Managing HSM so that HSM doesn’t manage you!

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Agenda Topics

• Introduction
• HSM Status
• Control data sets and journal
• Information sources
• Return Codes and reporting
• Common causes for migration and backup failures
• Thrashing
• Storage Group thresholds
• Message automation
• Reorganizing Control Data Sets
• HSM Audits
• Monitoring
Session Abstract

- In the normal data center, DFSMSHsm is an integral part of the overall production process. Do you know what is really happening in your HSM environment? Do you know what problems are lurking? We will provide suggestions on some of the error conditions that you can report on and monitor, using the DFSMS Report Generator and the latest tools to assist you.
- We will demonstrate how to use monitoring to do work for you and notify you right away before problems occur. At the end of this session, the attendee will have a better understanding of the typical daily activities of a storage administrator.

Check status of HSMs

- Make sure that the HSM started tasks are running as expected
  - No held functions
  - All functions held could indicate CDS backup failure!

<table>
<thead>
<tr>
<th>Function</th>
<th>Function Status</th>
<th>Dataset Requests</th>
<th>Volume Requests</th>
<th>Active Requests</th>
<th>Waiting Requests</th>
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<td>0</td>
<td>0</td>
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<td>0</td>
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<td>0</td>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
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Control Data Set Occupancy

- Automate action for Control data set backup failures
  - ARC0744E message
    - Highlighted message
- Monitor for ARC0026E (Journaling disabled)
  - Most functions will be held
- Monitor for ARC0909E message (CDS/Journal percent full)
  - Thresholds set by SETSYS MONITOR
  - Different thresholds can be set for different control entities
- If Journal fills up, processing will stop until journal is cleared
  - BACKVOL CDS
  - Recalls should still work

Information Source - HSM Log files

- HSM Logfiles are used to track HSM activity
- Required if using an ISV solution that reads the logs
- Disable if not needed
  - Additional overhead when using logging
- One set of log files per HSM started task
- Active logfile is always the HSMLOGX dataset
  - Exclusive enqueue issued by HSM started task
  - HSM swaps the log files by renaming them
    - Need to reside on the same disk volume
- HSMLOGY data set can be analyzed using ARCPRLOG/ARCPEDIT programs
Using ARCPRLOG

- Members provided by HSM starter set
  - Member ARCSTRST in SYS1.SAMPLIB

- ARCSTRST creates xxx.SAMPLE.CNTL

- HSMLOG prints the contents of the HSMLOGY data set
  - As delivered, the 2nd step zeros out the HSMLOGY data set

- HSMEDIT formats the output from the previous job

- Both are still somewhat cryptic

ARCPRINT PRINTLOG
ARCPRINT EDITLOG

- EDITLOG shows request but does not show outcome

Information Source – HSM Activity Logs

- Activity Logs contain information from the automated functions
  - Space Management (Primary & Secondary)
  - Automatic Backup
  - Autodump
- Not to be confused with HSMLOGX and LOGY
- Can be written to SYSOUT or DASD
  - SETSYS ACTLOGTYPE
  - SYSOUT can be accessed while automatic function is active
- SETSYS ACTLOGMSGLVL controls messages issued
  - Recommend FULL rather than EXCEPTIONONLY
  - This parm also controls which messages are written to LOGX/Y
### Activity Log Error Summary

**ERROR SUMMARY OF ERRORS IN DFSMSshm Space Management**  
2011/02/10

<table>
<thead>
<tr>
<th>RC</th>
<th>RC</th>
<th>TEXT</th>
<th>DATASETS</th>
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<tbody>
<tr>
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<td>DUPLICATE DATA SET NAME IN DFSMSHSM DATA BASE</td>
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<tr>
<td>13</td>
<td>1</td>
<td>DATASET IN USE (NON-VSAM)</td>
<td>4</td>
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<tr>
<td>13</td>
<td>0</td>
<td>DATASET IN USE (VSAM)</td>
<td>24</td>
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<td>26</td>
<td>4</td>
<td>NON-VSAM DATASET CATALOGED TO WRONG VOLUME</td>
<td>1</td>
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<tr>
<td>38</td>
<td>0</td>
<td>DATASET NOT CATALOGED</td>
<td>3</td>
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<tr>
<td>58</td>
<td>4</td>
<td>VTDC SAYS MULTI VOL, CAT SAYS NOT</td>
<td>2</td>
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<td>58</td>
<td>0</td>
<td>NO CATALOG ENTRY FOUND</td>
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<td>78</td>
<td>13</td>
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<td>99</td>
<td>14</td>
<td>APF AUTHORIZED DATASET</td>
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</table>

