Db2 Mirror for i

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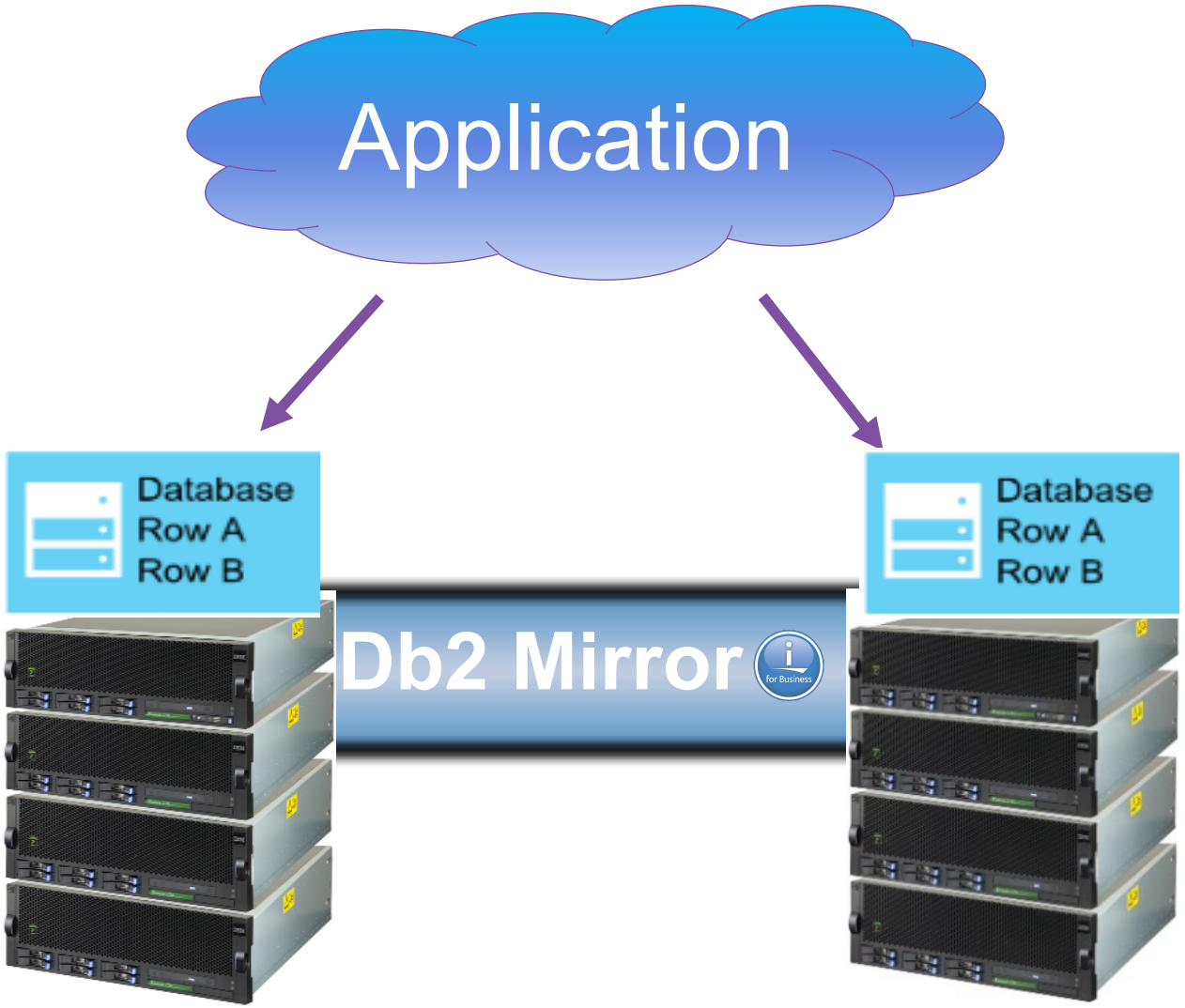
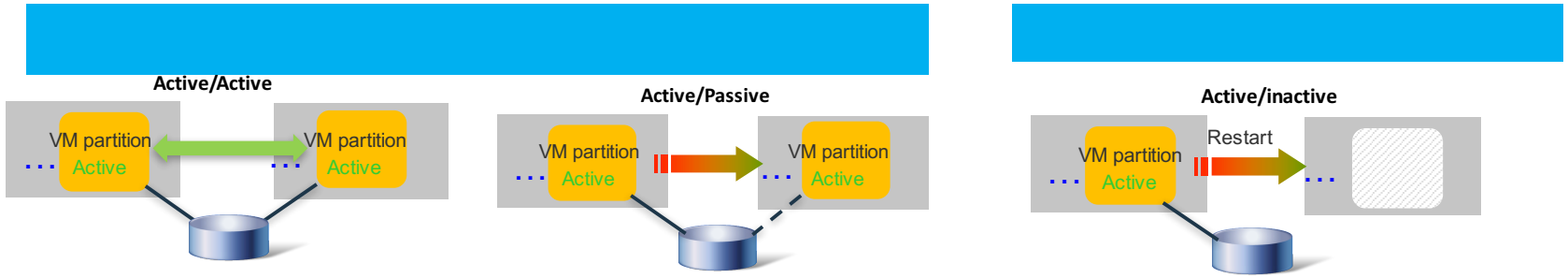
IBM Db2 Mirror for i



- **IBM Db2 Mirror for i: Enables Continuous Availability**
  - High speed synchronous replication of Db2 for i (Data Center Solution)
  - Access Db2 objects from either LPAR
- **Application Availability Enablement**
  - Two Nodes read and write to the same DB Files
  - Enables quickly moving all work to one node, for planned maintenance or node failure
- **Enables Business Continuity for Disruptive System Upgrades**
  - Nodes can be at different OS levels
  - Nodes can be on different Power Hardware Generations
  - Rolling upgrades for no downtime
  - Roll a node back a release with minimal impact if Active/Active applications are deployed

Requires POWER8 or later and IBM i 7.4
New IBM i LPP 5770DBM

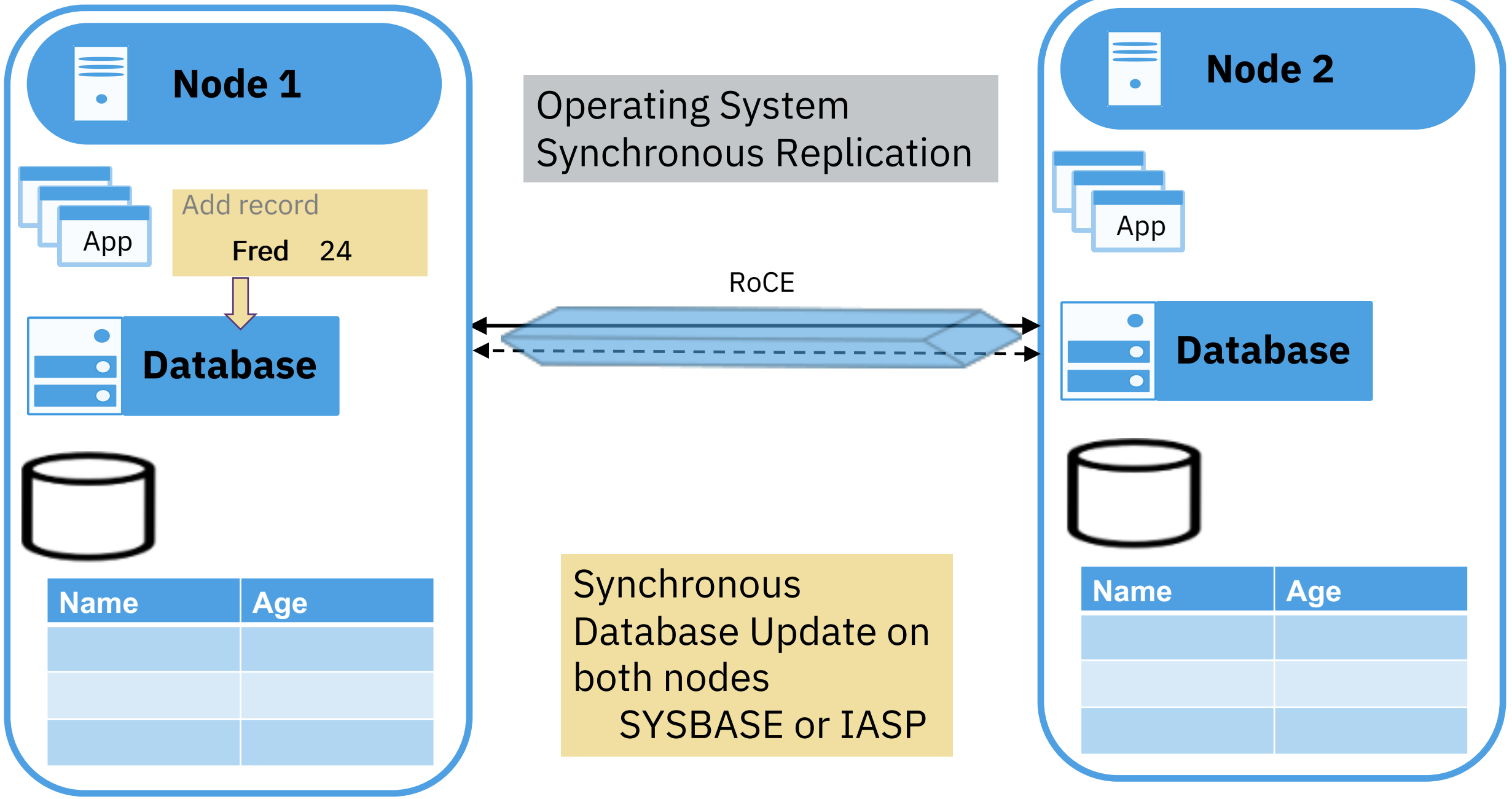
High Availability topology classification & positioning



Technology	Active/Active Clustering	Active/Passive Clustering	Active/Inactive
Definition	**Application level clustering**; applications in the cluster have simultaneous access to the production data therefore no app restart upon an app node outage. Certain types enable read-only access from secondary nodes	**OS level clustering**; one OS in the cluster has access to the production data, multiple active OS instances on all nodes in the cluster. Application is restarted on a secondary node upon outage of a production node.	**VM level clustering,** One VM in a cluster pair has access to the data, one logical OS, one or two physical copies. OS and applications must be restarted on a secondary node upon a primary node outage event. LPM enables the VM to be moved non-disruptively for a planned outage event.
Outage Types	SW,HW,HA, planned, unplanned RTO 0, limited distance	SW,HW,HA,DR, planned, unplanned, RTO>0, multi-site	HW,HA,DR, planned, unplanned, RTO>0, multi-site
OS integration	Inside the OS	Inside the OS	OS agnostic
RPO	Sync mode only	Sync/Async	Sync/Async
RTO	0	Fast (minutes)	Fast Enough (VM Reboot)
Licensing*	N+N licensing	N+1 licensing	N+0 licensing
Industry Examples	Oracle RAC, **Db2 Mirror**, pureScale	PowerHA, Redhat HA, Linux HA	VMware, VMR HA, LPM,

- N = number of licensed processor cores on each system in the cluster
- Illustrations represent two-node shared-storage configurations for conceptual simplicity. There are many other topologies and data resiliency combinations

Db2 Mirror – Active Active



Db2 Mirror – Database Supported Objects

Database replication eligible objects

Native:

- Database Physical & Logical File

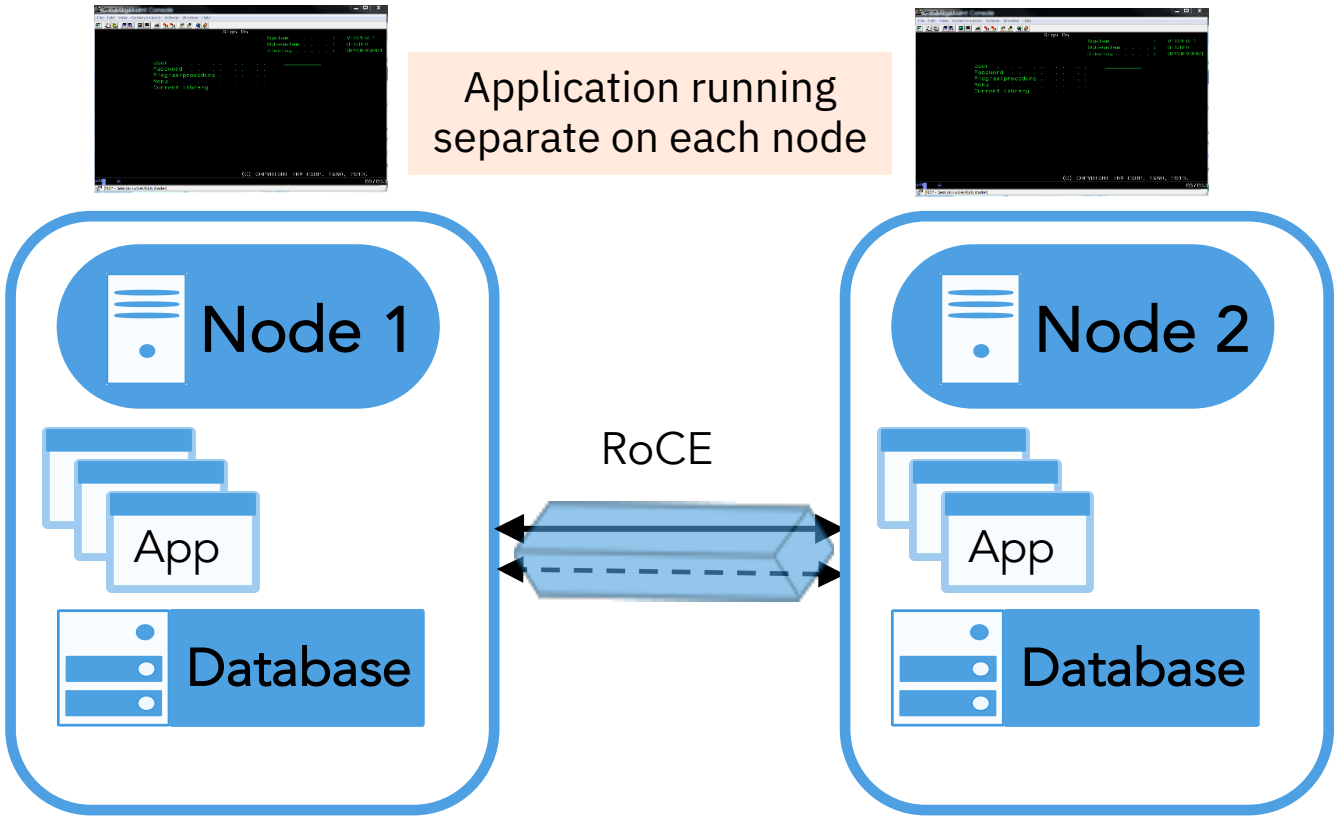
SQL:

- Alias
- Function
- Global Variable
- Index
- Procedure
- Schema
- Sequence
- SQL Package
- Table
- Trigger
- User Defined Type
- View
- XML Schema Repository

Included with File support:

- Row Permission
- Column Mask
- Temporal Table
- Constraint
- Etc...

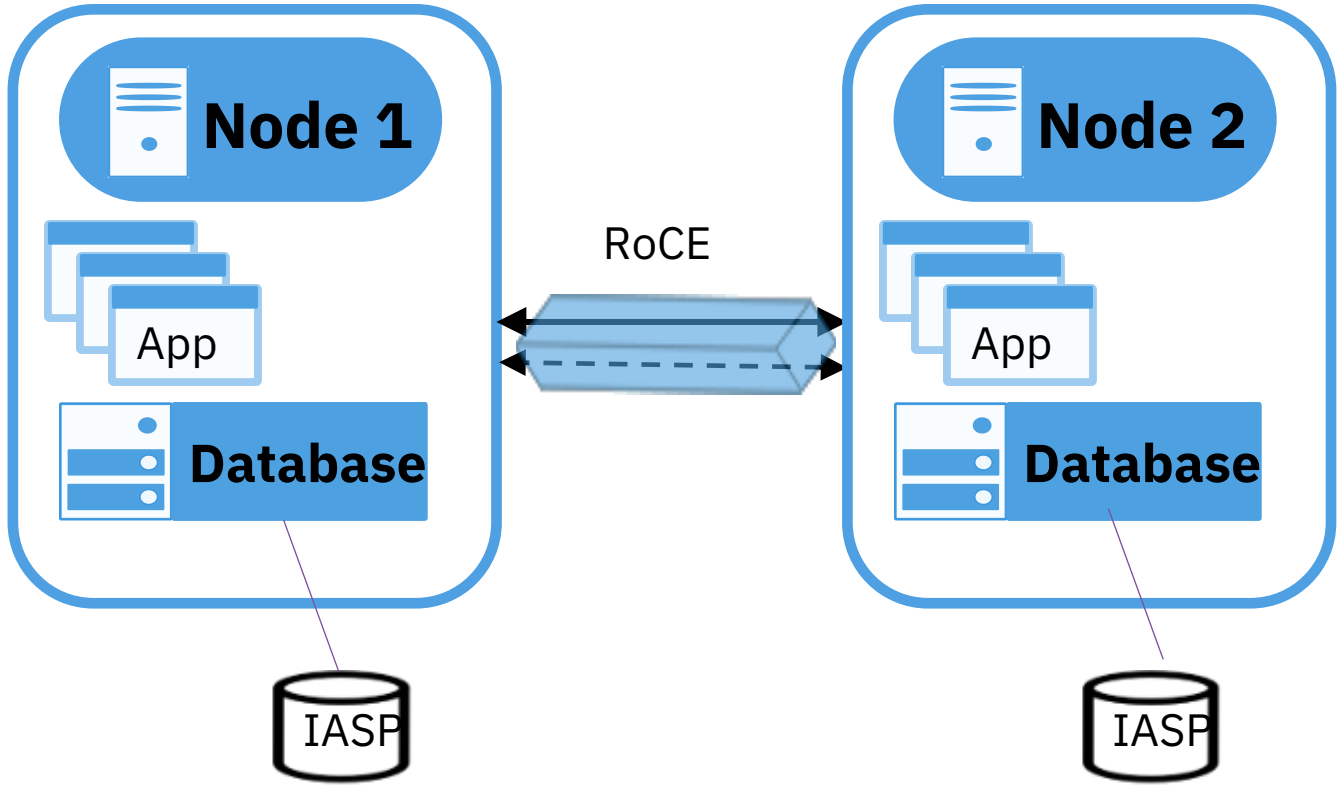
DDS / Record Level Access
SQL / Set Based Access



Db2 Mirror – Other Supported Objects

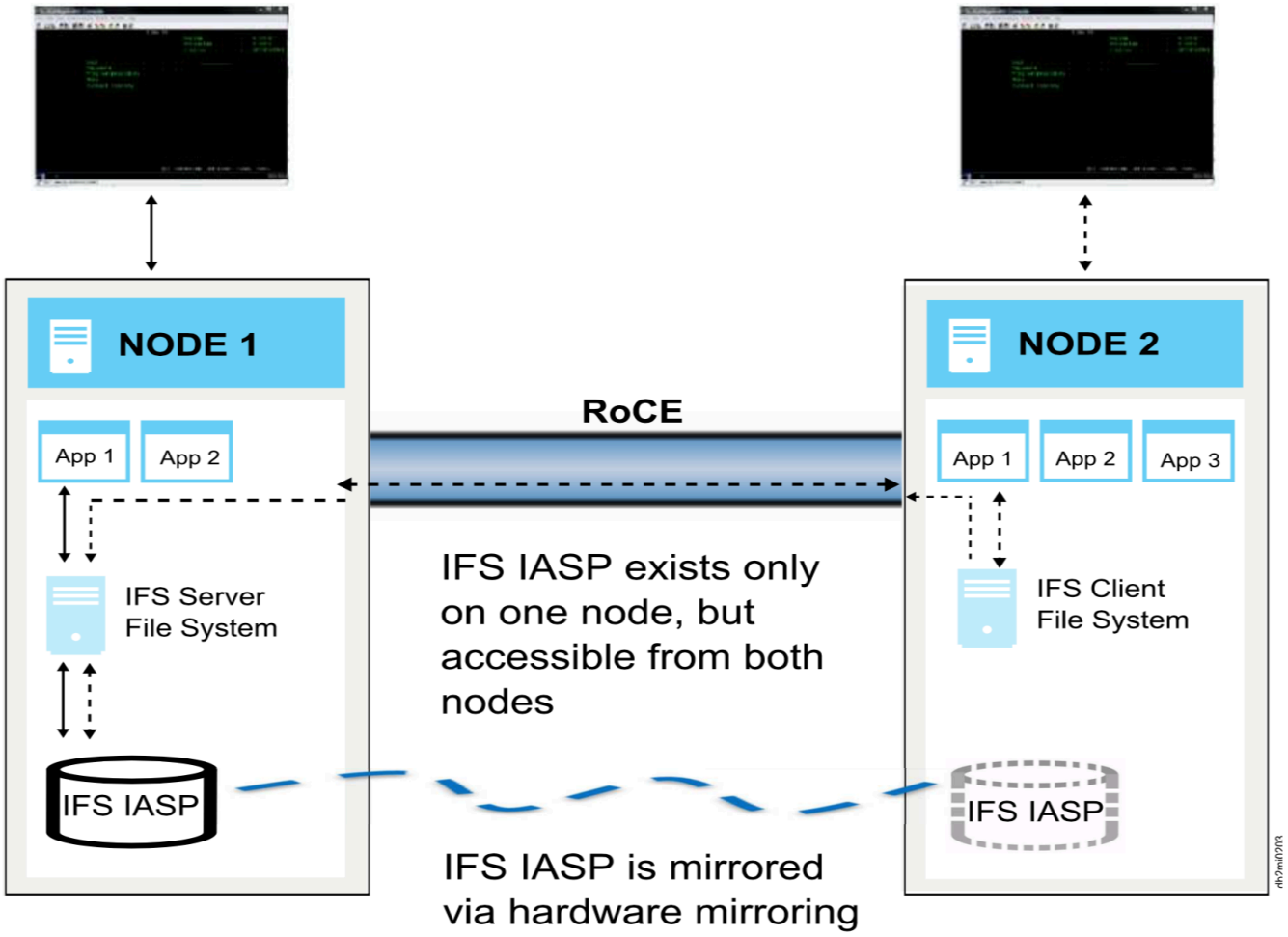
- Other Objects
  - User profiles
  - Authority
  - Ownership
  - Security
  - PGM/SRVPGM
  - Data Areas
  - Data Queues (DDL Only)
  - SYSVALs
  - ENVARs
  - LIB
  - JOBD
  - Journals
  - Files (also has DDL Only option)
- Special Handling
  - OUTQ / Spool
  - Job Queue

Objects can be in either **SYSBAS** or **IASP**s



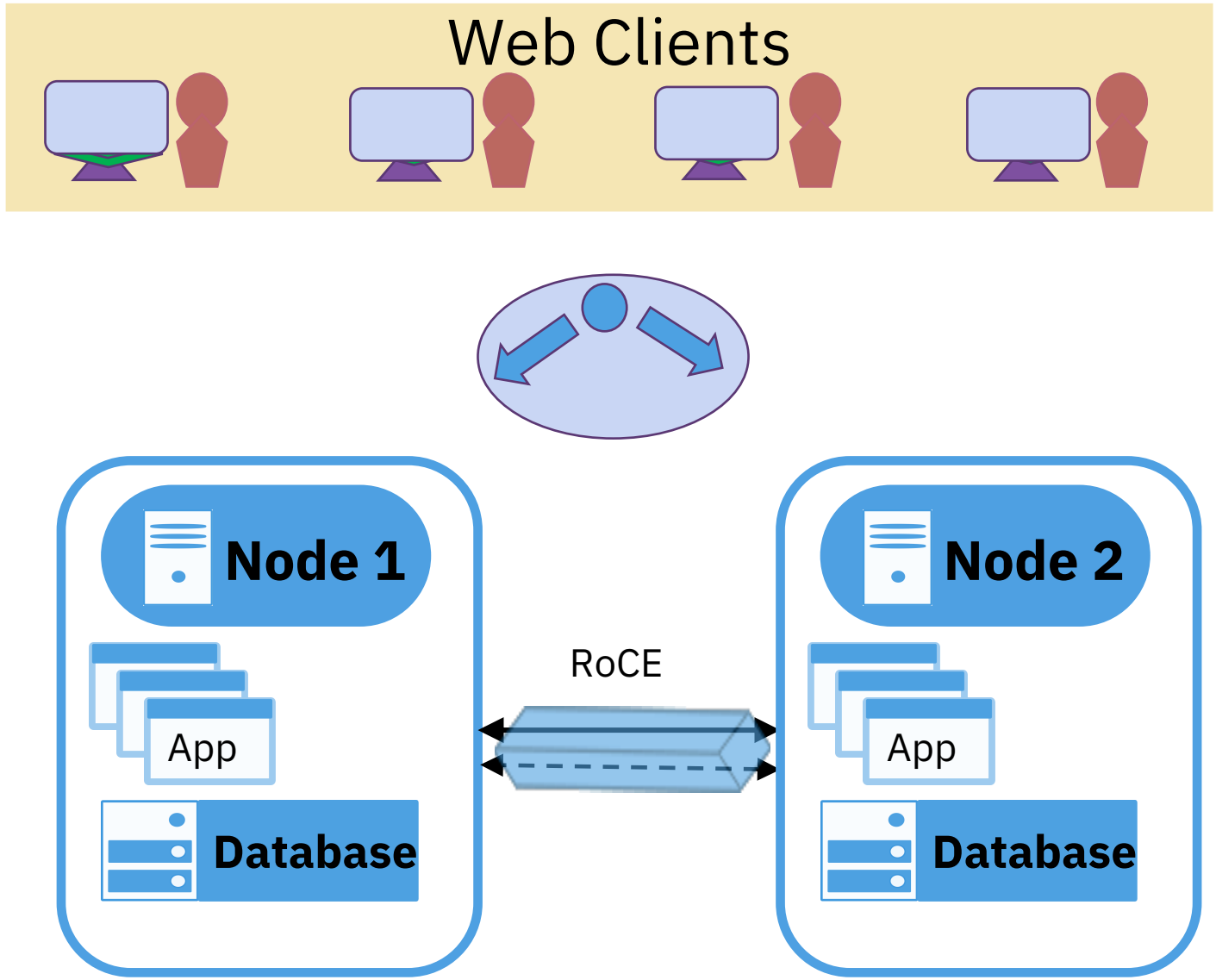
IFS Support

- Requires IASP
- IFS accessible on both Nodes (R/W)
- Requires PowerHA
  - Db2 Mirror provides the simultaneous access.
  - PowerHA switches the IASP
- Filesystem automatically ’mutates’ when the storage is switched



