



## IBM PowerHA SystemMirror for i



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IBM Power Systems



### IBM PowerHA SystemMirror for i

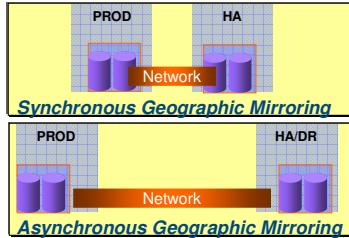
- First released in 2008 (IBM i 6.1 release)
- Hardware based replication solutions (disk level)
- Supports both:
  - IBM i replication – any storage
  - External storage replication – DS8000, SVC, Storwize models
- **Integrated** – Can manage IBM i and external storage HA from one IBM i GUI or command line
- **Reliable** – Using IBM replication technologies
- **Efficient** – Deeply integrated with lower levels of the OS
- **Automated** – Minimal IT management required
- **Versatile** – Solutions for any storage, any distance



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## PowerHA SystemMirror Replication Technologies

### IBM i replication



1 site  
Shared Storage

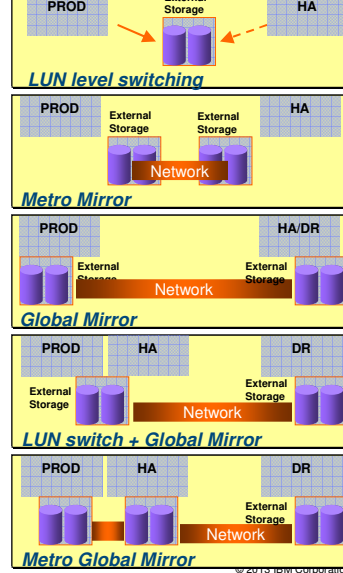
1 site  
Replication

2 site  
Replication

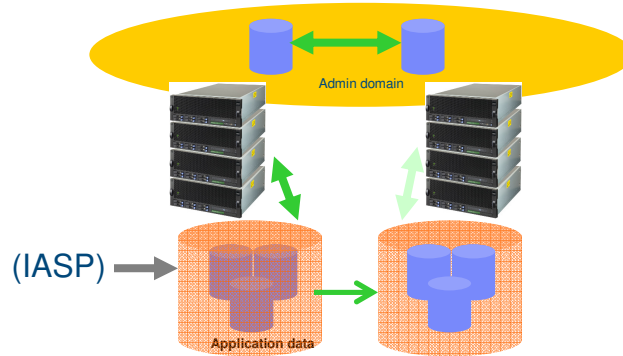
2 site  
HA + DR

3 site  
Replication  
(DS8K only)

### External Storage Replication



## PowerHA Basic Concepts



- **PowerHA SystemMirror creates and manages a cluster topology**
  - IASP volume group hosts the DB, IFS data
  - Admin Domain manages the SYSBAS data

## Who's Doing the Replication?

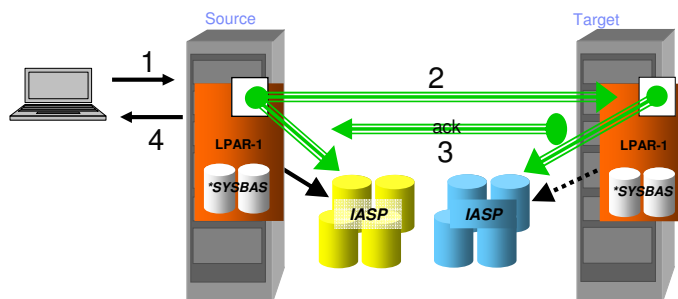
### IBM i

- **Technologies:** Synchronous and Asynchronous Geographic Mirroring
- Storage agnostic, although predominantly used with internal storage
- Source and target could be different storage types
- System failure affects production workload and data replication

### External Storage Server

- **Technologies:** Metro Mirror, Global Mirror, LUN switching, FlashCopy
- PowerHA supports specific external storage devices
  - DS8000, San Volume Controller (SVC), Storwize V7000, Storwize V5000, Storwize V3700
- Data replication independent of IBM i
- Replication overhead offloaded to external storage device
- Additional external storage functionality available, such as FlashCopy

