IAM: Improving Performance for VSAM Applications

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Improving Performance for VSAM Applications

- What is IAM
- IAM Concepts
- IAM Performance Strategies
- IAM Performance Summary
- How to IAM a VSAM Data Set
- IAM Advanced Functions
- IAM Version 9.2 Enhancements
What is IAM?

- **Reliable High Performance indexed access method**
  - Well established for over 40 years
  - Continuously evolving utilizing new technology to be responsive to customer needs

- **An alternative to VSAM**
  - VSAM API (Application Programming Interface)
  - Supports KSDS, ESDS, RRDS and Alternate Index.
  - Provides CPU time, I/O, and Response time savings
  - Hardware or Software data compression techniques
  - Minimizing manual tuning
  - Selected for use at the dataset level
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IAM Concepts

- Data stored in fixed length blocks
  - Not restricted to certain sizes
  - Maximizes space utilization of DASD architecture
- Resides on DASD as Non-VSAM data set:
  1. DSNTYPE=BASIC
     \[ \leq 64K \text{ tracks per volume} \]
  2. DSNTYPE=LARGE
     \[ >64K \text{ tracks per volume} \]
  3. DSNTYPE=EXTREQ or EXTPREF
     \[ >64K \text{ tracks per volume} \]
- Can Reside on Extended Address Volumes (EAV)
IAM Concepts

• IAM File Structure

<table>
<thead>
<tr>
<th>Control Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prime Data Area</td>
</tr>
<tr>
<td>Index</td>
</tr>
<tr>
<td>Extended Area</td>
</tr>
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IAM Performance Strategies

- Index in Virtual Storage
- Real Time Tuning Buffer Management
- Insert Strategy
  - Record Based Overflow
  - Prime Related Overflow
  - Prime Extension
- Data Compression
- Dynamic Tabling
- Overflow Caching
IAM Performance Strategies

- **Index in Virtual**
  - Read into storage during open
  - Eliminates index buffers and I/O
  - Compressed format to Reduce Storage Requirements
  - Use 64-bit virtual or z/OS Data Space storage
    - Eliminates impact on job region requirements
  - Prime Related Overflow (PRO)
    - Reduces Overflow index storage requirements
IAM Performance Strategies

- **Real Time Tuning**
  - Dynamic buffer management based on application processing
    - LRU management of randomly processed blocks
    - Automatic deferred writes for batch updates
    - Immediate reuse of buffers with sequentially processed blocks
    - Sequential read ahead
    - Sequential multiple blocks read/written per physical I/O
    - In mixed random/sequential environments, dynamically balances buffer usage based on application I/O demands
IAM Performance Strategies

- **Real Time Tuning (continued)**
  - Dynamically adjusts number of buffers
    - Works within a range of minimum/maximum number of buffers
    - Periodically evaluates buffer usage and adjusts as necessary
    - Provides indication if larger maximum would reduce I/O
    - Maximum buffer defaults (installation modifiable)
      - 65,536K (64M) buffer space for Batch/TSO
      - 1,024K (1M) buffer space for CICS
    - Defaults should yield excellent performance for most datasets
    - Increase maximum by using BUFND or BUFSP
    - Can use IAM Override facility to override buffering value
      - BUFSP, MINBUFNO, MAXBUNO
  - Turbo mode increases responsiveness
IAM Performance Strategies

- **Real Time Tuning (continued)**
  - Uses 31-bit virtual storage for all buffers
    - If a buffer is acquired in 24-bit storage, it will be released
  - Option to use 64-bit virtual for buffers
  - Does not connect buffers to place holders (strings)
    - Eliminates CI lockout/exclusive control problems
  - Simplified Manual Tuning
    - IAM will display the IAM368 message in the IAMINFO report for a dataset if it detects that more buffers would have been beneficial
- **Bottom line**
  - Typical results are a 30% to 80% reduction in elapsed time
IAM Performance Strategies

User Reported Benefit:

“We have a native VSAM file with about 2 million records and 1700 index records. Reading the entire file consumes over 2 hours elapsed time and 2 million EXCPs each to both the DATA and INDEX components of the VSAM file. We converted the file to IAM and ran the same program using the same inputs and the job completed in 13 minutes.”

