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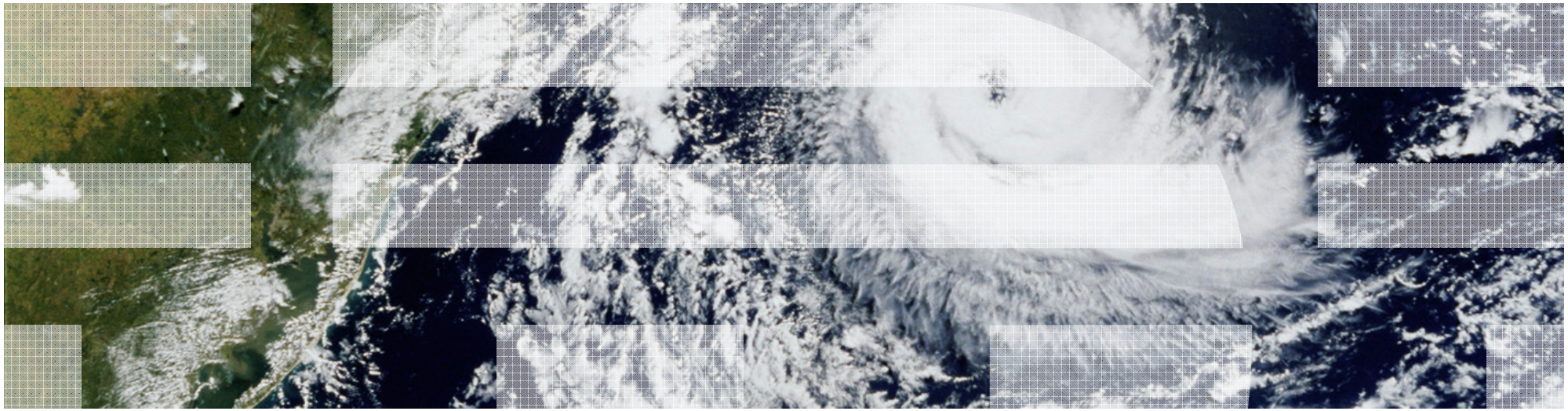
Hynes, Room 309

Best Practices: Tape Storage Administration with DFSMSrmm



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Agenda

- Why DFSMSrmm best practices?
- About the RMM CDS: Allocation, placement, monitoring, recovery
- Using client/server – the right way
- z/OS release coexistence with DFSMSrmm
- Safety Nets
- Diagnostics and performance hints

Some good reasons why you may not want to care about DFSMSrmm best practices…

- Your life is boring; some excitement would come just right
- Nobody in your shop knows you
- Nobody in your shop –except you- knows what DFSMSrmm is
- Everything is just running fine. Why care?
- You can still read up the manuals when anything fails:

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CDS Allocation, Monitoring and Maintenance

- Your CDS is a crucial resource to ensure
  - Continuous availability of the DFSMSrmm subsystem
  - Integrity of data
    - RMM-internal information
    - Consistency with TCDB and Library Manager databases
  - Your ability to recover quickly from problems
  - DFSMSrmm performance
- The following best practices apply to
  - Allocation and placement
  - Monitoring, and
  - Maintenance of your CDS

CDS Allocation

- Good starting point for CDS allocation is SYS1.SAMPLIB(EDGJMFAL)
  - Already addresses CISIZEs, Bufferspace

```
DEFINE CLUSTER (NAME(STSGWD.RMM.CDS)                -
                FILE(MASTER)                        -
                FREESPACE(15 0)                     -
                KEY(56 0)                           -
                REUSE                               -
                RECORDSIZE(512 9216)                -
                SHAREOPTIONS(3 3)                   -
                KILOBYTES(4500 1500)                -
                VOLUMES(DFRMMA))                    -
       DATA     (NAME(STSGWD.RMM.CDS.DATA)          -
                 BUFFERSPACE(829440)                -
                 CISZ(26624))                       -
       INDEX    (NAME(STSGWD.RMM.CDS.INDEX)         -
                 CISZ(2048))
```

- SMS-managed is preferred
- Add DATACLASS() to use
  - DSNTYPE EXTended REQuired
  - If your CDS is anywhere near to 4GB, define it such that it can extend beyond 4GB
    - Specify EXTENDED ADDRESSABILITY = Y
- Multi-volume allocation possible

- CDS is not a good candidate for striping or compression

CDS Sizing

- Estimate required space for CDS as documented
  - … and then allocate at least twice that much as primary allocation
- Add secondary allocation to allow for growth
- Recommended: Use GUARANTEEDSPACE in STORAGECLASS

Table 8. DFSMSrmm Control Data Set DASD Space Requirements

Control Data Set Content	DASD Space
Control record	1 MB (MB equals approximately 1 000 000 bytes)
Data sets	512 KB for every 1000 data sets
Shelf locations in the library that do not contain volumes	140 KB for every 1000 shelf locations
Shelf locations in storage locations	140 KB for every 1000 shelf locations
Owners	38 KB per 1000 volumes
Software products, average five volumes per product	420 KB for every 1000 software products
Volumes	1 MB for every 1000 volumes
Vital record specifications	212 KB for every 1000 vital record specifications

CDS Placement

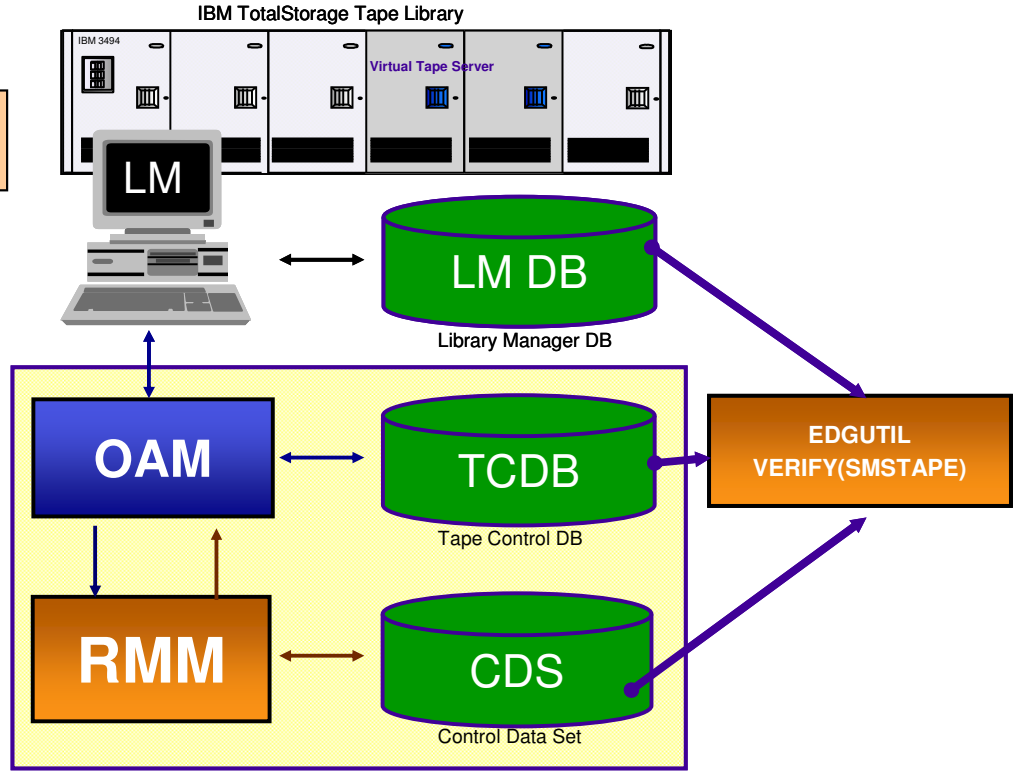
- CDS Placement considerations
  - Space to extend on volume(s)
  - Free entries in VTOC
- Place on suitable volume(s)
  - High performance
  - Consider AVAILABILITY=CONTINUOUS
  - Consider eligibility for concurrent copy/virtual concurrent copy/flashcopy
  - Separate from journal data sets
- If CDS will be shared across Sysplexes RESERVE/RELEASE will be used
  - No other critical data should be placed on same volume(s)
  - Customize GRSRNLxx to avoid GLOBAL ENQ in addition

