Michael Roecken is a senior software developer with DB2 for Linux, UNIX, and Windows platforms at the IBM Toronto Lab. Michael has worked since 2000 designing, implementing and supporting various features and capabilities in the areas of: backup/restore, crash/rollforward recovery, high availability/disaster recovery, and logging/transaction management.

Please connect with Michael on Twitter at @roecken and LinkedIn.

Objectives

Describe and discuss the following:

Learning Objectives

- **HADR Update**
  - HADR single standby and multiple standby mod/fix pack rolling update
  - HADR pureScale online member rolling updates
- **HADR Upgrade**
  - HADR single standby and multiple standby major version upgrade NEW
  - HADR pureScale major version upgrade COMING SOON

2

Moving to a new version or fix pack of DB2 should not be a scary event for databases using the high availability disaster recovery (HADR) feature. Fear of an outage or re-initialization of your standby is no longer a concern. This presentation will introduce to you and detail the procedures to perform a rolling update and a major release upgrade of your HADR single standby, HADR multiple standby and HADR pureScale databases. A detailed step by step analysis, with examples, from start to end so that you can get your database to the latest versions of DB2 with the least amount of concern.

The information contained in this publication is provided for informational purposes only. While efforts were made to verify the completeness and accuracy of the information contained in this publication, it is provided AS IS without warranty of any kind, express or implied. In addition, this information is based on IBM's current product plans and strategy, which are subject to change by IBM without notice. IBM shall not be responsible for any damages arising out of the use of, or otherwise related to, this publication or any other materials. Nothing contained in this publication is intended to, nor shall have the effect of, creating any warranties or representations from IBM or its suppliers or licensors, or altering the terms and conditions of the applicable license agreement governing the use of IBM software.

References in this presentation to IBM products, programs, or services do not imply that they will be available in all countries in which IBM operates. Product release dates and/or capabilities referenced in this presentation may change at any time at IBM's sole discretion based on market opportunities or other factors, and are not intended to be a commitment to future product or feature availability in any way. Nothing contained in these materials is intended to, nor shall have the effect of, stating or implying that any activities undertaken by you will result in any specific sales, revenue growth or other

results.

Performance is based on measurements and projections using standard IBM benchmarks in a controlled environment. The actual throughput or performance that any user will experience will vary depending upon many factors, including considerations such as the amount of multiprogramming in the user's job stream, the I/O configuration, the storage configuration, and the workload processed. Therefore, no assurance can be given that an individual user will achieve results similar to those stated here.

All customer examples described are presented as illustrations of how those customers have used IBM products and the results they may have achieved. Actual environmental costs and performance characteristics may vary by customer.

DB2 Versioning

- The official DB2 product signature consists of 4 parts and has the format **VV.RR.MM.FF** where:
  - **VV** = Version number
  - **RR** = Release number
  - **MM** = Modification number
  - **FF** = Fix pack number

9.7.0.11	10.1.0.6
10.5.0.8	11.1.1.1

- Until now, the modification value (**MM**) for DB2 LUW has always been **0** (zero)
  - Traditionally, interfaces that return the product signature have supplied only 3 elements – **VV**, **RR**, and **FF**
  - It has not always been obvious when a Fix Pack contains new functionality

Survey

1. What version of DB2 are you running?
   a) 9.7
   b) 10.1
   c) 10.5
   d) 11.1
   e) Other

2. What configuration / flavor of HADR are you running?
   a) ESE single standby
   b) ESE multiple standby
   c) pureScale (single standby)

5

Moving to a new version or fix pack of DB2 should not be a scary event for databases using the high availability disaster recovery (HADR) feature. Fear of an outage or re-initialization of your standby is no longer a concern. This presentation will introduce to you and detail the procedures to perform a rolling update and a major release upgrade of your HADR single standby, HADR multiple standby and HADR pureScale databases. A detailed step by step analysis, with examples, from start to end so that you can get your database to the latest versions of DB2 with the least amount of concern.

IDUG
Leading the DB2 User Community since 1988

IDUG DB2 North American Tech Conference
Anaheim, California | April 30 - May 4, 2017

#IDUGDB2

HADR: Update vs. Upgrade

- Update
  - Within the same major version (e.g. 10.5.0.7 to 10.5.0.8 or 11.1.1.1 to 11.1.2.2)
  - Can be done in a rolling fashion
    - Database service is available, with minor or no service interruption
    - Multiple standby can ensure one primary and one standby always providing service
    - Options:
      1. Use TAKEOVER HADR command
      2. Use pureScale HADR rolling member update
- Upgrade
  - To a new major version where UPGRADE DATABASE command is required
  - Cannot be done in a rolling fashion
    - Database outage will be required
    - Options:
      1. Maintain HADR roles and avoids re-initialization of standby
      2. Stops HADR service and requires re-initialization of standby

6

Update

https://www.ibm.com/support/knowledgecenter/SSEPGG_11.1.0/com.ibm.db2.luw.admin.ha.doc/doc/t0011766.html

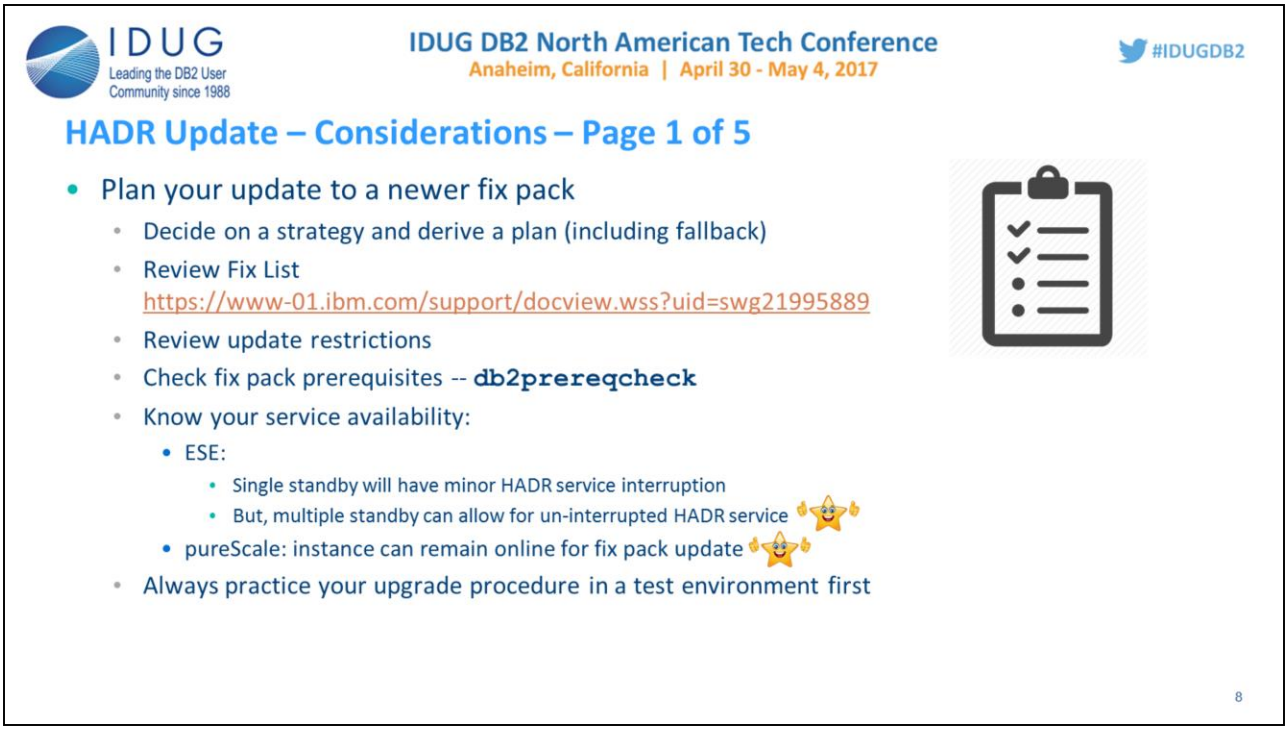
Upgrade

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.qb.upgrade.doc/doc/c0070028.html

HADR Update

Learning Objectives

- **Considerations**
- HADR Single Standby Mod/Fix Pack Rolling Update
- HADR Multiple Standby Mod/Fix Pack Rolling Update
- HADR pureScale Online Member Rolling Update
- HADR Single Standby Mod/Fix Pack Rolling Update in an Automated Environment



All DB2 fix pack updates, hardware upgrades, and software upgrades should be implemented in a test environment prior to applying them to your production system.

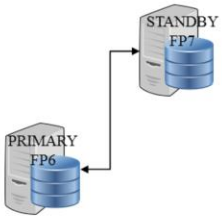
11.1.0.0 (GA) does not support online rolling member fix pack update. Need to use TAKEOVER method.

Preparing to install a fix pack

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.qb.server.doc/doc/t0024977.html

HADR Update – Considerations – Page 2 of 5

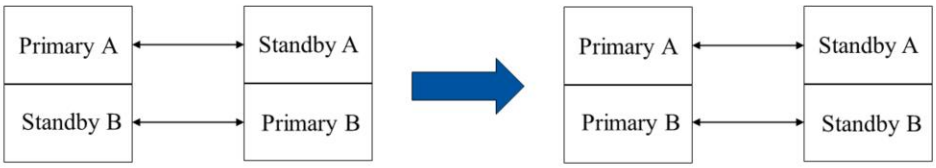
- Standby must always be on a code level current to or later than the primary
  - **Always start update on the standby to maintain communication**
  - New code level on standby can replay log records from previous code level on primary
  - Minimize time where primary / standby code levels differ



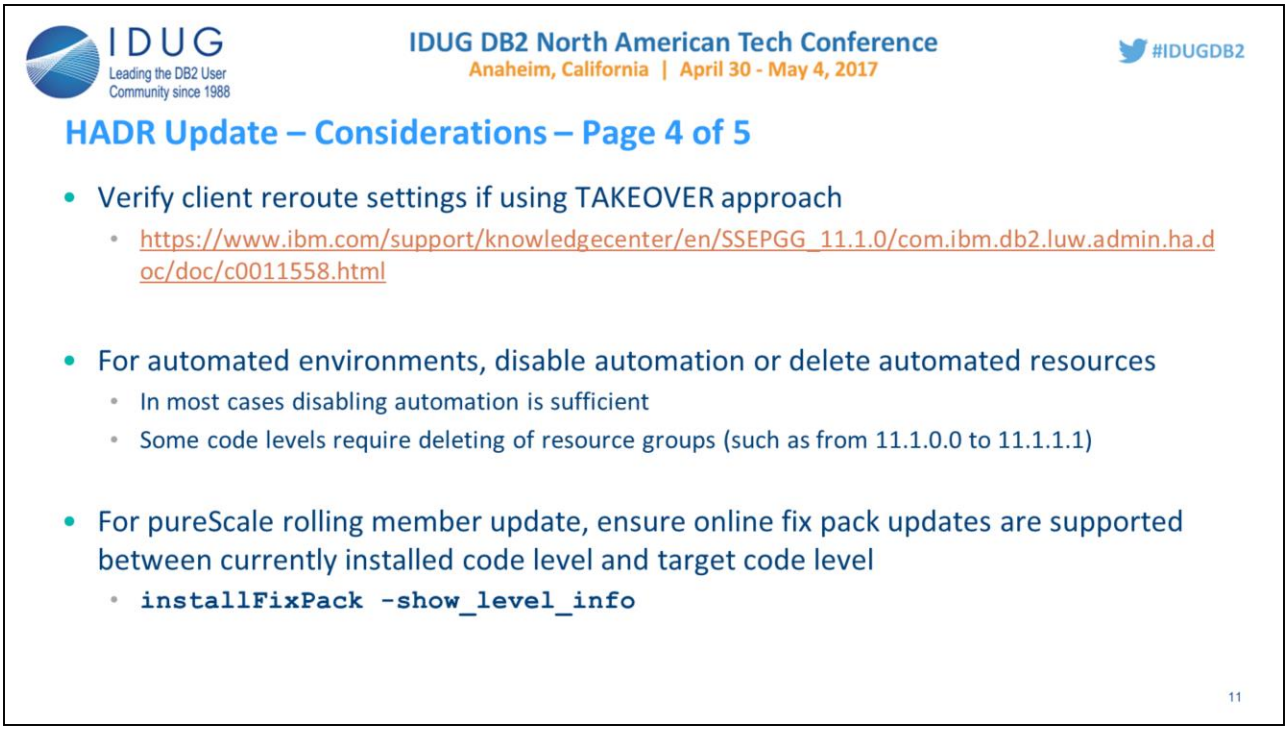
- Prepare for possible graceful takeover
  - Needed for ESE update and where pureScale rolling member update not available
  - Needed for mixed primary/standby instances
  - Needed if an issue arises with primary during the update process
  - **HADR pair must be in correct state**:
    - PEER for SYNC, NEARSYNC and ASYNC
    - For SUPERASYNC, ensure standby is not too far behind (e.g. log gap, replay pos.)
    - Consider whether workload on primary needs to be stopped or decreased

