

Unlocking the power of z/OS HyperSwap for High Availability of Storage

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z/OS HyperSwap

Keeping data highly available.

Protecting against disasters.

Agenda

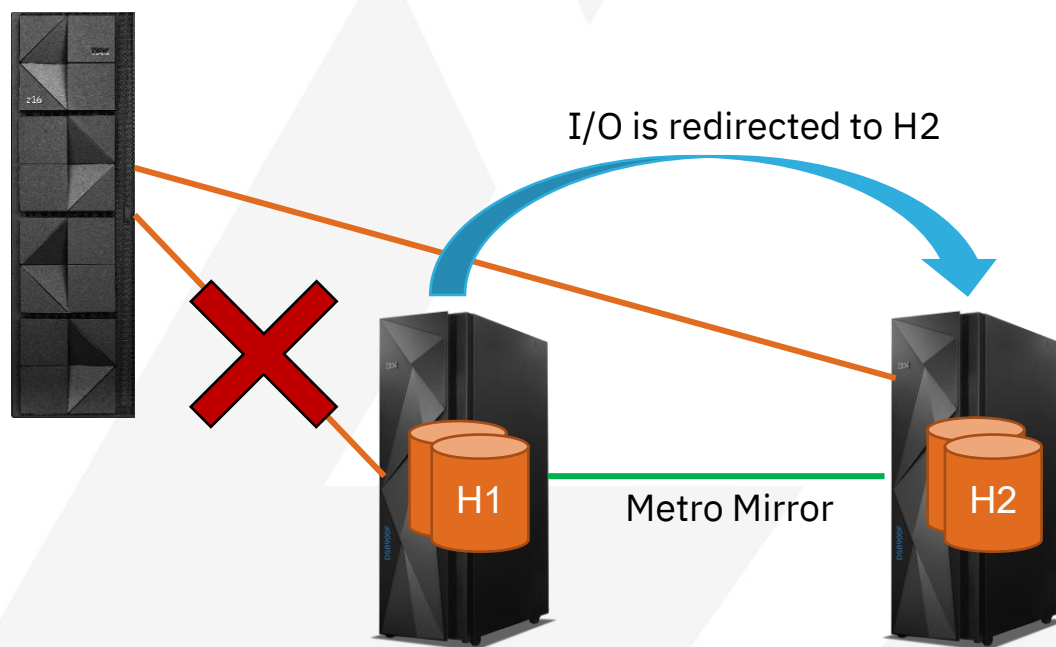
- What is z/OS HyperSwap
- Suggested considerations
 - HyperSwap specific considerations
 - General IOS recovery setting considerations
- Other HyperSwap Use Cases
- Current Focus and the future



What is z/OS HyperSwap

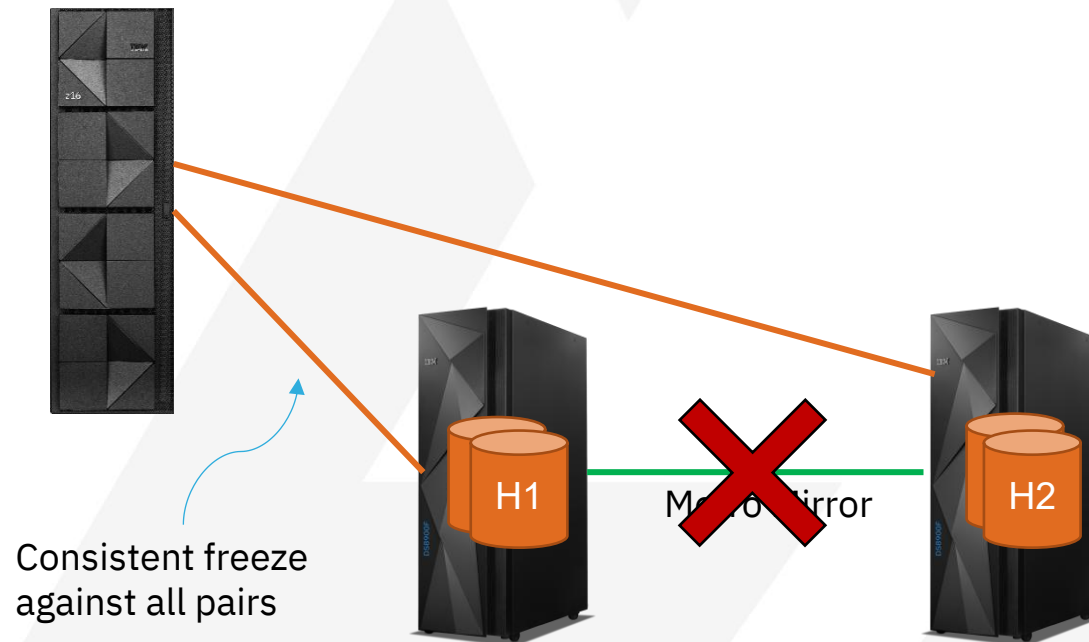
z/OS HyperSwap – What it Does

- Provides HA capabilities – High Availability
 - Extension to Sysplex capabilities, and runs within one Sysplex
 - Allows swapping to Metro Mirror (Synchronous PPRC) secondary devices
 - Swapping is transparent to applications running on the Sysplex



z/OS HyperSwap – What it Does

- Provides DR capabilities – Disaster Recovery
 - Performs consistent freeze of MM pairs to create time consistency on secondary devices
 - In a rolling disaster if a PPRC mirroring suspension occurs followed by a loss of primary devices, the consistent freeze allows recovery from the MM secondary devices



- Used in HyperSwap configurations, or in Metro Mirror Configurations using Hardened Freeze.
 - Note the Basic HyperSwap session type available in no-charge license of CSM is only HA capable, and does not support Disaster Recovery.

z/OS HyperSwap – Interaction with CSM

- IBM Copy Services Manager controls copy services in storage environments
 - Can run on z/OS, on Linux, Windows, DS8000 HMC and other platforms
- z/OS HyperSwap capability is built upon the CSM Metro Mirror session types and its variants

View / Modify Properties for session mm

Session Options **H1-H2 Options**

Metro Mirror Options:

Metro Mirror Suspend Policy:

Hold I/O after Suspend

Release I/O after Suspend

z/OS Management:

System or sysplex

LOCAL

Enable Hardened Freeze

Enable Hardware Reserves

Manage H1-H2 with HyperSwap

Disable HyperSwap

Reset In Use By System on Secondary Volumes

Unbox Secondary Volumes

On Planned HyperSwap Error:

Partition out the failing systems and continue HyperSwap processing on the remaining system

Disable HyperSwap after attempting backout

On Unplanned HyperSwap Error:

Partition out the failing systems and continue HyperSwap processing on the remaining system

Disable HyperSwap after attempting backout

OK Cancel

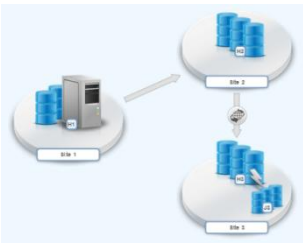
HyperSwap Session Types



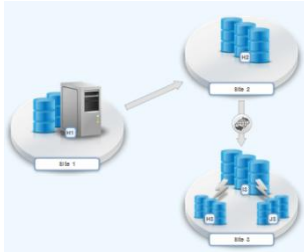
Metro Mirror

} 2 Site

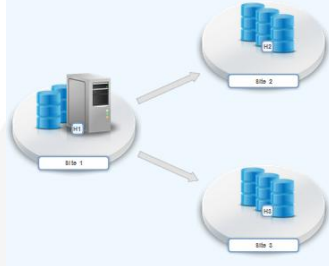
Metro Global Mirror



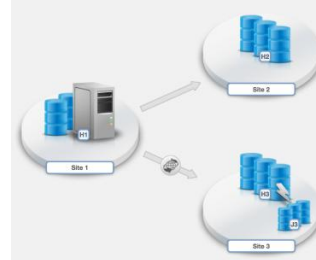
Metro Global Mirror w/Practice



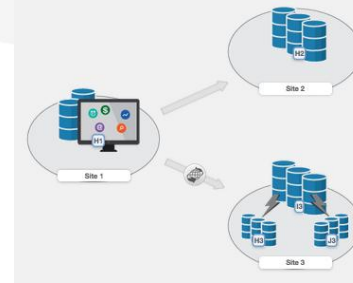
Multi-Target MM-MM Configuration



Multi-Target MM-GM Configuration

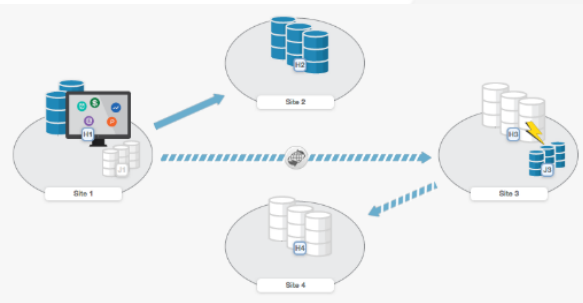


Multi-Target MM-GM w/ Practice Configuration

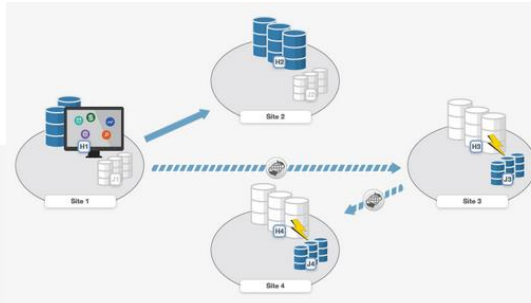


} 3 Site. Uses either multi-target, or cascaded relationships

Multi-Target MM-GM 4 Site Replication



4 Site Replication Enhanced



} 4 Site. Uses Multi Target MM-GM with cascaded GC replication to 4th site



What this means to you

z/OS HyperSwap - Why it is needed

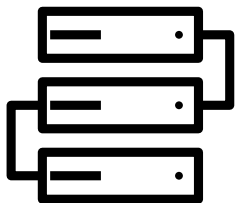
Unplanned HyperSwap

- Protects against failures of primary disk storage
- Protects against loss of pathing from host to disk storage
 - FICON director failure, severed fibre cables, etc

Planned HyperSwap

- Useful to swap away from controller for change activity:
 - Perform a service upgrade of a DS8000
 - Significant change to I/O configuration for the primary controller
- This allows the changes to be made non-disruptively

Value of HyperSwap



Understand the cost of an outage

- There could be fines or client satisfaction issues if certain applications are inaccessible for a period of time

Protection against unplanned storage disruptions can be viewed as an insurance policy

- Hopefully you will never have to use it for non-planned activity



Need for High Availability

- Provide for continuous application processing in the event of an unplanned outage, such as server failure.

