Full System Replication with IBM i

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2015
IBM Systems Technical University
IBM z Systems • IBM Power Systems • IBM Storage

October 5–9 | Hilton Orlando, Florida
Session objectives

- What is full system replication?
- Who are the target customers for full system replication?
- What methods are available to achieve full system replication?
- An example of manual management of switchover using full system replication
- Introduction to PowerHA Full System Replication (FSR)
  - A toolkit for automated management of full system replication strategies
  - Provided by IBM Lab Services Power Systems Delivery Practice
- Features of PowerHA FSR
- Planning, Requirements and Considerations for PowerHA FSR
- Understanding the relationship between PowerHA FSR and other Lab Services offerings under PowerHA Tools
What is “Full System Replication”?

- Full system replication is a means to provide a real-time full copy of your system/partition disks at another site.

- All volumes/LUNS are replicated, including the load source.

- Planned switchovers include a shut-down of “source” host, SAN storage switch operations, and an IPL of the “target” host.

- Unplanned switchovers include SAN storage switch operations and an abnormal IPL of the “target” host.

- NOTE: While replication is active, the “target” host is not online. This solution does not provide maintenance window opportunity to perform upgrades on the “target” host.
Benefits of Full System Replication Strategies

- Disaster Recovery (DR) solution
  - Requires manual SAN switch operations and abnormal IPL and cleanup of “target”
- Off-site backup options
  - Using “Detach” operation to temporarily suspend replication and allow read-write to target volumes
  - Using FlashCopy of “target” volumes to bring a host mapped to the FC volumes on-line
- “Clone” a copy of a system at another site
  - Temporary use of full system replication
- Replication processes separate from operating system
  - Although IBM i hosting with geographic mirroring is host-based, replication is at LIC level

Most PowerHA-managed solutions and solutions managed through IBM Lab Services toolkits are IASP-based

- Only data in the IASP is replicated and switched or detached, then brought online to an existing system with its own version/copy of *SYSBAS and its associated objects
- Geographic mirroring still requires the IASP concept for replication, even if a full system is being replicated from within an IBM i hosting i type of environment)
Who are the Target Customers for Full System Replication?

- Customers unable (or un-willing) to implement Independent Auxiliary Storage Pools (IASPs) for any reason
  - Time constraints
  - Resource limitations
  - Budgetary constraints
  - Application-specific technical obstacles
- Customers needing an interim solution while migrating to IASP
- Customers requiring a Disaster Recovery (DR) solution for their entire system, not limited to IASP
- Customers NOT needing simultaneous access to host attached to target volumes, while source (production) host is online and replication is active
  - Only ONE production copy IBM i host is accessible/online at any one time while replication is active
  - Replication CAN be stopped, and the target host CAN be IPL’ed but caution should be taken and manual changes will be required (these steps are outlined later)
What Available Methods Can Achieve Full System Replication?

• **IBM i Hosting i with Geographic Mirroring**
  - Full IBM i partition hosted within an Independent ASP (IASP)
  - PowerHA geographic mirroring replicates the IASP contents
  - Dependent on host IBM i availability, PowerHA clustering, LIC-level replication

• **SAN Replication with DS8000 Family**
  - Metro mirror – synchronous remote mirror & copy (PPRC)
  - Global Copy – asynchronous remote mirror & copy (PPRC)
  - Global Mirror – global copy, consistency groups, and flashcopy

• **SAN Replication with SVC/Storwize Family**
  - Metro mirror – synchronous replication
  - Global mirror – asynchronous continuous copy
  - Global mirror with change volumes – multi-cycling asynchronous copy with continuous remote flashcopy
Management of Full System Replication: A manual planned switchover with metro-mirror

Initial Environment: Full system replication from production site to DR site

1) End Applications/Jobs on production site
2) Monitor/Wait for all jobs to end
3) Issue the shut down command
4) Monitor/Wait for shut-down to complete
5) Log into SAN Storage as Admin
6) Issue a switch operation on the CG

7) Log into HMC at DR site as hmcsuperadmin
8) IPL the DR site partition in manual mode
9) Modify “autostart” objects (lines, interfaces, devices, applications) to not start
10) Correct comm resources, storage resources, IP interfaces, TCP routes, ...etc
11) Apply license keys
12) Complete startup processes
13) Revert all changed settings back to “normal”
What is PowerHA Full System Replication?

