Topic: What’s New with the DS8800?

Session # 12040

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bobkern@us.ibm.com
 Agenda

- **DS8800 Overview**
- **Performance -> End to End Focus**
  - zHPF Improvements
  - z/OS DB Exploitation of zHPF + DS8K
  - DS8K Easy Tier
  - zWLM + DS8K I/O Priority Manager
- **Management & Growth**
  - Saving Device Addresses
  - Larger Volumes EAVs
  - HyperPavs
  - Alternate Subchannel Exploitation
- **Business Continuity -> Availability & Disaster Recovery**
  - DS8700/DS8800 Data Replication Technology
    - Eliminating DB2 & IMS Backup Windows
      - zCDP for DB2 (DB2 System Level Backup & Restore)
      - zCDP for IMS
    - GDPS High Availability & D/R Protection
- **Summary**
DS8000 - General Hardware Structure –

Three-Tier Cooperative Processing Architecture

- Host Adapters
- P6 4-way SMP
- Volatile Memory
- Persistent Memory
- LPAR
- Switched Fabric
- RAID Adapters
- Volatile Memory
- Persistent Memory
- LPAR
- RAID Adapters

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IBM DS8800 Disk Storage Subsystem

Up to over 40% increase in performance and almost 90% more drives in same single-frame footprint

System-wide hardware upgrade and IBM POWER Server synergy

- New POWER6+ controller
- New 8Gb/s host and device adapters
- New 2.5" 6Gb/s SAS (SAS-2) drives and drive enclosures

Features / Business Value

- New processors and adapters boost performance with faster access to host servers and disk drives
- New small-form-factor drives offer faster performance, higher availability, lower energy consumption, and allow denser footprint for more effective scalability
- Easy Tier – Dynamic Storage Hierarchy – SDD/FC/SATA
- IBM Storage Common GUI
- Synergy with System z
- Storage Based Data Replication Functionality
- GDPS High Availability & Disaster Recovery

Client Benefits

- System-wide upgrades enable faster performance and higher storage capacity within the same footprint
- Smaller form factor drives offer faster performance, higher availability, smaller footprint, and lower energy consumption

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System Storage and System z  A unique synergy

- **System z and System Storage Synergy Advantages:**
  - Collaborate on architecture and design
  - End to End Focus – Place Function in correct place in HW/SW Stack!
    - System z Hardware/Channel/DS8800
    - DB2/z/OS DFSMS, IOS/zHPF/DS8800
    - zWLM can manage workload end to end
  - Performance, Availability, Management & Growth
  - Conduct early, rigorous and comprehensive stress testing in System z labs for every enterprise storage release. Tests are designed to push the limits of functionality and robustness.
  - Share skilled support resources with enterprise class experience and expertise

- **This helps System Storage and System z development to:**
  - Better design products that work well together with more robust interlocking
  - Bypass potential pitfalls with fixes implemented before customers are ever impacted
  - Implement streamlined, efficient, integrated solution offerings
  - Ensure that products that have passed stringent testing together

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**System z DS8800 Synergy Items**

- FICON Express2 MIDAW
- Support for 64K cylinder 3390s (about 19 3390-3s)
- AMP: Adaptive Multi-stream Prefetching in a Shared Cache *
- Maximum concurrent FICON requests per FICON port
- HyperPAV
- C.U.I.R. (control unit initiated reconfiguration))
- I/O Priority Queuing
- Full FlashCopy compatibility
- GDPS /Global Mirror
- XRC (a.k.a. z/OS Global Mirror)
- z/OS Global Mirror (XRC) write pacing
- z/OS Global Mirror (XRC) suspend rather than long busy
- Dynamic volume expansion *
- z/OS Global Mirror (XRC) multiple reader
- z/OS Global Mirror (XRC) ext. distance FICON
- z/OS M/GM HyperSwap with incremental resync
- z/OS Basic HyperSwap
- 3390s larger than 64K cylinders
Performance
Link Protocol Comparison for a 4KB READ

