



# IDUG

2024 EMEA Db2 Tech Conference

## The all new TSA-less pureScale with Pacemaker on Linux

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*IBM Canada Ltd*

*Db2 Night Show, 25 April 2025*

*High Availability, New Features*

Platform: <Insert Platform(s) here>



@IDUGDb2  
#IDUG\_EMEA24

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# Agenda

- A quick history of Db2 pureScale
- In-depth look at Db2 pureScale: from TSA to Pacemaker
  - New prerequisites
  - Up & Running
  - Day 2 operations
- Db2 pureScale on AWS with Pacemaker
- Your new cluster administration tool - db2cm

**And some  
sneak peaks...**

# Agenda

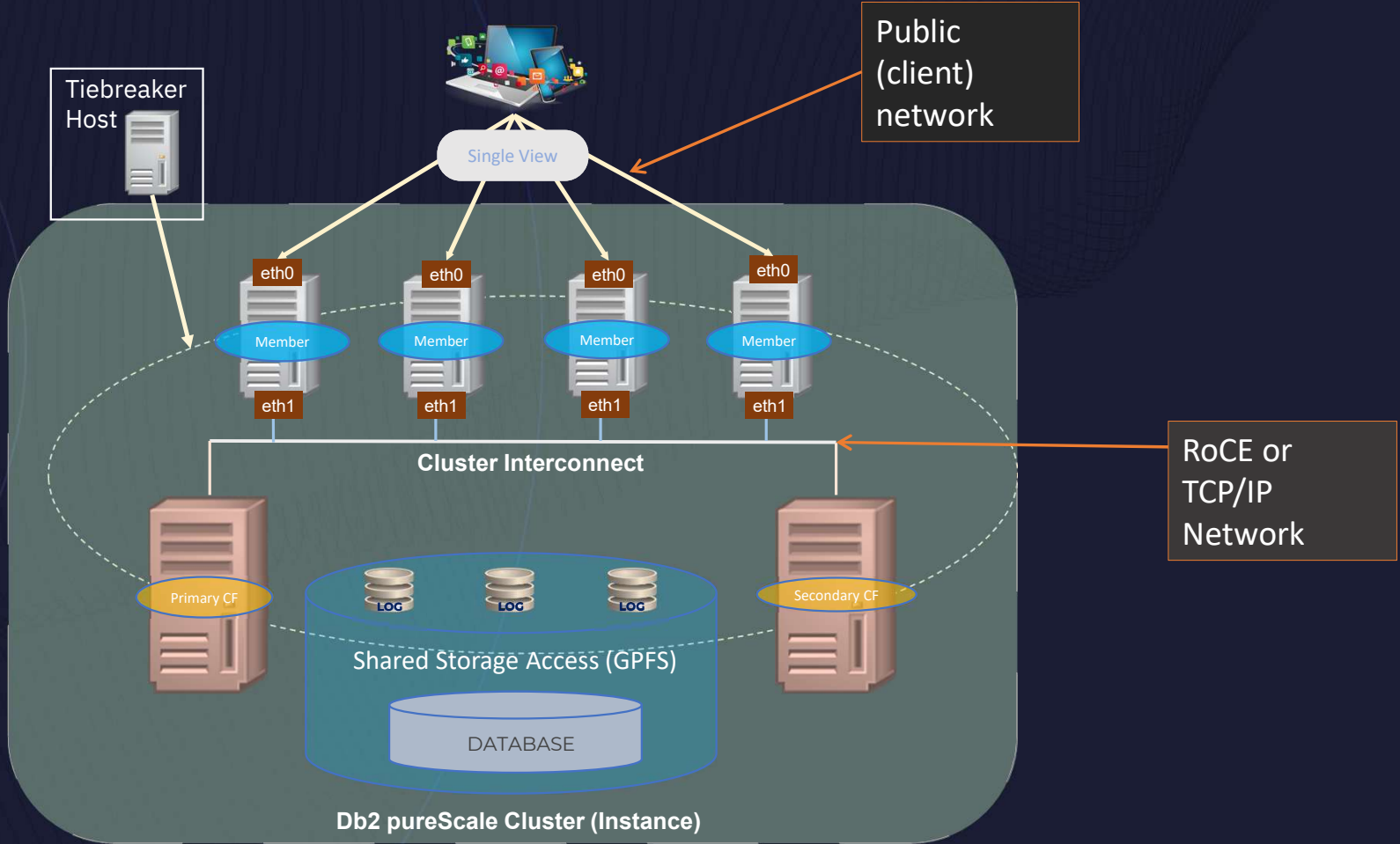
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## From the mainframe ...

