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IAM: Improving Performance for Transaction and Batch VSAM Applications

Richard Morse
Innovation Data Processing

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www.LinkedIn.com/pub/richard-morse/13/597/775/
EMAIL: rmorse@fdrinnovation.com

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IAM: Improving Performance for Transaction & Batch VSAM Applications

- What is IAM
- IAM Concepts
- IAM Performance Strategies
- IAM Performance Summary
- IAM/PLEX
- IAM Version 9.1 Enhancements

What is IAM?

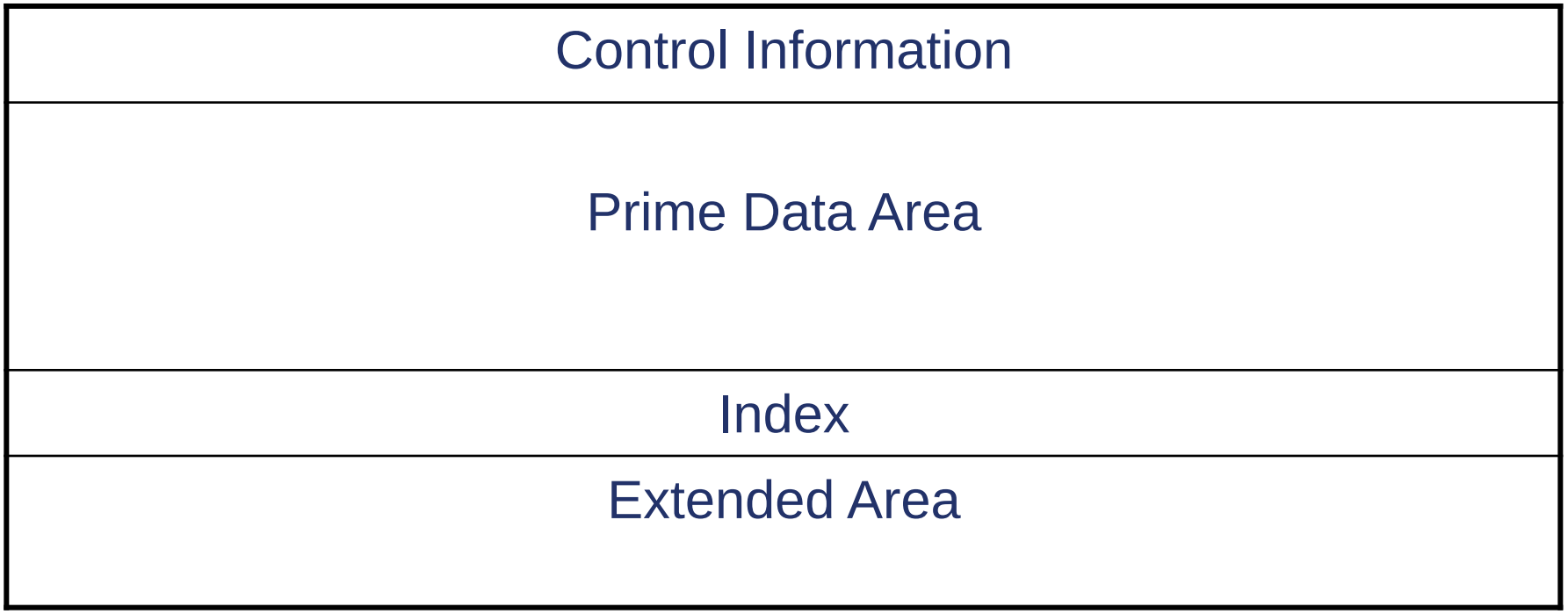
- Performance oriented access method
  - Well established for over 40 years
  - Continuously evolving to be responsive to customer
- An alternative to VSAM
  - Plug compatible VSAM API (Application Programming Interface)
  - Supports KSDS, ESDS, RRDS and AIX type datasets
  - Provides CPU time and I/O savings
  - Hardware or Software data compression techniques
  - Minimizing manual tuning
  - Does not replace VSAM
  - Selected for use at the dataset level

IAM Concepts

- Data stored in fixed length blocks
  - Not restricted to certain sizes
  - Maximizes space utilization of DASD architecture
- Resides on DASD in 1 of 3 formats:
  1. Non-VSAM dataset (DSORG=PS)
  2. DSNTYPE=LARGE Format
     For >64K tracks per volume
  3. DFSMS Extended Format Sequential Dataset
     For >64K tracks per volume
- Can Reside in the Extended Addressing Space (EAS) on Extended Address Volumes (EAV)

