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**Würzburg**

# Update and Upgrades Approaches for Db2 HADR with TSA

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Implementation, upgrade approaches and experiences in Db2 HADR with  
TSAMP

# Content

- Db2 HADR restrictions & prerequisites
- HADR at Customer Data Center (DC)
- Db2 Fixpack Update (Rolling Update)
- Db2 Major Release Upgrade (Rolling Upgrade)

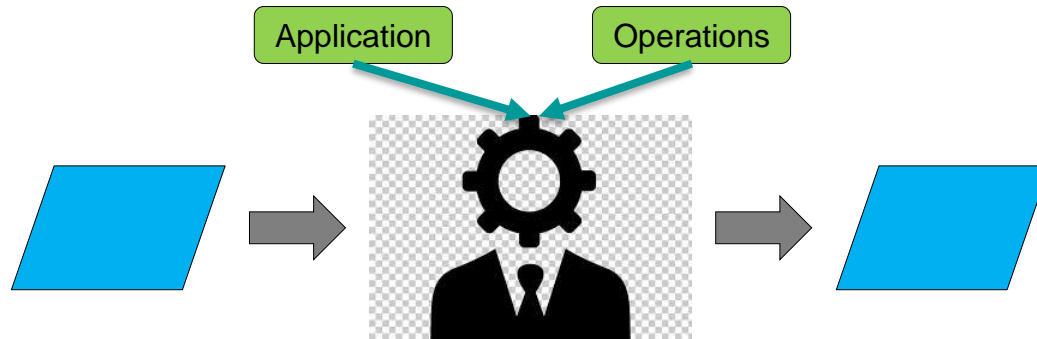
# About me

- Diploma in Informatics
- IBM SWG Services, since 20 years
- Senior IT Specialist Db2 LUW, IBM and Open Group Certified Professional
- My skills: **Db2 LUW** (consulting, performance analysis & tuning, PD, design, JDBC, Db2 on Cloud, replication)
- Main project in last 5 years: Consulting at Customer central database center
- Germany, Stuttgart
- [peter.schurr@de.ibm.com](mailto:peter.schurr@de.ibm.com)

# Objectives

Show you how to

- Assess and refine requirements
  - Specify context of downtime / availability
  - Develop a decision tree
- as a consultant



# Content

- **Db2 HADR restrictions & prerequisites**
- HADR at Customer data center
- Db2 Fixpack Update (Rolling Update)
- Db2 Major Release Upgrade (Rolling Upgrade)

# HADR restrictions & prerequisites

- Same Db2 edition, same Db2 version, same Db2 Fixpack level
- Same OS-level
- **Rolling update** supports diff. Fixpacks and OS sub levels  
E.g. SLES ServicePack can be different during rolling update
- (Rolling) **upgrade** (to newer major release) requires downtime
  
- Same names for Primary and Standby HADR **databases**
- Logging
  - No infinite logging supported
  - TSM archiving: **proxy TSM** node for backup and log archiving required
  - Non logged operations (LOAD, NLI) are not replicated
- Application must be capable of **re-connect** (when takeover occurs)
- Longest Transaction defines minimal HADR takeover duration

# Content

- Db2 HADR restrictions & prerequisites
- **HADR at Customer data center**
- Db2 Fixpack Update (Rolling Update)
- Db2 Major Release Upgrade (Rolling Upgrade)

# HADR at Customer data center (1)

- **SLES 11 & 12**
- **Db2 10.5 and 11.1 (WSE)**
- **Relationship:** One instance <-> one database
- **> 1000 Instances:** DEV / TEST / CONS / PROD
- Main projects requesting HADR
  - Connected car:  
6-7 instances (and databases) on server, 2 HADR nodes;  
Main motivation: rolling update
  - Central user directory:  
Multiple standby (4 nodes); Main motivation: HA & DR
- 4 Projects (but total 200 database) using HADR currently
  - All Stages, 2-4 nodes



# HADR at Customer data center (2): TSAMP

- **TSA / TSAMP** for

- Failure detection
- Automatic takeover



- Default 2 nodes (Primary and principal standby)

- **VIP**=Virtual IP (versus **ACR**=Automatic Client Reroute)

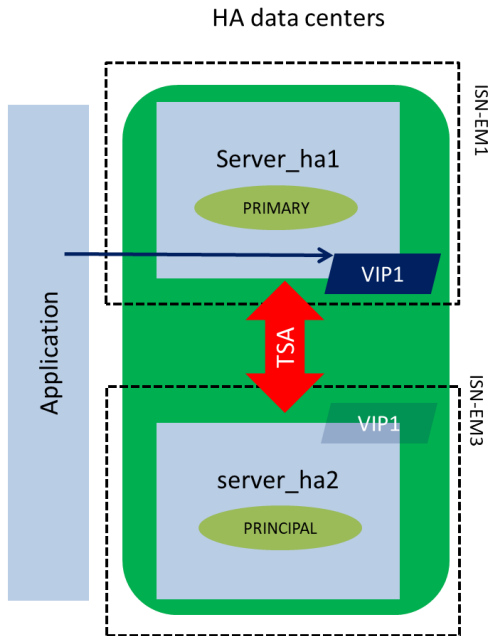
- + Minimize Split brain risk, only single IP for application
- + Application connect for db directory cache not required
- Failover duration longer (resource movement in TSAMP)

- Read On Standby (optional)

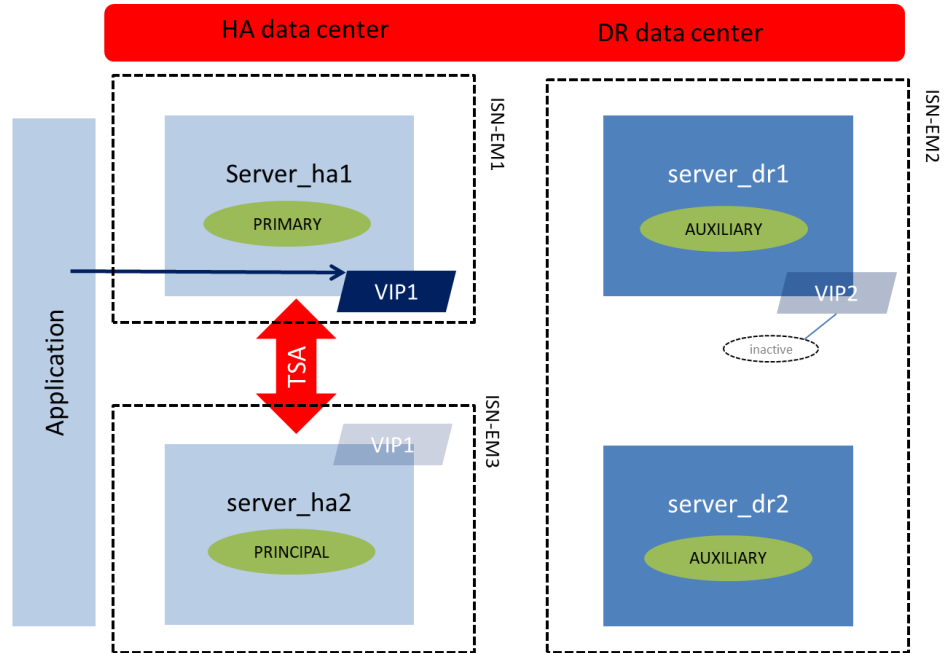
- 4 nodes recommended (First auxiliary for rolling updates, Second auxiliary for RoS)
- RoS on static auxiliary standby (no ACR or second VIP)