**FICON**

- OPEN EXCHANGE, PREFIX CMD & DATA
- READ COMMAND
- CMR
- 4K of DATA
- STATUS

**zHPF**

- OPEN EXCHANGE, send a Transport Command IU
- 4K OF DATA
- Send Transport Response IU
- CLOSE EXCHANGE

IU – Information Unit

zHPF provides a more streamlined link protocol than FICON
zHPF Evolution

- Single domain, single track I/O
- Reads, update writes
- Media manager exploitation
- z/OS R8 and above
- Multi-track, but <= 64K
- Multi-track any size
- Extended Distance I

- Format writes
- QSAM/BSAM exploitation
- z/OS R11 and above, EXCP

- DS8100/DS8300 with R4.1 or above
- z10 processor
- z196 processor >64K transfers

100% of DB2 I/O is now converted to zHPF
Typical Client will have 90%+ of all DASD I/O converted to zHPF

Extended Distance II
- EXCPVR support
- ISV Exploitation
- SDM, DFSORT, TPF, etc.

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z/OS Storage Leadership with DS8700/DS8800 R6.2

- High Performance FICON (zHPF) extensions for optimal system performance

- Shorter elapsed times for I/O intensive batch reduces batch window

  - New DS8000 I/O commands optimize QSAM, BPAM, and BSAM access methods for exploiting zHPF
    - Benefits non-extended format sequential and basic and large format sequential data sets
  - I/O service times are improved by up to 30%

- Complete conversion of DB2 I/O to zHPF maximizes resource utilization and performance -> Significant Throughput gains in many areas.

  - Format write throughput increases up to 52% (4K pages)
    - Applies to Load, Reorg writes to shadow, Restores
    - DB2 V8 increase only 30%, DB2 9/10 increase up to 52%.
  - Pre-formatting throughput increases up to 100%
  - Sequential pre-fetch throughput increases up to 19%
  - Dynamic pre-fetch throughput increases up to 23% (40% with SSD)
  - Disorganized index scans yield throughput increases up to 111% on DB2 10 (more with 8K pages)
    - DB2 V9 throughput increases up to 43%
    - Together, DB2 10 and zHPF is up to 11 times faster
    - Synchronous I/O cache hit response time decreases by up to 30%
  - Improvements in cache handling decrease response times
    - Skip sequential index-to-data access improves cache miss processing by 3x to 4x
  - Up to 50% reduction in the number of I/O operations for query and utility functions
    - New DS8700/DS8800 R6.2 Algorithm to handle DB2 List-Prefetch I/O feature with the z114, z196 GA2.
Skip Sequential – Dynamic Pre-fetch

- Data may be accessed in a skip sequential manner
  - Gaps between required sequential pages
    - Dynamic pre-fetch learns into pre-fetch after 5 sequential pages
      - Triggering next pre-fetch quantity
  - What if application does not need pre-fetched pages?

![Diagram showing skip sequential and dynamic pre-fetch](image)
Skip Sequential – DB2 List Pre-fetch

- List-prefetch does not need to learn into sequential access
  - Only those pages required are read into the buffer pool
- zHPF List-Prefetch Support can yield 20x I/O Service Time Reduction compared to cache miss
- z/OS DB2 keeps 2 Read I/O Chains Outstanding at a time each reading 32 DB2 Pages -> 64 DB2 Pages read at any PiT by DS8800.
DB2 Prefetch

- DB2 uses “sequential prefetch” for table scans
- DB2 uses “dynamic prefetch” for...
  - Index scan if the index is organized
  - Index-to-data access if the data pages are sequential
- DB2 uses list prefetch for...
  - Index scan if the index is disorganized (DB2 10 only)
  - Log apply (e.g. Online REORG and RECOVER)
  - Incremental COPY
  - Reading a fragmented LOB
  - RUNSTATS table sampling (DB2 10 only feature)
- zHPF increases sequential prefetch by 19%
- zHPF increases dynamic prefetch by 23%
- With FICON Express 8, zHPF increases list prefetch by 111%
  - FICON Express 8S adds another 16% (145% more than FEx8 FICON)
- With 8S, dynamic prefetch still has 78% more throughput than list prefetch
List prefetch 32x4K pages from cache
FICON Express 8 & 8S