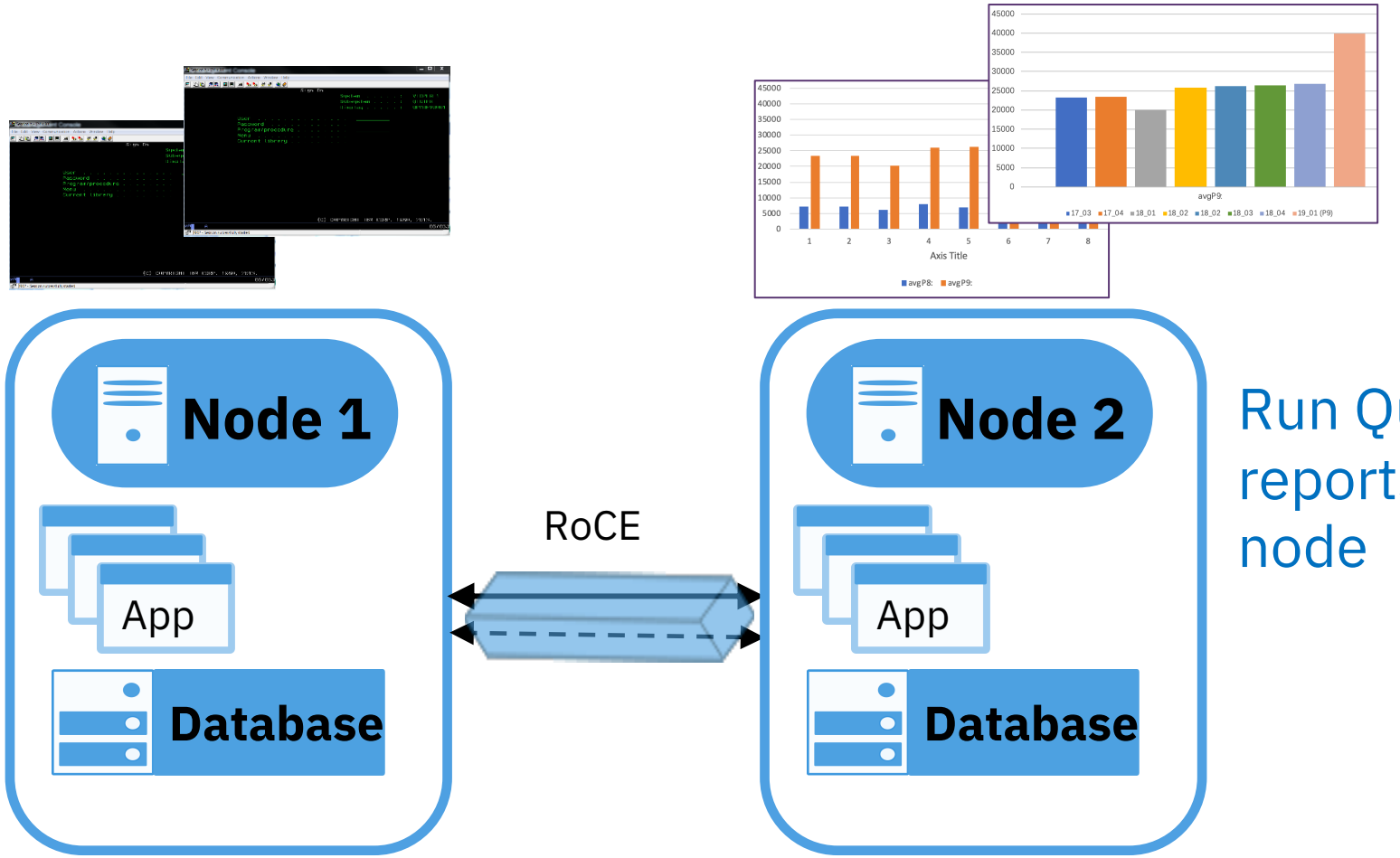
Db2 Mirror – Active Active, Web Clients

Application layer connects with either JDBC or Load Balancer



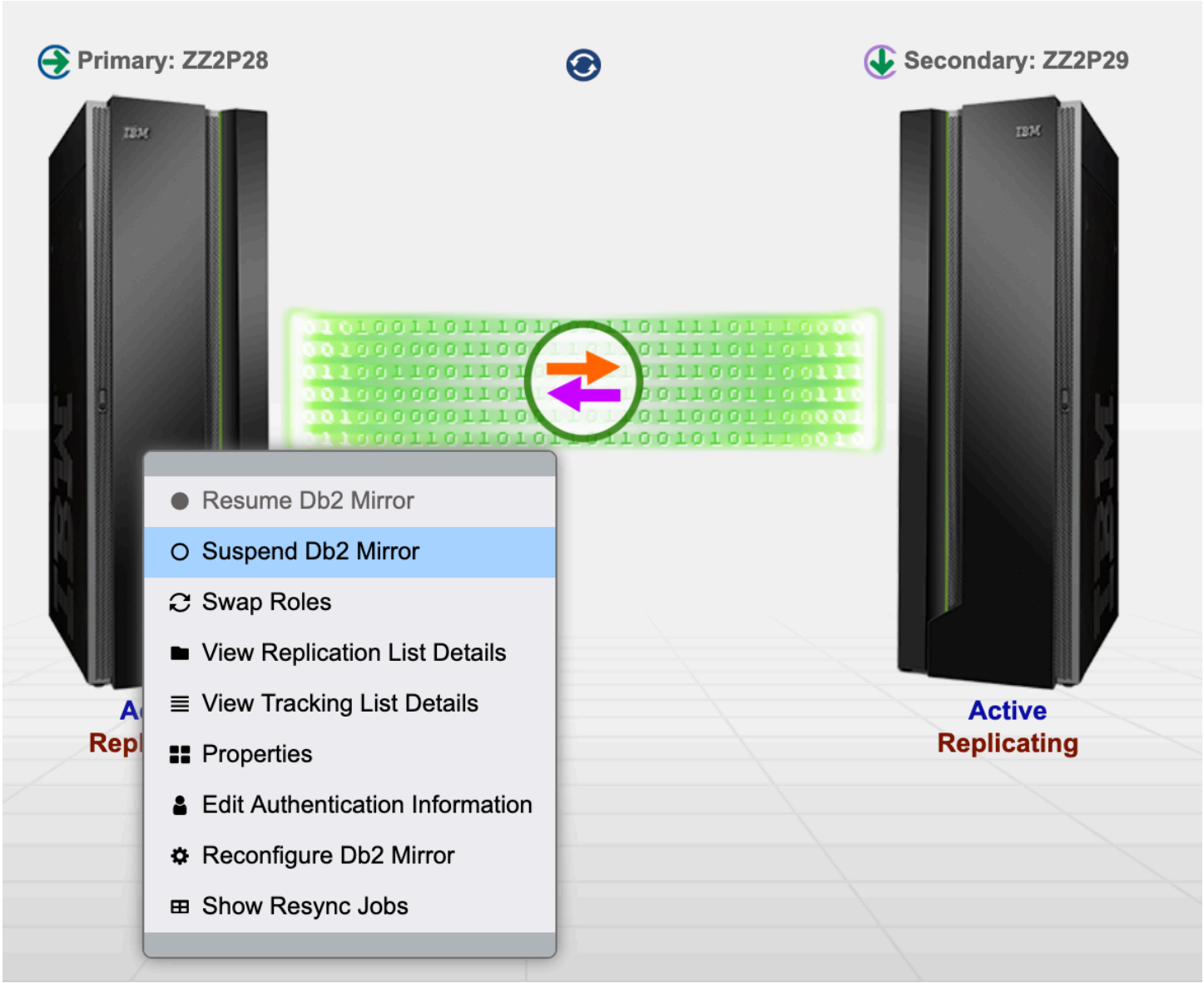
Db2 Mirror – Active Passive

Run Production Workloads on this node

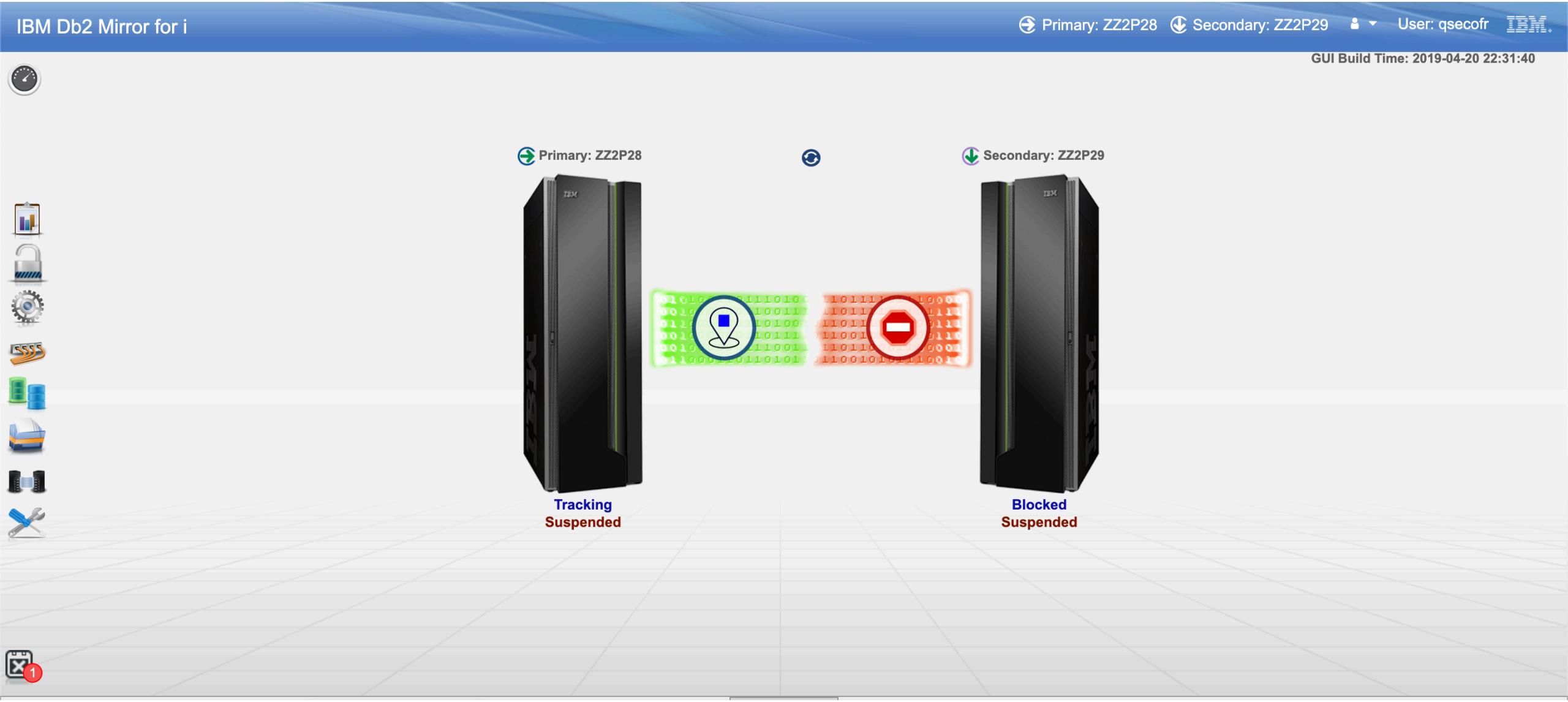


Run Queries and reports on this node

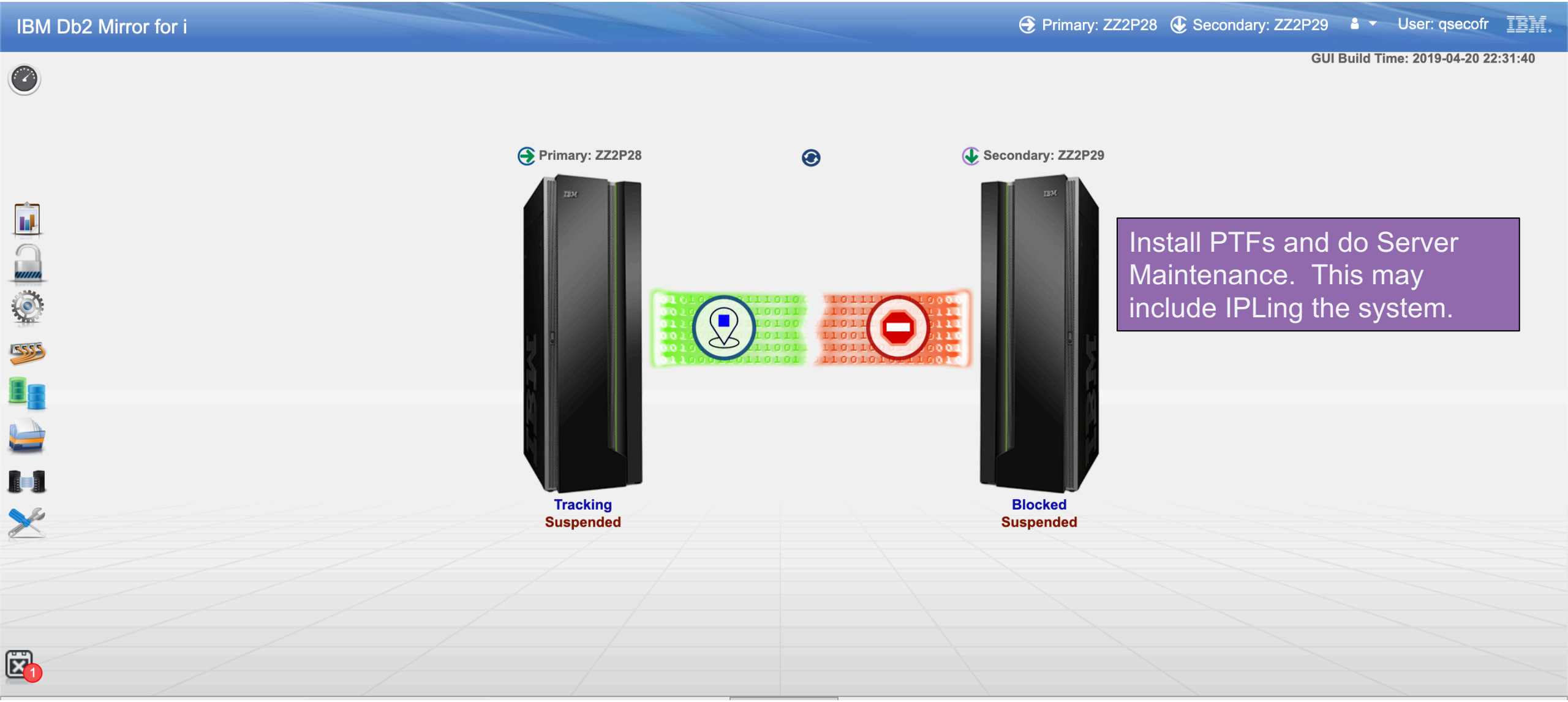
Rolling Upgrade Scenario



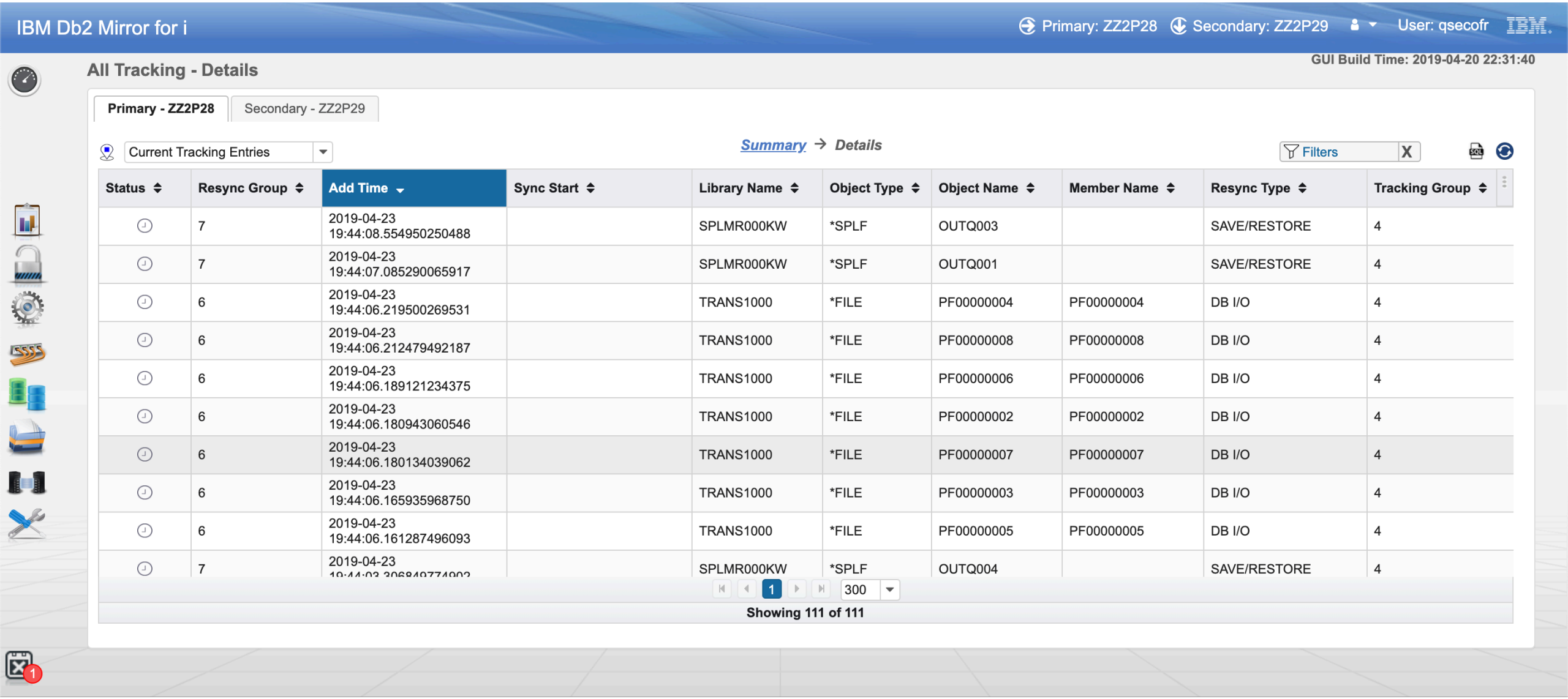
Suspend the secondary node



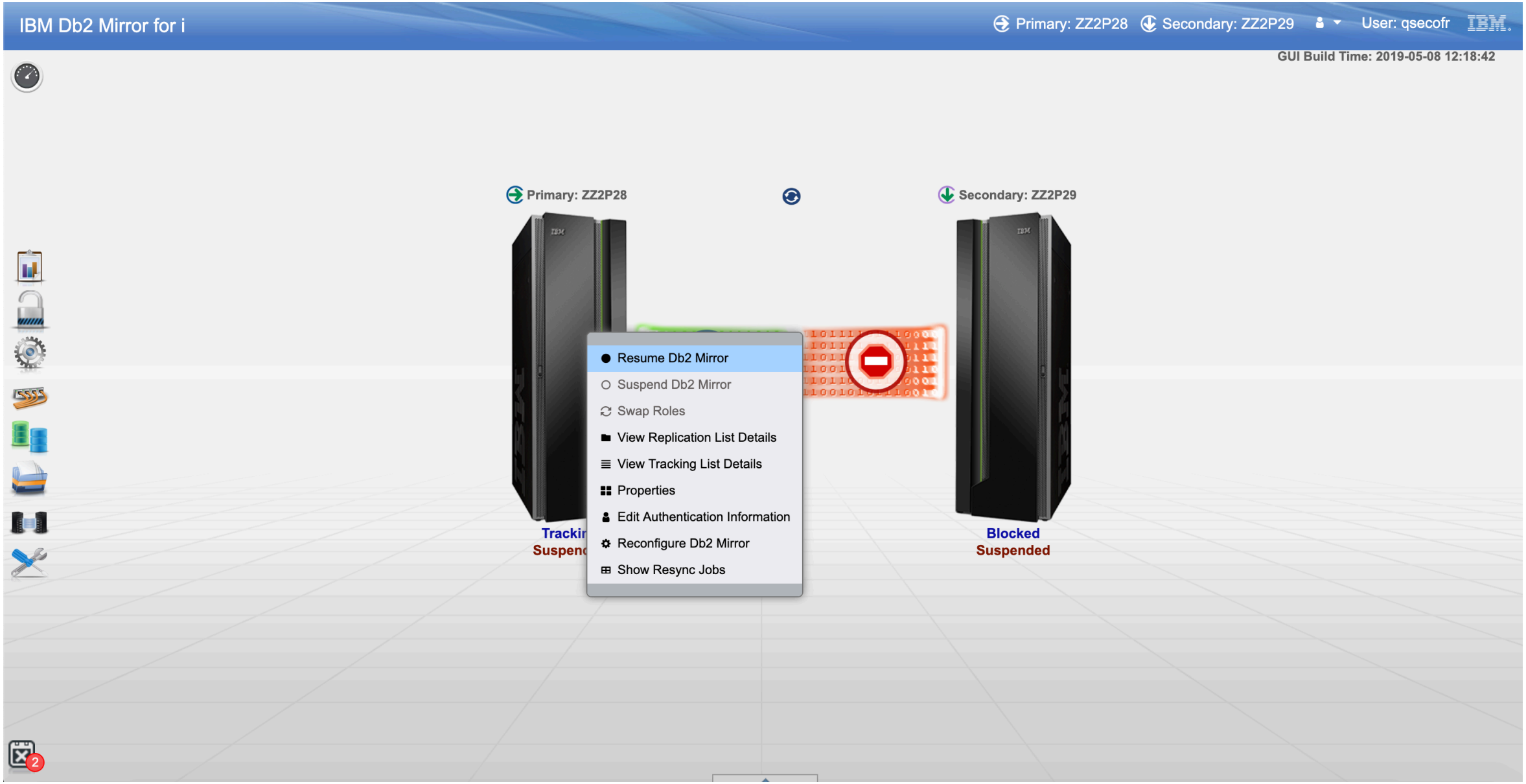
Do your maintenance on the Secondary suspended node



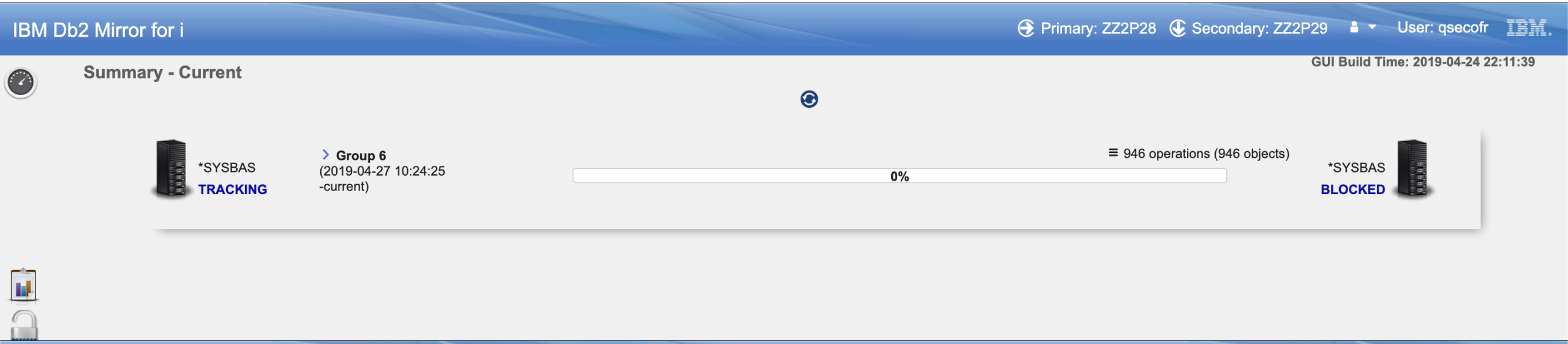
The Primary Node is the one designated to track changes

