

# Storage Management White Paper

From Mainstar Software Corporation



## Real-World Storage Management

By Steven Clar

While on a recent road trip, I was asked if I could visit a customer site and do a two-day analysis of their storage environment. Without hesitation, I agreed. What better way to see how our products are used and how they perform in actual environments?

My plan was to focus on specific areas that would provide detailed information about the requirements of the site, their knowledge about their data, how our products are performing in their environment, and how they use our products. Our areas of focus were:

- **CR+**
  - ICF catalogs
- **FastAudit/390 Suite**
  - DFSMSHsm control data sets
  - HSM tapes
  - HSM controlled data
  - Tape Management System
  - Catalogs and DASD
  - Etc.
- **HSM Reporter/Manager**
  - The data controlled by HSM
  - How long it has been migrated
  - Migrated data without a valid backup
  - HSM Data Thrashing
  - Un-referenced migrated data
  - DFSMSHsm overall health and daily errors
  - Etc.
- **Storage Manager**
  - Health of all data on primary DASD
  - Data without a backup
  - Data over-allocated
  - Pools over-allocated
  - Un-referenced data
  - Etc.

The plan was accepted: the users were

truly interested in having their environment analyzed, documenting what they did well and determining where improvement might be needed.

On the first day of the analysis, we met and discussed their environment, how they were set up, what products they had installed, how they use the products, and the scope of the project. Next, they provided an overview of their environments, catalogs, CDSs, pools, which LPARs were shared and which were separate, etc.

From their senior Storage Administrator, I learned how they implemented Mainstar products in their day-to-day operations. They used **Catalog RecoveryPlus (CR+)**, **FastAudit/390 Suite**, and **HSM Reporter/Manager**.

### The Environment:

The production environment consisted of approximately 20 terabytes of primary storage, with two million data sets controlled by DFSMSHsm and about 45 defined user catalogs. On average, this customer moved about 20 thousand data sets daily through DFSMSHsm.

### The Analysis:

First, we used **CR+** to analyze all the catalogs in the environment, ensuring they were complete and healthy.

Then we ran the audits provided in **FastAudit/390 Suite** and reviewed the output. It was amazing how few errors were found. The **FastAudit/390 Suite** contains four audit products: **Catalog & DASD Audit**, **HSM FastAudit**, **HSM FastAudit-MediaControls**, and **Tape Audit**. These audits help customers ensure that every data set in their mainframe environments is accessible.

**FastAudit/390 Suite** provides additional audits not available by IBM's DFSMSHsm audits. IBM does not provide audits for master catalogs, DASD, or tape management databases.

We reran the audits, verifying that the same errors were found and reported. We were able to rerun the audits continually, due to the speed of the audit jobs and because **FastAudit/390 Suite** audits outside the DFSMSHsm started task, so it doesn't affect or interfere with the DFSMSHsm environment.

The senior storage administrator assigned to the project acknowledged that he regularly audits his whole environment, CDSs, catalogs, DASD, and tape management systems, and corrects errors found and reported by **FastAudit/390 Suite**. Because the **FastAudit/390 Suite** audits run fast, they can be proactive and continually audit their complete environment. What else made this successful? Every HSM fix needed is supplied in the **FastAudit/390 Suite** product. When an error is reported, the customer simply picks the appropriate fix and the errors are resolved. This makes maintaining a clean environment much easier.

Record extractions of all the catalogs, CDSs, tape management database, primary DASD, and level-1 migration and level-2 migration were checked and verified by the audit product. The errors found and reported are detailed in six separate sub-groups in this report:

- Migration Control Data Set (MCDS) Errors
- Backup Control Data Set (BCDS) Errors
- Offline Control Data Set (OCDS) Errors
- DFSMSHsm Tape Errors
- Catalog and DASD Errors
- Tape Management Errors

### **MCDS Errors**

There are 26 different file structures checked, verified, and reported for this audit process. Of the 26 different MCDS structures checked, errors were reported for seven groups, five of which are considered critical errors with data accessibility affected.