# HADR at Customer data center (3): HA / DR

## SETUP: HA

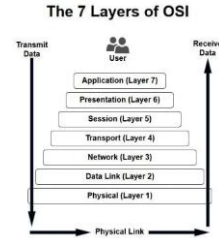


## SETUP: DR



# HADR at Customer data center (4): prerequisites

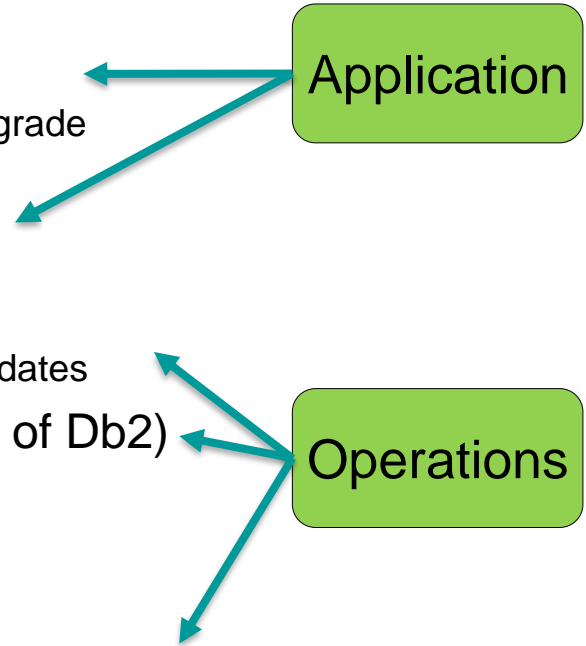
- Minimum 2 GB RAM per database (higher capacity for extra HADR buffers)
- Automatic storage tablespaces (to simplify layout changes)
- Requires **TSA** for automatic takeover
- Archiving to TSM
- LOAD only supported with option COPY YES USE TSM
- **Virtual IPs** are used for the application connection (no ACR), this requires TSA (TSA manages switch of VIP in takeover case)
  - data center PODs (Point Of Delivery) are disjoint layer-3 networks
  - DC1 and DC2 uses different network PODs
  - VIPs are using datalink layer-2 for broadcasting which is not available (only layer-3)
  - **Therefore VIPs can not be shared between data centers DC1 and DC2**



# HADR at Customer DC (5): Global requirements

## ▪ Update or Upgrade

- Minimal downtime for database (DB Availability)
  - Lowest when Primary HADR is active (Update), not for Upgrade
- No data loss
  - With HADR and specific configuration it is guaranteed
- Best practices (from IBM)
  - Good documentation and presentations; technotes with updates
- Stable and simple methods and procedures (tools of Db2)
  - On which node running command?
  - Use db2haicu, db2iupdt, ...
- As much automation as possible
  - No prompts in tools: with db2iupdt okay, with db2haicu via tricks



# Availability levels: „On“ or „Off“

Impact



Level	+	-
TSA	Active	No failure detection No automatic failover
HADR	Active	HA inactive
Application	No impact	Blocked (short duration)
Database [Primary]	Connectable	Not Connectable

Workarounds

Manual

- Monitoring
- Takeover

Recovery  
by restore & rfw

Adjust  
HADR\_TIMEOUT

# Availability considerations

Level	Considerations
TSA	<ul style="list-style-type: none"><li>• VIP or ACR</li><li>• Multiple instances</li><li>• Installation procedure (license)</li></ul>
HADR	Auxiliaries [ min. 3 nodes ]
Application	Configuration [HADR_TIMEOUT]
Database [Primary]	<ul style="list-style-type: none"><li>• Update Db2 Fixpack</li><li>• Update OS sublevel</li><li>• Upgrade Db2 version</li></ul>

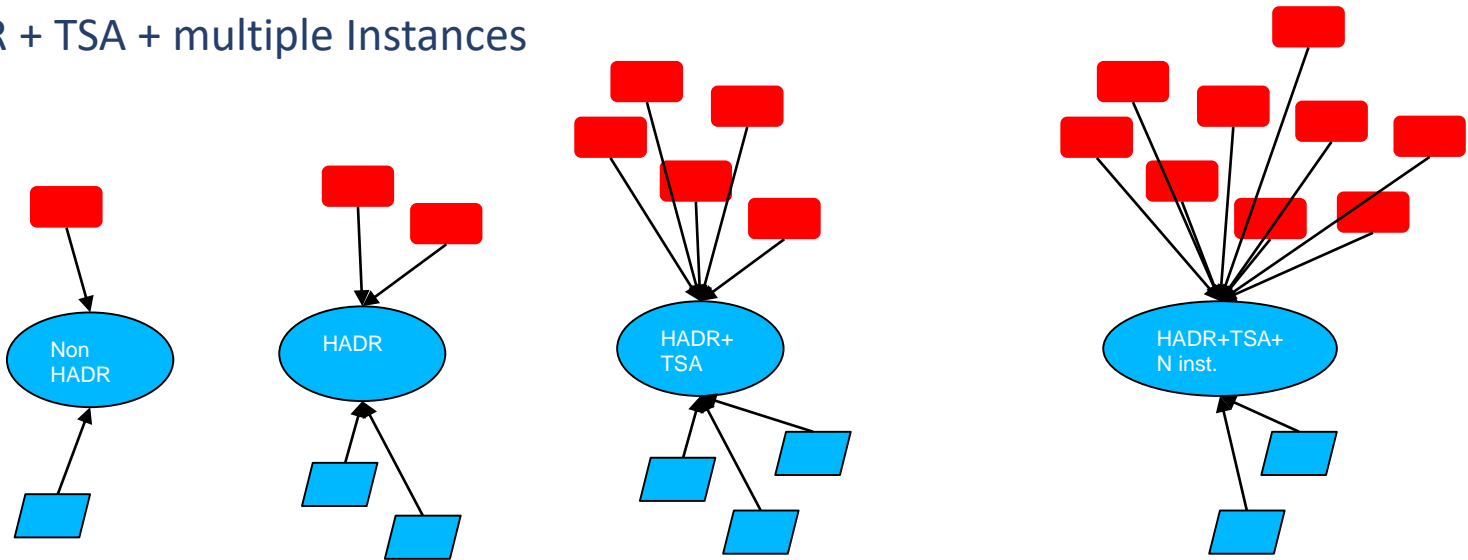
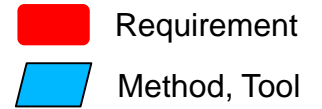
# Content