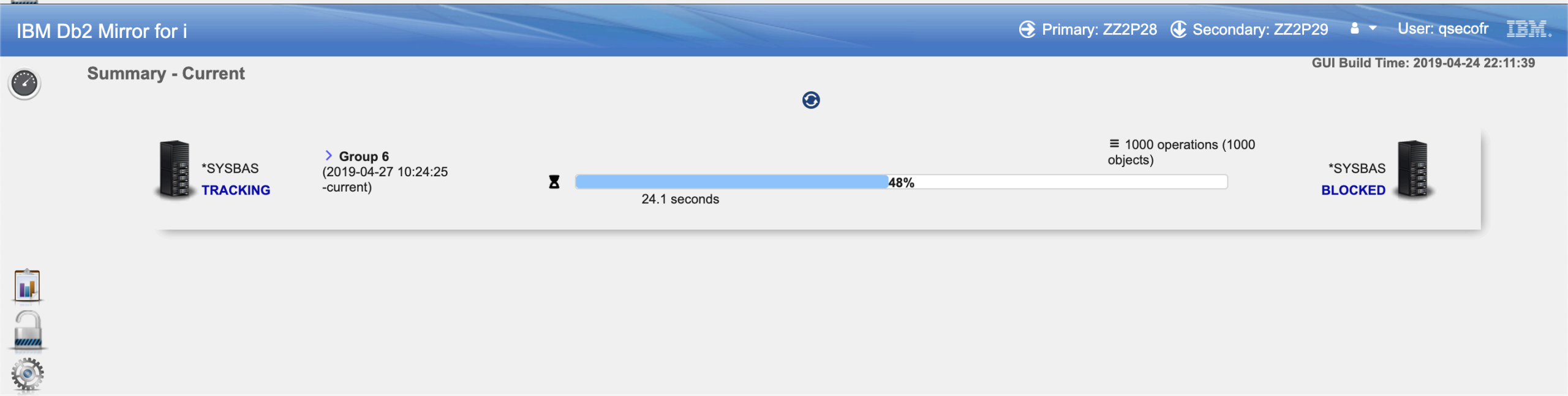


Resume Mirroring to get the Systems back in Sync



Mirror Resume Progress

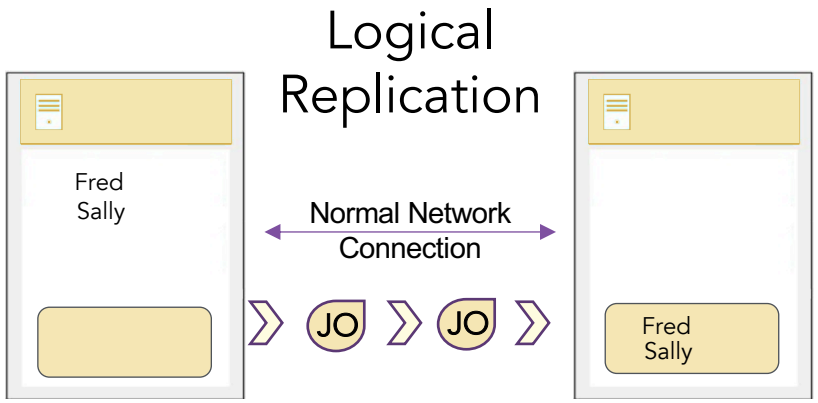


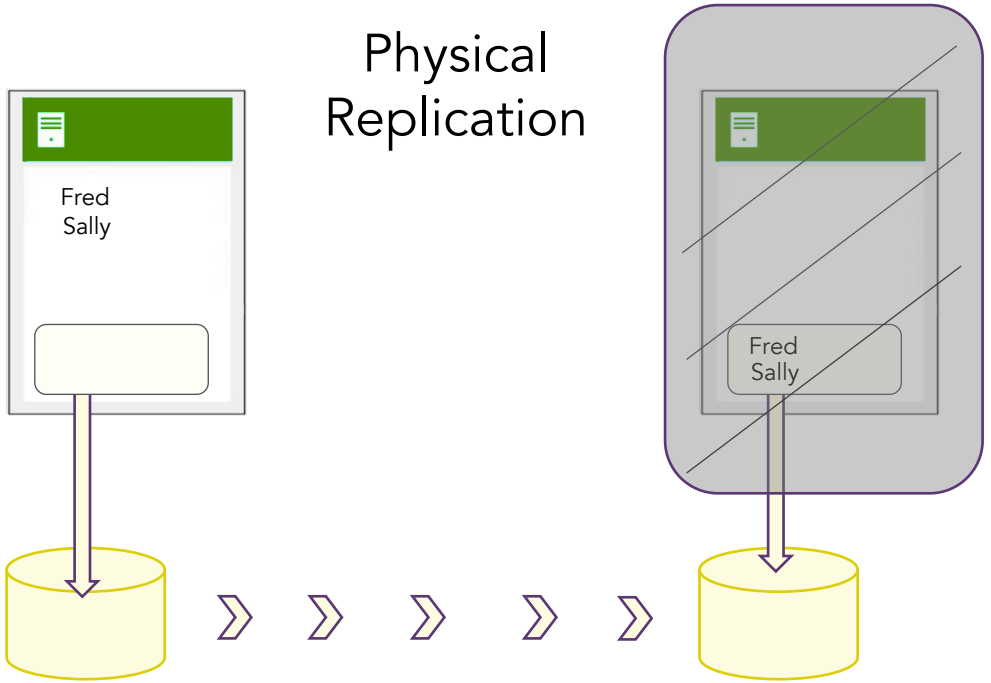


Resync is Complete, Swap roles and repeat

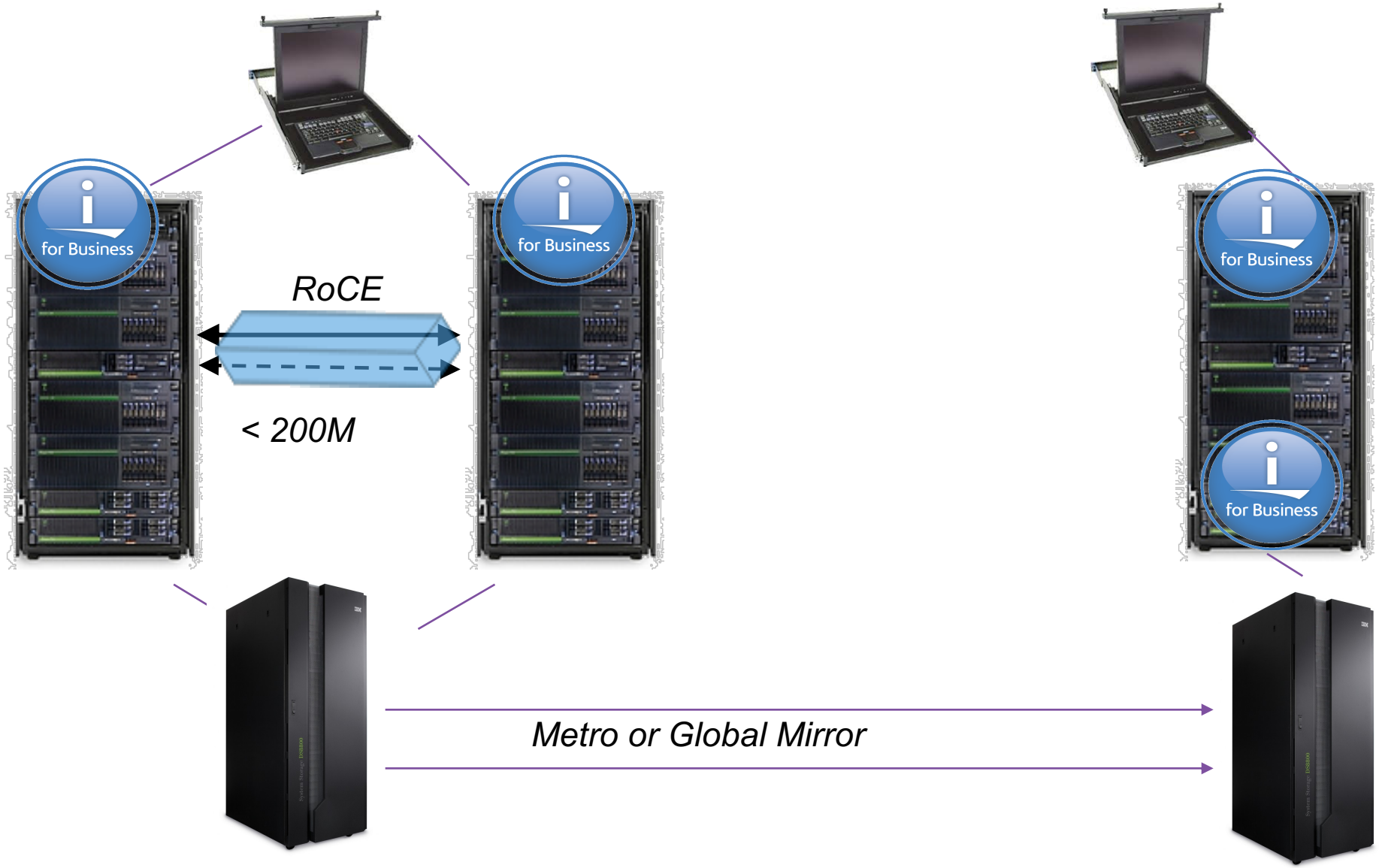
Db2 Mirror – What makes it different

- New integrated IBM i synchronization technology
- Does not leverage any existing availability technology to provide continuous availability
  - But does work with existing technology

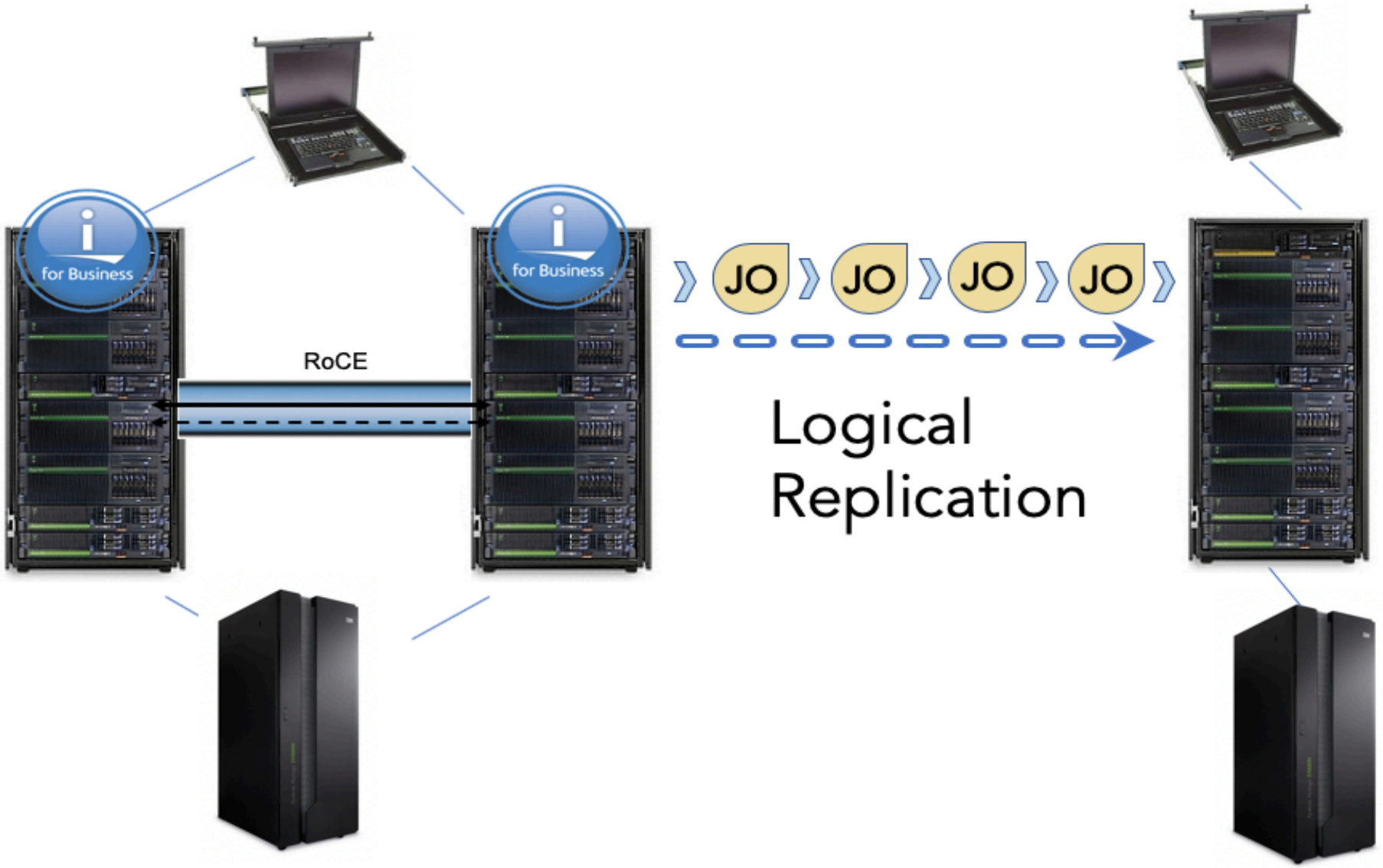




DR Solutions Built on Top of Db2 Mirror for IBM i



DR Solutions Built on Top of Db2 Mirror for IBM i



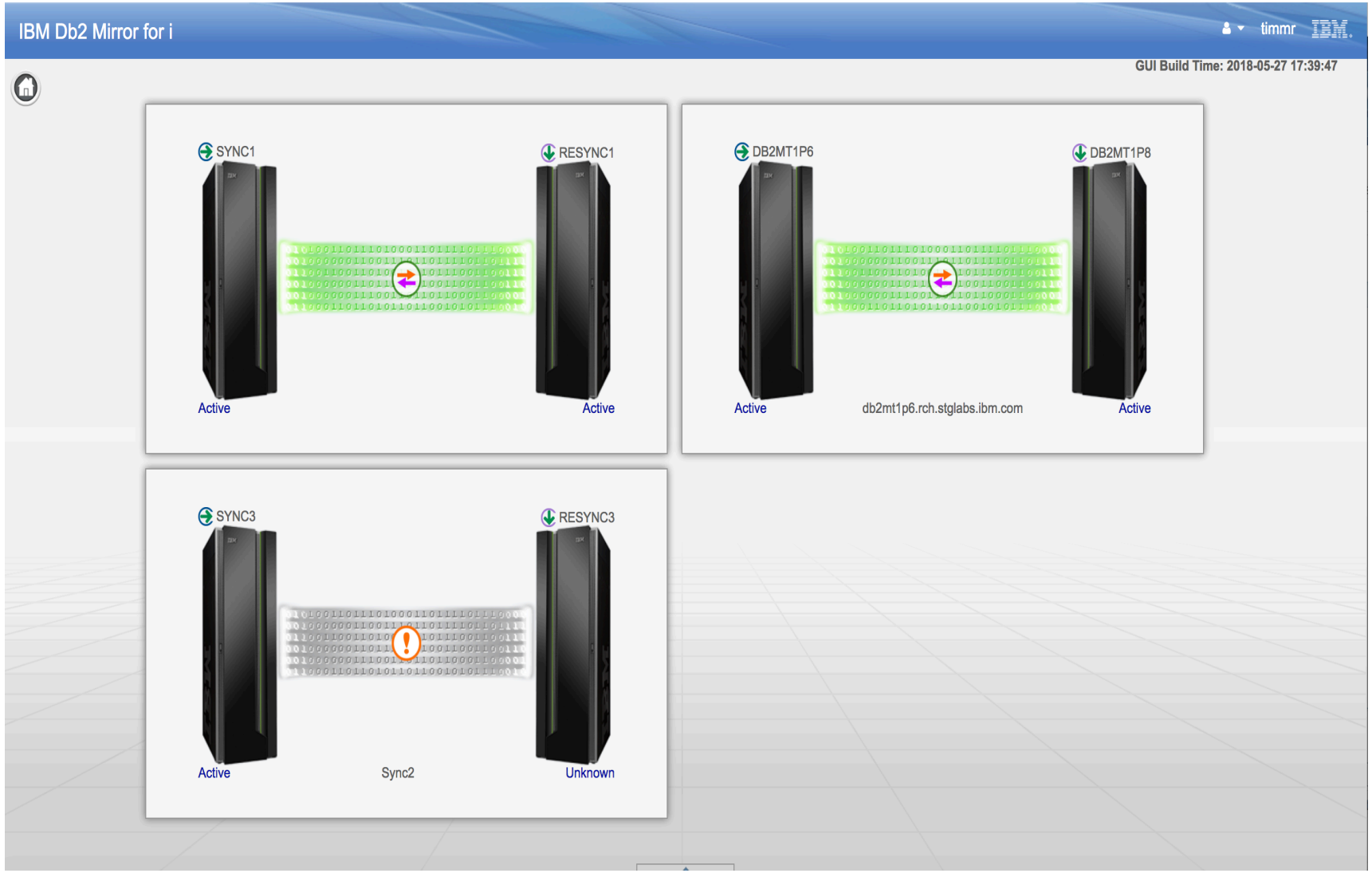
Db2 Mirror GUI

GUI runs on IBM i

GUI can run on the Db2 Mirror nodes

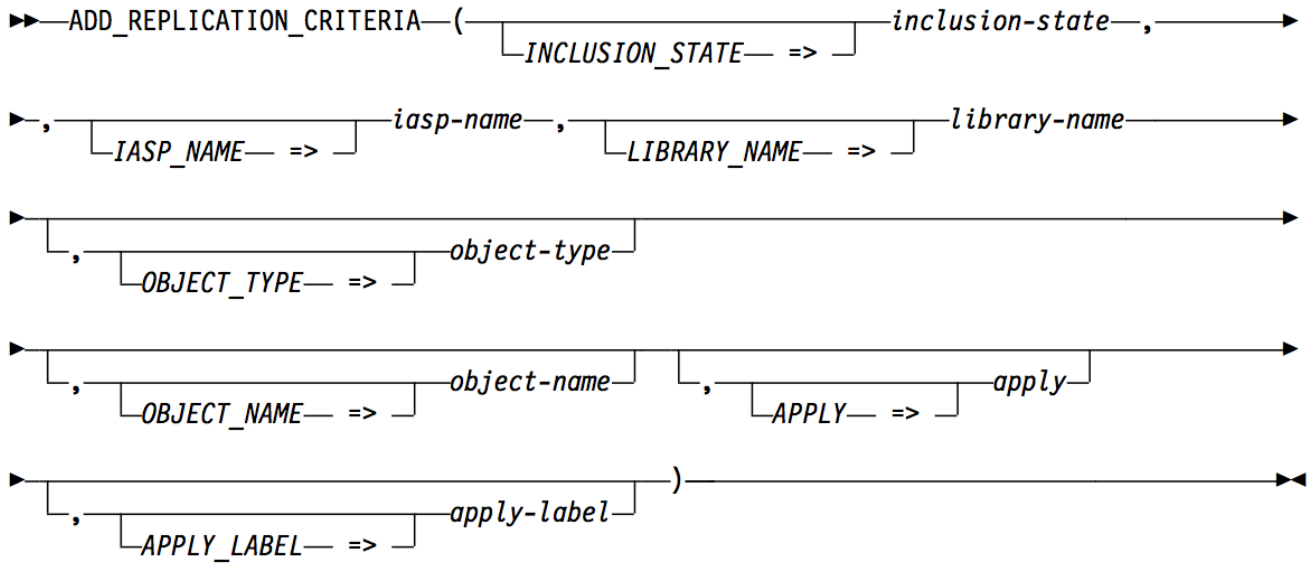
GUI can run outside of the Db2 Mirror nodes and manage multiple pairs

http://systemname:2006/Db2Mirror

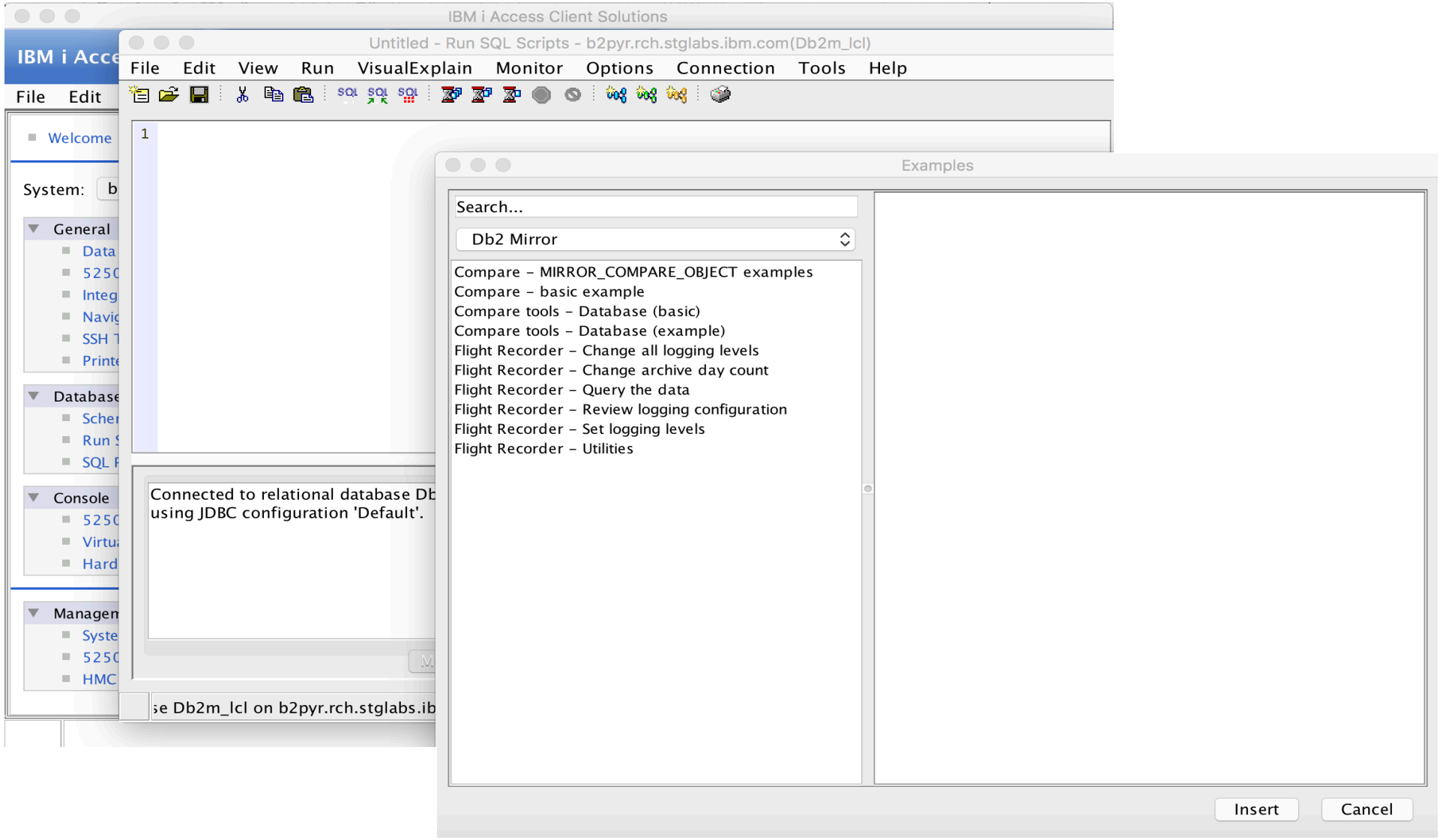


SQL Services

- EXECUTE SQL privilege on this procedure
- *USE authority on the QSYS/QMRDBSSDBA *SRVPGM.

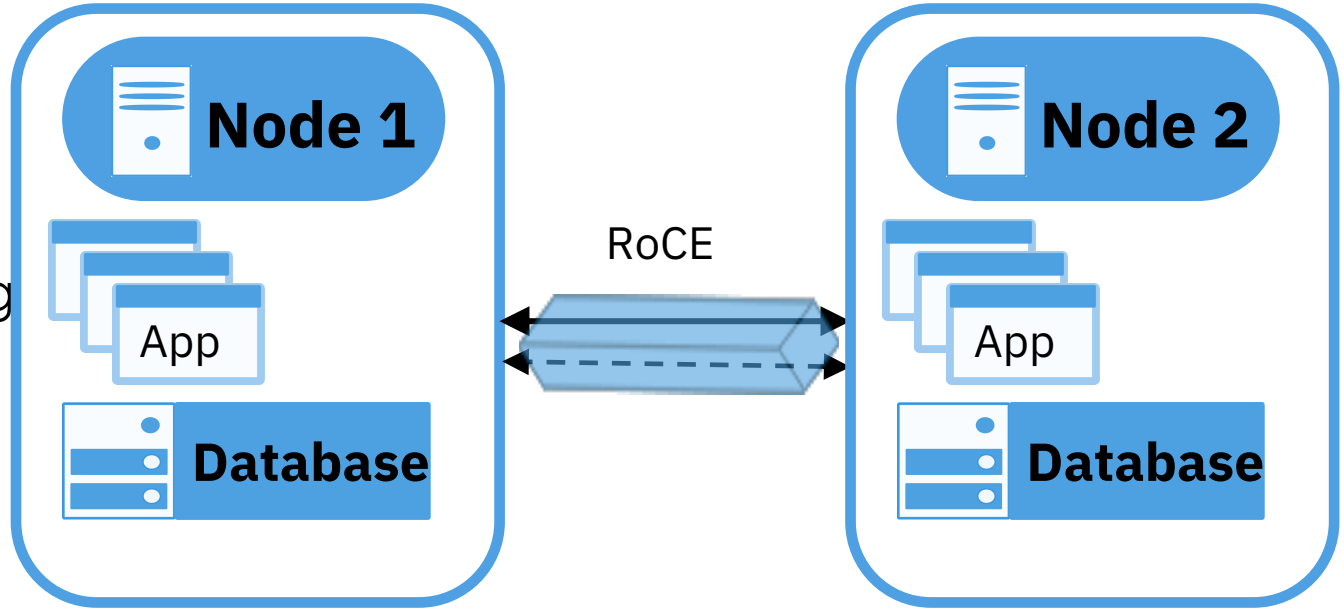


ACS Insert from Examples



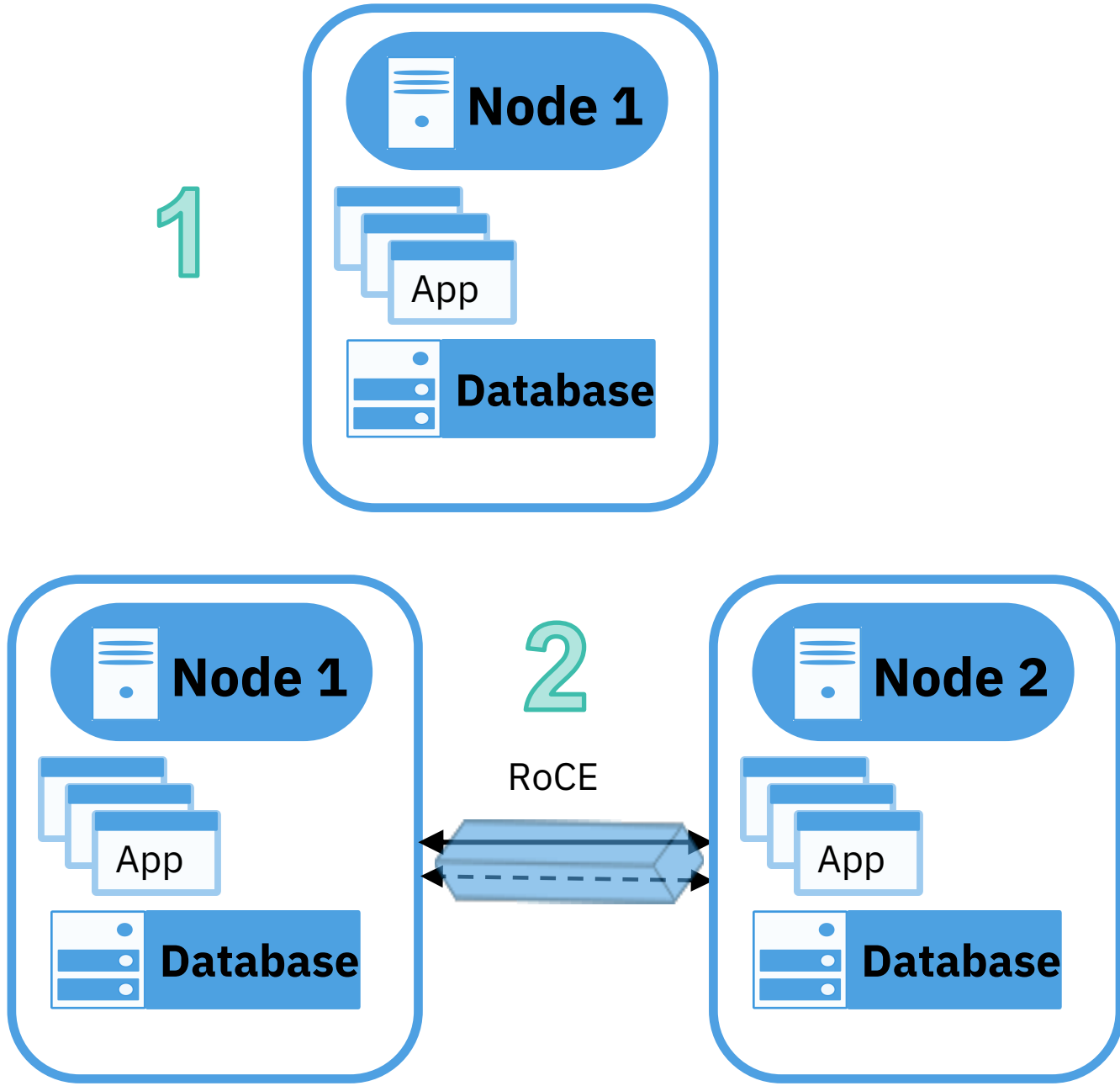
Performance Expectations

- With synchronous replication the complete path length will increase since the action may drive I/O on both nodes in order to finish. This could increase by up to ~(2-3)X for Db2 changes
- The ability to run transactions on both nodes will mitigate per transaction overhead and with a target of achieving equal to or greater transactional throughput
- Read workloads will not be impacted since they do not have to be replicated
- Single threaded or serial I/O workloads will be the most impacted.