- IAM Reduced Elapsed Time by 89%
- IAM Reduced EXCP’s by 96%
IAM Performance Strategies

User Reported Benefit:

User Experience Feb. 2015

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IAM Performance Strategies

- **Real Time Tuning: File Load Buffering**
  - Sequential output process
  - Defaults to obtaining enough buffers for 2 cylinders of data
  - Uses 31-bit or 64-bit virtual storage for buffers
  - Controlled by CRBUFOPT Override or Global Option
  - When 1/2 buffers are filled, issues EXCP to write that set of buffers
  - Application can concurrently fill up rest of buffers
  - Uses Data Space to hold index while writing data
  - *Note: For SMS Extended Format datasets BSAM is used, so IAM does not have direct control on number blocks written per physical I/O*
IAM Performance Strategies

- **High Performance FICON: z/HPF**
  - An alternative internal I/O architecture
  - Reduces channel connect time
  - A single TCW structure vs multiple CCW structure
  - Recently enhanced by IBM to support EXCP

- **Benefits**
  - Improved I/O efficiency and capacity
  - IAM: Averages 26% reduction in connect time
  - May provide some elapsed time savings
IAM Performance Strategies

- **Insert Strategy: Record Based Overflow**
  - Record placement based on space, not on key
  - Indexed by record key in virtual storage

- **Benefits**
  - Less I/O overhead than VSAM CI/CA splits
  - More efficient use of DASD space
  - Unused Overflow space has no restrictions on use
  - Works exceptionally well for the vast majority of files
IAM Performance Strategies

- **Insert Strategy: Prime Related Overflow (PRO)**
  - Record placement based on key by a block split technique
  - All records in block related to same Prime Data Block
  - Indexed by block

- **Benefits**
  - Reduces Overflow Index Size and Reorg Frequency
  - Improved Sequential Processing over Record based overflow
  - Works well on files with hundreds of thousands of inserts
  - No restrictions on reuse of empty overflow blocks
IAM Performance Strategies

- **Insert Strategy: Prime Extension**
  - Records with Keys Beyond Current End of File
  - Records in Ascending Key Sequence
  - Indexed by block, written out to disk

- **Benefits**
  - Less index storage required than overflow
  - Good sequential performance
  - Reduced need for Reorg
IAM Performance Strategies

• **Data Compression**
  • Increases effective amount of data transfer per I/O
  • Reduces EXCP counts
  • Reduces data set size
  • IAM Software Compression
    • High performance, proprietary run length encoding algorithm
    • No dictionary required
    • Typical results are 20% to 50% compression
  • IAM use of System z Hardware Compression
    • Dictionary dynamically built during file load
    • Optional user provided customized dictionaries
    • Typical results are similar to Software Compression
    • Customized dictionaries may achieve > 90% compression
IAM Performance Strategies

- IAM’s Dynamic Data Space
  - Record based cache in virtual storage
  - Used for randomly read records
  - May significantly reduce I/O and buffer needs
  - Records stored in segments, less unused storage for variable length records
  - Dynamic LRU management of records in table
  - Statistics provided in IAMINFO reports
IAM Performance Strategies

- **IAM Overflow Area Cache**
  - Block based cache area for record based overflow blocks
  - Entire overflow area at open time is cached
  - Cache is in 64-bit virtual storage
  - Usage is triggered by CACHE64 Override

- **Benefits**
  - Intended usage is for files with large record based overflow
  - Inserts have been done in a very random manner
  - Improve sequential processing
IAM Performance Strategies

