2 PiT Image Copies, with the Data never going through the host

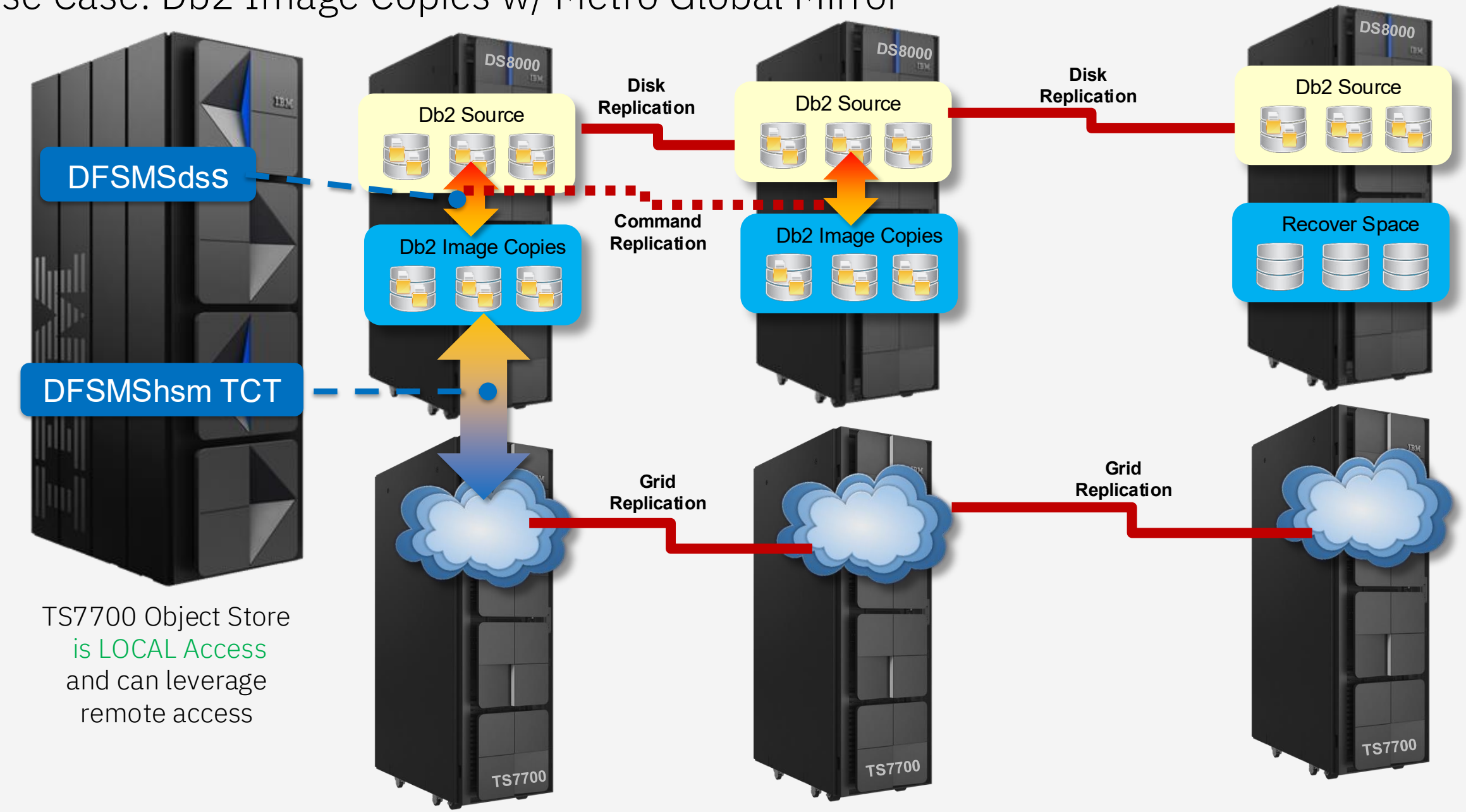
- **Step 1:** Create PiT Db2 Image Copies using DSS FlashCopy into an HSM managed storage group
- **Step 2:** Automatically, or by command, offload copies to TS7700 Object Store with HSM
- Periodic Deep Archive, “Golden Copy” or ‘Seven Year Retention’

Notes:

- *For now, manual recall required before DSS Restore*
- *Not limited to Db2, any DFSMSdss FlashCopy backup*

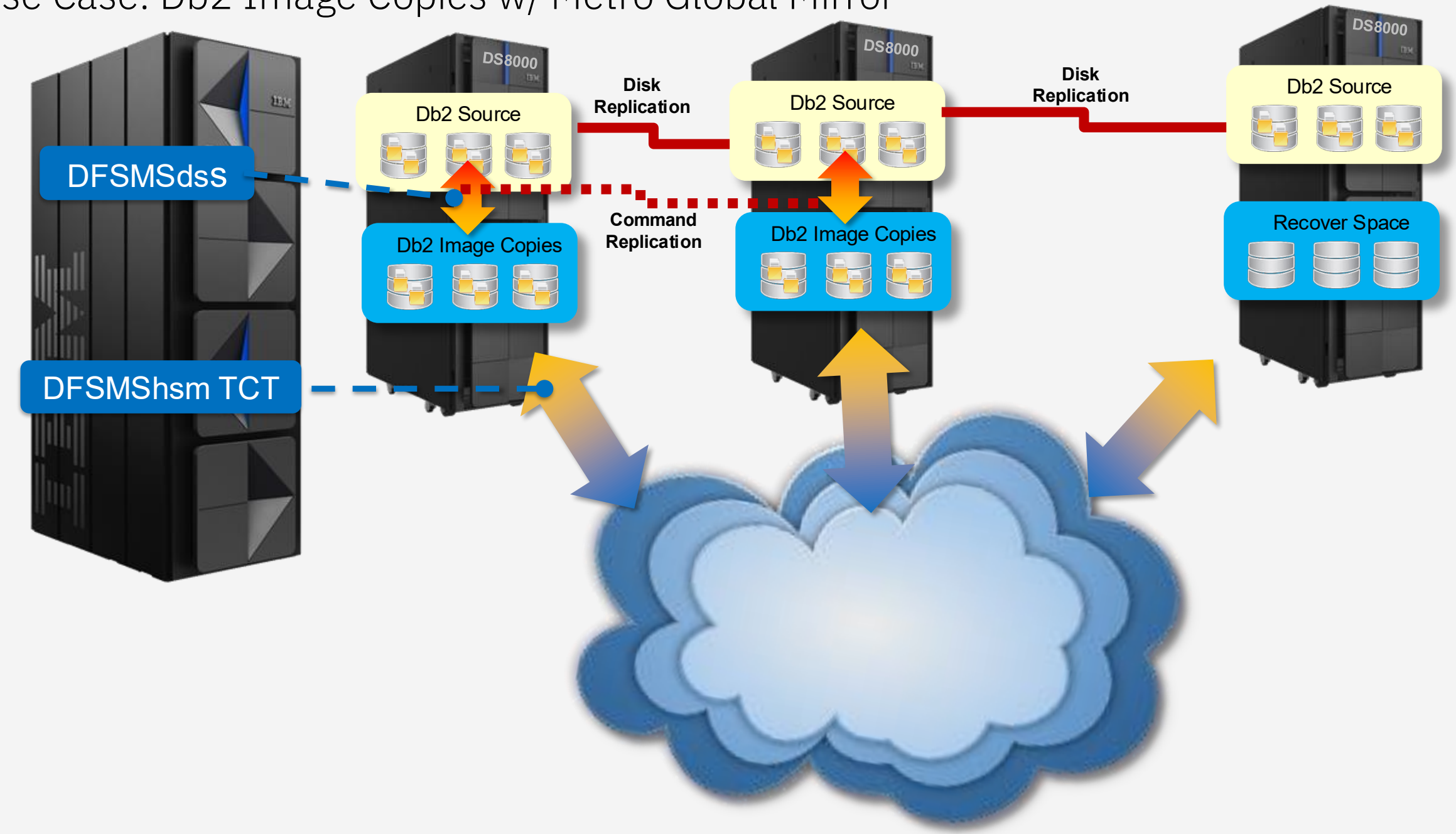


Use Case: Db2 Image Copies w/ Metro Global Mirror



TS7700 Object Store
is LOCAL Access
and can leverage
remote access

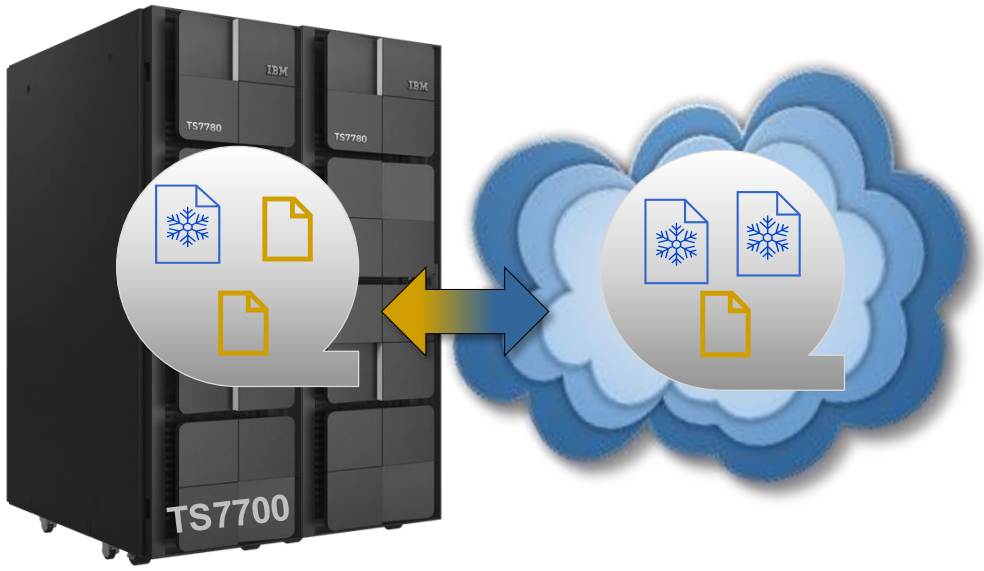
Use Case: Db2 Image Copies w/ Metro Global Mirror