CDS Monitoring (1)

- Always monitor the CDS for **space** bottlenecks
  - Objective that there is always enough space allocated, or available via secondary extensions
  - It is difficult to determine actual usage of a KSDS cluster
    Focus on ensuring that the CDS either has sufficient space allocated, or that it will be able to extend. Check:
    - HURBA/HARBA in RMM LISTCONTROL or LISTCAT
      - Baseline of % Full changes with allocations
    - Well below 123 extents/volume limit
    - Free space on volume(s) sufficient for secondary allocation(s)
    - VTOC space
    - Current size + secondary space < 4GB or use EF & EA

CDS Monitoring (2)

- Regularly monitor the CDS for **integrity**
  - Use EDGUTIL VERIFY(ALL) to check for CDS mismatches
  - Use EDGUTIL VERIFY(SMSTAPE) to check consistency across TCDB, CDS and library manager database



CDS Maintenance

- To reclaim CDS space use EDGBKUP; PARM='BACKUP(REORG)'
  - As in SYS1.SAMPLIB(EDGJBKUP)
  - After the REORG note the HURBA for later comparisons
  - There is little value in REORG other than to reclaim space
    - Frequent REORGs tend to increase the number of CI/CA splits required
  - On z/OS V1.12 and above VSAM CA reclaim should further reduce the requirements for REORGs

- Repair CDS inconsistencies
  - Only when previously identified by VERIFY
  - Run MEND against a copy of the CDS
    - Check changes, then copy back
  - Always quiesce all DFRMM subsystems sharing the CDS

- Recommendation: Test your recovery and REORG procedures

Preparing for CDS recovery

- Certain events can render the CDS unusable
  - Physical data loss or corruption
  - CDS update errors
    - I/O errors during CDS update
    - “CDS full” condition while doing multi-record updates
- Recommendation: Have current and tested recovery jobs available at any time.
  - Recovery strategy depends on specific situation
  - Incorrect recovery attempts make the problem even worse and cause unneeded outage times
- For recovery procedures, refer to “DFSMSrmm Implementation and Customization Guide”, chapter 17: Maintaining the Control Data Set

Recovery strategy

- Physical data loss or corruption
  - The CDS needs to be recovered to the most current clean state
    Forward recovery:
    - Base is the last backup taken from the CDS
    - Then apply (“replay”) all subsequent changes recorded in the journal data set(s)

- CDS update errors
  1. DFRMM auto-recovery will be attempted
  2. If auto-recovery fails, perform manual recovery
     - Base is the currently active CDS
     - Then apply all subsequent changes recorded in the journal data set(s)

- Journal “replay” depends on the CDS backup format
  - DSS: Start with the journal backup taken at the **same** time
  - AMS: Start with the journal backup taken at the **next** backup

DFRMM will automatically attempt to recover

- Automatic recovery
  - EDG2111I DFSMSrmm STARTING AUTOMATIC RECOVERY OF THE CONTROL DATA SET
  - DFRMM will automatically use the current journal to perform automatic recovery

- If successful, DFRMM will continue:
  - EDG2112I DFSMSrmm AUTOMATIC RECOVERY OF CONTROL DATA SET SUCCESSFUL
- Otherwise manual recovery needs to be performed:
  - EDG2115I RECOVERY OF CONTROL DATA SET IS REQUIRED
  - EDG2116A DFSMSrmm QUIESCED - START CONTROL DATA SET RECOVERY PROCEDURE
  - Possible reasons include
    - Journal / CDS mismatch
    - Journal not available or disabled

How to resolve a CDS-full condition (sample)

```
EDG2109I MASTER   FILE IS FULL FOR FUNCTION LADD,18 -
          RC=0008 REAS=001C KEY=…
*nn EDG4001D DFSMSrmm I/O ERROR IN …
ENTER "RETRY" OR "CANCEL"
EDG2110I DFSMSrmm DETECTED A FAILED CONTROL DATA SET UPDATE
EDG2111I DFSMSrmm STARTING AUTOMATIC RECOVERY OF THE CONTROL DATA SET
EDG2109I MASTER   FILE IS FULL FOR FUNCTION LADD,18 - RC=0008 REAS=001C
EDG2114I AUTOMATIC RECOVERY OF CONTROL DATA SET HAS FAILED
EDG2116A DFSMSrmm QUIESCED - START CONTROL DATA SET RECOVERY PROCEDURE
*nn EDG4012D DFSMSrmm INACTIVE FOR …,ENTER "RETRY", "CANCEL" OR "CONTINUE"
```

- **Recovery**:
  - Do not yet reply to EDG4001D
  - Do not reply to EDG4012D. Leave this message outstanding until RMM is active again after the recovery
    - On refresh, RMM will continue without a reply
    - Do not auto-reply to this message
  - Run reorg to reclaim some space:
    - `// EXEC PGM=EDGBKUP,PARM='BACKUP(REORG)'`
  - Reply EDG4001D with “RETRY”

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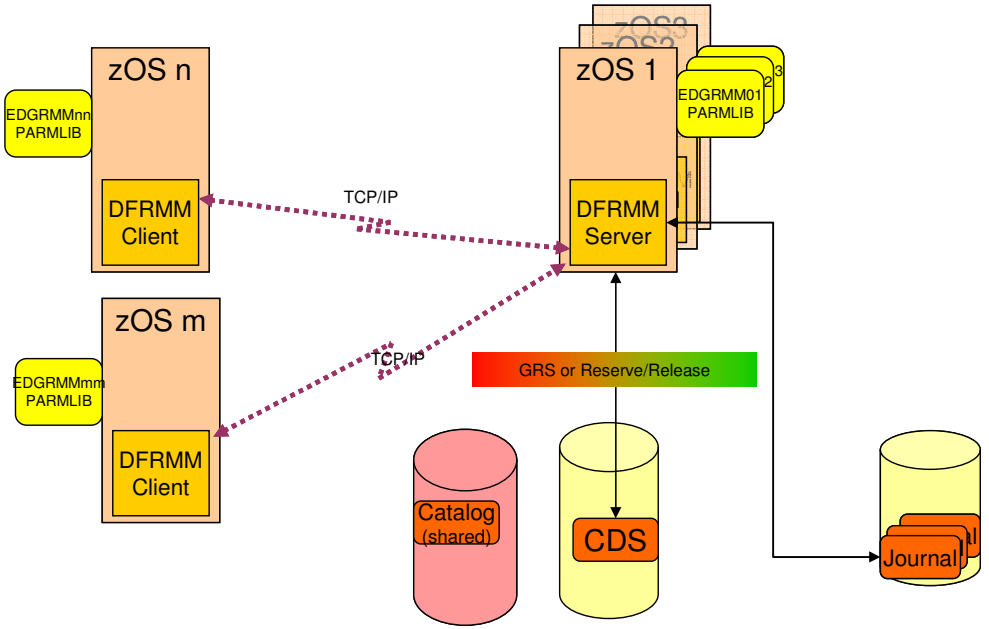
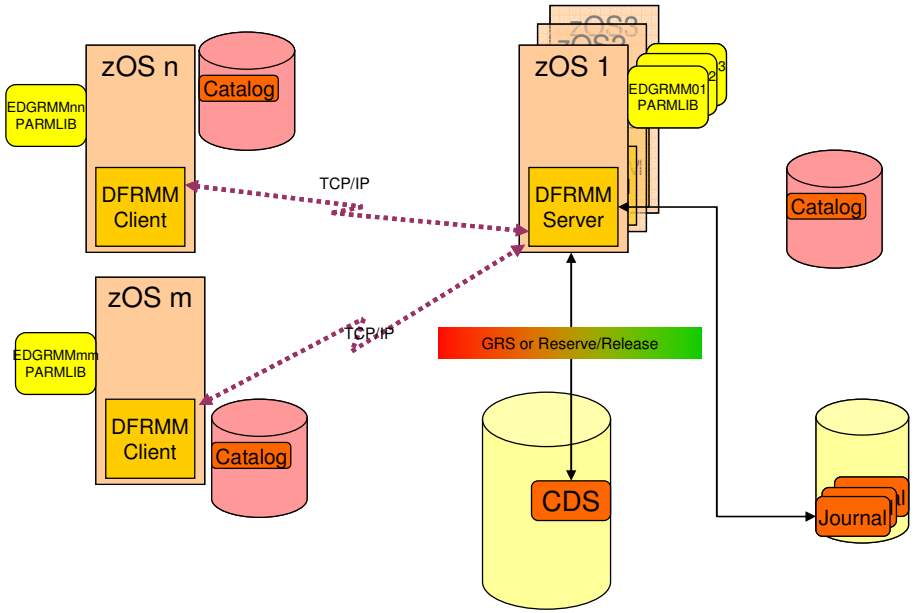
Using DFSMSrmm Client/Server the right way