Setup of Db2 Mirror 2nd Node

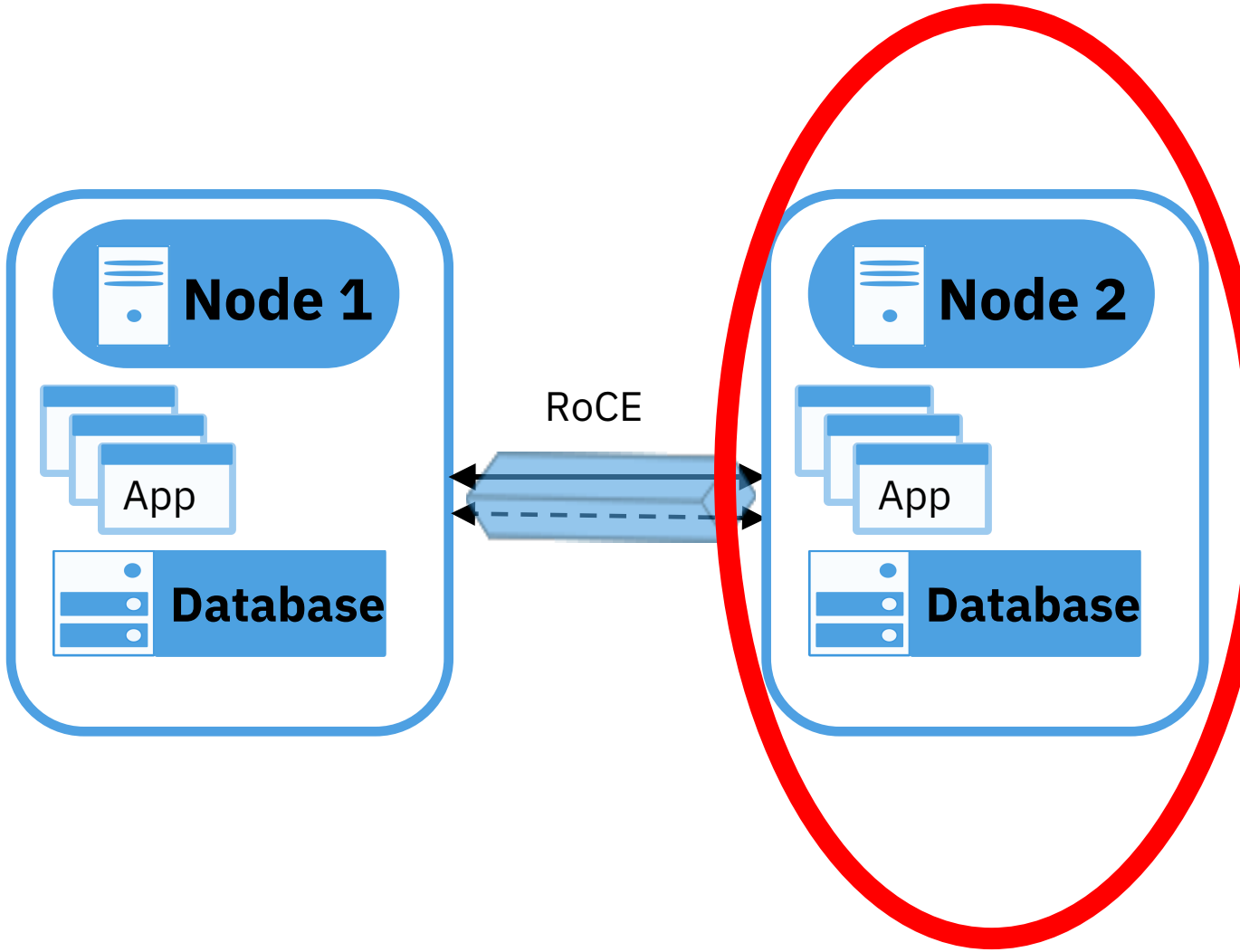
- Guided wizard to setup
  - Input secondary config information
  - Start DB2Mirror
  - Clone original lpar
- On the clone lpar initial IPL, the config information will be set. ie IP addresses and system name.
- The Source and Clone will connect and form a cluster.
- The Source will sync any new changes that have happened after the clone and before the cluster formation.



Setup of Db2 Mirror 2nd Node

— Before starting setup

1. Define a second lpar at the HMC
   - CPU/MEM should be similar to the the source lpar
2. Zone/Connect Storage Controller to the Node 2 lpar
3. Create LUNs the same number and size as Node1.
4. Assign LUNs to Node 2

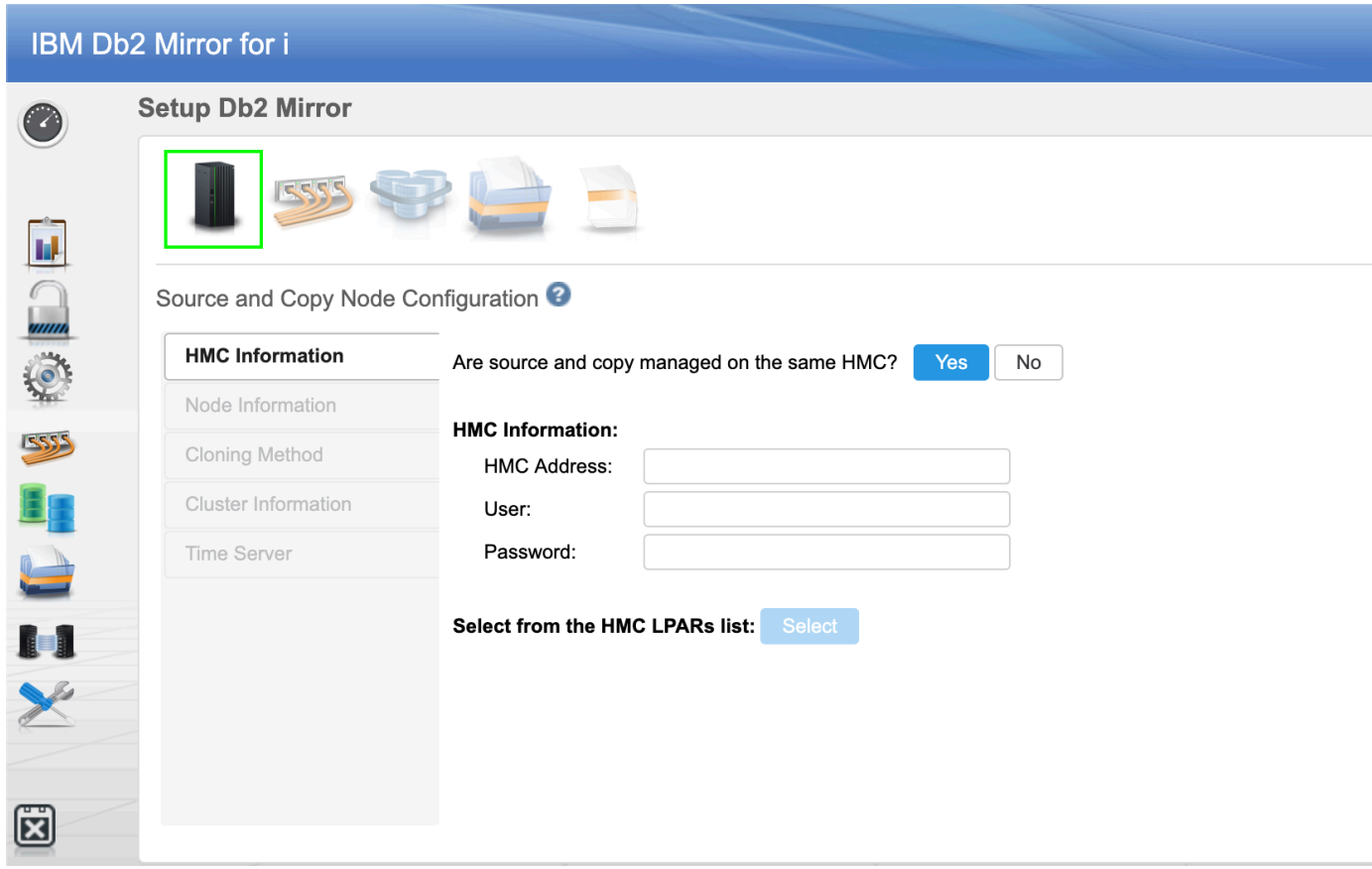


Setup of Db2 Mirror 2nd Node

— Input HMC info:

- Source and Target don't have to be on the same HMC

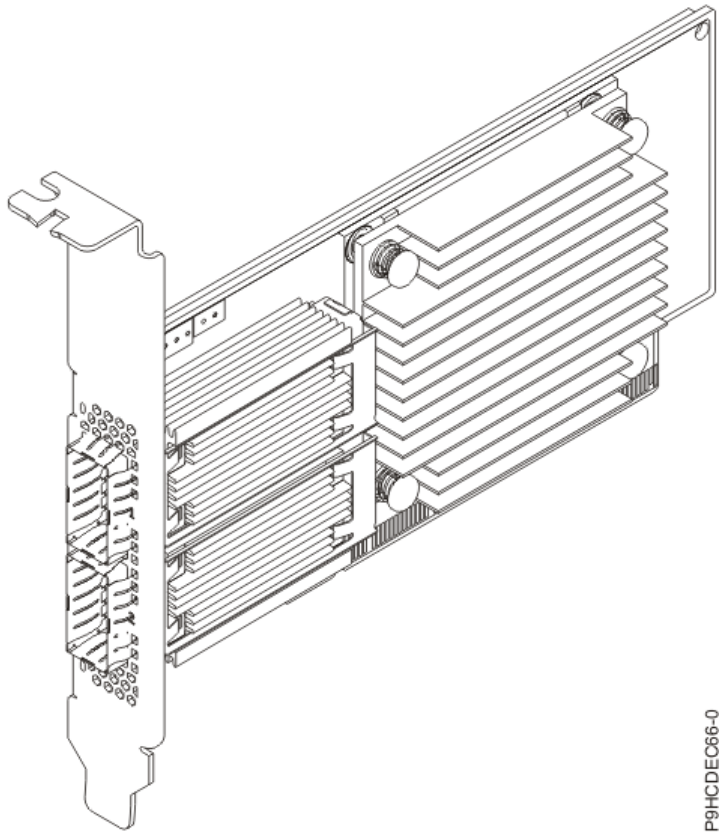
— Select the LPARs from the List



Communication Hardware

4 Adapter Options

- PCIe3 2-port 10 Gb NIC & ROCE SR/Cu adapter (FC EC2R and EC2S; CCIN 58FA)
- PCIe3 2-port 25/10 Gb NIC & ROCE SFP28 adapter (FC EC2T and FC EC2U; CCIN 58FB)
- PCIe3 2-port 100 GbE NIC & ROCE QSFP28 Adapter (FC EC3L and EC3M; CCIN 2CEC)
- PCIe4 2-port 100 GbE ROCE x16 adapter (FC EC66 and EC67; CCIN 2CF3)



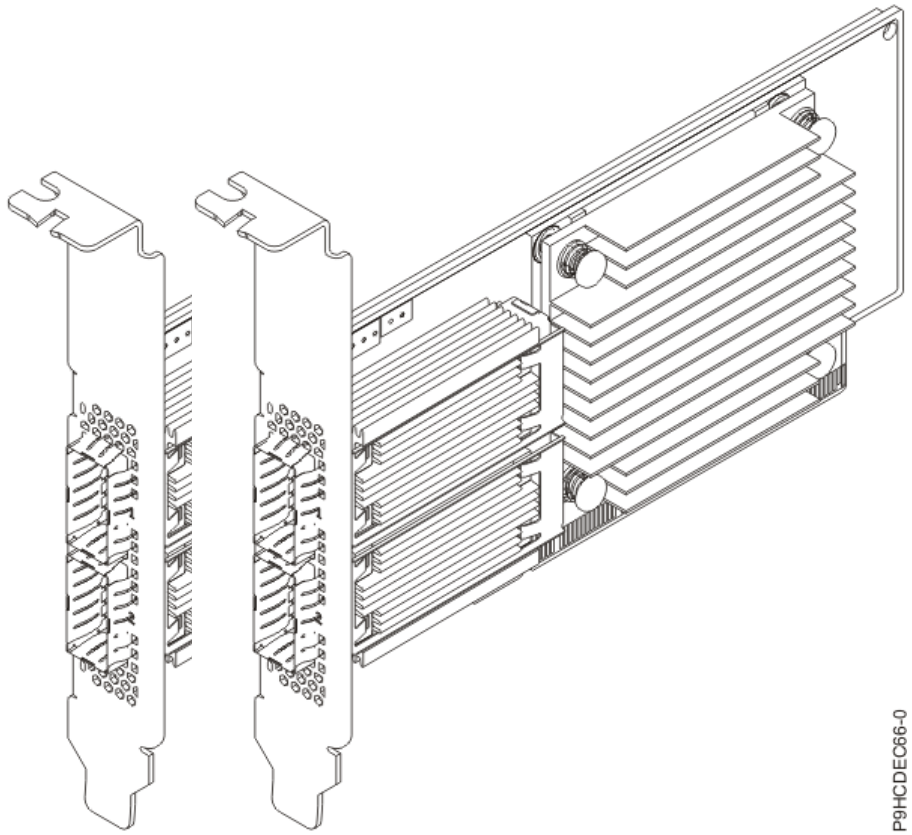
Max Cable length = 100 M

Optional RoCE switch

Power9 enables SR-IOV

Network Redundancy Groups (NRG)

- Network Redundancy Groups are a logical group of physical ports.
- Up to 16 links can form an NRG.
- Ability to prioritize different types of traffic onto separate physical links
- Failover domain is the entire group of ports



Db2 Mirror Setup

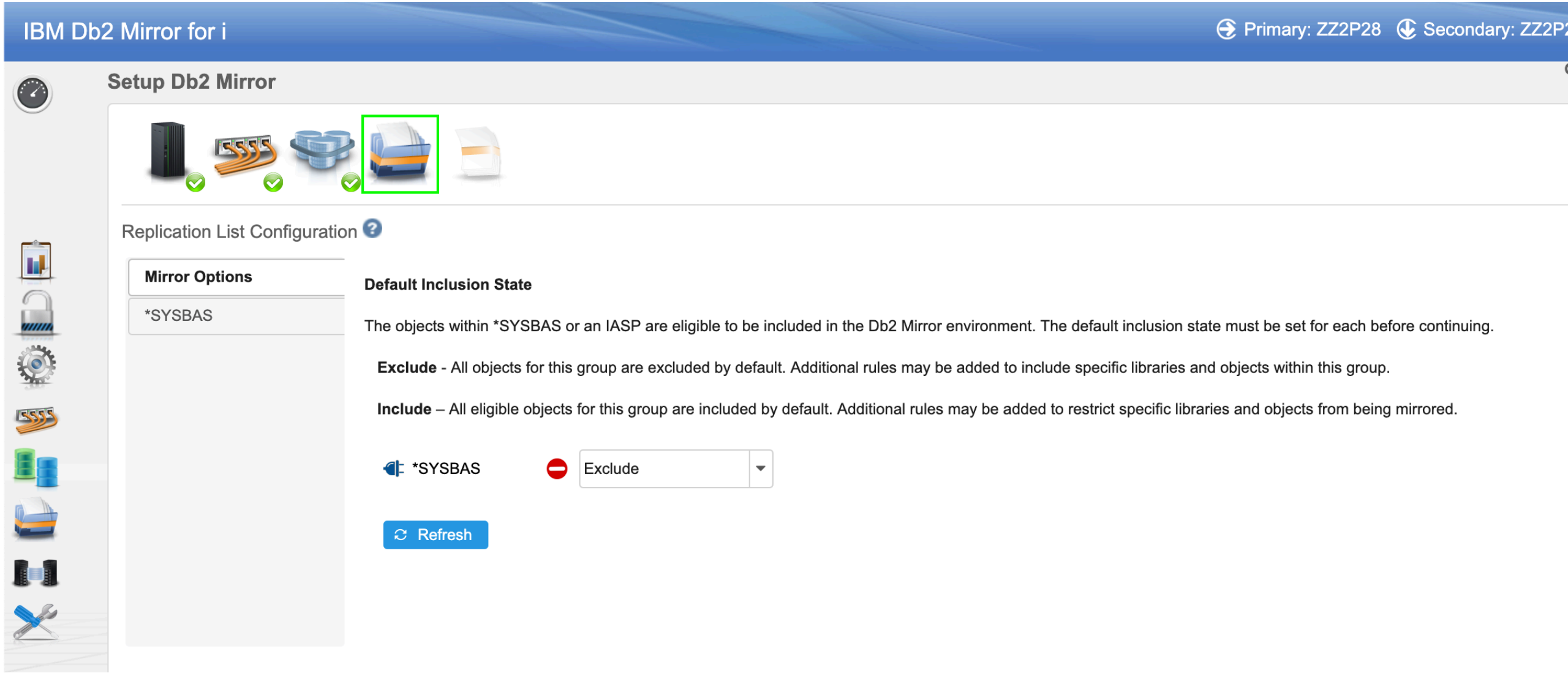
Primary - ZZ2P28 | Secondary - ZZ2P29

Group	IP Address - ZZ2P28	Priority	Link State	IP Address - ZZ2P29
All	All	All	All	All
Database Replication	169.254.2.28	1	Up	169.254.2.29
	169.254.3.28	1	Standby	169.254.3.29
Db2 Mirror Environment Manager	169.254.2.28	1	Up	169.254.2.29
	169.254.3.28	1	Standby	169.254.3.29
IFS Replication	169.254.2.28	1	Up	169.254.2.29
	169.254.3.28	1	Standby	169.254.3.29
System Object Replication	169.254.2.28	1	Up	169.254.2.29
	169.254.3.28	1	Standby	169.254.3.29
Resynchronization	169.254.2.28	1	Up	169.254.2.29
	169.254.3.28	1	Standby	169.254.3.29

View NRG Statistics

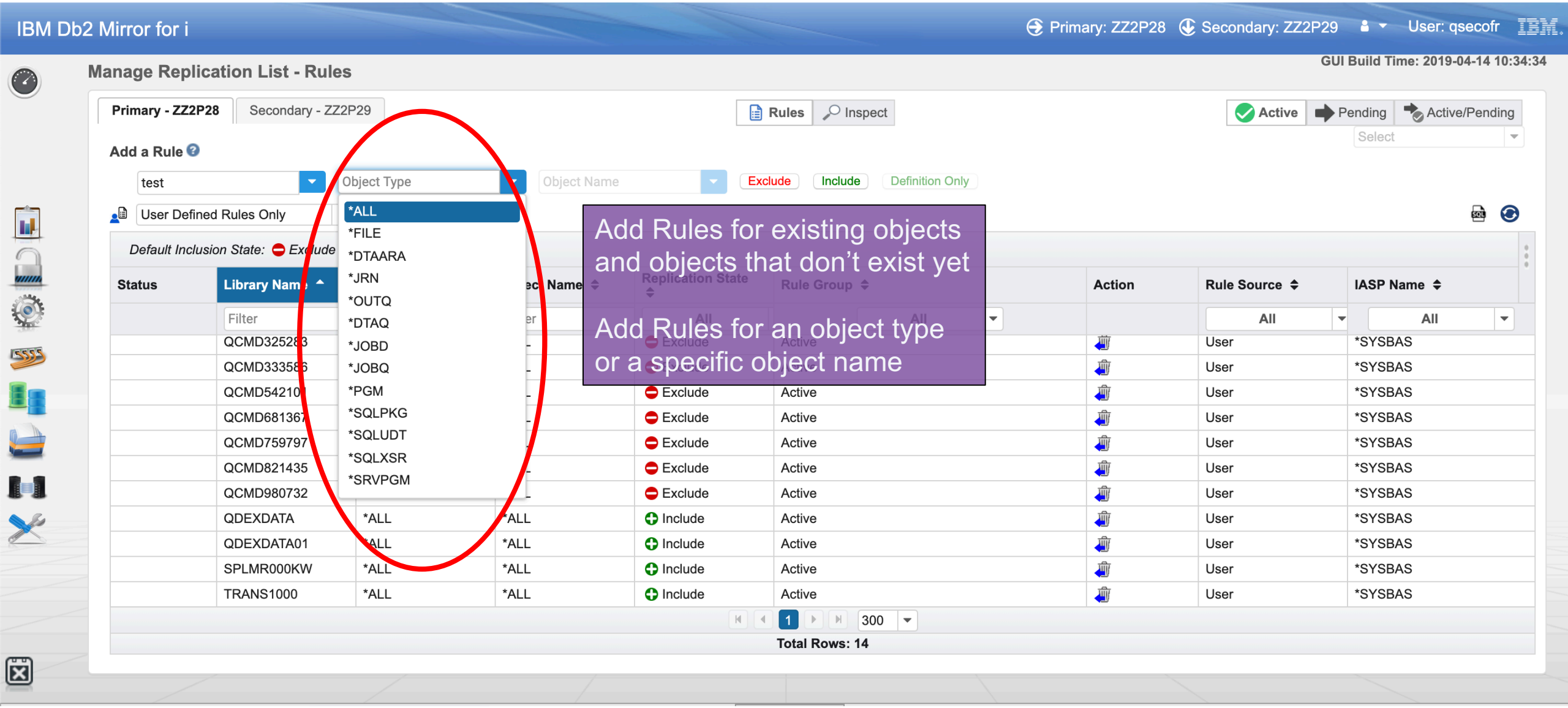
5 separate NRG categories to isolate traffic

Default Inclusion State for Replication Rules

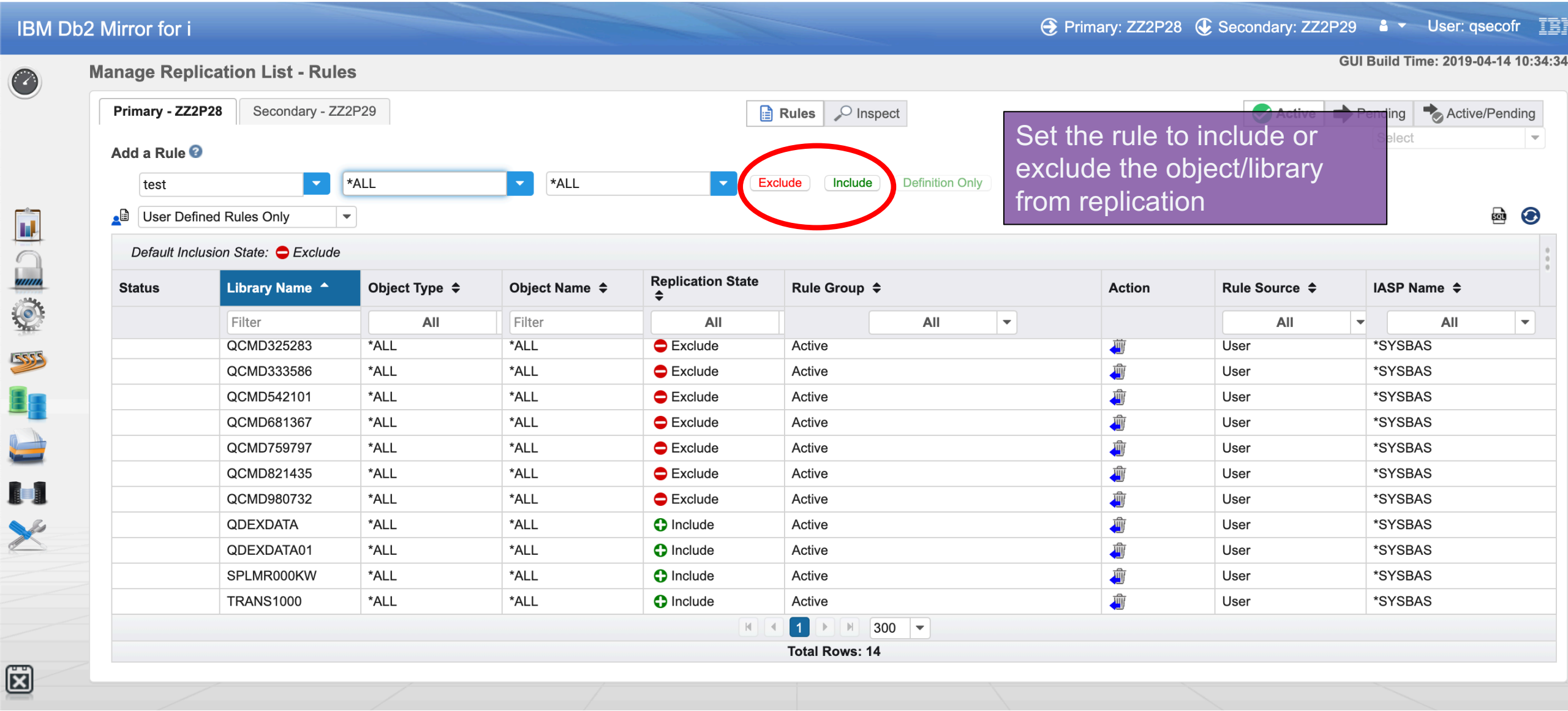


NOTE: Can only be chosen at setup time or re-configuration time.