- With FICON Express 8, zHPF increases list prefetch by 111%
- FICON Express 8S adds another 16% (145% more than FEx8 FICON)
DS8800 R6.3 zHPF Enhancements

✓ QSAM, BPAM, BSAM & EXCPVR access methods
✓ All Format Writes across all access methods now zHPF eligible
✓ Ficon Express 8S -> DB2 List PreFetch (QUERY & Utility Functions) – Further Performance improvements.
✓ SETSMS SAM_USE_HPF(YES/NO) – Turn function ON/Off.
DS8700/DS8800 – I/O Priority Manager

Application Level Quality of Service
- Managed by zWLM based on Service Class (QoS) specified.

- Dynamic workload control
- Host Management & DS8800. (I/O Priority & QoS Management controls.)

- Automatic performance adjustment to customer needs

- Customer needs: Applications (Volume/LUN groups) & workload priorities
DS8K Easy Tier


- **More Efficiency (R6.2)**
  - Hybrid storage pools can be created between any two types of storage (SSD, FC, SATA)
    - Mix of FC and SATA for a cost optimized “tier 1.5” system

- **More Flexibility**
  - Automatic data relocation between all 3 storage types (Release 6.2)
    - For customers with sparsely accessed data sets
    - Coldest data migrates to SATA tier
  - Manual mode depopulation of an array or of a tier

- **More Performance**
  - Within a hybrid volume, data is arranged across multiple arrays for optimum performance
  - Release 6.2: Automatic performance rebalance within one tier
    - For customers with a single storage type (i.e. Enterprise disk), RAID hotspots are avoided by balancing hot extents across multiple arrays
IBM Self-Optimizing Storage with Easy Tier

Easy Tier balances performance and cost automatically

- Automatic movement of data to the right disk tier to balance cost and performance
- Continuous rebalancing *within* each tier to maintain peak performance across all drives
- Maximum benefit when Easy Tier extends beyond the disk system
IBM Easy Tier optimizes performance and costs across tiers

- Storage analyzes data I/O patterns and adapts to improve performance
- Makes efficient use of flash technology
- Analytics-based approach to identify data that can be hosted on a lower tier
SSD optimization boosts application performance by 4x

Financial Brokerage Application
(Easy Tier with SSD + HDD)

4x throughput increase with only
10% of a database onto SSD

* Internal IBM Performance benchmark testing
Easy Tier also optimizes within each tier

- Continuous rebalancing keeps performance optimized
3x performance boost for single-tier optimization
And better response times

3X Improvement

OLTP

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1. DS8000 designed to leverage direct attached solid state storage on selected AIX and Linux servers. Easy Tier will manage the solid state storage as a large and low latency cache for the hottest data, while preserving advanced disk functions such as RAID & remote mirroring.

2. API for Middle-ware and ISV programs to provide hints on data usage to Easy Tier.

3. A new high density flash storage module that will accelerate performance to another level with cost-effective, high density, SSD drives.
Lets Review - “I am Running Out of UCBs”

- Alternate Subchannel Set Exploitation
  - 50% reduction in device numbers

- HyperPAV
  - 10x reduction in PAV devices by assign PAV aliases on demand as the work load requires
  - PAV-aliases virtualized across operating system images for more efficient use on addressing constructs

- Extended Addressability Volumes
  - 223 GB Volume & Now 1TB volume Sizes
  - Reduce system resources and overhead with managing fewer resources

- Dynamic Volume Expansion
  - Without copy services intact

- MIDAWs
  - Performance enhancement for using larger datasets

- TDMF and zOSDMC (aka LDMF)
  - Non-disruptively consolidate data on to a single larger volume and consolidate device number ranges

- PPRC Secondary’s in Alt Subchannel Set w/HyperSwap
DS8K R6.2 - Extended Addressability Volumes (EAV)