## PowerHA – Synchronous Geographic Mirroring



## PowerHA – Synchronous Geographic Mirroring

**Best Use:** Have internal storage and want a 2nd copy of data to protect against planned and unplanned outages, and no need to protect against site disasters

### Benefits

- IBM i does the replication, so works with any type of storage
- Both copies of the data are guaranteed to be identical (RPO)

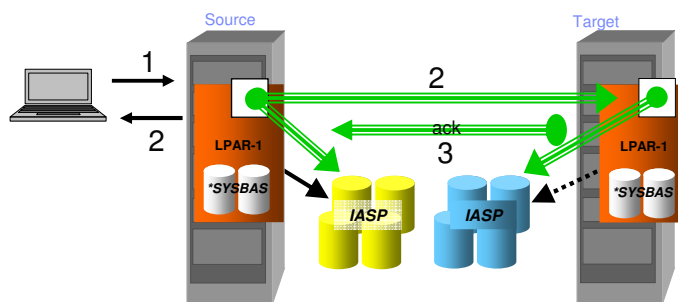
### Caveats

- Replication is synchronous, so distance is limited (within data center or dark fiber)
- Full synchronization is required on abnormal vary-off of either copy of the IASP, and during full synchronization, there is no valid 2nd copy of the data

### Requirements

- Bandwidth to support max production write rate
- Bandwidth also determines the amount of time required to complete a full synchronization

## PowerHA – Asynchronous Geographic Mirroring



## PowerHA – Asynchronous Geographic Mirroring

**Best Use:** Have internal storage and want a 2nd copy of data to protect against planned, unplanned outages plus site disasters

### Benefits

- IBM i does the replication so works with any type of storage
- Unlimited distance

### Caveats

- Replication is asynchronous, so a small amount of data could be lost upon production outage
- Full synchronization is required on abnormal vary-off of either copy of the IASP, and during full synchronization, there is no valid 2nd copy of the data

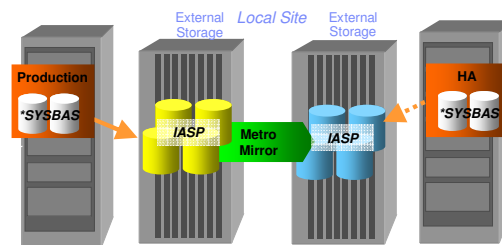
### Requirements

- Bandwidth to support average production write rate
- Bandwidth also determines the amount of time required to complete a full synchronization

## PowerHA and External Storage Copy Services

- PowerHA integrates the storage system copy services functions with IBM i clustering technology to provide an integrated solution
  - Copy Services technology does the replication of the IASP
  - Cluster technology monitors the health of the IBM i nodes as well as the health of the copy services replication
  - PowerHA controls the direction of the replication within the storage server
- Storage connection : all supported by PowerHA
  - Native
    - ‘Traditional’
    - Started with DS8K, now also support SVC, V7000, V5000, V3700
  - VIOS (vSCSI)
    - Enables virtualization functionality such as Live Partition Mobility
    - NOTE: LUN switching technology not available
  - NPIV
    - Allows virtualization of adapters

## PowerHA - Metro Mirror



## PowerHA - Metro Mirror

**Best Use:** Have DS8K, SVC, or Storwize and want a 2nd copy of data to protect against planned and unplanned outages, and no need to protect against site disasters

### Benefits

- Uses technology you already own if you have DS8K, SVC, V7000, V5000, or V3700
- Offloads replication overhead to external storage device
- Both copies of the data are guaranteed to be identical (RPO)

### Caveats

- Replication is synchronous, so distance is limited (roughly 30K)

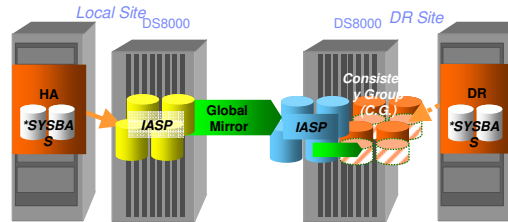
### Requirements

- External storage required (DS8K, SVC, V7000, V5000, V3700)
- DS8K – native attach, NPIV, VIOS
- SVC / V7000 / V5000 / V3700 – requires 7.1, native attach, NPIV, VIOS