HADR Update – Considerations – Page 3 of 5

- No mixed primary/standby setups – perform graceful takeover
  - All databases on host 1 must be primary
  - All databases on host 2 must be standby



- Verify (and correct) data availability on standby
  - Check if any tables and/or table spaces are unavailable
    https://www-01.ibm.com/support/docview.wss?uid=swg21993013



Configuring automatic client reroute and High Availability Disaster Recovery (HADR)

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.admin.ha.doc/doc/c0011558.html

DB2 high availability instance configuration utility (db2haicu)

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.admin.ha.doc/doc/c0051371.html

installFixPack - Update installed DB2 database products command

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.admin.cmd.doc/doc/r0023700.html

HADR Update – Considerations – Page 5 of 5

- Familiarize yourself with HADR monitoring
  - db2pd –hadr and MON_GET_HADR are your friend
    - db2pd –hadr is accessible on primary or standby
    - MON_GET_HADR is accessible on primary or read enabled standby
  - Data Server Manager also has handy views

- Verify HADR configuration parameters
  - You cannot change when performing a rolling update

HADR Update

Learning Objectives

- Considerations
- **HADR Single Standby Mod/Fix Pack Rolling Update**
- HADR Multiple Standby Mod/Fix Pack Rolling Update
- HADR pureScale Online Member Rolling Update
- HADR Single Standby Mod/Fix Pack Rolling Update in an Automated Environment

IDUG
Leading the DB2 User Community since 1988

IDUG DB2 North American Tech Conference
Anaheim, California | April 30 - May 4, 2017

#IDUGDB2

HADR Single Standby Mod/Fix Pack Rolling Update – Page 1 of 4

Sample Scenario:

- Single database A in an ESE instance
- Primary on host 1 and standby on host 2
  - Database activated on both

- **Step 0 of 6:** Prepare for update
- **Step 1:** Update standby
  - Shutdown standby database – DEACTIVATE DATABASE
  - Stop instance – db2stop
  - Install fix pack and update software / hardware

14

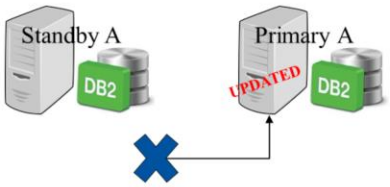
Performing rolling updates in a DB2 high availability disaster recovery (HADR) environment

https://www.ibm.com/support/knowledgecenter/SSEPGG_11.1.0/com.ibm.db2.luw.admin.ha.doc/doc/t0011766.html

HADR Single Standby Mod/Fix Pack Rolling Update – Page 2 of 4

- **Step 2:** Restart standby
  - Start instance – db2start
  - Start standby database – ACTIVATE DATABASE
  - Verify replay services are healthy – db2pd -hadr

- **Step 3:** Switch roles
  - On standby, issue TAKEOVER HADR to become new primary
  - Optional: Reroute clients to new primary
  - Old primary will become standby and fail to establish a connection since on older code level



HADR Single Standby Mod/Fix Pack Rolling Update – Page 3 of 4

- **Step 4:** Update old primary
  - Shutdown old primary database, if not already – DEACTIVATE DATABASE
  - Stop instance – db2stop
  - Install fix pack and update software / hardware
- **Step 5:** Restart old primary as standby
  - Start instance – db2start
  - Start new standby database – ACTIVATE DATABASE
  - Verify replay services are healthy – db2pd -hadr

HADR Single Standby Mod/Fix Pack Rolling Update – Page 4 of 4

- **Step 6:** Switch back to original configuration
  - On standby, issue TAKEOVER HADR to become new primary
  - On new primary issue db2updv*
    - REBIND may be necessary
  - If necessary, reroute clients to new primary
  - Verify replay services are healthy – db2pd -hadr

HADR Update

Learning Objectives

- Considerations
- HADR Single Standby Mod/Fix Pack Rolling Update
- **HADR Multiple Standby Mod/Fix Pack Rolling Update**
- HADR pureScale Online Member Rolling Update
- HADR Single Standby Mod/Fix Pack Rolling Update in an Automated Environment

IDUG
Leading the DB2 User Community since 1988

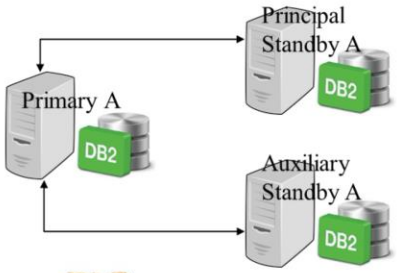
IDUG DB2 North American Tech Conference
Anaheim, California | April 30 - May 4, 2017

#IDUGDB2

HADR Multiple Standby Mod/Fix Pack Rolling Update – Page 1 of 4

Sample Scenario:

- Single database A in an ESE instance
- Primary on host 1; principal standby on host 2; auxiliary standby on host 3
  - Database activated on all



- **Step 0 of 5:** Prepare for update
  - **Always a primary and at least one standby available to provide service**
  - Procedure basically the same as single standby except perform update one at a time starting with auxiliary standby

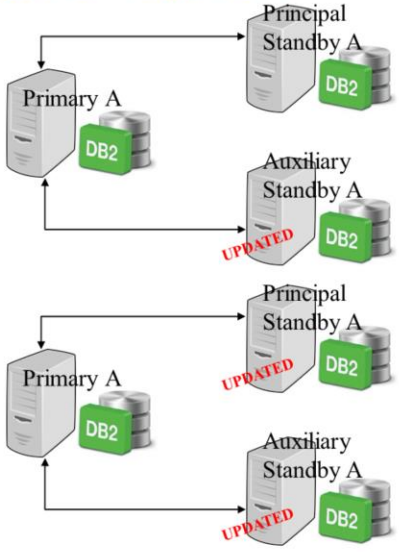
19

Rolling updates with multiple HADR standby databases

https://www.ibm.com/support/knowledgecenter/SSEPGG_11.1.0/com.ibm.db2.luw.admin.ha.doc/doc/c0060225.html

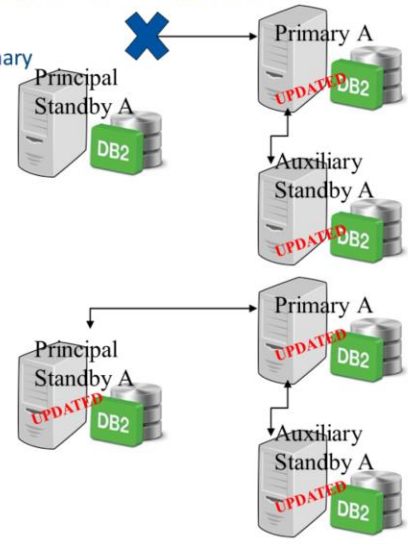
HADR Multiple Standby Mod/Fix Pack Rolling Update – Page 2 of 4

- **Step 1:** Update auxiliary standby
  - Shutdown standby database – DEACTIVATE DATABASE
  - Stop instance – db2stop
  - Install fix pack and update software / hardware
  - Start instance – db2start
  - Start standby database – ACTIVATE DATABASE
  - Verify replay services are healthy – db2pd -hadr
- **Step 2:** Update principal standby
  - Repeat Step 1



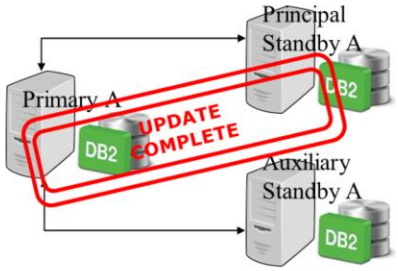
HADR Multiple Standby Mod/Fix Pack Rolling Update – Page 3 of 4

- **Step 3:** Switch roles
  - On principal standby, issue TAKEOVER HADR to become new primary
  - Verify replay services are healthy – db2pd -hadr
  - Optional: Reroute clients to new primary
  - Old primary will become standby and fail to establish a connection since on older code level
  - Auxiliary standby will be available for replay
- **Step 4:** Update old primary
  - Shutdown old primary database, if not already – DEACTIVATE DATABASE
  - Stop instance – db2stop
  - Install fix pack and update software / hardware
  - Start instance – db2start
  - Start new principal standby database – ACTIVATE DATABASE
  - Verify replay services are healthy – db2pd -hadr



HADR Multiple Standby Mod/Fix Pack Rolling Update – Page 4 of 4

- **Step 5:** Switch back to original configuration
  - On principal standby, issue TAKEOVER HADR to become new primary
  - On new primary issue db2updv*
    - REBIND may be necessary
  - If necessary, reroute clients to new primary
  - Verify replay services are healthy – db2pd -hadr



HADR Update

Learning Objectives

- Considerations
- HADR Single Standby Mod/Fix Pack Rolling Update
- HADR Multiple Standby Mod/Fix Pack Rolling Update
- **HADR pureScale Online Member Rolling Update**
- HADR Single Standby Mod/Fix Pack Rolling Update in an Automated Environment

IDUG
Leading the DB2 User Community since 1988

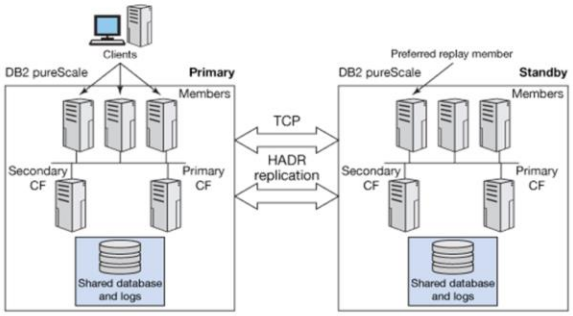
IDUG DB2 North American Tech Conference
Anaheim, California | April 30 - May 4, 2017

#IDUGDB2

HADR pureScale Online Member Rolling Update – Page 1 of 7

Sample Scenario:

- Single database A in a pureScale instance
- Primary cluster:
  - Two CF servers
  - Members m0 / m1 / m2
- Secondary cluster:
  - Two CF servers
  - Members m0 / m1 / m2
- Database activated on both



24

Installing online fix pack updates to a higher code level in a HADR environment

https://www.ibm.com/support/knowledgecenter/SSEPGG_11.1.0/com.ibm.db2.luw.qb.server.doc/doc/t0061250.html

HADR pureScale Online Member Rolling Update – Page 2 of 7

- **Step 0 of 11:** Prepare for update using online rolling member update
  - Ensure that you have root user authority and instance owner authority
  - Must update all members and CFs in both primary and standby clusters before you can commit level
  - Ensure online fix pack updates are supported between currently installed code level and target code level – `installFixPack -show_level_info`
  - `installFixPack` with `-online` option does:
    - Quiesces member, stops member/CF
      - Existing transactions can finish but new transactions re-routed to other members
    - Stops instance on host
    - Installs binaries
    - Updates instance to use new binaries
    - Starts instance on host
    - Starts member/CF
      - Uses new binaries but has not (yet) enabled new function
  - `installFixPack` with `-commit_level` option does:
    - New function now available