Need to recover from disasters

- Ranging from nature, to deliberate attacks, to human error

z/OS HyperSwap - Getting Started

Best Practices for DS8000 and z/OS HyperSwap with Copy Services Manager:

Updated for IBM DS8000 Release 10.1

<https://www.redbooks.ibm.com/redpieces/abstracts/sg248431.html>



High level, what you need:

- CSM (Copy Services Manager), either on z/OS or on an external server such as Windows, Linux, or DS8000 HMC
 - If external, TCP/IP communication is used, with AT/TLS encryption
- Primary and secondary storage controllers at metro distance, and cabled for PPRC (Metro Mirror)
- Two address spaces running on every system in the Sysplex (HSIB and HSAPI)
 - The z/OS code is part of the I/O Supervisor component, built into the base control program of z/OS



Suggested Considerations



CSM and HyperSwap Considerations

Monitoring a HyperSwap Configuration

Messages to look out for

Consider automating on messages to alert team of events that may require attention:

- Start of a HyperSwap event:
 - IOSHM0400I <timestamp> HyperSwap requested
- HyperSwap going disabled, or enabled with limited capability
 - *IOSHM0803E HyperSwap enabled with limited capability
 - *IOSHM0803E HyperSwap Disabled

Messages to look out for

Consider having automation periodically issue a display command to ensure HyperSwap is enabled

```
D HS, STATUS
IOSHM0303I HyperSwap Status 002
Number of configurations: 1
Replication Session: MigrationSwapH1H2
Socket Port: 14000
HyperSwap enabled
Swap Highest Priority: No
Disallow Non-MultiTarget System: No
Hardware Reserve Support: Enabled
New member configuration load failed: Disable
Planned swap recovery: Disable
Unplanned swap recovery: Partition
FreezeAll: Yes
Stop: No
```

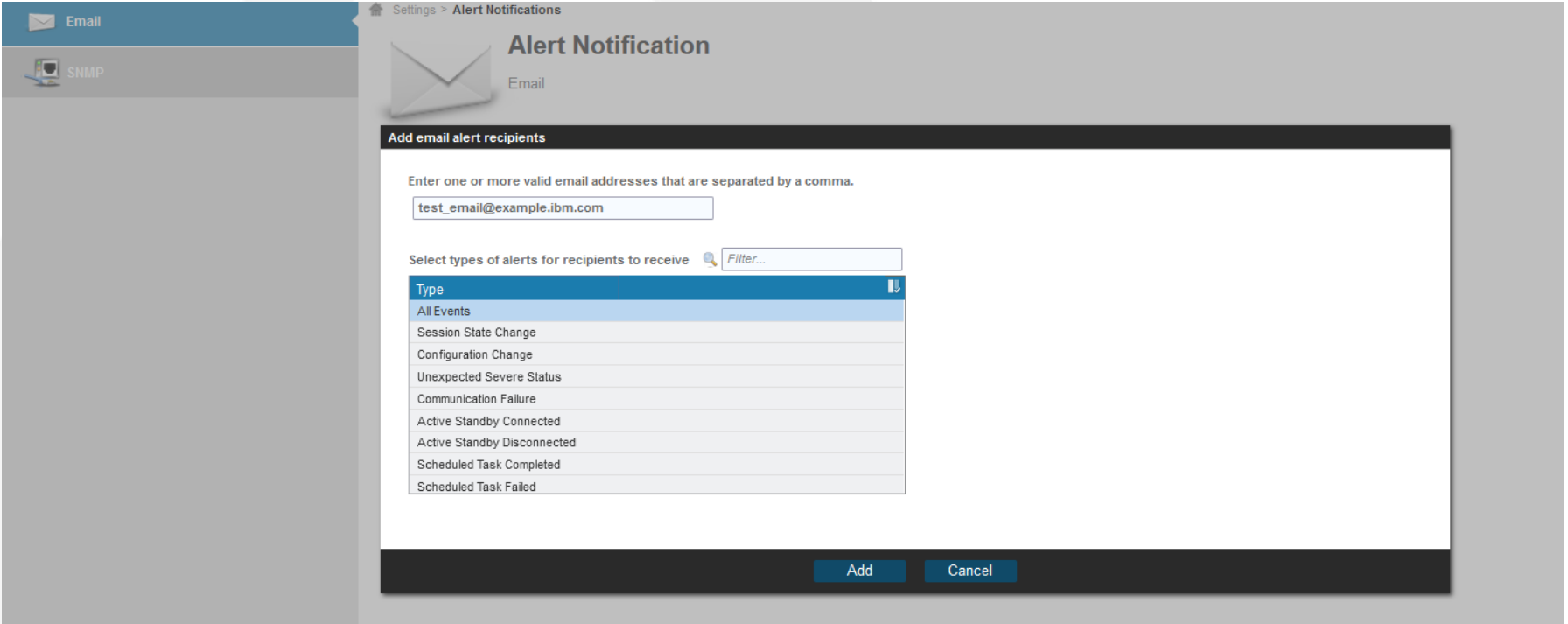
Verify the text does not show:
HyperSwap enabled with
limited capability
or
HyperSwap Disabled

CSM Alerting

CSM can notify users via email notifications or SNMP traps

Consider setting these up to notify your team of potential problems and unexpected events

Note: an unplanned HyperSwap event would be seen by the session transitioning states



Settings > Alert Notifications

Alert Notification

Email

Add email alert recipients

Enter one or more valid email addresses that are separated by a comma.

Select types of alerts for recipients to receive

Type
All Events
Session State Change
Configuration Change
Unexpected Severe Status
Communication Failure
Active Standby Connected
Active Standby Disconnected
Scheduled Task Completed
Scheduled Task Failed

Testing HyperSwap

Testing HyperSwap

Test Planned HyperSwap:
SETHS SWAP

Test Unplanned HyperSwap:
SETIOS HYPERSWAP

Suggestion: Test while CSM is down to show that z/OS can perform the HyperSwap actions without communication to CSM

Testing PPRC Suspension

- Prior to z/OS 3.1:
 - TSO command CGROUP with the FREEZE parameter can be used:
`CGROUP DEVN(X'0F40') PRIM(X'6060' 62019) SEC(X'6061' 68006) FREEZE`
- Starting with z/OS 3.1:
 - If using a single target config:
 - `SETIOS HYPERSWAP,FREEZE`
 - If in a multi-target HyperSwap environment:
 - `SETIOS HYPERSWAP,FREEZE,CONFIG=MYCONFIGH1H2`
 - This command is safer than the CGROUP option: it validates the HS config is loaded and PPRC is in the correct state before issuing the freeze

Either method will raise an Extended Long Busy condition on the PPRC primary device, as well as suspend PPRC. This allows z/OS HyperSwap to perform the consistent suspend.

```
IOSHM0308I PPRC suspension detected for replication session MYCONFIGH1H2
FreezeAll and Run completed. Reason: 0000
```

HyperSwap Environment and Operational Considerations

HyperSwap Control System

- HyperSwap actions are Sysplex in scope
- One system is the HyperSwap Controlling System, which facilitates activities among all other systems.
 - In most cases it should not matter
- Some messages are issued only on the controlling system (e.g. HyperSwap requested, etc), so you can usually infer from operlog which system it is.
 - e.g. the following are examples of messages that only are issued on the control system

```
IOSHM0803E HyperSwap Disabled
IOSHM0400I 20:38:02.05 HyperSwap requested
```

Undocumented command F HSIB,D also tells you which system is the Control System

```
F HSIB,D
IOSHMOPR Control System = SYS1
IOSHM0424I Global Status = 00000000 00000000 0000000A00000000
IOSHMOPR System=SYS1 Status=00000000
IOSHMOPR System=SYS2 Status=00000000
```

HyperSwap Control System

- z/OS prioritizes the HS control system as follows:
 - Most capable system
 - For example, if system A has no paths to a secondary device but system B is fully capable for HyperSwap, then system B will automatically be the HS control system
 - Highest functional level
 - If different members of the Sysplex have different code levels, depending on the levels, the most up to date one may be prioritized as the HS control system
 - Otherwise if all else is equal, the first system with HSIB started wins
- Example: One member of Sysplex is underpowered
 - Recommendation: Avoid this type of setup, because an underpowered system could be a bottleneck in performing HyperSwap steps
 - If this configuration is necessary, consider verifying that system is not the HS control system
 - Start HSIB on all other systems before starting it on this system
 - Use command F HSIB,D to verify which system is the HS Control system

Service fixcats

- We recommend in general to stay up to date on IOS and DFSMS service.
 - All HyperSwap related fixes are in IBM.Function.HyperSwap
 - z/OS fixes related to DS8K: IBM.Device.Disk.DS8000-2107
 - Check for service SMP/E by using REPORT MISSINGFIX against that fixcat

When things go wrong

Collecting documentation

For z/OS:

- Collect console dumps including IOSAS, HSIB, and HSAPI, preferably on all systems

```
DUMP COMM=(Dump title)
```

```
R xx, JOBNAME=(IOSAS, HSIB, HSAPI), CONT
```

```
R xx, SDATA=(ALLNUC, PSA, CSA, GRSQ, LPA, LSQA, RGN, SQA, SUM, SWA, TRT), END
```

- Collect SYSLOG or OPERLOG
- Collect either raw LOGREC buffers, or formatted detailed EREP with type=CHOSXIE

For CSM:

- Gather Diagnostic Package File
 - Settings->Advanced Tools->Package Log Files->Create

Other Diagnosis

- Debugging: Errors in CSM for Device Not Found
 - IWN5401E No NED was found for the target volume DS8000:2107.FPG11:VOL:8F01. Finding the target NED failed with return code 920
- Common error codes:
 - 901 – LSS not Found
 - 905 – UCB not found
 - 920 – IOSCDR error
 - 925 – No paths to volume
- Diagnosis:
 - For your configuration, identify what the z/OS device number should be. z/OS command `DS QD,SSID=ssss` can help with this if it is not known
 - Use commands `D M=DEV(ddd)` to verify the configuration data IOS has saved matches what is expected
 - Use command `DS P,ddd` to verify paths are accessible to the device
 - Use command `DS QD,ddd,SSSCB` to verify the SSSCB exists for this device (this is a DFSMS control block that IOS needs to locate the device)
 - If not, try commands `DS QD,SSID=ssss,DELETE` followed by `DS QD,SSID=ssss,VALIDATE`

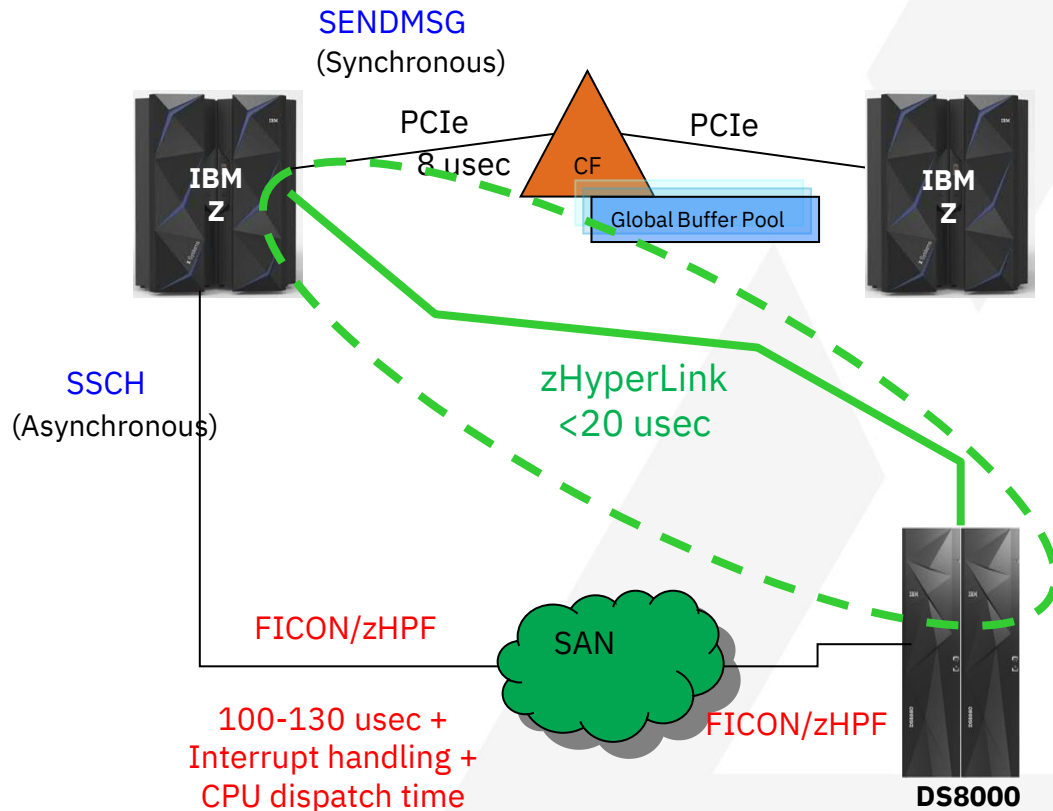


Technologies to Consider

zHyperLink

zHyperLink

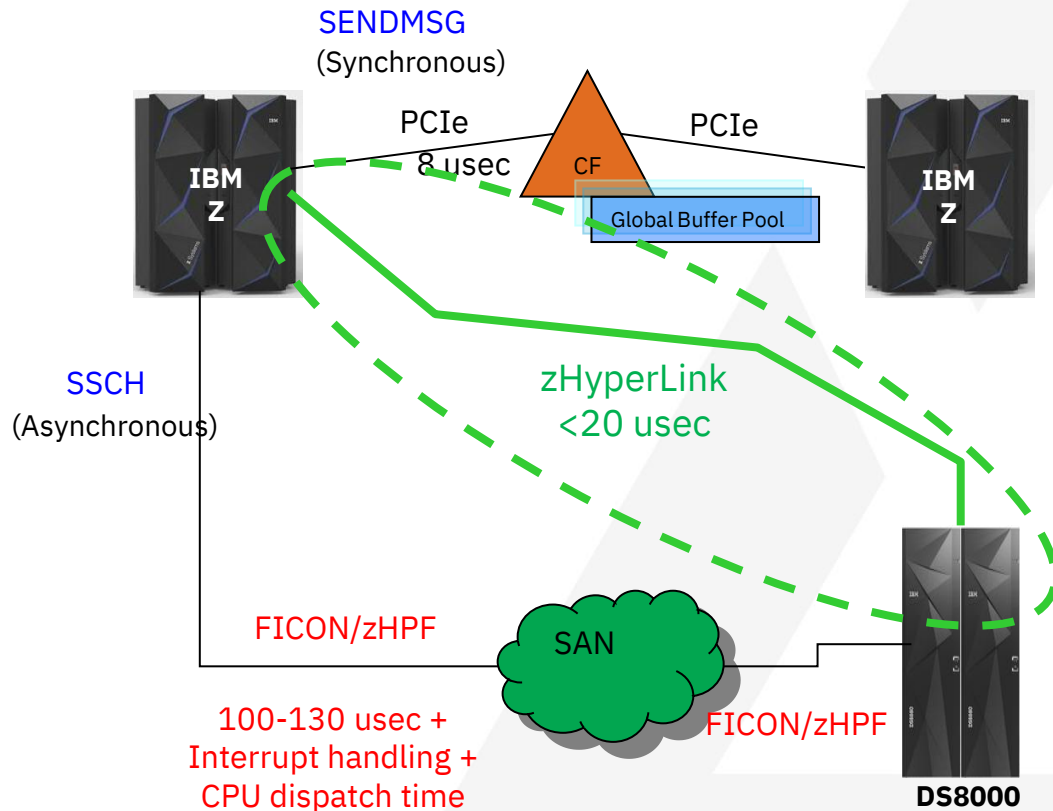
Direct connect short distance IBM Z I/O feature designed to work in conjunction with a FICON or High Performance FICON SAN infrastructure.



- FAST enough that the CPU can just wait for the data
 - No un-dispatch of the running task
 - No I/O interrupt delay
 - No CPU Queuing Delays to resume the I/O
 - No host CPU cache disruption
 - Very small I/O Service time
- Operating System and Middleware (e.g. DB2) keep running over an I/O rather than giving up control
- Transparently gives DB2 and VSAM applications fundamentally better latency than applications on platforms without zHyperLink (excludes 100% in-memory databases)

zHyperLink

Interested in learning more about zHyperLink?



zBNA (IBM Z Batch Network Analyzer) can be used to estimate the benefit of zHyperLink and show top data set candidate lists

- Customers:
<https://www.ibm.com/support/pages/node/6354321>
- Business Partners:
<https://www.ibm.com/partnerworld/techdocs/prs5133>
- IBMers:
<https://supportcontent.ibm.com/support/pages/node/6354319>

Redbook: [Getting Started with IBM zHyperLink for z/OS](#)

Consistent Read from Secondary

Consistent Read from Metro Mirror Secondary

For environments with HyperSwap, with secondary storage kilometers away from the processor

Without CRS:

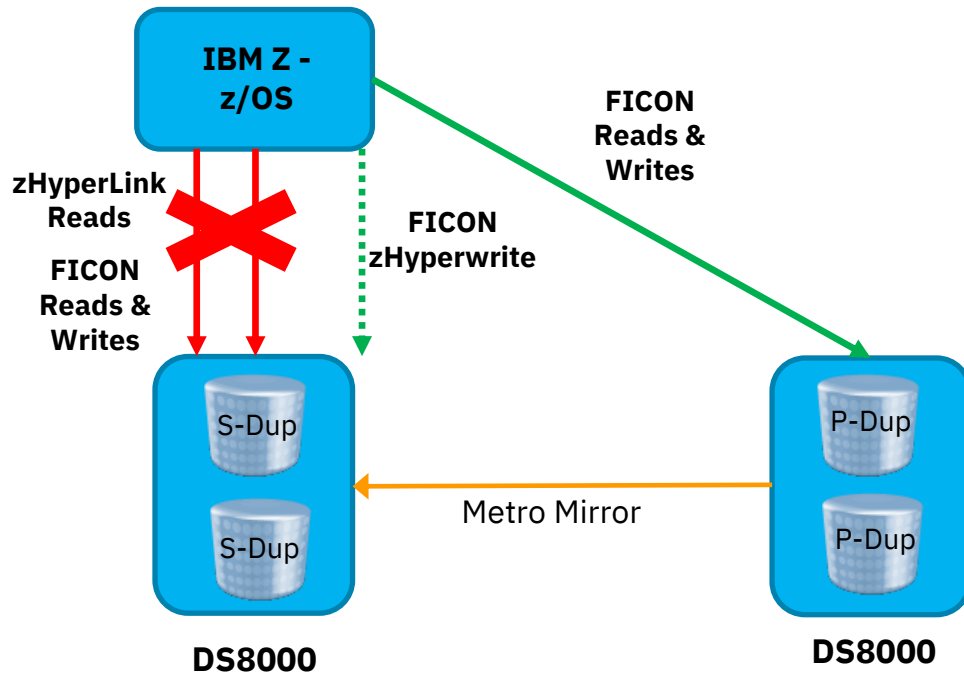
- Without CRS: Lose the benefit of zHyperLink, and asynchronous reads may have to travel over distance to the primary
- May cause performance objectives and SLAs to be missed

CRS: Improve read performance in a metro-mirror environment for eligible data sets for the following environments:

- For single site environment where the primary DASD is close to the processor and the secondary DASD is significantly distanced from the primary, and a swap event occurs
- For multiple site environment where there are one or more processors in both sites, some in the site with the primary DASD and some in the site with the secondary DASD
Only processors at the primary site have local access to DASD and zHL read capability.