## PowerHA - Global Mirror

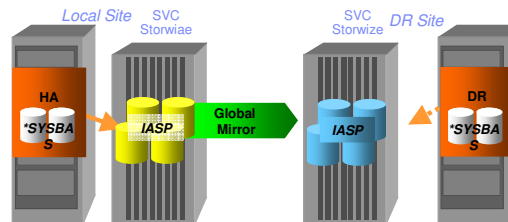
### DS8000

- Sends writes out of order
- Uses consistency group to maintain recoverable image



### SVC / Storwize

- Initial release supported by PowerHA sends in order so copy is always consistent
  - RPO bandwidth dependent and non-configurable
- SVC V6.3 supports Change Volumes
  - similar to DS8K approach
  - 1Q2014 support in PowerHA



## PowerHA - Global Mirror

**Best Use:** Have DS8K, SVC, or Storwize and want a 2nd copy of data to protect against planned, unplanned outages plus site disasters

### Benefits

- Uses technology you already own if you have DS8K, SVC, V7000, V5000, or V3700
- Offloads replication overhead to external storage device
- Unlimited distance

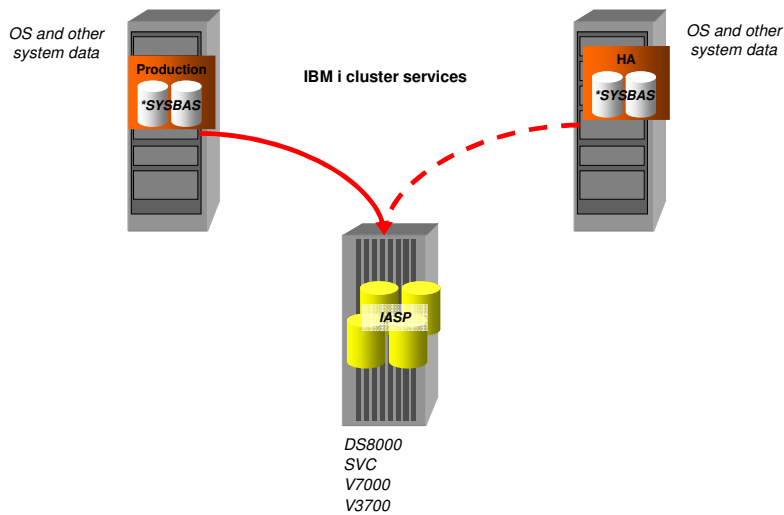
### Caveats

- Replication is asynchronous, so a small amount of data could be lost upon production storage server outage

### Requirements

- External storage required (DS8K, SVC, Storwize V3700, V5000, V7000)
- DS8K – native attach, NPIV, VIOS
- SVC / V7000 / V5000 / V3700 – requires 7.1, native attach, NPIV, VIOS

## LUN-level switching



## PowerHA – LUN-level switching

**Best Use:** Have external storage and want protection against planned and unplanned IBM i outages, and no need to protect against storage failures or site disasters (can combine with other technologies for better use case)

### Benefits

- Uses technology you already own if you have external storage
- Easy add-on to Metro Mirror or Global Mirror for local HA

### Caveats

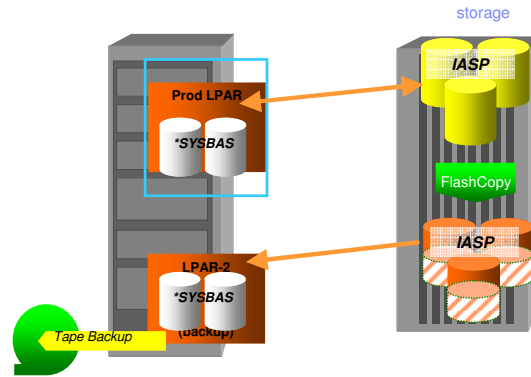
- One copy of the data, so no protection against storage failures
- One external storage device, so no site failure coverage

### Requirements

- External storage required (DS8K, SVC, V7000, V5000, V3700)
- DS8K – native attach, NPIV
- SVC, V7000, V5000, V3700 – native attach, NPIV



## PowerHA - FlashCopy



## PowerHA – FlashCopy

**Best Use:** Have DS8K, SVC, or Storwize and want one or multiple copies of the data for offline backups, development, testing, etc.