WARNING: 11.1.1.1 does NOT support pureScale online member rolling update from 11.1.0.0 GA

HADR pureScale Online Member Rolling Update – Page 3 of 7

- **Step 1:** (Standby cluster) Update online all members
  - Update preferred replay member last to reduce interruption
  - For each member:
    - Logon to member server as root
    - Uncompress fix pack to directory (**<dir>**) accessible by instance owner and root user
    - **<dir>/installFixPack -p <fpInstallPath> -online -I <instanceName> -l <logfile> -t <tracefile>**

- **Step 2:** (Standby cluster) Update online secondary CF
  - Logon to secondary CF server as root
  - Uncompress fix pack to directory (**<dir>**) accessible by instance owner and root user
  - **<dir>/installFixPack -p <fpInstallPath> -online -I <instanceName> -l <logfile> -t <tracefile>**

HADR pureScale Online Member Rolling Update – Page 4 of 7

- **Step 3:** (Standby cluster) Update online primary CF
  - Ensure secondary CF is in peer state – **`db2instance -list`**
    Logon to primary CF server as root
  - Uncompress fix pack to directory (**`<dir>`**) accessible by instance owner and root user
  - **`<dir>/installFixPack -p <fpInstallPath> -online -I <instanceName> -l <logfile> -t <tracefile>`**
- **Step 4**: (Standby cluster) Verify online fix pack update was successful
  - **`<dir>/installFixPack -check_commit-I <instanceName>`**
- **Step 5:** (Primary cluster) Update online all members
  - For each member:
    - Logon to member server as root
    - Uncompress fix pack to directory (`<dir>`) accessible by instance owner and root user
    - `<dir>/installFixPack -p <fpInstallPath> -online -I <instanceName> -l <logfile> -t <tracefile>`

HADR pureScale Online Member Rolling Update – Page 5 of 7

- **Step 6:** (Primary cluster) Update online secondary CF
  - Logon to secondary CF server as root
  - Uncompress fix pack to directory (**<dir>**) accessible by instance owner and root user
  - **<dir>/installFixPack -p <fpInstallPath> -online -I <instanceName> -l <logfile> -t <tracefile>**

- **Step 7:** (Primary cluster) Update online primary CF
  - Ensure secondary CF is in peer state – **db2instance -list**
  - Logon to primary CF server as root
  - Uncompress fix pack to directory (**<dir>**) accessible by instance owner and root user
  - **<dir>/installFixPack -p <fpInstallPath> -online -I <instanceName> -l <logfile> -t <tracefile>**

HADR pureScale Online Member Rolling Update – Page 6 of 7

- **Step 8**: (Primary cluster) Verify online fix pack update was successful
  - `<dir>/installFixPack -check_commit -I <instanceName>`
- **Step 9:** (Standby cluster) Commit the online fix pack update
  - Minimize the amount of time that the cluster is running with mixed fix packs
  - `<dir>/installFixPack -commit_level -I <instanceName> -l <logfile> -t <tracefile>`
  - Verify the new committed fix level – db2pd –ruStatus
- **Step 10:** (Primary cluster) Commit the online fix pack update
  - Minimize the amount of time that the cluster is running with mixed fix packs
  - `<dir>/installFixPack -commit_level -I <instanceName> -l <logfile> -t <tracefile>`
  - Verify the new committed fix level – db2pd –ruStatus

HADR pureScale Online Member Rolling Update – Page 7 of 7

- **Step 11:** (Primary cluster) Update system catalog objects
  - Issue db2updv*
    - REBIND may be necessary
  - Verify replay services are healthy – db2pd -hadr

HADR Update

Learning Objectives

- Considerations
- HADR Single Standby Mod/Fix Pack Rolling Update
- HADR Multiple Standby Mod/Fix Pack Rolling Update
- HADR pureScale Online Member Rolling Update
- **HADR Single Standby Mod/Fix Pack Rolling Update in an Automated Environment**

IDUG
Leading the DB2 User Community since 1988

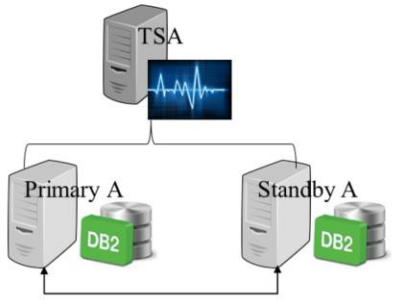
IDUG DB2 North American Tech Conference
Anaheim, California | April 30 - May 4, 2017

#IDUGDB2

HADR Single Standby Mod/Fix Pack Rolling Update in an Automated Environment – Page 1 of 6

Sample Scenario:

- Single database A in an ESE instance
- Primary on host 1 and standby on host 2
  - Database activated on both
- Instances configured with TSA for HADR failover



- **Step 0 of 14:** Prepare for update
- **Step 1:** (Host 1 & Host2) Disable automation or delete automated resources
  - In most cases disabling automation is sufficient – `db2haicu -disable`
  - Some code levels require deleting of resource groups (such as from 11.1.0.0 to 11.1.1.1) – `db2haicu -delete`

32

Performing rolling updates in an automated DB2 high availability disaster recovery (HADR) environment

https://www.ibm.com/support/knowledgecenter/SSEPGG_11.1.0/com.ibm.db2.luw.admin.ha.doc/doc/t0056202.html

HADR Single Standby Mod/Fix Pack Rolling Update in an Automated Environment – Page 2 of 6

- **Step 2:** (Host 2) Update standby – Stop database and instance
  - Shutdown standby database – DEACTIVATE DATABASE
  - Stop instance – db2stop
- **Step 3:** (Host 2) Take standby node offline from peer domain
  - Take offline if a newer TSA version is bundled in DB2 fix pack
  - As root – **`stoprpnode -f <hostname Host 2>`**
- **Step 4:** (Host 2) Install fix pack and update software / hardware
- **Step 5:** (Host 1) Bring standby node back online to peer domain
  - Must be run from a host already in domain
  - As root – **`startrpnode <hostname Host 2>`**

HADR Single Standby Mod/Fix Pack Rolling Update in an Automated Environment – Page 3 of 6

- **Step 6:** (Host 2) Restart standby
  - Start instance – db2start
  - Start standby database – ACTIVATE DATABASE
  - Verify replay services are healthy – db2pd -hadr

- **Step 7:** Switch roles
  - (Host 2) On standby, issue TAKEOVER HADR to become new primary
  - Optional: Reroute clients to new primary
  - Old primary will become standby and fail to establish a connection since on older code level

HADR Single Standby Mod/Fix Pack Rolling Update in an Automated Environment – Page 4 of 6

- **Step 8:** (Host 1) Update old primary – Stop database and instance
  - Shutdown old primary database, if not already – DEACTIVATE DATABASE
  - Stop instance – db2stop
- **Step 9:** (Host 1) Take old primary node offline from peer domain
  - Take offline if a newer TSA version is bundled in DB2 fix pack
  - As root – **`stoprpnode -f <hostname Host 1>`**
- **Step 10:** (Host 1) Install fix pack and update software / hardware
- **Step 11:** (Host 2) Bring old primary node back online to peer domain
  - Must be run from a host already in domain
  - As root – **`startrpnode <hostname Host 1>`**

HADR Single Standby Mod/Fix Pack Rolling Update in an Automated Environment – Page 5 of 6

- **Step 12:** (Host 1) Restart old primary as standby
  - Start instance – db2start
  - Start new standby database – ACTIVATE DATABASE
  - Verify replay services are healthy – db2pd –hadr
- **Step 13:** Switch back to original configuration
  - (Host 1) On standby, issue TAKEOVER HADR to become new primary
  - On new primary issue db2updv*
    - REBIND may be necessary
  - If necessary, reroute clients to new primary
  - Verify replay services are healthy – db2pd -hadr

HADR Single Standby Mod/Fix Pack Rolling Update in an Automated Environment – Page 6 of 6

- **Step 14:** (Host 1 & Host2) If required, migrate TSA domain
  - Only required if DB2 fix pack includes a new TSA version
  - TSA domain migration required if active version number (AVN) does not match the installed version number (IVN)
    – **`lssrc -ls IBM.RecoveryRM |grep VN`**
  - To migrate:
    - **`export CT_MANAGEMENT_SCOPE=2`**
    - **`runact -c IBM.PeerDomain CompleteMigration Options=0`**
    - **`samctrl -m  # Type 'Y' to confirm migration`**
  - Verify AVN and IVN match – **`lssrc -ls IBM.RecoveryRM |grep VN`**
  - Verify that `MixedVersions` is set to No for CM – **`lsrpdomain`**
  - Re-enable automation using **`db2haicu`** command

HADR Major Version Upgrade

- **General Upgrade Planning / Considerations**
- HADR Major Version Upgrade Requiring Standby Re-initialization
- HADR Single Standby Major Version Upgrade
- HADR Multiple Standby Major Version Upgrade
  - HADR Multiple Standby Major Version Upgrade - Overview
  - HADR Multiple Standby Major Version Upgrade – Method 1
  - HADR Multiple Standby Major Version Upgrade – Method 2
- HADR pureScale Major Version Upgrade
- HADR Major Version Upgrade in an Automated Environment
- HADR Major Version Upgrade – Dealing with Failures
- HADR Major Version Upgrade – The Future

Learning Objectives

IDUG
Leading the DB2 User Community since 1988

IDUG DB2 North American Tech Conference
Anaheim, California | April 30 - May 4, 2017

#IDUGDB2

General Upgrade Planning

- Plan your upgrade to Version 11.1.x.x
  - Decide on a strategy and derive a plan for each component:
    - Servers, clients, applications, routines, tools and scripts
  - Always practice your upgrade procedure in a test environment first
  - DB2 Upgrade Portal
    http://www.ibm.com/software/data/db2/upgrade/portal
  - Upgrade to DB2 Version 11.1.x.x
    https://www.ibm.com/support/knowledgecenter/SSEPGG_11.1.0/com.ibm.db2.luw.qb.upgrade.doc/doc/c0023662.html
- For each component ensure you are familiar with:
  - Prerequisites, pre-upgrade tasks, upgrade steps, post-upgrade tasks
  - C09 Do It Right! Upgrade to DB2 LUW 11.x (most recent version)
    - Wednesday, May 3 @ 08:00AM - Melanie Stopfer, IBM

39

Upgrading a DB2 server (Windows)

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.qb.upgrade.doc/doc/t0007199.html

Upgrading a DB2 server (Linux and UNIX)

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.qb.upgrade.doc/doc/t0007200.html