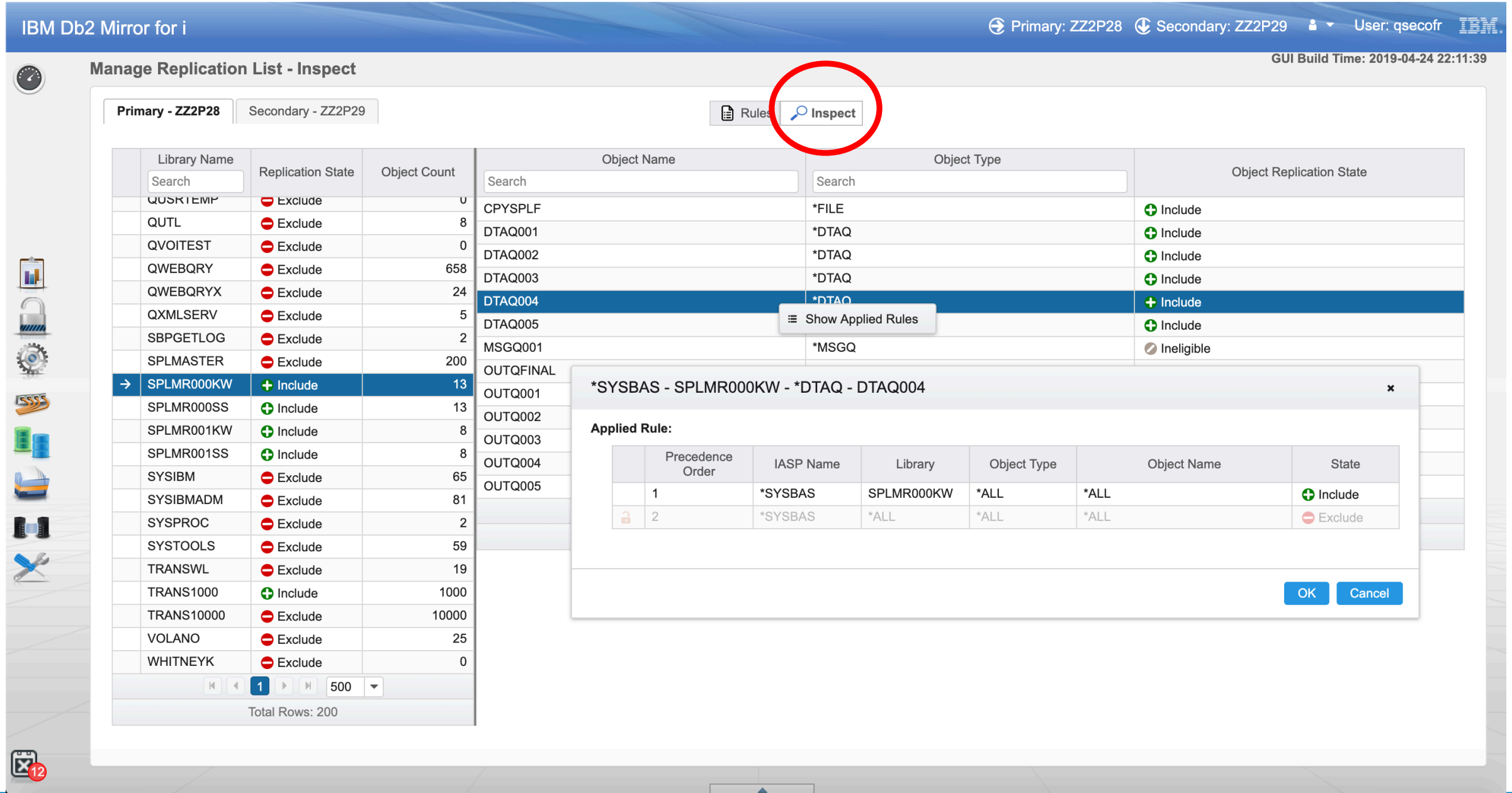
Replication List Rules



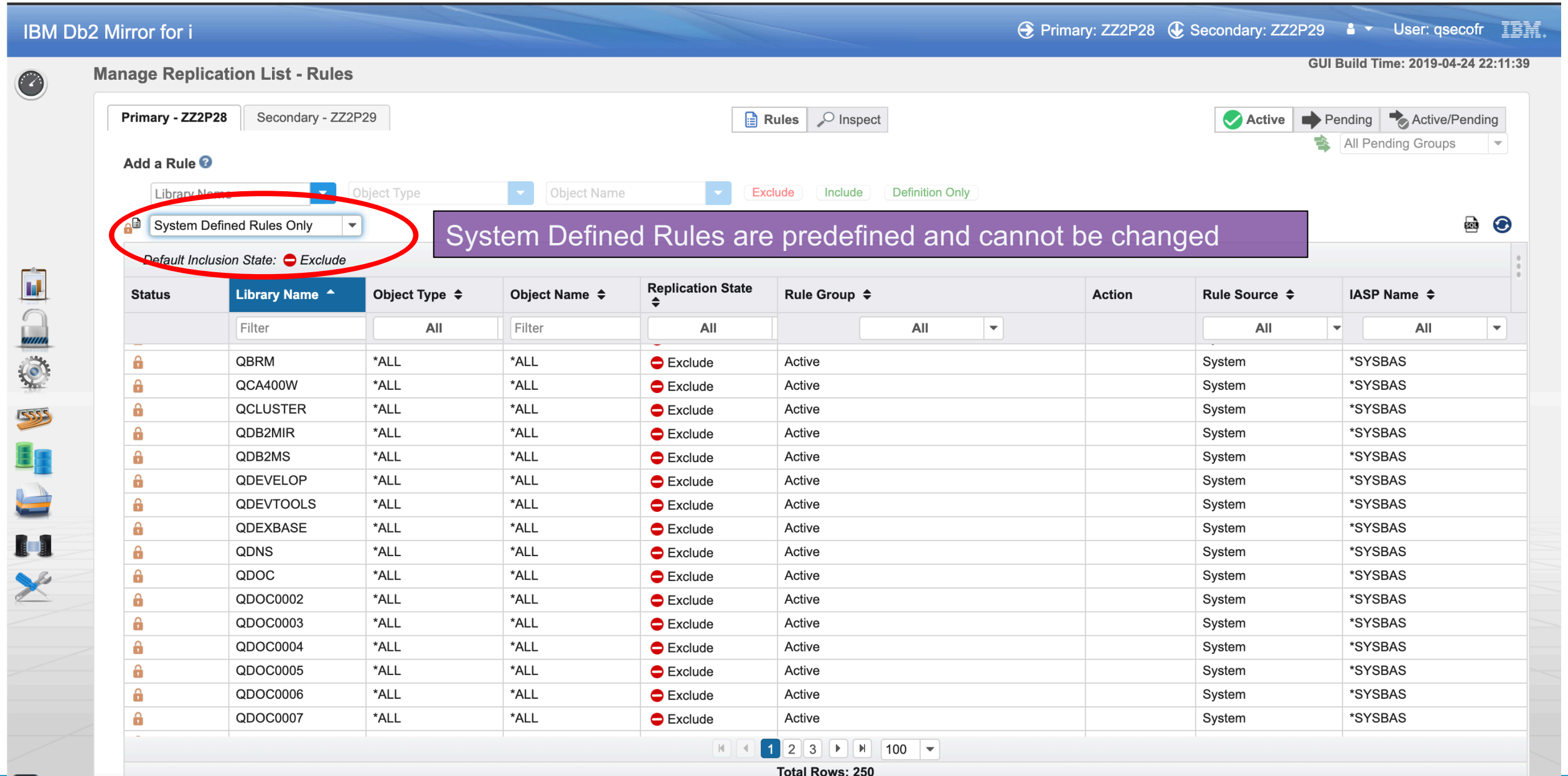
Replication List Rules



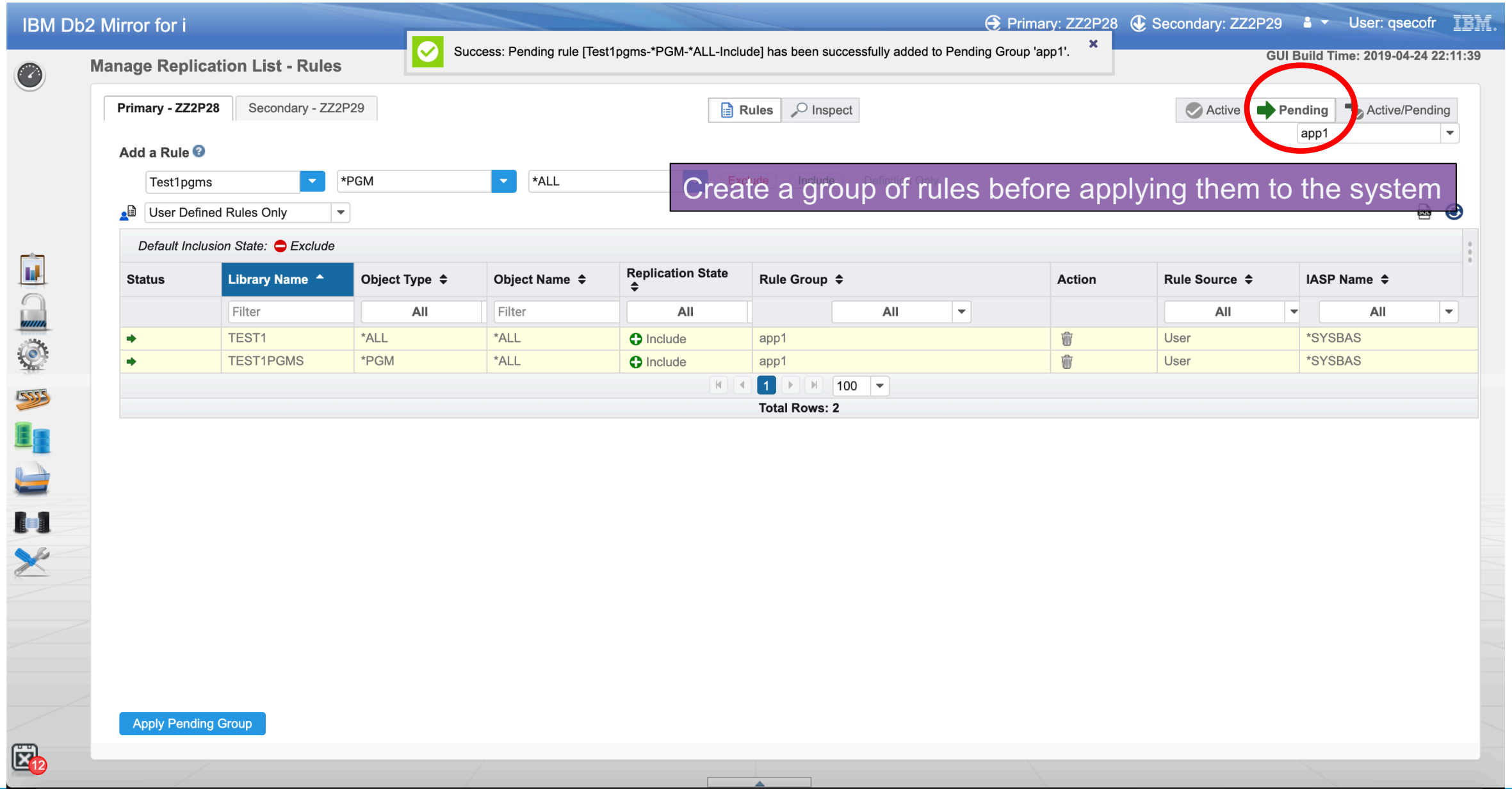
Inspect what the Rules look like applied to the System



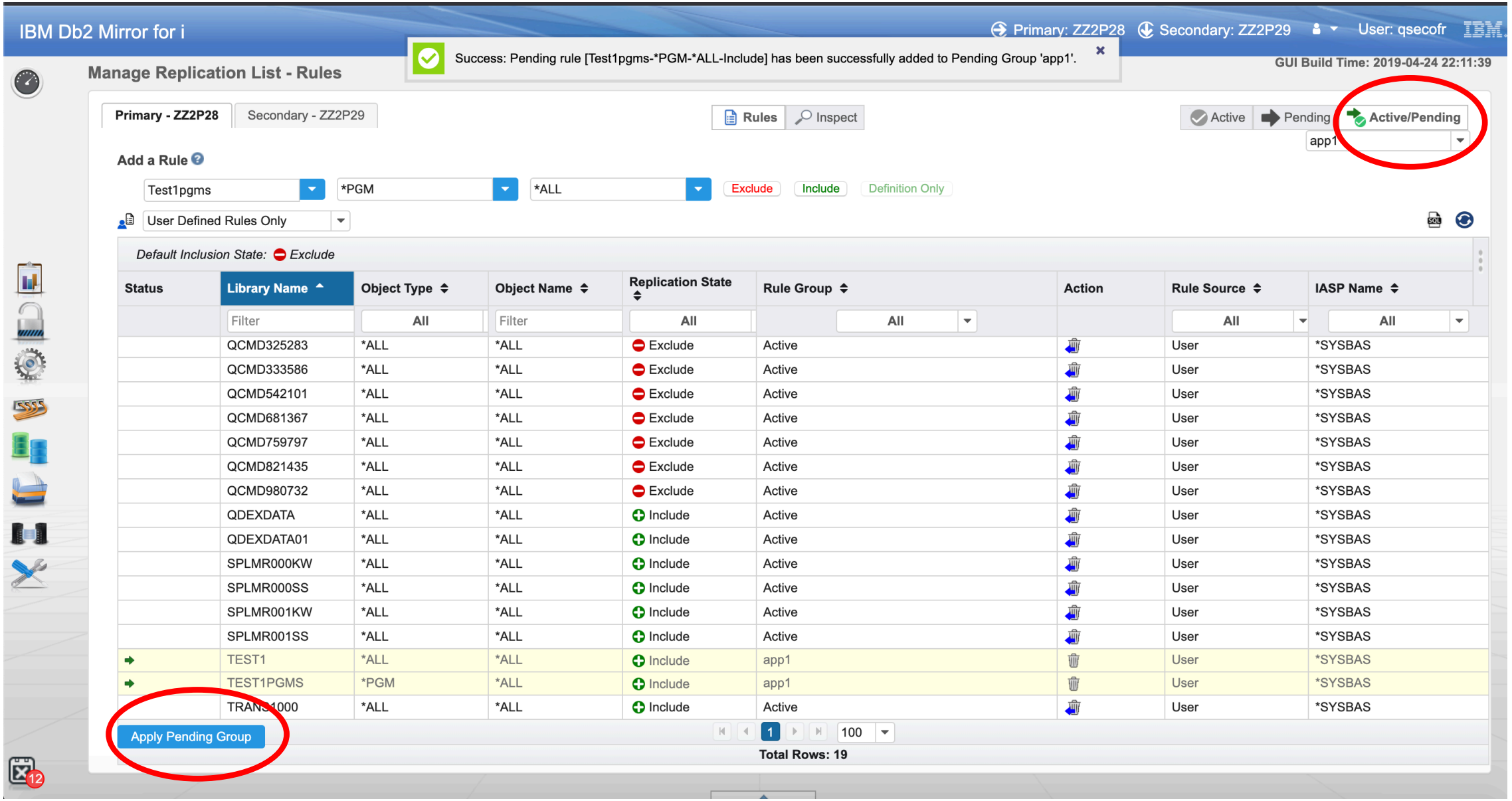
System Defined Rules



Pending Rules

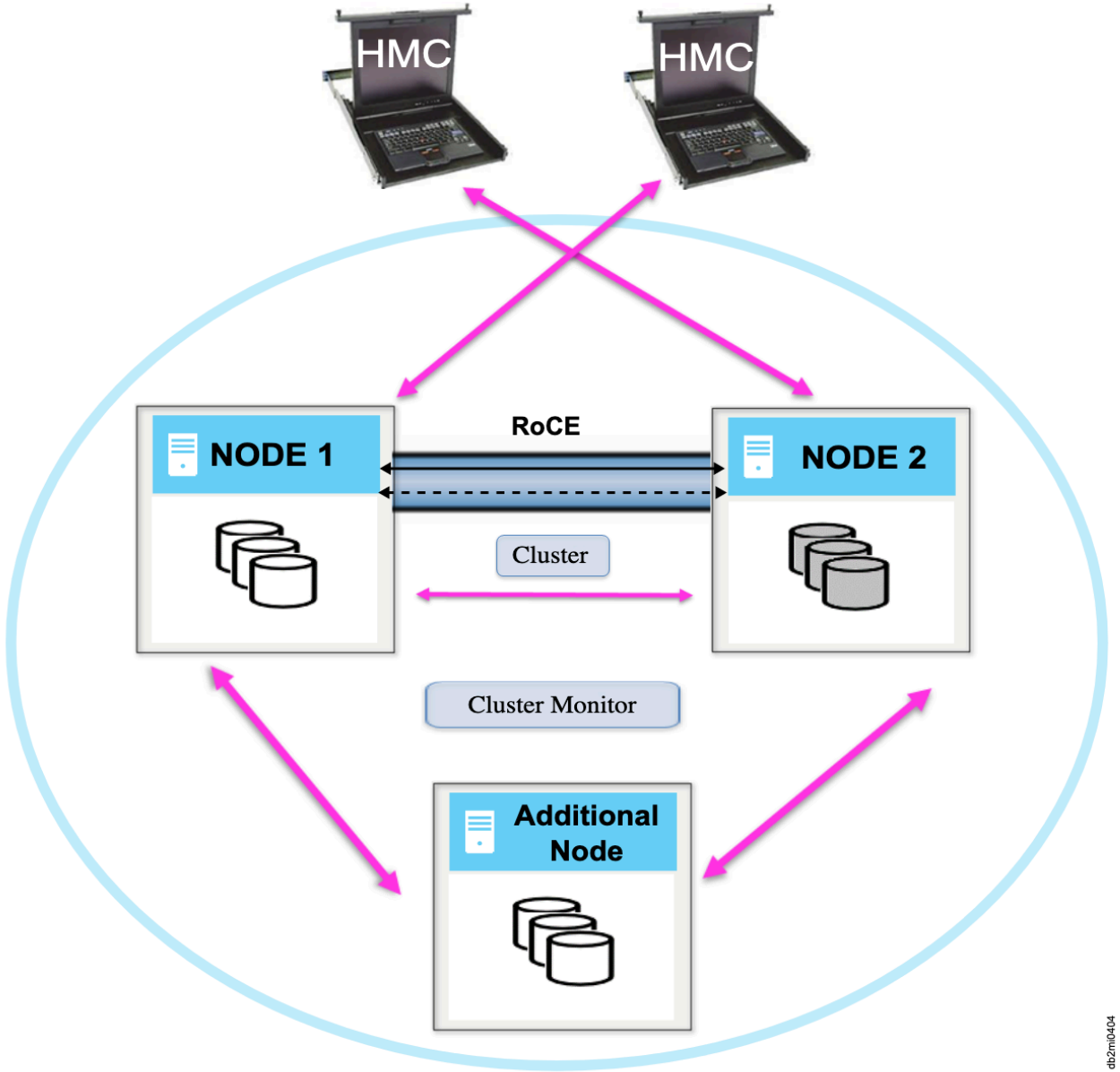


Visualize Pending Groups



Detecting Errors

- Nodes are designed as a ’Primary’ or ’Secondary’ to indicate which node is preferred to ‘track’.
- HMCs are used for failure detection of the partner node to indicate the Secondary can automatically take over as the Primary and begin tracking to allow Db2 transactions to continue.
- The Secondary side will block changes to Db2 transactions

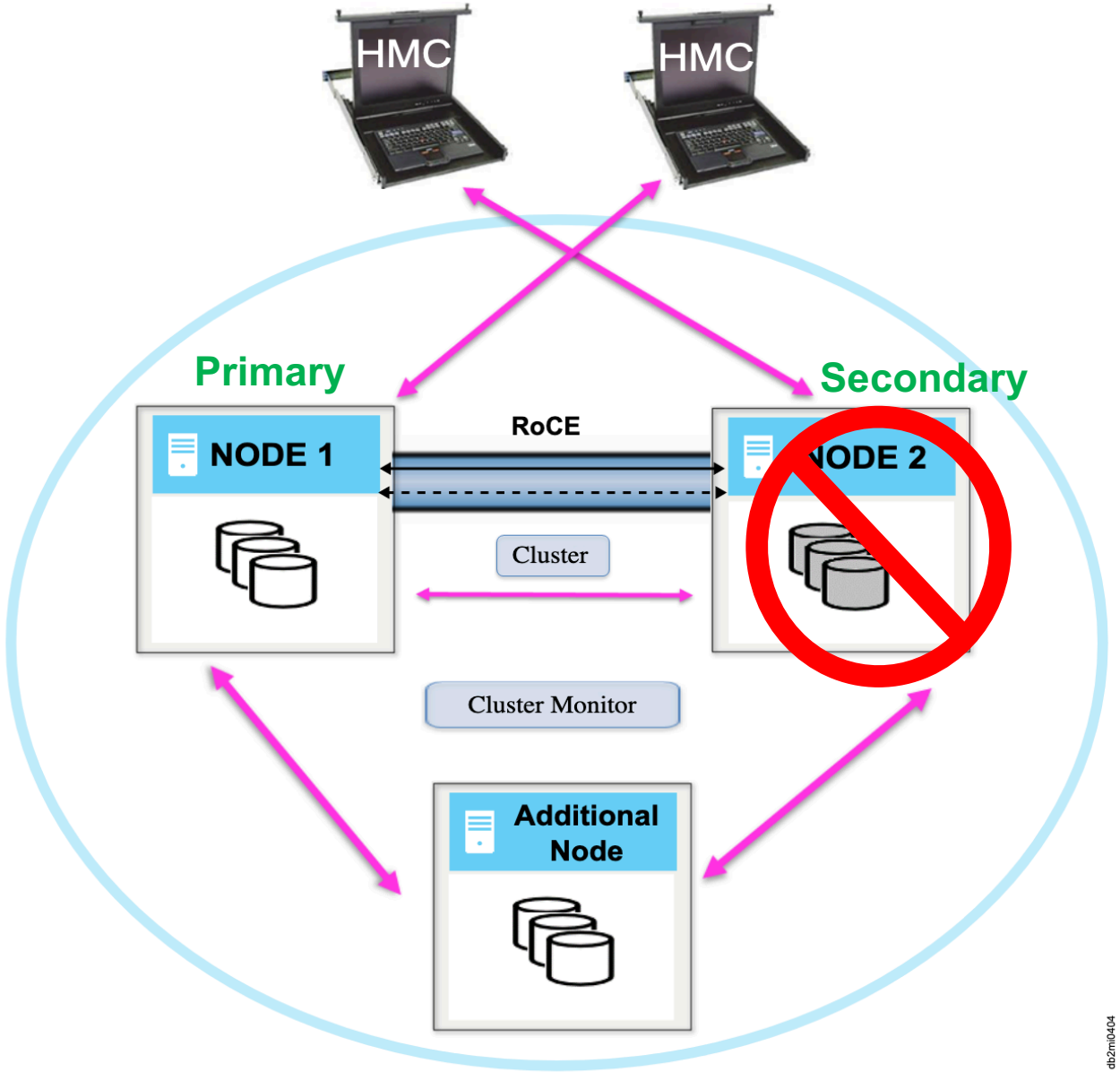


Detecting Errors – State Change

- **If the Secondary Fails:**
  - **IPLs**
- **MSD**
- **Goes to Restricted State**

- The Primary will begin tracking replicated object changes and the application will continue to run.

- The Secondary will be in a ‘blocked’ state and not allow changes to replicated objects until the two nodes have resumed mirroring.

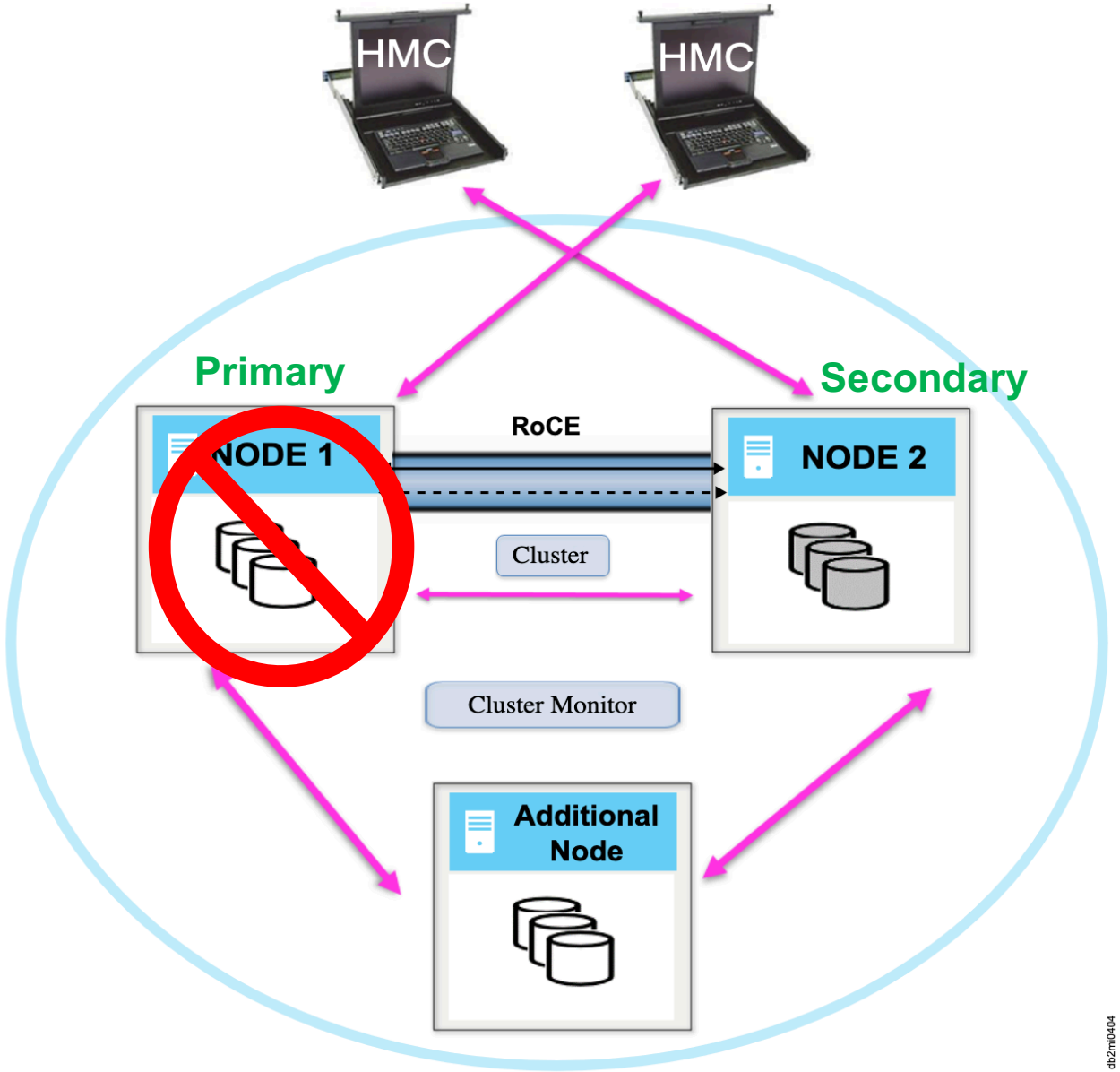


Detecting Errors – State Change

- **If the Primary Fails (Crash/MSD):**

- If the secondary can connect to the HMC and determine the primary has failed, the secondary will take over as the primary and begin tracking.

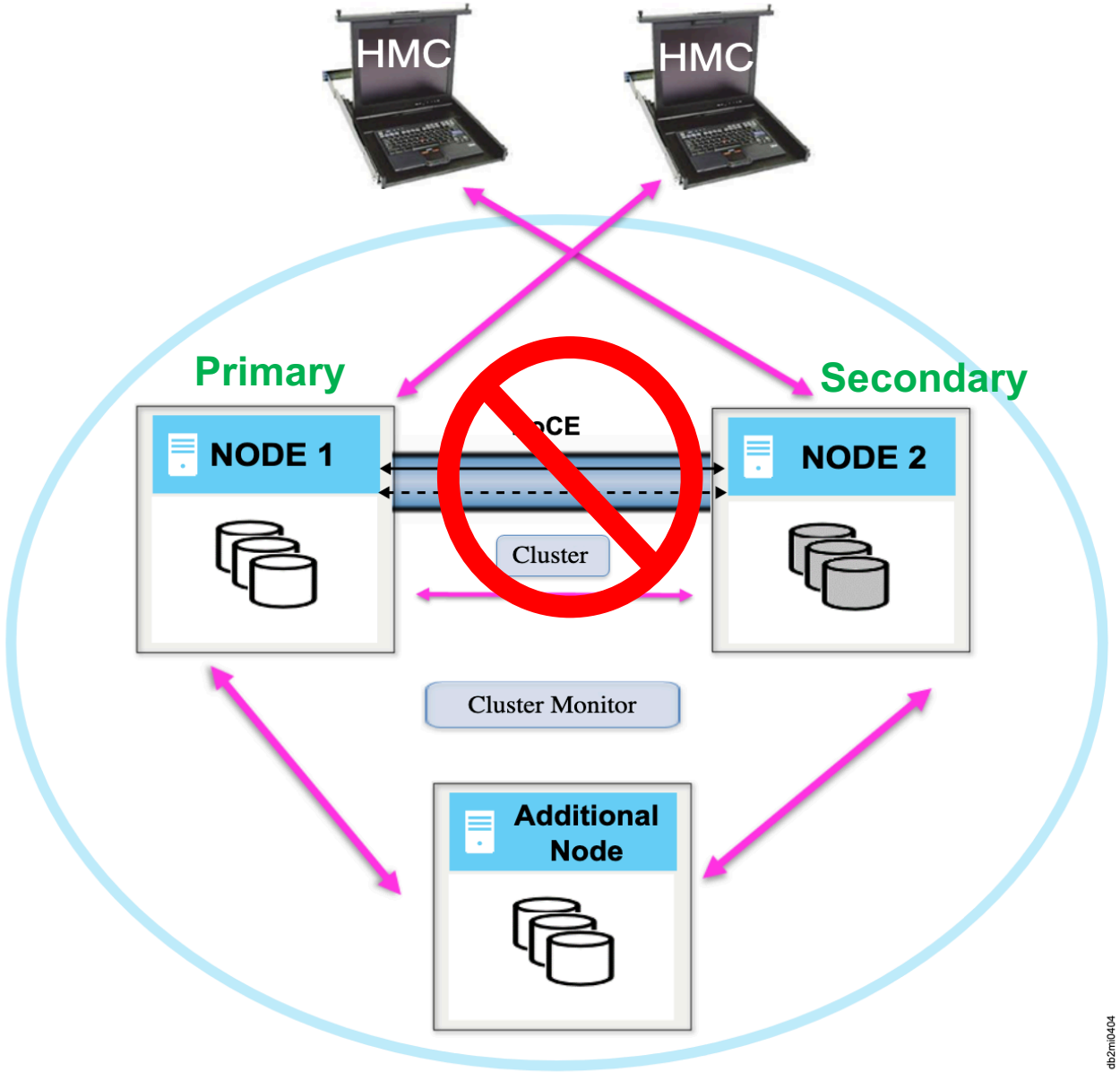
- If the secondary cannot detect the failure it will remain blocked. The user may choose to force the secondary to become the primary.