- Db2 HADR restrictions & prerequisites
- HADR at Customer data center
- **Db2 Fixpack Update (Rolling Update)**
- Db2 Major Release Upgrade (Rolling Upgrade)

# Complexity of update (1)

Levels:

- Non HADR
- HADR
- HADR + TSA
- HADR + TSA + multiple Instances





# Complexity of update (2)

## Levels:

- Non HADR
  - KISS approach possible
- HADR
  - Two nodes: dependencies => sequence / cluster group
- HADR + TSA
  - Roadmap for Db2 and **TSA**
  - Dependencies on actions [install with or without TSAMP in parallel]; sequence
  - TSA specific requirements
- HADR + TSA + multiple Instances
  - Multiple instances influences TSA [multiple commands; longer duration]
  - Different approaches for TSA level [no TSAMP installation]

TSAMP+Fixpacks							
TSAMP Versions bundled with DB2							
Linux & AIX							
		DB2 10.1		DB2 10.5		DB2 11.1	
Fixpack	TSAMP	TSAMP recommended		TSAMP shipped	TSAMP recommended	TSAMP shipped	TSAMP recommended
GA	3.2.2.1	-		3.2.2.5	3.2.2.5	4.1.0.3	4.1.0.4
fp1	3.2.2.1	-		3.2.2.5	3.2.2.5	4.1.0.3	4.1.0.4
fp2	3.2.2.1	-		3.2.2.5	3.2.2.5	4.1.0.3	4.1.0.4
fp3	3.2.2.5	-		3.2.2.5	3.2.2.5	4.1.0.3	4.1.0.4
fp3a	-	-		-	-	4.1.0.3	4.1.0.4 (TSAMP FP4)
fp4	3.2.2.5	-		3.2.2.8	3.2.2.8		
fp5	3.2.2.8	-		3.2.2.8	4.1		
fp6	3.2.2.8	3.2.2.9 (TSAMP FP9)		3.2.2.8	4.1		
fp7				3.2.2.8	4.1		
fp8				4.1.0.3 + efix1	4.1.0.3 + efix1		
fp9				4.1.0.3 + efix1	4.1.0.3 + efix1		
fp10				4.1.0.3 + efix1	4.1.0.4 (TSAMP FP4)		

# Example TSA roadmap (1)

## Example 1:

- Installed: Db2 10.5 FP4 => TSAMP 3.2.2.8
- Target: Db2 10.5 FP7 (is still TSAMP 3.2.2.8)
- Update Db2 [no change in TSAMP]

## Example 2:

- Installed: Db2 10.5 FP4 => TSAMP 3.2.2.8
- Target: Db2 10.5 FP8 (is TSAMP 4.1.0.0)
- Update Db2 [including change in TSAMP]

# Example TSA roadmap (2)

## Example 3:

- Installed: Db2 10.1 FP4 => TSAMP 3.2.2.5
- Target: Db2 10.1 FP5 (is only TSAMP 3.2.2.8)  
TSAMP 3.2.2.9
- Update
  - First TSAMP
  - Then Db2

Latest fix required due to errors

Time =>	T1	T2	T3	T4	T5	T6	T7
HADR states	HADR connected	HADR connected	HADR connected	HADR disconnected	HADR connected	HADR disconnected	HADR connected
TSA states	TSA online	TSA offline	TSA offline	TSA online	TSA online	TSA online	TSA online
Role	TSA/ DB2	TSA Upgrade FP9	TSA Upgrade FP9	DB2 Upgrade FP5 without TSA	Switch roles	DB2 Upgrade FP5 without TSA	
S	3.2.2.5	3.2.2.9	3.2.2.9	3.2.2.9	P	3.2.2.9	3.2.2.9
	10.1.4	10.1.4	10.1.4	10.1.5		10.1.5	10.1.5
P	3.2.2.5	3.2.2.5	3.2.2.9	3.2.2.9	S	3.2.2.9	3.2.2.9
	10.1.4	10.1.4	10.1.4	10.1.4		10.1.5	10.1.5

# Example TSA roadmap (3)

## Example 3:

### ■ TSAMP

- Stop TSA domain [stoprpdomain -f <domain-name>]
- update TSA on standby node [installSAM]
- update TSA on primary node [installSAM]
- Start TSA domain with TSAMP 3.2.2.9 [startrpdomain <domain-name>]

TSA inactive

### ■ upgrade Db2 Fixpack without TSAMP

- On standby: install Db2 without TSAMP; update to FP 5
- Db2 is now 10.1.5 on standby, TSAMP is 3.2.2.9
- Takeover
- On new standby: install Db2 without TSAMP; update to FP 5
- Now all are on Db2 10.1.5 and TSAMP 3.2.2.9

HA inactive

Primary  
active

# Fixpack rolling update

## General considerations

- TSA update included by Db2 Fixpack?
  - Separation into Db2 and TSA (Fixpack) update
- HADR and TSAMP executing commands:
  - on primary or standby server - or both?
  - Which sequence (First standby then primary)?
- Installation
  - Db2 Fixpack in parallel or over installation directory?  
Recommendation: in parallel (for Fallback)
  - With or without TSAMP (TSAMP as separate installation)?
- Number of instances/databases on server
  - Sequence of TSAMP update and Db2 update

# Fixpack rolling update [HADR]

- Requirement
  - No downtime of database
- Method HADR Rolling update (2 nodes)
  - Deactivate standby database [HADR is inactive]
  - Install and apply fixpack on standby
  - Takeover [HADR in PEER and CONNECTED]
    - fixpack level is different; application shortly blocked
  - Install and apply fixpack on new standby (previous primary)
  - Start HADR [activate Standby]