- Installation Selectable Defaults
  - Buffering
  - Data Compression
  - SMF Records
  - Use of 64-bit Virtual for the Index Space
  - Use of 64-bit Virtual for buffers
  - Can be easily changed with provided program: IAMZAPPOP
IAM Performance Strategies

- **Installation Selectable Defaults**
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Performance Summary

- IAM Improves VSAM Application Performance
  - Index in virtual storage
    - Eliminates index component I/O and buffers
  - Dynamic Real Time Tuning
    - IAM dynamically selects best buffer management technique
    - IAM dynamically decides on number of buffers
  - Record based overflow
    - Eliminates I/O overhead of CI and CA splits
  - Data Compression
    - Increases effective data transfer per I/O
    - Reduces EXCP counts
Performance Summary
User Experience

- TRMS Database I/O Savings of About 79%
Performance Summary
User Experience

- Parts Master File I/O Savings of 68%
Performance Summary
With a Lawson Application from INFOR

• IAM Reduced CPU Time by 40.6%

Avg. CPU Time with VSAM: 23.78
Avg. CPU Time with IAM: 14.12
Performance Summary
With a Lawson Application from INFOR

- IAM Reduced Elapsed Time by 68.8%
Performance Summary
With a Lawson Application from INFOR

- IAM Reduced VSAM EXCPS by 99%

Weekly EXCP Counts from 2012

- VSAM Avg. EXCP: 6,174,370
- IAM Avg. EXCP: 60,673
Performance Summary
Typical Results

- Reduces Batch Processing Time by 20% to 60%
- Reduces Physical I/O (EXCP’s) by 40% to 80%
- Reduces CPU time by 20% to 40%
  - CPU savings may be reduced by Data Compression
- Data Compression Reduces DASD Space by 20% to 50%
Performance Summary
Can IAM Help?

- **SMF Analysis Program**
  - Determine how much VSAM I/O activity a system has
    - Do we have high enough VSAM I/O activity to justify IAM?
  - Identify Datasets that are Candidates for Conversion to IAM
    - Report on VSAM datasets with most I/O activity
    - Report on largest VSAM datasets
    - What datasets will yield the most savings from IAM?

- **Available for Free Trial**
  - Includes Review and Analysis of Results from your installation
Example of SMF Analysis Program Output

```
DEVI CE TYPE........ 3390   VSAM CYLINDERS...... 1737106
TOTAL DISK EXCP S..... 10809424107   VSAM EXCP S....... 3092629292

VSAM EXCP REPORT

<table>
<thead>
<tr>
<th>DATA SET NAME</th>
<th>% CLUSTER</th>
<th>TOTAL EXCPS</th>
<th>RECORDS</th>
<th>READS</th>
<th>INSERTS</th>
<th>UPDATES</th>
<th>DELETES</th>
<th>SPLITS</th>
<th>ALLOC</th>
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<td></td>
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<td>EXCPS</td>
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</tbody>
</table>
```

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How to IAM a VSAM Data Set

Initial Steps

1. Install the IAM Product
   • Refer to Section 90 of the IAM Manual for Instructions
   • Recommend placement in Link List to avoid need for STEPLIB

2. Activate the IAM VSAM Interface
   • Run the IAMSTART procedure

3. Define an IAM Data Set with IDCAMS
   • Add OWNER($IAM) to DEFINE CLUSTER Statement

4. Use as you do any standard VSAM Data Set
   • No JCL changes necessary if in Link List
   • Otherwise add a STEPLIB to the IAM Load Library
How to IAM a VSAM Data Set
Example of IDCAMS DEFINE

DEFINE CLUSTER(NAME(my.vsam.ksd)  -
  VOLUME(*) CYL(10 1)  -
ADD → OWNER($IAM) )  -
  DATA(NAME(my.vsam.ksd.data)  -
  RECORDSIZE(200 256) KEYS(16 0)  -
  CISIZE(4096) FREESPACE(10 10))  -
  INDEX(NAME(my.vsam.ksd.index)  -
  CISIZE(1024))
How to IAM a VSAM Data Set
The IAMINFO Report