- Db2 pureScale (first known internally as Coral)
  - Inherits much of the topology and design from Db2 for z/OS SYSPLEX
  - CFs source-code machine translated from Db2 z/OS implementation
  - Started out RDMA-only
  - Cluster Automation tightly tied to RSCT and TSA technologies

# pureScale - Architecture: High level



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Our vision with Pacemaker ...

## Db2 Integrated Cluster Manager of Choice

PAST PRESENT FUTURE



TSA  
RSCT

Corosync  
Pacemaker  
The Corosync Cluster Engine

Corosync  
Pacemaker  
The Corosync Cluster Engine

100%  
commitment



v11.5.8.0

- Announcement of Deprecation of TSA Support on Linux

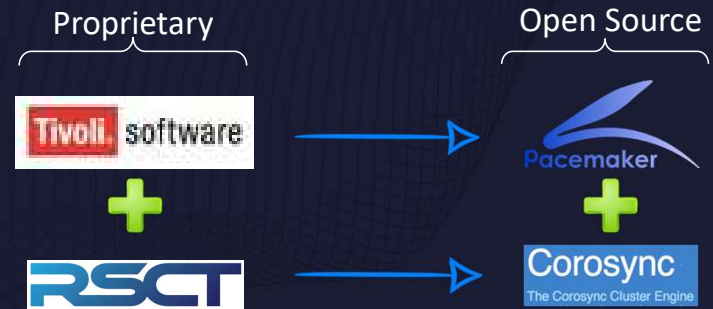
- Target: TSA will no longer be bundled with Db2 on Linux in v12.1.0

# Why Pacemaker over TSA ?

- 18+ years in industry as HA resource cluster manager
- Included by RHEL and SuSE distros via paid add-on High Availability package
- Open source: inspect, collaborate and innovate
- Align with IBM Open-Source Strategy

## Key driver for change

- Surge of requests for cloud support
- Lack of flexibility with TSA
- Need single solution for all OSES, architectures, form factors



BE  
NE  
FIT  
S

<p>Cloud Ready</p>	<p>PERFORMANCE Faster Failover Recovery</p>	<p>Lower \$\$\$</p>
<p>First contribution to community in V11.5.6.0 !!!!</p> <p>STACK MODERNIZATION open source</p>	<p>One Team Just Db2 Technical Support</p>	<p>Simpler Cluster Software Architecture Simplified PD</p>

# Why is Db2 Linux leaving TSA behind?

- TSA development is in stasis
  - Bug fixes and new OS enablement only (months after release)
  - No new cloud support
- Pacemaker is the go-to Cluster Manager automation in the Linux space
  - Red Hat / SuSE / Ubuntu and other vendors supporting and developing
- Pacemaker is Cloud-ready
  - Supported by community on almost every cloud
  - Supported by Db2 LUW for AWS, MS Azure, GCE (Google) and IBM Cloud