# Fixpack rolling update [HADR + TSA]

- Requirement
  - No downtime of database
- Method HADR Rolling update (2 nodes)
  - Disable Critical Resource Protection
  - Deactivate standby database [HADR is inactive] ; offline node [*stoprpnode*]
  - Install and apply fixpack on standby
  - Bring standby online [*startrpnode*]
  - Takeover [HADR in PEER and CONNECTED]
    - fixpack level is different; application shortly blocked
  - Install and apply fixpack on new standby (previous primary)
  - Start HADR [activate Standby]
  - Activate new TSA code level ; Enable Critical Resource Protection

asynchronous

asynchronous

Automation

Automation

# Fixpack rolling update



- data center: Errors on Fixpack Update (Std. Ticket):
  - SQL1770N Takeover HADR cannot complete. Reason code = "7".  
"One or both databases of the HADR pair is configured incorrectly"  
The db2 release level on this machine, SQL10016, is different from that on the remote machine, SQL10014.  
ADM12502E Unable to establish HADR primary-standby connection because the DB2 versions do not match the primary and standby databases.
- IBM Case
  - This issue is caused by APAR IT02964:  
"DB2 ROLLING UPDATE GIVES SQL1770N TAKEOVER HADR CANNOT COMPLETE. REASON CODE = "7" WHILE TAKE OVER COMMAND"
- Technote swg21994790
  - Changes to procedure for Performing rolling updates in an automated high availability disaster recovery (HADR) environment



# Fixpack rolling update

- Changes to procedure for Performing rolling updates in an automated high availability disaster recovery (HADR) environment
  - <http://www-01.ibm.com/support/docview.wss?uid=swg21994790>

**Question:** Are there any changes to the procedure for Performing rolling updates in an automated high availability disaster recovery (HADR) environment?

**Answer:**

The DB2/LUW v9.7 document titled "Rolling upgrade in an automated High Availability Disaster Recovery (HADR) environment" ... require some procedure changes.

**These changes will be reflected within the v11.1 Knowledge Center document**, but not within the Knowledge Center documents in previous versions.

- „db2haicu -disable“ command required
  - ‚db2haicu -disable‘ also disables „*Cluster manager*„ in DBM CFG .  
It prevents that monitor scripts for the HADR resource will call action.
  - Note: starting 10.1 *Cluster Manager* cannot be updated via command line [db2 update dbm cfg using CLUSTER\_MGR]

# Fixpack rolling update

- db2haicu disabled means
  - **lock** all the resource groups for the instance and disable the HA configuration parameter
  - The instance will not failover if a system outage occurs while the instance is disabled.
  - Monitor scripts of rsct (/usr/sbin/rsct/sapolicies/db2) are still active
  - But also VIP will not be managed by TSAMP
    - But VIP must be moved to primary database during takeover
- VIP must be moved **manually** before executing Db2 takeover command
- Task of startprnode / stopprnode:
  - these commands are used to bring **individual** nodes online and offline to the cluster
  - used when performing maintenance to a particular system (e.g. OS patching)
  - stopprnode brings resource group offline

→ Stable

→ Automation

# Fixpack rolling update

- db2haicu -disable
  - locks resource group
- stopprnode:
  - brings resource group offline

```

ha21:~ # lssam
Online IBM.ResourceGroup:db2_z05xat01_ha21_0-rg Nominal=Online
'- Online IBM.Application:db2_z05xat01_ha21_0-rs
  '- Online IBM.Application:db2_z05xat01_ha21_0-rs:ha21
Failed offline IBM.ResourceGroup:db2_z05xat01_ha22_0-rg Nominal=Online
'- Failed offline IBM.Application:db2_z05xat01_ha22_0-rs
  '- Failed offline IBM.Application:db2_z05xat01_ha22_0-rs:ha22 Node=Offline
Online IBM.ResourceGroup:db2_z05xat01_z05xat01_Z05XAT01-rg Control=MemberInProblemState Nominal=Online
|- Online IBM.Application:db2_z05xat01_z05xat01_Z05XAT01-rs:ha21
  '- Failed offline IBM.Application:db2_z05xat01_z05xat01_Z05XAT01-rs:ha22 Node=Offline
  '- Online IBM.ServiceIP:db2ip_192_168_70_91-rs Control=MemberInProblemState
    '- Online IBM.ServiceIP:db2ip_192_168_70_91-rs:ha21
      '- Failed offline IBM.ServiceIP:db2ip_192_168_70_91-rs:ha22 Node=Offline
Online IBM.Equivalency:db2_public_network_0
|- Online IBM.NetworkInterface:eth0:ha21
  '- Offline IBM.NetworkInterface:eth0:ha22
Online IBM.Equivalency:db2_z05xat01_ha21_0-rg_group-equ
  '- Online IBM.PeerNode:ha21:ha21
Online IBM.Equivalency:db2_z05xat01_ha22_0-rg_group-equ
  '- Offline IBM.PeerNode:ha22:ha22 Node=Offline
Online IBM.Equivalency:db2_z05xat01_z05xat01_Z05XAT01-rg_group-equ
|- Online IBM.PeerNode:ha21:ha21
  '- Offline IBM.PeerNode:ha22:ha22 Node=Offline
ha21:~ #
  
```

```

z05xat01@ha22:~> lssam
Online IBM.ResourceGroup:db2_z05xat01_ha21_0-rg Request=Lock Nominal=Online
'- Online IBM.Application:db2_z05xat01_ha21_0-rs Control=SuspendedPropagated
  '- Online IBM.Application:db2_z05xat01_ha21_0-rs:ha21
Online IBM.ResourceGroup:db2_z05xat01_ha22_0-rg Request=Lock Nominal=Online
'- Online IBM.Application:db2_z05xat01_ha22_0-rs Control=SuspendedPropagated
  '- Online IBM.Application:db2_z05xat01_ha22_0-rs:ha22
Online IBM.ResourceGroup:db2_z05xat01_z05xat01_Z05XAT01-rg Request=Lock Nominal=Online
|- Online IBM.Application:db2_z05xat01_z05xat01_Z05XAT01-rs Control=SuspendedPropagated
  |- Online IBM.Application:db2_z05xat01_z05xat01_Z05XAT01-rs:ha21
  '- Offline IBM.Application:db2_z05xat01_z05xat01_Z05XAT01-rs:ha22
'- Online IBM.ServiceIP:db2ip_192_168_70_91-rs Control=SuspendedPropagated
  |- Online IBM.ServiceIP:db2ip_192_168_70_91-rs:ha21
  '- Offline IBM.ServiceIP:db2ip_192_168_70_91-rs:ha22
Online IBM.Equivalency:db2_public_network_0
|- Online IBM.NetworkInterface:eth0:ha21
  '- Online IBM.NetworkInterface:eth0:ha22
Online IBM.Equivalency:db2_z05xat01_ha21_0-rg_group-equ
  '- Online IBM.PeerNode:ha21:ha21
Online IBM.Equivalency:db2_z05xat01_ha22_0-rg_group-equ
  '- Online IBM.PeerNode:ha22:ha22
Online IBM.Equivalency:db2_z05xat01_z05xat01_Z05XAT01-rg_group-equ
|- Online IBM.PeerNode:ha21:ha21
  '- Online IBM.PeerNode:ha22:ha22
z05xat01@ha22:~>
  