### Activity Log Error Details

**ERROR CATEGORIZATION OF DFSMSshm Space Management**  
2011/02/16

**RETURN CODE REASON CODE DSN**  

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<td></td>
<td>ITN622.ACCD.RKDSYMR</td>
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<td>ITN622.ACCD.RKDSHPRE</td>
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<td></td>
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<td>ITN622.ACCD.RKDSRPM</td>
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Information Source – SMF Records

- HSM can write SMF records
  - Default is SETSYS NOSMF
- To activate, SETSYS SMF(xxx)
  - SETSYS SMF(240) commonly used
- If activated, HSM writes 2 SMF records
  - In above example, 240 and 241
- 1st record contains
  - Daily Statistics (DSR)
  - Volume Statistics (VSR)
- 2nd record contains
  - Function Statistics (FSR)
  - ABARS function Statistics (WWFSR)

SMF Records

- Monitoring products can gather SMF records
  - Hooks into IEFU83, IEFU84, etc.

- Warning! Not all records are written to SMF
  - Example:
    - RC=99
    - RC=58
    - There may be others…….
Homegrown Reporting Tools

• Purpose –
  • Report on DFSMSshsm activity.
    • Migration, backup, recall, recover, extent reduction, PSM, SSM, etc.
      • What and Why?
      • Age, times, etc.
  • Successful/unsuccessful
    • What, Why and How long?
• Things to know –
  • Requires in-depth knowledge of HSM and records.
  • Requires other OEM software license
    • SAS
    • What is the plan for support and knowledge transfer?

DFSMSrmm Report Generator

• DFSMSshsm reporting added in z/OS V1R10 DFSMS
• Available in ISMF Option G
  • Create Storage Management Reports
• Reports created from FSR and WWFSR SMF records
• Additional reports from data obtained using DCOLLECT
• SMF records need to be dumped from SYS1.MANx or logstream first
Storage Management Reports

- Various reports available

Backup Error Report using DFSMSrmm Report Generator
Migration Error Report using DFSMSrmm Report Generator

Statistics for Migration  1  07/14/2011  11:14:31

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<td>SM6802</td>
<td>8</td>
<td>8</td>
<td>148426</td>
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</tbody>
</table>

Using an ISPF-based product

- Ability to filter on particular conditions
  - Functions
  - Return Codes
  - Date/Time
- Ability to store queries
- Able to take corrective actions
- Also provides means to execute in batch
ISPF view of Migration errors

FILTERED VIEW OF MIGRATE/BACKUP
Enter 0 at Command for list of options.
Panel 1 of 3. Scroll right for more information.
Key 5 beside entry for return/reason codes.

<table>
<thead>
<tr>
<th>Entry</th>
<th>Action</th>
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<th>Trks</th>
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<td>266</td>
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<tr>
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<td>266</td>
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<td>90008</td>
<td>266</td>
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</tbody>
</table>

Drill-down from migration errors

Advanced Reporting for DFSMSHsm V2R3

Refer to DFSMS message ABC1294I for more information
MIGRATE Return Code 99 - UNSUPPORTED DS
Reasons=> 00314 OIS IS HP AUTHORIZED LIBRARY
Monitor ABARS events

- If using ABARS, ensure that these jobs are successful

<table>
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<tr>
<th></th>
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<td>00:24:53</td>
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<td>02/11/11 10:00:16</td>
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<td>02/11/11 10:00:16</td>
<td>00:00:00</td>
<td>0</td>
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</table>

Common Causes of Migration & Backup Failures

- Everyday in most shops DFSMShsm primary, secondary and backup are run at specific times daily. In most cases business’s have grown, storage farms have grown and managed data has grown, but when was the last time your scheduled tasks were reviewed or verified?