TS7700 CST: DFSMShsm Migration Tapes

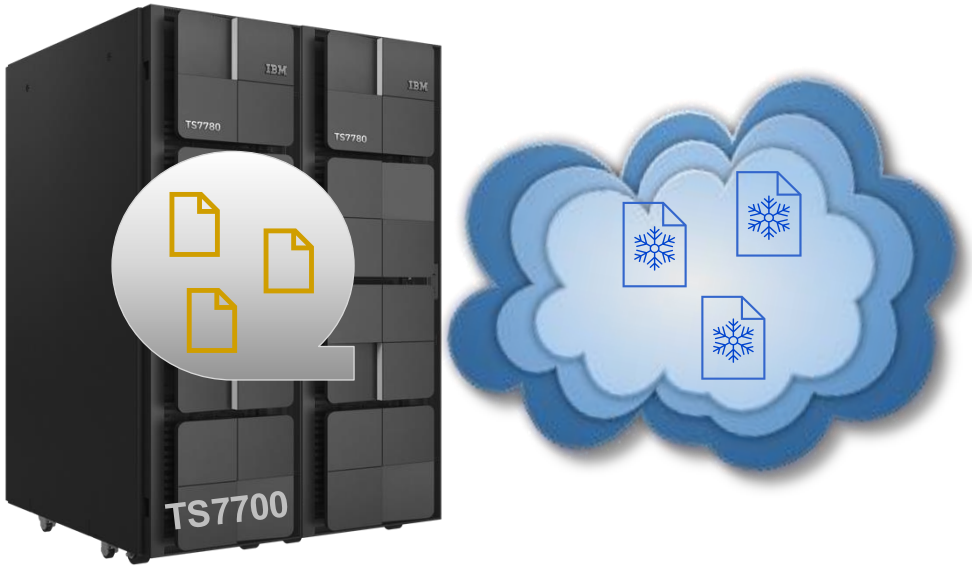
DFSMShsm Recall can cause thrashing of tapes between cache and cloud

DFSMShsm Recycle can place recently migrated data on the same virtual tape as very old data that has never been recalled

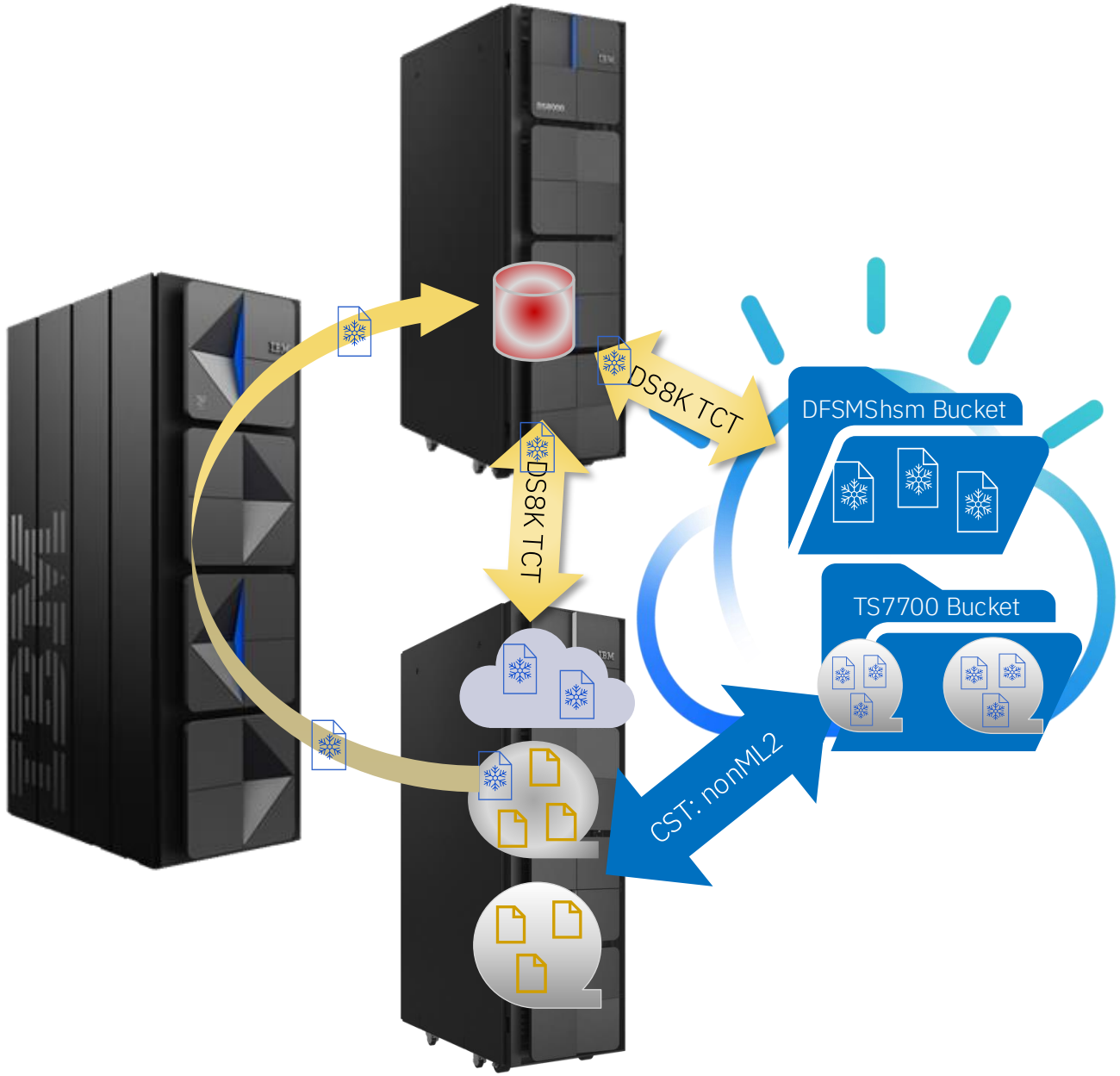


Best of both worlds

- Recently migrated data in TS7700 cache for fast Recall
- Older, unreferenced migrated data in cloud object storage… ‘Deep Archive’



DFSMScdm – Cloud Data Manager 1.1



Cloud Data Manager drives a standard recall and a subsequent TCT migration to cloud to convert ML2 data to MLC data.

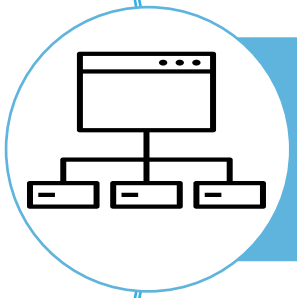
- ✓ *Maintains original last reference date*
- ✓ *Maintains original migration date*
- ✓ DFSMShsm inventory updated to show new location
  - Transparent to applications
  - Fast Subsequent Migration back to Cloud
- ✓ *Removed from Recycle processing*
  - Never processed again by DFSMShsm until it expires
- ✓ Slower than TS7700, but acceptable since it is your ‘Deep Archive’

Note: TCT to cloud object storage does not yet support compression

DFSMScdm: Main Functions

Summary

Reads the entire HSM Migration Control Data Set giving the user an overall summary of cold HSM data



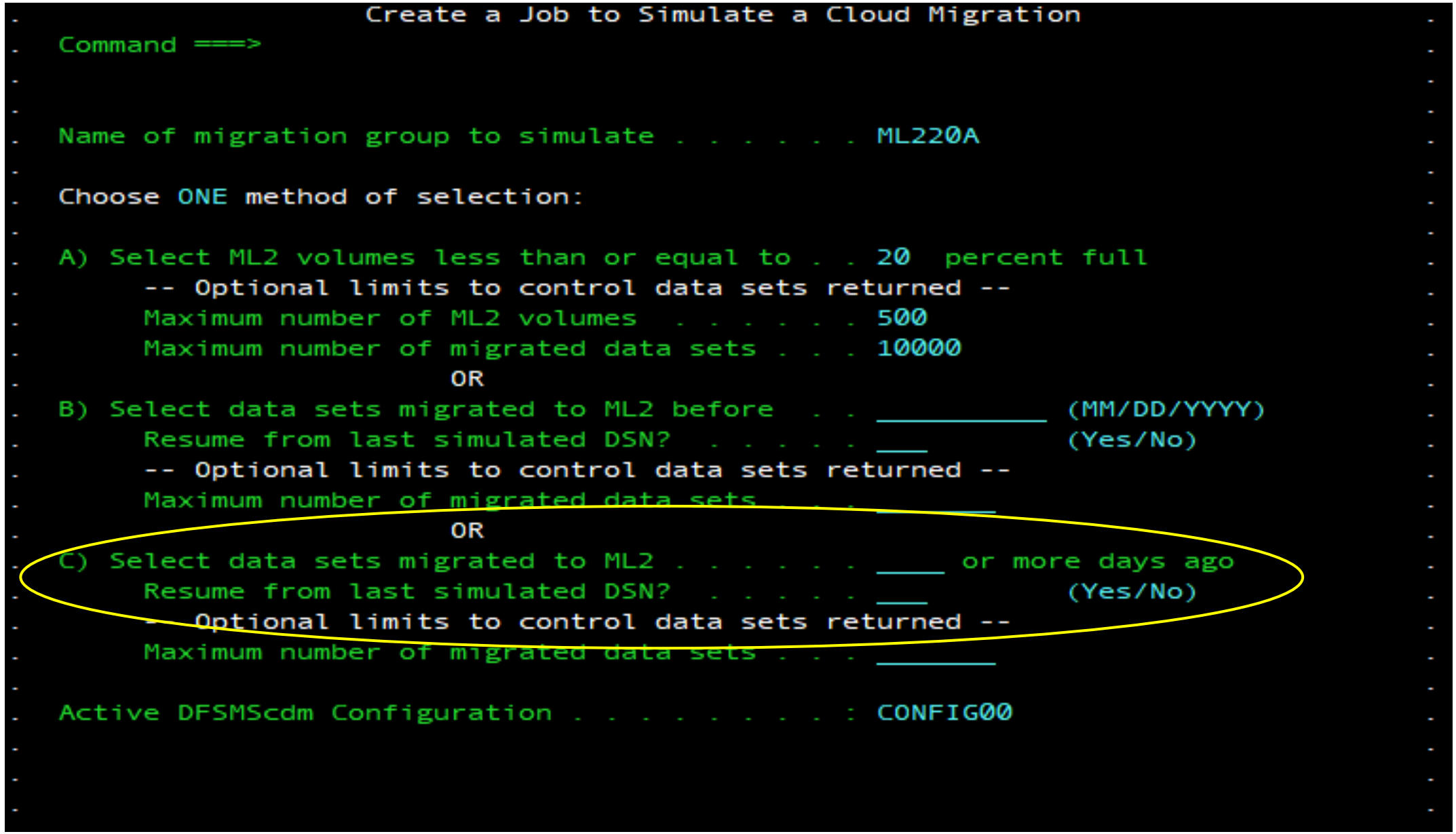
Simulate

User creates manageable and trackable groups of data sets to be remigrated to the Cloud

Migrate

Uses the migration groups created by Simulate to allow for an orderly remigration of data sets, including tuning parameters to reduce or prevent impact on production HSM