```

```

ha21:~ # lssam
Online IBM.ResourceGroup:db2_z05xat01_ha21_0-rg Nominal=Online
'- Online IBM.Application:db2_z05xat01_ha21_0-rs
  '- Online IBM.Application:db2_z05xat01_ha21_0-rs:ha21
Online IBM.ResourceGroup:db2_z05xat01_ha22_0-rg Nominal=Online
'- Online IBM.Application:db2_z05xat01_ha22_0-rs
  '- Online IBM.Application:db2_z05xat01_ha22_0-rs:ha22
Online IBM.ResourceGroup:db2_z05xat01_z05xat01_Z05XAT01-rg Nominal=Online
|- Online IBM.Application:db2_z05xat01_z05xat01_Z05XAT01-rs:ha21
  '- Offline IBM.Application:db2_z05xat01_z05xat01_Z05XAT01-rs:ha22
  '- Online IBM.ServiceIP:db2ip_192_168_70_91-rs
    |- Online IBM.ServiceIP:db2ip_192_168_70_91-rs:ha21
    '- Offline IBM.ServiceIP:db2ip_192_168_70_91-rs:ha22
Online IBM.Equivalency:db2_public_network_0
|- Online IBM.NetworkInterface:eth0:ha21
  '- Offline IBM.NetworkInterface:eth0:ha22
Online IBM.Equivalency:db2_z05xat01_ha21_0-rg_group-equ
  '- Online IBM.PeerNode:ha21:ha21
Online IBM.Equivalency:db2_z05xat01_ha22_0-rg_group-equ
  '- Online IBM.PeerNode:ha22:ha22
Online IBM.Equivalency:db2_z05xat01_z05xat01_Z05XAT01-rg_group-equ
|- Online IBM.PeerNode:ha21:ha21
  '- Online IBM.PeerNode:ha22:ha22
ha21:~ #
  
```

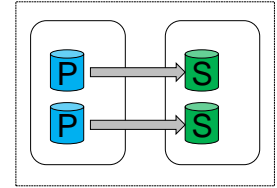
# Fixpack rolling update [HADR + TSA] Db2 11.1

- Requirement
  - No downtime of database
- Method HADR Rolling update (2 nodes)
  - Disable TSA automation [*db2haicu -disable*]
  - Disable Critical Resource Protection
  - Deactivate standby database [HADR is inactive] ; offline node [*stoprpnode*]
  - Install and apply fixpack on standby
  - Bring standby online [*startpnode*]
  - Takeover [HADR in PEER and CONNECTED]
    - fixpack level is different; application shortly blocked
    - **Manual movement of VIP (as VIP managed by TSA) !** → Stable
  - Install and apply fixpack on new standby (previous primary)
  - Start HADR [activate Standby]
  - Activate new TSA code level ; Enable Critical Resource Protection
  - Enable TSA automation [*db2haicu*] → Automation