- DS8700/DS8800 R6.2 (RQ 6785) R6.1.5
  - Support up to Mod 1062 = 1,182,006 Cylinders = 1.004+ TB ($10^{12}$)
  - Prior limit was Mod 236
  - Configurable in increments of
    - Mod1 (1113 Cylinders) on volumes > 65520 cylinders (Mod 58+)
    - One cylinder on volumes with <= 65520 cylinders
  - Includes FlashCopy, PPRC, and XRC support
  - Allows 20x growth in data without the complexity in defining and managing additional devices
  - Provides for significant device number consolidation
  - Supported on z/OS V1R12, V1R13 and above

- Continue Exploitation (z/OS 1.11 – z/OS 1.13)
  - Non-VSAM Extended Format Datasets
  - Sequential Datasets
    - PDS
    - PDSE
    - BDAM
    - BCS/VVDS
    - 1 TB Volume Sizes
  - Dynamic Volume Expansion
    - Not permitted with Copy Services
    - Automatic VTOC and Index Rebuild

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IBM DS8000 HyperPAVs

Background – What are HyperPavs?
- Heritage PAV design designed and implemented for ESCON attachments
  - Relatively static binding of PAV-alias to PAV-base
  - Dynamically PAVs Tunable by zWLM on zWLM interval (5 min. default)
  - Complex rules of thumb for allocating the number of PAV-aliases
  - Many times PAVs are over allocated needlessly
- HyperPAV maintains a shared pool of PAV-aliases
  - PAV-aliases bound to PAV-bases on an I/O request basis dynamically by DS8K on each I/O request
  - Up to 10X increase in efficiency

Benefits
- Reduce number of required aliases
  - Give back addressable device numbers
  - Use additional addresses to
    - support more base addresses
    - larger capacity devices.
- z/OS can react more quickly to I/O loads
  - React instantaneously to situations like ‘market open’ conditions
- Overhead of managing alias exposures reduced
  - WLM not involved in measuring and moving aliases
  - Alias moves not coordinated throughout Sysplex
- Initialization doesn’t require “static” bindings
  - Static bindings not required after swaps
- IO reduction, no longer need to BIND/UNBIND to manage HyperPAV aliases in the DS8000
- Increases I/O Parallelism
- On a HyperSwap, HyperPavs are effective immediately
GDPS Alternate Subchannel Exploitation

- GDPS/PPRC w/HyperSwap, GDPS PPRC HS Manager & TPC-R HyperSwap -> PPRC
  Targets placed in alternate Subchannel Set & Subchannel Set switch occurs on HyperSwap.

- GDPS/XRC
  - Removes restriction that all devices in a GDPS/XRC configuration be defined and identified with unique device addresses.
  - GDPS can bypass checking for unique device addresses
    - Allows duplicate device addresses to be used across SDM systems
    - Increases the number of devices that can be managed in a GDPS/XRC configuration.

- Additional UCB constraint relief provided with
  - Allows the FlashCopy target devices to be defined only in the GDPS Controlling system but not to be defined in the SDM systems.
  - Support for a 'no UCB FlashCopy' where the FlashCopy targets need not be defined to any systems in the GDPS.

- Largest GDPS/MzGM w/HyperSwap environment is now approaching 1.2PB+ of primary data. (4.8pbs total). Largest GDPS/MGM w/HyperSwap customer has 450+TBs Primary Data. (2.25pbs total)
Business Continuity – Availability & Disaster Protection
Tiers of Disaster Recovery
Level Setting GDPS/Active-Active

Failover models can only achieve so much in improving RTO
Storage Based Data Replication Enabling Core Technologies

FlashCopy
- Internal Copy
- Available on:
  - DS6000, DS8000, ESS
  - SAN Volume Controller
  - DS4000, DS400, DS300, XIV

PiT Incremental FlashCopy
- + Metro Mirror
- Available on:
  - DS6000, DS8000, ESS

- Optional background copy
- When copy is complete, relationship between source and target ends

[Diagram showing source, target, read, write, and PIT copies]
FlashCopy Client Scenarios