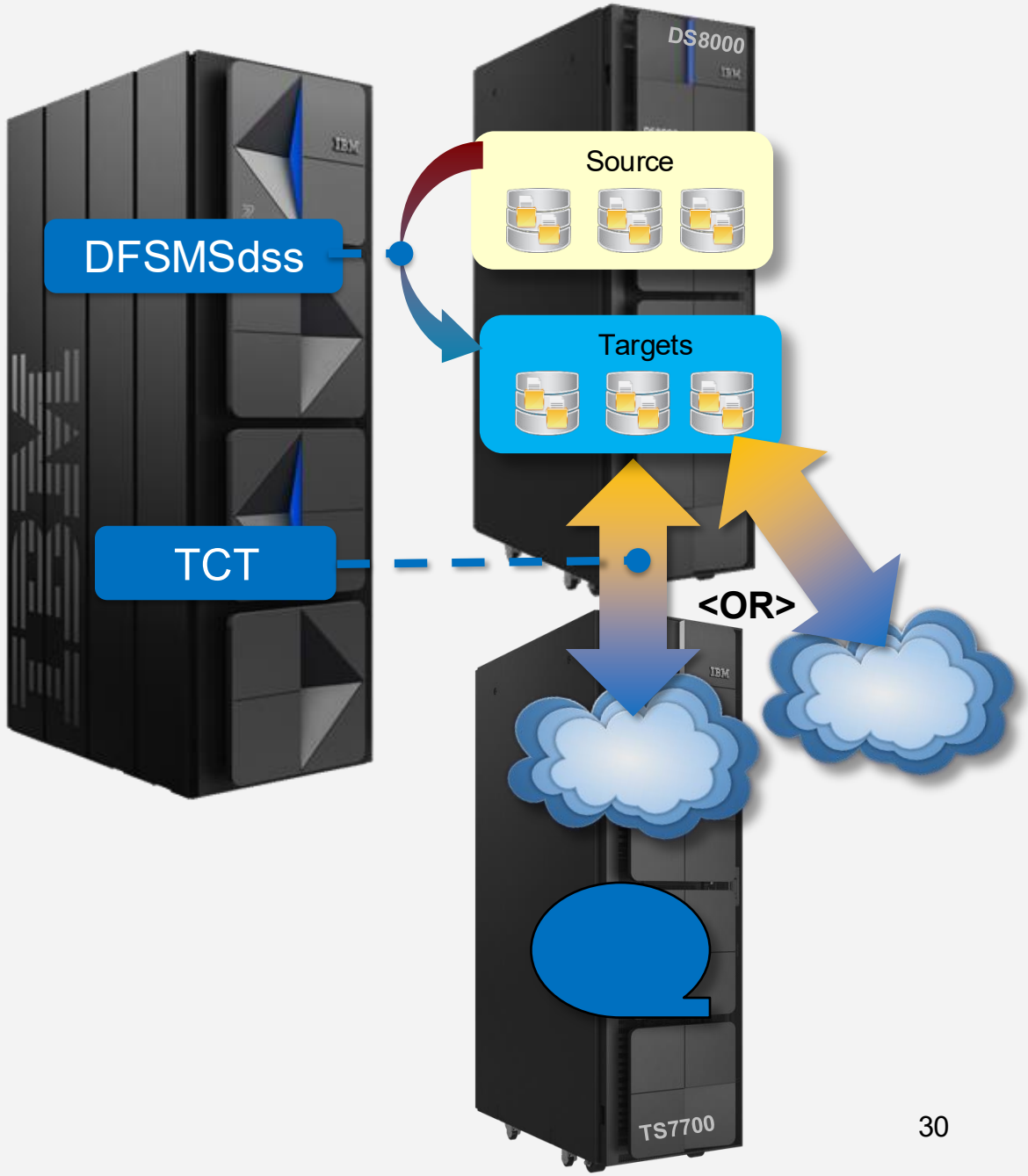
DFSMScdm


Create a Job to Simulate a Cloud Migration
Command ===>
Name of migration group to simulate ML220A
Choose ONE method of selection:
A) Select ML2 volumes less than or equal to . . 20 percent full
-- Optional limits to control data sets returned --
Maximum number of ML2 volumes 500
Maximum number of migrated data sets . . . 10000
OR
B) Select data sets migrated to ML2 before . . _____ (MM/DD/YYYY)
Resume from last simulated DSN? . . . . . ___ (Yes/No)
-- Optional limits to control data sets returned --
Maximum number of migrated data sets . . . _____
OR
C) Select data sets migrated to ML2 . . . . . ____ or more days ago
Resume from last simulated DSN? . . . . . ___ (Yes/No)
-- Optional limits to control data sets returned --
Maximum number of migrated data sets . . . _____
Active DFSMScdm Configuration . . . . . : CONFIG00

Use Case: PiT Copy, Full Volume Dump to Cloud

- **Step 1:** Create DSS Full Volume FlashCopies
- **Step 2:** Create Full Volume Dump

	Maintain SLAs	Application Transparent	Leverage cloud capabilities	Sharable
DSS TCT				
HSM TCT				



Use Case: Golden Copy

z/OS cloud object storage enables a cost-effective Cyber Resiliency solution with significant reduction in CPU

- Step I: DFSMSdss FlashCopy
  - No data passes through Z
  - Source volume immediately available for update
  - NOCOPY w/ Space Efficient – minimal storage
- Step II: DFSMSdss TCT Full Volume Dump
  - No Data passes through Z
  - Very minimal MIPS consumed
  - All data encrypted
- Destination: Cloud Object Storage
  - Isolated
  - Protected (Object Lock)

Use Case: Db2 SYSTEM LEVEL BACKUP

Offline PiT Backup of entire Db2 Subsystem, with the Data never going through the host

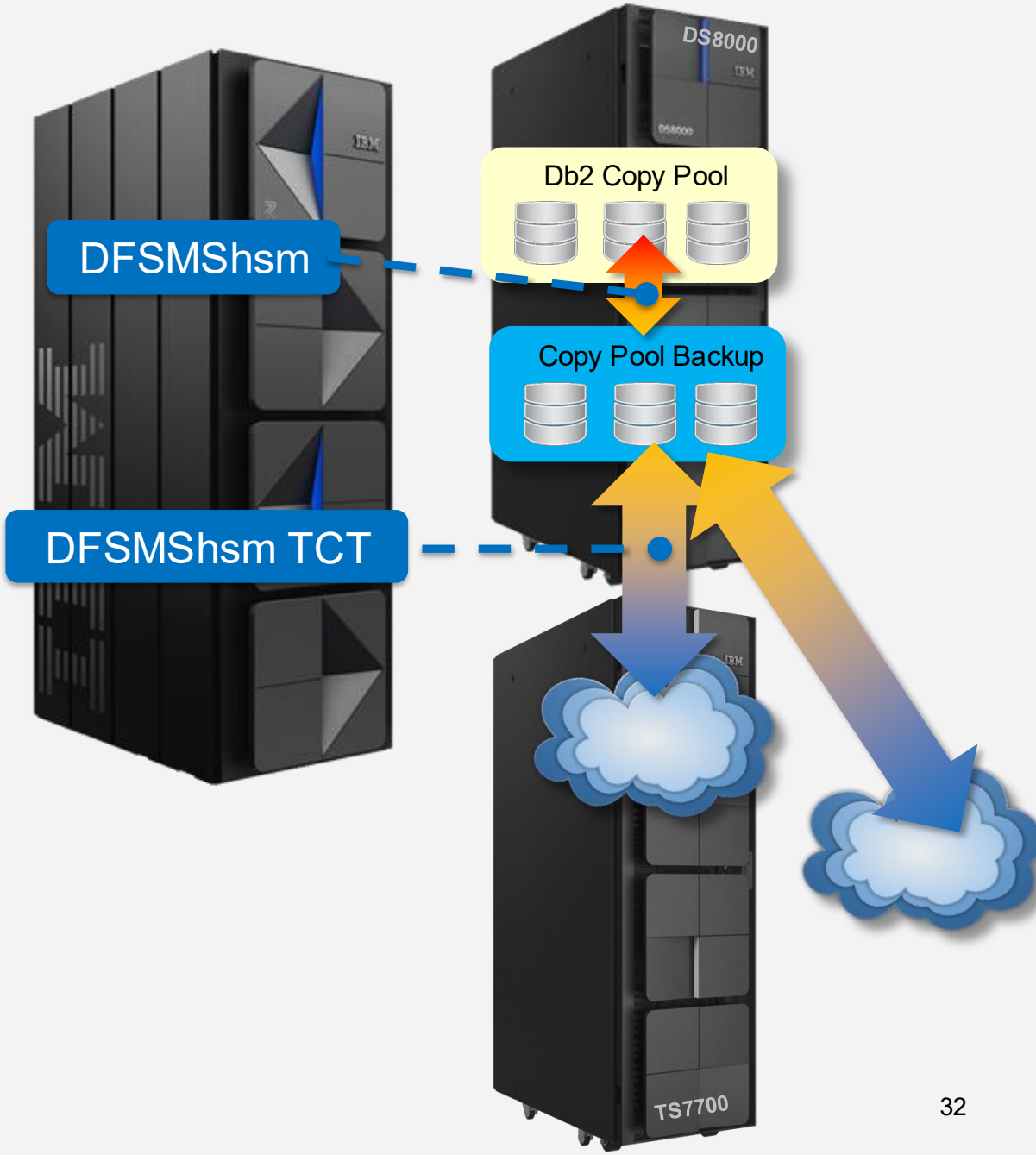
- Step 1: PiT Db2 System Level Backup invokes HSM for Full Volume FlashCopy of entire Db2 Subsystem.
  - All variations supported
- Step 2: Automatically, or by command, offload copies to TS7700 Object Store with HSM

- Single Command Deep Archive, “Golden Copy” or ‘Seven Year Retention’

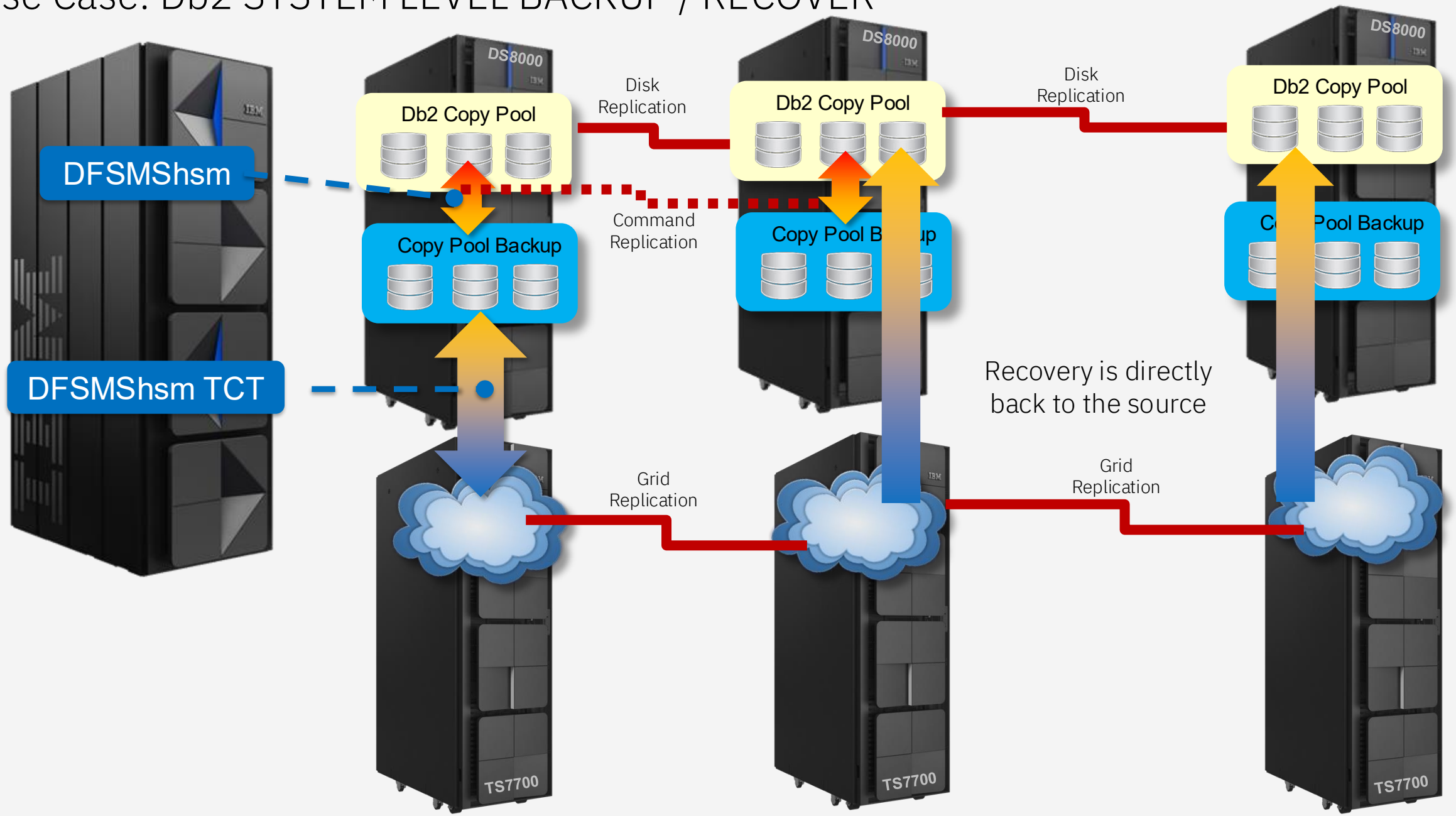
★ Single Command, Transactionally Consistent Recovery from any tier!