IAM Concepts

- IAM File Structure



IAM Concepts

- Transparent VSAM Interface
  - KSDS
  - ESDS
  - AIX – Alternate Index (Optional feature)
  - RRDS and Variable RRDS (Included with AIX feature)
  - IAM does not support Linear Data Sets (LDS)
- Data Compression
  - Software or System z Hardware compression
  - Can be used on all IAM supported dataset types: KSDS, ESDS, RRDS, Variable RRDS

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 Size
    - Prime Data Index Compressed
    - Overflow index compressed
  - Use 64-bit virtual or z/OS Data Space storage
  - Prime Data index never changed after file load

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):
      - *32,768K buffer space for Batch/TSO*
      - *1,024K 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
      - *MINBUFNO, MAXBUNO, BUFSP*
  - Turbo mode increases responsiveness and buffer limits

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
  - Does not connect buffers to place holders (strings)
    - Eliminates CI lockout/exclusive control problems
    - May require less buffers than VSAM
  - Does not use VSAM LSR buffers (although IAM can be used with applications that have specified LSR buffering)
  - Bottom line
    - Simplified Tuning and Improved Performance
    - Typical results are a 30% to 80% reduction in elapsed time

IAM Performance Strategies

- Real Time Tuning: File Load Buffering
  - Essentially sequential output process
  - Defaults to obtaining enough buffers for 2 cylinders of data
  - 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

- Insert Strategy: Record Based Overflow
  - Record placement based on space, not on key
  - Indexed by record 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 very well for most files
- Potential Problems
  - Storage required for index
  - Possible long time to open and/or read sequentially

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, and is written to disk
- 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
- Potential Problems
  - Will Use More DASD Space
  - Not as sharable without IAM/RLS or IAM/PLEX

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
- Potential Problems
  - Restricted reuse of empty space to records within key range
  - Index is not compressed

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
    - 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

- IAM Run Time Reports: IAMINFO
  - One page statistical report on IAM file activity
  - Produced whenever an IAM file is closed
    - Requires IAMINFO DD card
  - Optionally can be written as SMF record
    - IAMINFO Report from provided IAMSMF program
    - Can be produced in CSV format for spread sheet 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