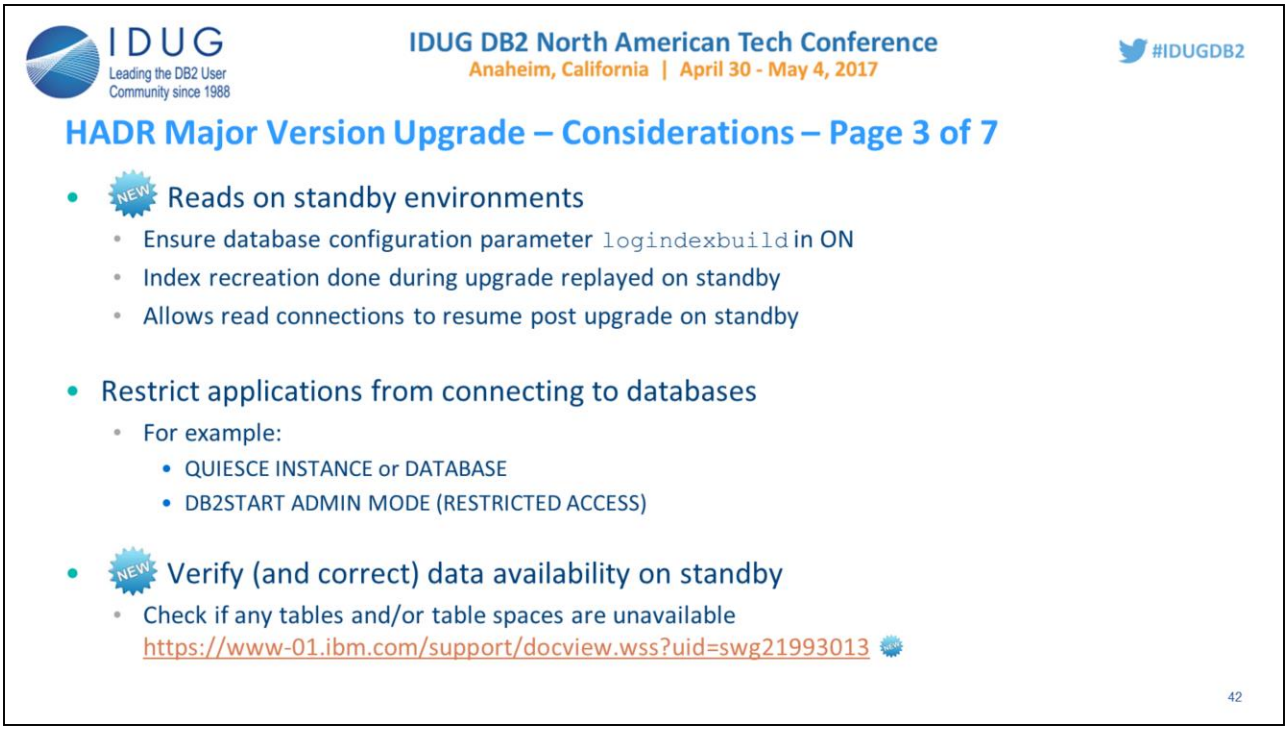
HADR Major Version Upgrade – Considerations – Page 1 of 7

- Cannot be done in a rolling fashion
  - Database outage will be required
    - Limitation of UPGRADE DATABASE command and log replay
  - As of 11.1.0.0, two options now available:
    1. **Maintain HADR roles and avoids re-initialization of standby**
    2. Stops HADR service and requires re-initialization of standby
- (Old procedure) HADR Upgrade requiring re-initialization of standby
  - Available from all releases and fix packs – 9.7.x.x / 10.1.x.x / 10.5.x.x (and future)
  - Only option if coming from 9.7.x.x or 10.1.x.x
  - 10.5.x.x: Available as last resort if cannot update while maintaining HADR roles or not on proper fix pack
  - Will need to stop HADR
  - Post upgrade take new database backup and ship across to standby to restore

HADR Major Version Upgrade – Considerations – Page 2 of 7

- NEW HADR Upgrade (to 11.1.x.x) maintains HADR roles without requiring re-initialization of standby
  - Option if coming from 10.5, but only …
    - **ESE: 10.5.0.7+**
    - **pureScale: 10.5.0.9+** COMING SOON
  - HADR roles are maintained during upgrade procedure
  - Primary and standby must validate log positions in downlevel release
  - Primary must be shutdown first, but standby must be upgraded before primary
  - Primary and standby must be at same code level to communicate
  - UPGRADE now a recoverable operation that standby can replay

- NEW Ensure replay delay is turned off on standbys
  - Set database configuration parameter `hadr_replay_delay` to 0
  - Enables standby to catch up to primary in downlevel release



QUIESCE command

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.admin.cmd.doc/doc/r0008635.html

db2start - Start DB2 command

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.admin.cmd.doc/doc/r0001939.html

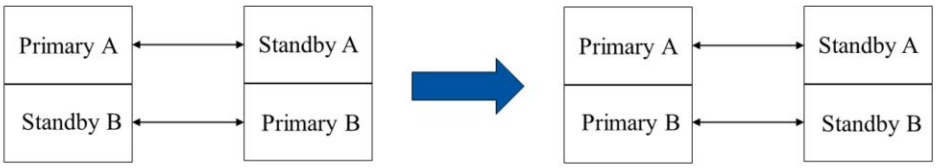
IDUG
Leading the DB2 User Community since 1988

IDUG DB2 North American Tech Conference
Anaheim, California | April 30 - May 4, 2017

#IDUGDB2

HADR Major Version Upgrade – Considerations – Page 4 of 7

- No mixed primary/standby setups – perform graceful takeover
  - All databases on host 1 must be primary
  - All databases on host 2 must be standby



- For automated environments, delete automated resources

43

DB2 high availability instance configuration utility (db2haicu)

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.admin.ha.doc/doc/c0051371.html

IDUG
Leading the DB2 User Community since 1988

IDUG DB2 North American Tech Conference
Anaheim, California | April 30 - May 4, 2017

#IDUGDB2

HADR Major Version Upgrade – Considerations – Page 5 of 7
db2iupgrade / db2ckupgrade

- db2iupgrade calls db2ckupgrade under the covers
- db2ckupgrade can be executed manually if need be
- Verifies database's readiness for upgrade; for all databases:
  - Database states (including consistency)
  - Table and table space attributes
- NEW For HADR databases, key checks done by db2ckupgrade needs exclusive access to database

44

db2iupgrade - Upgrade instance command

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.admin.cmd.doc/doc/r0002055.html

db2ckupgrade - Check database for upgrade command

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.admin.cmd.doc/doc/r0002028.html

HADR Major Version Upgrade – Considerations – Page 6 of 7
db2iupgrade / db2ckupgrade (continued)

- Detects version of downlevel database and for HADR databases:
  - If supports NEW procedure
    - Standby: Will skip database
    - Primary: Verifies database; on top of normal checking, specific for primary:
      - Checks for table space availability; any table space in abnormal state reports warning:
        `DBT5552W The db2ckupgrade utility has detected that a table space is in an invalid state on the HADR standby database and needs attention.`
      - **Validates primary log shipping position matches with each standby's log replay position**
        - Waits approx. `hadr_timeout` / 2 seconds; minimum 5 seconds
        - Purpose is to avoid moving to new release and need to replay downlevel log records
        - On error:
          `DBT5535N The db2ckupgrade utility failed because the HADR primary's log shipping position does not match the HADR standby's log replay position.`

45

HADR Major Version Upgrade – Considerations – Page 7 of 7
db2iupgrade / db2ckupgrade (continued)

- Detects version of downlevel database and for HADR databases:
  - If supports only old procedure
    - Standby: Reports failure – SQL1776N rc = 3:
      `The UPGRADE DATABASE command is not supported on an HADR standby database.`
      ➔ recommend DROP DATABASE to continue
    - Primary: Under db2iupgrade executes STOP HADR; reports:
      `DBT5551I The db2ckupgrade utility has detected an HADR primary database and has successfully stopped HADR services. The HADR role has been changed to STANDARD.`

- 10.5.0.7+: If all checks pass will set database to UPGRADE PENDING state
  - Prevents new connections and workload after validation has happened

HADR Major Version Upgrade

- General Upgrade Planning / Considerations
- **HADR Major Version Upgrade Requiring Standby Re-initialization**
- HADR Single Standby Major Version Upgrade
- HADR Multiple Standby Major Version Upgrade
  - HADR Multiple Standby Major Version Upgrade - Overview
  - HADR Multiple Standby Major Version Upgrade – Method 1
  - HADR Multiple Standby Major Version Upgrade – Method 2
- HADR pureScale Major Version Upgrade
- HADR Major Version Upgrade in an Automated Environment
- HADR Major Version Upgrade – Dealing with Failures
- HADR Major Version Upgrade – The Future

Learning Objectives

IDUG Leading the DB2 User Community since 1988

IDUG DB2 North American Tech Conference
Anaheim, California | April 30 - May 4, 2017

#IDUGDB2

HADR Major Version Upgrade Requiring Standby Re-initialization – Page 1 of 3

Sample Scenario:

- Single database A in an ESE instance
- Primary on host 1 and standby on host 2

- **Step 0 of 8:** Prepare for upgrade
  - Standby will need to be re-initialized
  - ESE coming from 9.7.x.x or 10.1.x.x or 10.5.0.6 (or earlier)
  - pureScale coming from 10.1.x.x or 10.5.0.8 (or earlier)
  - Last resort on failure of new procedure

- **Step 1**: (Primary) Stop HADR, database and instance
  - STOP HADR
  - Shutdown primary database – DEACTIVATE DATABASE
  - Stop instance – db2stop

48

Upgrading DB2 servers in HADR environments

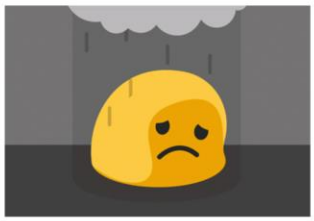
https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.qb.upgrade.doc/doc/t0070030.html

HADR Major Version Upgrade Requiring Standby Re-initialization – Page 2 of 3

- **Step 2:** (Primary) Install new version and upgrade instance software / hardware
  - Includes db2iupgrade and all pre- / during / post- upgrade tasks
- **Step 3:** (Primary) Upgrade database; take new database backup and ship to standby
  - UPGRADE DATABASE
  - Perform post upgrade tasks
  - Verify new release meets expectations
  - BACKUP DATABASE
  - Ship backup image (or make available) to standby site
- **Step 4:** (Standby) Drop database and stop instance
  - Shutdown standby database – DEACTIVATE DATABASE
  - DROP DATABASE
  - Stop instance – db2stop

HADR Major Version Upgrade Requiring Standby Re-initialization – Page 3 of 3

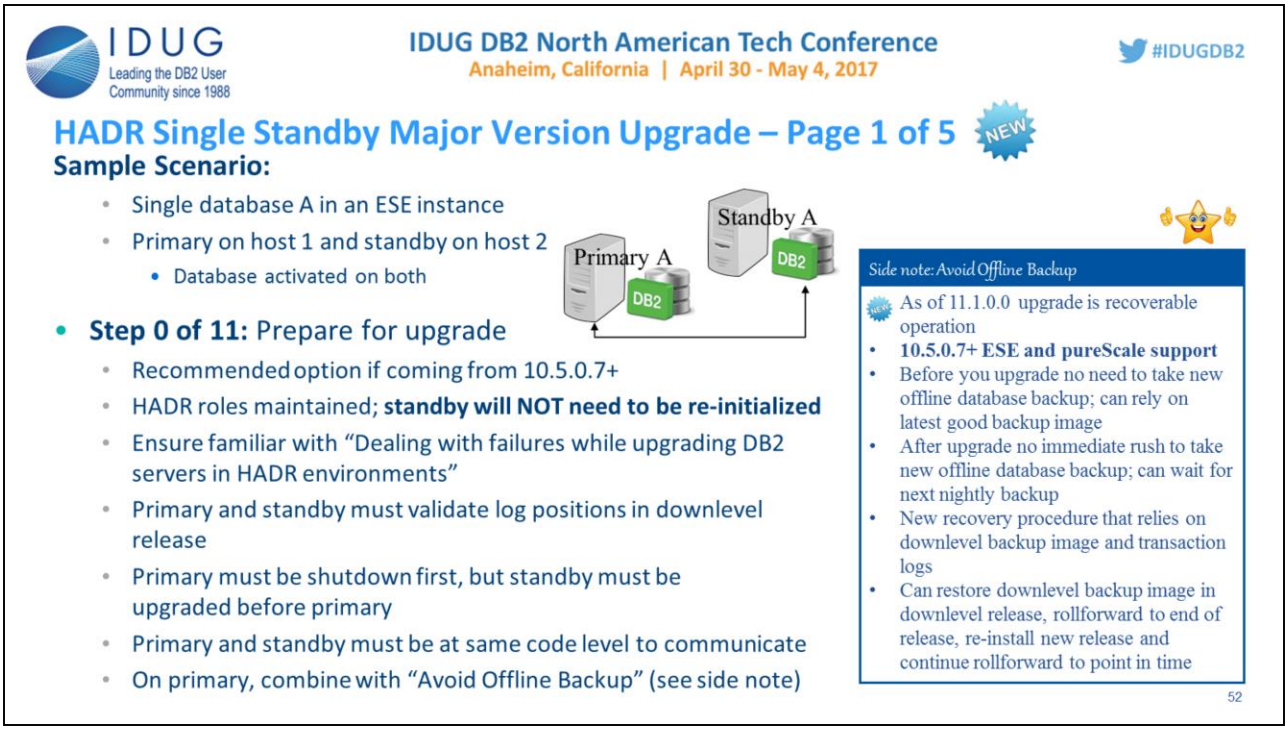
- **Step 5:** (Standby) Install new version and upgrade instance software / hardware
- **Step 6:** (Standby) Restore database backup image from primary
  - RESTORE DATABASE
- **Step 7:** (Standby) Configure and start HADR
  - Set configuration parameters
  - START HADR … AS STANDBY
- **Step 8:** (Primary) Configure and start HADR
  - Set configuration parameters
  - START HADR … AS PRIMARY