Notes:

- *For now, object level recovery not supported*



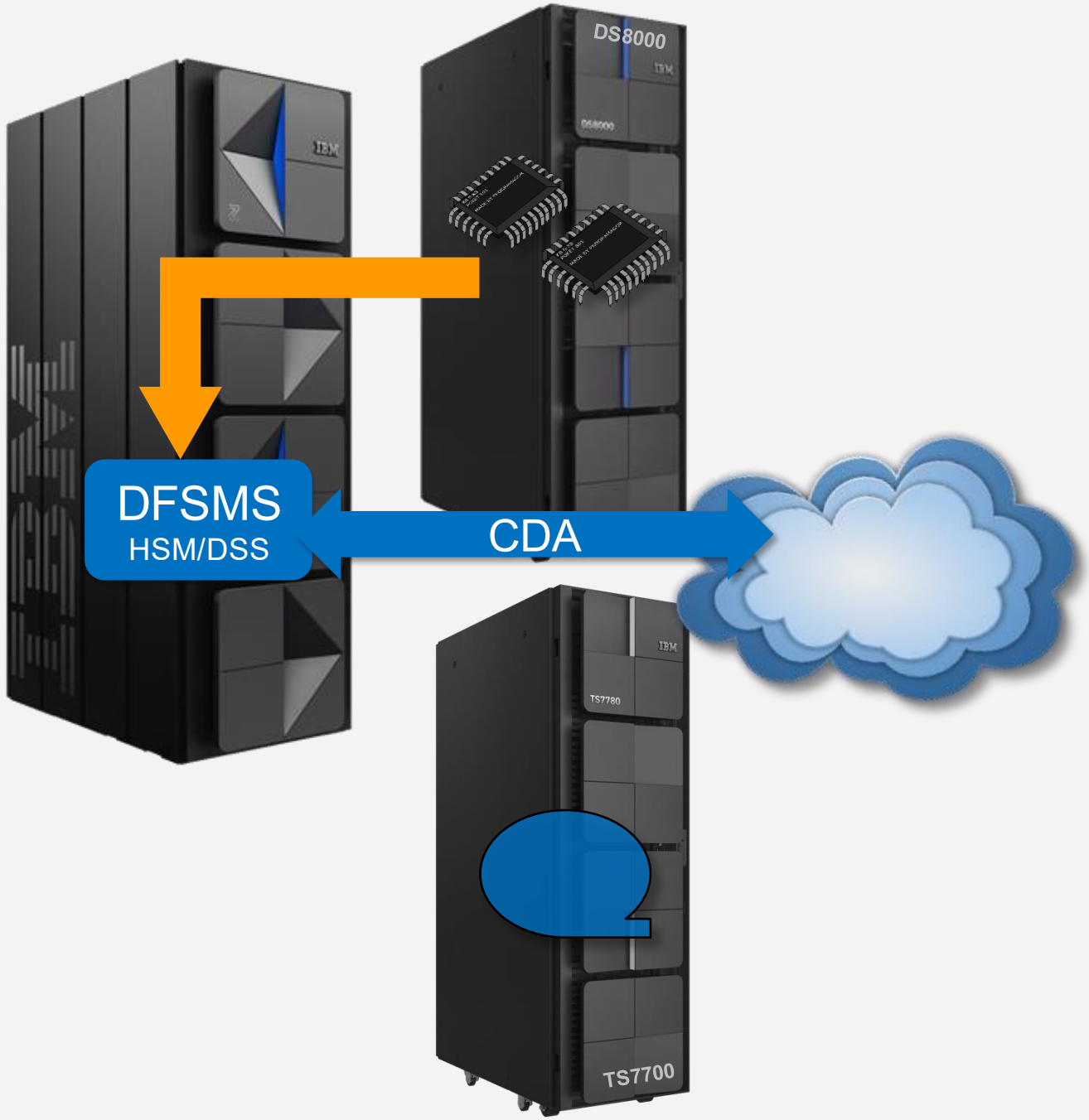
Use Case: Db2 SYSTEM LEVEL BACKUP / RECOVER



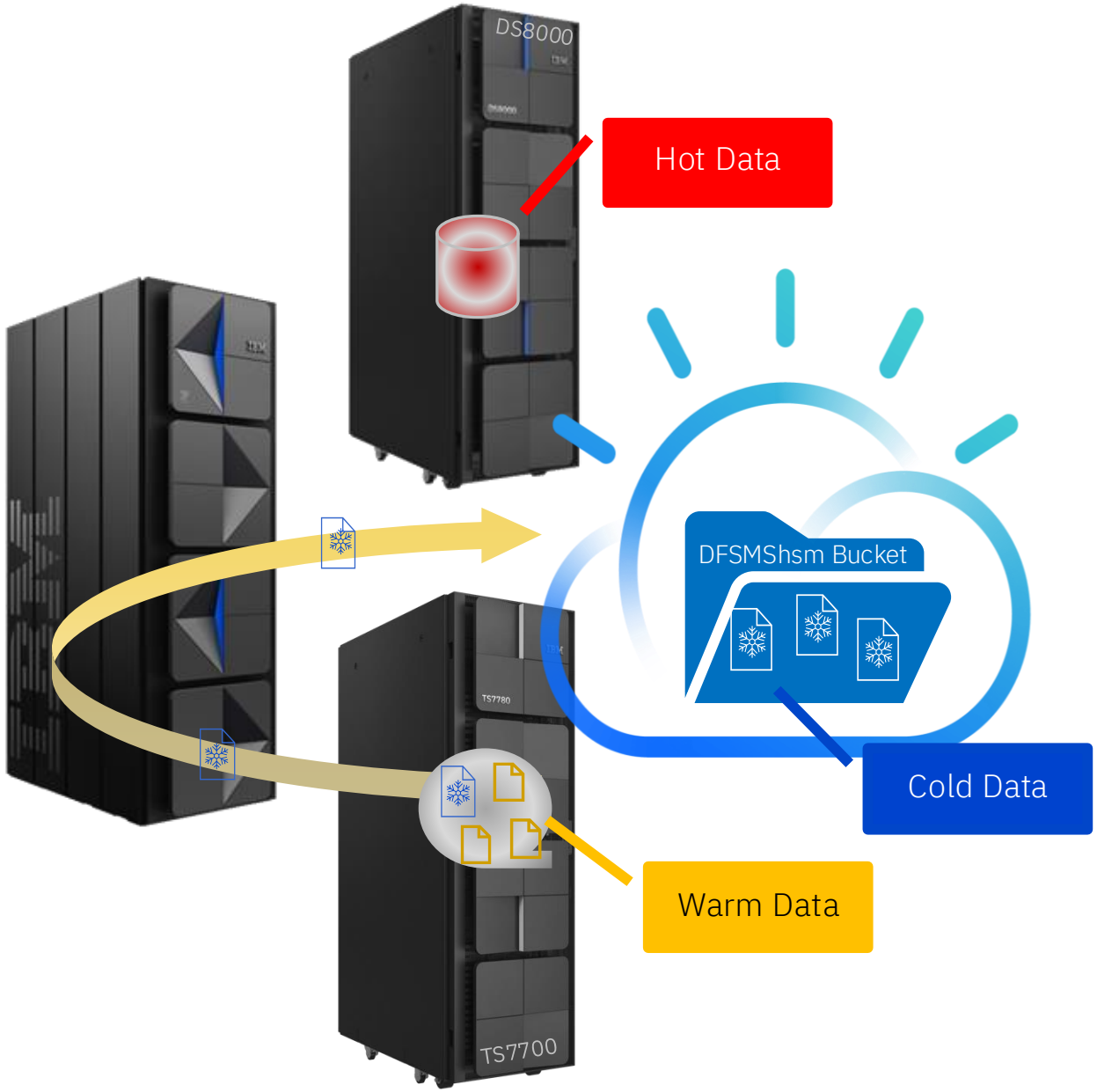
Vendor Agnostic Solution

- ★ DFSMSdss & DFSMShsm
  - Leverage CDA to target Object Storage directly
  - Storage vendor agnostic solution
  - DFSMShsm policy based
  - More flexibility, but it uses IBM Z CPU to perform the data movement

	Maintain SLAs	Application Transparent	Leverage cloud capabilities	Sharable
DFSMS CDA				