# Fixpack rolling update [HADR + TSA] Db2 11.1 - N

## Multiple (N) instances:

- Primary on single server side



## Two approaches:

- Single loop

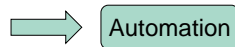


- For each instance: *db2haicu -disable; stoprpnode; db2iupdt; startprnode*

- Multiple loops **[recommended]**

- For each instance *db2haicu -disable*

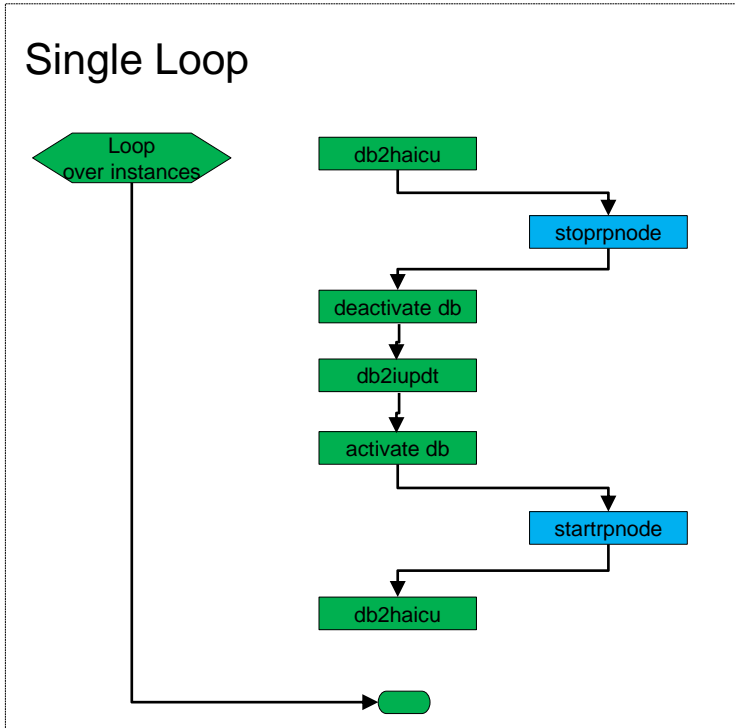
- On each node



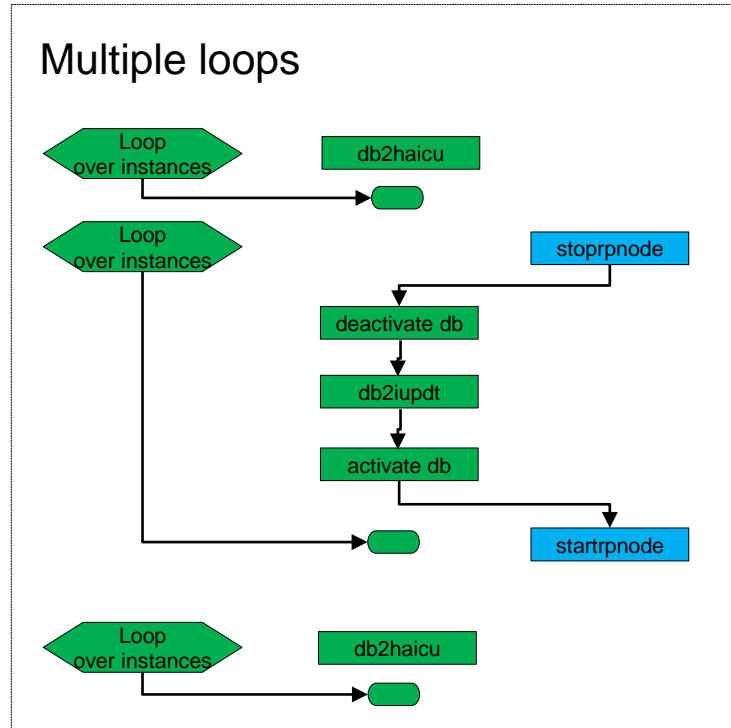
- *stoprpnode*
- For each instance *db2iupdt*
- *startprnode*

# Fixpack rolling update [HADR + TSA] Db2 11.1 - N

## Single Loop



## Multiple loops



Legend:

Instance level

Node level

# Fixpack rolling update [HADR + TSA] Db2 11.1

- Run the 'db2haicu -disable' command on **both** nodes (**first** standby, then primary)
- Disable Critical Resource Protection as **root**
- On the standby node run deactivate db <database-name> & db2stop force [as instance owner]
- Run the 'stoprpnode -f <standby node>' command as **root** on the **primary** node
- Apply the fix pack
- On the primary node, run the 'startprnode <standby node>' command as **root**
- On the standby node run activate db <database-name> & db2start [as instance owner]
- Takeover:
  - a) On the primary node delete the VIP manually by os command Note: After this action the application will hang as connection VIP is not available. Adding VIP to new primary should be performed immediately.
  - b) On the standby node add the VIP manually by os command
  - c) On the standby node issue: 'db2 takeover hadr on db <database-name>'
- On the old primary node, repeat all steps starting from deactivate to takeover [as instance owner]
- Optional: Migrate TSA domain (Activate new TSA code level) as **root**
- Enable Critical Resource Protection as **root**
- Run the 'db2haicu' command on **both** nodes to re-enable automation(**first** standby, then primary)

# Fixpack rolling update commands (1)

1. Run 'db2haicu -disable', prompts for "YES" ("1"), you can redirect from file: 'db2haicu -disable < 1.txt'
2. Disable Critical Resource Protection:  
export CT\_MANAGEMENT\_SCOPE=2; chrsrc -c IBM.PeerNode CritRsrcProtMethod=5
3. Example of stoprpnode: 'stoprpnode -f sDCbdbt0250' [On the primary node as root]
4. Check status by 'lsrpnode'
5. On the standby node: 'db2 deactivate db tstxat21; db2stop force '
6. Apply the fix pack
7. Example of startrpnode: 'startrpnode sDCbdbt0250' [On the primary node as root]
8. On the standby node: 'db2level; db2start ; db2 activate db tstxat21 '
9. Takeover:
  - HADR should be in CONNECTED and PEER
  - Check on which node VIP is saved (should be primary node)
  - As root: identify the IP address, broadcast, device and the alias name of the VIP [ip addr show ; ipconfig -a]
  - Delete VIP on primary: ip addr del <VIP> broadcast <brdcast> dev eth<n>:<m>
  - Add VIP on standby: ifconfig eth<n>:<m> <VIP> broadcast <brdcast> up
  - Issue the TAKEOVER HADR command on the HADR STANDBY database.



## Fixpack rolling update commands (2)

10. On new standby repeat steps 'stoprpnod' till 'activation of database' [3-8]
11. Enable Critical Resource Protection:  
`export CT_MANAGEMENT_SCOPE=2; chrsrc -c IBM.PeerNode CritRsrcProtMethod=3`
12. Optional: Migrate TSA domain
13. Run 'db2haicu ' [on each instance] prompts twice for "YES" ("1")

# Fixpack rolling update [HADR + TSA] 2 instances

Node1 – inst1	Node1 – inst2	Node2 – inst1	Node2 – inst2
db2haicu –disable	db2haicu -disable	db2haicu –disable	db2haicu -disable
... CritRsrcProtMethod=5			
stoprnode -f Node2			
		deactivate db inst1; db2stop force	deactivate db inst2; db2stop force
		Install fixpack	
		db2iupdt inst1	db2iupdt inst2
startpnode -f Node2			
		db2start; activate db inst1	db2start; activate db inst2
		<Takeover>	
		stoprnode -f Node1	
deactivate db inst1; db2stop force	deactivate db inst2; db2stop force		
Install fixpack			
db2iupdt inst1	db2iupdt inst2		
		startpnode -f Node1	
db2start; activate db inst1	db2start; activate db inst2		
... CritRsrcProtMethod=3			
<Migrate the TSA domain>			
db2haicu	db2haicu	db2haicu	db2haicu

# Fixpack rolling update: Fallback

## ■ Failure and solution cases

### – First db2iupdt command fails

- Stop update & keep **old** fixpack level of old primary  
+ Remove standby & reinitialize HADR  
OR

- Rollback to **old** fixpack level (db2iupdt -f level of standby if required)

