

The Introduction of DFSMS

Session 17134

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Prior to DFSMS

- Applications had to be very aware of the where there data was stored
 - Applications had to be given VOLSERS they could use to allocate their data sets
 - Before removing volumes, applications had to remove references to those volumes from their JCL
- Managing storage was very manual and labor intensive
 - EDT gen's and SYS1.PARMLIB(VATLST00)
 - Private volumes
 - Releasing free space from over allocated data sets
 - Scratching uncataloged data sets
 - Deleting old data sets
 - Tools were limited

Catalogs

- Non-VSAM data sets were cataloged in OS/CVOL catalogs
 - Data set A.B.C could not be allocated unless A.B existed
 - IEHPROGM was used to catalog and uncatalog data sets as well as GDG bases
 - IEHLIST was used to list entries in a catalog
- VSAM data sets were cataloged in VSAM catalogs
 - A VSAM catalog “owned” the volumes that contained VSAM data sets cataloged in that catalog, and VSAM data sets cataloged into different VSAM data sets could not be placed on the same volume
 - Often VSAM data sets were defined across a whole volume, and other VSAM data sets were sub-allocated into the space of that VSAM data set

Pre-DFSMS IEBGENER Example

```
//STEP01 EXEC PGM=IEBGENER  
//SYSPRINT DD SYSOUT=Q  
//SYSIN DD DUMMY  
//SYSUT1 DD DSN=TS.LOGDATA(0),DISP=SHR  
//SYSUT2 DD DSN=TS.LOGDATA.FEB20,  
//      DISP=(NEW,CATLG,DELETE),  
//      UNIT=3380,VOL=SER=PRD105,  
//      SPACE=(CYL,(100,10),RLSE),  
//      DCB=(RECFM=FBA,LRECL=133,BLKSIZE=12901)
```

Managing Catalog Entries

```
//STEP010 EXEC PGM=IEHLIST  
//SYSPRINT DD SYSOUT=*  
//DD1 DD UNIT=3380,VOL=SER=MPLC01,DISP=SHR  
//SYSIN DD *  
LISTCTLG VOL=3380=MPLC01
```

```
//STEP010 EXEC PGM=IEHPROGM  
//SYSPRINT DD SYSOUT=Q  
//SYSIN DD *  
BLDG INDEX=BU.PROD.PAYMSTR,ENTRIES=4,DELETE  
BLDG INDEX=CPY.BU.PROD.PAYMSTR,ENTRIES=2,DELETE
```

Defining Suballocated VSAM Data Sets

```
//STEP010 EXEC PGM=IDCAMS
//STEP010 DD DSN=VSAMCAT.PROD,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSIN DD *
DEFINE SPACE (CYLINDERS(300 50) VOLUMES(PRD105)) -
  CATALOG(VSAMCAT.PROD)
DEFINE CLUSTER (SUBALLOCATION -
  NAME (PROD.CUST.MASTER) -
  KEYS (16,0) -
  CYLINDERS (50,10) -
  RECORDSIZE (200,255) -
  SHAREOPTIONS (1 3) -
  VOLUMES (PRD105) -
  INDEXED -
  IMBED -
  REPLICATE -
  SPEED) -
  DATA(NAME (PROD.CUST.MASTER.DATA) -
  CONTROLINTERVALSIZE (4096)) -
  INDEX(NAME (U37989.VTEST.INDEX))
```

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Introduction of ICF Catalogs

- ICF catalogs were introduced in 1979 with DF/EF
 - Replaced both OS/CVOL's and VSAM catalogs
 - Many customers did not convert due to problems with DF/EF
- ICF catalogs could be used to catalog both VSAM and non-VSAM data sets
- Physical information for VSAM data sets was stored on the volume with the data set in a new structure called a VSAM Volume Data Set (VVDS)

Guide and SHARE Influenced the Development of DFSMS

- Guide 1983 White Paper
- SHARE
 - SHARE MVS Storage Management (MVSS) Project
 - San Jose Fly-In
 - Storage Technical Steering Committee
- MVS Storage Management Project mascot
 - Prior to 1988 it was the duck
 - In 1988 it became Godzilla
 - SYS1.LPALIB(IGDZILLA)
 - A made-up acronym was used to get this by the IBM lawyers