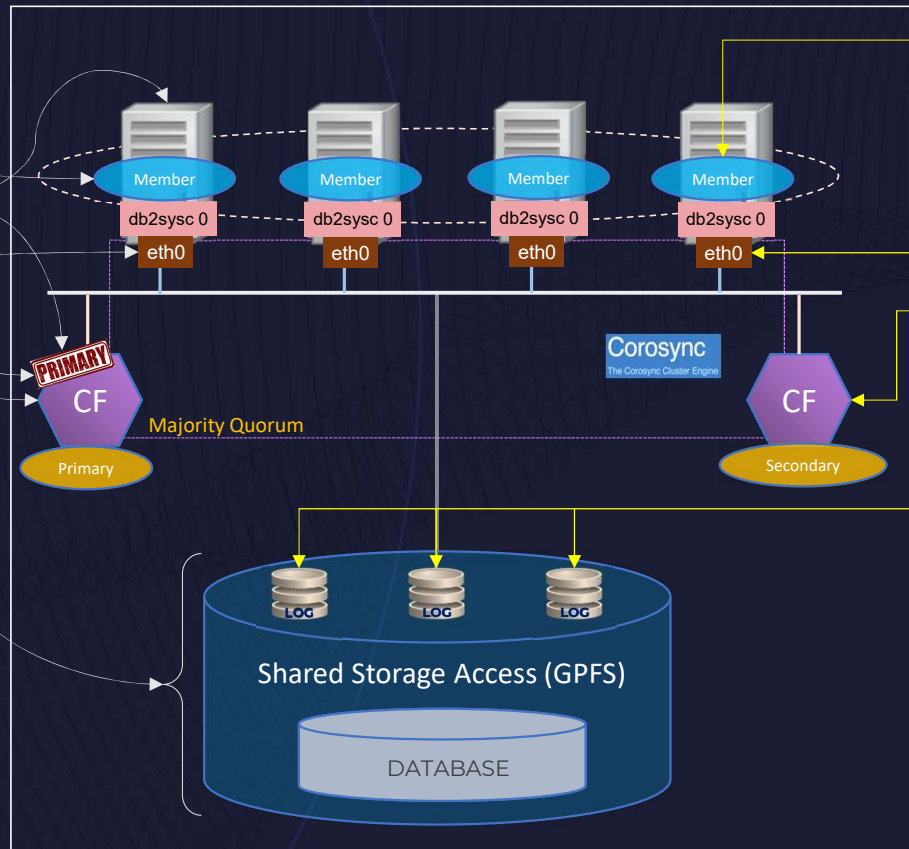
**NEW**

# pureScale

Resource Agents

- Pacemaker
- db2member
- db2instancehost
- db2ethmonitor
- db2cfprimary
- db2cf
- db2idle
- db2mount\_ss
- db2fence\_ps

monitors



## Resources

1. Member
2. Network Interface
3. CF
4. Mount
5. Fence
6. Instance
7. CF Primary
8. Idle

## pureScale: Up and Running: db2prereqcheck

```
[root@regrlnxps01 server]# ./db2prereqcheck -v 12.1.0.0

=====

Tue Aug 13 00:33:04 2024
Checking prerequisites for DB2 installation. Version "12.1.0.0". Operating
system "Linux"

Validating "kernel level " ...
  Required minimum operating system kernel level: "5.14.0".
  Actual operating system kernel level: "5.14.0".
  Requirement matched.
...
Validating "db2prereqPCMK" ...
  Requirement matched.
...
Validating "libnuma.so version " ...
DBT3610I The db2prereqcheck utility successfully loaded the libnuma.so.1
file.
  Requirement matched.
...
Validating "/lib/libpam.so*" ...
  Requirement matched.
DBT3533I The db2prereqcheck utility has confirmed that all installation
prerequisites were met.
```

**Pacemaker  
prerequisites  
are validated**

Validating "db2prereqPCMK" ...  
Requirement matched.

## pureScale: Up and Running: Install

- Pacemaker installed with Db2 on Linux
  - TSA packages are not in the Db2 Install Image
  - TSA installer is gone
- This includes:
  - db2\_install
  - GUI install (db2setup)
  - Silent install via db2setup



# pureScale: Up and Running: db2\_install

```
[root@reglrxps01 server]# ./db2_install
Read the license agreement file in the db2/license directory.

*****
To accept those terms, enter "yes". Otherwise, enter "no" to cancel the install process.
[yes/no]
yes

Default directory for installation of products - /opt/ibm/db2/V12.1

*****
Install into default directory (/opt/ibm/db2/V12.1) ? [yes/no]
yes

Specify one of the following keywords to install DB2 products.

SERVER
CONSV
CLIENT
RTCL

Enter "help" to redisplay product names.

Enter "quit" to exit.
SERVER
*****
*****
Do you want to install the DB
yes
...
```

**Pacemaker  
installed  
automatically**

```
...
DB2 installation is being initialized.

Total number of tasks to be performed: 61
Total estimated time for all tasks to be performed: 3053 second(s)

Task #1 start
Description: Checking license agreement acceptance
Estimated time 1 second(s)
Task #1 end

...

Task #19 start
Description: Pacemaker
Estimated time 100 second(s)
Task #19 end

...

Task #52 start
Description: Installing or updating Db2 resource agent scripts for Pacemaker
Estimated time 20 second(s)
Task #52 end

...

Task #62 start
Description: Updating global profile registry
Estimated time 3 second(s)
Task #62 end

The execution completed successfully.

For more information see the DB2 installation log at
"/tmp/db2_install.log.3245355".
```

## pureScale: Up and Running: Instance Creation

- Additional checks done for pacemaker at instance creation time: same as V11.5
  - Prerequisite checking happens implicitly on remote hosts, automatically
  - Installed on remote hosts with db2 pureScale remote install (if not already installed)

**Pacemaker  
installed  
remotely,  
automatically**

```
[root@reglrxps01 instance]# ./db2icrt -d -m reglrxps01 \  
-mnet reglrxps01-roe0,reglrxps01-roe1,reglrxps01-roe2,reglrxps01-roe3 \  
-cf reglrxps02 -cfnet reglrxps02-roe0,reglrxps02-roe1,reglrxps02-roe2,reglrxps02-roe3 \  
-m reglrxps03 -mnet reglrxps03-roe0,reglrxps03-roe1,reglrxps03-roe2,reglrxps03-roe3 \  
-cf reglrxps04 -cfnet reglrxps04-roe0,reglrxps04-roe1,reglrxps04-roe2,reglrxps04-roe3 \  
-instance_shared_dev /dev/dm-8 -tbdev /dev/dm-7 -u db2sdin1 db2sdin1
```

DBI1446I The db2icrt command is running.