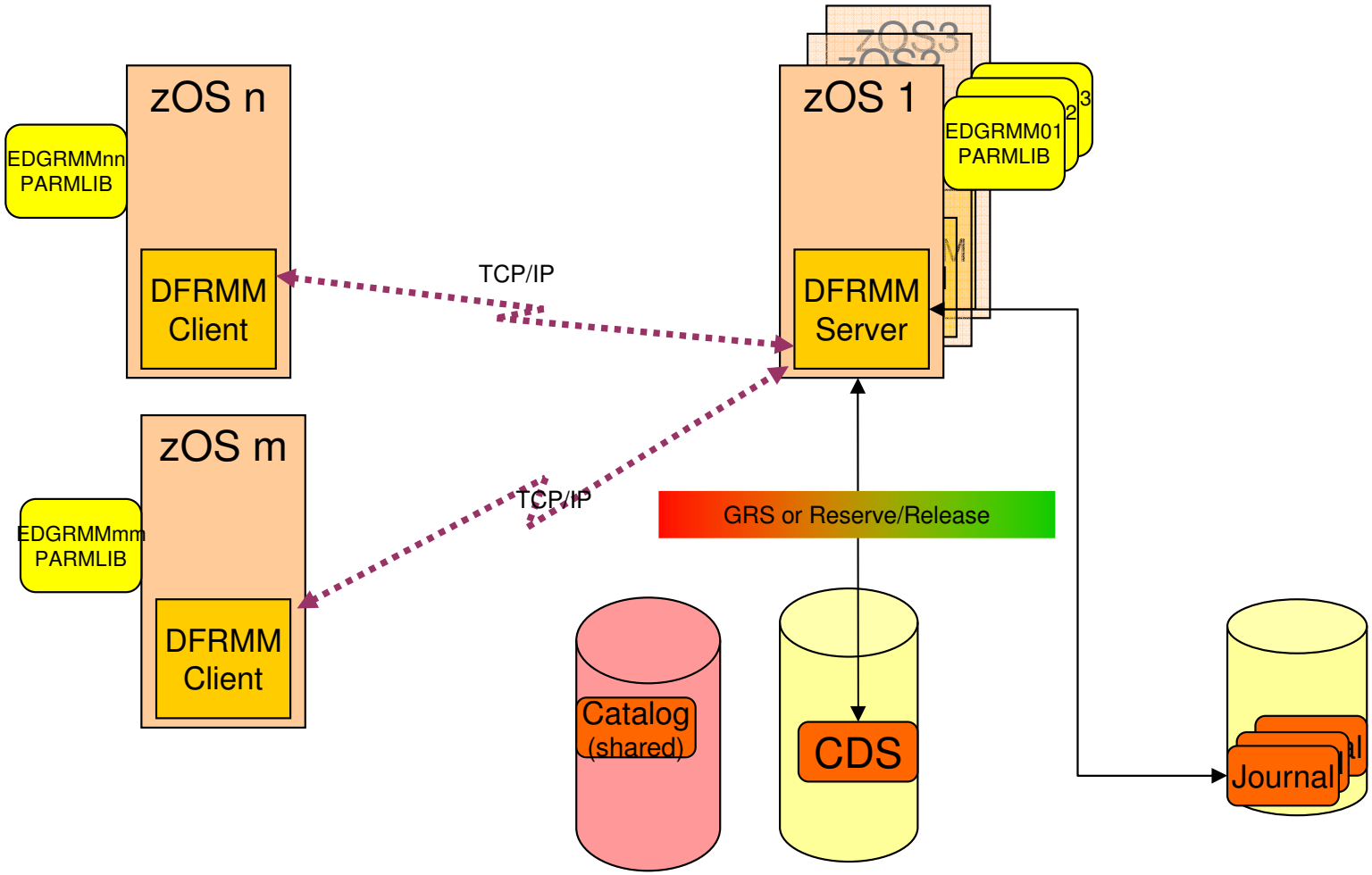
- Reasons for using client/server:
  - Many systems that should share a common database
    - and expect significant concurrent access to CDS
  - No shared volumes available
  - Avoids RESERVE/RELEASE
    - Hyperswap manager does not tolerate cross-plex sharing
  - Catalogs may be shared or non-shared

- Prerequisites for using client/server
  - Reliable network (TCP/IP) connectivity
  - All coexistence maintenance applied
    - Same coexistence requirements as for non-C/S environment!
  - Adjust RMM usage and operational procedures for C/S – see next chart