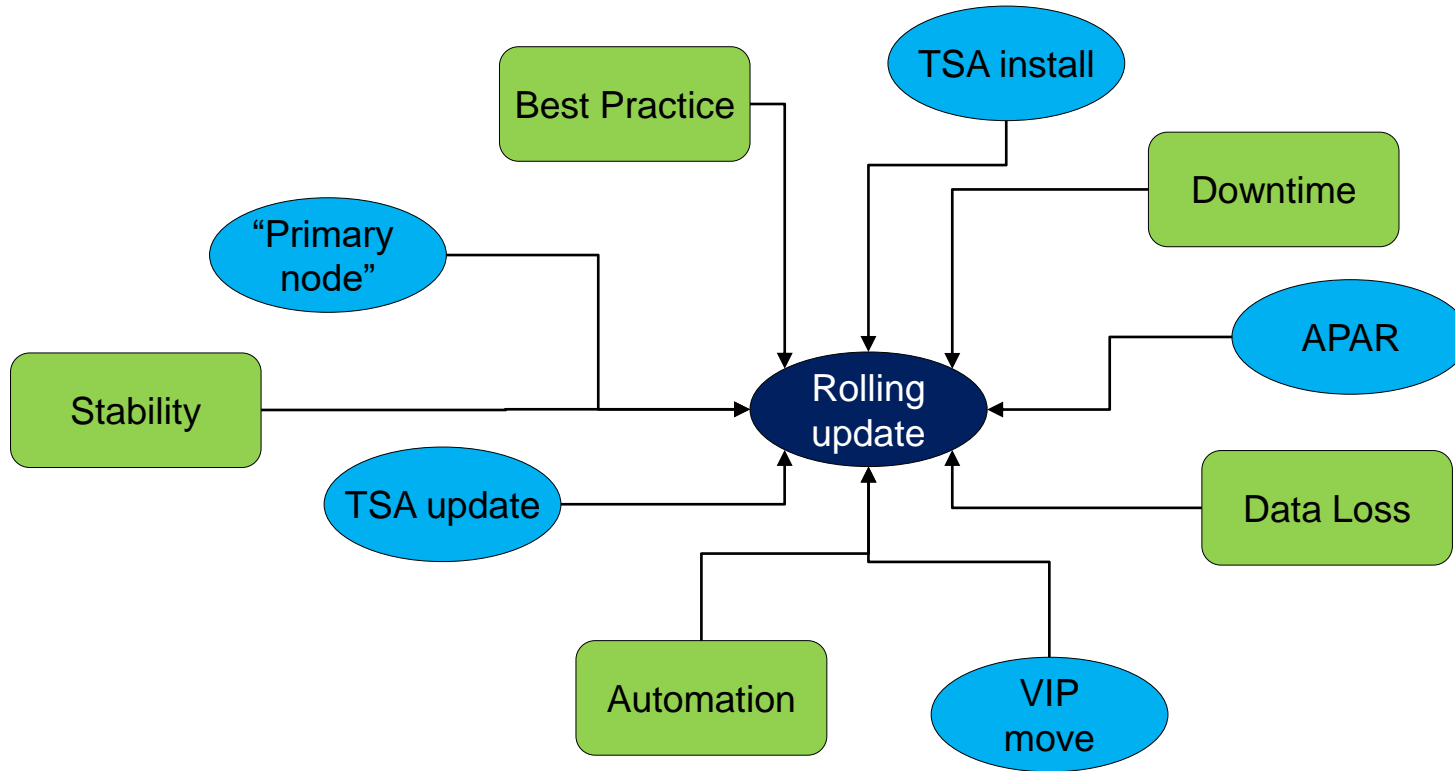
### – Second db2iupdt command fails

- Stop update & keep **new** fixpack level of new primary  
+ Remove standby & reinitialize HADR  
OR

- Rollback to **old** fixpack level (db2iupdt -f level of primary, and of standby if required)



# Fixpack rolling update: Parameters



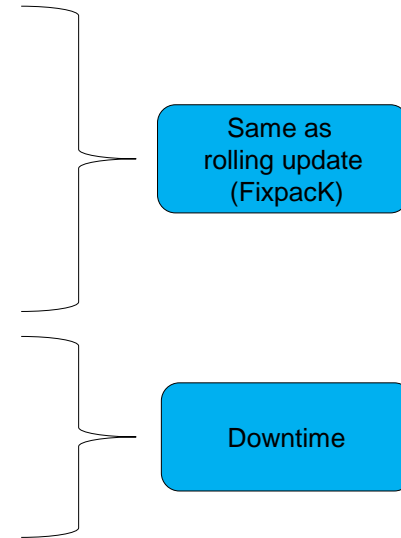
# Content

- Db2 HADR restrictions & prerequisites
- HADR at Customer data center
- Db2 Fixpack Update (Rolling Update)
- **Db2 Major Release Upgrade (Rolling Upgrade)**

# Rolling upgrade to major release

## General considerations

- TSA update included in Db2 version?
- HADR and TSAMP commands
- Installation
- Number of instances/databases on server
- **Re-initialization of standby required?**
- **Maximal accepted downtime duration?**
- **Fallback plan and duration?**



# Rolling upgrade to major release

## General requirements and decision criteria:

### 1) Requirements of application owner:

- One phase required or two phases possible? [fast upgrade in first phase]
- Availability required? [Fast takeover possible]
- Only short downtime possible? [Reduce downtime if possible / global application]
- Fast fallback required? [Total downtime includes worst case of fallback]

### 2) Environment:

- Multiple instances? [Duration of commands per instance ]
- Database size? [Restore in case of reinitialization]

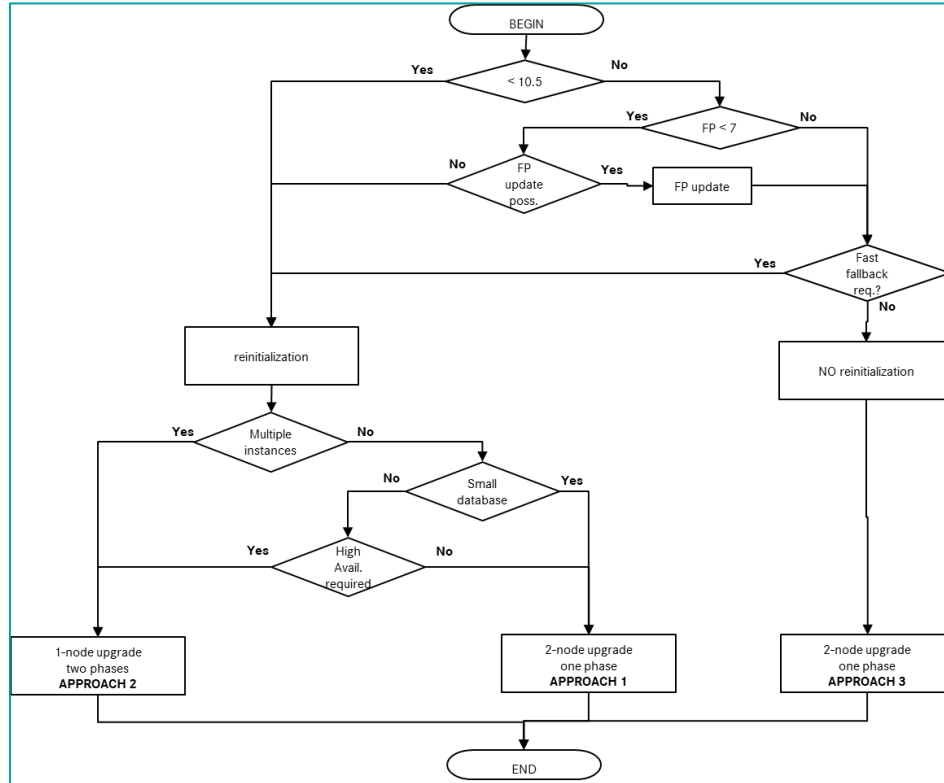
# Rolling upgrade to major release: Considerations