• PowerHA Full System Copy Services Manager Replication for Storwize (PowerHA FSR) is a toolkit offering developed by IBM Lab Services Power Systems Delivery Practice

• PowerHA FSR automates the shut-down, switch, IPL, reconfiguration and overall management of a full system replication environment

• PowerHA FSR provides switchover, failover and “detach” options in *SYSBAS-managed environments via single command-line interfaces

• IASP-based replication environments can still be managed via PowerHA or Lab Services toolkits (using PowerHA technology) simultaneously
PowerHA FSR – Scheduled Switchover – SWCSE Command

• **SWCSE** command will perform the following items:
  - Send inquiry message to QSYSOPR on Production requesting permission to proceed
  - Call the customer-specified power-down command(s)
  - Monitor and wait for production LPAR to deactivate
  - Switch replication direction status on storage
  - Start reverse replication, if requested in command
  - IPL the DR node
  - Call the customer startup program
  - Automatically make necessary changes for communication resources, storage resources, TCP/IP configuration and BRMS resources
  - Automate any additional changes, as deemed in the startup program based on serial number (e.g. applying license keys)
Management of Full System Replication: PowerHA FSR planned switchover with metro-mirror

Initial Environment: Full system replication from production site to DR site + (2) PowerHA FSR Controllers

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PowerHA FSR – AUTOMATED SWCSE (or Menu Option)

Controlling LPAR (Production Site)
Controlling LPAR (DR Site)
Production LPAR (Production Site)
Production LPAR COPY (DR Site)

Metro Mirror Replication
Storwize Storage
Storwize Storage
PowerHA FSR – Summary of Key Features/Benefits

- Redundant controlling (managing) partitions with PowerHA

- Fully-automated switchover, failover, AND detach operations

- Automated resource assignment and TCP/IP activation/deactivation based on serial number and LPAR number

- Built-in command to check switch-readiness (CHKCSE)

- API’s to customize start-up program

- Command-based or menu-driven options for ease of use

- Reduces need for high-level security log-in’s on multiple systems
PowerHA FSR – Controlling Partitions

• A “controlling” partition is selected or built into the environment to control the management of all partitions, SAN storage and HMC functions of the automation.

• A controlling partition exists at both sites, and uses PowerHA clustering technology to synchronize required data between nodes
  • One controlling partition is possible, preferably at the DR site for failover options
  • One or two controlling partitions still require PowerHA for code requirements

• PowerHA FSR resides on the controlling partitions and configuration is kept on these systems, separate from production environments

• Stores all environment, configuration, resource and log-in information to manage entire process with single command
PowerHA FSR – Switchover, Failover and Detach Options

• Scheduled Switch (Switchover)
  - Fully-automated through SWCSE command or WRKCSE menu option from controlling partition
  - Production site partition is shut down, replication direction is reversed and started (optional) on SAN, DR site partition is IPL'ed
  - All resource, TCP/IP configurations, and additional customer-defined processes started

• Unscheduled Switch (Failover)
  - Fully-automated through SWCSE command or WRKCSE menu option from controlling partition
  - Used in the event of production site disaster or system failure
  - Replication on SAN is reversed but not automatically started (started through separate menu option)
  - DR site partition is IPL’ed with all changes being made as with a scheduled switch

• Detach
  - Fully-automated through WRKCSE menu option from controlling partition
  - Replication on SAN is stopped, and target volumes are set to allow read-write access
  - DR site partition is started in restricted state with all TCP/IP settings set to remain inactive
  - Can be used as a backup strategy or DR test, but no DR solution is active while detached
PowerHA FSR – Automatic Resource Assignment

- Start-up resources are defined on a per-environment basis with initial configuration

- **WRKSTRPRSC** is used to add, change or delete entries
  - **TYPE(*CMN)** - Communication resources (e.g. CMNxx) assigned automatically to line descriptions
  - **TYPE(*RTE)** - TCP routes added or changed, based on which serial number / LPAR number is IPL’ing
  - **TYPE(*STG)** - Storage resources (e.g. TAPxx, TAPMLBxx) assigned automatically to media device descriptions
  - **TYPE(*BRM)** - BRMS objects defined based on which serial number / LPAR number is IPL’ing

- PowerHA FSR automates these changes during switchover, failover or detach operations
PowerHA FSR – CHKCSE Command for Switch-Readiness

- Similar to ICSM’s (ACS Toolkit’s) CHKPPRC command that checks switch-readiness of a DS8K PPRC environment
- Used prior to SWCSE and can be used programmatically to periodically check switch-readiness of the environment
- CHKCSE will check the following items:
  - The environment must be *PPRC (No FlashCopy)
    - **NOTE:** The use of “PPRC” in this toolkit encompasses the remote copy relationships in SVC-based storage as well
  - The storage type must be *SVC
  - At least one HMC for the production LPAR must be available
  - At least one HMC for the DR LPAR must be available
  - DSPCSED TA must show Use = *SYSTEM
  - The *PPRC direction in the CRG must match that of the actual replication on storage
PowerHA FSR – Customized Start-up Process