IAM Performance Strategies

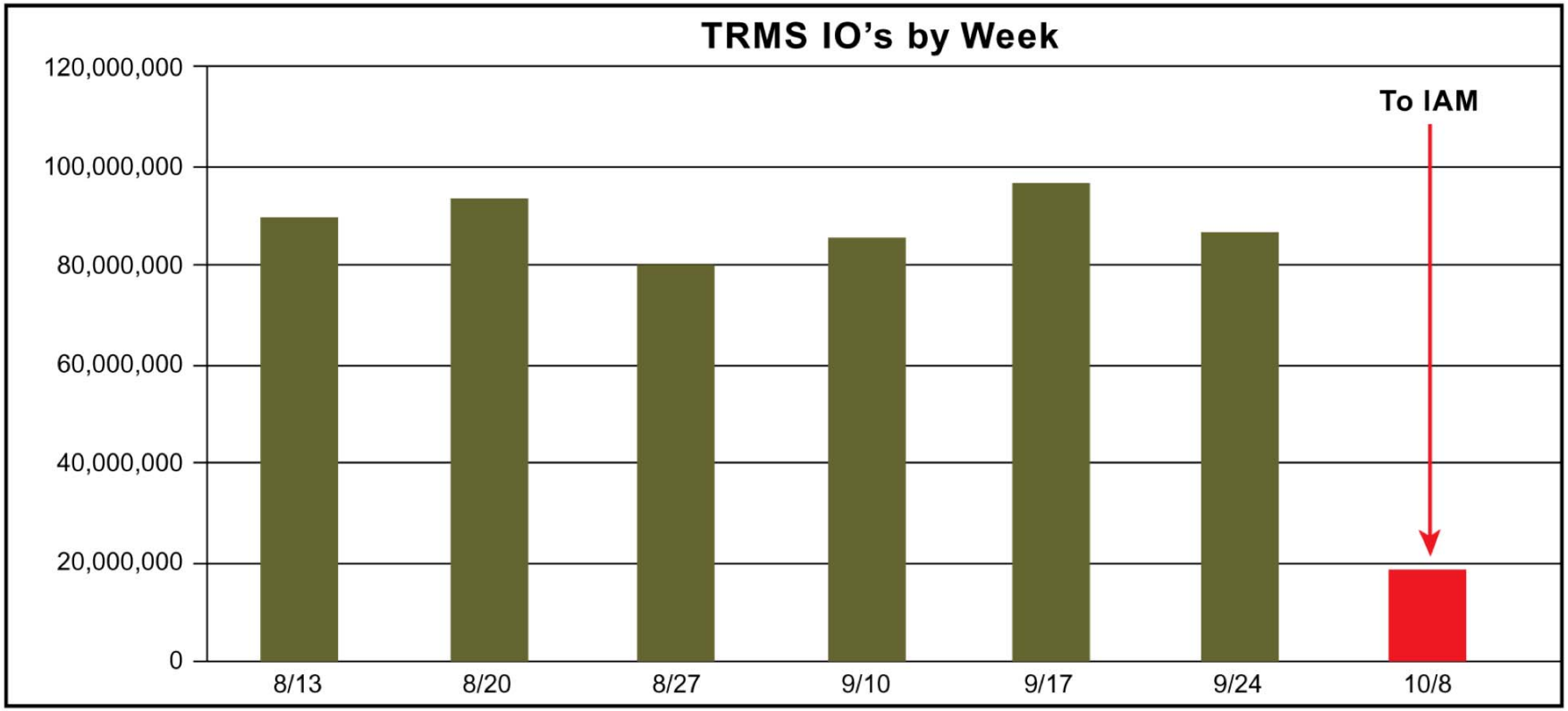
- Installation Selectable Defaults
  - Buffering
  - Data Compression
  - SMF Records
  - Data Space Size
  - Use of 64-bit Virtual and Index Space
  - Can be easily changed with provided program: IAMZAPOP