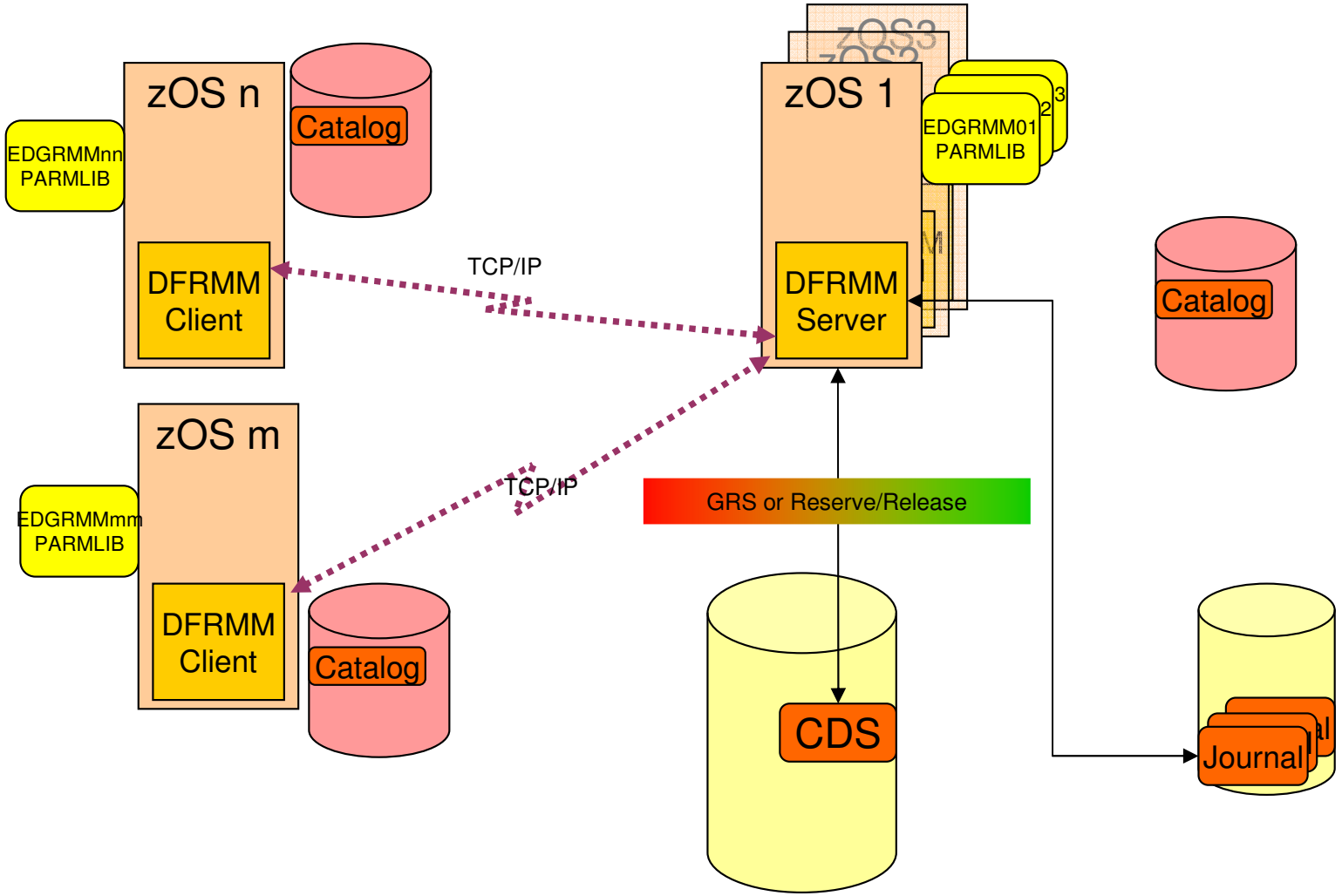




C/S Topology – Shared Catalog

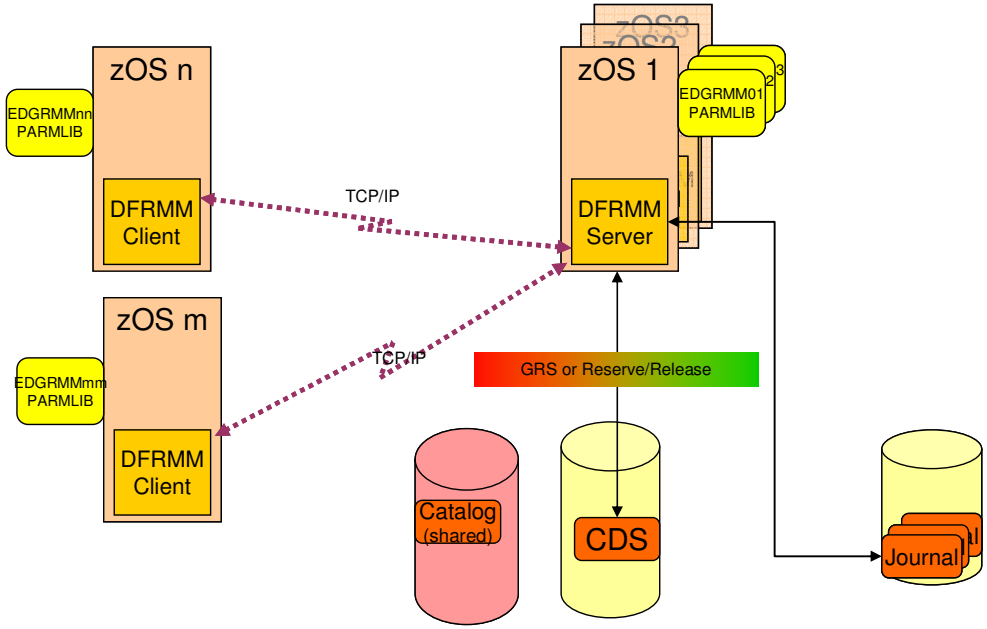


C/S Topology – Non-shared Catalogs



DFSMSrmm Operations und usage in a Client/Server Environment

Must run on client:
- CATSYNCH
- EXPROC



Must run on server:
- BACKUP

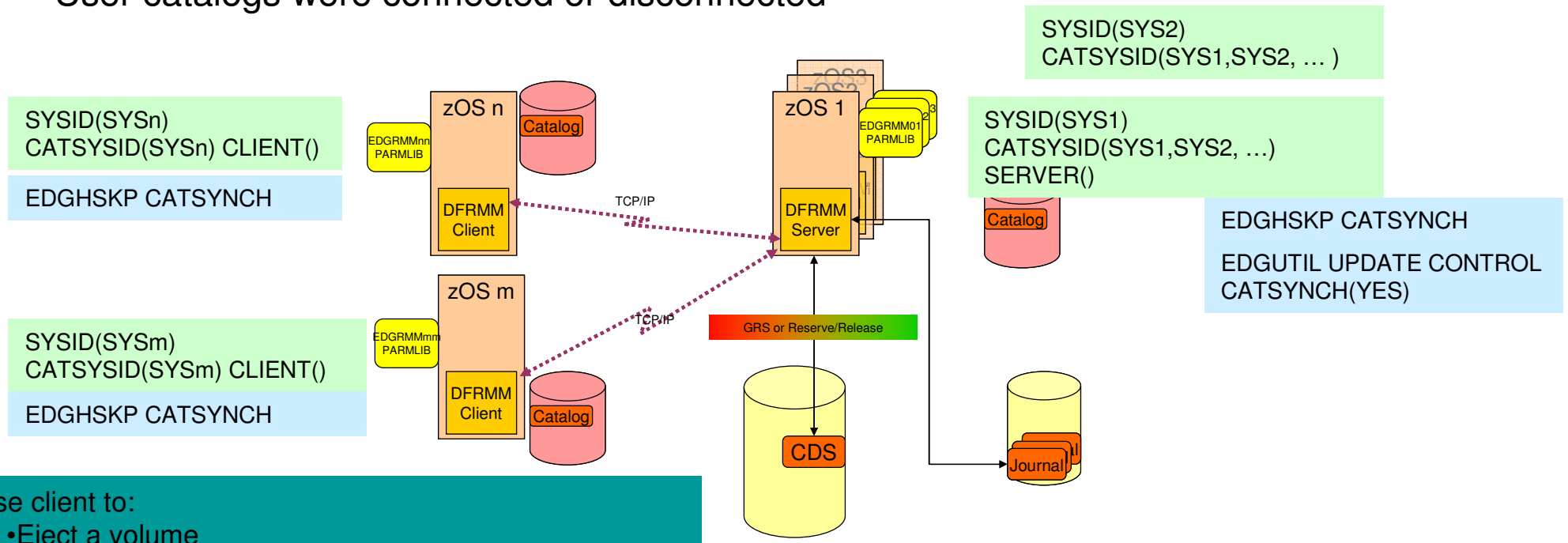
Should run on server:
- VRSEL
- DSTORE
- RPTEXT

See next chart for actions to be performed on client side if catalog is not shared.

Preferably use server for all tasks that do not require to run on client.

Some special considerations apply in a Client/Server environment with non-shared catalogs

- CATSYSID must define list of systems that share catalogs with the system
- Catalogs and CDS may need resynchronization:
  - Identified EDGHSKP CATSYNCH/VERIFY
  - Synchronization was lost because RMM was unavailable or errors occurred
  - User catalogs were connected or disconnected



Use client to:
- Eject a volume
- Add volumes using STATUS(VOLCAT)
- Change volume attributes maintained in the TCDB
- Return to scratch with uncatalog

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z/OS release coexistence with DFSMSrmm

- DFSMSrmm follows z/OS rules for coexistence
- Coexistence maintenance is *critical* if CDS is shared across different releases of z/OS
- Any migration actions required?
  → Check z/OS migration guides applicable to your releases
  → Run migration checks identified for the target release (if any)
    - Refer to DFSMSrmm migration health checks for V1R11
    - MODIFY HZSPROC,ACTIVATE,CHECK=(IBM,ZOSMIGV1R11_RMM_*)
- Any coexistence maintenance required?
  → Run SMP/E FIXCAT to check all required service is applied

```
---------------------------- Fix Category Explorer ----------- Row 1 to 6 of 6
===> _                                                        SCROLL ===> PAGE

Commands: FIND -Find a string, E -Expand all, C -Collapse all, U -Unselect all

Actions:  E -Expand, C -Collapse, S -Select, U -Unselect, V -View patterns

   Fix Categories                                                  Selected
   ------------------------------------------------------------    --------
  -IBM.*
   +IBM.Coexistence.*
   +IBM.Device.*
   +IBM.Function.*
    IBM.ProductInstal
   +IBM.TargetSystem-
```

```
MISSING FIXCAT SYSMOD REPORT FOR ZONE T110019

                                  HOLD      MISSING  HELD      ____RESOLVING SYSMOD_____
FIX CATEGORY      FMID            CLASS     APAR     SYSMOD    NAME      STATUS  RECEIVED
_________________ _______         ________  _______  _______   _______   ______  ________
IBM.Coexistence.z/OS.V1R12
                  HBB7760                   AA28873  HBB7760   UA53936   HELD    YES
                                            AA30848  HBB7760   UA54053   GOOD    YES
                                            AA32250  HBB7760   UA54344   GOOD    YES
                                            AA32285  HBB7760   UA55013   GOOD    YES
                  HDZ1B1N                   AA32804  HDZ1B1N   UA55131   GOOD    YES
                  HJE7760                   EA32712  HJE7760   UA54558   GOOD    YES
```