• IAM Run Time Reports: IAMINFO
  • One page statistical report on IAM file activity
  • Produced whenever an IAM file is closed
    • Requires IAMINFO DD card: //IAMINFO DD SYSOUT=*  
  • Optionally can be written as SMF record
    • IAMINFO Report from provided IAMSMF program
    • Can be produced in CSV format for spreadsheet use
  • Provides detailed information to assist with tuning
  • IAM368 Message if more buffers would have reduced I/O
  • IAM373 Message will tell you if file should be reorganized
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Example IAMINFO Report – Top Portion

IAM400 IAMINFO DATASET STATI STI CS REPORT -- VERSIO N 9.2/0 0 SP I N 0 0 -- I NNOVATI O N DATA PROCESSI NG
DATE- 2015. 06 9
IAM600 STE P - BNC1KF DDNAME - VSAMCRT1 DATA SET MDNI TORED - I AM/ BNC1KI . CLUSTER
IAM611 IAMINFO REQUESTED BY PROGRAM RANUPD FOR UPDATE PROCESSI NG OPENED 2015. 06 9. 15: 06: 36
CLOSED 015. 06 9. 15: 06: 59

IAM62 IAM DATA CHARACTERI STI CS -
IAM FILE FORMAT----------------- = ENHANCED - I AM FILE STATUS----------------- = LOADED
LOGICAL RECORD LENGTH------ = 1000 - CI SI ZE----------------- = 8192
KEY SI ZE----------------- = 8 - KEY OFFSET----------------- = 0
TOTAL RECORDS----------------- = 2000000 - TOTAL RECORDS DELETED------ = 0
TOTAL RECORDS UPDATED------ = 1000000 - TOTAL RECORDS I NSERTED------- = 0

IAM63 IAM FILE CHARACTERI STI CS -
BLOCKING FACTOR------------- = 4 - BLOCK SI ZE----------------- = 13682
TRACKS IN USE-------------- = 38492 - VARIABLE LENGTH OVERFLOW- = YES
NUMBER OF EXTENTS--------- = 13 - NUMBER OF VOLUMES--------- = 2
DATASET TYPE-------------- = KSDS - SHARE OPTI ONS--------- = 2
NUMBER OF IAM DATA BLOCKS= = 153849 - HIGH ALLOCATED RBN------ = 0
INTEGRATED OVERFLOW ( CI %)- = 0 - DASD RESERVE ( CA%)- = 0
FILE DEFINED DATE---------- = 2015. 06 9 - FILE DEFINED TIME- = 15: 04: 32
FILE LOADED DATE---------- = 2015. 06 9 - FILE LOADED TIME- = 15: 04: 50
FILE UPDATE DATE---------- = 2015. 06 9 - FILE UPDATE TIME- = 15: 06: 59

IAM72 IAM EXTENDED AREA CHARACTERI STI CS -
EXT. OVERFLOW RECORDS------ = 0 - EXT. OVERFLOW BLOCKS------- = 0
EXTENDED BLOCKS ALLOCATED= = 0 - EXTENDED PB BLOCKS------- = 0
EXTENDED BLOCKS USED------- = 0 - EXTENDED BLOCKS AVAI LABLE- = 0

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### Example of IAMINFO Report – Bottom Portion

#### IAM365

<table>
<thead>
<tr>
<th>IAM EXECUTI ON STATI STI CS -</th>
<th>TOTAL STORAGE REQUI RED</th>
<th>STORAGE ABOVE THE LI NE</th>
<th>64- BI T BUFFER STORAGE (K)</th>
<th>64- BI T I NDEX STORAGE (K)</th>
<th>REQUESTS PROCESSED</th>
<th>DI SK BLOCKS READ</th>
<th>DYNAMC C BUFFER RETRI EVALS</th>
<th>M INI MUM BUFFERS USED</th>
<th>DYNAMC C TABLE RETRI EVALS</th>
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#### IAM366