HADR Major Version Upgrade

- General Upgrade Planning / Considerations
- HADR Major Version Upgrade Requiring Standby Re-initialization
- **HADR Single Standby Major Version Upgrade**
- HADR Multiple Standby Major Version Upgrade
  - HADR Multiple Standby Major Version Upgrade - Overview
  - HADR Multiple Standby Major Version Upgrade – Method 1
  - HADR Multiple Standby Major Version Upgrade – Method 2
- HADR pureScale Major Version Upgrade
- HADR Major Version Upgrade in an Automated Environment
- HADR Major Version Upgrade – Dealing with Failures
- HADR Major Version Upgrade – The Future

Learning Objectives



Upgrading DB2 servers in HADR environments (without standby reinitialization)

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.qb.upgrade.doc/doc/t0070029.html

Recovering through a DB2 server upgrade

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.qb.upgrade.doc/doc/t0070050.html

HADR Single Standby Major Version Upgrade – Page 2 of 5 NEW

- **Step 1:** (Primary) [RoS] Turn on `logindexbuild`
  - Index recreation done during upgrade replayed on standby
  - Allows read connections to resume post upgrade on standby
- **Step 2:** (Standby) Turn off `hadr_replay_delay`
  - Set `hadr_replay_delay` to 0
  - Allows standby's log replay position to catch up to the primary's log shipping position
- **Step 3:** (Primary) Monitor log positions
  - Ensure primary log shipping and standby log replay positions are "healthy"
  - Helps to reduce the chance of failures later in the process
  - Use db2pd –hadr or MON_GET_HADR
  - Adjust `hadr_timeout` accordingly to prepare for log position validation

HADR Single Standby Major Version Upgrade – Page 3 of 5 NEW

- **Step 4:** (Primary) Stop database and instance
  - Need to stop log activity
  - Shutdown primary database – DEACTIVATE DATABASE
  - Prevent database from being activated unintentionally
  - Stop instance – db2stop
  - **NOTE:** Standby is still activated

- **Step 5:** (Primary) Install new version and upgrade instance software / hardware
  - KEY Upgrade instance using `db2iupgrade`, calls `db2ckupgrade` under the covers
  - **Validates primary log shipping position matches with standby's log replay position**
    - Waits approx. `hadr_timeout` / 2 seconds; minimum 5 seconds
    - Purpose is to avoid moving to new release and need to replay downlevel log records
  - On success, database marked upgrade pending – new log activity prevented

HADR Single Standby Major Version Upgrade – Page 4 of 5 NEW

- **Step 6:** (Standby) Stop database and instance
  - Shutdown standby database – DEACTIVATE DATABASE
  - Stop instance – db2stop
- **Step 7:** (Standby) Install new version and upgrade instance software / hardware
  - Upgrade instance using **db2iupgrade**, calls **db2ckupgrade** under the covers
  - Will skip databases marked as a supported standby
- **Step 8:** (Standby) Start database upgrade on standby
  - Upgrade standby database – UPGRADE DATABASE ➔ asynchronous
    - `SQL1103W The UPGRADE DATABASE command was completed successfully.`
  - Will upgrade database metadata files and starts replay service in background
  - Waits for primary to form a connection
  - Considered upgrade in progress state – monitor with db2pd –hadr (`STANDBY_UPGRADE_IN_PROGRESS`) and db2diag.log
  - [RoS] No new connections are allowed in while in this state; reports failure – SQL1776N rc = 9:
    `Connection requests to an HADR standby are not allowed while database upgrade is in progress.`

HADR Single Standby Major Version Upgrade – Page 5 of 5

- **Step 9:** (Primary) Start database upgrade on primary
  - Upgrade primary database – UPGRADE DATABASE ➔ synchronous
    - `DB20000I The UPGRADE DATABASE command completed successfully.`
  - Consider REBINDALL option
  - Will upgrade database metadata files and attempts to form a connection with standby
  - Must have a standby at same code level available to communicate
  - Once complete primary will deactivate
- **Step 10:** (Primary) Start using database in new DB2 version
  - Start primary database – ACTIVATE DATABASE
  - Monitor standby upgrade progress – db2pd –hadr (no `STANDBY_UPGRADE_IN_PROGRESS`)
    - Standby will stay activated once it completes replay of upgrade log data
  - Perform post upgrade tasks
- **Step 11:** (Primary / Standby) Verify database configuration parameters
  - Reset values like `hadr_timeout`, `logindexbuild`, `hadr_replay_delay`

HADR Major Version Upgrade

- General Upgrade Planning / Considerations
- HADR Major Version Upgrade Requiring Standby Re-initialization
- HADR Single Standby Major Version Upgrade
- **HADR Multiple Standby Major Version Upgrade**
  - **HADR Multiple Standby Major Version Upgrade - Overview**
  - **HADR Multiple Standby Major Version Upgrade – Method 1**
  - HADR Multiple Standby Major Version Upgrade – Method 2
- HADR pureScale Major Version Upgrade
- HADR Major Version Upgrade in an Automated Environment
- HADR Major Version Upgrade – Dealing with Failures
- HADR Major Version Upgrade – The Future

Learning Objectives

IDUG
Leading the DB2 User Community since 1988

IDUG DB2 North American Tech Conference
Anaheim, California | April 30 - May 4, 2017

#IDUGDB2

HADR Multiple Standby Major Version Upgrade - Overview NEW

Multiple standby configurations have a choice between two upgrade methods:

1. **Method 1: Upgrade all standbys together to 11.1.x.x**
   - Committed to moving and staying in new code level
   - Many of the standby steps can be completed in parallel
     - In theory principal first, auxiliaries at your own pace
   - Like to keep procedure common among all standbys

2. **Method 2: Leave some auxiliary standby behind in 10.5.0.x**
   - Upgrade primary and principal standby first
   - Want a fail safe in case of complications with procedure or new code level

58

Upgrading DB2 servers in HADR multiple standby environments (without standby reinitialization)

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.qb.upgrade.doc/doc/t0070095.html

IDUG
Leading the DB2 User Community since 1988

IDUG DB2 North American Tech Conference
Anaheim, California | April 30 - May 4, 2017

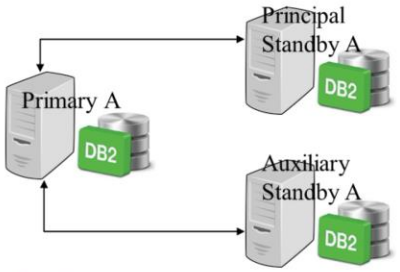
#IDUGDB2

HADR Multiple Standby Major Version Upgrade - Method 1 – Page 1 of 5

NEW

Sample Scenario:

- Single database A in an ESE instance
- Primary on host 1; principal standby on host 2; auxiliary standby on host 3
  - Database activated on all
- Upgrade all standbys together in parallel



- **Step 0 of 11:** Prepare for upgrade
  - HADR roles maintained; **standby will NOT need to be re-initialized**
  - Ensure familiar with "Dealing with failures while upgrading DB2 servers in HADR environments"
  - Primary and **all** standbys must validate log positions in downlevel release
  - Primary must be shutdown first, but **principal** standby must be upgraded before primary
  - **All standbys can be upgraded in parallel**
  - Primary and each standby must be at same code level to communicate
  - On primary, combine with "Avoid Offline Backup"

59

Recovering through a DB2 server upgrade

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.qb.upgrade.doc/doc/t0070050.html

HADR Multiple Standby Major Version Upgrade - Method 1 – Page 2 of 5

- **Step 1:** (Primary) [RoS] Turn on `logindexbuild`
  - Index recreation done during upgrade replayed on each standby
  - Allows read connections to resume post upgrade on each standby
- **Step 2:** (All Standbys) Turn off `hadr_replay_delay`
  - For each standby (in parallel, principal first)
    - Set `hadr_replay_delay` to 0
  - Allows each standby's log replay position to catch up to the primary's log shipping position
- **Step 3:** (Primary) Monitor log positions
  - Ensure primary log shipping and all standby log replay positions are "healthy"
  - Helps to reduce the chance of failures later in the process
  - Use db2pd –hadr or MON_GET_HADR
  - Adjust `hadr_timeout` accordingly to prepare for log position validation

HADR Multiple Standby Major Version Upgrade - Method 1 – Page 3 of 5

NEW

- **Step 4:** (Primary) Stop database and instance
  - Need to stop log activity
  - Shutdown primary database – DEACTIVATE DATABASE
  - Prevent database from being activated unintentionally
  - Stop instance – db2stop
  - **NOTE:** All standbys are still activated

- **Step 5:** (Primary) Install new version and upgrade instance software / hardware
  - KEY Upgrade instance using `db2iupgrade`, calls `db2ckupgrade` under the covers
  - **Validates primary log shipping position matches with all standby's log replay position**
    - Waits approx. `hadr_timeout` / 2 seconds; minimum 5 seconds
    - Purpose is to avoid moving to new release and need to replay downlevel log records
  - On success, database marked upgrade pending – new log activity prevented

HADR Multiple Standby Major Version Upgrade - Method 1 – Page 4 of 5

NEW

- **Step 6:** (All Standbys) Stop database and instance
  - For each standby (in parallel, principal first)
    - Shutdown standby database – DEACTIVATE DATABASE
    - Stop instance – db2stop
- **Step 7:** (All Standbys) Install new version and upgrade instance software / hardware
  - For each standby (in parallel, principal first)
    - Upgrade instance using **db2iupgrade**, calls **db2ckupgrade** under the covers
    - Will skip databases marked as a supported standby
- **Step 8:** (All Standbys) Start database upgrade on standby
  - For each standby (in parallel, principal first)
    - Upgrade standby database – UPGRADE DATABASE → asynchronous
      - `SQL1103W The UPGRADE DATABASE command was completed successfully.`
    - Will upgrade database metadata files and starts replay service in background
    - Waits for primary to form a connection
    - Considered upgrade in progress state – monitor with db2pd –hadr (`STANDBY_UPGRADE_IN_PROGRESS`) and db2diag.log
    - [RoS] No new connections are allowed in while in this state; reports failure – SQL1776N rc = 9:
      `Connection requests to an HADR standby are not allowed while database upgrade is in progress.`