Detecting Errors – State Change

- **If the network fails:**

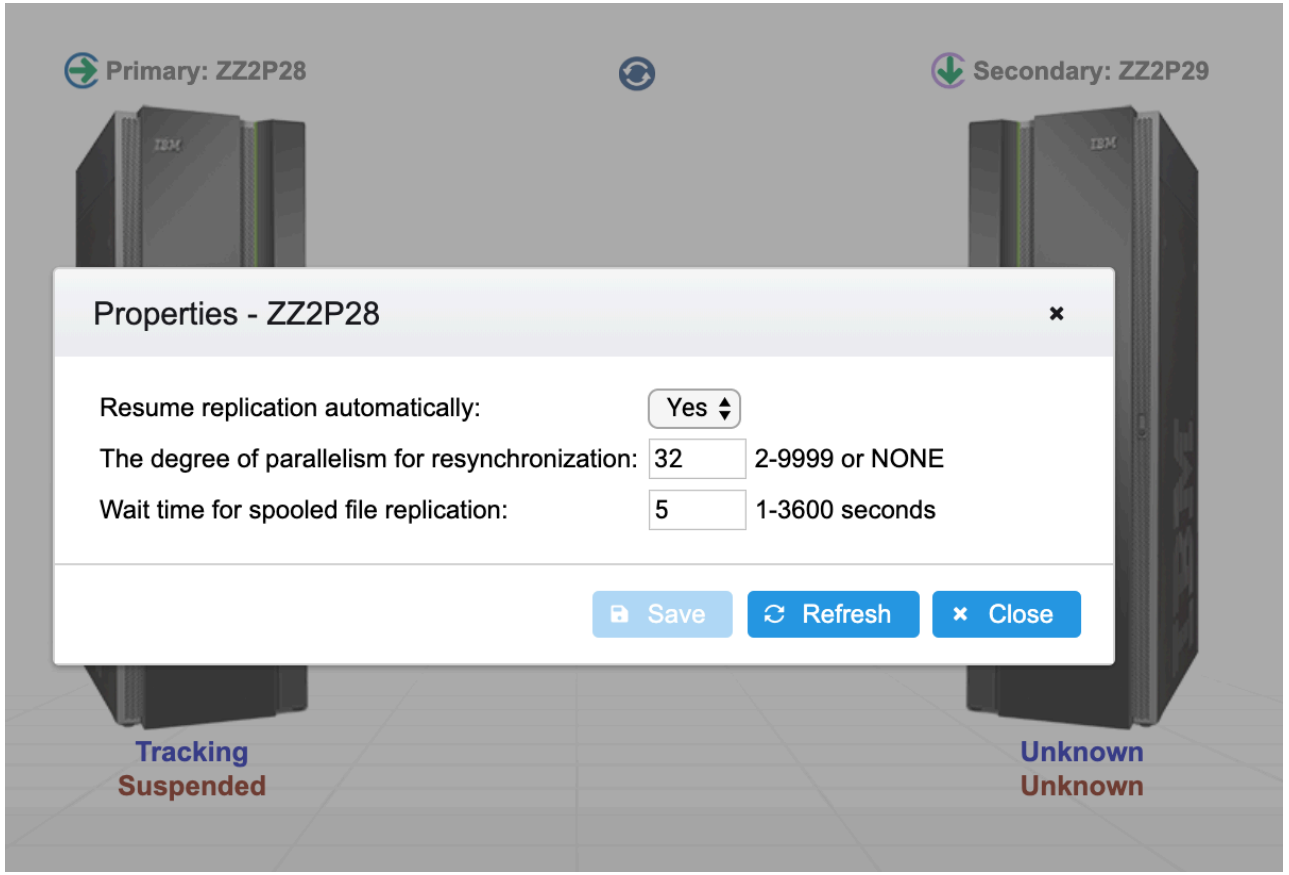
- If there is no communication between the 2 nodes over the RoCE network, the Primary will continue to track replicated objects and the secondary will block changes to replicated objects until the mirroring is resumed.



Resume Automatically

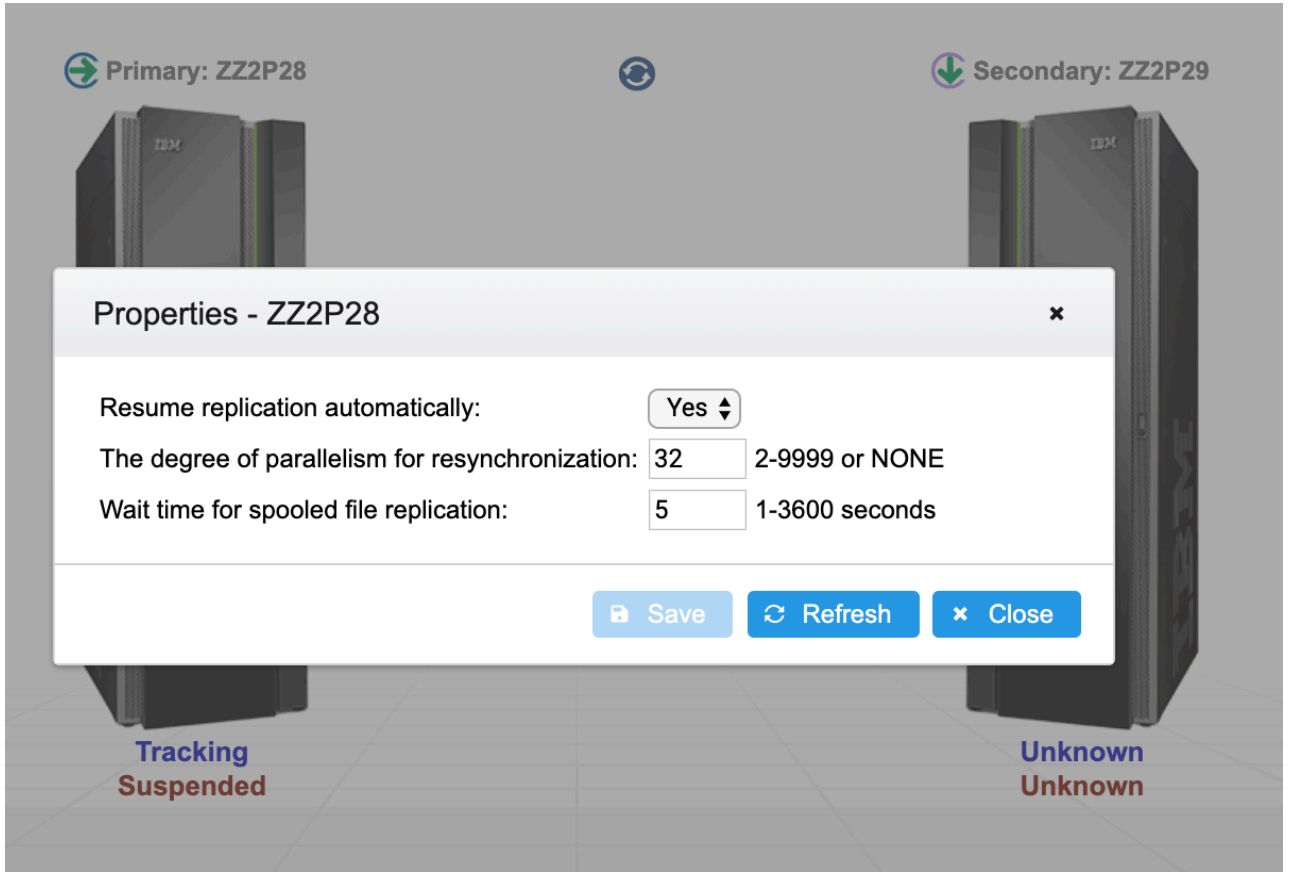
- The resume automatically property is defaulted to yes. This means if it was a system detected event such as a communication failure or crash, the mirror will resume once the failure is resolved.

- If the user suspends mirroring, then the user has to explicitly call resume.



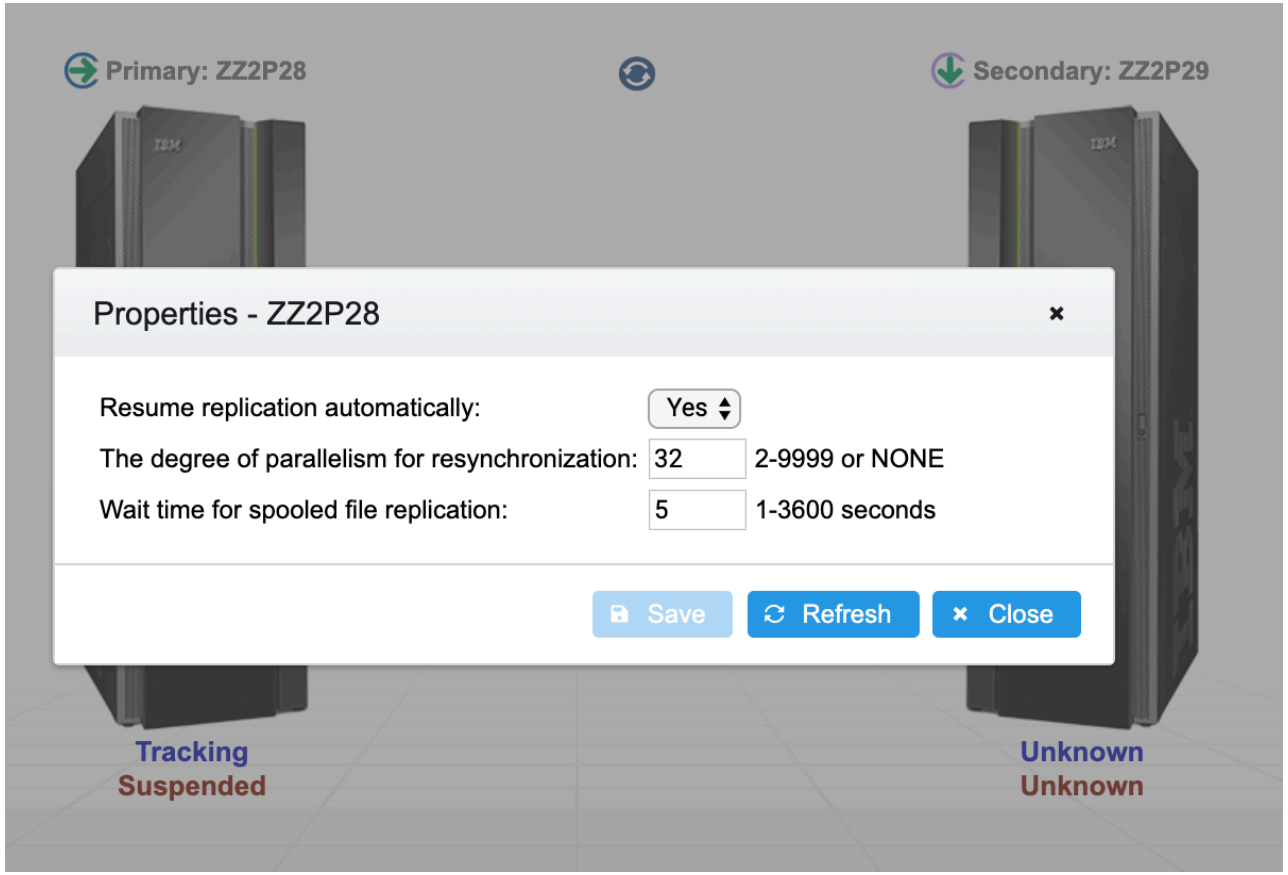
Resync Parallelism

- If 5770SS1 Option 26 (DB2® Symmetric Multiprocessing) is installed you can take advantage of resyncing multiple objects at the same time.



Spool File Wait Time

- Spool files are periodically gather up and save/restored to the other node. The wait time defines the interval to wait before bundling them up. If your system creates spool files very rapidly this can be a more efficient way to replicate them to the other side.

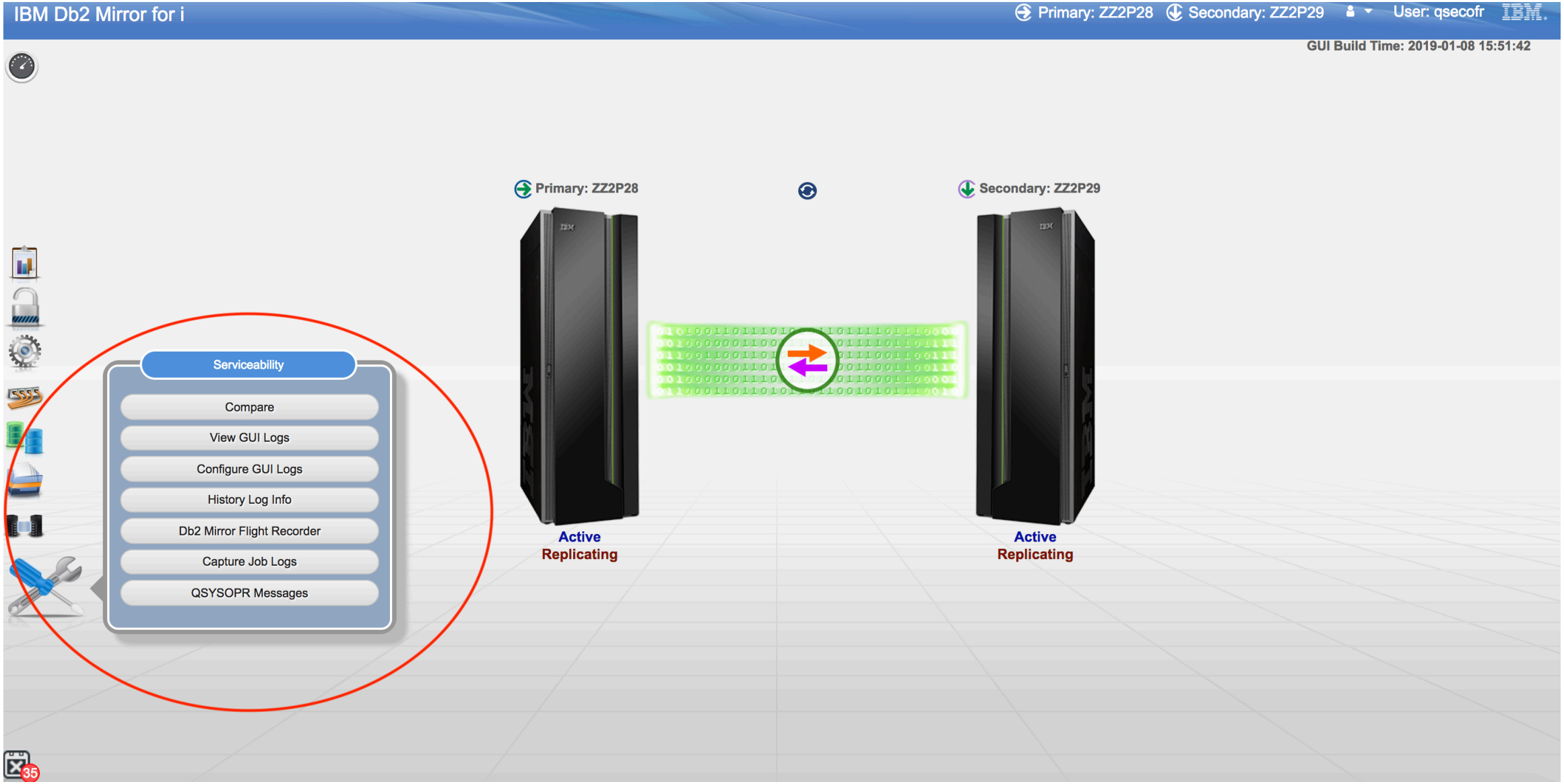


Managing and Monitoring

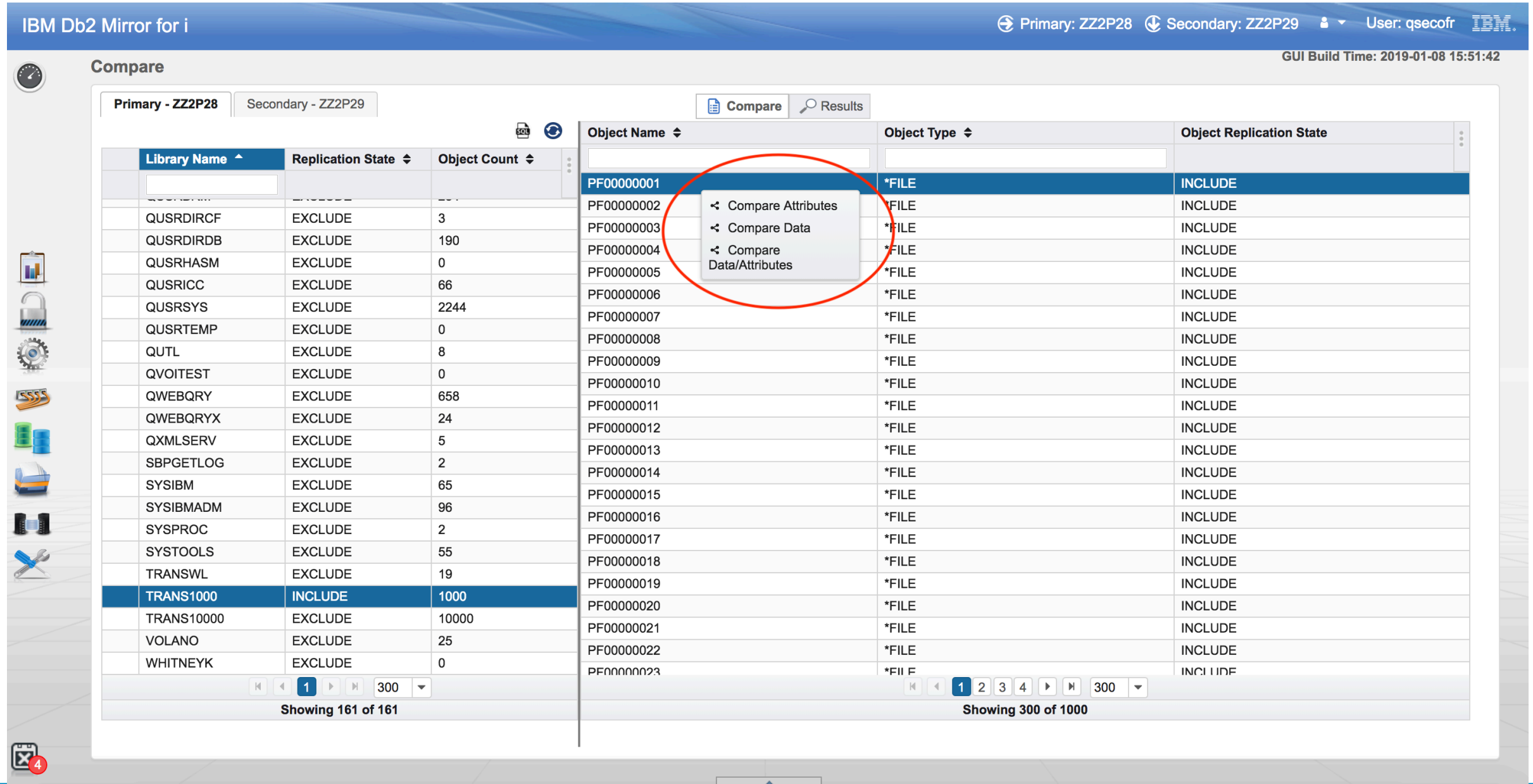
— Exit Points for several of the state transitions

Exit Point	Exit Point Format	Description
QIBM_QMRDB_PRECLONE	PREC0100	Db2 Mirror ASP pre-clone
QIBM_QMRDB_POSTCLONE	PSTC0100	Db2 Mirror ASP post-clone
QIBM_QMRDB_ROLE_CHG	RCHG0100	Db2 Mirror replication role change
QIBM_QMRDB_STATE_CHG	SCHG0100	Db2 Mirror replication state change

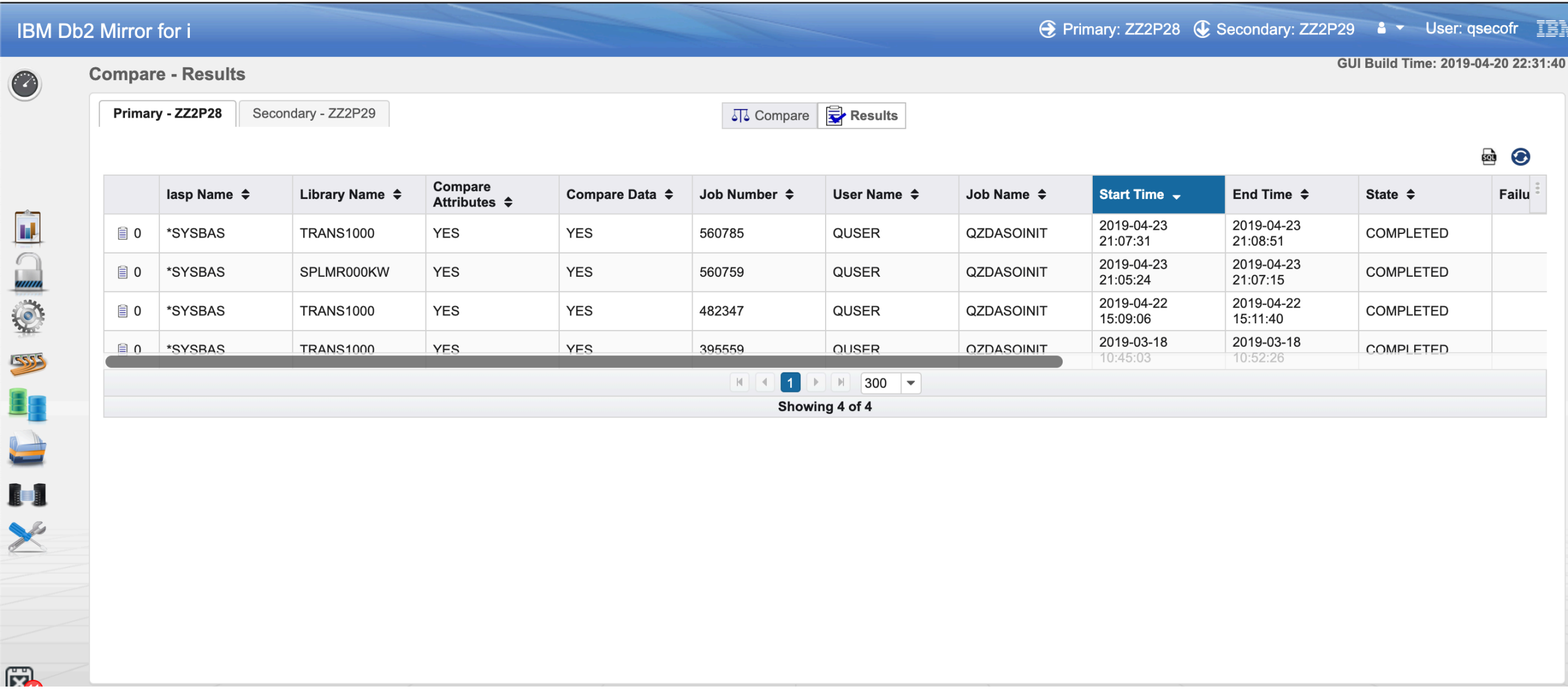
Serviceability



Compare


IBM Db2 Mirror for i
Primary: ZZ2P28
Secondary: ZZ2P29
User: qsecofr
IBM
GUI Build Time: 2019-01-08 15:51:42
Compare
Primary - ZZ2P28
Secondary - ZZ2P29
Compare
Results
Library Name
Replication State
Object Count
QUSRDIRCF EXCLUDE 3
QUSRDIRDB EXCLUDE 190
QUSRHASM EXCLUDE 0
QUSRICC EXCLUDE 66
QUSRSYS EXCLUDE 2244
QUSRTEMP EXCLUDE 0
QUTL EXCLUDE 8
QVOITEST EXCLUDE 0
QWEBQRY EXCLUDE 658
QWEBQRYX EXCLUDE 24
QXMLSERV EXCLUDE 5
SBPGETLOG EXCLUDE 2
SYSIBM EXCLUDE 65
SYSIBMADM EXCLUDE 96
SYSPROC EXCLUDE 2
SYSTOOLS EXCLUDE 55
TRANSWL EXCLUDE 19
TRANS1000 INCLUDE 1000
TRANS10000 EXCLUDE 10000
VOLANO EXCLUDE 25
WHITNEYK EXCLUDE 0
Showing 161 of 161
Object Name
Object Type
Object Replication State
PF00000001 *FILE INCLUDE
PF00000002 *FILE INCLUDE
PF00000003 *FILE INCLUDE
PF00000004 *FILE INCLUDE
PF00000005 *FILE INCLUDE
PF00000006 *FILE INCLUDE
PF00000007 *FILE INCLUDE
PF00000008 *FILE INCLUDE
PF00000009 *FILE INCLUDE
PF00000010 *FILE INCLUDE
PF00000011 *FILE INCLUDE
PF00000012 *FILE INCLUDE
PF00000013 *FILE INCLUDE
PF00000014 *FILE INCLUDE
PF00000015 *FILE INCLUDE
PF00000016 *FILE INCLUDE
PF00000017 *FILE INCLUDE
PF00000018 *FILE INCLUDE
PF00000019 *FILE INCLUDE
PF00000020 *FILE INCLUDE
PF00000021 *FILE INCLUDE
PF00000022 *FILE INCLUDE
Compare Attributes
Compare Data
Compare Data/Attributes
Showing 300 of 1000

Compare Results

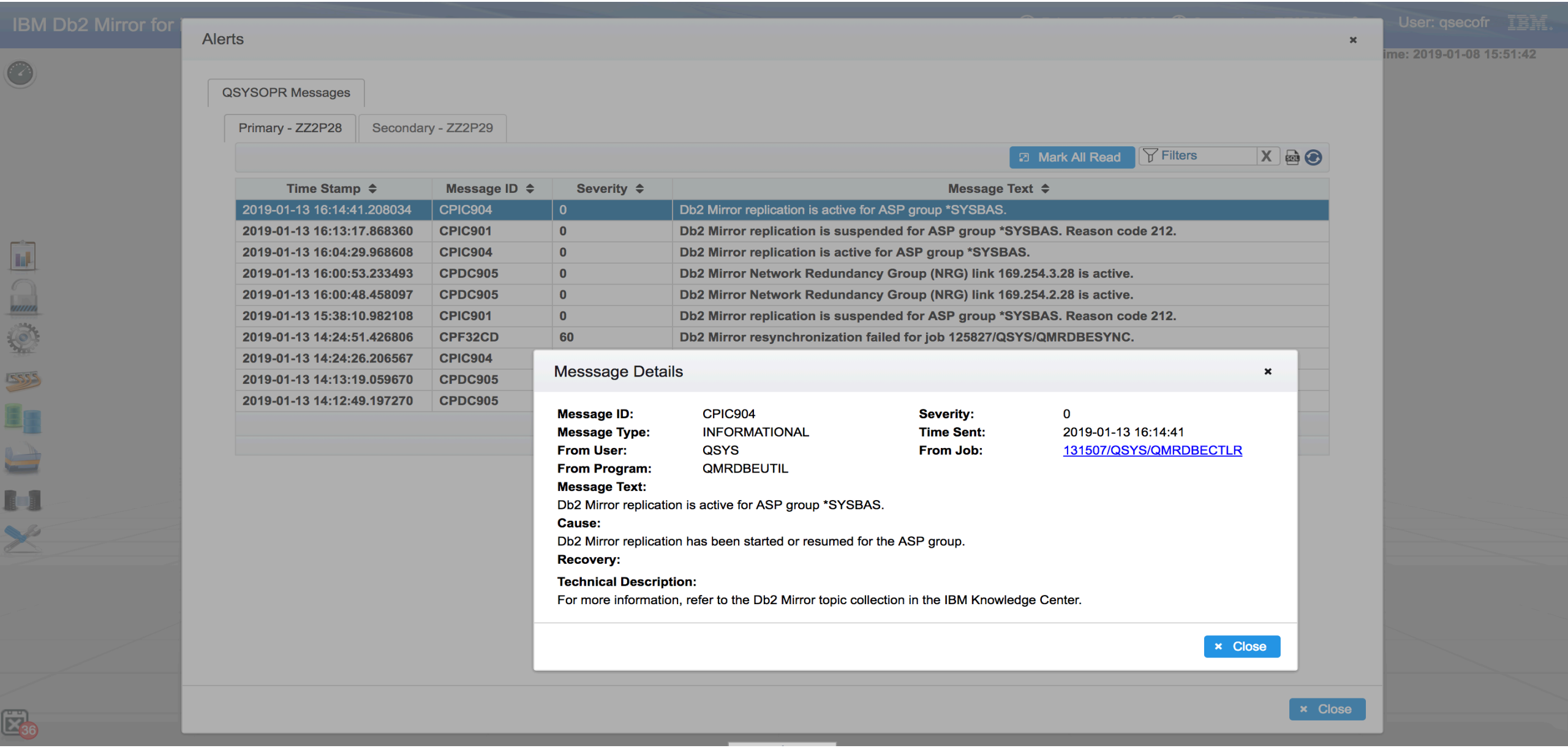


	Iasp Name	Library Name	Compare Attributes	Compare Data	Job Number	User Name	Job Name	Start Time	End Time	State	Failu
0	*SYSBAS	TRANS1000	YES	YES	560785	QUSER	QZDASOINIT	2019-04-23 21:07:31	2019-04-23 21:08:51	COMPLETED	
0	*SYSBAS	SPLMR000KW	YES	YES	560759	QUSER	QZDASOINIT	2019-04-23 21:05:24	2019-04-23 21:07:15	COMPLETED	
0	*SYSBAS	TRANS1000	YES	YES	482347	QUSER	QZDASOINIT	2019-04-22 15:09:06	2019-04-22 15:11:40	COMPLETED	
0	*SYSBAS	TRANS1000	YES	YES	395559	QUSER	QZDASOINIT	2019-03-18 10:45:03	2019-03-18 10:52:26	COMPLETED	