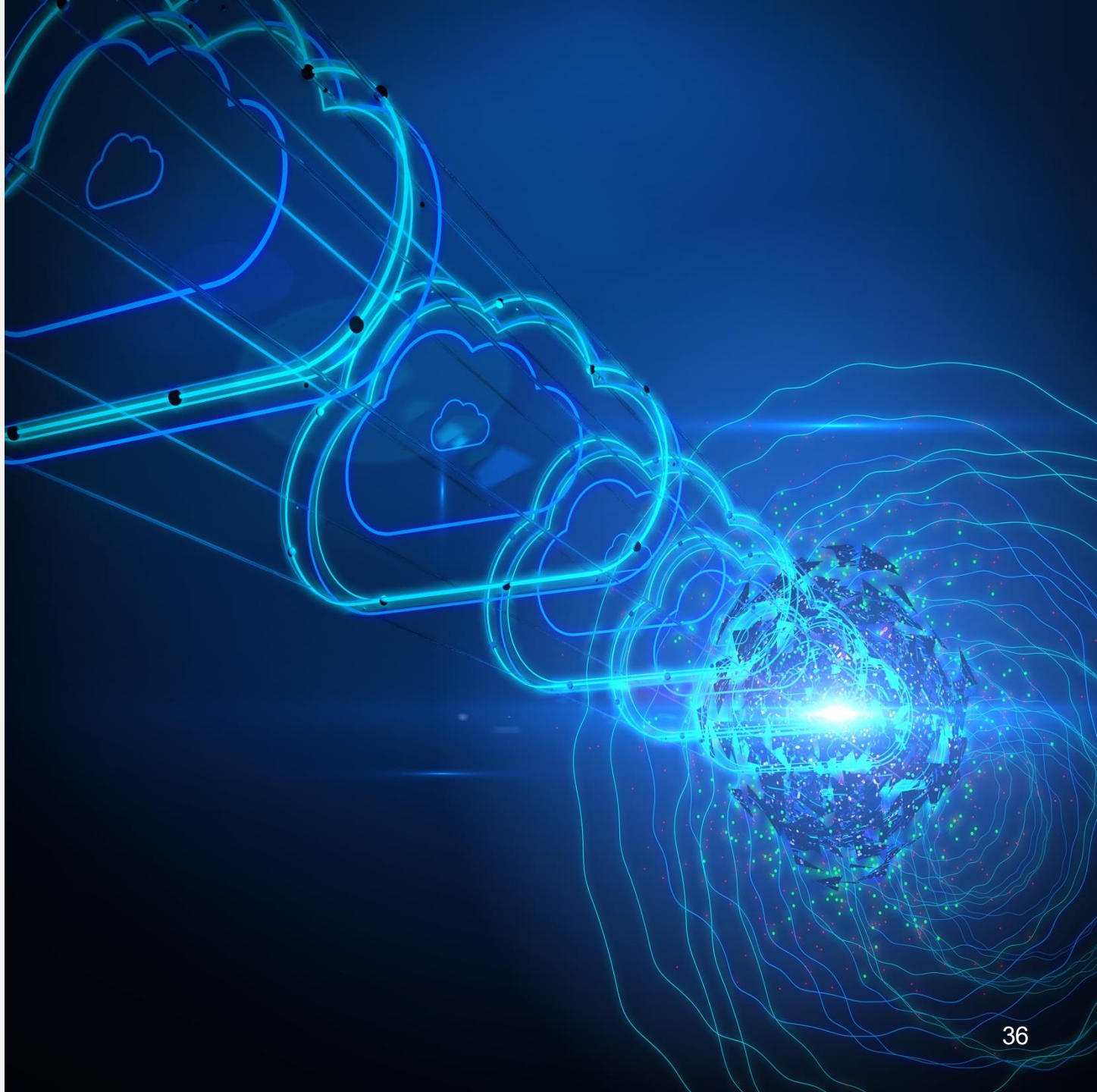
Vendor Agnostic



DFSMScdm - Cloud Data Manager drives a standard recall and a subsequent HSM cloud migration to cloud to convert ML2 data to MLC data using a storage vendor agnostic technology.

- ✓ *Transparent to applications*
- ✓ *Maintains original last reference date*
- ✓ *Maintains original migration date*
- ✓ *Removes serial access from tape*
- ✓ *Removed from Recycle processing*
  - Never processed again by DFSMShsm until it expires

Update Applications and Processes to be Object Storage Aware



Application Data
Direct Access

z/OS Cloud Data Access Strategy

There are various ways to copy data between disk & tape and to import & export data into and out of z/OS.

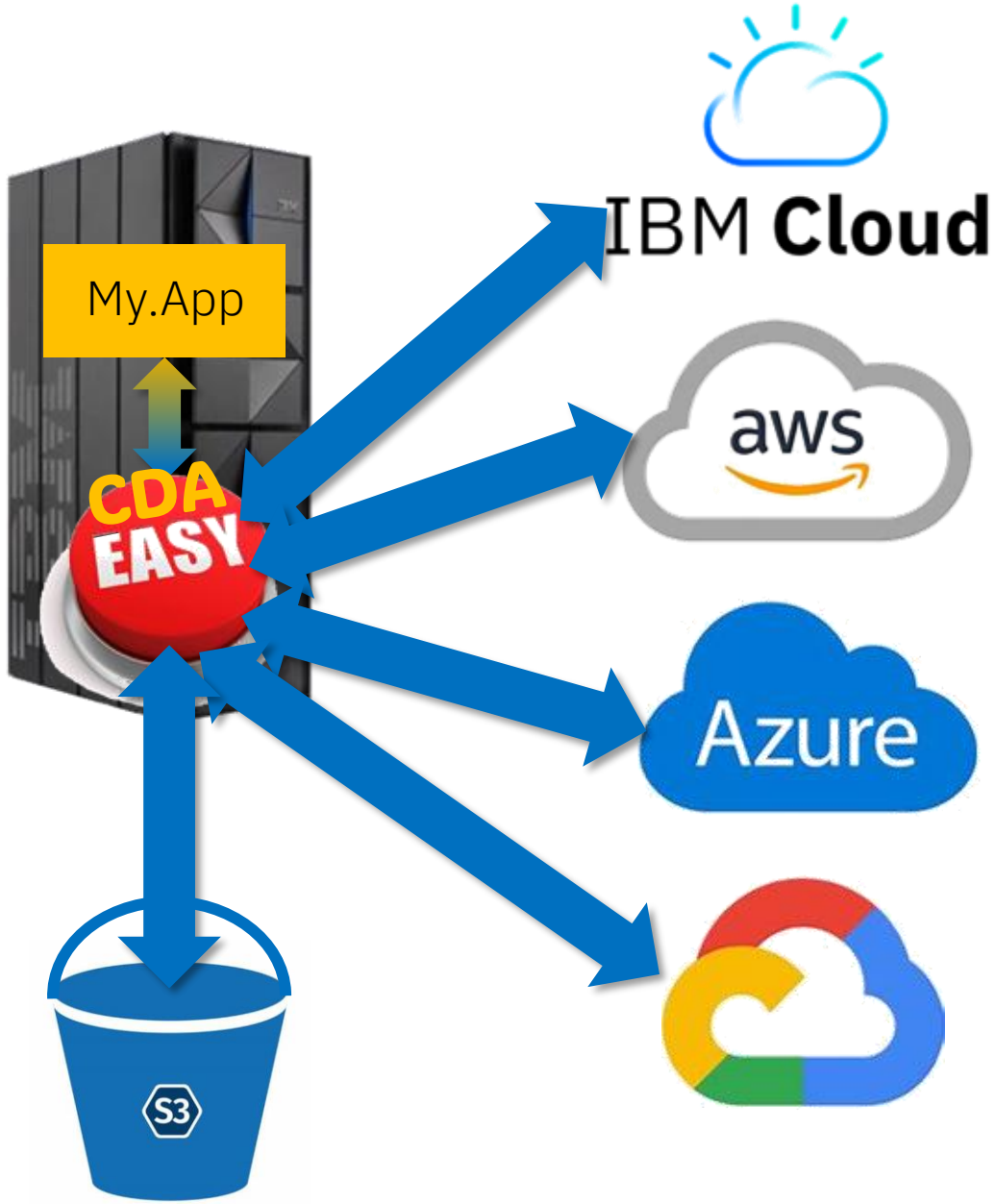
DFSMS's strategy is to provide a simple to use access method that stores and reads data directly to and from cloud object storage. This capability will enable application developers to directly leverage the strengths of cloud object storage for their application data, such as simply and securely sharing it across an enterprise.

	Maintain SLAs	Application Transparent	Leverage cloud capabilities	Sharable
CDA				

Foundation: Cloud Data Access (*Method*) - CDA

- An ‘Access Method’, similar to other access methods
- Included in base z/OS at no charge

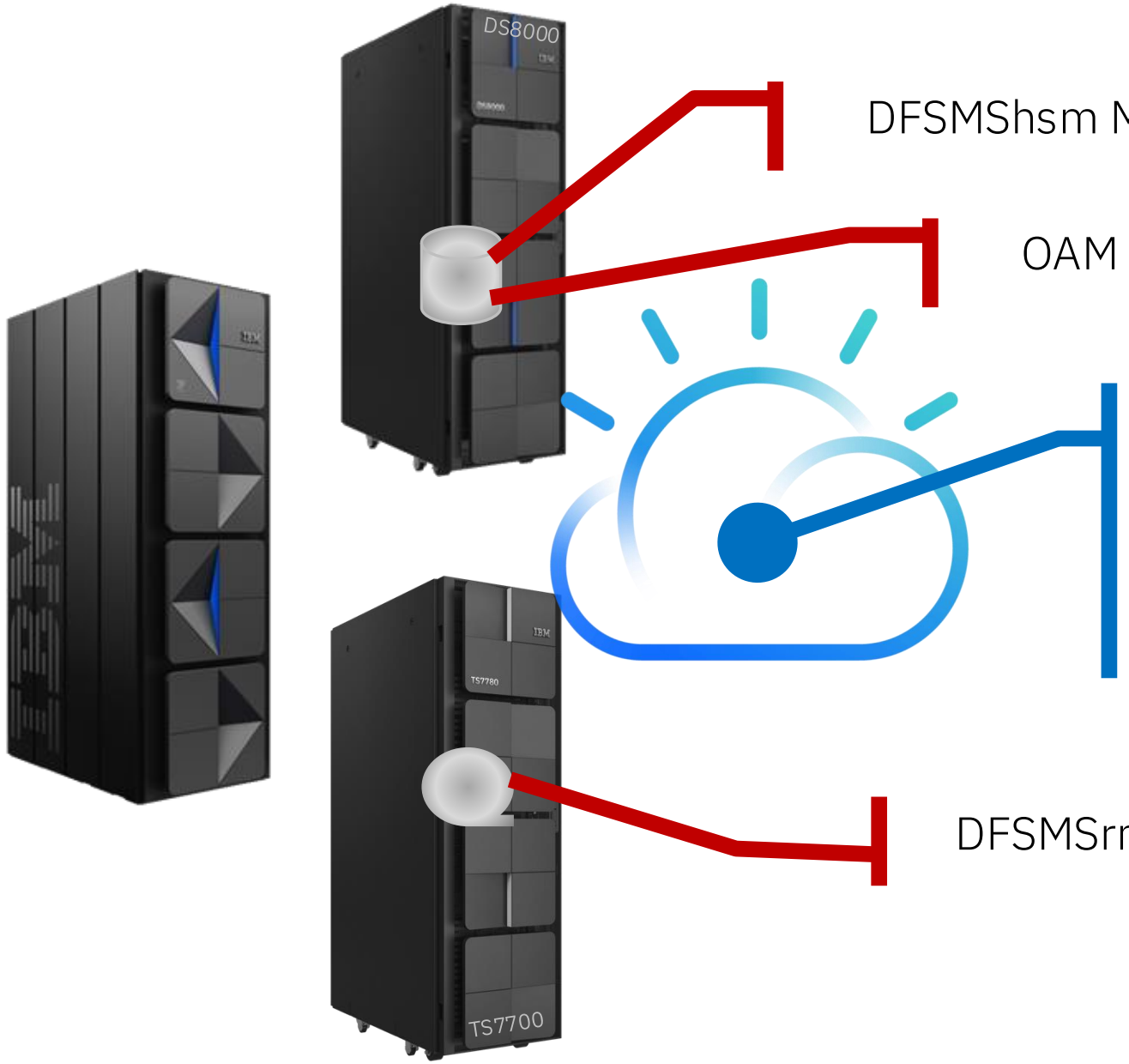
- Application owners code to *single CDA* Authorization and Data Access APIs
  - Enable S3 / Cloud Object Storage as another tier for z/OS applications
  - Single API to interact with various object storage providers
  - Manage Account IDs and Credentials
  - Target lower cost storage
  - Simplified data sharing (eliminate ETL)