- Here are some common failures that we have seen
  - Data Set in Use (migration/backup) –
    - A common encountered error, everyday DFSMShsm will try to migrate and backup these data sets and fail.
    - Waste of DFSMShsm resources
Common Causes of Migration & Backup Failures

- Common causes of migration/backup failures (continued) –
  - No space on ML1 Volume
    - This is usually seen with large data sets. Some simple solutions include adding additional volumes to ML1 pool, modifying management rules to expire more data on primary pools, using an ARCMDEXT to migrate large data sets straight to tape or consider ML1 Overflow volumes
  - HSM Backup Critical Errors (condition code ne 0) –
    - HSM backup is critical to shops using this as their first level data recovery.
      - Backup window overlaps batch processing
      - Ctlg errors (rc30) / DFDSS errors (rc68) / vtoc discrepancy (rc87)
        - Waste of DFSMShsm resources

- Unsupported Datasets (rc99, rsn04) are a very common migration and backup error.
  - Cause of the problem is incorrectly defined data sets (no DSORG).
  - Everyday HSM will try to migrate/backup these data sets and fail. We have seen situations where the same data sets have been failing for nine years and more. The quickest and easiest correction is to update the SMS routines to automatically assign a data class.
    - Waste of DFSMShsm resources.
  - Running Interval Migration means that errors may occur multiple times a day
    - Reports show repeated errors against same data set name
Patches – Problem Determination

• Examples
  • PATCH .MGCB.+26 X’FF’
    • Used to determine why an SMS-managed data set is not selected during volume migration
  • PATCH .BGCB.+24 X’FF’
    • Used to determine why SMS-managed data sets are not being selected during volume backup
  • These patches produce a lot of messages
    • ARC1245I with Reason Codes GT 90 for migrations
    • ARC1334I with Reason Codes GT 90 for backups
  • Use diagnostic patches only when needed or directed by Level 2 support
    • Excessive non-zero return codes
    • Extra processing overhead

Recall Failures

• You will probably hear about recall issues long before running a report!
  • RC=2 often means that the user tried the recall multiple times
• If you see a lot of failures, check to see if a process is issuing HRECALLs, regardless of whether the data is migrated or not

<table>
<thead>
<tr>
<th>DATE</th>
<th>TIME_REQ</th>
<th>COR</th>
<th>RC</th>
<th>AGE</th>
<th>TARGET</th>
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<td>INCER</td>
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</tr>
<tr>
<td>01/08/19</td>
<td>17:00</td>
<td>P08</td>
<td>8</td>
<td>366</td>
<td>SMS307</td>
<td>INCER</td>
<td>1</td>
</tr>
</tbody>
</table>
Common Recall Queue - CRQ

- Consolidates recall requests and spreads them across HSM instances
  - Balances workloads around the complete HSMplex
  - Can help reduce recall delays
- Allows important recalls to be prioritized ahead of lesser ones
  - Use ARCRPEXT (Return Priority exit)
- Optimizes Tape mounts
  - Single tape mount satisfies requests from multiple LPARS
- Requests can be carried out by all or some of the systems
  - Allows systems without attached tape to issue recall requests

expire Errors

- Expire processing is performed as part of Space Management
  - Primary, Secondary Space Management & Interval Migration
- Check for RC=53
  - Means that data set needs a backup first
  - Can also be seen when trying to migrate to ML2
- Data sets with explicit expiration dates can be expired by HSM
  - Review SETSYS EXPIREDDATASETS
    - SCRATCH will delete, NOSCRATCH will ignore
  - Explicit expiration dates override management class rules
Thrashing

Thrashing can be described in 2 ways

- A data set which is migrated and recalled within a few days
- Data sets which are migrated and recalled multiple times