Alerts


IBM Db2 Mirror for i
Primary: ZZ2P28
Secondary: ZZ2P29
User: qsecofr
GUI Build Time: 2019-01-08 15:51:42
Primary: ZZ2P28
Secondary: ZZ2P29
Active
Replicating
Active
Replicating
Alerts
35

Alerts

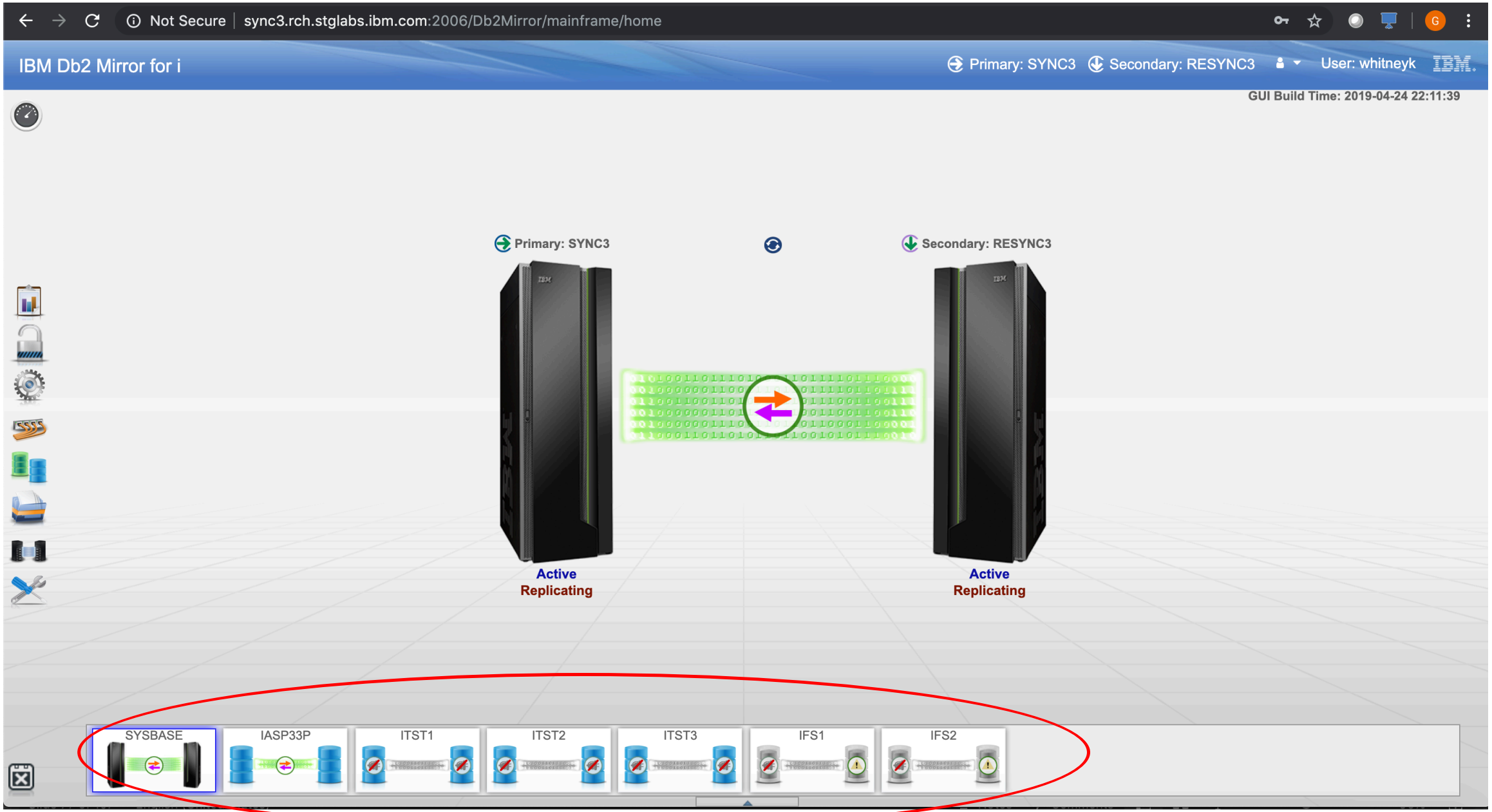

IBM Db2 Mirror for
User: qsecofr
Alerts
QSYSOPR Messages
Primary - ZZ2P28
Secondary - ZZ2P29
Mark All Read
Filters
Time Stamp
Message ID
Severity
Message Text
2019-01-13 16:14:41.208034 CPIC904 0 Db2 Mirror replication is active for ASP group *SYSBAS.
2019-01-13 16:13:17.868360 CPIC901 0 Db2 Mirror replication is suspended for ASP group *SYSBAS. Reason code 212.
2019-01-13 16:04:29.968608 CPIC904 0 Db2 Mirror replication is active for ASP group *SYSBAS.
2019-01-13 16:00:53.233493 CPDC905 0 Db2 Mirror Network Redundancy Group (NRG) link 169.254.3.28 is active.
2019-01-13 16:00:48.458097 CPDC905 0 Db2 Mirror Network Redundancy Group (NRG) link 169.254.2.28 is active.
2019-01-13 15:38:10.982108 CPIC901 0 Db2 Mirror replication is suspended for ASP group *SYSBAS. Reason code 212.
2019-01-13 14:24:51.426806 CPF32CD 60 Db2 Mirror resynchronization failed for job 125827/QSYS/QMRDBESYNC.
2019-01-13 14:24:26.206567 CPIC904
2019-01-13 14:13:19.059670 CPDC905
2019-01-13 14:12:49.197270 CPDC905
Messsage Details
Message ID: CPIC904
Severity: 0
Message Type: INFORMATIONAL
Time Sent: 2019-01-13 16:14:41
From User: QSYS
From Job: 131507/QSYS/QMRDBECTLR
From Program: QMRDBEUTIL
Message Text:
Db2 Mirror replication is active for ASP group *SYSBAS.
Cause:
Db2 Mirror replication has been started or resumed for the ASP group.
Recovery:
Technical Description:
For more information, refer to the Db2 Mirror topic collection in the IBM Knowledge Center.
Close
Close

IASPs

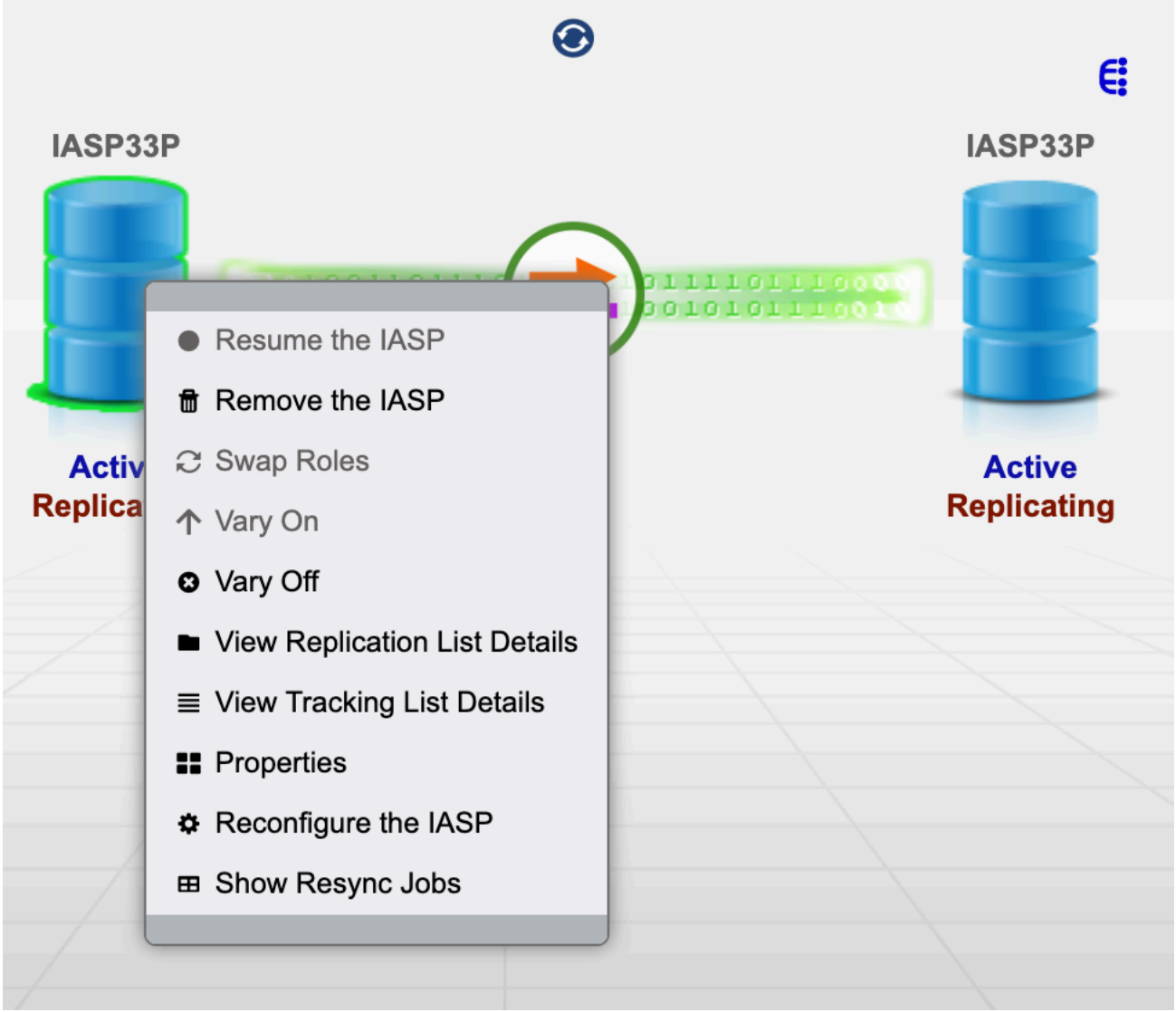
Db2 Mirror IASP Support

- IASPs are optional for Db2 data
- IASPs are required for IFS concurrent sharing
  - PowerHA required to switch IFS IASPs
- DB IASPs have there own Replication Rules and Object Tracking List

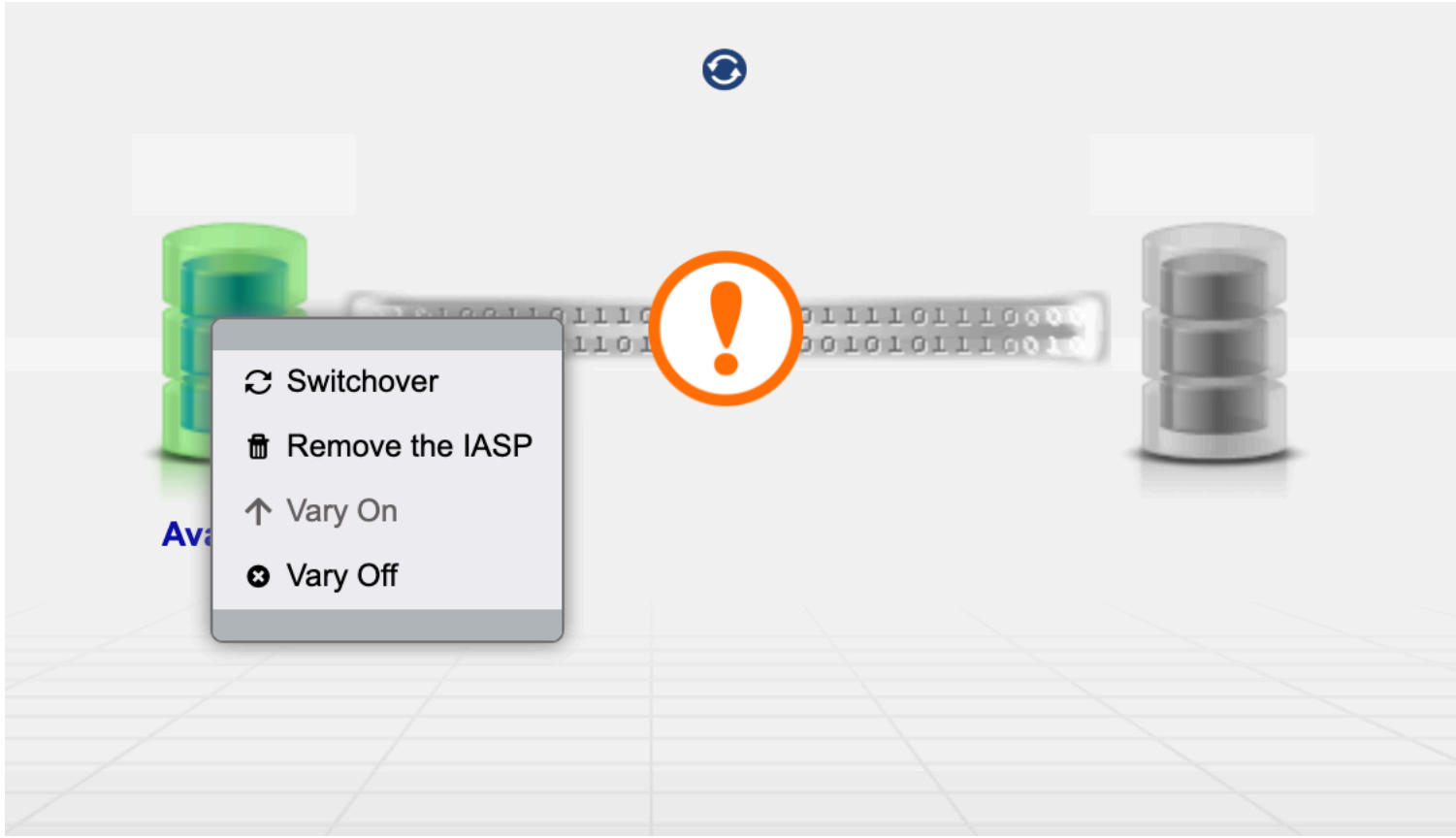
IASP Support



IASP Support



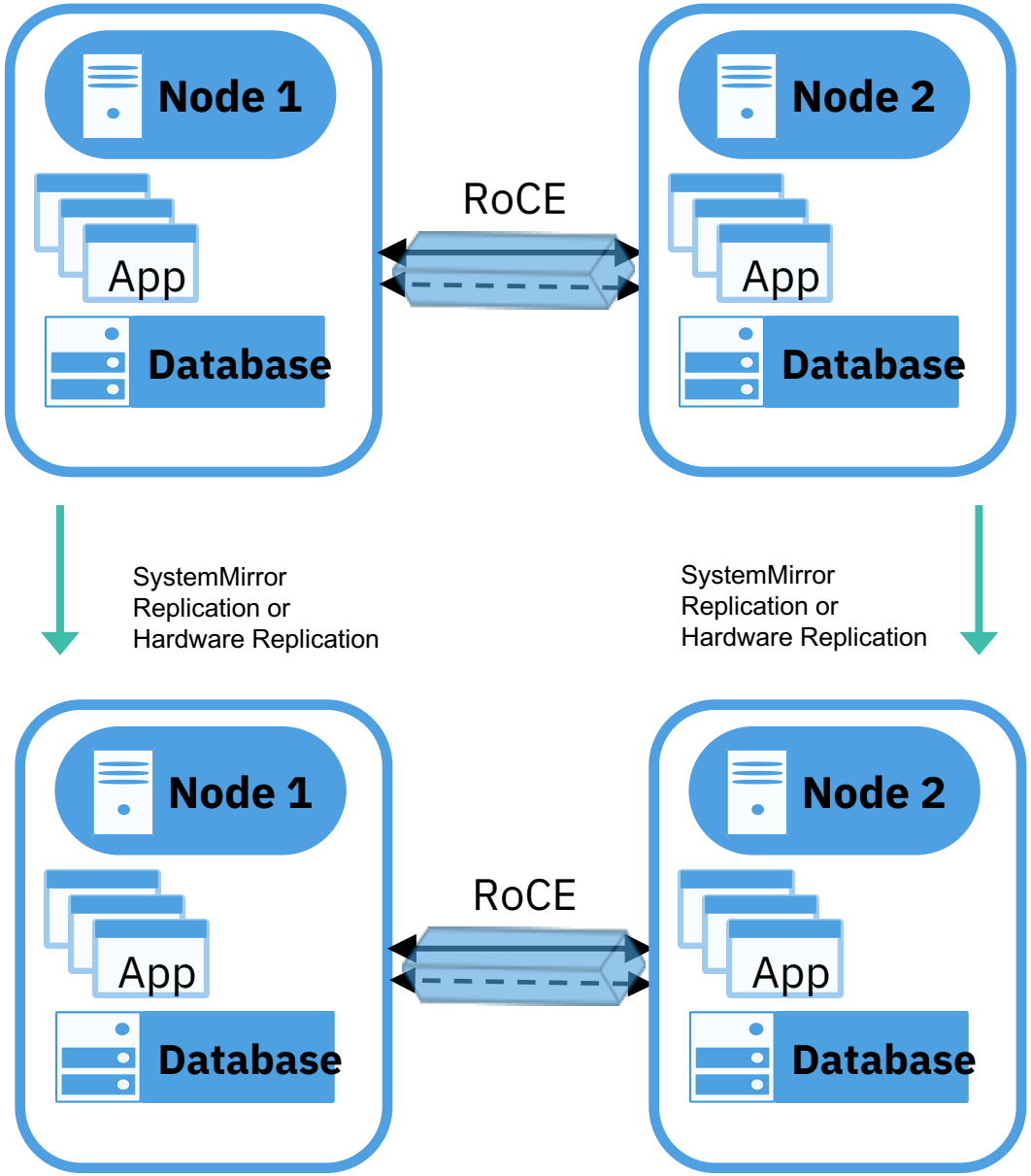
Switch over IFS IASPs



Disaster Recovery

Topology Options – DR

- As long as one local Db2Mirror node is up, production will remain at the local site.
- If both local nodes are unavailable, then a switch to the DR site can be initiated.
- The default will be that a switch to DR requires system administrator intervention, although a policy could be defined to initiate the switch automatically.
- Only one node will be activated at the DR site, and then a Db2Mirror resynch will be started to the 2nd DR node.



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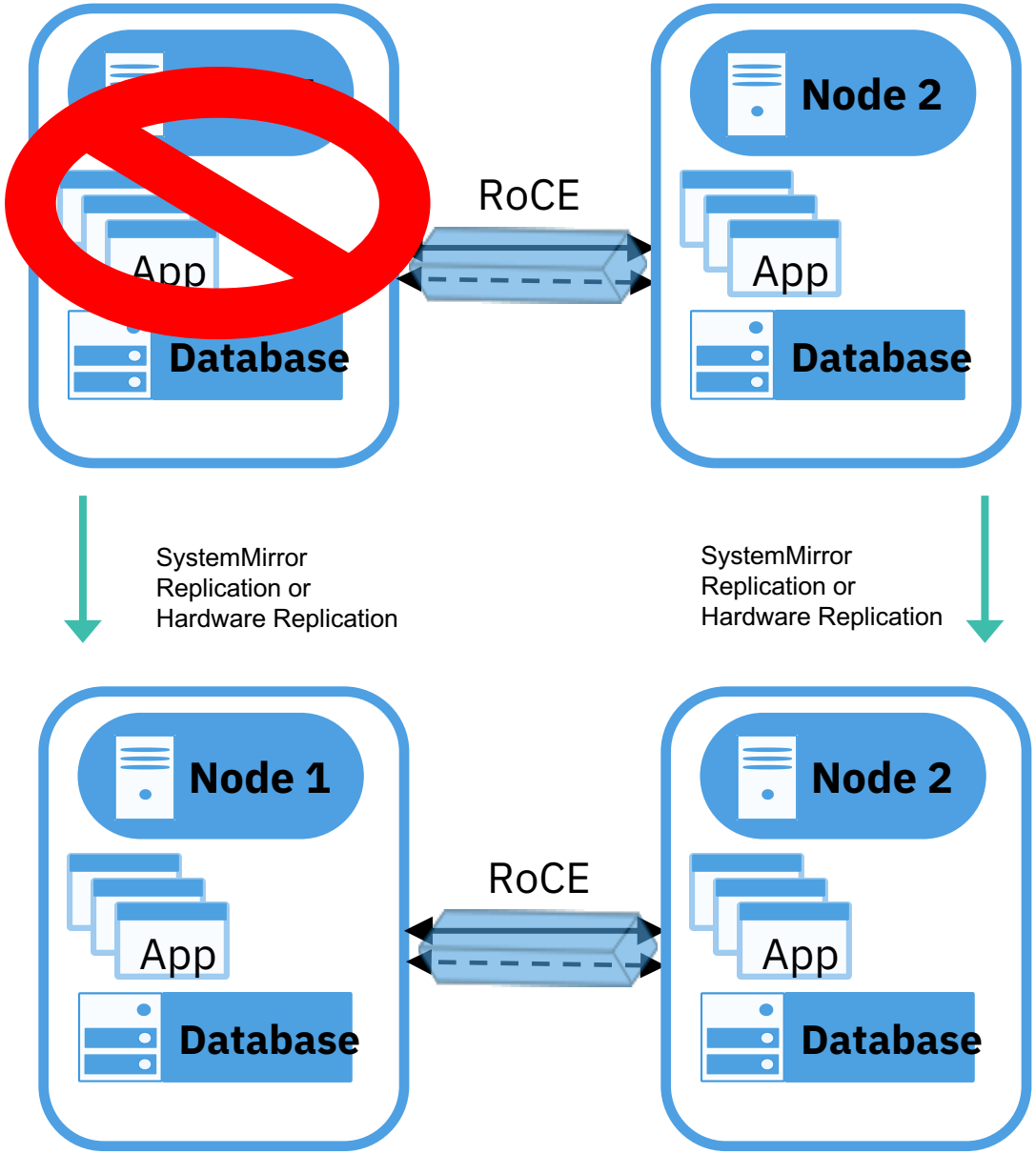

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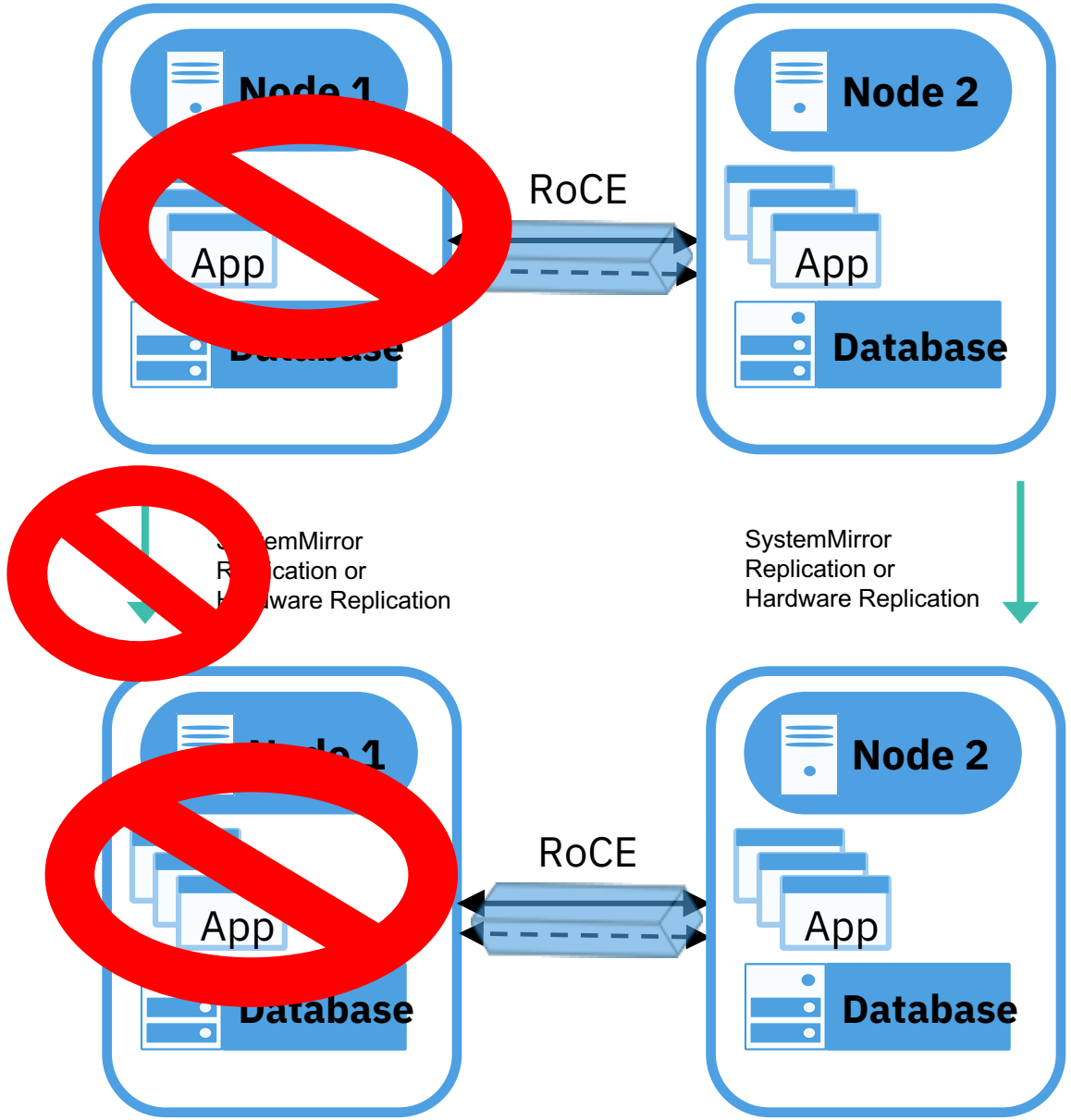

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Topology Options – DR

- As long as one local Db2Mirror node is up, production will remain at the local site.
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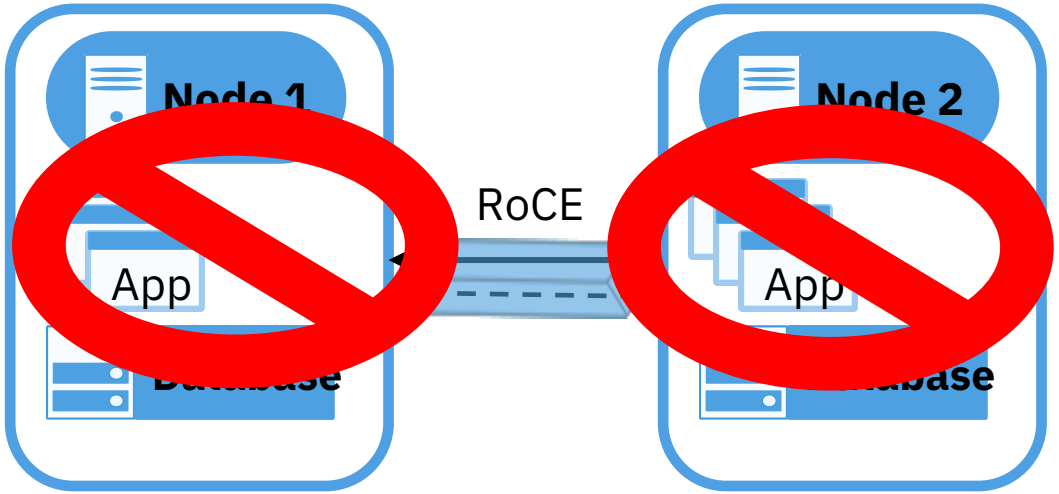
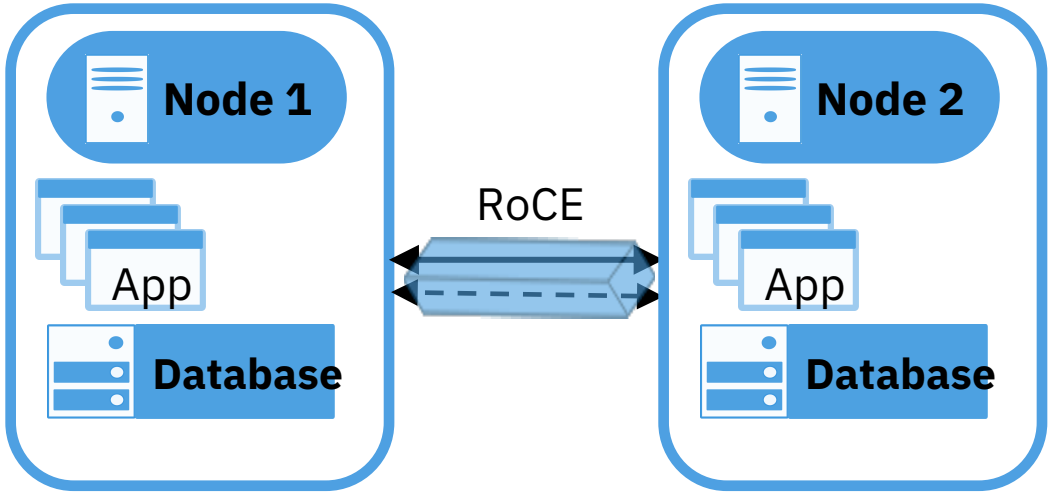
- The default will be that a switch to DR requires system administrator intervention, although a policy could be defined to initiate the switch automatically.
- Only one node will be activated at the DR site, and then a Db2Mirror resynch will be started to the 2nd DR node.