With Consistent Read From Secondary, eligible reads can be satisfied from the local secondary copy of the data and zHyperLink read will be supported

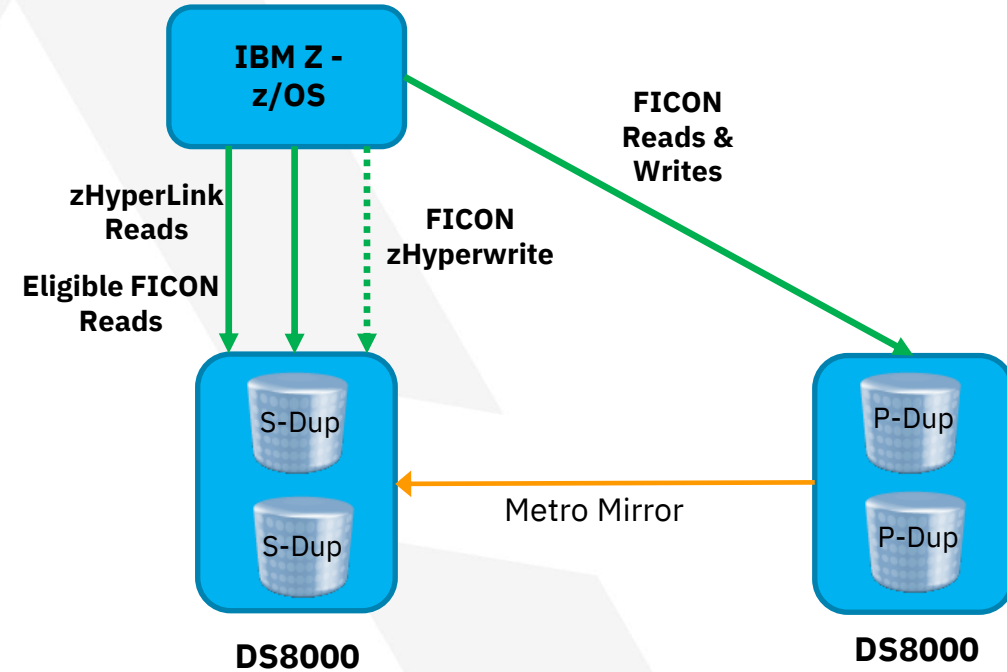
Consistent Read from Metro Mirror Secondary Single Site Workload



Without Consistent Read

Single Site workload means all systems benefit from local reads and zHyperLink I/O in normal operation.

but not following a HyperSwap.

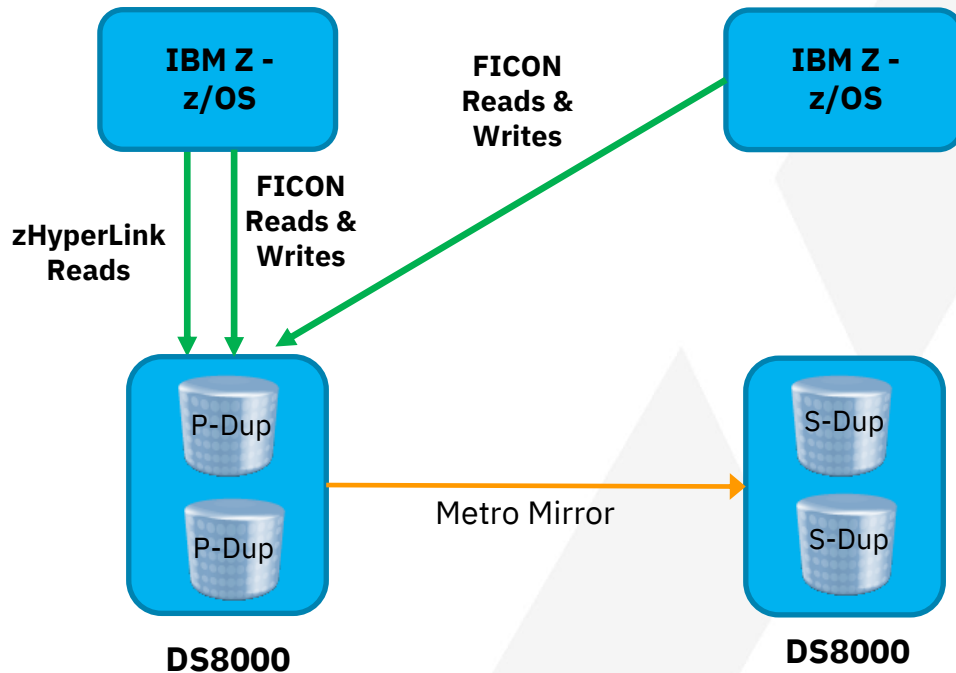


With Consistent Read

Even after a hyperswap, zHyperLink and FICON reads can be performed on the secondary devices.

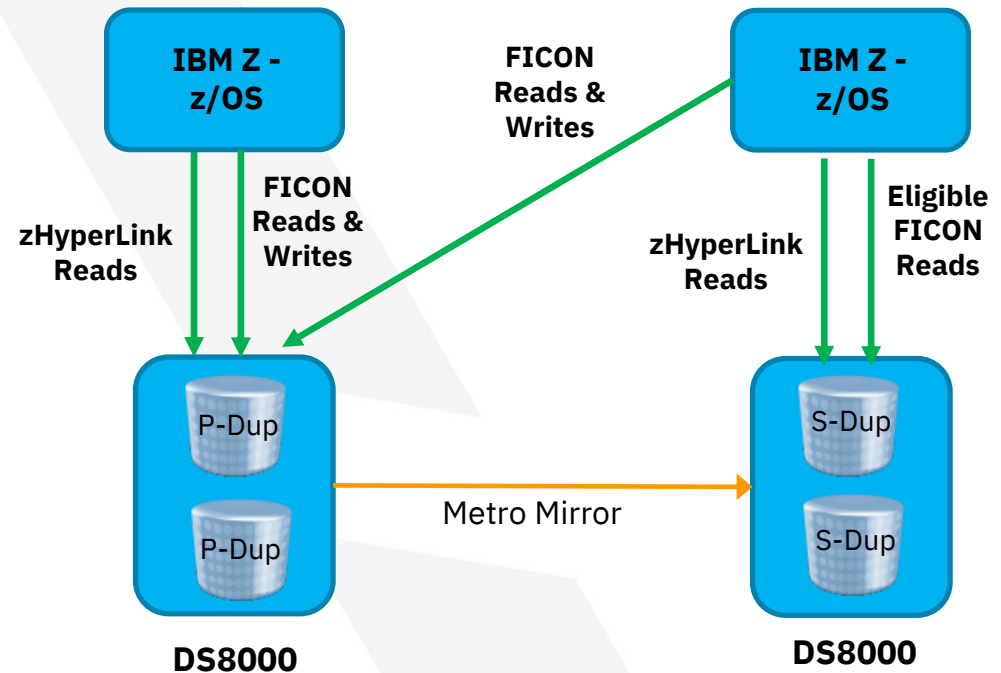
* Eligible reads – bypass extent checking requested

Consistent Read from Metro Mirror Secondary Multi-Site Workload



Without Consistent Read

Multi Site workload results in some systems performing cross-site IO and not benefiting from zHyperLink reads in normal operation



With Consistent Read

zHyperLink and FICON reads can be performed to the local disk (primary or secondary) regardless of which DASD is the primary.