New Function Overview

z/OS (RMM) release / *Function*	*z/OS V1.12*	*z/OS V1.11*	*z/OS V1.10*	*z/OS V1.9*
Retention limit reporting	+	**OA30881**	**OA30881**	
•Volume Hold •EAS Eligibility •OPENRULE IGNORE •IPv6 •AUTOR •Add. Status commands & RAS enhancements	+			
Option to turn uppercasing on/off	+	**OA32661**	**OA32661**	**OA32661**
TS7700 1.6 Support , Logical WORM	+	**OA28637**	**OA28637**	**OA28637**
Report generator extensions	+	+		
Migration checks for z/OS V1.11+ coexistence	+	**OA32028**	**OA26947 OA32028**	**OA26947 OA32028**
z/OS V1.11+ coexistence	-	-	**OA25714 OA28232**	**OA25714 OA28232**

+: Support integrated into release base

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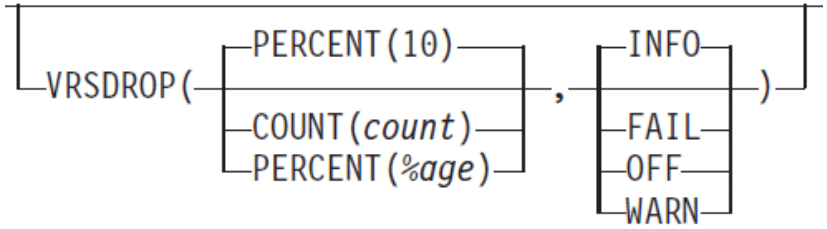
- Safety Nets and Library Partitioning
- Diagnostics and performance hints

Exploit additional safety nets for your data

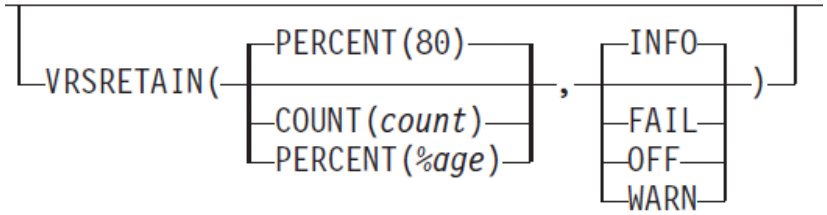
- Some problems may cause volumes to be dropped that really should be retained
  - Incorrect VRS changes
  - Operational problems
  - Bugs ☹
- DFSMSrmm offers capabilities to
  - Alert you when an unexpected amount of volumes are dropped
  - Prevent volumes from being dropped permanently
- Use these features as an additional safety net to prevent data loss
  - EXPDTDROP / **VRSDROP** / **VRSRETAIN**
    - Thresholds may be specified as absolute numbers or as percentages.
    - If threshold is exceeded INFO, WARN, or FAIL actions be performed.
  - Volume “Hold” attribute prevents a volume being set to pending release

Safety net: EXPDTDROP / VRSDROP / VRSRETAIN

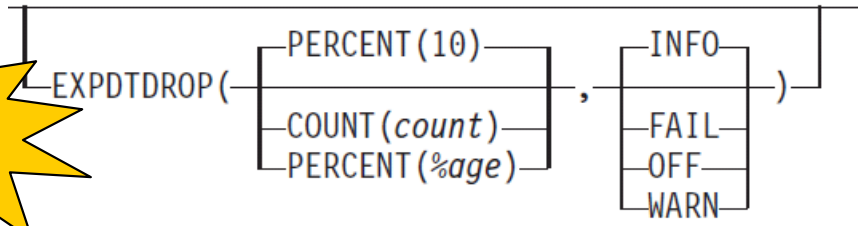
- **VRSDROP** to specifies how many existing VRS-retained volumes may be dropped from vital records retention and the action to be taken by DFSMSrmm.



- **VRSRETAIN** specifies how many newly assigned volumes are to be retained by vital records retention.
  - A newly assigned volume is one that has a volume assignment time that is higher than the run time of the previous VRSEL processing and that is not VRS-retained.

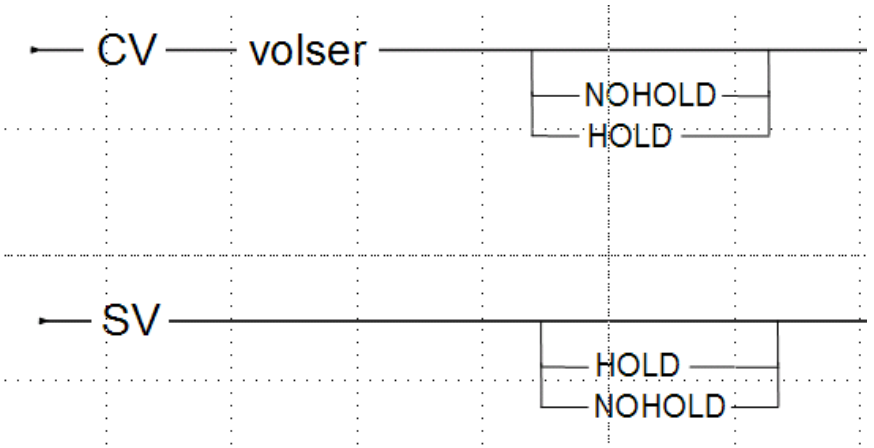


- EXPDTDROP specifies how many existing expiration date retained volumes may be dropped from retention. An EXPDT-retained volume is one that is not VRS-retained and is not newly assigned
  - EXPROC: additional processing may be required

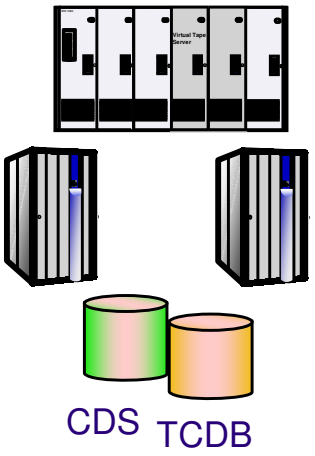


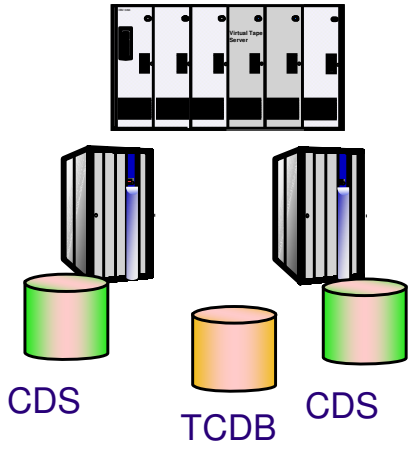
Safety net: Volume “Hold”

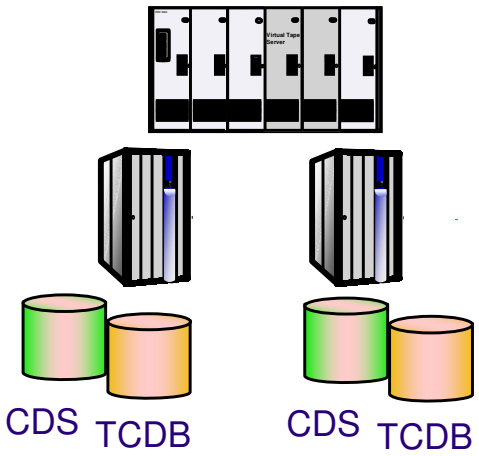
- **Volume “Hold” attribute**
  - prevents a volume being set to pending release
  - only valid for non-scratch, non-pending release volumes
  - DV RELEASE subcommands fail if the HOLD attribute is set
    - DV FORCE is accepted as per normal
  - new HY and HN line commands
- The hold attribute is only honored on z/OS V1.12 and above. Lower levels ignore it!