### Benefits

- Uses technology you already own if you have DS8K, SVC, V7000, V5000, V3700
- Easy add-on to Metro Mirror or Global Mirror for offline backups

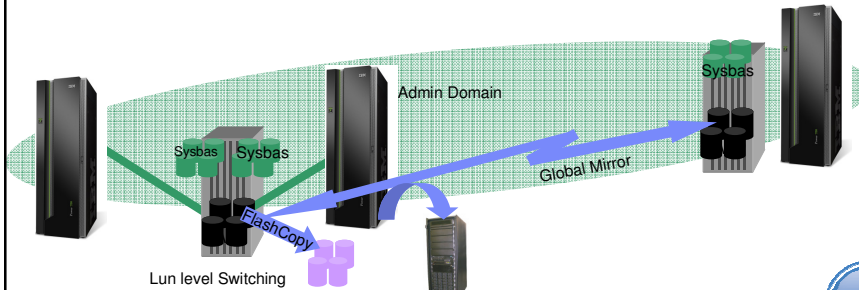
### Caveats

- Not an HA solution
- Only available on external storage

### Requirements

- External storage required (DS8K, SVC, V7000, V5000, V3700)
- DS8K – native attach, NPIV, VIOS
- SVC / V7000 / V5000 / V3700 – 7.1, native attach, NPIV, VIOS

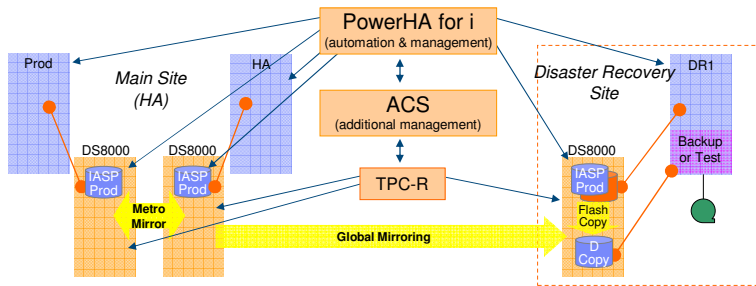
## Combination of Technologies



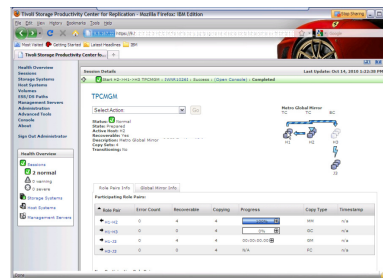
- Combine technologies for a complete solution
  - Local HA for planned outages
  - Disaster recovery
  - Offline backups



## PowerHA SystemMirror Integration for Advanced HA and DR



- Metro/Global Mirroring
  - Local copies for advanced HA, remote copies for DR, testing and backups
- Advanced Copy Services (Lab Services)
  - Integrates best of breed products for centralized monitoring and control of complex environments
    - PowerHA - DS8000 - TPC-R\*



\* TPC-R = Tivoli Productivity Center - Replication

## ACS – Metro Global Mirror

**Best Use:** Have DS8K and need three copies of real-time data to protect against planned, unplanned outages plus site disasters

### Benefits

- Uses technology built into DS8K
- Offloads replication overhead to external storage device
- Unlimited distance
- Replication to 2<sup>nd</sup> local site with no loss of data plus replication to 3<sup>rd</sup> site with minimal loss of data

### Caveats

- More complicated to manage

### Requirements

- DS8K External storage required
- Requires TPC-R, as well as PowerHA and ACS

## A PowerHA Technology for Every Storage Type

|                      | Internal SAS/SSD | DS6000 DS8000 | SVC V7000 V5000 V3700 | XIV | DS5000 | Other Storage |
|----------------------|------------------|---------------|-----------------------|-----|--------|---------------|
| Geographic Mirroring | ✓                | ✓             | ✓                     | ✓   | ✓      | ✓             |
| Metro Mirror         |                  | ✓             | ✓                     |     |        |               |
| Global Mirror        |                  | ✓             | ✓                     |     |        |               |
| Metro Global Mirror  |                  | ✓             |                       |     |        |               |
| LUN switching        |                  | ✓             | ✓                     |     |        |               |
| FlashCopy            |                  | ✓             | ✓                     |     |        |               |