- FC Targets are a GC Source (Send to remote site)
- zCDP for DB2, zCDP for IMS
- Fast Batch Restart After Batch Failure
- FlashCopies for Backups/Clones etc
  - Consistent FlashCopies
  - Backups -> PiT FlashCopy off MM, GM, zGM Targets
    - Data Freeze MM -> PiT FlashCopy Target Devices
    - Remote Pair FlashCopy
    - Pause GM -> FC target Devices
    - zGM (XRC) Zero Suspend FC
- FlashCopy as an Acceleration Function
  - Fast Defrag
  - DB Utilities
zCDP for DB2 & zCDP for IMS – Eliminate Backup Windows

DB2 & IMS System Level Backup & System Level Restore
- Backup calls HSM with DB Tables, HSM FlashCopy to SMS Copy Pool, then DB Logs.
- DB2 & IMS Maintain Cross Volume Data Consistency. No Quiesce of DB required.

DFSMShsm function that manages Point-in-Time copies
- Combined with DB2 BACKUP SYSTEM, provides non-disruptive backup and recovery to any point in time for DB2 & IMS databases and subsystems (SAP)

★ Recovery at all levels from either disk or tape!
- Entire copy pool, individual volumes and …
- Individual data sets

- Up to 5 copies and 50 Versions of DB2 & IMS Image Copies, managed by MC.
- Automatic Expiration

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Storage Based Data Replication Enabling Core Technologies

- **Metro Mirror**
  - Synchronous mirroring
  - Available on:
    - DS6000, DS8000, ESS
    - SAN Volume Controller
    - DS4000, DS400, DS300,
    - XIV

- **Global Mirror**
  - Asynchronous mirroring
  - Available on:
    - DS6000, DS8000, ESS
    - DS4000, DS5000
    - XIV

- **Metro Global Mirror**
  - Three site synchronous and asynchronous mirroring
  - DS6000, DS8000

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**Diagram:**
- **Primary Site A**
- **Metro Site B**
- **Unlimited Distance**
- **Out of Region Site C**
DS8700/DS8800 System z - Storage Based Data Replication
Enabling CoreTechnologies

- **z/OS Global Mirror (XRC)**
  - Asynchronous mirroring – System z ONLY)
  - Available on DS8000 & ESS

- **z/OS Metro Global Mirror (MzGM)**
  - Asynchronous mirroring – System z ONLY)
  - Available on DS8000

IBM Confidential
IBM HyperSwap Technology: Near Continuous Data Availability

- Designed to provide continuous availability of data for System z
- Facilitated by new PPRC microcode functionality and z/OS® IOS code
- Also now available with AIX (OpenSwap) managed by TPC-R
- HyperSwap™ is:
  - Integration of very fast swapping of PPRC’d disk subsystems with z/OS, System z hardware, and GDPS or TPC-R.
  - Switching to alternate copy of System z data can be accomplished in seconds to minutes.
- Supported on Synchronous PPRC
- HyperSwap Options:
  - z/OS Basic HyperSwap,
  - TPC-R Full Function HyperSwap,
  - GDPS HyperSwap Manager
  - GDPS/PPRC w/HyperSwap Full Function
- Intended Benefits:
  - Designed to offer continuous availability of data
  - Disk Maintenance
  - Site Maintenance
  - Data Migration
  - Disk Failure
  - Site Failure
- Fast and Scalable System z Enterprise Data Center swap: scales to very large configurations
- Repeatable, reliable, confident recovery: No operator interaction,

DS8700/DS8800 R6.2 New Function:
HyperSwap Synergy zOS Resilience (Health Status Message)
Improves detection of when to trigger a HyperSwap. Provides a mechanism for the DS8K to alert the host of specific events that may cause an adverse effect to host operations. These messages indicate to GDPS that action may need to be taken in order to preemptively avoid problems on this controller and to swap to the secondary DS8K.

Link Summary Event Notification
Improves detection and handling of PPRC Suspends. Allows for the DS8K to notify all hosts connected to a single LSS for a PPRC suspend event that spans across multiple volumes in that LSS through a single summary notification mechanism.
IBM DS8000 Feature - Remote Pair FlashCopy
(ex. GDPS/PPRC HS + FlashCopy)

Function: FlashCopy to PPRC Source, send FC command to target instead of all data (Duplex Pending). Maintains HyperSwap being Active.