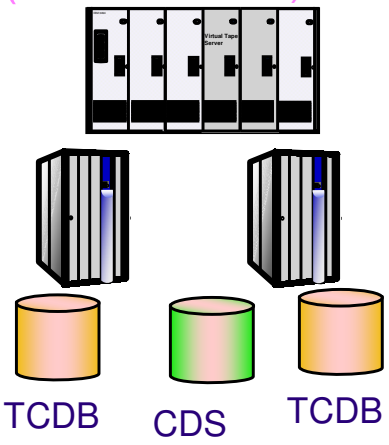
System Managed Library Partitioning Prior to z/OS V1.10







(Client/Server)



1:1
Partitioned
- by exits
  - CBRUXENT
  - EDGUX200
- scratch categories

EXPROC by system
Shared private

1:n
Partitioned
- by cds/system
- REJECT ANYUSE
- Scratch categories

EXPROC by CDS
Shared private
- use 98000

n:n
Partitioned
- by system
- REJECT ANYUSE
- Scratch categories

EXPROC by CDS
No shared private
- add TCDBentry & 98000

n:1
Partitioned
- by system
- custom CBRUXENT
- Scratch categories

EXPROC by TCDB
No shared private
- add TCDBentry

System Managed Library Partitioning (Current)

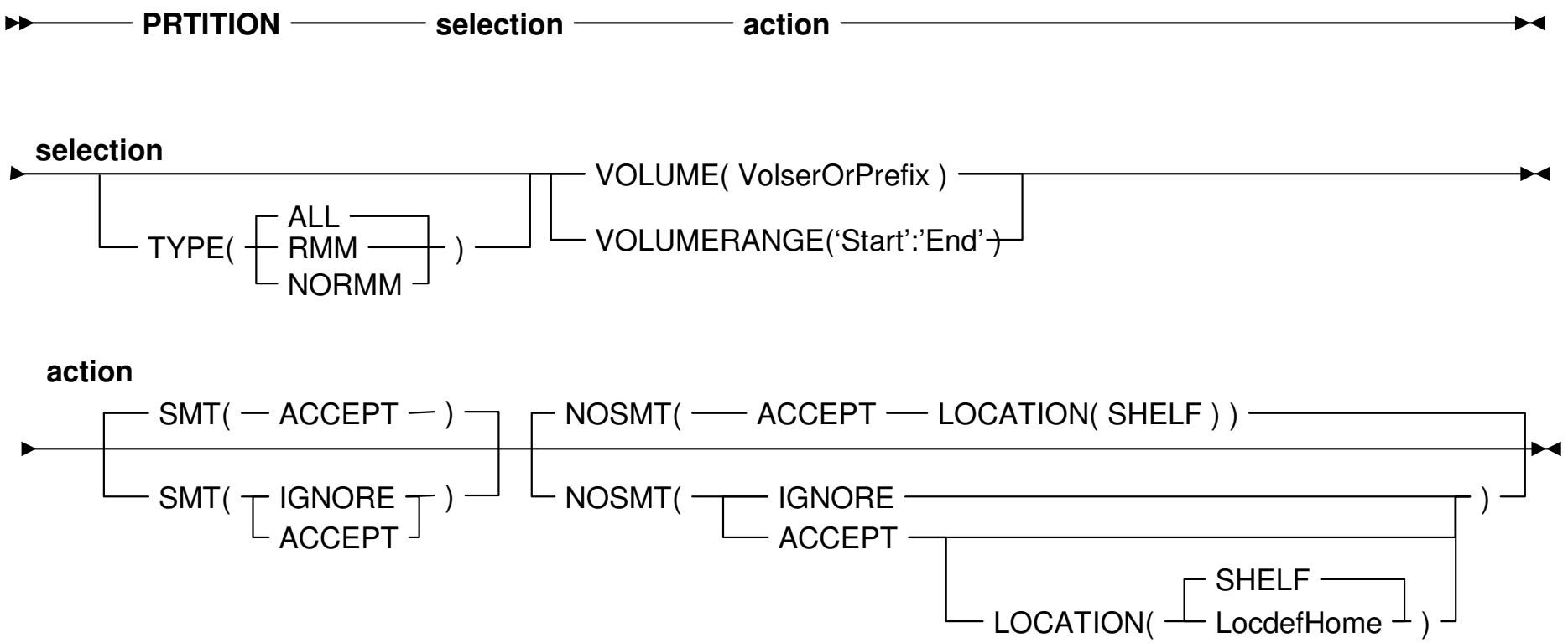
- **2 Ways to control entry processing**
  - REJECT ANYUSE(*)
    - All volumes undefined in RMM CDS left in insert category
    - Must pre-define volumes to enable entry of volumes
  - No REJECTs or Selective REJECTs
    - All un-REJECTed volumes added automatically to RMM CDS
    - Pre-define volumes to RMM as an exception based on
      - volume status
      - ISMF library default entry status
- **Any alternative requires CBRUXENT exit customization**
  - For 1:1 case, EDGUX200 logic must match that in CBRUXENT
- **EDGUX200 is required if RMM CDS contains volumes from multiple partitions and TCDB is shared or has entries created manually for private sharing**
  - CATSYSID(sysid_list) can be used instead of EDGUX200
  - Run EXPROC once per scratch category set

System Managed Library Partitioning (z/OS V1.10)

- Addresses many problems:
  - REJECT used for both OPEN and Partitioning
    - New PRTITION and OPENRULE statement
  - Complex environments are unmanageable because of number of REJECTs
    - New options on OPENRULE/PRTITION that allow global action setting then one or more specific overrides based on different options
  - REJECT for partitioning is not effective in Client/Server or if CDS is shared
    - New PRTITION statement allows both RMM and NORMM volumes to be handled
  - Only PREFIX can be defined
    - VOLUMERANGE and VOLUME allow more flexibility including specific and generic volser
  - IGNORE support requires EDGUX100 / EXPDT=98000
    - OPENRULE with ACTION(IGNORE) avoids the need for EDGUX100 customization or JCL EXPDT=98000
  - OPENRULE action REJECT based on creating system
    - Force data sets to be cataloged
    - Cross-check creating SYSID