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

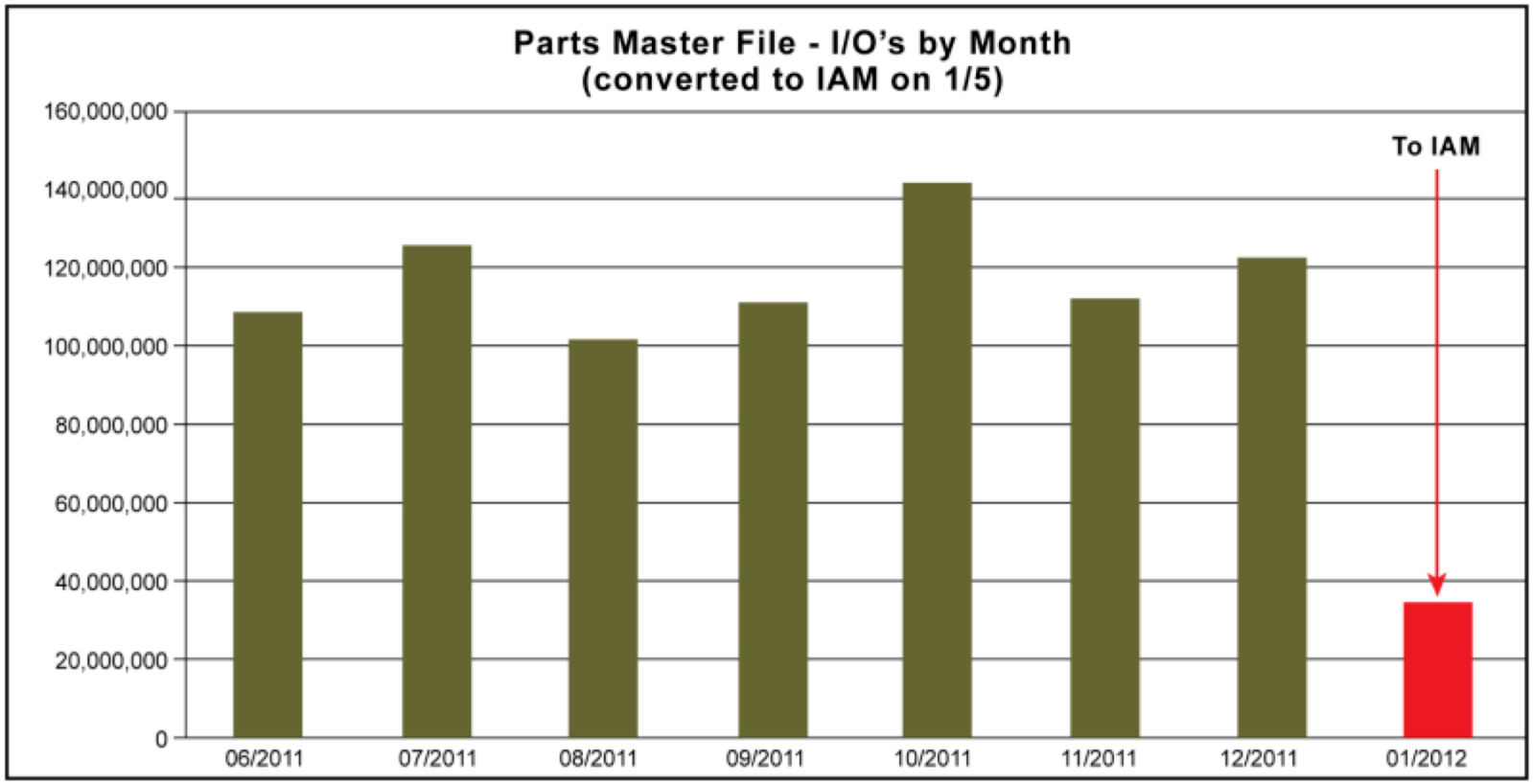
Performance Summary
User Experience

TRMS Database I/O Savings of About 79%



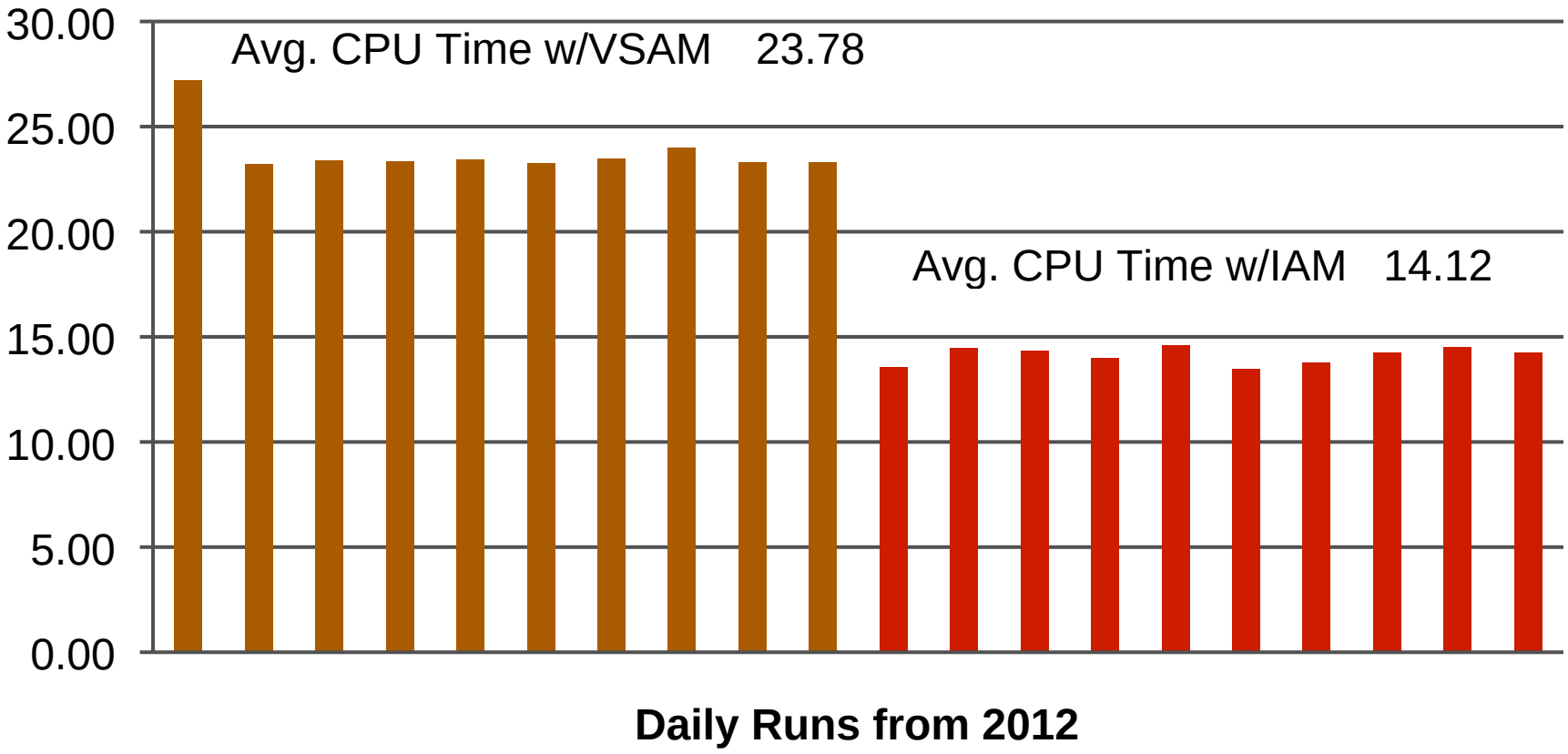