<table>
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<th>IAM COMMAND EXECUTI ON SUMMARY -</th>
<th>GET RANDOM</th>
<th>GET SEQUENTI AL</th>
<th>GET PREVI OUS</th>
<th>GET KGE/ GENERI C</th>
<th>GET ( SKI P SEQUENTI AL)</th>
<th>ENDRQ</th>
<th>I AM STATI STI CS</th>
<th>CLOSE</th>
<th>CLOSE TYPE=T</th>
<th>I NVALID REQUESTS</th>
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How to IAM a VSAM Data Set
IAM Override Facility

- Control IAM functions for which there are no JCL parameters
- Change parameters for IAM without affecting VSAM
- Specified by //IAMOVRID DD card
  - Card image (LRECL=80) data set
  - Can be DD *
  - Can be sequential dataset or PDS Member
- CREATE control card for define and file load
- ACCESS control card for other IAM dataset processing
- Described in Section 30 of the IAM Manual
How to IAM a Data Set
Best Practices

1. Have current version IAM load library in Link List
2. Run IAMSTART automatically with each IPL
3. Activate collection of the IAM SMF records
4. Avoid use of SMS Extended Format for IAM Data Sets
   • Use DSNTYPE=LARGE instead
5. Always delete / define multi-volume IAM data sets prior to reorgs, reload, or as target of data set copy functions
6. Always do a LISTCAT ALL after defining an IAM data set
7. Add an IAMINFO DD to SYSOUT on job steps that use IAM
8. Set Global Options to minimize need for IAM Overrides
How to IAM a Data Set
Best Practices – Global Options

1. Keep DSORG=PS set
2. Keep BELOWPOOL=YES set
3. Set SMF=YES and RECTYPE=nnn to an unused SMF user record type.
4. Set ENABLE=LARGE
5. Set ESDSINTEGRATED=5 if using IAM ESDS files and
6. Set ENABLE=XESDS or ENABLE=PSEUDO if using ESDS
7. Set ENABLE=EAV if IAM files will be on EAV volumes
8. Set COMPRESSTYPE=HW For Hardware Instruction
How to IAM a Data Set
Best Practices – Global Options

1. Keep DSORG=PS set
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7. Set ENABLE=EAV if IAM files will be on EAV volumes
8. Set COMPRESSTYPE=HW For Hardware Instruction
How to IAM a Data Set
Best Practices – Global Options Continued

9. DATACOMPRESS=999999999 turns off data compression
10. INDEXSPACE=64BIT or ALL
11. ENABLE=BUF64 and CRBUFOPT=64BIT for 64-bit buffers
12. Keep set to DATASPACE=2048
13. Be careful of using RLS=(REQUIRED, TABLE).
IAM Advanced Functions

- Alternate Index (AIX) and Relative Record (RRDS) Support
- IAMRLS – Single System Record Level Sharing
- IAM/PLEX – Record Level Sharing on a SYSPLEX
IAM Advanced Functions
Alternate Index Support (AIX)

- IAM Performance to Alternate Index Processing
- Defined and Functions like VSAM Alternate Index, only faster
  - Define Base Cluster as IAM (OWNER($IAM))
  - Define Alternate Index – Automatically becomes IAM AIX
    - Unique or Non-Unique Keys
    - Upgrade or NoUpgrade
  - Define Path – Automatically becomes IAM Path
    - Update or NoUpdate
- No Application Program or CICS Changes
- Additional Cost Option to IAM Product
- Includes Support for VSAM RRDS type data sets
IAM Advanced Functions
Record Level Sharing