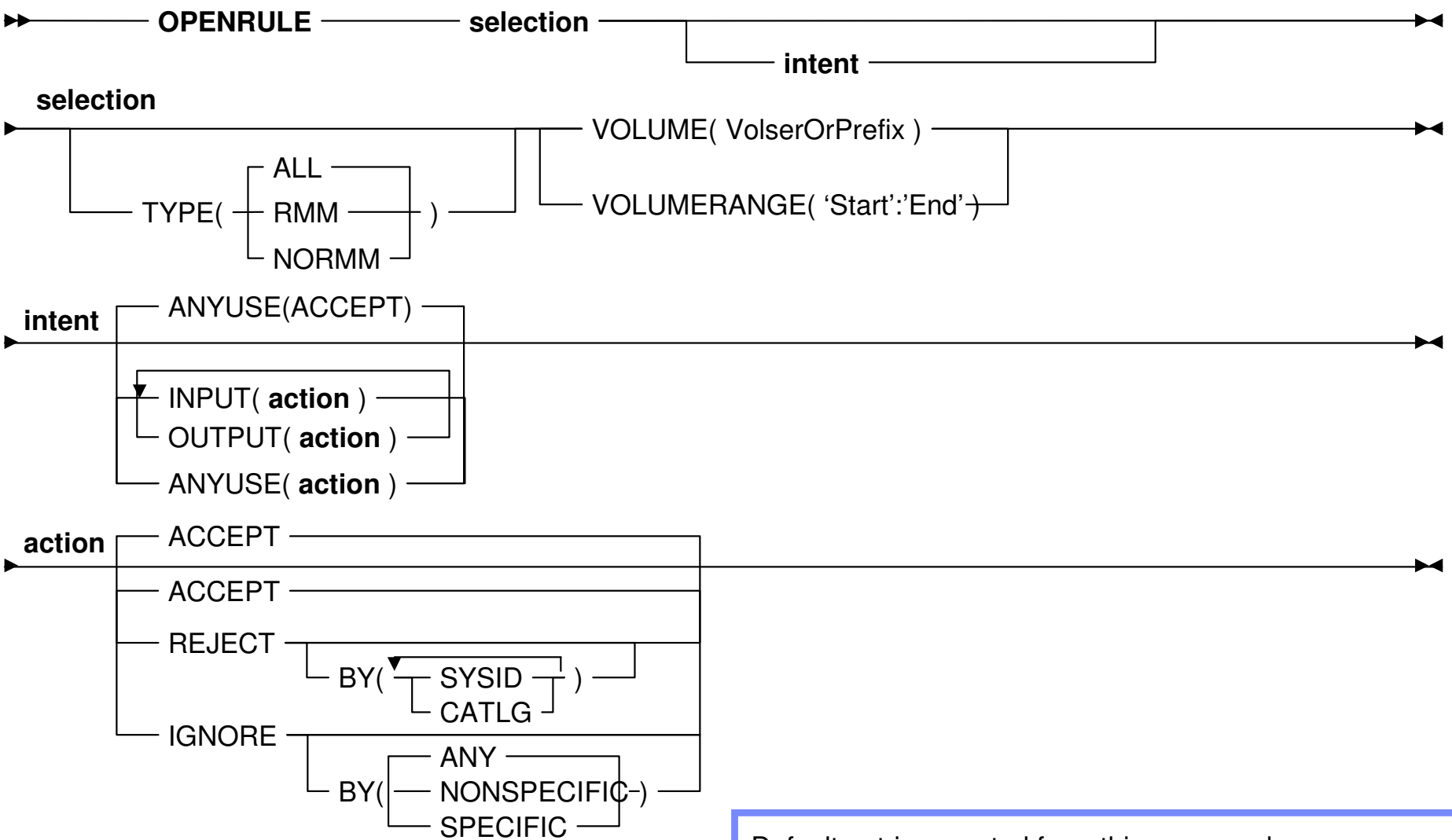
- **Recommendation**
  - **Use PRTITION / OPENRULE rather than REJECTs!**

PRTITION Syntax



Default entries created from this command
PRTITION VOLUME(*) TYPE(ALL) SMT(ACCEPT) NOSMT(ACCEPT LOCATION(SHELF))

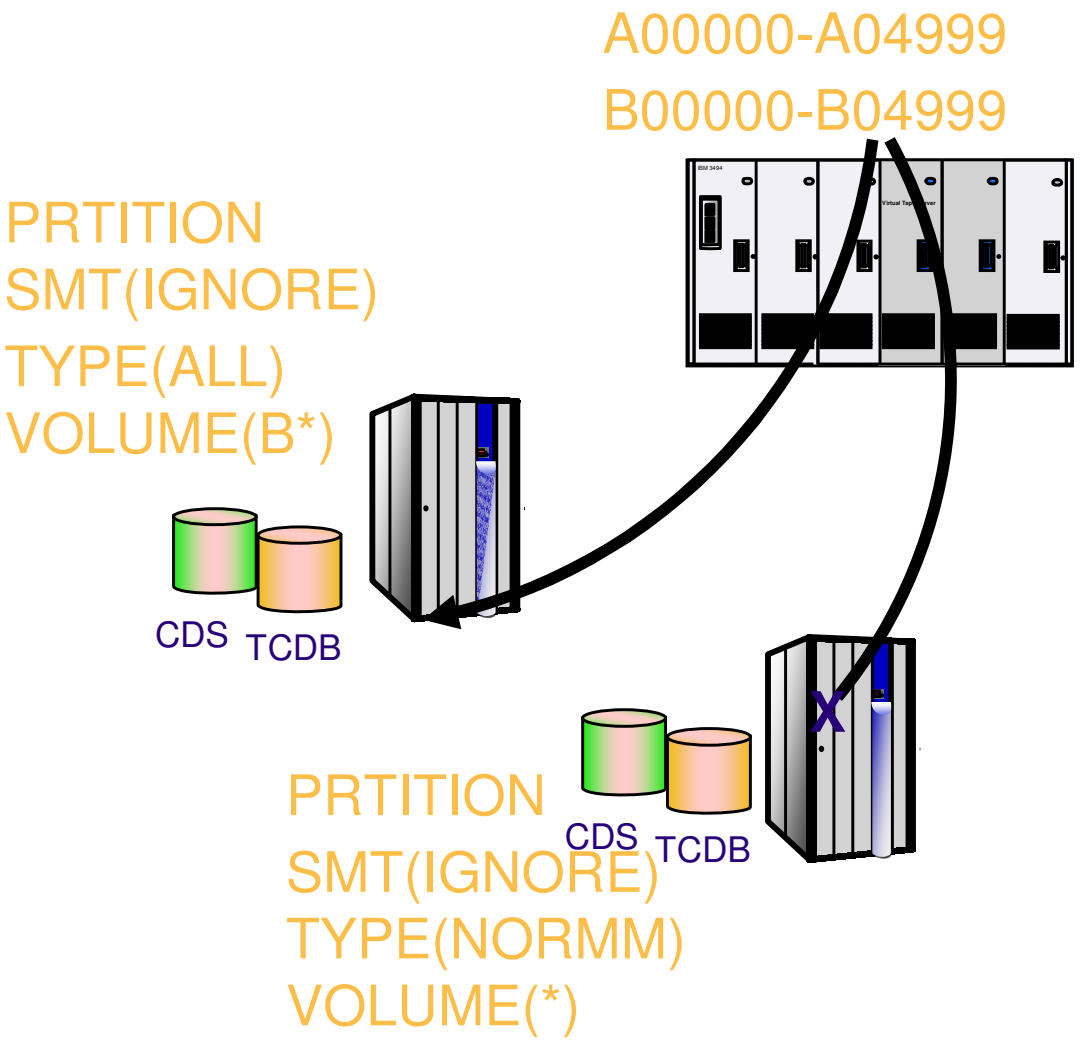
OPENRULE Syntax



Default entries created from this command
OPENRULE VOLUME(*) TYPE(ALL) ANYUSE(ACCEPT)

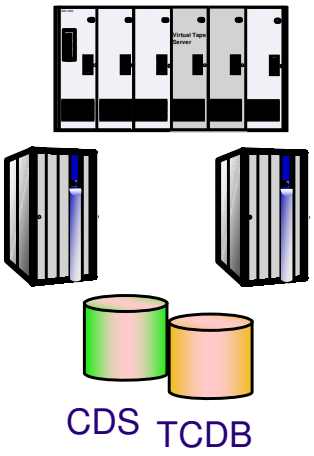
System Managed Library Partitioning z/OS V1.10 and above. . .

- Parmlib Control using
  - PRTITION VOLUME(prefix) SMT(action)
  - Automatic define unless SMT(IGNORE)
  - OAM Leaves in INSERT category
  -
- At OPEN time
  - OPENRULE determines if Use is rejected
  - Can be ignored using
    - ANYUSE(IGNORE) VOLUME(prefix)
    - EDGUX100

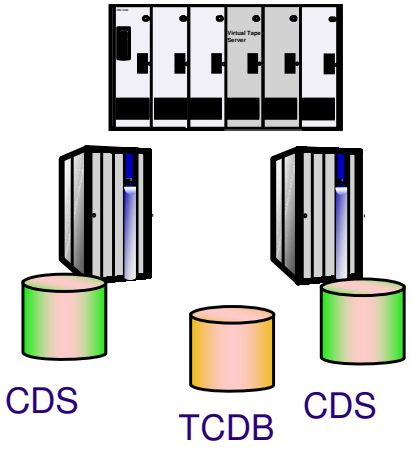


System Managed Library Partitioning . . .