HADR Multiple Standby Major Version Upgrade - Method 1 – Page 5 of 5

NEW

- **Step 9:** (Primary) Start database upgrade on primary
  - Upgrade primary database – UPGRADE DATABASE ➔ synchronous
    - `DB20000I The UPGRADE DATABASE command completed successfully.`
  - Consider REBINDALL option
  - Will upgrade database metadata files and attempts to form a connection with standby
  - Must have a standby at same code level available to communicate
  - Once complete primary will deactivate
- **Step 10:** (Primary) Start using database in new DB2 version
  - Start primary database – ACTIVATE DATABASE
  - Monitor each standby's upgrade progress – db2pd –hadr (no `STANDBY_UPGRADE_IN_PROGRESS`)
    - Standby will stay activated once it completes replay of upgrade log data
  - Perform post upgrade tasks
- **Step 11:** (Primary / All Standbys) Verify database configuration parameters
  - Reset values like `hadr_timeout`, `logindexbuild`, `hadr_replay_delay`

HADR Major Version Upgrade

- General Upgrade Planning / Considerations
- HADR Major Version Upgrade Requiring Standby Re-initialization
- HADR Single Standby Major Version Upgrade
- HADR Multiple Standby Major Version Upgrade
  - HADR Multiple Standby Major Version Upgrade - Overview
  - HADR Multiple Standby Major Version Upgrade – Method 1
  - **HADR Multiple Standby Major Version Upgrade – Method 2**
- HADR pureScale Major Version Upgrade
- HADR Major Version Upgrade in an Automated Environment
- HADR Major Version Upgrade – Dealing with Failures
- HADR Major Version Upgrade – The Future

Learning Objectives

IDUG
Leading the DB2 User Community since 1988

IDUG DB2 North American Tech Conference
Anaheim, California | April 30 - May 4, 2017

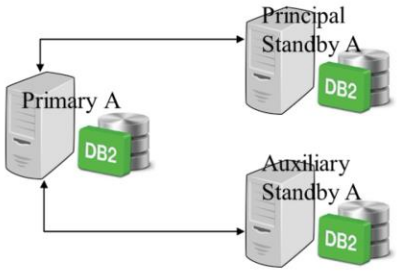
#IDUGDB2

HADR Multiple Standby Major Version Upgrade - Method 2 – Page 1 of 6

NEW

Sample Scenario:

- Single database A in an ESE instance
- Primary on host 1; principal standby on host 2; auxiliary standby on host 3
  - Database activated on all
- Upgrade primary and principal, but leave auxiliary standby behind



- **Step 0 of 14:** Prepare for upgrade
  - Recommended option if coming from 10.5.0.7+
  - Recommended of two multiple standby methods
  - HADR roles maintained; **standby will NOT need to be re-initialized**
  - Ensure familiar with "Dealing with failures while upgrading DB2 servers in HADR environments"
  - Primary and **all** standbys must validate log positions in downlevel release
  - Primary must be shutdown first, but **principal** standby must be upgraded before primary
  - **Leave auxiliary standby in downlevel until primary and principal standby upgraded successfully**
  - Primary and each standby must be at same code level to communicate
  - On primary, combine with "Avoid Offline Backup"

65

Recovering through a DB2 server upgrade

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.qb.upgrade.doc/doc/t0070050.html

HADR Multiple Standby Major Version Upgrade - Method 2 – Page 2 of 6

- **Step 1:** (Primary) [RoS] Turn on `logindexbuild`
  - Index recreation done during upgrade replayed on each standby
  - Allows read connections to resume post upgrade on each standby
- **Step 2:** (All Standbys) Turn off `hadr_replay_delay`
  - For each standby (in parallel, principal first)
    - Set `hadr_replay_delay` to 0
  - Allows each standby's log replay position to catch up to the primary's log shipping position
- **Step 3:** (Primary) Monitor log positions
  - Ensure primary log shipping and all standby log replay positions are "healthy"
  - Helps to reduce the chance of failures later in the process
  - Use db2pd –hadr or MON_GET_HADR
  - Adjust `hadr_timeout` accordingly to prepare for log position validation

HADR Multiple Standby Major Version Upgrade - Method 2 – Page 3 of 6

NEW

- **Step 4:** (Primary) Stop database and instance
  - Need to stop log activity
  - Shutdown primary database – DEACTIVATE DATABASE
  - Prevent database from being activated unintentionally
  - Stop instance – db2stop
  - **NOTE:** All standbys are still activated

- **Step 5:** (Primary) Install new version and upgrade instance software / hardware
  - KEY Upgrade instance using `db2iupgrade`, calls `db2ckupgrade` under the covers
  - **Validates primary log shipping position matches with <u>all</u> standby's log replay position**
    - Waits approx. `hadr_timeout` / 2 seconds; minimum 5 seconds
    - Purpose is to avoid moving to new release and need to replay downlevel log records
  - On success, database marked upgrade pending – new log activity prevented

HADR Multiple Standby Major Version Upgrade - Method 2 – Page 4 of 6

- **Step 6:** (All Standbys) Stop database and instance
  - For each standby (in parallel, principal first)
    - Shutdown standby database – DEACTIVATE DATABASE
    - Stop instance – db2stop
- **Step 7:** (Principal Standby) Install new version and upgrade instance software / hardware
  - Upgrade instance using **db2iupgrade**, calls **db2ckupgrade** under the covers
  - Will skip databases marked as a supported standby
- **Step 8:** (Principal Standby) Start database upgrade on standby
  - Upgrade standby database – UPGRADE DATABASE ➔ asynchronous
    - `SQL1103W The UPGRADE DATABASE command was completed successfully.`
  - Will upgrade database metadata files and starts replay service in background
  - Waits for primary to form a connection
  - Considered upgrade in progress state – monitor with db2pd –hadr (`STANDBY_UPGRADE_IN_PROGRESS`) and db2diag.log
  - [RoS] No new connections are allowed in while in this state; reports failure – SQL1776N rc = 9:
    `Connection requests to an HADR standby are not allowed while database upgrade is in progress.`

HADR Multiple Standby Major Version Upgrade - Method 2 – Page 5 of 6

- **Step 9:** (Primary) Start database upgrade on primary
  - Upgrade primary database – UPGRADE DATABASE ➔ synchronous
    - `DB20000I The UPGRADE DATABASE command completed successfully.`
  - Consider REBINDALL option
  - Will upgrade database metadata files and attempts to form a connection with standby
  - Must have a standby at same code level available to communicate
  - Once complete primary will deactivate
- **Step 10:** (Primary) Start using database in new DB2 version
  - Start primary database – ACTIVATE DATABASE
  - Monitor each standby's upgrade progress – db2pd –hadr (no `STANDBY_UPGRADE_IN_PROGRESS`)
    - Standby will stay activated once it completes replay of upgrade log data
  - Perform post upgrade tasks
- **Step 11:** (Primary / Principal Standby) Verify database configuration parameters
  - Reset values like `hadr_timeout`, `logindexbuild`, `hadr_replay_delay`

HADR Multiple Standby Major Version Upgrade - Method 2 – Page 6 of 6

- **Step 12:** (Auxiliary Standby) Install new version and upgrade instance software / hardware
  - Once satisfied with new code level can begin with auxiliary
  - Same as principal standby
- **Step 13:** (Auxiliary Standby) Start database upgrade on standby
  - Same as principal standby
- **Step 14:** (Auxiliary Standby) Verify database configuration parameters
  - Reset values like `hadr_replay_delay`

HADR Major Version Upgrade

- General Upgrade Planning / Considerations
- HADR Major Version Upgrade Requiring Standby Re-initialization
- HADR Single Standby Major Version Upgrade
- HADR Multiple Standby Major Version Upgrade
  - HADR Multiple Standby Major Version Upgrade - Overview
  - HADR Multiple Standby Major Version Upgrade – Method 1
  - HADR Multiple Standby Major Version Upgrade – Method 2
- **HADR pureScale Major Version Upgrade**
- HADR Major Version Upgrade in an Automated Environment
- HADR Major Version Upgrade – Dealing with Failures
- HADR Major Version Upgrade – The Future

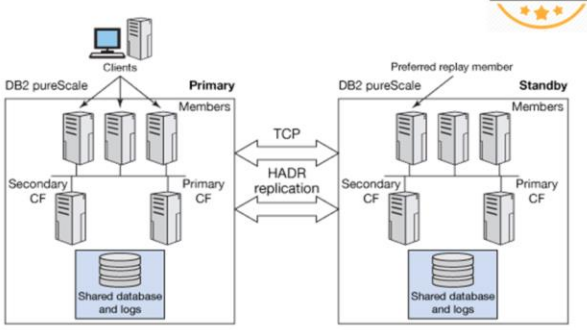
Learning Objectives

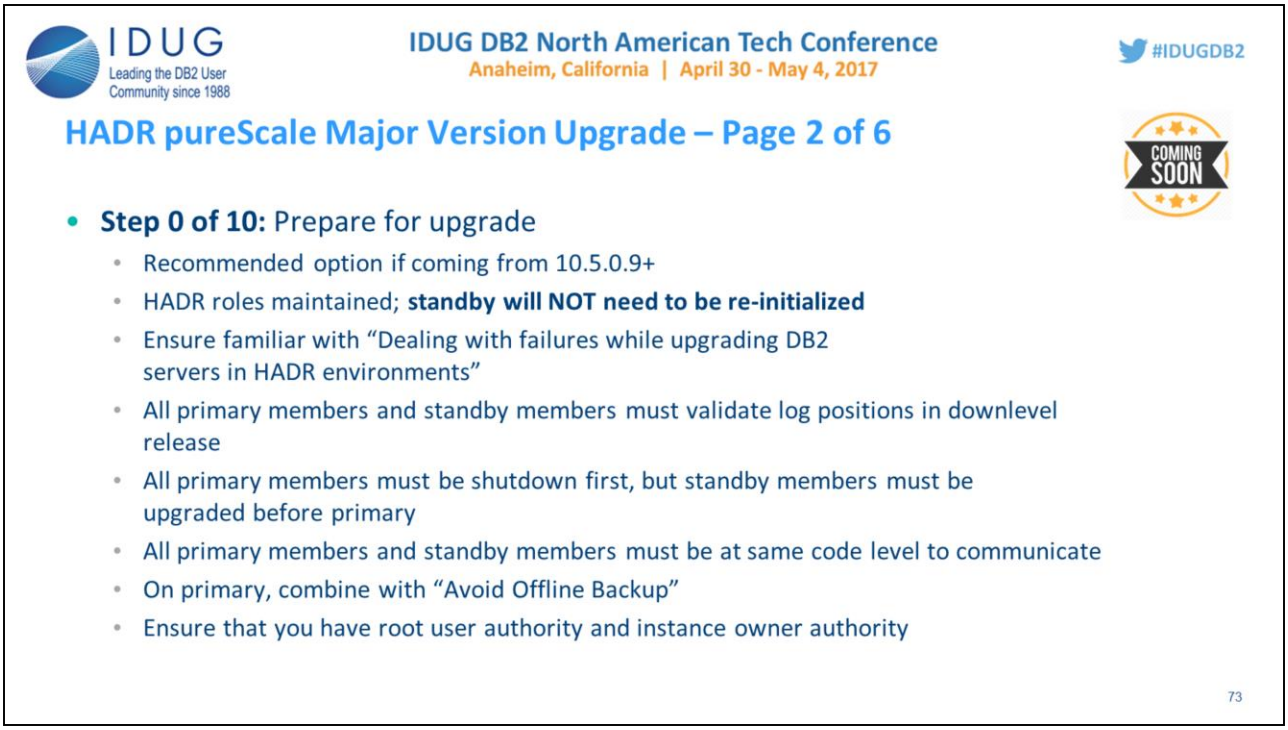
HADR pureScale Major Version Upgrade – Page 1 of 6

COMING SOON

Sample Scenario:

- Single database A in a pureScale instance
- Primary cluster:
  - Two CF servers
  - Members m0 / m1 / m2
- Secondary cluster:
  - Two CF servers
  - Members m0 / m1 / m2
- Database activated on both





Upgrading DB2 servers in HADR pureScale environments (without standby reinitialization)