(Ex. zCDP for DB2 Backups at both Sites w/HyperSwap.)

Scope & Restrictions:
- Full volume and data set level operations
  - IBM Remote Copy FC can be combined with:
    - Incremental FlashCopy
    - Background copy or no background copy
    - Nocopy to copy
    - FlashCopy consistency groups
    - FlashCopy of open devices using a CKD access device

FlashCopy features not supported with Preserve Mirror function:
- Commit, Revert, Fast Reverse Restore
- Space Efficient FlashCopy (Source or Target)

- Local target and remote target cannot be space efficient
- Both PPRC pairs must be Metro Mirror pairs in full duplex
- Withdraw of Preserve Mirror relationship will cause bit to be set for PPRC pair at target indicating not true mirror while still full duplex
- Function will be provided with REQUIRED and PREFERRED options

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Data Replication Management Options

- PPRC Manager (FlashCopy Manager)
- TPC-R
- GDPS/PPRC HyperSwap Manager
- GDPS/PPRC HyperSwap
TPC Replication Manager

- Setup Copy Sessions
- Execute Copy Operations
- Monitor Copy Status
- Manage/Monitor Consistent Groups
- Alert Operations on Exceptions / Failures

- Automated copy services configuration
- Central operations for copy services
- Operational status on copy services operations
- Assistance with recovery on failures

- DS6000, DS8000 support
- Global Mirror Support
- Replication Progression Monitoring
- High Availability
- Disaster Recovery Automation (failover, failback)
GDPS Solutions

There are multiple GDPS service products under the GDPS solution umbrella to meet various customer requirements for Availability and Disaster Recovery.

**GDPS/PPRC HM**
- Continuous Availability of Data within a Data Center
- Single Data Center
- Applications remain active
- Continuous access to data in the event of a storage subsystem outage
- RPO=0 & RTO=0

**GDPS/PPRC**
- Continuous Availability / Disaster Recovery within a Metropolitan Region
- Multi-site workloads can withstand site and/or storage failures
- A/S RPO=0 & RTO<1 hr or A/A RPO=0 & RTO mins

**GDPS/GM & GDPS/XRC**
- Disaster Recovery at Extended Distance
- Two Data Centers
- Rapid Systems Disaster Recovery with “seconds” of Data Loss
- Disaster recovery for out of region interruptions
- RPO secs & RTO <1 hr

**GDPS/MGM & GDPS/MzGM**
- Continuous Availability Regionally and Disaster Recovery Extended Distance
- Three Data Centers
- High availability for site disasters
- Disaster recovery for regional disasters
- A/S RPO=0 & RTO<1 hr or A/A RPO=0 & RTO mins and RPO secs & RTO <1 hr

**GDPS/Active-Active**
- Continuous Availability, Disaster Recovery, and Cross-site Workload Balancing at Extended Distance
- Two or More Data Centers
- All sites active
- RPO secs & RTO secs

**Components**
- **Tivoli** – NV, SAz
  - STG – System z, DS8K, PPRC
  - GTS – GDPS code, Services
- **Tivoli** – NV, SAz, SA MP, AppMan
  - STG – System z, DS8K, PPRC, VTS
  - GTS – GDPS code, Services
- **Tivoli** – NV, SAz
  - STG – System z, DS8K, GM, XRC
  - GTS – GDPS control, Services
- **Tivoli** – NV, SAz
  - STG – System z, DS8K, MGM, MzGM
  - GTS – GDPS code, Services
- **Tivoli** – NV, SAz
  - AIM – Multi-site Workload Lifeline
  - IM – DB2 & IMS replication
  - STG – System z, DS8K, GC
  - GTS – GDPS code, Services

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z/OS GDPS Active/Standby at Distance

- Active/Standby Sites is positioned as the next generation of GDPS
- Sites separated by unlimited distances, running same applications and having the same data to provide cross-site Workload Balancing and Continuous Availability / Disaster Recovery
- Customer data at geographically dispersed sites kept in sync via replication
- Configurations: Active/Standby, Active/Query (SOD)