Performance Summary
User Experience

Parts Master File I/O Savings of 68%



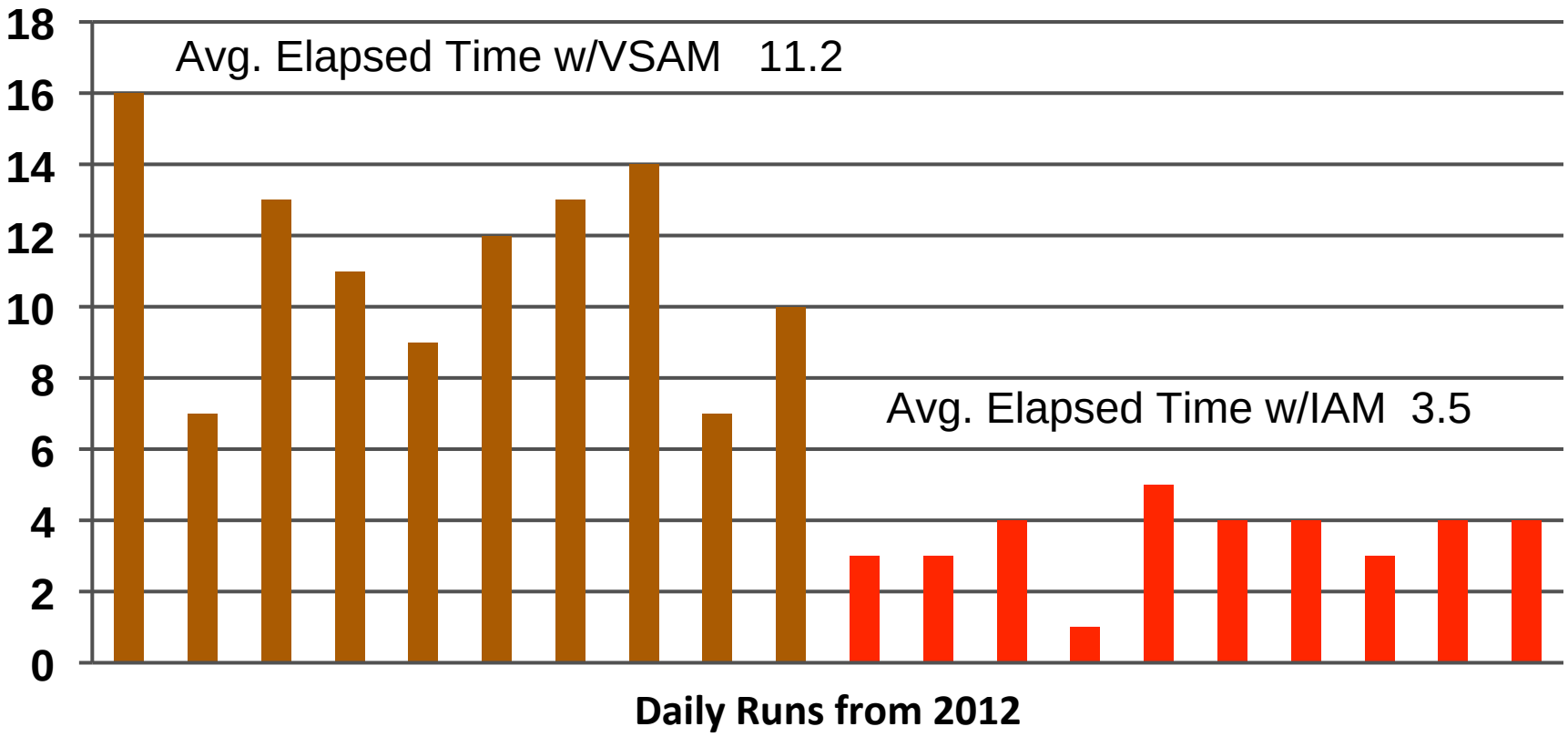
Performance Summary
With a Lawson Application from INFOR