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.qb.upgrade.doc/doc/t0070096.html

Upgrading a DB2 pureScale server

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.qb.upgrade.doc/doc/t0060571.html

Recovering through a DB2 server upgrade

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.qb.upgrade.doc/doc/t0070050.html

HADR pureScale Major Version Upgrade – Page 3 of 6

- **Step 1:** (Standby cluster) Turn off `hadr_replay_delay`
  - Set `hadr_replay_delay` to 0
  - Allows standby's log replay position to catch up to all the primary member's log shipping positions
- **Step 2:** (Primary cluster) Monitor log positions
  - Ensure on all members that primary log shipping and standby log replay positions are "healthy"
  - Helps to reduce the chance of failures later in the process
  - Use db2pd –hadr or MON_GET_HADR
  - Adjust `hadr_timeout` accordingly to prepare for log position validation

HADR pureScale Major Version Upgrade – Page 4 of 6

- **Step 3:** (Primary cluster) Stop database and instance
  - Need to stop log activity
  - Shutdown primary database – DEACTIVATE DATABASE
  - Prevent database from being activated unintentionally
  - Stop instance on all members and CFs – db2stop
  - **NOTE:** Standby is still activated

- **Step 4:** (Primary cluster) Install new version and upgrade instance software / hardware
  - KEY Upgrade instance on all members and CFs using `db2iupgrade`, calls `db2ckupgrade` under the covers
  - **Validates on all members primary's log shipping position matches with standby's log replay position**
    - Waits approx. `hadr_timeout` / 2 seconds; minimum 5 seconds
    - Purpose is to avoid moving to new release and need to replay downlevel log records
  - On success, database marked upgrade pending – new log activity prevented

HADR pureScale Major Version Upgrade – Page 5 of 6

- **Step 5:** (Standby cluster) Stop database and instance
  - Shutdown standby database – DEACTIVATE DATABASE
  - Stop instance on all members and CFs – db2stop
- **Step 6:** (Standby cluster) Install new version and upgrade instance software / hardware
  - Upgrade instance on all members and CFs using **db2iupgrade**, calls **db2ckupgrade** under the covers
  - Will skip databases marked as a supported standby
- **Step 7:** (Standby cluster) Start database upgrade on standby
  - From preferred member, upgrade standby database – UPGRADE DATABASE ➔ asynchronous
    - `SQL1103W The UPGRADE DATABASE command was completed successfully.`
  - Will upgrade database metadata files and starts replay service in background
  - Waits for primary to form a connection
  - Considered upgrade in progress state – monitor with db2pd –hadr (`STANDBY_UPGRADE_IN_PROGRESS`) and db2diag.log

HADR pureScale Major Version Upgrade – Page 6 of 6

- **Step 8:** (Primary cluster) Start database upgrade on primary
  - Upgrade primary database – UPGRADE DATABASE ➔ synchronous
    - `DB20000I The UPGRADE DATABASE command completed successfully.`
  - Consider REBINDALL option
  - Will upgrade database metadata files and attempts to form a connection with standby
  - Must have all standbys at same code level available to communicate
  - Once complete primary will deactivate
- **Step 9:** (Primary cluster) Start using database in new DB2 version
  - Start primary database – ACTIVATE DATABASE
  - Monitor standby upgrade progress – db2pd –hadr (no `STANDBY_UPGRADE_IN_PROGRESS`)
    - Standby will stay activated once it completes replay of upgrade log data
  - Perform post upgrade tasks
- **Step 10:** (Primary / Standby cluster) Verify database configuration parameters
  - Reset values like `hadr_timeout`, `hadr_replay_delay`

77

HADR Major Version Upgrade

- General Upgrade Planning / Considerations
- HADR Major Version Upgrade Requiring Standby Re-initialization
- HADR Single Standby Major Version Upgrade
- HADR Multiple Standby Major Version Upgrade
  - HADR Multiple Standby Major Version Upgrade - Overview
  - HADR Multiple Standby Major Version Upgrade – Method 1
  - HADR Multiple Standby Major Version Upgrade – Method 2
- HADR pureScale Major Version Upgrade
- **HADR Major Version Upgrade in an Automated Environment**
- HADR Major Version Upgrade – Dealing with Failures
- HADR Major Version Upgrade – The Future

Learning Objectives

IDUG
Leading the DB2 User Community since 1988

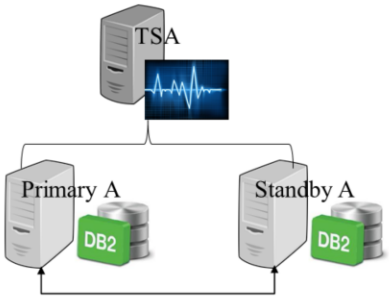
IDUG DB2 North American Tech Conference
Anaheim, California | April 30 - May 4, 2017

#IDUGDB2

HADR Major Version Upgrade in an Automated Environment NEW

Sample Scenario:

- Single database A in an ESE instance
- Primary on host 1 and standby on host 2
  - Database activated on both
- Instances configured with TSA for HADR failover



- **Step 0 of 3:** Prepare for upgrade
  - Decide what non-automated HADR upgrade procedure to use and follow same prepare step
- **Step 1:** (Host 1 & Host2) Delete automated resources
  - Delete cluster domain – `db2haicu -delete`
- **Step 2:** Follow steps from appropriate non-automated HADR upgrade procedure
- **Step 3:** (Host 1 & Host2) Re-enable automation
  - Use `db2haicu` command

79

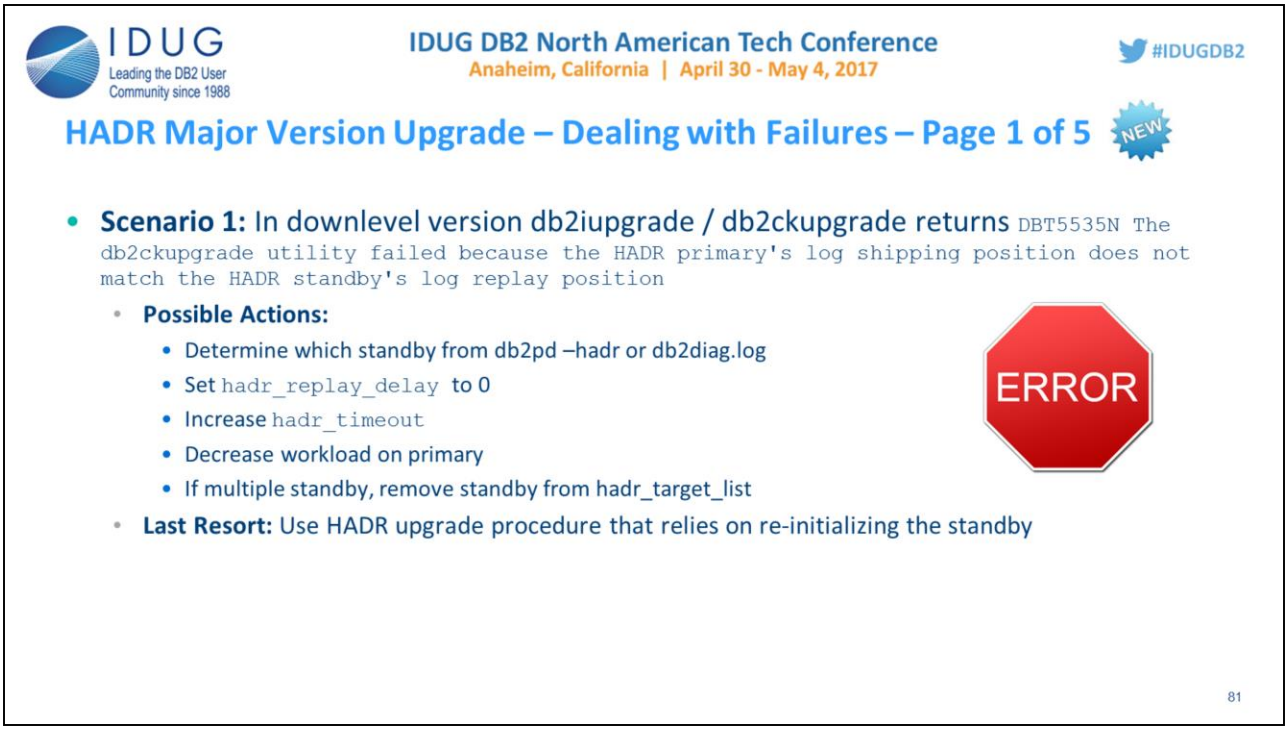
Upgrading DB2 servers in an automated HADR environment

https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.qb.upgrade.doc/doc/t0070016.html

HADR Major Version Upgrade

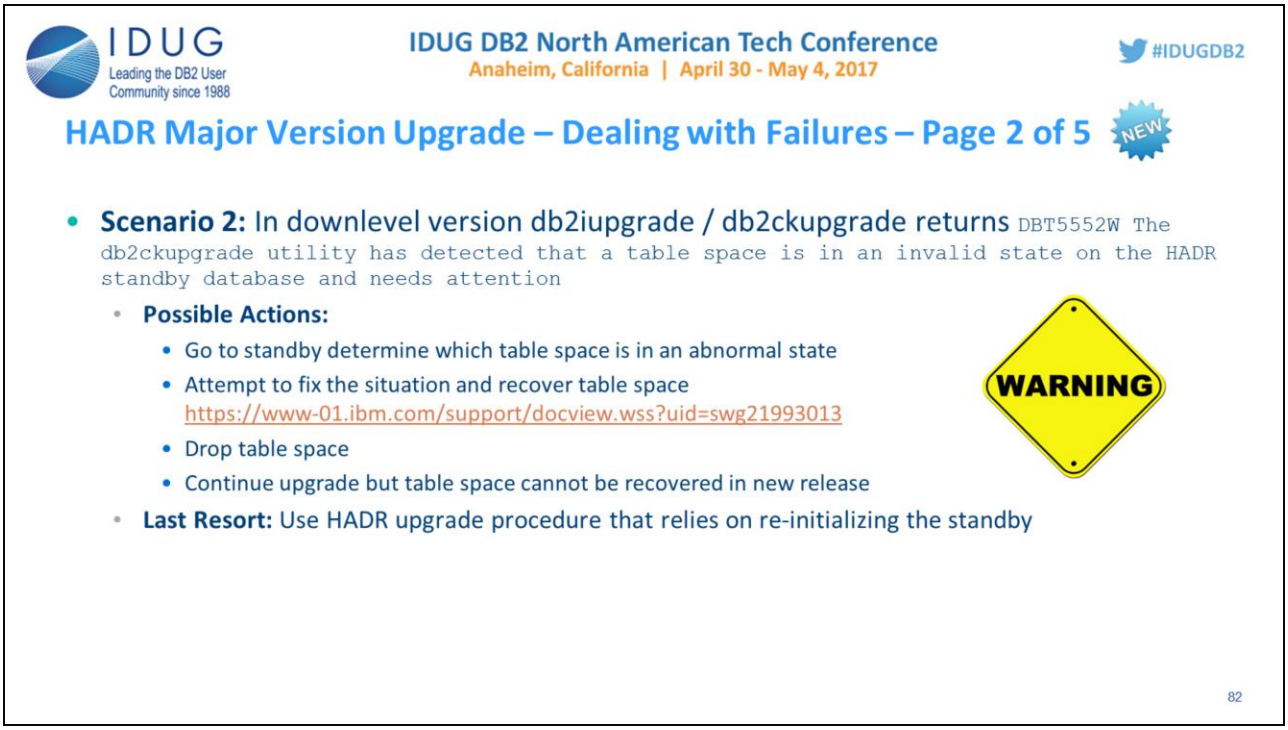
- General Upgrade Planning / Considerations
- HADR Major Version Upgrade Requiring Standby Re-initialization
- HADR Single Standby Major Version Upgrade
- HADR Multiple Standby Major Version Upgrade
  - HADR Multiple Standby Major Version Upgrade - Overview
  - HADR Multiple Standby Major Version Upgrade – Method 1
  - HADR Multiple Standby Major Version Upgrade – Method 2
- HADR pureScale Major Version Upgrade
- HADR Major Version Upgrade in an Automated Environment
- **HADR Major Version Upgrade – Dealing with Failures**
- HADR Major Version Upgrade – The Future

Learning Objectives



Scenario 1: In DB2 Version 10.5 Fix Pack 7 or later, if the primary's log shipping functionality and the standby's log replay functionality are not healthy causing db2iupgrade/db2ckupgrade to fail.