The highest group of errors were reported for error 11D1C/11D2C – MCD ENTRY IS

NOT CATALOGED (VSAM and nonVSAM). **HSM FastAudit** found 563 occurrences of these errors, reporting migrated data records with no catalog entry. There were 32 data sets found with a catalog entry of migrated, but no associated MCD/MCO record was found in the MCDS or on any migration volumes. Every DFSMSHsm migrated data set requires an MCD and an MCO record to be present to recall the data set. There were also three tapes reported with TTOC block count discrepancies. These tapes will need to be verified, audited, and corrected to guarantee data accessibility. These errors are most commonly caused when DFSMSHsm is abnormally terminated.

Two other critical errors were reported. One data set was cataloged on a volume different from the catalog entry and 34 catalog entries were found not connected to the master catalog. Again, this data is inaccessible and is usually caused by some type of system or environment change.

With more than 1.3 million migrated data sets controlled by DFSMSHsm, the errors reported affected *less than one percent* of the total migrated records in the MCDS.

*On a whole, the MCDS was very healthy.*

### **BCDS Errors**

There are 16 different file structures checked, verified, and reported for this audit process. The BCDS contains the DFSMSHsm backup information for every data set migrated and every data set backed up (incremental, volume, etc.) by DFSMSHsm.

No errors were found or reported for this audit process. Any data set requiring a restore or recovery using the DFSMSHsm copy is accessible.

*The BCDS was in perfect health.*

### **OCDS Errors**

There are 11 different file structures checked, verified, and reported for this audit process. A total of 14 errors were reported for the hundreds of tapes controlled by DFSMSHsm. These tapes hold the DFSMSHsm migration level-2, DFSMSHsm backup and spill volume data. This accounts for more than 75% of the HSM controlled data.

Three tapes were reported in failed-create status and would need to be audited by mediacontrols to be corrected. One tape had a broken sequence record and would need to be corrected with mediacontrols. These errors are usually caused by abnormal termination of DFSMSHsm while the tape is being written to. Ten tapes were found not full and not eligible for recycle. Again, this problem could be caused by abnormal termination of DFSMSHsm and fixes are supplied in the product to correct these errors.

*The OCDS was in very good health.*

### **DFSMSHsm Tape Errors**

There are seven different file structures checked, verified, and reported for this audit process. This audit is extremely important to ensure tapes are used, freed, and available for future use by DFSMSHsm or the RMM Tape Management System.

Two tapes were found to have MCV/MCT records, but no matching TTOC record. The data can be recalled from these tapes, but the tapes would never successfully recycle. Several corrective actions are detailed in the IBM Redbook *DFSMSHsm Audit and Mainstar: FastAudit/390*. There were also three tapes found to be valid in RMM and HSM, but that had no valid data. Because so few tapes had problems, it is safe to say that the HSM and RMM catalogs are in synch with each other. Again, several corrective actions are detailed in the IBM Redbook to correct this error.

*The DFSMSHsm owned tapes were in very good health.*

### **Catalog and DASD Errors**

**Catalog & DASD Audit** checked, verified, and reported on 16 different file structures, of which 10 are considered critical errors. Five groups were reported as having data with critical errors.

The highest group of critical errors consisted of nonVSAM VTOC entry not cataloged. An entry is found in a VTOC, but not in a catalog. This error is usually caused by abnormal system termination or changes to an MVS environment. Though a total of 8,633 data sets were in error for the **Catalog & DASD Audit**, this accounts for *less than one*

*percent* of all the data residing on primary storage. Several warning groups were reported. Most of the warnings were for GDGs defined with no associated data, or for nodes connected with no data cataloged. These warnings were researched back to changes made to the environment, and work that still needed to be completed. Although these are not critical errors, they can increase backup and recovery time of a catalog.

About 110 catalogs were scanned and several hundred thousand data sets were verified during this audit process.

*It is safe to say that the site's catalogs and DASD were in good health.*

### **Conclusion**

In this analysis of a real-world storage environment, we found that their data was in excellent health, due to frequent audits and the monitoring of their DFSMSHsm scheduled tasks and requests. However, they had no tools to analyze, monitor, and maintain their primary storage devices. After completing the analysis and reviewing the report, the customer immediately started considering Mainstar's **Storage Manager**, for analyzing and maintaining their primary storage environment as effectively as they currently manage their migration environment.

The user stated many times during this project, that without Mainstar's products, he would never be able to do his job with the same accuracy or efficiency.

For more information, visit our web site at [www.mainstar.com](http://www.mainstar.com) or e-mail us at [product\\_info@mainstar.com](mailto:product_info@mainstar.com).

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