IAM Reduced CPU Time by 40.6%



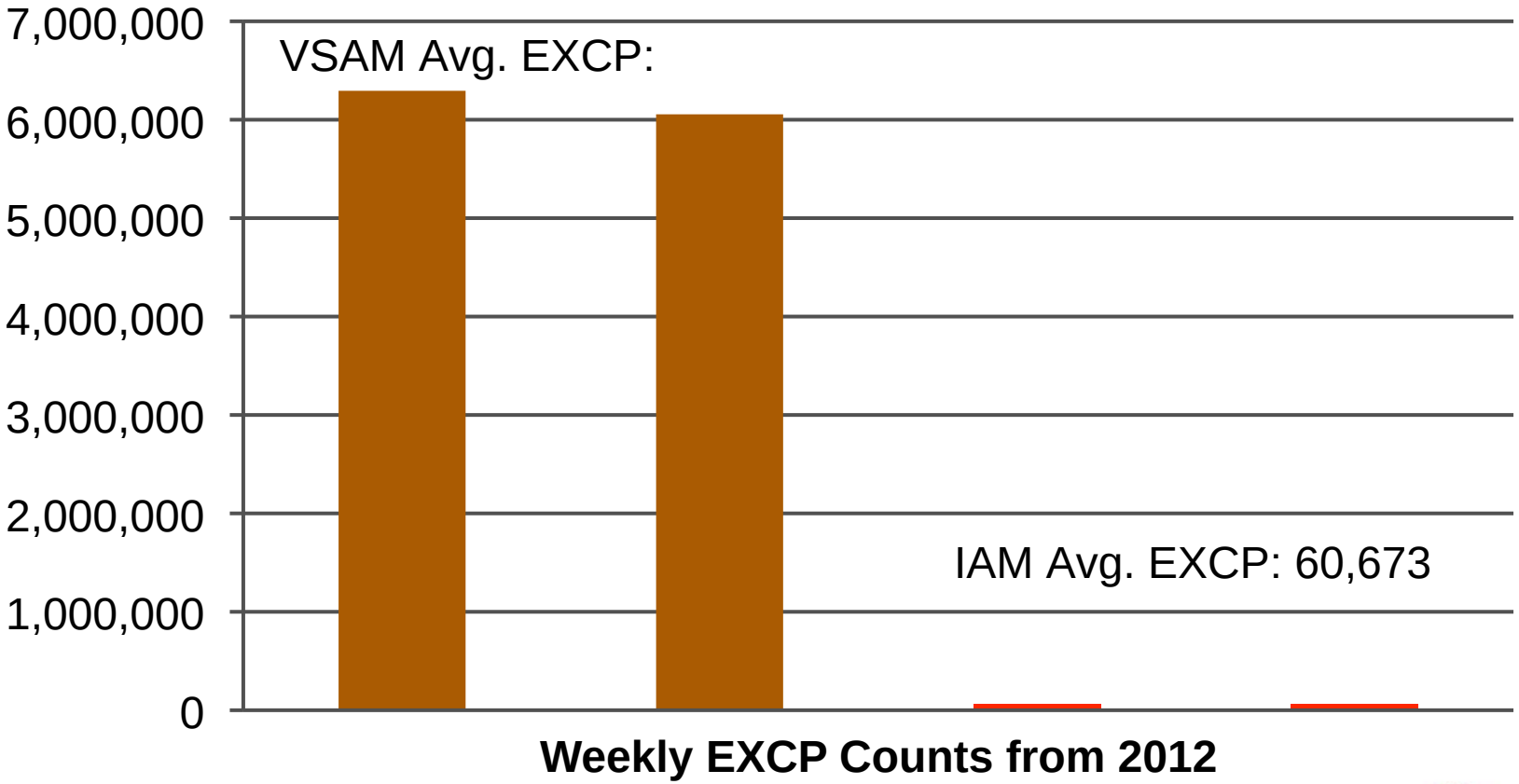
Performance Summary
With a Lawson Application from INFOR