- Often generation data sets involved
  - Management Class says to allows GDS early migration
    - MC Class field # GDG Elements on Primary
  - Some jobs recall entire GDG rather than relative generation
    - Data is recalled even when not needed

- Consider not migrating small datasets
  - Migration may not be worth the processing overhead
  - Use ARCMDEXT exit to exclude from migration
    - Can also allow migration to ML1 but exclude from ML2

Thrashing

- HSM SMF records (FSR) can be used to look for thrashing

Note: FSR records can also include data sets processed for extent reduction

- These are not really thrashing
- Review SETSYS MAXEXTENTS
Thrashing – IEFBR14

- Production jobs often use IEFBR14 with DISP=(x,DELETE) as first step
- HSM will recall the data set in order to delete
- z/OS V1R11 allows data sets to be deleted without Recall
- Changes in ALLOCxx member in SYS1.PARMLIB
  - SYSTEM IEFBR14_DELMIGDS(NORECALL)
  - Default value is LEGACY
- Recommend NORECALL unless another product already being used
  - e.g. zOSEM

Migration and SMS Storage Group Thresholds

- We have seen sites using unrealistic storage group thresholds
  - E.g. High threshold 80%, low threshold 1%
- Primary Space Management will attempt to process down to low threshold
- Interval Migration starts after halfway between high- & low-threshold is exceeded
  - Ends at low-threshold
- Leads to excessive cycles and missed space management windows
- Set values that are realistic for the storage group
Automation for SMS Allocation failures

- Monitor syslog for allocation failures and space issues
  - IGD17380I when high threshold has been exceeded
  - IGD17223I when an overflow storage group is used
  - IGD17272I when allocation failed due to insufficient space

- Initiate action
  - E-mail
  - Volume migration
  - On-demand migration (new V1V13 function)

Automation for early completion

- Check for following messages
  - ARC0717I Automatic Backup
  - ARC0625I Automatic Dump
  - ARC0521I Primary Space Management

- Solution
  - Increase windows
    - Earlier start time, later end-time
  - Increase number of tasks
    - This can be automated and performed dynamically if needed
  - Device availability may be restricting factor
    - Physical tape drives
Reorganizing Control Data Sets

• Should you reorganize a Control Data Set?
  • Some Say Yes, Some Say No

• Why are you Reorganizing a Control Data Set?
  • Receiving warning messages from DFSMShsm
    • Incorrect sizing
    • Single cluster at 4Gb limit
    • “That is what we have been doing for years”

Reorganizing Control Data Sets

• Should you reorganize a Control Data Set (cont) ?

• Think of DFSMShsm as a crucial part of the OS
  • Every minute it is down —
    • Migrated data cannot be recalled
    • Production delays
  • Backed up data cannot be recovered
Reorganizing Control Data Sets

- Should you reorganize a Control Data Set (cont)?
  - Look for alternative solutions
    - Correct sizing of CDSs
    - Reorg While Active products
    - CA Reclaim (Session 9007, 11am, Room 201C)
    - Review why and if needed, use tested procedure

- Is there a performance increase after a reorg?
  - Yes, the reorg removes all splits, but when HSM is restarted the first thing it will do inside a CDS is a split.
  - Performance impact for a number of weeks

HSM Audits

- Recommend running audits regularly

- Always run an audit after the CDSs have been reorganized

- HSM audits run l-o-n-g…………
  - VSAM Record Level Sharing can help improve CDS audits

- If you are not able to regularly run audits, you might need an external audit product
  - Allows a more targeted approach
  - Example: IBM Tivoli Advanced Audit for DFSMShsm
Using a monitoring product

- Allows drilling down to additional information
- Ability to group similar errors together
- Allows setting up of automation
  - Situations
  - Policies
- Visual indicators
  - User thresholds
- Problem determination is built in
  - Dynamic workspace links for faster diagnosis

Monitoring

Monitoring Products:

- IBM Tivoli Advanced Audit for DFSMShsm
- IBM Tivoli Advanced Reporting for DFSMShsm
- IBM Tivoli Advanced Backup and Recovery Manager
- IBM Tivoli Advanced Catalog Management