Note 1: Native attach only

## A PowerHA Technology for Every Outage Type

|                      | Planned /Unplanned Partition Outages | Planned /Unplanned Server Outages | Planned /Unplanned Storage Outages | Site Outage | Offline Backups | >2 copies of real-time data |
|----------------------|--------------------------------------|-----------------------------------|------------------------------------|-------------|-----------------|-----------------------------|
| Synch Geo Mirroring  | ✓                                    | ✓                                 | ✓                                  |             |                 |                             |
| Asynch Geo Mirroring | ✓                                    | ✓                                 | ✓                                  | ✓           |                 |                             |
| Metro Mirror         | ✓                                    | ✓                                 | ✓                                  |             |                 |                             |
| Global Mirror        | ✓                                    | ✓                                 | ✓                                  | ✓           |                 |                             |
| Metro Global Mirror  | ✓                                    | ✓                                 | ✓                                  | ✓           | ✓               | ✓                           |
| LUN switching        | ✓                                    | ✓                                 |                                    |             |                 |                             |
| FlashCopy            |                                      |                                   |                                    |             | ✓               |                             |

**Where's My Data?**

## IASPs: Foundation for PowerHA

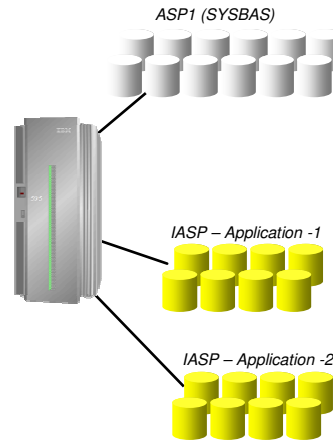
### Pools of disk which operate separately from SYSBAS

- Enables switching a disk pool within a cluster
- Contains the data that is replicated by the hardware

### Foundation for all PowerHA and ACS solutions

### Characteristics

- Can be taken offline or brought online without a system restart
- Separate namespace and database



## iASP Supported Objects Types (IBM i 6.1 and 7.1)

|         |         |         |         |         |
|---------|---------|---------|---------|---------|
| *ALRTBL | *DTAQ   | *JRNRCV | *PAGDFN | *SPLF   |
| *BLKSF  | *FCT    | *LIB    | *PAGSEG | *SQLPKG |
| *BNDDIR | *FIFO   | *LOCALE | *PDG    | *SQLUDT |
| *CHRSF  | *FILE   | *MEDDFN | *PGM    | *SRVPGM |
| *CHTFMT | *FNTRSC | *MENU   | *PNLGRP | *STMF   |
| *CLD    | *FNTTBL | *MGTCOL | *NODGRP | *SVRSTG |
| *CLS    | *FORMDF | *MODULE | *PSFCFG | *SYMLNK |
| *CMD    | *FTR    | *MSGF   | *QMFORM | *TBL    |
| *CRQD   | *GSS    | *MSGQ   | *QMGRY  | *USRIDX |
| *CSI    | *IGCDCT | *NODGRP | *QRYDFN | *USRQ   |
| *DIR    | *JOBQ   | *NODL   | *SBSD   | *USRSPC |
| *DTAARA | *JOBQ   | *OUTQ   | *SCHIDX | *VLDL   |
| *DTADCT | *JRN    | *OVL    | *SPADCT | *WSCST  |

## Object Types Which Don't Belong in an IASP

**Security Objects** (Objects affecting security remain in SYSBAS)

**Legacy Objects** (Non strategic objects (i.e \*36 must remain in SYSBAS))

**Configuration Objects** (System configuration objects have no use on another system)

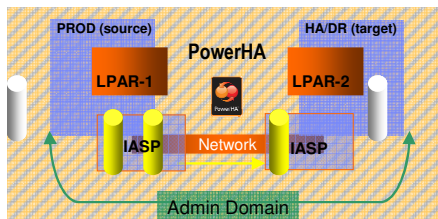
|         |         |         |         |
|---------|---------|---------|---------|
| *AUTHLR | *DDIR   | *IMGCLG | *NWS D  |
| *AUTL   | *DEV D  | *IPXD   | *PRDAVL |
| *CFGL   | *DOC    | *JOBSCD | *PRDDFN |
| *CNNL   | *DSTMF  | *LIND   | *PRDLOD |
| *COSD   | *EDTD   | *MODD   | *SOCKET |
| *CRG    | *EXITRG | *M36    | SSND    |
| *CSPMAP | *FLR    | *M36CFG | *S36    |
| *CSPTBL | *IGCSRT | *NTBD   | *RCT    |
| *CTLD   | *IGCTBL | *NWID   | *USRPRF |