If the issue cannot be fixed within the upgrade window, then follow the previous HADR procedure that requires the stopping of HADR and reinitialization discussed in Upgrading DB2 servers in HADR environments.



Scenario 2: In DB2 Version 10.5 Fix Pack 7 or later, if the primary's log shipping functionality and the standby's log replay functionality are healthy but the standby's replay position is still behind the primary's log shipping position causing db2iupgrade/db2ckupgrade to fail.

Ensure that replay delay is turned off by setting hadr_replay_delay to 0. Try to allow more time for the standby to catch up by increasing the hadr_timeout value. If neither of these options allow for the log positions to match within the upgrade window, then follow the previous HADR procedure that requires the stopping of HADR and reinitialization discussed in Upgrading DB2 servers in HADR environments.

IDUG Leading the DB2 User Community since 1988

IDUG DB2 North American Tech Conference
Anaheim, California | April 30 - May 4, 2017

#IDUGDB2

HADR Major Version Upgrade – Dealing with Failures – Page 3 of 5

NEW

- **Symptom 3:** In downlevel version the primary database becomes unavailable and cannot be brought back up within upgrade window
  - **Possible Actions:**
    - Switch roles through TAKEOVER HADR and use HADR upgrade procedure that relies on re-initializing the standby
- **Symptom 4:** In downlevel version the standby database becomes unavailable and cannot be brought back up within upgrade window
  - **Possible Actions:**
    - Use HADR upgrade procedure that relies on re-initializing the standby

83

Scenario 3: In DB2 Version 10.5 Fix Pack 7 or later, if the primary database becomes unavailable preventing db2iupgrade/db2ckupgrade from being run.

If the primary database cannot be brought back up within the upgrade window, switch roles on the standby and then follow the previous HADR procedure that requires the stopping of HADR and reinitialization discussed in Upgrading DB2 servers in HADR environments.

Scenario 4: In DB2 Version 10.5 Fix Pack 7 or later, if the standby database becomes unavailable preventing db2iupgrade/db2ckupgrade from being run.

If the standby database cannot be brought back up within the upgrade window, then follow the previous HADR procedure that requires the stopping of HADR and reinitialization discussed in Upgrading DB2 servers in HADR environments.

IDUG Leading the DB2 User Community since 1988

IDUG DB2 North American Tech Conference
Anaheim, California | April 30 - May 4, 2017

#IDUGDB2

HADR Major Version Upgrade – Dealing with Failures – Page 4 of 5

NEW

- **Symptom 5:** In uplevel version the primary database becomes unavailable preventing the upgrade procedure from starting or continuing on the standby
  - **Possible Actions:**
    - No TAKEOVER HADR allowed
    - On standby, turn database into standard
      - STOP HADR and ROLLFORWARD DATABASE with STOP option
      - UPGRADE DATABASE and re-initialize the standby

- **Symptom 6:** In uplevel version the standby database becomes unavailable preventing the UPGRADE DATABASE command from starting on the primary
  - **Possible Actions:**
    - STOP HADR
    - UPGRADE DATABASE and re-initialize the standby

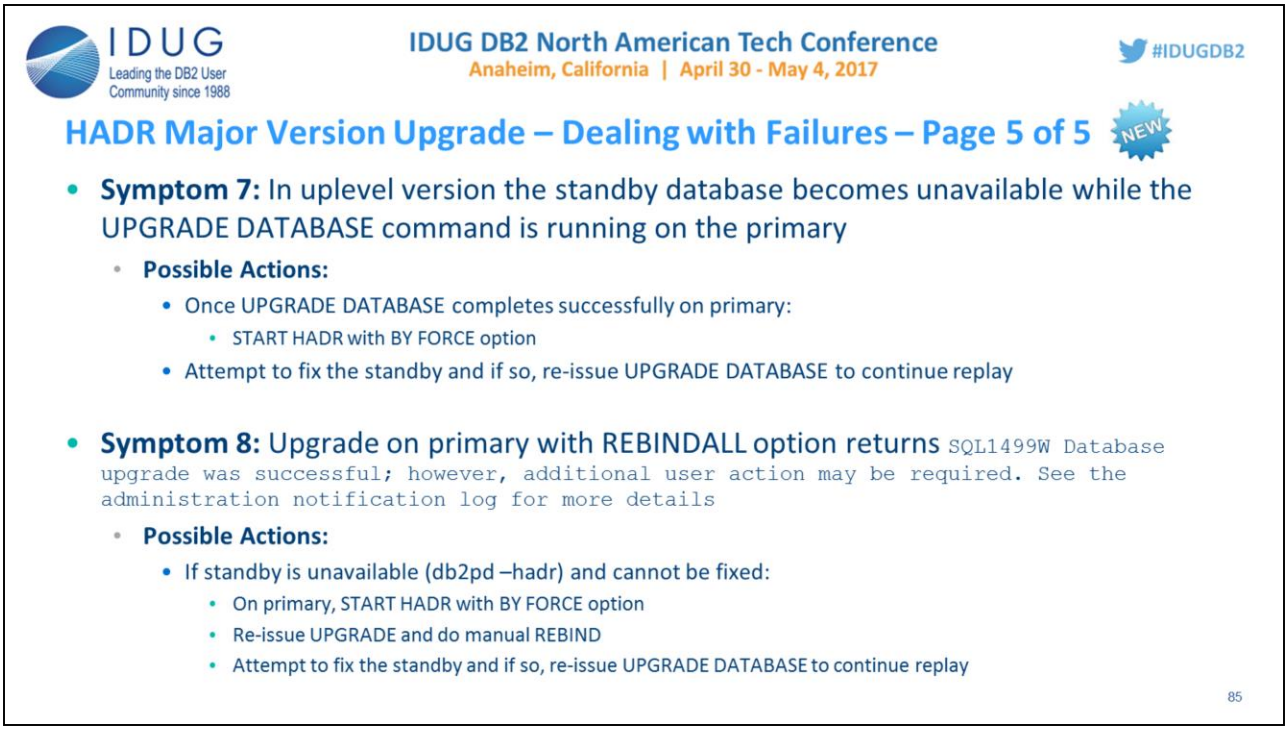
84

Scenario 5: In DB2 Version 11.1, if the primary database becomes unavailable preventing the upgrade procedure from continuing on the standby.

If the primary database cannot be brought back up within the upgrade window, on the standby issue STOP HADR followed by ROLLFORWARD DATABASE with the STOP option. This will turn the database into a non-HADR database. The database will now be upgrade pending and so issue the UPGRADE DATABASE command to continue the upgrade. Once complete refer to Post-upgrade tasks for DB2 servers and Verifying upgrade of DB2 servers. HADR must be reinitialized.

Scenario 6: In DB2 Version 11.1, if the standby database becomes unavailable preventing the UPGRADE DATABASE command from starting up on the primary.

If the standby database cannot be brought back up within the upgrade window, on the primary issue STOP HADR. This turns the database into a non-HADR database. The database will still be upgrade pending so reissue the UPGRADE DATABASE command to continue the upgrade. Once complete refer to Post-upgrade tasks for DB2 servers and Verifying upgrade of DB2 servers. HADR will have to be reinitialized.



Scenario 7: In DB2 Version 11.1, if the standby database becomes unavailable while in upgrade in progress state.

Once the UPGRADE DATABASE command is issued on the primary and the primary forms a connection with a standby database, the upgrade will proceed without issue on the primary and will eventually complete successfully. The concern is that there is no standby database replaying log data, which leaves an exposure to a loss of the primary. Post upgrade the primary database can still be brought up through the START HADR command specifying the BY FORCE option. At this point, all attempts should be made to resolve the issues with the standby. Once resolved, since the standby was in upgrade in progress state, the UPGRADE DATABASE command should be issued. The standby continues to replay the upgrade log data shipped by the primary until it completes and is no longer in the upgrade in progress state.

Scenario 8: In DB2 Version 11.1, if the UPGRADE DATABASE command with the REBINDALL option was specified on the primary and the standby database becomes unavailable while in upgrade in progress state.

The difference from Scenario 7 is that on the primary the UPGRADE DATABASE command was specified with the REBINDALL option. In this case, the UPGRADE DATABASE command requires and attempts a new connection to the database. If the standby database is not available during this second connection attempt, the UPGRADE DATABASE command returns

SQL1499W. SQL1499W can be returned for many other reasons so the DB2 diagnostics log may be required to tell what failed and whether this scenario applies. If so, the primary database can still be brought up through the START HADR command specifying the BY FORCE option. Rebinding can still take place manually at this point. But, all attempts should be made to resolve the issues with the standby. Once resolved, since the standby was in upgrade in progress state, the UPGRADE DATABASE command should be issued. The standby continues to replay the upgrade log data shipped by the primary until it completes and is no longer in the upgrade in progress state.

At any time, if there are issues with the upgrade to DB2 Version 11.1, you can reverse the upgrade or fall back from DB2 Version 11.1 to a pre-DB2 Version 11.1 release. See Reversing DB2 server upgrade to learn all the required steps to reverse a database upgrade.

HADR Major Version Upgrade

- General Upgrade Planning / Considerations
- HADR Major Version Upgrade Requiring Standby Re-initialization
- HADR Single Standby Major Version Upgrade
- HADR Multiple Standby Major Version Upgrade
  - HADR Multiple Standby Major Version Upgrade - Overview
  - HADR Multiple Standby Major Version Upgrade – Method 1
  - HADR Multiple Standby Major Version Upgrade – Method 2
- HADR pureScale Major Version Upgrade
- HADR Major Version Upgrade in an Automated Environment
- HADR Major Version Upgrade – Dealing with Failures
- **HADR Major Version Upgrade – The Future**

Learning Objectives

HADR Major Version Upgrade – The Future

- In a perfect world we have:
  - Rolling Version Upgrades
    - Treat like fix pack updates
    - Minimal, if any, disruption
    - Better system catalog table support
    - Log replay supports downlevel log record / file formats
  - Other ???

The future is no difference between rolling updates and rolling upgrades. Be able to update/upgrade versions with no or very minimal database outage.

End of Service Dates Reminder

- DB2 LUW Versions 9.7 and 10.1
  - End of service: **September 30, 2017**
  - http://www-01.ibm.com/support/docview.wss?uid=swg21168270

With the announcement of the end of service of DB2 LUW Versions 9.7 and 10.1 now is the time to start preparing your upgrade strategy.

Resources

- DB2 11.1 Knowledge Center – Performing Rolling Updates in HADR
  - https://www.ibm.com/support/knowledgecenter/SSEPGG_11.1.0/com.ibm.db2.luw.admin.ha.doc/doc/t0011766.html
- DB2 11.1 Knowledge Center – Upgrading HADR Environments
  - https://www.ibm.com/support/knowledgecenter/en/SSEPGG_11.1.0/com.ibm.db2.luw.qb.upgrade.doc/doc/c0070028.html
- DB2 Upgrade Portal
  - http://www.ibm.com/software/data/db2/upgrade/portal

89

Come and learn more about general upgrade best practices and what is new by industry expert Melanie Stopfer. These 2 presentations are also available at IDUG NA 2017.

Please complete your evaluations before leaving and connect with Michael on Twitter at @roecken and LinkedIn.