• **FIXSTRPRSC** command used in start-up program to correct and assign resources appropriately, previously defined in **WRKSTRPRSC**

• **RTVLPARINF** used to retrieve the serial number and LPAR number of the partition, and feed that information to **FIXSTRPRSC** in start-up program

• **RUNLPARCMD** can be used to start any customer-defined commands or programs in the start-up program, based on the serial number and LPAR number of the IPL’ing partition
PowerHA FSR – Commands and Menu Options

• PowerHA FSR integrates some commands from ICSM (formerly Advanced Copy Services (ACS) Toolkit) and FSCSM (formerly Full System FlashCopy (FSFC) Toolkit), as well as new commands for ease of set-up and use.

• **WRKCSE** also has built-in menu options to automate switchover, failover, suspend/resume, detach/reattach, and display of replication.

• Menu options can be secured to restrict functions to a limited number of users (via QZRDSECURE program).
PowerHA FSR – Log-in Management for Various Systems

- During initial set-up, the controlling partition(s) will store user log-in’s and encrypted passwords for HMC’s at both sites, and for SAN storage at both sites

- **WRKCSECRDL, ADDCSECRDE, RMVCSECRDE, CHGCSECRDE**
  - Credential entries stored in a credentials “list”

- PowerHA FSR automates partition shut-down, partition IPL, IPL monitoring, storage switch operations, replication suspend/resume, and monitoring of FSR-initiated storage functions

- Reduces the need for system operators to have high-level security access to those systems in order to initiate tasks manually
PowerHA FSR – Planning and Requirements

- IBM i partitions must be 7.1 or 7.2
- At least one controlling partition to manage process
  - Recommended to have one at each site (production site and DR site)
  - If only one, it is recommended to have it at the DR site
  - Does not need to be newly-created or solely dedicated to this purpose, but must be different than the production, and must be able to communicate to all needed systems as part of the management process
- IBM i clustering has been configured on all controlling partitions
  - Two controlling partitions clustered together and added to the same device domain, OR
  - One controlling partition, as a 1-node cluster, added to a device domain
  - Requires PowerHA Enterprise edition, due to future plans and requirements
  - Can only be part of one cluster at a time (consideration if using an existing LPAR)
- Each partition has its own Fiber Channel attachment card(s) or access to NPIV adapters
- Licensing for remote copy services is enabled on Storwize
- FSR (toolkit) is loaded and enabled on controllers
- Java Secure Channel code loaded on controllers
PowerHA FSR – Additional Considerations

- PowerHA FSR submits jobs using user QLPAR
  - Default job description is QDFTJOBD; Default job queue is QBATCH
  - Ensure the job queue is not single-threaded by associating a different job description with QLPAR
- PowerHA Cluster Security Requirements
  - QUSER is *ENABLED and does NOT have *SECADM or *ALLOBJ authority
  - “Allow add to cluster” (ALWADDCLU) in DSPNETA on controllers is *ANY or *RQSAUT
- Internet Daemon (INETD) Server Active on all Controllers
  - Can be set in IBM i Navigator GUI or in QUSRFSYS/QATOCSTART file, member SERVERS
- QTIME Coordinated Between all Nodes/Systems
  - Recommended to use SNTP (Simple Network Time Protocol) to same SNTP server
  - Cannot be synchronized with an Admin Domain
- The user for the Storwize must have Administrator authority
- Licenses for 3rd-party software need to be available for either serial number of production LPAR being activated
- Licenses for 3rd-party software requiring specific LPAR numbers may need to be adjusted after a switch
PowerHA FSR vs FSCSM (FlashCopy)

• Full System Copy Services Manager (FSCSM) FlashCopy can currently be used with metro-mirror or global mirror w/change volumes to provide a BACKUP solution at a DR site.

• FSCSM FlashCopy does NOT provide disaster-recovery or automatic management of the replication

• FSCSM FlashCopy also does not automate functionality for the replication target disks to be used with an IBM i partition

• PowerHA FSR extends these environments to include a DR solution

• When the PowerHA FSR environment is switched, a separate configuration (and possibly a separate controlling partition) can be used to continue the FSCSM FlashCopy operations at the DR site
PowerHA FSR – Additional Information

• Questions?

• Further information can be provided through IBM Lab Services Power Systems Delivery Practice (PowerHA Team)
  • Sales Reps
  • Technical Support Specialists
  • Opportunity Managers

• Email can also be sent to iessspt@us.ibm.com
  • Sent to primary individuals developing the code

• OR send email to Kyle Bliss (kyleb@us.ibm.som)