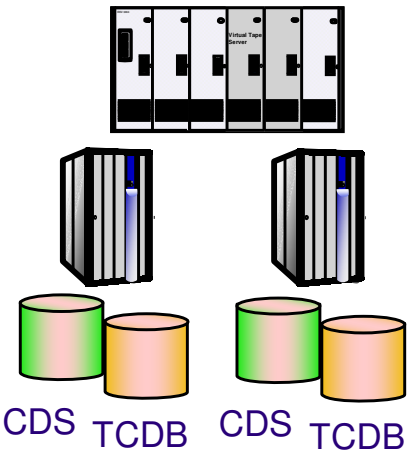
Updated to reflect new options in z/OS 1.10



1:1
Partitioned
by system
PRTITION
scratch categories
EXPROC by system
PRTITION
Shared private

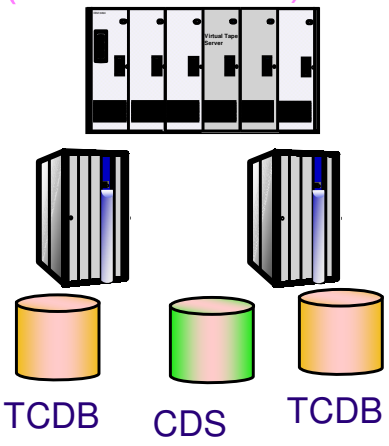


1:n
Partitioned
by cds/system
PRTITION
Scratch categories
EXPROC by CDS
Shared private



n:n
Partitioned
by system
PRTITION
Scratch categories
EXPROC by CDS
No shared private
add TCDBentry &
Use; 98000, or,
OPENRULE with
ANYUSE(IGNORE)

(Client/Server)



n:1
Partitioned
by system
PRTITION
Scratch categories
EXPROC by TCDB
or PRTITION
No shared private
add TCDBentry &
Use; 98000, or,
OPENRULE with
ANYUSE(IGNORE)

System Managed Library Partitioning . . .

Updated to reflect new options in z/OS 1.10

- **Ways to control entry processing**
  - PRTITION TYPE(NORMM) VOLUME(*) SMT(IGNORE)
    - All volumes undefined in RMM CDS left in insert category
    - Must pre-define volumes to enable entry of volumes
  - No PRTITIONs and no OPENRULE
    - Processing is as for earlier releases
  - Selective PRTITIONs
    - All ACCEPTed volumes added automatically to RMM CDS
      - ISMF library default entry status
    - Pre-defined volumes only considered for TYPE(RMM) cases
      - volume status set by RMM during volume entry
- **Any alternative requires CBRUXENT exit customization**
  - In most cases this can now be avoided
- **For EXPROC**
  - PRTITION TYPE(ALL/RMM) action IGNORE skips exproc SCRATCH processing
    - Even if TCDB Entry Exists (TCDB shared or created manually for private sharing)
  - CATSYSID(sysid_list) can also be used to skip volumes
  - Run EXPROC once per scratch category set

Agenda

- Why DFSMSrmm best practices?
- About the RMM CDS: Allocation, placement, monitoring, recovery
- Using client/server – the right way
- z/OS release coexistence with DFSMSrmm
- Diagnostics and performance hints

Just in case: Collect diagnostic information

- Collect PDA trace diagnostics
  - Valuable for identifying RMM logic problems at a very small expense
  - The PDA facility consists of
    - in-storage trace (PDA), and
    - optional DASD log data sets. Identified by their DD names, EDGPDOX and EDGPDOY.
  - Recommendation:
    - In EDGRMMxx specify OPTION PDA(ON) PDALOG(ON)
    - Have sufficiently sized PDA log data sets defined
    - For sizing refer to appendixes *"Problem Determination Aid Log Data Set SizeWork Sheet for Long/Short-Term Trace History"* in "DFSMSrmm Implementation and Customization Guide"
      - ROT: Begin with 50 CYL (3390)

- Collect RMM SMF records
  - Use the IBM assigned SMF record type of 42, the audit records subtype of 22, and the security records subtype of 23.
  - OPTION SMFAUD(YES) and SMFSEC(YES).

Just in case: Keep the output of your STCs and housekeeping jobs

- Output of the RMM started tasks and housekeeping jobs should be kept for “some” time
  - Duration depends on the cycle times of your RMM-processes
  - These jobs may provide important information if a problem is detected
    - What decisions were taken?
    - When were first symptoms of the problem visible
    - What steps might have been involved and eventually lead to the problem?

- What output?
  - JES joblog / Syslog/Operlog
  - Output data sets
    - MESSAGE, REPORT, ACTIVITY files
    - Keep a cycle of generations

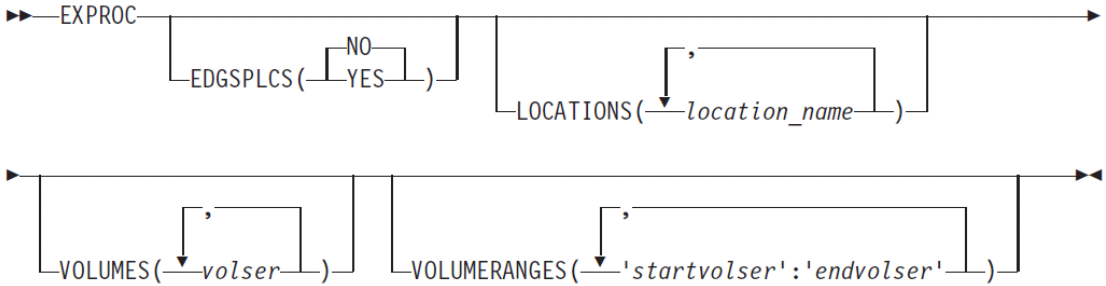
Recommended RMM options and performance hints

- Recommendation is to synchronize catalogs
  - CATSYSID(…)/CATSYNCH
  - Upon the following messages synchronization needs to be re-established:
    - `EDG8200E DFSMSrmm INACTIVE DURING CATALOG PROCESSING FOR DATA SET …`
    - `EDG8201E DFSMSrmm SUBSYSTEM REQUEST FAILED RETURN CODE … DURING CATALOG PROCESSING FOR DATA SET …`
    - Should be automated

- Workload Management (WLM) classification of DFRMM address space
  - DFRMM is a system task serving many other jobs
  - Requires appropriately high classification in WLM service definition
  - Recommended: SYSSTC
    - Alternatively: Single period service class with a high importance and tight velocity goal
  - Same consideration applies to RMM housekeeping jobs
    - Depending on setup, JES-managed initiators may result in faster initiation

Use EDGSPLCS for parallel library updates

- Specify EDGSPLCS(YES) on EXPROC to create that file



- **Run multiple copies of EDGSPLCS** so that processing can be done **in parallel** for multiple libraries

```
//EXEC PGM=EDGSPLCS,PARM='ACTION(S),LOCATION(ATLBA999)'
//INDD DD DISP=SHR,DSN=my.edgsplcs.data.set
//OUTDD DD SYSOUT=*
```

```
//EXEC PGM=EDGSPLCS,PARM='ACTION(S),LOCATION(ATLBA111)'
//INDD DD DISP=SHR,DSN=my.edgsplcs.data.set
//OUTDD DD SYSOUT=*
```

Questions

- What other areas do you feel require attention?
- What events did lead to problems or even outages in your environment?

Thank you!

धन्यवाद
Hindi

多謝
Traditional Chinese

ขอบคุณ
Thai

Спасибо
Russian

Gracias
Spanish

Thank You
English

شكرا
Arabic

Obrigado
Brazilian Portuguese

多谢
Simplified Chinese

Danke
German

Bedankt
Dutch

Grazie
Italian

Merci
French

நன்றி
Tamil

ありがとうございました
Japanese

감사합니다
Korean

Backup