DFSMS was Introduced in 1988

- MVS/ESA 370
- DFP Version 3.1
 - SMS was introduced in this release
 - Introduced the concepts of DATACLAS, MGMTCLAS, and STORCLAS
 - System Determined Blocksize
 - New JCL parameters
 - LIKE
 - AVGREC

Logical View vs. Physical View Separation

- Allows the users to concentrate on their jobs instead of spending part of their time managing their data
- Removes the need for the application programmers to have to be concerned with the device types used to store their data
- Frees the storage administrator to concentrate on more important work
- Lets the system do the mundane work

SMS Makes the Storage Environment More Dynamic

- Allows volumes to be dynamically added or removed from the environment
 - No more EDT gens
 - No more JCL changes
- Users are no longer involved when making changes to the storage environment

SMS Better Meets User Requirements

- Provided more granularity for managing their data
- Provides a mechanism to change how their data is managed when their requirements change
- Allows their data to get allocated on the most cost effective device to meet their requirements and change the devices as the costs change

Efficiency Improvements in Storage Administration

- Prior to SMS, IBM study showed that on average there was 1 storage administrator per 10GB of storage
- About 1996/97, the average was 1 storage administrator per 1.5 TB
- In 2001/2002, the average storage administrator managed between 10 – 16 TB
- Today the average storage administrator manages from 50TB to over 300TB

And now, for a different perspective on DFSMS...

- More history
- Stories
- Myth busting
- And the story of a truly visionary product. I'm just not sure we knew it at the time!!

Much Progress has been made, meaning....If the aircraft industry had progressed as fast as the storage industry...



- Assume a 787 Dreamliner were flying in 1956 (OK, let's go for the DC7), if a DC7, flying in 1956, carried 120 passengers, and was traveling at 360 mph, if compared to the storage industry, it would today (if there are any DC7's left in the world) be:
 - Traveling at 4.3 million MPH, and
 - Would be carrying 74.5 TRILLION passengers.
 - And their ticket price would be .000018 cents, all 74 trillion of them
- Is that progress, or what!!!

Mythbusting, Part #1

- DFSMS was a decade-long project, involving dozens of designers, hundreds of programmers, and hundreds of thousands of lines of code
- There is no single “inventor” of DFSMS, it was an evolution of the above
- Was it visionary? Hell, yes! Today's mainframe data stores are roughly 1,000,000 times larger than when DFSMS was released
 - At 1 storage administrator per 10 GB of storage, that's literally hundreds of admins today.

Mythbusting, Part #2

- DFSMS was not “designed” in a bar!
 - Well, actually, the Management Class construct was heavily influenced in one, but all the napkins have gone missing. Sorry! But I’ll keep looking...
 - Strongly influenced by the Guide whitepaper and SHARE involvement

Mythbusting, Part #3

- I - IBM
 - G - ??
 - D - ??
 - Z – Zero Defect
 - I - Integrated
 - L - Logical
 - L – Labor-saving
 - A – Application
-
- And, no, IBM was not afraid of being sued by the country of Japan

Some More Background...



- **Early 1980's**
 - Largely distributed and departmental systems
 - DASD utilization rates were very, VERY low, generally < 10%
 - DASD was running about \$15/MB, or
 - \$15,000/GB or \$15,000,000 a TB
 - Anyone wanna petabyte?
- **The “Task Force”**
 - Commissioned by Jack Akers (soon to be CEO of IBM) and Dr. Art Anderson (GM of the storage division)
 - IBM market share in storage dropping at a rapid rate amidst 3380 problems
 - Solution? Sell less storage. Really?
 - “Gang of Four” formed to spread the gospel of better storage management – the “Road Warriors”

Some More Background...