- Other vendors products can monitor as well
Monitoring

Items to be monitored
• HSM Function Status
• HSM CDS utilization
• HSM ML1 Volumes
• Migrate/Recall Success/Failure
• Return Codes LOGX
• HSM user catalog
  • Space
  • Backup
• Aggregate Backups
• Common Recall Queue HSMPLEX
Monitoring

- HSM CDS Utilization

### HSM CDS Utilization Report

<table>
<thead>
<tr>
<th>DSNAME</th>
<th>Percent Available Space</th>
<th>Percent Free Space</th>
<th>Rate (I/O)</th>
<th>Number of Entries</th>
<th>Percent Available Space</th>
<th>Percent Free Space</th>
<th>Size (I/O)</th>
<th>Number of Entries</th>
</tr>
</thead>
<tbody>
<tr>
<td>HMG01</td>
<td>95.6</td>
<td>69.5</td>
<td>72000</td>
<td>1</td>
<td>92.3</td>
<td>63.4</td>
<td>252</td>
<td>1</td>
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<tr>
<td>BWG01</td>
<td>73.5</td>
<td>60.3</td>
<td>140000</td>
<td>1</td>
<td>79.7</td>
<td>59.4</td>
<td>304</td>
<td>1</td>
</tr>
<tr>
<td>JT01</td>
<td>92.9</td>
<td>69.0</td>
<td>72000</td>
<td>1</td>
<td>99.9</td>
<td>69.7</td>
<td>252</td>
<td>1</td>
</tr>
<tr>
<td>IPERMAL</td>
<td>n/a</td>
<td>79.7</td>
<td>43000</td>
<td>1</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
<td>n/a</td>
</tr>
</tbody>
</table>

### HSM ML1 Volume Utilization

A group of the HSM ML1 volumes is defined to track the free space and fragmentation index.

GRAPH WOULD CONTAIN VOLUMES WITH < 10% FREE SPACE

<table>
<thead>
<tr>
<th>Group Name</th>
<th>SMS Volumes</th>
<th>Non-SMS Volumes</th>
<th>Total Volumes</th>
<th>VTDC Index Status</th>
<th>Low Volume Free Space %</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSM ML1</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>Enabled</td>
<td>34.5</td>
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</tbody>
</table>
Monitoring
HSM ML1 Volume Utilization DETAILS

<table>
<thead>
<tr>
<th>Volume</th>
<th>Device Address</th>
<th>Device Type</th>
<th>Total Capacity Megabytes</th>
<th>Free Space Megabytes</th>
<th>Percent Free Space</th>
<th>Fragmentation Index</th>
<th>Largest Free Extent MB</th>
<th>YTOC Index Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>HSM001</td>
<td>01MB</td>
<td>32MB</td>
<td>2702</td>
<td>1288</td>
<td>69.7</td>
<td>18</td>
<td>1499</td>
<td>Enabled</td>
</tr>
<tr>
<td>HSM002</td>
<td>09PC</td>
<td>2290</td>
<td>2707</td>
<td>322</td>
<td>12.2</td>
<td>12</td>
<td>325</td>
<td>Enabled</td>
</tr>
<tr>
<td>HSM003</td>
<td>0A8</td>
<td>2290</td>
<td>2707</td>
<td>1960</td>
<td>69.0</td>
<td>0</td>
<td>1499</td>
<td>Enabled</td>
</tr>
<tr>
<td>HSM004</td>
<td>0A8</td>
<td>2290</td>
<td>2707</td>
<td>1960</td>
<td>69.0</td>
<td>0</td>
<td>1499</td>
<td>Enabled</td>
</tr>
</tbody>
</table>