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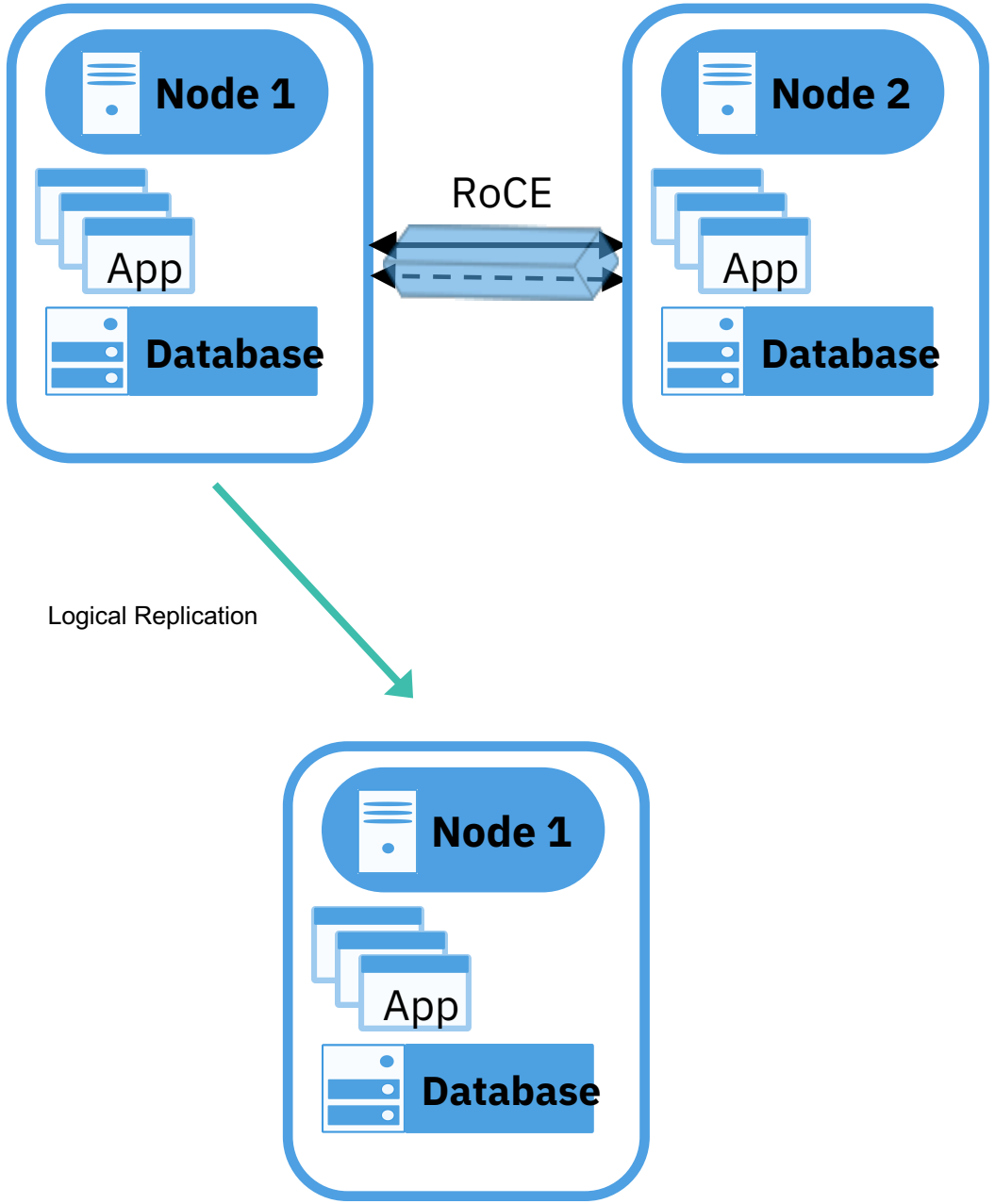
Logical Replication

- Logical replication solutions have the option to move the source node between the Db2 Mirror nodes and go to a single DR node



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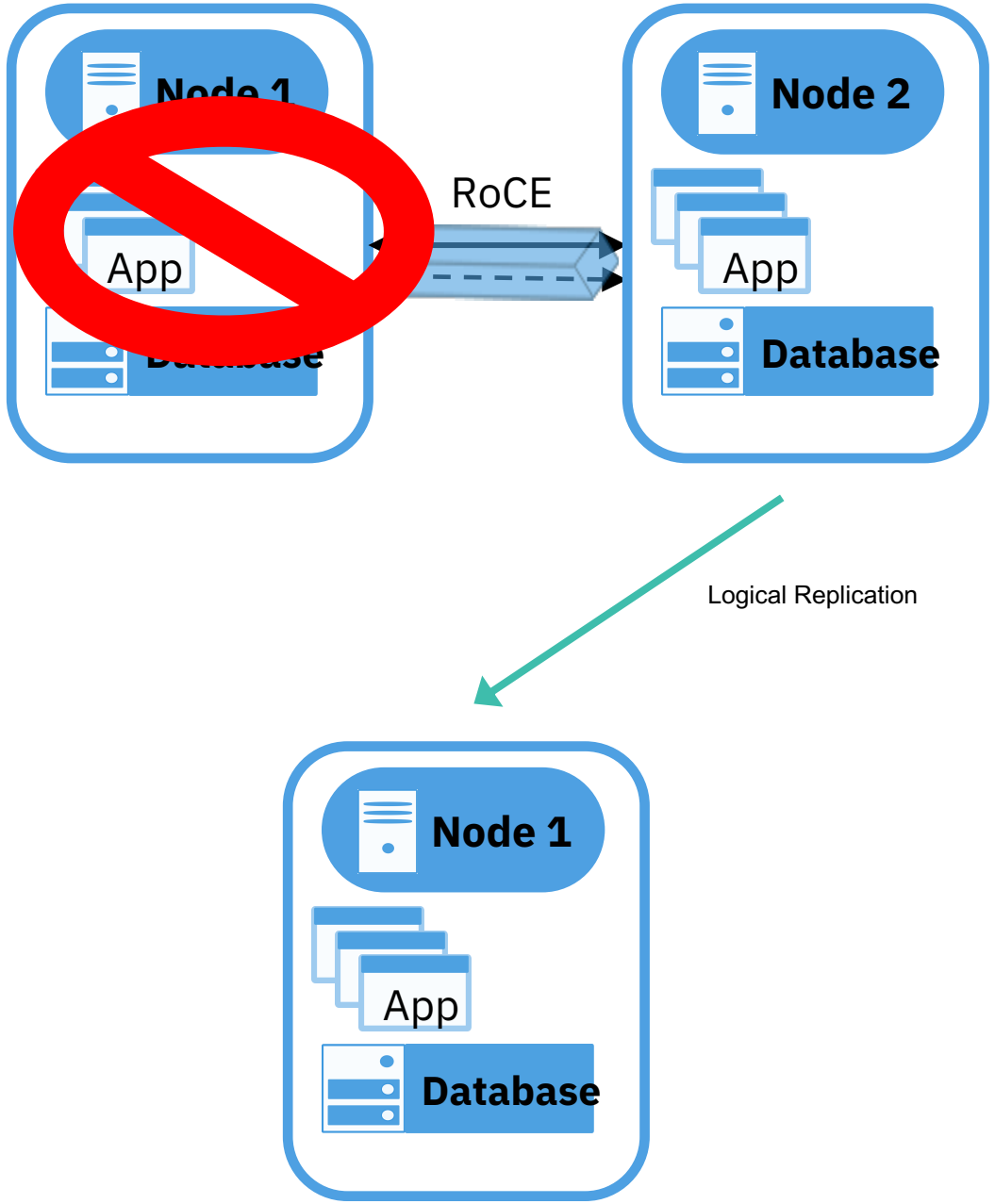
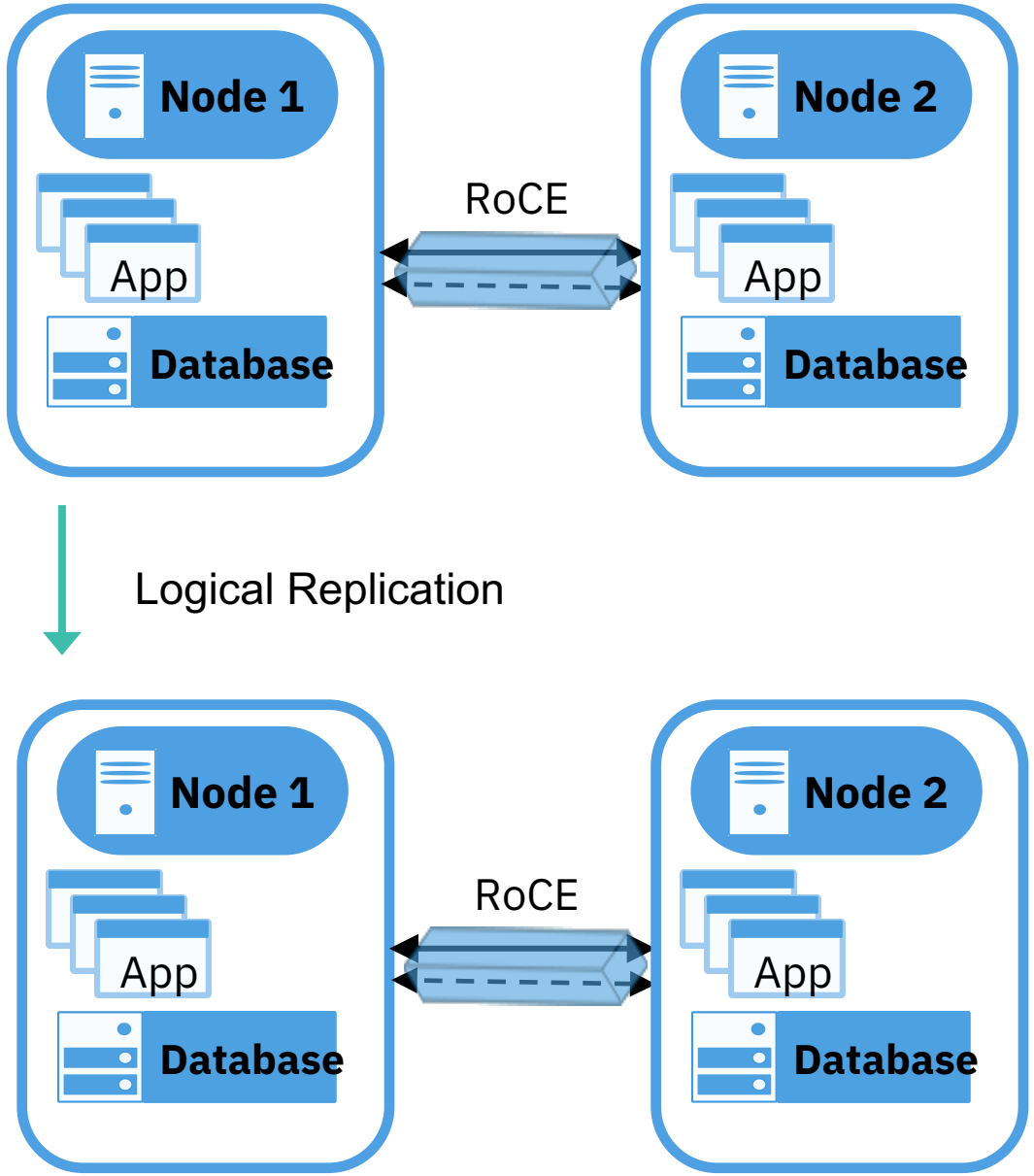


Logical Replication

- Logical replication solutions have the option to move the source node between the Db2 Mirror nodes and go to a Db2 Mirror pair.



Logical Replication

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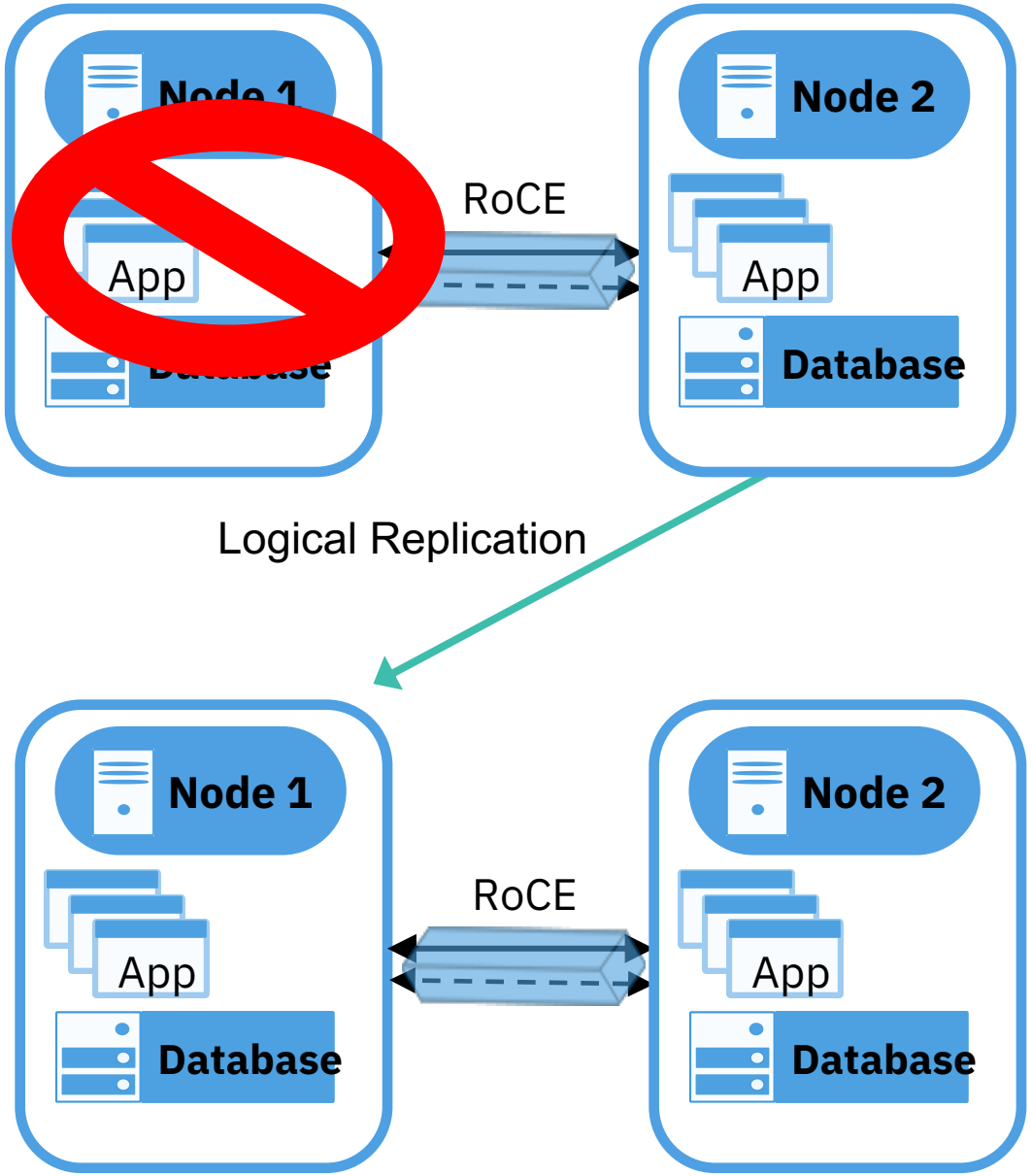

Software Requirements and Licensing

Software Required for Db2 Mirror Pair

- 5770SS1 Option 3 (Extended Base Directory Support)
- 5770SS1 Option 12 (Host Servers)
- 5770SS1 Option 26 (DB2® Symmetric Multiprocessing) - Optional
- 5770SS1 Option 30 (Qshell)
- 5770SS1 Option 34 (Digital Certificate Manager)
- 5770SS1 Option 41 (High Availability Switchable Resources)
- 5770SS1 Option 48 (IBM Db2Mirror)
- 5770JV1 *BASE (IBM Developer Kit for Java)
- Option 16 (Java SE 8 32 bit)
- Option 17 (Java SE 8 64 bit)
- 5733SC1 *BASE(IBM Portable Utilities for i)
- Option 1 (OpenSSH, OpenSSL, zlib)
- 5770DG1 *BASE (IBM HTTP Server for i)
- 5770DBM *BASE (IBM Db2 Mirror for i)
- Option 1 (Db2 Mirror Enablement)

Open Source Packages Required for Setup

- python2-six-1.10.0-1.ibmi7.1.noarch.rpm
- python2-itoolkit-1.5.1-1.ibmi7.1.ppc64.rpm
- python2-ibm_db-2.0.5.8-1.ibmi7.1.ppc64.rpm
- cloudinit-1.0-0.ibmi7.1.ppc64.rpm

Software Required for Db2 GUI Node

- 5770SS1 Option 3 (Extended Base Directory Support)
- 5770SS1 Option 12 (Host Servers)
- ~~5770SS1 Option 26 (DB2® Symmetric Multiprocessing) - Optional~~
- 5770SS1 Option 30 (Qshell)
- ~~5770SS1 Option 34 (Digital Certificate Manager)~~
- ~~5770SS1 Option 41 (High Availability Switchable Resources)~~
- ~~5770SS1 Option 48 (IBM Db2Mirror)~~
- 5770JV1 *BASE (IBM Developer Kit for Java)
- Option 16 (Java SE 8 32 bit)
- Option 17 (Java SE 8 64 bit)
- 5733SC1 *BASE(IBM Portable Utilities for i)
- Option 1 (OpenSSH, OpenSSL, zlib)
- 5770DG1 *BASE (IBM HTTP Server for i)
- 5770DBM *BASE (IBM Db2 Mirror for i)
- ~~Option 1 (Db2 Mirror Enablement)~~

Licensing

Db2 Mirror for i (5770-DBM)

- Pricing: $20K (U.S. list price)* per processor core - for any size machine
  - Note: e-config offers Small and Medium price features, both are priced the same
  - Includes one year of SWMA
- License both source and target
  - The processor cores to support the workload on source and target must be licensed
- IBM i (5770-SS1) Option 48 “Db2 Data Mirroring” is required and automatically included with 5770-DBM orders
  - No additional charge for Option 48
  - Option 48 is only available with Db2 Mirror and cannot be ordered separately
- 70-day evaluation period available for 5770-DBM and IBM i Option 48
  - I.e. standard try-and-buy period as IBM i and the keyed IBM i LPPs. After 70 days, enter the software license key

* Prices are subject to change without notice

Licensing, continued

— Db2 Mirror price structure:
  - Processor feature is 5051 is the priced feature
  - Base feature 5050 is a no-charge user interface for managing Db2 Mirror on other systems in the network

— The Db2 Mirror two production nodes will not qualify as a CBU. DR nodes could qualify

— For Db2 Mirror, the processor charge metric and subcapacity terms are the same for DB2 Mirror as, e.g., IBM i operating system and PowerHA for i
  - Workload Capping Groups are not supported for subcapacity licensing for Db2 Mirror

Db2 Mirror Software License Terms

Db2 Mirror for i workshop

IBM Systems Lab Services — Power Systems IBM i

Overview

The Db2 Mirror for i workshop will provide customers and business partners the opportunity to build skills in Db2 mirror as well as testing their applications on a DB2 Mirror environment in the lab. The workshop will be 2 weeks with the first week covering planning, implementation, setting up libraries in a DB2 Mirror environment and Database requirements/changes. The second week will focus on application changes and performance requirements/testing.

Target Audience

- Any customer or BP who wishes to learn about Db2 mirror in depth and test their application

Benefits

- By the end of the workshop, the attendees will have the skills to start planning their Db2 mirror environment.

Qualifying Questions

- Do you need a zero time failover environment to an active high availability system
- Do you wish to start working towards a true active/active solution

Team Contacts

Owner: Selwyn Dickey sdickey@us.ibm.com
Eric Barsness ericbar@us.ibm.com
Opportunity manager Mike Gordon mgordo@us.ibm.com

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Key Features

- The workshop is fixed price for 2 weeks. It is anticipated that not all people will attend both weeks. The first week is aimed more at technical specialists while the second week is more application and performance.
- During the 2 weeks, access to consultants across aspects of IBM i will be available to maximize the benefit of the workshop. This includes, performance, database/SQL, application and infrastructure experts
- The hardware will be capped at 5 x Power 8 processors per partition with 32 GB of memory per core, and 10TB of DS8000 disk per partition.
- The testing can be performed for IASP/PowerHA, or full system
- No HIPAA or PHI data can be loaded on the IBM systems

Deliverables

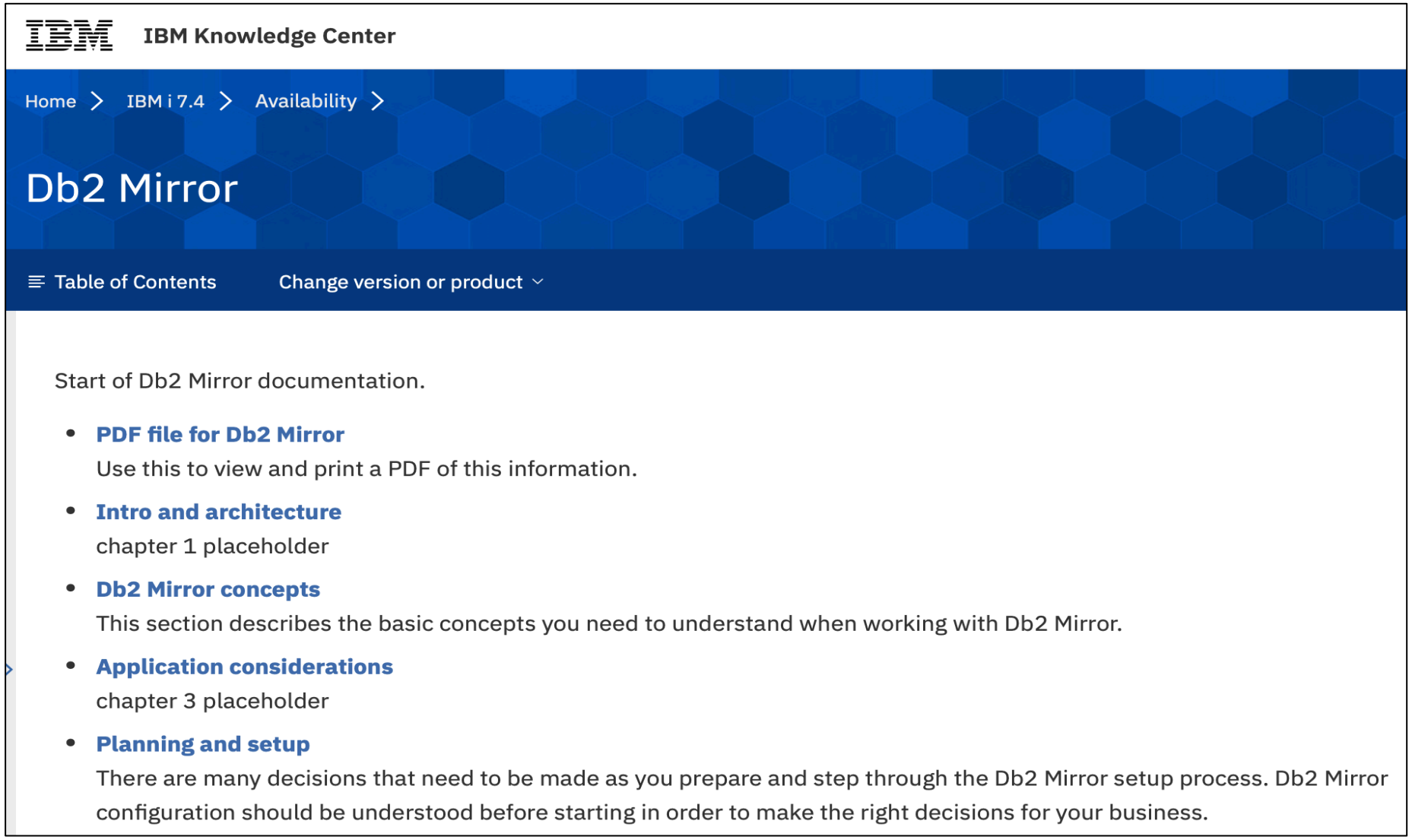
- Any presentation used in the workshop will be available to the attendees
- Any data (performance, object changes etc) will be available for the attendees to save to tape and take home

Duration (optional)

80 hours (no outside working hours)

Db2 Mirror – Where to get more information

www.ibm.com/support/knowledgecenter/ssw_ibm_i_74/db2mi/db2mintro.htm



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Notices and disclaimers continued

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