DB2 installation is being initialized.

Total number of tasks to be performed: 11

Total estimated time for all tasks to be performed: 1084 second(s)

Task #1 start

Description: Installing DB2 files on remote hosts

Estimated time 600 second(s)

Task #1 end

...

Task #11 start

Description: Updating global profile registry

Estimated time 3 second(s)

Task #11 end

The execution completed successfully.

For more information see the DB2 installation log at "/tmp/db2icrt.log.3422830".

DBI1070I Program db2icrt completed successfully.

**Cluster manager is  
set**

```
[db2sdin1@reglrxps02 db2dump]$ rpm -qa | grep "^pacemaker-[0-9].*db2pcmk"  
pacemaker-2.1.7-4.db2pcmk.el9.2.x86_64
```

```
[db2sdin1@reglrxps02 db2dump]$ rpm -qa | grep "^corosync-[0-9].*db2pcmk*"  
corosync-3.1.8-3.db2pcmk.el9.x86_64
```

```
[db2sdin1@reglrxps01 db2dump]$ db2 get dbm cfg | grep -i cluster  
Cluster manager = PACEMAKER
```

# pureScale: Topology Changes

- Add/drop member and CF adds/deletes resources in Pacemaker accordingly for both offline and online
- Procedure remains unchanged
- Example: Online add member 2 to a cluster

Topology change operations:

- Online add member
- Online add/drop CF
- Offline add/drop member
- Offline add/drop CF

**Pacemaker  
cluster  
installed and  
grown  
automatically**

1: As root, from the install path (/opt/ibm/db2/V12.1/bin):

```
[root@reglnxps01 ~]# cd /opt/ibm/db2/V12.1/instance  
[root@reglnxps01 instance]# ./db2iupdt -add -m reglnxps04 \  
-mnet reglnxps04-roe0,reglnxps04-roe1,reglnxps04-roe2,reglnxps04-roe3 \  
-u db2sdin1 db2sdin1
```

DBI1446I The db2iupdt command is running.

DB2 installation is being initialized.

Total number of tasks to be performed: 10  
Total estimated time for all tasks to be performed: 1054 second(s)

```
Task #1 start  
Description: Installing DB2 files on remote hosts  
Estimated time 600 second(s)  
Task #1 end  
  
Task #2 start  
Description: Installing or updating Db2 resource agent scripts for Pacemaker  
Estimated time 20 second(s)  
Task #2 end
```

```
...  
Task #10 start  
Description: Updating global profile registry  
Estimated time 3 second(s)  
Task #10 end  
  
The execution completed successfully.  
  
For more information see the DB2 installation log at  
"/tmp/db2iupdt.log.946792".  
DBI1070I Program db2iupdt completed successfully.
```

2: As the db2 user, start the member

```
[db2sdin1@reglnxps01 ~]$ db2start member 2  
08/13/2024 16:41:49 2 0 SQL1063N DB2START processing was successful.  
SQL1063N DB2START processing was successful.
```

# pureScale: Maintenance Mode

- Maintenance procedure is the same as before, except db2cm command is used
- 11.5 reference: <https://www.ibm.com/docs/en/db2/11.5?topic=environment-performing-maintenance-db2-purescale-host>
- Example below: enter and exit on member 0 using db2cm

### Enter Maintenance:

#### 1: As instance user:

```
db2sdin1@regrlnxps02> db2stop member 0 quiesce 30
08/13/2024 11:40:32 0 0 SQL1064N DB2STOP processing was successful.
db2sdin1@regrlnxps02> db2stop instance on regrlnxps01
SQL1064N DB2STOP processing was successful.
```

#### 2: As root, from the install path (/opt/ibm/db2/V12.1/bin):

```
[root@regrlnxps01 bin]# export DB2INSTANCE=db2sdin1
[root@regrlnxps01 bin]# ./db2cm -cm -enter -maintenance
Host 'regrlnxps01' has entered maintenance mode.
[root@regrlnxps01 bin]# ./db2cm -cfs -enter -maintenance
Host 'regrlnxps01' has successfully entered file system maintenance mode
```

db2cm  
commands  
now used

### Exit Maintenance:

#### 3: As root, back to the install path (/opt/ibm/db2/V12.1/bin):

```
[root@regrlnxps01 bin]# export DB2INSTANCE=db2sdin1
[root@regrlnxps01 bin]# ./db2cm -cm -exit -maintenance
Successfully exited maintenance.
[root@regrlnxps01 bin]# ./db2cm -cfs -exit -maintenance
Host 'regrlnxps01' has successfully exited file system maintenance mode.
```