Note: Object types in blue can be synchronized via Admin Domain

## PowerHA – Administrative Domain

Synchronize non-IASP objects across systems in the cluster

- 5.4 / 6.1 / 7.1
- Monitors for changes made to the object on any node
- Propagates those changes to the other nodes in the admin domain



### Monitored Resources (5.4)

- User profiles (\*USRPRF)
- Class (\*CLS)
- Job description (\*JOB D)
- ASP device description (\*ASPDEV)
- System values (\*SYSVAL)
- Network attributes (\*NETA)
- Environment variables (\*ENVVAR)
- TCP/IP Attributes (\*TCPA)

### Additional Monitored Resources (6.1)

- Subsystem Descriptions (\*SBSD)
- Network Server Descriptions (\*NWS D) of types \*WINDOWSNT, \*IXSVR, and \*ISCSI.
- NWS Configurations (\*NWS CFG)
- NWS Device Descriptions (\*NWSHDEV)
- NWS Storage Spaces (\*NWSSTG)
- Tape Device Descriptions (\*TAPDEV)
- Optical Device Descriptions (\*OPTDEV)
- Ethernet Line Descriptions (\*ETHLIN)
- Token-ring Line Descriptions (\*TRNLIN)

### Additional Monitored Resources (7.1)

- Authorization lists (\*AUTL)
- Printer Device Descriptions (\*PRTDEV)


# Putting It All Together

## Updated PowerHA GUI

PowerHA X

PowerHA > Independent ASPs > Independent ASP Details

Cluster: TROYCLU  
Local Node:  Z1515AP1



Independent ASP Details

Independent ASP Name: IASP001  
Current Configuration: Geographic Mirroring  
Independent ASP Type: Primary  
Cluster Resource Group:  DEVCRG   
Advanced Actions: -- Select Action --

**SITE2**

|          | Role            | Status    |
|----------|-----------------|-----------|
| Z1515AP2 | Primary         | Active    |
| IASP001  | Production Copy | Available |

Geographic Mirroring

Status: Active

-- Select Action --

**SITE1**

|          | Role          | Status    |
|----------|---------------|-----------|
| Z1515AP1 | Backup 1      | Active    |
| IASP001  | Properties... | Varied On |
| Z1515BP1 | Detach        | Active    |

## Timeline

## PowerHA Supported Technology



- 6.1
  - Switched Disk
  - Synchronous Geographic Mirroring
  - DS8000 Metro Mirror, Global Mirror, FlashCopy
  
- 7.1 Standard Edition
  - DS8000 LUN-level Switching
  - Space-Efficient FlashCopy
  - SVC / Storwize LUN-level switching, FlashCopy
  
- 7.1 Enterprise Edition
  - Asynchronous Geographic Mirroring
  - SVC / Storwize Metro Mirror, Global Mirror



## Enhancements Since 7.1 GA

Complete list, including release date and PTF numbers, is available at [www.ibm.com/developerworks/ibmi/techupdates/ha](http://www.ibm.com/developerworks/ibmi/techupdates/ha)

Examples:

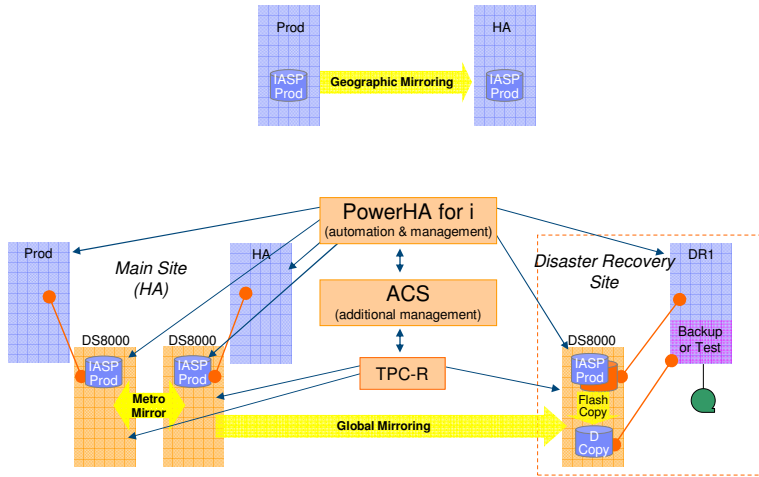
- SVC Split Cluster with PowerHA LUN level switching
- Metro Mirror, Global Mirror, FlashCopy and LUN level switching for SVC and Storwize storage servers
- PowerHA GUI support
- Global Mirror target FlashCopy
- Reverse FlashCopy support for remote mirror copy and no-copy relationships
- WRKCADMRE command
- CFGGgeomir command
- CFGDEVASP command
- PowerHA support for live partition mobility
- ...

## High Availability PTF Group

- Available for both 6.1 and 7.1
- Plan to refresh 3-4 times per year
- Recommended fixes support site will still list HA-related PTFs which are not yet in the PTF group
  
- 6.1 – SF99606
  
- 7.1 – SF99706

Note: Appropriate for logical replication environments as well as PowerHA

## PowerHA SystemMirror Solutions for Everyone



\* TPC-R = Tivoli Productivity Center - Replication

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## PowerHA Lab Services and Training

Key Offerings - High Availability Services on IBM i

- **Availability Workshop for IBM Power Systems**
- **IBM PowerHA SystemMirror for i**
- **Copy Services for IBM i**  
Utilizing Copy Services Toolkit (CST)  
Advanced Copy Services for IBM PowerHA on IBM i  
The DS Storage Management for IBM i Toolkit
- **Independent ASP (IASP) Migration Workshop for IBM i**
- **Full System Flash Copy for IBM i**
- **Attaching and integrating IBM i to IBM external storage** Consulting services associated with the planning, design, and implementation of best practices when attaching IBM i to IBM external storage.  
Logical configuration to ensure optimal performance and redundancy.  
Exploitation of Copy Services functions such as FlashCopy, Metro Mirror, and Global Mirror.

Americas, WW Contacts

Mark Even  
even@us.ibm.com

IBM i, High Availability

### Why IBM®?

• Deep skills in IBM storage, clustering and IBM i planning, implementation and integration.

• Experience in application architecture and design gained from thousands of engagements across many industries.

• Ability to deliver skills transfer as part of service engagement.

[http://www-03.ibm.com/systems/services/labservices/platforms/labservices\\_power.html#show-hide](http://www-03.ibm.com/systems/services/labservices/platforms/labservices_power.html#show-hide)

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## PowerHA Resources

- PowerHA Wiki
  - [www.ibm.com/developerworks/ibmi/ha/](http://www.ibm.com/developerworks/ibmi/ha/)
- Lab Services
  - <http://www-03.ibm.com/systems/services/labservices>
- Redbooks at [www.redbooks.ibm.com](http://www.redbooks.ibm.com)
  - Implementing PowerHA for IBM i - SG24-7405-00 (Nov 2008)
  - IBM I 6.1 Independent ASPs - SG24-7811-00
  - PowerHA SystemMirror for IBM i Cookbook – SG24-7994-00
- IBM System Storage Solutions for IBM i
  - Course code: AS930
  - Duration: 4.0 days
  - [www-304.ibm.com/jct03001c/services/learning/ites.wss/us/en?pageType=course\\_description&courseCode=AS930](http://www-304.ibm.com/jct03001c/services/learning/ites.wss/us/en?pageType=course_description&courseCode=AS930)
- High Availability Clusters (Power HA) and Independent Disk Pools for IBM i
  - Course code: AS541
  - Duration: 4.0 days
  - [www-304.ibm.com/jct03001c/services/learning/ites.wss/us/en?pageType=course\\_description&courseCode=AS541](http://www-304.ibm.com/jct03001c/services/learning/ites.wss/us/en?pageType=course_description&courseCode=AS541)

## Resiliency Without Downtime -- PowerHA

*High availability solutions for UNIX, and i clients*



**Thank you!**

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