- **Motivation to develop System Managed Storage from 3 sources**
 - Road Warriors spreading the gospel of data management and consolidation
 - Best practices and utilities
 - Consolidation of departmental systems
 - Increase utilization rate
 - “Ivory Tower”
 - Designated to rewrite the MVS device code
 - Focus on Automation
 - Address the Access Density problem
 - Guide/SHARE

Result? Ivory Tower, meet the Road Warriors....and thousands of bar napkins later, SMS was born!!!

Intelligent Storage – Changing the Landscape



- **Prior to 1992, storage was a commodity**
 - Pack 14-inch disk packs in a box and sell them to customers
 - Vendors (HDS, IBM, and EMC) tried to compete on performance, reliability, and price. Customers heard price, price, and price
- **1992 brought Concurrent Copy, the first intelligent function to storage controllers**
 - This was pre-RAID
 - New functionality brought never before heard software licenses and required professional services
 - From there, years of additional functionality, networked storage, and quickly, no one knew what storage actually cost.
 - And with today's capacity efficiency products, what's a terabyte?

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Mainframe Storage 1956 - 2015



- Continuing to grow at rapid rates
- Being managed better with fewer people thanks to SMS

Appendix



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1990 Enhancements

- MVS/ESA 390
- ESCON Channels
- DFP 3.2
 - PDSE data sets were introduced
 - Eliminated need to compress
 - Dynamic directory
 - Enhanced sharing capability
 - OAM (Object Access Method)

1993 – Introduction of DFSMS/MVS

- DFSMS/MVS 1.1
 - DFP
 - DF/HSM
 - DF/DSS
 - DF/RMM

DFSMS 1.1 (March 1993)

- Concurrent Copy
- Sequential Data Striping
- Dynamic Cache Management (DCME)
- Tape Mount Management (TMM)
- ECKD Optical 3995 Support
- Tape Library Dataserver
- ABARS and PDSE Enhancements

DFSMS 1.2 (June 1994)

- Data Compression
- Extended Remote Copy (XRC)
- Backup While Open (BWO)
- SMS Device Selection
- VSAM Partial Release
- OAM Tape Library
- SMS System Group Name Support
- Open Edition/MVS

DFSMS 1.3 (December 1995)

- VSAM KSDS Extended Addressability
- PDSE Performance Enhancements
- SMS Support for 32 systems
- HSM Support for 100 backup versions and RECOVER multi-tasking
- UCB VSCR (above the line)
- VSAM Record Level Sharing (September 1996)

DFSMS 1.4 (Sept 1997)

- SAM Tailored Compression
- VSAM Load Enhancements and Dynamic Buffering
- Catalog Search Interface
- HSM Support for Duplexed Tapes
- VSAM RLS Support for Extended Addressability

DFSMS 1.5 (March 1999)

- HFS Performance Improvements
- Enhanced Catalog Sharing
- HSM Enhancements
 - Extended Addressability for CDS's
 - Secondary Host Promotion
 - Single GRSplex Serialization Improvements
 - Volume Backup Performance Improvements
- RMM Improvements
- VSAM Advanced Functions

DFSMS OS/390 R10 (Sept 2000)

- DFSMS was integrated as a component on OS/390
- VSAM
 - Striping
 - System Managed Buffering
- HSM Enhancements
 - Data Set Backup and Multi-Tasking
 - Fast Subsequent Migration
 - Multi-Address Space Support
- RMM Enhancements
 - OPC/ESA
 - Pre-ACS Interface & ACS Support Extended
 - VTS Support for Stacked volumes
 - Fast Tape Positioning
 - Improved Auditing

DFSMS Initially Was Not on z/OS Release Boundaries

- z/OS DFSMS V1R3 – March 2002
- z/OS DFSMS V1R4 – September 2002
- Z/OS DFSMS V1R5 – March 2004
- z/OS DFSMS V1R6 – September 2004
- z/OS DFSMS V1R7 – September 2005
- z/OS DFSMS V1R8 – September 2006
- z/OS DFSMS V1R9 – September 2007
- z/OS DFSMS V1R10 – September 2008
- z/OS DFSMS V1R11 – September 2009
- z/OS DFSMS V1R12 – September 2010
- z/OS DFSMS V1R13 – September 2011
- z/OS DFSMS V2R1 – September 2013