## Considerations

- 10.5 or 11.1? [ $< 10.5.7$  requires Reinitialization]
- Which Fixpack level? [ $< \text{Fixpack 7}$  requires Reinitialization, Fixpack update]
- Fallback requirements
  - Fast? [for example by switching to standby node]
- Reinitialization [Restore and config of standby]
- Number of instances [TSA dependencies, command duration]
- Database size [Restore duration]
- Availability requirements? [If highly required, then restart of HADR could be delayed ]
- HADR requirements? [Upgrade both nodes]



# Rolling upgrade to major release: Decisions



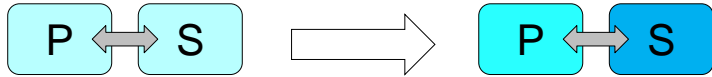
# Rolling upgrade to major release: Decision steps

## Decision steps

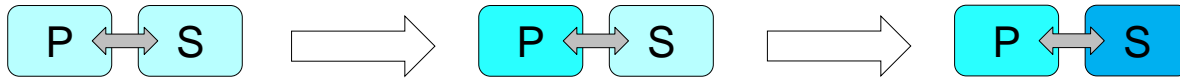
- check current Db2 level of target database:
  - less than Db2 10.5: Reinitialization is required
  - If current Db2 level is 10.5, but Fixpack level is less than 7 then consider a Fixpack update to the latest fixpack level ( $\geq 7$ ) to avoid a reinitialization.
- single or multiple instances are running
  - if multiple instances are running then perform upgrade in two phases
  - else perform upgrade in a single step
- if reinitialization is required then
  - check size of database
    - if high, then keep standby for fallback
    - else upgrade both nodes
  - check availability requirements
    - if high, then restart of HADR could be delayed
    - else upgrade both nodes

# Rolling upgrade to major release: Approaches (1)

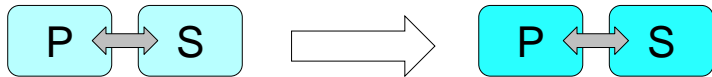
- APPROACH 1: **2-node** upgrade in **one** phase **with reinitialization**



- APPROACH 2: **1-node** upgrade, **two** phases



- APPROACH 3: **2-node and database upgrade** in **one** phase



# Rolling upgrade to major release: Approach 1

## Upgrade with reinitialization

- Remove TSAMP Automation (db2haicu -delete)
- Install software on primary and standby node
- Upgrade instance on primary (db2iupgrade)
- Upgrade database on primary (upgrade database)
- Online Backup on primary
- Restore on standby
- Reconfigure HADR on standby
- Start HADR (standby, primary)
- Activate TSAMP Automation (db2haicu)

reinitialization

TSA	HADR	DB
YES	YES	YES
NO	YES	YES
NO	NO	NO
NO	NO	NO
NO	NO	NO
NO	NO	NO
NO	NO	NO
NO	YES	YES
YES	YES	YES

# Rolling upgrade to major release: Approach 2

## Upgrade in two phases

- Phase 1
  - Remove TSAMP Automation (db2haicu -delete)
  - Install software on primary and standby node
  - Upgrade instance on primary (db2iupgrade)
  - Upgrade database on primary (upgrade db)
  - Activate database on primary (**no HADR**)
- Phase 2
  - Online backup on primary
  - Upgrade instance on standby (db2iupgrade)
  - Restore on standby
  - Reconfigure HADR on standby
  - Start HADR (standby, primary)
  - Activate TSAMP Automation (db2haicu)

TSA	HADR	DB
YES	YES	YES
NO	YES	YES
NO	YES	YES
NO	NO	NO
NO	NO	NO
NO	NO	YES
NO	NO	YES
NO	NO	YES
NO	NO	YES
NO	YES	NO
YES	YES	YES

# Rolling upgrade to major release: Approach 3

## Upgrade without reinitialization

- Remove TSAMP Automation (db2haicu -delete)
- Install software on primary and standby node
- Upgrade instance on primary (db2iupgrade)
- Upgrade instance on standby (db2iupgrade)
- Upgrade database on standby (upgrade db)
- Upgrade database on primary (upgrade db)
- Activate database on primary and on standby
- Activate TSAMP Automation (db2haicu)

upgrade in progress [SQL1103W]

Finally the primary database connects to standby database ( HADR\_TIMEOUT)

TSA	HADR	DB
YES	YES	YES
NO	YES	YES
NO	NO	NO
NO	NO	NO
NO	NO	NO
NO	NO	NO
NO	YES	YES
YES	YES	YES

# Rolling upgrade to major release: Duration / Downtime

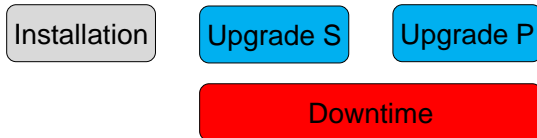
- APPROACH 1: **2-node** upgrade in **one** phase **with reinitialization**



- APPROACH 2: **1-node** upgrade, **two** phases



- APPROACH 3: **2-node** and **database** upgrade in **one** phase



# Rolling upgrade to major release: Approaches (3)

	Approach 1	Approach 2	Approach 3
Phases	One	Two	One
Nodes in phase 1	Both	One	Both
HADR active after upgrade	Yes	No	Yes
Fast fallback	Restore old primary	Takeover to standby	Restore old primary
Fast upgrade	No	No	Yes
Downtime	High	Medium (2 times)	Small
Fallback duration	High	Small	High
Automatic failover available	Yes	No	Yes
Use cases	non-reinitialization single instance small database	HA requirement of single instance	Db2 >= 10.5.7



# Rolling upgrade to major release: Criteria

## Summary of criteria:

- Downtime: How long is primary down?
- Duration of fallback: If upgrade fails, how long does fallback take?
- Standby is available or not, is standby required?
- Automatic failover is available: TSAMP active or manual steps?
- Second phase required: A second downtime to be planned?

# Conclusion

1. Check technotes (SQL1770N, RC 7)
2. Consider all roadmaps (Db2, TSAMP)
3. Check requirements (SLA / application owner)
4. Explain approaches (decision criteria, impact, duration, risk)
5. Plan your Design (VIP or ACR)



# Questions?