GDKUTIL Upload and Download Utility

```
Command ===>                                                  Scroll ===> CSR
000904 //*************************************************************
000905 //* FIRST UPLOAD THE LRECL 80 DATA SET
000906 //*************************************************************
000907 //STEP001U EXEC PGM=GDKUTIL,REGION=0M
000908 //SYSPRINT DD   SYSOUT=*
000909 //SYSOUT   DD   SYSOUT=*
000910 //SYSIN    DD   *
000911  UPLOAD PROVIDER(DFLINUX1) CONVERT
000912 /*
000913 //OBJNAME  DD   *
000914    /oa62318r/GDKUA001_lrecl80-FB.txt
000915 /*
000916 //LOCAL    DD   DISP=SHR,DSN=OA62318.SMSAU001.LRECL80.SAM.RECFMFB
000917 //*
000918 //*************************************************************/
000919 //*
000920 //*
000921 //*************************************************************
000922 //* DOWNLOAD THE OBJECT
000923 //*************************************************************
000924 //STEP001D EXEC PGM=GDKUTIL,REGION=0M
000925 //SYSPRINT DD   SYSOUT=*
000926 //SYSOUT   DD   SYSOUT=*
000927 //SYSIN    DD   *
000928  DOWNLOAD PROVIDER(DFLINUX1) CONVERT
000929 /*
000930 //OBJNAME  DD   *
000931    /oa62318r/GDKUA001_lrecl80-FB.txt
000932 /*
000933 //LOCAL    DD   DISP=(NEW,CATLG),SPACE=(CYL,(5,5),RLSE),RECFM=FB,
000934 //             LRECL=80,BLKSIZE=27920,VOL=SER=D9XWRK,
000935 //             DSN=OA62318.CLDAU001.LRECL80.SAM.RECFMFB
****** ********************** Bottom of Data **********************
```

IBM z/OS DFSMS Family of Data Managers



DFSMShsm Manages Structured Disk Data

OAM Manages Unstructured Data

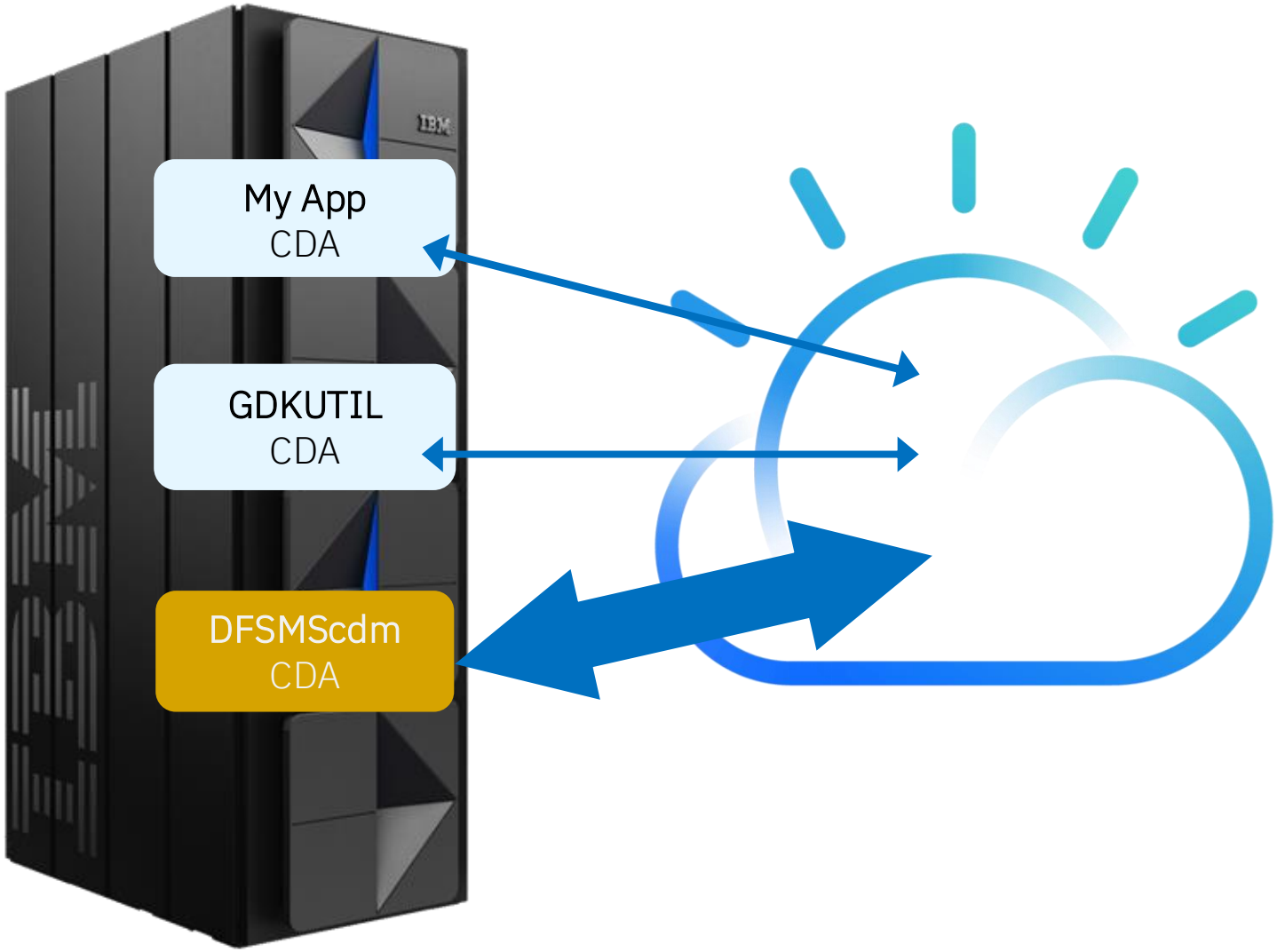
DFSMScdm Manages Object Storage Data

z/OS Governance of z/OS data in the cloud!

(Key difference: OTC)

DFSMSrmm Manages Tape Data

IBM z/OS DFSMScdm



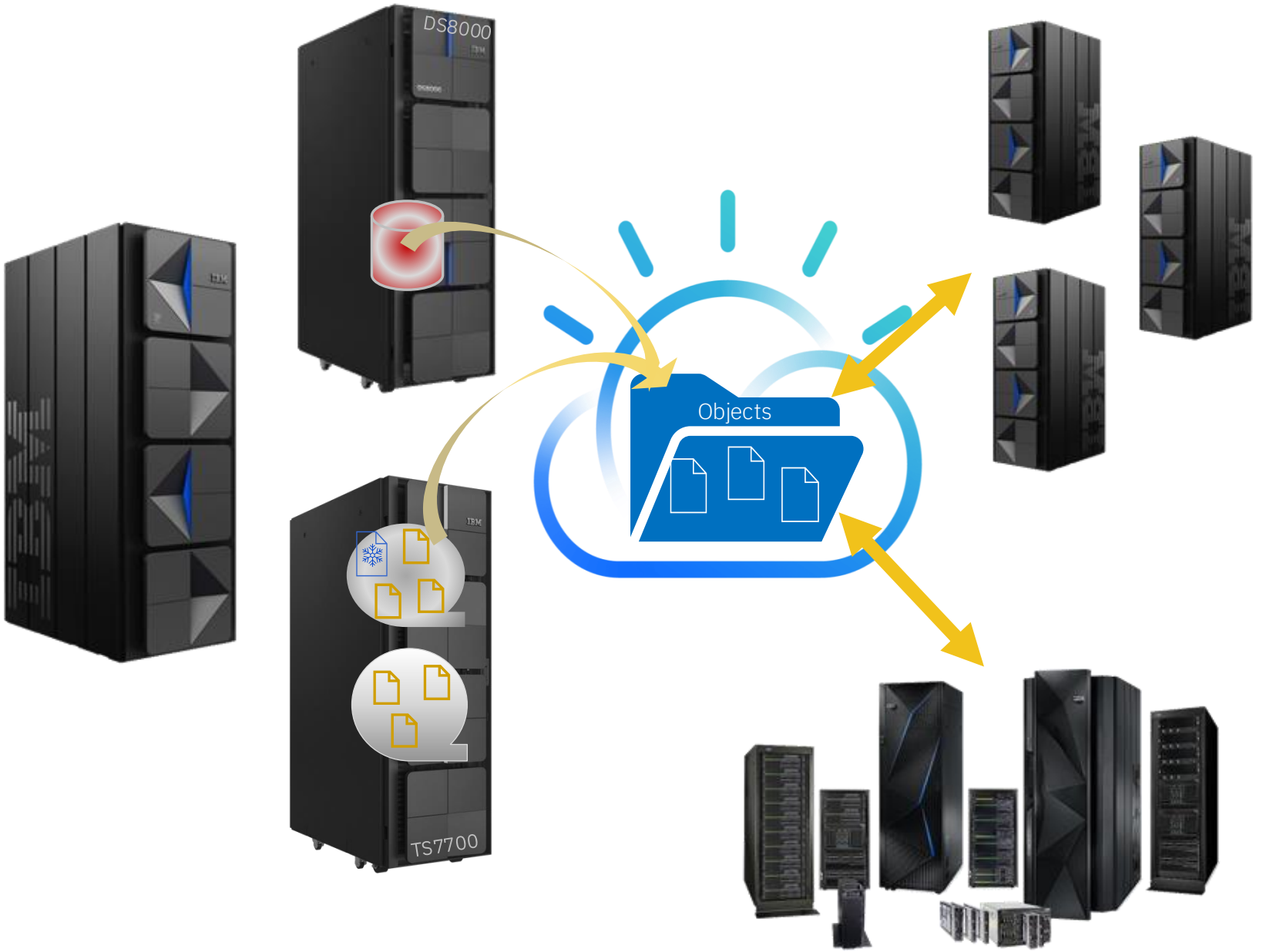
- **CDA** – Update your application to directly Put/Get data on Object Storage
- **GDKUTIL** – Single threaded movement via JCL

- **DFSMScdm V1.1** – Convert HSM ML2 data to MLC
- **DFSMScdm V1.2** – Move data between disk/tape and object storage ***at Scale***
  - *EBCDIC <> UTF 8, ISPF Object List, etc*