IAM Reduced Elapsed Time by 68.8%



Performance Summary
With a Lawson Application from INFOR

IAM Reduced VSAM EXCPs by 99%



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
  - Includes Review and Analysis of Results at your installation

IAM/PLEX
Record Level Sharing

- Record Level Sharing for IAM Datasets
  - Multiple LPAR's in a SYSPLEX
  - Multiple concurrent CICS regions and batch jobs
  - Accessed by standard VSAM I/O requests
- Journal and Recovery Facilities Utilizing System Logger
- CICS Support
  - Must install IAM provided CICS exits
  - No CICS application program changes required
  - Looks like non-RLS VSAM file to CICS
- Batch applications
  - May need syncpoints for jobs that do heavy update activity

IAM/PLEX
Record Level Sharing

- Basic Record Level Sharing Truth
  - It requires significantly more computing system resources to facilitate sharing than the resources actually needed to access and update the data
- IAM/PLEX Design Objective
  - Provide Record Level Sharing for IAM datasets with the best possible performance
  - Concerned that additional utilization of Coupling Facility required to support the sharing of the IAM overflow structure would be detrimental to performance

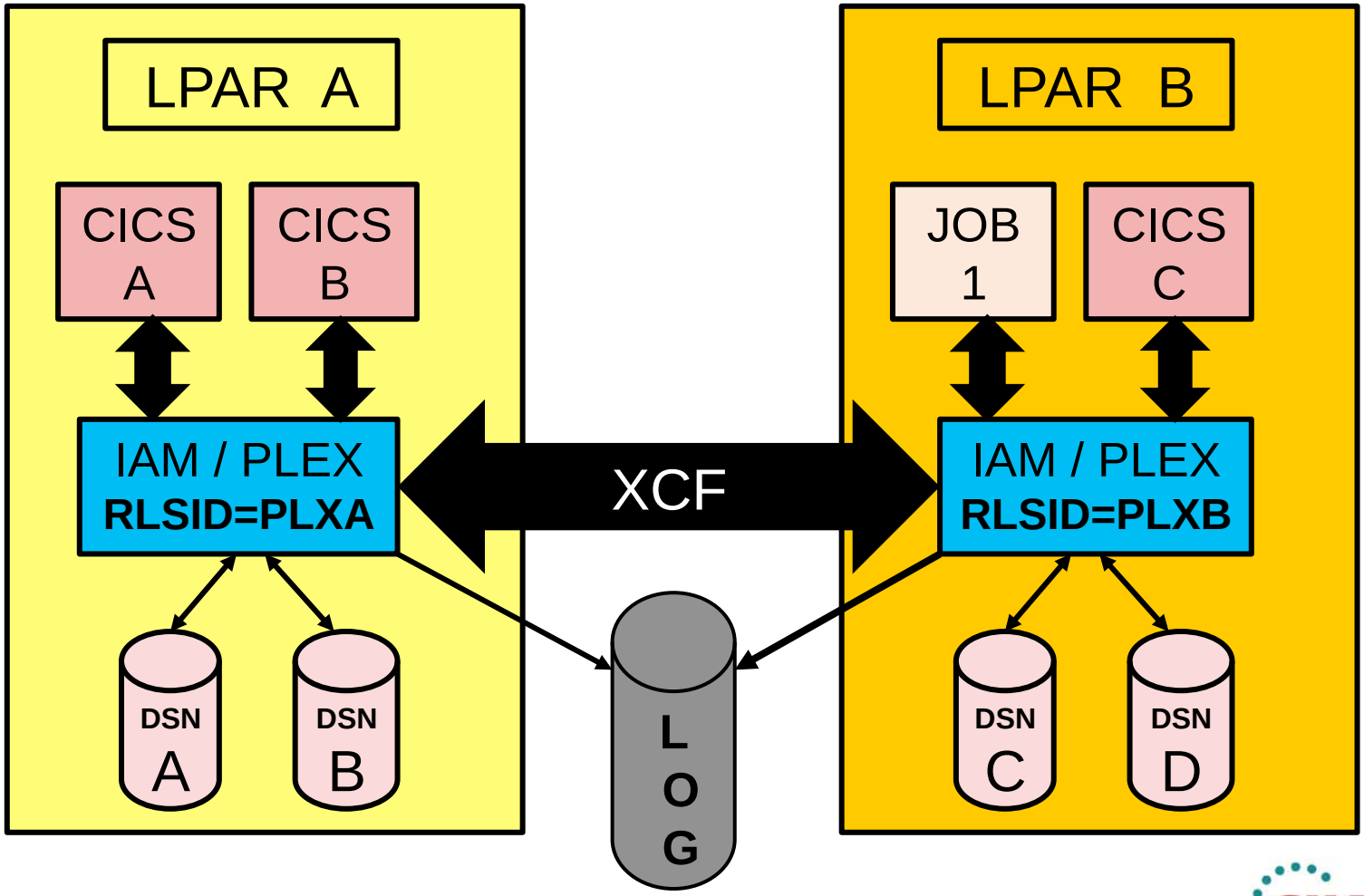
IAM/PLEX
Record Level Sharing

- IAM/PLEX Design Conclusion
  - IAM performance using the complete Coupling Facility Protocols would not perform at a satisfactory level
  - IAM Sysplex sharing performance would be better using a single address space to do the I/O, record locking, and journaling rather than multiple calls to Coupling Facility
  - Utilize reliability of existing IAM/RLS structure to build Sysplex level sharing of IAM datasets rather than developing a lot of new processing to the IAM I/O process for necessary Coupling Facility Protocols

IAM/PLEX Concepts

- **RLSID:** A unique name for each IAM/PLEX address space running in a SYSPLEX
- **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
  - Any particular application address space (CICS region, batch job) can be connected to only one RLSGROUP