I/O Recovery Settings

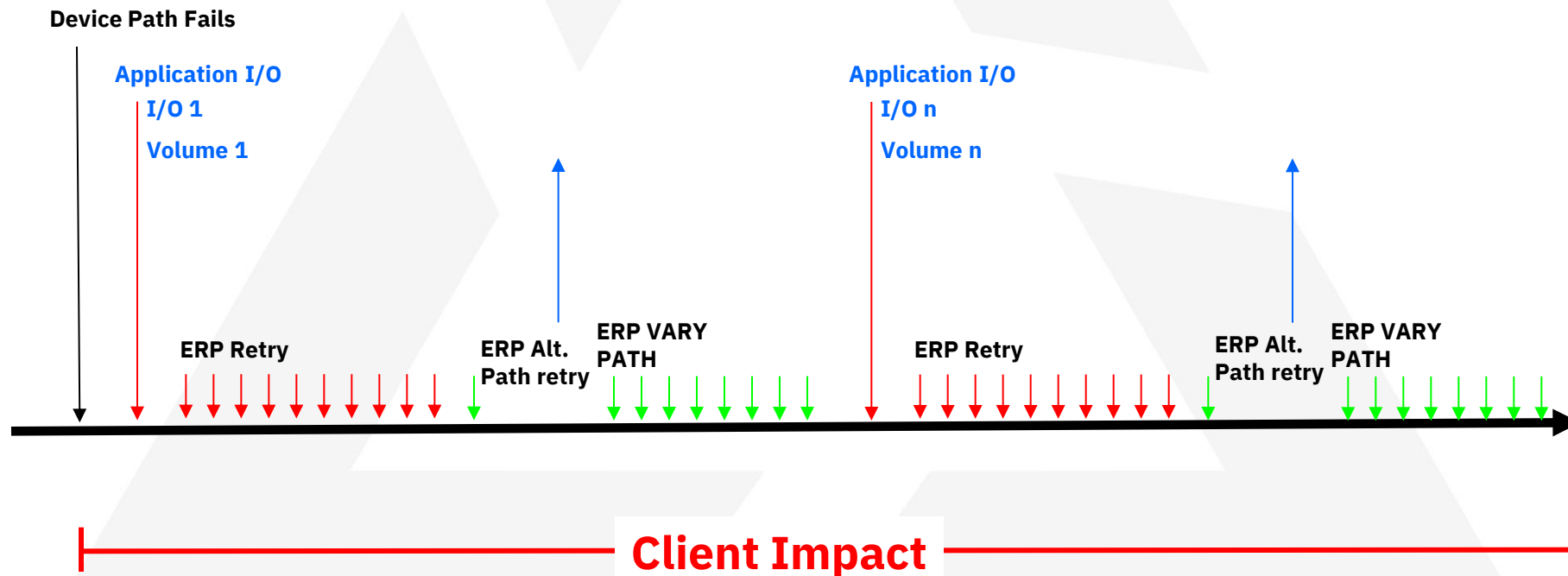
Improved Channel Path Recovery

Improved Channel Recovery

- "PATH_SCOPE=CU" recovery
- Improves system resilience for H/W errors
- It is often better to take a "sick but not dead" path offline sooner rather than later
 - IOS recovery delays application I/O even when there are other paths
- In particular:
 - IFCC and other path error thresholds
 - Proactively removing a path from all devices in an LCU
 - IOS can also identify the detecting component in IOS05xI messages, to help with problem determination
- DASD and tape only

I/O Recovery for Failing Path - Using default settings

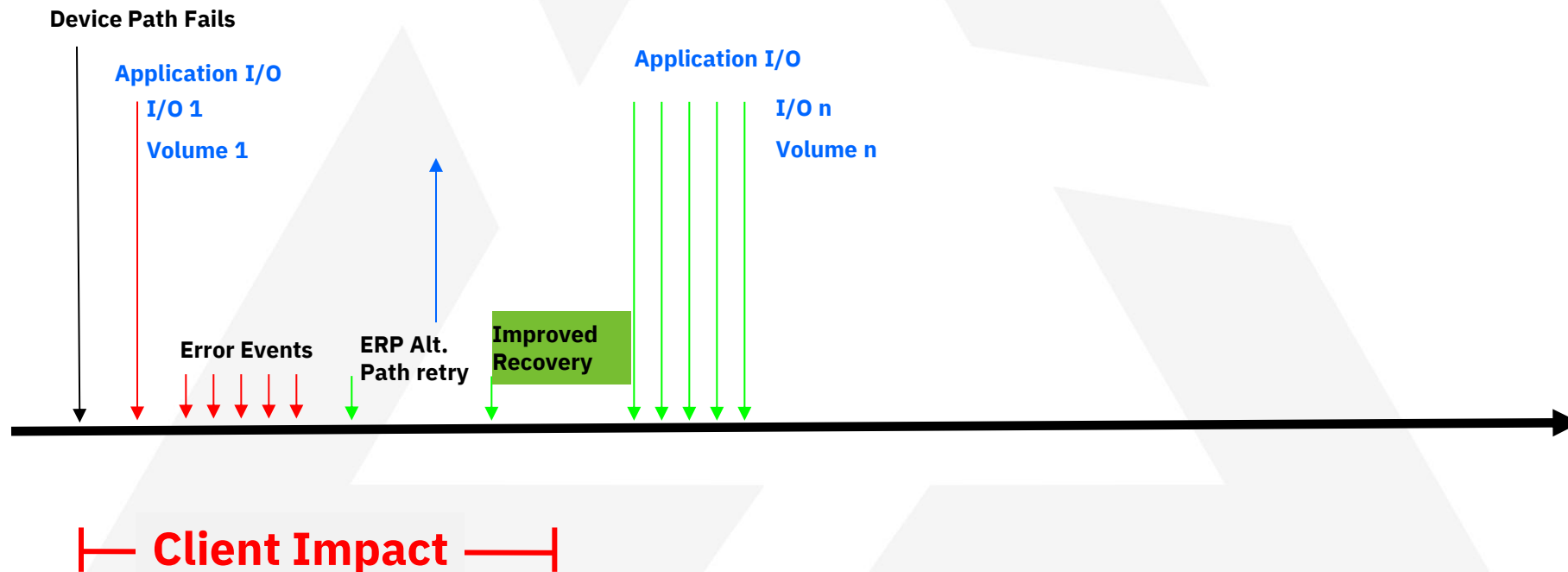
- Example of one bad path affecting a range of devices



I/O Recovery for Failing Path - Using Improved Channel Recovery

- Example of one bad path affecting a range of devices - significant improvement with ICR enabled

Improved channel path recovery can take path off to entire Logical Control Unit, allowing subsequent I/Os to use other paths



Improved Channel Recovery

- IECIOSxx parmlib and SETIOS commands to enable the function:

```
RECOVERY,PATH_SCOPE={DEVICE|CU}
                PATH_INTERVAL=nn
                PATH_THRESHOLD=nnn
```

- Display IOS command to display the status:

```
D IOS,RECOVERY
IOS103I hh.mm.ss RECOVERY OPTIONS
LIMITED RECOVERY FUNCTION IS DISABLED
PATH RECOVERY SCOPE IS BY CU
PATH RECOVERY INTERVAL IS nn MINUTES
PATH RECOVERY THRESHOLD IS nnn ERRORS
```

Default is scope of device.
Changing this to Control Unit
will take full advantage of ICR

Improved Channel Recovery

- IFCC Thresholding
 - Remove path for intermittent errors
 - Remove the path from all devices in the LCU
 - ERP path related error monitoring

```
IOS050I CHANNEL DETECTED ERROR ON dddd,yy,op,stat,  
PCHID=pppp
```

```
IOS210I PATH RECOVERY INITIATED FOR PATH pp ON CU cccc,  
REASON=PATH ERROR THRESHOLD REACHED
```

Improved Channel Recovery - Suggestion

- Typical fabric errors will occur in bursts
 - Installations may opt to be more pro-active in terms of how quickly to remove a path from a control unit.
- If the desired outcome is to be more pro-active, consider using PATH_SCOPE=CU with more aggressive PATH_INTERVAL & PATH_THRESHOLD values than the default.

```
RECOVERY, PATH_SCOPE=CU, PATH_INTERVAL=1,  
PATH_THRESHOLD=[3-10]
```

- For this option the path will be removed if there are enough errors in a 1 minute interval to reach the specified PATH_THRESHOLD
- Note: This RECOVERY function will NOT remove a path from a particular device on the given control unit if this is the last path to the device, regardless of whether the device is allocated or not.

Improved Channel Recovery

- Proactively Removing Paths –
 - PATH_SCOPE=CU recovery also takes effect to remove path from entire LCU for:
 - DPS Validation Error

```
IOS051I INTERFACE TIMEOUT DETECTED ON ON dddd,yy,op,stat, PCHID=pppp
IOS071I dddd,cc,jjjjjjjj, START PENDING
```

```
IOS450E dddd, cc NOT OPERATIONAL PATH TAKEN OFFLINE
```

```
IOS210I PATH RECOVERY INITIATED FOR PATH pp ON CU cccc,
REASON=DYNAMIC PATHING ERROR
```

```
IOS001E dddd,INOPERATIVE PATHS pp pp pp
```

```
IOS2001I dddd,INOPERATIVE PATHS
```

```
STATUS FOR PATH(S) pp,pp,pp....
```

```
LOGICAL PATH IS REMOVED OR NOT ESTABLISHED (A0)
```

```
LINK RECOVERY THRESHOLD EXCEEDED FOR LOGICAL PATH (06)
```

```
IOS210I PATH RECOVERY INITIATED FOR PATH pp ON CU cccc,
REASON=LINK THRESHOLD EXCEEDED
```

Improved Channel Recovery

- D M=DEV(devno,chp) will display offline reasons

```

D M=DEV(410,(48))
IEE174I hh.mm.ss DISPLAY M idr
  DEVICE 0410      STATUS=ONLINE
  CHP              48
  ENTRY LINK ADDRESS  22
  DEST LINK ADDRESS  E0
  PATH ONLINE        N
  CHP PHYSICALLY ONLINE Y

      . . .

PATH OFFLINE DUE TO THE FOLLOWING REASON(S) ]
      [PATH RECOVERY ERROR]
      [BY OPERATOR]
      [CONTROL UNIT INITIATED RECOVERY]
      [CONFIGURATION MANAGER]
  
```

Limited Recovery Time

Limited Recovery Time

Problem

- Missing interrupt condition or interface timeout (e.g., IOS051I) causes z/OS to validate the channel path
- Validation consists of issuing an I/O to test each path
- Bad paths can encounter elongated recovery times
 - I/O timeout is 15 seconds + 2 retries are performed = 45 seconds.
- The problem is, application I/O is held to the entire device while validation is performed

Solution

- z/OS parmlib option to limit the amount of time spent doing recovery operations
 - IECIOSxx RECOVERY,LIMITED_RECTIME=nn,DEV={DASD|IOTIMING}
 - Range 2-14 seconds
 - All DASD or only devices with I/O timing enabled
- z/OS uses the specified value to time the recovery I/Os on each path
- If recovery I/O fails with a missing interrupt start pending condition or interface timeout condition, I/O is not retried on that path