DFSMScdm

Managed, parallel movement of all the data sets specified by a single partially-qualified name

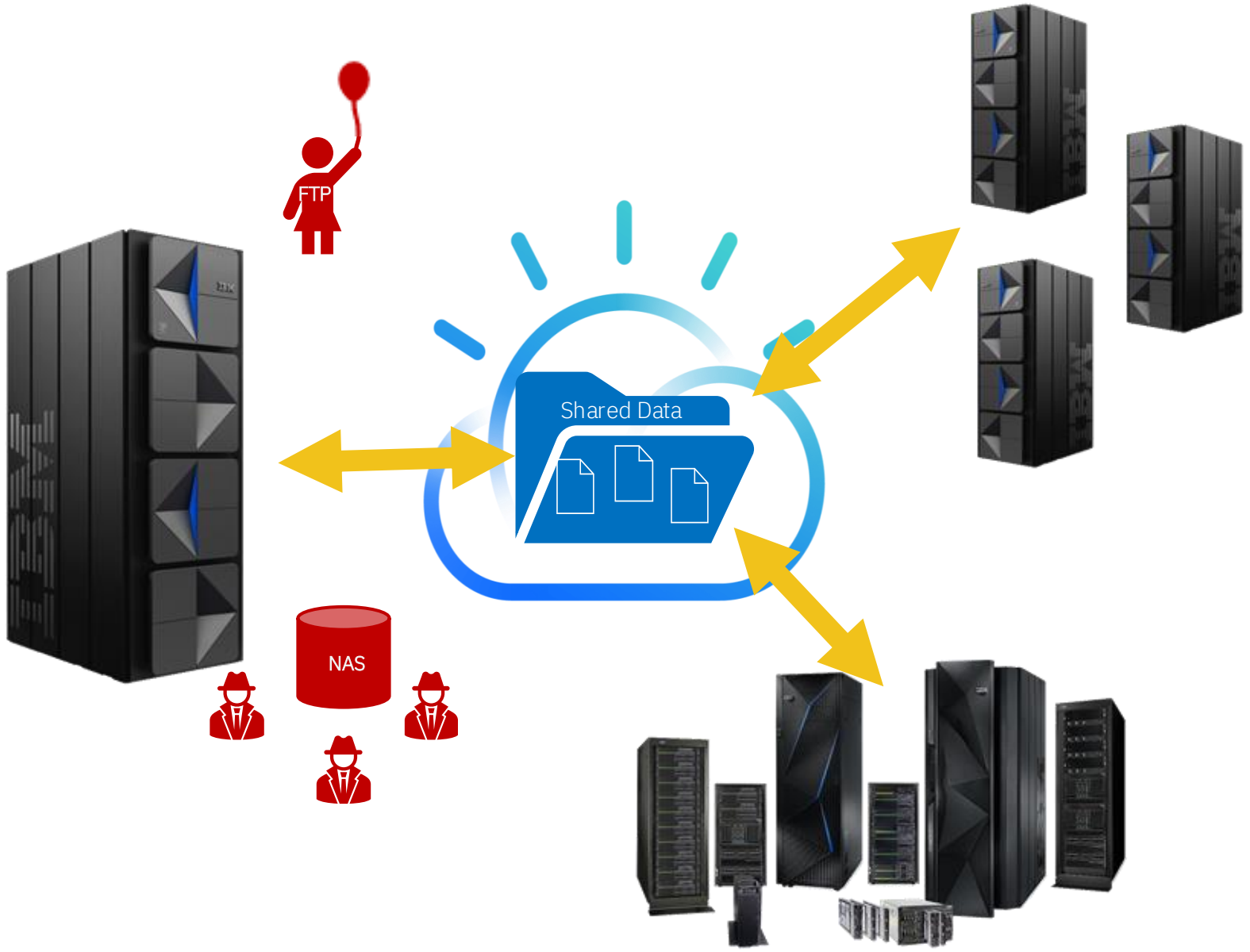
- ✓ *Alternative to FTP, NAS, etc*
- ✓ *Share data sets across sysplexes & enterprises*
- ✓ *Protected Copies*



DFSMScdm Use Case

Alternative to FTP, NAS, etc

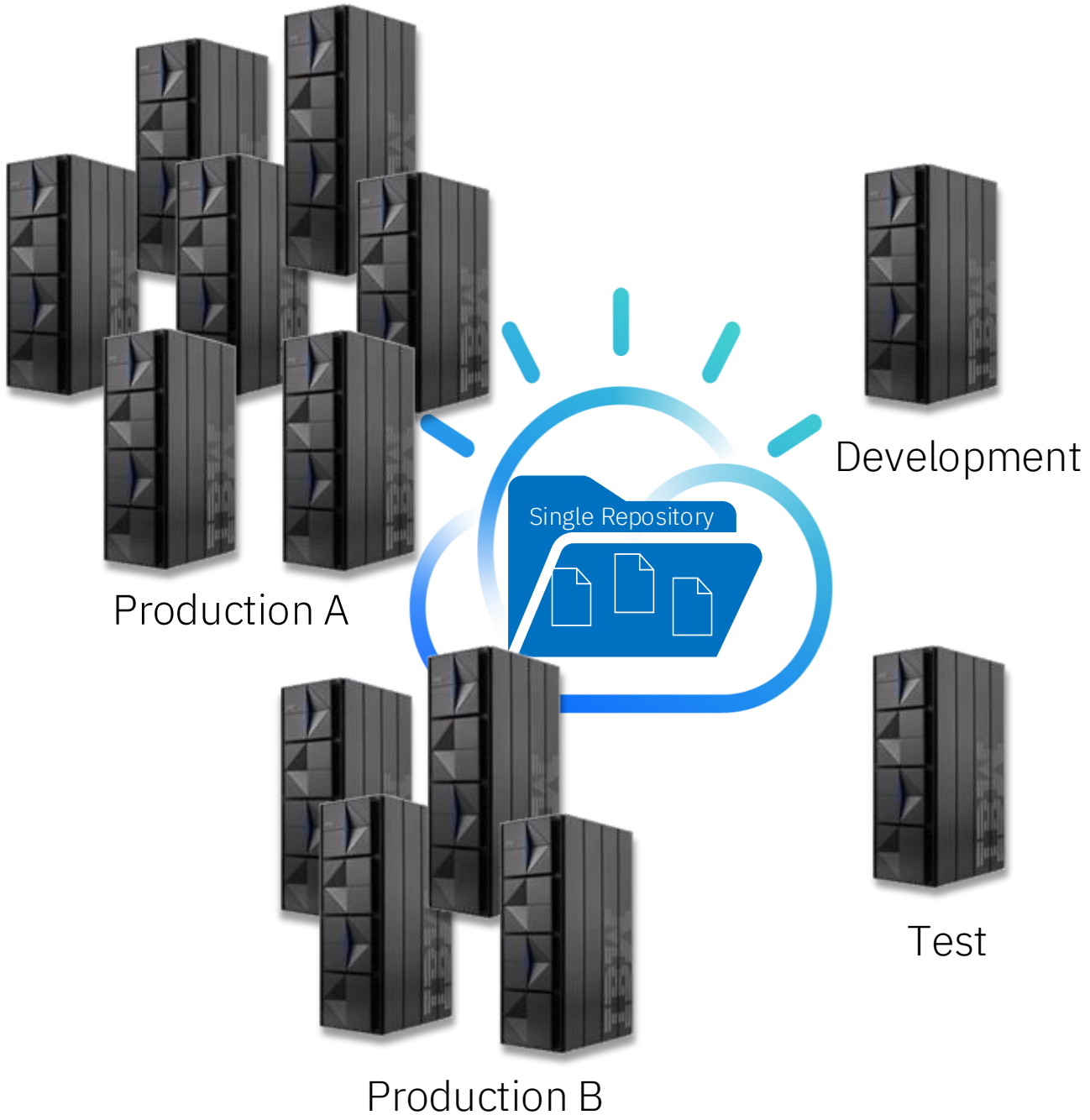
- X FTP is a one-way data share with no control of data after it has been sent
- X NAS storage has limited sharing controls



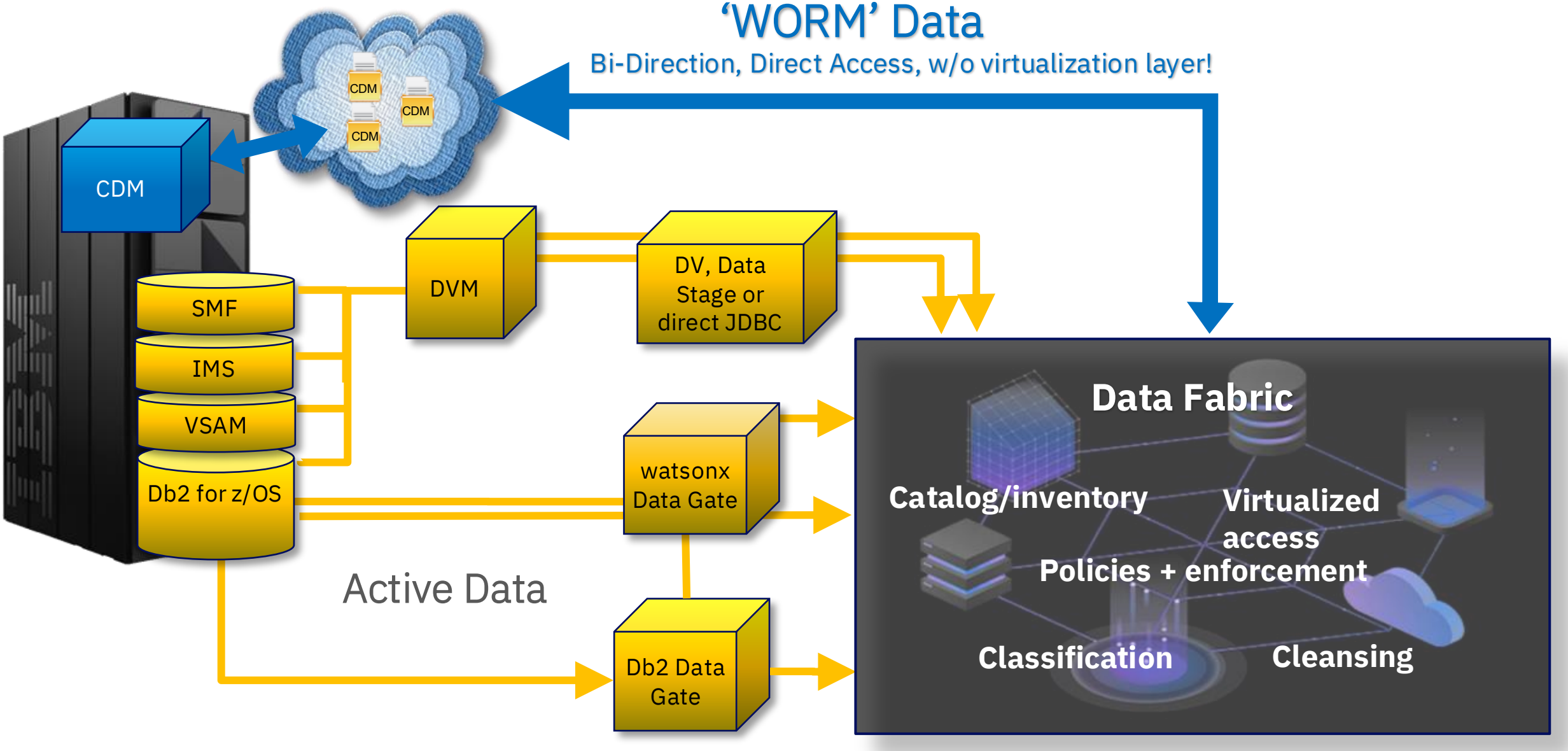
DFSMScdm Use Case

Share data across systems / sysplexes

- ✓ *Single, primary copy of data for all systems to ingest*
- ✓ *Graduate data through Dev, Test to Prod*
- ✓ *etc*