  - Can only access those IAM datasets that are being handled by an IAM/PLEX address space within that RLSGROUP
- XCF services are used to communicate between IAM/PLEX address spaces within the RLSGROUP

IAM/PLEX
RLSGROUP=IAMPLEX1



IAM/PLEX and IAM/RLS Enhancements

- CICS Automated Recovery Processing
  - If an IAM/PLEX or IAM/RLS region becomes unavailable
    - Close and disable affected files
    - Abend in-flight transactions causing them to be set up for backout when region is available
  - 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
- Persistent Record Locks
  - An IAM/PLEX address space will re-establish records locks for recoverable files that were held at time it became unavailable

IAM/PLEX and IAM/RLS Enhancements

- HiperDispatch performance enhancement
  - Utilize Pause/Release for faster synchronization
  - Enhanced internal work dispatching
    - Reduce number of I/O subtasks being used
  - Reduce utilization of z/OS local lock
    - Increase use of PLO instruction for serialization
    - Reduce frequency of various z/OS SVC calls
- Automated detection of recoverable files under CICS
  - Eliminates need for override for non-recoverable datasets
- CICS TS 5.1 Support

Additional IAM Version 9.1 Enhancements

- Uncaptured UCB Support
  - IAM files can be allocated and opened with 31-bit UCB
- Automatic support of VSAM editors under ISPF
  - File-Aid, File Manager, Ditto…
- Automatic recatalog of IAM/AIX after Copy/Renames
  - Eliminate need for DEFINE RECATALOG job steps when name change is consistent amongst components
- GA: March 2013

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

QUESTIONS

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Closing
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INNOVATION® DATA PROCESSING

CORPORATE HEADQUARTERS: 275 Paterson Ave., Little Falls, NJ 07424 • (973) 890-7300 • Fax: (973) 890-7147
E-mail: support@fdrinnovation.com • sales@fdrinnovation.com • http://www.innovationdp.fdr.com

EUROPEAN OFFICES:	FRANCE 01-49-69-94-02	GERMANY 089-489-0210	NETHERLANDS 036-534-1660	UNITED KINGDOM 0208-905-1266	NORDIC COUNTRIES +31-36-534-1660