Limited Recovery Time

For scenarios where all paths are affected by a hardware delay, we want a HyperSwap to trigger as soon as possible

Maximum I/O impact time =

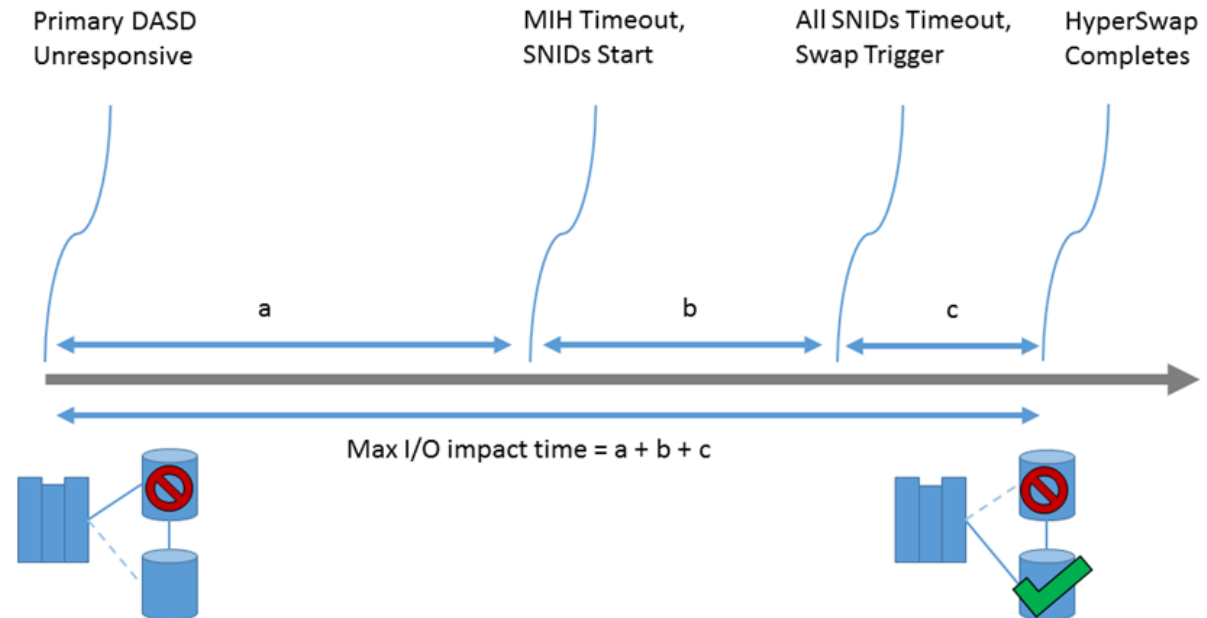
The sum of:

a: The MIH Timeout Value

b: The time for dynamic pathing validation to complete

- Without LIMITED_RECTIME:
 - $b = \text{number of paths} \times \text{at least one 15-second timeout with multiple retries}$
- With LIMITED_RECTIME:
 - $b = \text{number of paths} \times \text{LIMITED_RECTIME value}$

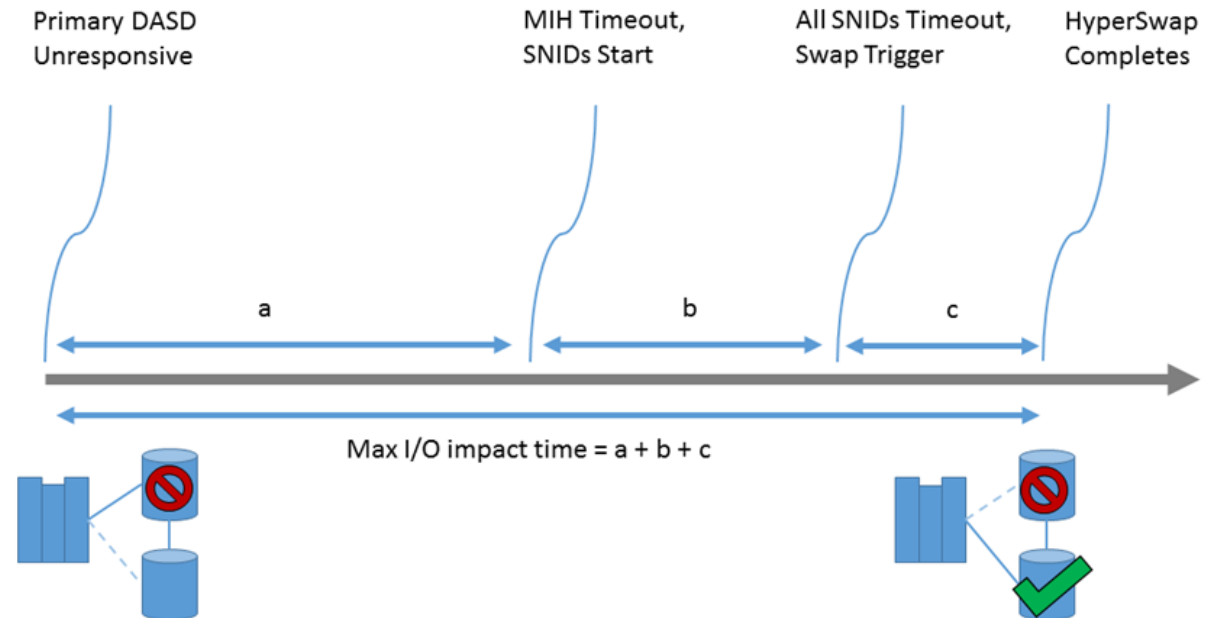
c: user impact time of the HyperSwap processing after it has been triggered



Limited Recovery Time

Consider a low value such as 2

```
RECOVERY, LIMITED_RECTIME=2, DEV=DASD
```





Other HyperSwap Use Cases



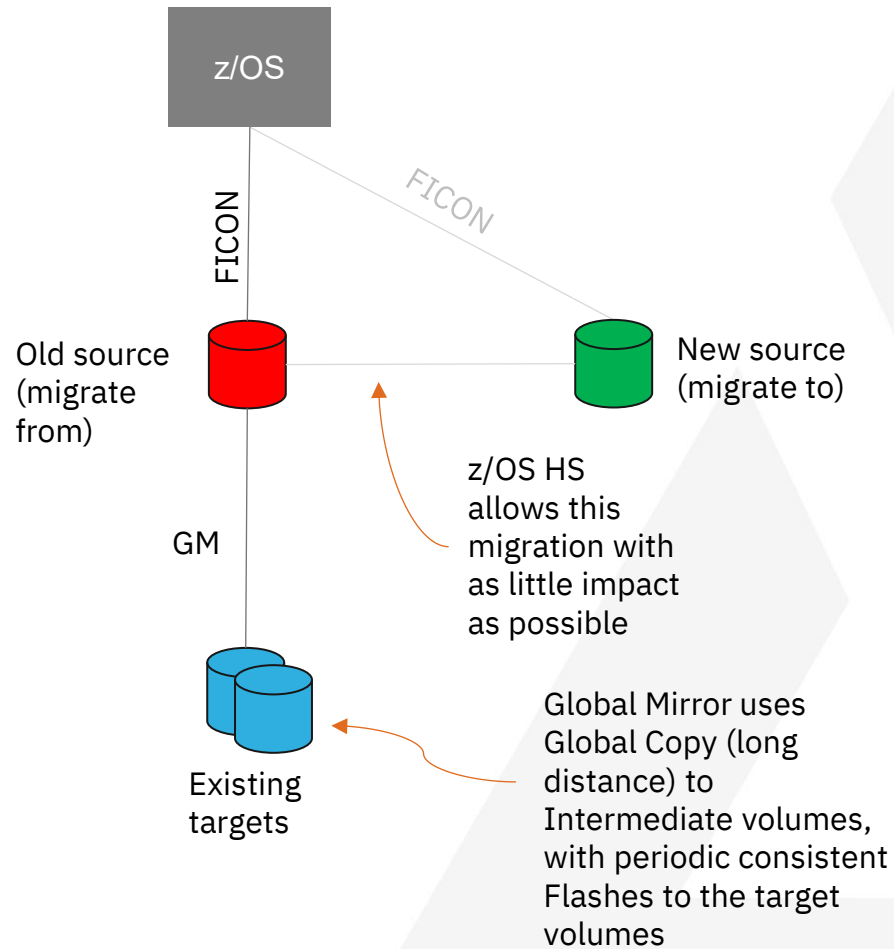
DS8000 Migration Using z/OS HyperSwap

DS8000 Migrations using z/OS HyperSwap



- z/OS and CSM can manage a migration session using HyperSwap
 - Provides an easy way to migrate production data to a new DS8K
 - Perform the migration **without needing to stop applications**
- This support expands the **Migration session type** to use the capabilities of z/OS HyperSwap

DS8000 Migrations using z/OS HyperSwap



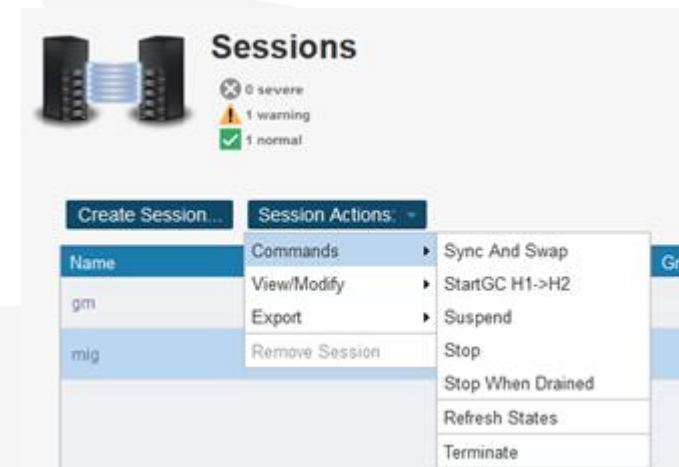
Release:

- APAR OA62931
- CSM 6.3.7 or later

Example configuration:

- Existing session is replicating Global Mirror to **existing targets**
- Goal is to replace **old sources** with **new sources**

Similar to a HyperSwap session, z/OS HyperSwap has a **Migration session** type between the Migrate-from and Migrate-to devices



DS8000 Migrations using z/OS HyperSwap

CSM sets up relationship between the current sources and new sources, starts mirroring in Global Copy mode

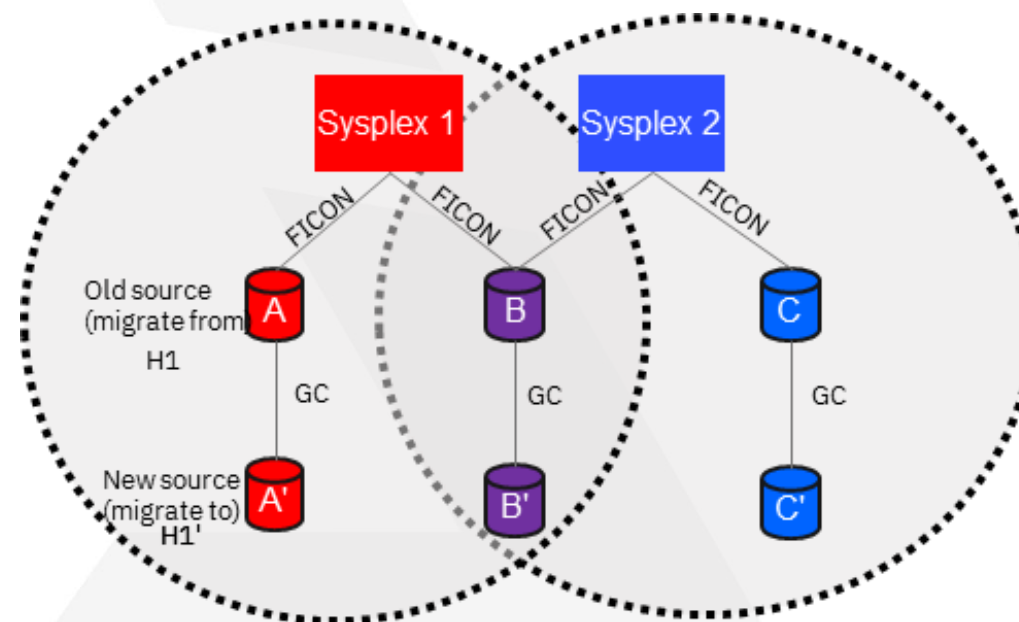
When the user is ready to perform the actual migration:

- z/OS HyperSwap performs the steps to start pairs in Metro Mirror mode
- This helps minimize the time when I/O writes are being synchronously mirrored, so we minimize production I/O impact
- z/OS HyperSwap then waits for all pairs to convert to Full Duplex, and automatically performs HyperSwap

After the Migration, z/OS HyperSwap clips VOLSERs for old sources to give extra layer of protection to prevent the user from accessing downlevel data

This also works in a Multi-Sysplex environment

- z/OS HyperSwap will detect when devices are shared outside the Sysplex
- CSM performs some coordination, and waits for all Sysplexes to be ready to migrate before any can be migrated





HyperSwap Hardware reserve Support

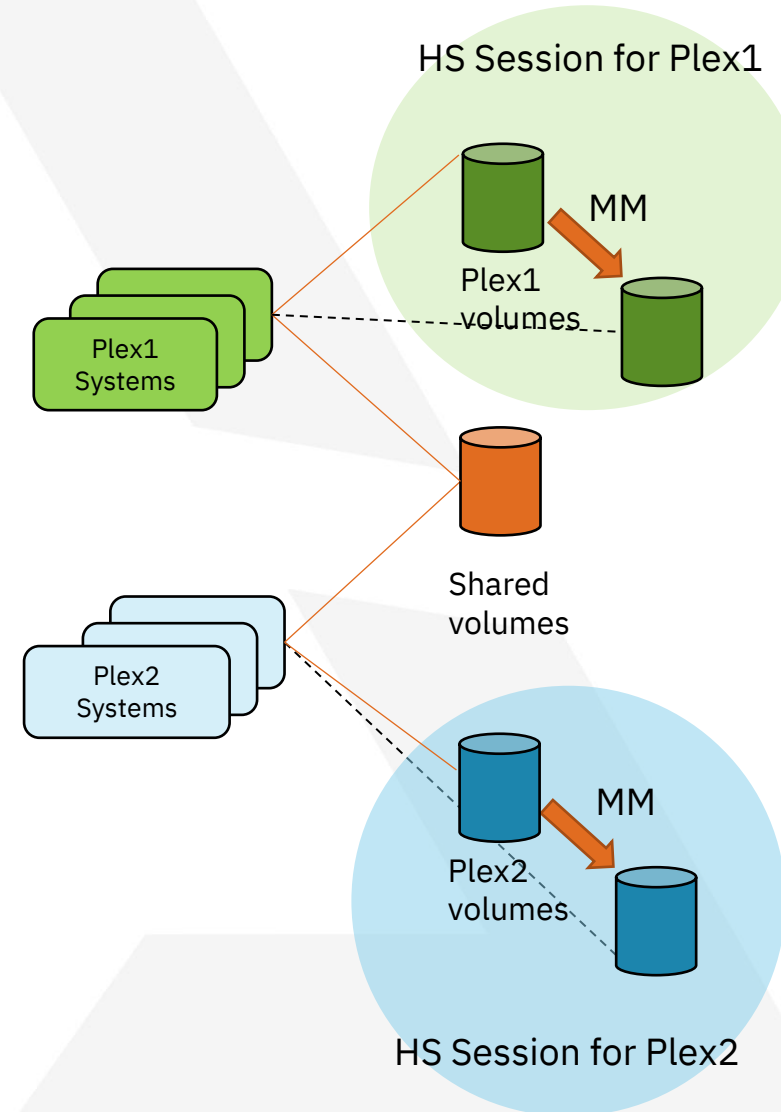
Sharing volumes with Systems outside the Sysplex

General recommendation:

- Avoid sharing HyperSwap managed volumes outside of the Sysplex
- Convert Hardware Reserves to Global ENQs

Benefit:

- Simplifies the replication management. Each CSM session corresponds to one Sysplex
- Keeps each HyperSwap session independent. An unplanned swap trigger on Plex 1 that is isolated to that Sysplex would not affect Plex 2
- IBM recommendation is to use GRS STAR mode and convert all RESERVEs to ENQs to improve performance, availability, and serviceability
 - See Health Check [GRS_CONVERT_RESERVES](#)



Sharing volumes with Systems outside the Sysplex

However...

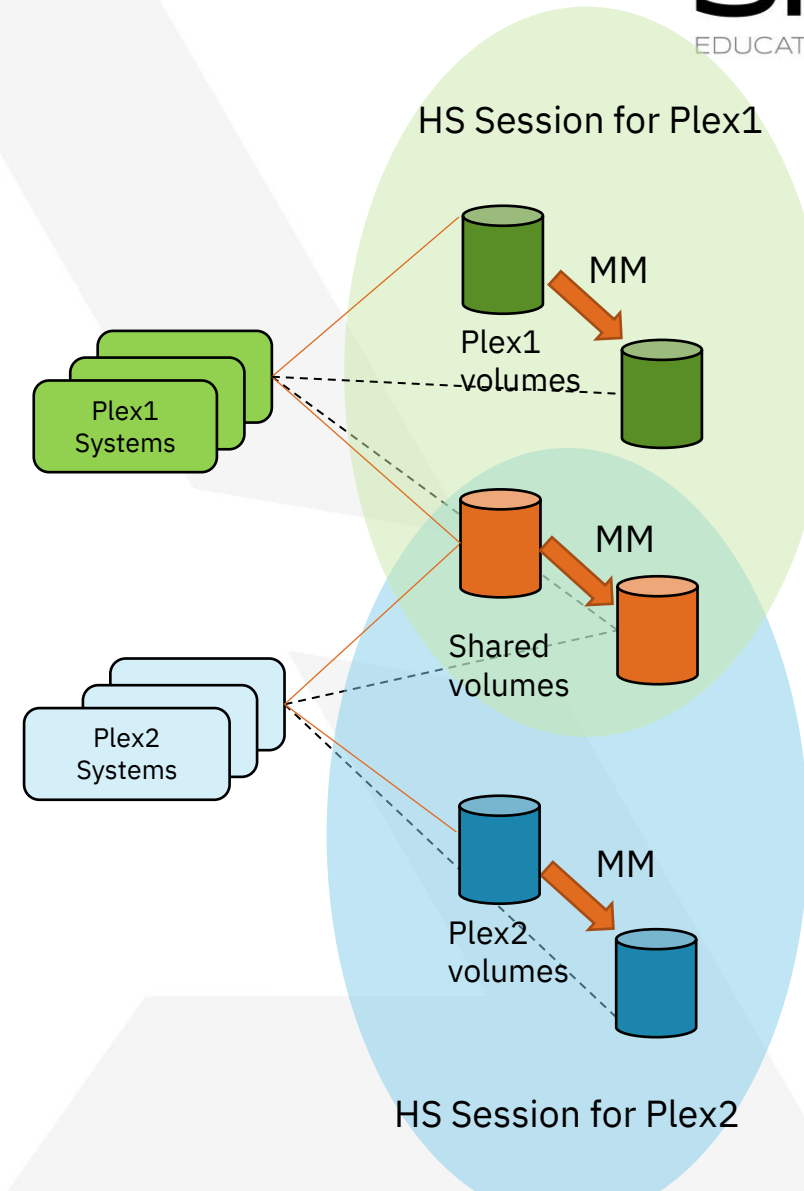
A lot of environments are complicated, and it is easier said than done to isolate all volumes