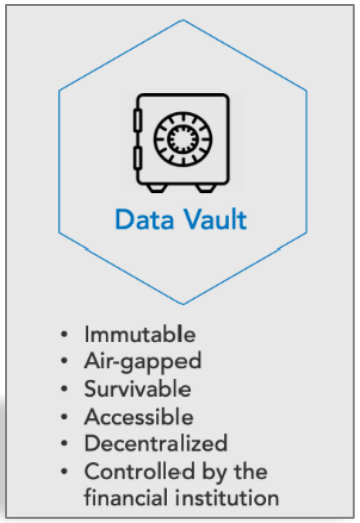


DFSMScdm Use Case



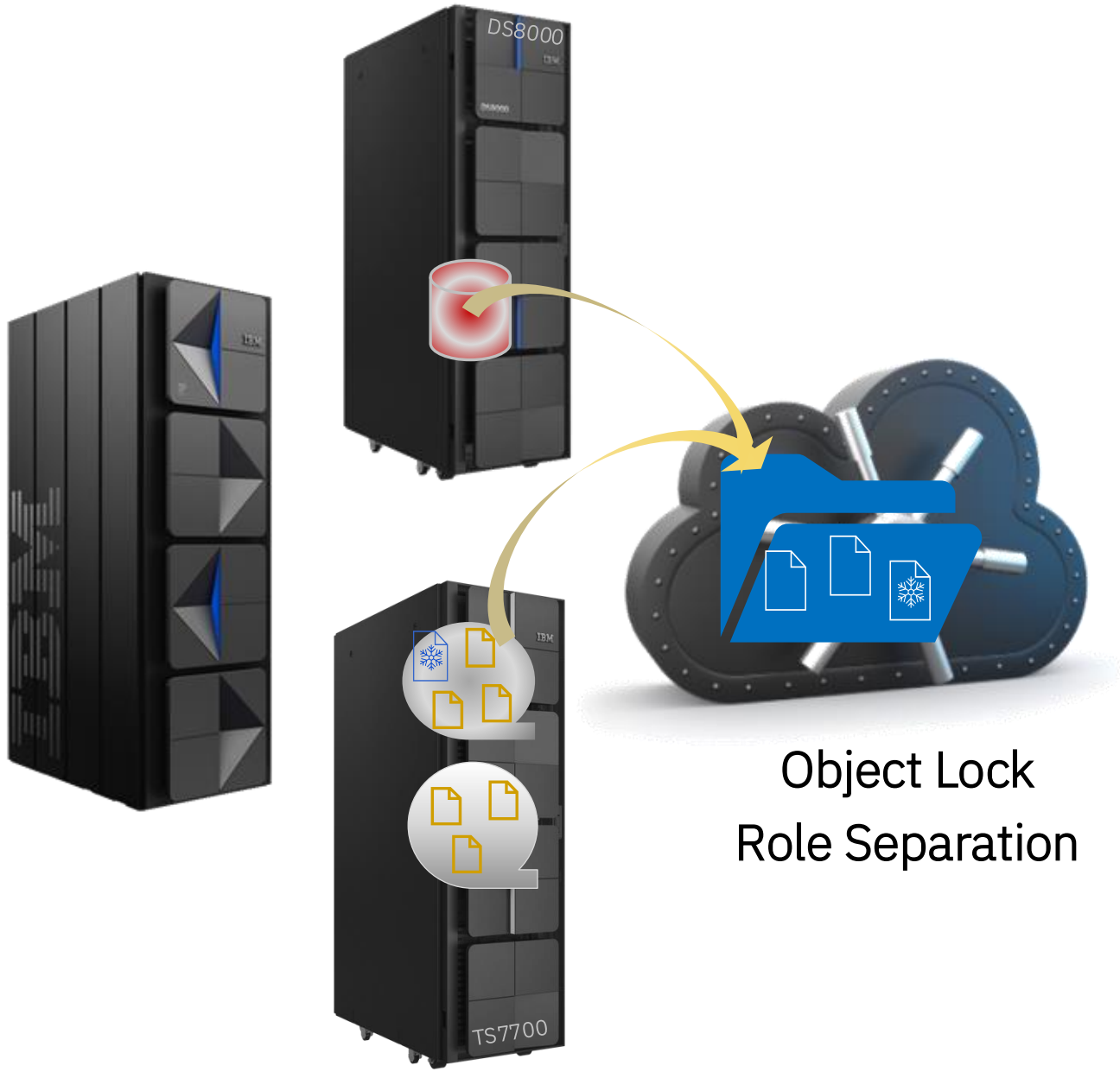
DFSMScdm Use Case

✓ *Protected Copy of z/OS Data*



Data Vaulting is a core element of Sheltered Harbor

(Sheltered Harbor is the not-for-profit, industry-led effort developed by and for the financial services industry as a critical backup of last resort.)



Object Lock
Role Separation

DFSMScdm *compliments* other IBM z/OS Object Storage Solutions

Basics

CDA provides simple APIs for interacting with the various object storage providers and managing credentials. GDKUTIL is an IEBGENER-like utility

Backup and Migration

DFSMSdss and DFSMShsm provide the capability to backup and migrate unreferenced data to object storage via DS8K Transparent Cloud Tiering.
DSS can also leverage CDA.

Virtual Tape

IBM Z Cloud Tape Connector (CTC) provides a software-only solution

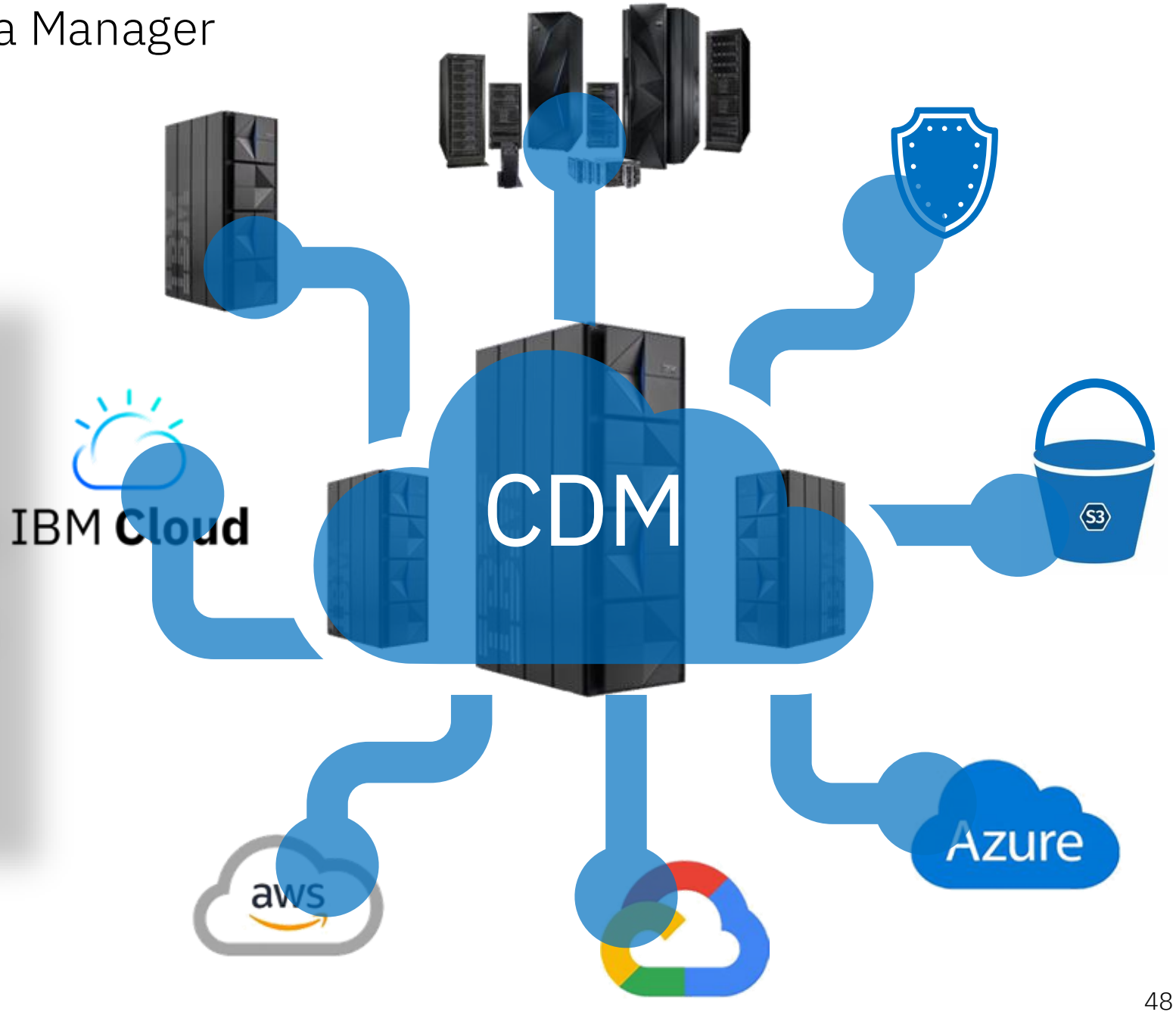
IBM TS7700 Cloud Storage Tier is a storage-based host transparent solution

Unstructured Data

OAM provides native support for leveraging object storage directly for z/OS unstructured data (PDFs, audio, video, etc)

z/OS DFSMScdm – Cloud Data Manager

- Amplify your Hybrid Cloud Strategy
- Simplify your z/OS architecture by leveraging industry standard storage and APIs
- Integrate z/OS data into your enterprise's Data Fabric
- Secure your data off-prem with S3 Object Lock
- Lower costs



Resources

IBM Cloud Object Storage

DFSMScdm

Tape Environments

TS7700
Cloud Storage Tier

Cloud Tape Connector

Transparent Cloud Tiering

DS8900 & DFSMS
Transparent Cloud Tiering

TS7700
DS8000 Object Store

DFSMS TCT Support

DFSMShsm TCT Overview
WebEx Recording

DFSMShsm TCT
CPU Savings Estimator

Application Data

Cloud Data Access

GDKUTIL Guide

OAM
Object Support Guide

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