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<th>GDPS/XRC or GDPS/GM</th>
<th>Active/StandBy (Appl FO/FB)</th>
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<tr>
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<td>Failover Model</td>
<td>Near CA model</td>
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<td>Recovery Time ≈ 2 min</td>
<td>Recovery Time &lt; 1 hour</td>
<td>Recovery time &lt; 1 minute</td>
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<td>Distance &lt; 20 km</td>
<td>Unlimited distance</td>
<td>Unlimited distance</td>
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<td>DB2 &amp; IMS Data</td>
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z/OS + DS8700/DS8800 Synergy Summary
Distributed Systems and DS8000 Synergy Items

- Pre-Deposit Write (Copy Services one protocol exchange & Keeps Pipe Full)
- Caching Algorithms – AMP, ARC, WOW, 4K Cache Blocking
- Easy Tier
- I/O Priority Manager

- HyperSwap (AIX)
- GDPS x/DR, GDPS DCM
- Power HA p, Power HA i
- Remote Pair FlashCopy & Enhancements
- FlashCopy & Functions like Fast Reverse Restore

- Dynamic Volume Expansion
- Thin Provisioning
- Space Efficient FlashCopy
- z/OS Distributed Data Backup
- Disk Encryption

Performance

Availability

Management/Growth
z/OS and DS8000 Synergy Items

- zHPF Enhancements (now includes all z/OS DB2 I/O)
- Extended Distance FICON
- Caching Algorithms – AMP, ARC, WOW, 4K Cache Blocking
- DFSMS Recognition of SSDs
- Easy Tier
- z/OS GM Multiple Reader Support
- SSDs + DFSMS + zHPF + HyperPAV + DB2
- I/O Priority over Ficon & within DS8K managed by zWLM Service Class
- zWLM + DS8K I/O Priority Manager

- HyperPAV
- GDPS & GDOC Automation
- GDPS/Active/Standby
- HyperSwap Technology Improvements
- Remote Pair FlashCopy & Enhancements
- zCDP for DB2, zCDP for IMS – Eliminating Backup Windows

- 1 TB EAVs
- Quick Init for CKD Volumes
- Dynamic Volume Expansion
- Space Efficient FlashCopy
- z/OS Distributed Data Backup
- System z Discovery & Automatic Configuration (zDAC)
- Alt Subchannel Exploitation
- Disk Encryption

Performance

Availability

Management/Growth
Additional Information, References, Disclaimers and Trademarks etc.
References

- TechDocs White Paper: IBM Handbook on Using DS8000 Data Replication for Data Migration -
  http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101716

- TechDocs White Paper: IBM z/OS Multi-Site Business Continuity
  http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101635

- TechDocs White Paper: IBM DS8800 Data Consolidation
  http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP102100

- TechDocs White Paper: IBM HyperSwap Technology April 2010

- TechDocs White Paper: IBM System z and DS8000 z/OS Synergy

- Title: IBM z/OS Data Corruption Trends & Directions
  http://www.ibm.com/support/techdocs/atsmastr.nsf/WebIndex/WP101804

- Redpaper: IBM Storage Infrastructure for Business Continuity

- Redpaper: IBM System Storage DS8700 Easy Tier

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Additional Information

- **Web sites:**
  - GDPS: [www.ibm.com/systems/z/gdps](http://www.ibm.com/systems/z/gdps)
  - Parallel Sysplex: [www.ibm.com/systems/z/pso](http://www.ibm.com/systems/z/pso)
  - Bus Resiliency z: [www.ibm.com/systems/z/resiliency](http://www.ibm.com/systems/z/resiliency)
  - System z: [www.ibm.com/systems/z/hardware](http://www.ibm.com/systems/z/hardware)
  - Storage: [www.ibm.com/systems/storage](http://www.ibm.com/systems/storage)

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  - GDPS Family: An Introduction to Concepts and Capabilities

- **GDPS Web Site White Papers and Presentations**
  - GDPS: The Ultimate e-business Availability Solution
  - IBM Implementation Services for GDPS/Global Mirror
  - GDPS Business Continuity Solutions
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