Monitoring
Return Codes
Monitoring
Return Codes

<table>
<thead>
<tr>
<th>Return Code</th>
<th>Count</th>
<th>Message</th>
<th>Action</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>487</td>
<td>BACKUP OK</td>
<td>BACK-UP</td>
<td>Migrate</td>
</tr>
<tr>
<td>60</td>
<td>55</td>
<td>BKUP FAILED BECAUSE OF DFDS ERR</td>
<td>BACK-UP</td>
<td>Migrate</td>
</tr>
<tr>
<td>19</td>
<td>1</td>
<td>DATA SET IN USE</td>
<td>REDUCED</td>
<td>Migrate</td>
</tr>
<tr>
<td>19</td>
<td>19</td>
<td>DATA SET IN USE</td>
<td>MIGRATE</td>
<td>Migrate</td>
</tr>
<tr>
<td>30</td>
<td>3</td>
<td>DATA SET NOT CATALOGED</td>
<td>MIGRATE</td>
<td>Migrate</td>
</tr>
<tr>
<td>6</td>
<td>2</td>
<td>DUPLICATE DSN IN MPCS</td>
<td>MIGRATE</td>
<td>Migrate</td>
</tr>
<tr>
<td>148</td>
<td>0</td>
<td>MIGRATION OK</td>
<td>MOVE VT</td>
<td>Migrate</td>
</tr>
<tr>
<td>1501</td>
<td>0</td>
<td>MIGRATION OK</td>
<td>MIGTT12</td>
<td>Migrate</td>
</tr>
<tr>
<td>1152</td>
<td>0</td>
<td>MIGRATION OK</td>
<td>RECYCLED</td>
<td>Migrate</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>MIGRATION OK</td>
<td>SCRATCH</td>
<td>Migrate</td>
</tr>
<tr>
<td>58</td>
<td>0</td>
<td>MIGRATION OK</td>
<td>EXPIRED</td>
<td>Migrate</td>
</tr>
<tr>
<td>194</td>
<td>0</td>
<td>MIGRATION OK</td>
<td>BK-SHO</td>
<td>Migrate</td>
</tr>
<tr>
<td>45</td>
<td>0</td>
<td>MIGRATION OK</td>
<td>MIGRATE</td>
<td>Migrate</td>
</tr>
<tr>
<td>178</td>
<td>1</td>
<td>MIGRATION OR DBA DEU FAILED</td>
<td>MIGRATE</td>
<td>Migrate</td>
</tr>
<tr>
<td>20</td>
<td>0</td>
<td>NOT ELIGIBLE FOR MIGRATION</td>
<td>MIGRATE</td>
<td>Migrate</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>RECALL RECOVERY OK</td>
<td>RECALL</td>
<td>RECALL</td>
</tr>
<tr>
<td>20</td>
<td>0</td>
<td>RECALL RECOVERY OK</td>
<td>DELETE</td>
<td>RECALL</td>
</tr>
<tr>
<td>16</td>
<td>0</td>
<td>SMS DS ERROR</td>
<td>MIGRATE</td>
<td>Migrate</td>
</tr>
<tr>
<td>70</td>
<td>4</td>
<td>SMS DS ERROR</td>
<td>BACK-UP</td>
<td>Migrate</td>
</tr>
</tbody>
</table>

Monitoring
Migration Return Codes
Audit Example

Monitoring

HSM user catalog  Space and Backup Status
Monitoring
HSM user catalog backup status. Extents

Monitoring
HSMplex and Common Recall Queue
Monitoring

Hosts in your HSMplex

Monitoring

HSMplex information
Monitoring
HSM Host Details

Monitoring
HSM Common Recall Queue Details
Monitoring
HSM CRQPlex Details

Monitoring
HSM CRQ Requests
Monitoring

The monitoring tools aren’t just used to look at the information from another product!

Let the TOOLS work for you….

Automate the monitor to look at value and WARN you
Send out a Page, text or email
Issue a command

Rest easy (or get your other work done) knowing your HSM’s health is clean

Recap

• Introduction
• HSM Status
• Control data sets and journal
• Information sources
• Return Codes and reporting
• Common causes for migration and backup failures
• Thrashing
• Storage Group thresholds
• Message automation
• Reorganizing Control Data Sets
• HSM Audits
• Monitoring