• Enables shared access to IAM files with data integrity

• IAM/RLS
  • Sharing with multiple address spaces on single LPAR
    • Supports CICS, Batch, TSO, other address spaces
    • Included with base IAM product
    • All I/O for shared data set handled by IAMRLS address space

• IAM/PLEX
  • Sharing with Multiple Systems in a SYSPLEX
    • Supports CICS, Batch, TSO, other address spaces
    • All I/O to each shared data set routed to owning IAMPLEX
    • Additional Cost Option to base IAM product
IAM Advanced Functions
Record Level Sharing

- CICS Support
  - Must install IAM provided CICS exits
  - No CICS application program changes required
    - Version 9.2 adds support for various VSAM RLS only I/O requests
  - Looks like non-RLS VSAM file to CICS
- Automated Recovery Processing
  - If an IAM/PLEX or IAM/RLS region becomes unavailable
    - Close and disable affected files
    - Abend in-flight transactions using any of the affected files
  - When IAM/PLEX or IAM/RLS region is available
    - Open all of the IAM files that had been in use
    - Restart shunted transactions to do the recovery
IAM Advanced Functions
Record Level Sharing

- Journal and Recovery Facilities Capabilities
  - Use SYSPLEX System Logger
  - IAM/RLS only: Use Sequential DASD data sets
- Persistent Record Locks
  - Will re-establish record locks for recoverable files that were held at time IAM/RLS or IAM/PLEX became unavailable
- Batch applications
  - May need syncpoints for recoverable data sets
IAM Advanced Functions
Record Level Sharing

• **RLSID:** Name of IAM/RLS or IAM/PLEX address space that is providing the I/O service for a specific data set
  • Unique name assigned via RLSID in IAM/RLS or IAM/PLEX startup parameters
  • Data Set Ownership assigned by:
    • Common Data set Name Table
    • When defined with RLSID IAM CREATE Override
    • When access with RLSID IAM ACCESS Override
    • Default from IAM Global Options
IAM Advanced Services
Record Level Sharing: IAMPLEX

• **RLSGROUP**: Refers to a group of related IAM/PLEX address spaces that form an XCF group that are able to directly communicate with each other
  - IAM/PLEX address spaces assigned to an RLSGROUP by startup parameter RLSGROUP
  - Any particular application address space (CICS region, batch job) can only access those IAM datasets that are being handled by an IAM/PLEX address space within a single RLSGROUP
  - All member IAM/PLEX address spaces in an RLSGROUP will share the same System Logger
  - XCF services are used to communicate to each IAM/PLEX address space within the RLSGROUP
IAM/PLEX
RLSGROUP=IAMPLEX1

LPAR A
CICS A
CICS B
IAM/PLEX
RLSID=PLXA
DSN A
DSN B

LPAR B
JOB 1
CICS C
IAM/PLEX
RLSID=PLXB
DSN C
DSN D

LOG

XCF
IAM Version 9.2 Enhancements

- z/HPF I/O Architecture Support
- 64-bit Virtual I/O Buffers
- Enhanced I/O Error Information
  - Includes full 32-byte sense data when available
- IAM WTO Message Enhancements
  - Use of Multi-Line WTO messages for automated operations
  - Split IAMW22 reasons into separate message numbers
- IAM/RLS and IAM/PLEX Support for VSAM RLS functions
- Enhanced IAMSMFVS Report
- GA: February 2015
IAM in Summary

• Transparently improves VSAM application performance
• Uses a simpler file structure, dynamic buffer management and caching
• Reduces physical I/O (EXCP’s) by 40% to 80%
• Cuts CPU time by 20% to 40%
• Reduces elapsed processing times 20% to 60%
• Data Compression can save DASD space by 20% to 50%
• Provide Record Level Sharing across a SYSPLEX
## Vendor Products that Use IAM