If there is a requirement to share volumes:

- This is supported with *HyperSwap Hardware Reserve support* enabled

How this works:

- Each Sysplex still has its own HyperSwap session
- Hardware Reserves do not have to be converted to ENQs
- Reserve serialization is maintained on the swap-to devices when a HyperSwap event occurs



HyperSwap Hardware Reserve Support

Two main aspects to what HyperSwap Hardware Reserve Support does:

- When a RESERVE is requested for a HyperSwap Primary device, IOS will synchronously reserve the primary device
 - At any given time, all primary and secondary devices have a consistent view of being reserved or not
- If one Sysplex performs planned or unplanned HyperSwap, all sharing Sysplexes will HyperSwap
 - During the HyperSwap of any given Sysplex, IOS will soft fence all swap-from devices
 - As soon as another Sysplex tries accessing one of those devices, it will detect the Soft Fence condition and will also perform HyperSwap

Enabling HyperSwap Hardware Reserve Support

Contact IBM PFE to set a pokeable on DS8K for enabling HyperSwap Hardware Reserve

Create sessions for each Sysplex

- Associate each one with the corresponding Sysplex
- Check the “Enable Hardware Reserves” option in CSM

View / Modify Properties for session TestHRS_Plx1

Session Options H1-H2 Options

Metro Mirror Options:

Metro Mirror Suspend Policy:

Hold I/O after Suspend
 Release I/O after Suspend

z/OS Management:

System or sysplex
SVPLEX1

Enable Hardened Freeze
 Enable Hardware Reserves
 Manage H1-H2 with HyperSwap

Disable HyperSwap
 Reset In Use By System on Secondary Volumes
 Unbox Secondary Volumes

On Planned HyperSwap Error:

Partition out the failing systems and continue HyperSwap processing on the remaining system
 Disable HyperSwap after attempting backout

On Unplanned HyperSwap Error:

Partition out the failing systems and continue HyperSwap processing on the remaining system
 Disable HyperSwap after attempting backout

OK Cancel



Current Focus and The Future

z/OS HyperSwap

Current focus:

- Improving performance, expanding use cases and supported environments

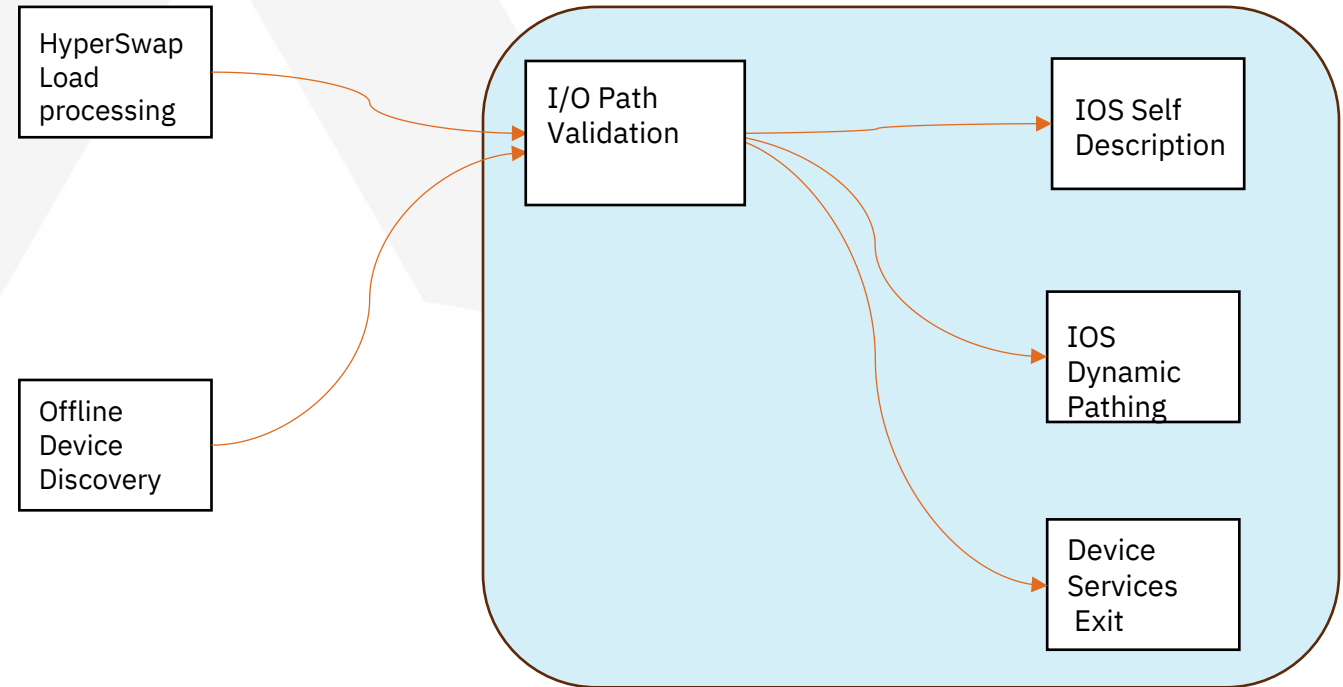
Have a request for enhancement?

Please submit to ideas.ibm.com, and vote on ideas that would be valuable to your business.

- These help us prioritize our work, and we love hearing feedback.

z/OS 3.2 Improved HyperSwap Load Processing

- At HyperSwap load time, IOS performs I/O Path Validation for all PPRC secondary devices
- In z/OS 3.2, Performance of I/O Path Validation is improved, which reduces the CPU overhead of HyperSwap load processing, Offline Device Discovery, and other callers.
- In a configuration with 8 paths per device, this will avoid:
 - 42 getmains per device
 - 14 I/Os per device



- z/OS 3.1 and below: Each of these sections of code would perform individual getmains/freemains for their dynamic areas
 - With thousands or tens of thousands of devices, this is a lot of repetitive getmains
- In z/OS 3.2, IOS will obtain one storage pool per LSS, and reuse it for each of the sections of code

Links and further information

CSM Documentation and Pages

Documentation home for IBM Copy Services Manager

<https://www.ibm.com/docs/en/csm>

CSM Supported Products and Platforms Interoperability Matrix Links

<https://www.ibm.com/support/pages/find-copy-services-manager-supported-storage-system-and-platform-matrix-links>

CSM YouTube channel

<https://www.youtube.com/channel/UC2KaP7qpv4Z9yJ75YioI-pA>

Books related to z/OS HyperSwap

Best Practices for IBM DS8000 and IBM z/OS HyperSwap with IBM Copy Services Manager

New draft available, updated December 2025

<https://www.redbooks.ibm.com/redpieces/abstracts/sg248431.html>

IBM Copy Services Manager Implementation Guide

<http://www.redbooks.ibm.com/abstracts/sg248375.html?Open>

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Come back each day for fresh topics and demos at our expert stations.



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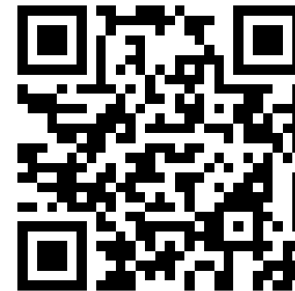
Find out more information using the QR code below.



[IBM Digital Asset Haven](#)

IBM Digital Asset Haven is the operational backbone for financial institutions and regulated enterprises entering the digital asset economy.

Find out more information using the QR code below.



Thank you

Questions?

Please also reach out through email or LinkedIn at any time with z/OS HyperSwap questions, comments, and suggestions

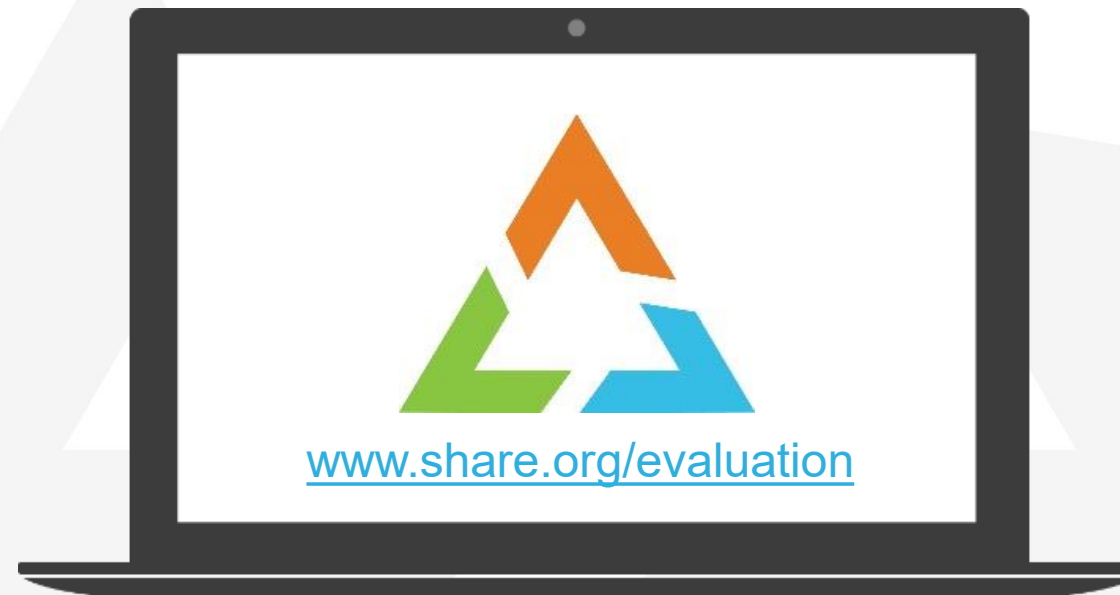
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Tariq Hanif - thanif@us.ibm.com

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