<table>
<thead>
<tr>
<th>Vendor</th>
<th>Product</th>
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<tbody>
<tr>
<td>Accero (CYBORG)</td>
<td>Payroll</td>
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<tr>
<td>American Software</td>
<td>DRP</td>
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<tr>
<td>ASG (Mobius)</td>
<td>View Direct</td>
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<tr>
<td>CGI</td>
<td>CGI Advantage</td>
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<tr>
<td>CSC</td>
<td>Hogan, Cyberlife, Capsil</td>
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<tr>
<td>CSI</td>
<td>Bank Trade</td>
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<td>Fidelity National</td>
<td>Systematics Banking Appl</td>
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<td>First Data</td>
<td>Vision Plus</td>
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<td>Fiserv</td>
<td>Pep Plus, Mortgage-Serv</td>
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<tr>
<td>Infor (GEAC)</td>
<td>GL, AR, MSA, Millenium, Walker, Infopoint Deposits, Lawson</td>
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<td>JDA</td>
<td>Compass Contract</td>
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<td>Jes Q Print</td>
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<td>Serena</td>
<td>TRMS, SAVRS</td>
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<td>Changeman ZMF</td>
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<td>Siemens Medical Systems</td>
<td>Collections</td>
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<td>Sigma</td>
<td>Invision, Signature</td>
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<td>SunGuard (SCT)</td>
<td>SAM (Student Aid Management)</td>
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<td>Empower Software (Tesseract)</td>
<td>SIS+, HRS, FRS Payroll, HR, Benefits</td>
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<td>Medicare Part B, SuperOP</td>
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Vendor Products that work with IAM

**DASD MANAGEMENT SOFTWARE:**
- FDR/ABR (INNOVATION DATA PROCESSING)
- FDREPORT (INNOVATION DATA PROCESSING)
- FDRREORG (INNOVATION DATA PROCESSING)
- DF/SMS (IBM)
- DF/HSM (IBM)
- DF/DSS (IBM)
- CA ALLOCATE (formerly VAM) (CA)
- DMS/OS (CA)
- POOLDASD (BOOLE & BABBAGE)
- MAINVIEW SRM STOPX37/II (BMC)

**JOURNALING AND RECOVERY:**
- FILE SAVE (CA)
- DRS (BMC)
- AR/CTL (BMC)
- CICS/VR (IBM)
- RRDF - Remote Recovery Data Facility (E-Net)

**PERFORMANCE MONITORS:**
- OMEGAMON (TIVOLI)
- THE MONITOR TMON (ASG)
- STROBE (COMPUWARE)
Vendor Products that work with IAM

**MISCELLANEOUS PRODUCTS:**
- FILE-AID (COMPUWARE)
- File Manager (IBM)
- ABEND-AID (COMPUWARE)
- CICS (IBM)
- CONNECT: DIRECT (IBM-Sterling)
- ISPF (IBM)
- NETWORK DATA MOVER (CA)
- SELCOPY and SELCOPY/i (CBL Compute (Bridgend) Ltd)
- SHRINK (CA)

**SECURITY PRODUCTS:**
- RACF (IBM)
- ACF/2 (CA)
- TOPSECRET (CA)

**PROGRAMMING LANGUAGES:**
- VS/COBOL (IBM)
- COBOL II (IBM)
- FORTRAN (IBM)
- PL/1 (IBM)
- BAL (IBM)
- CA/OPTIMIZER (CA)
- SAS (SAS INSTITUTE)

**SHARING PACKAGES:**
- IAM/PLEX (IDP)
- SHARE OPTION 5 (CA)
- SYSB (H & W)

**SORT PRODUCTS:**
- SYNCSORT (SYNCSORT)
- DF/SORT (IBM)
- CA/SORT (CA)
Additional Resources

- Innovation Website: [http://www.fdr.com](http://www.fdr.com)
- FREE Trial: [http://www.fdr.com/riskfreetrial](http://www.fdr.com/riskfreetrial)
- Support Email: support@fdrinnovation.com
Closing: IAM
Improving Performance
for VSAM Applications

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