#### 4: Back to the instance user:

```
db2sdin1@regrlnxps02> db2start instance on regrlnxps01
SQL1063N DB2START processing was successful.

db2sdin1@regrlnxps02> db2start member 0
08/13/2024 11:47:54 0 0 SQL1063N DB2START processing was successful
```

Note: procedure is similar if it was a CF, only db2start/db2stop commands change:

```
db2sdin1@regrlnxps02> db2stop CF 128/129
db2sdin1@regrlnxps02> db2start CF 128/129
```

## Db2 pureScale upgrade from TSA to Pacemaker in v12.1 GA

- Will be driven by the regular upgrade process (no additional steps)
- Will backup resource model metadata
- Will stop and drop TSA (and related) daemons
- Will install and start Pacemaker (and related) services
- Will build the new Pacemaker resource model from the resource metadata
  - Using the same internal references used by `db2cluster -repair -resources` in v11.5

# pureScale: Upgrading an Instance

- Upgrade to V12.1 offline (major version update)

## Procedure for Upgrade:

### 1: As instance user:

```
> db2stop  
> db2stop instance on <hostname> (for each host)
```

### 2: As root, from the old install path:

```
> db2cluster -cm -enter -maintenance -all  
> db2cluster -cfs -enter -maintenance -all
```

### 3: As root, change to the 12.1 image path and run:

```
> db2prereqcheck -v 12.1.0.0 (on all hosts)  
> db2_install (on all hosts)
```

### 4: Back to the old version's install path:

```
> db2cluster -cm -exit -maintenance -all  
> db2cluster -cfs -exit -maintenance -all  
> db2cluster -cfs -commit
```

### 5: As instance user:

```
> db2start instance on <hostname> (for each host)
```

### 6: As root, run db2iupgrade (from the new 12.1 install path):

```
> cd /opt/ibm/db2/V12.1/instance  
> db2iupgrade -d -g -u <fenced ID> <instance name>
```

### 7. As instance user:

```
> db2start
```

## db2iupgrade:

- Migrates the the RSCT domain with its TSA resources to a Corosync domain with Pacemaker resources
- Updates the instance on all hosts
- Verifies that resources have been migrated correctly
- Afterwards, the 'db2 get dbm cfg' command will show that "Cluster manager" was changed to PACEMAKER

**TSA changed  
to Pacemaker  
automatically**



## pureScale: Rolling update

- Update a fix pack within Db2 V12.1 (CSB, future modpacks / fixpacks) with the cluster online
- Rolling update procedure is the same as V11.5
- Example below is to auto-update with a single installFixPack command

Procedure for update:

1: As instance user:

```
> db2instance -list
```

\* Make sure all members are in the STARTED state and the secondary is in PEER state before proceeding to the next step

2: As root, in the 12.1 image path, to show the update order:

```
> installFixPack -p /opt/ibm/db2/V12.1 -I <instance name> -autoupdate -show_update_order
```

\* Primary CF always listed last

3: As root, in the 12.1 image path, perform the fix pack update:

```
> installFixPack -p /opt/ibm/db2/V12.1 -I <instance name> -autoupdate
```

\* It will update secondary CF and members first, then the primary CF last

4: As root, in the 12.1 image path, to commit the update:

```
> installFixPack -commit_level -I <instance name> -l <log file> -t <trace file>
```

\* Now the instance is fully updated to the new level

5: As an instance user, verify database(s) are at the new level:

```
> db2updv121 -d <database name> (for each database)
```

**Pacemaker  
updated with  
the fix pack  
update**

- Can use the -concurrency <N> only update <N> number of hosts at a time instead
- Can update hosts one by one without concurrency or autoupdate options

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# Db2 pureScale v12.1 on AWS

- AWS Marketplace will be updated around v12.1 GA
  - Db2 pureScale v12.1 with Pacemaker only
    - RHEL 9.4
    - SLES 15 SP6
- Existing pureScale v11.5.8 / v11.5.9 on AWS deployments can still be used and are supported until 11.5 EOL
  - Upgrading to v12.1 will follow the same documentation as on-prem
  - Requires outage (offline upgrade)



# Db2 pureScale v12.1 on Azure

- AWS was just the first step...
  - Many customers looking for equivalent solution on Azure
  - Azure already supports both TCP/IP and RDMA private networks
  - Competitive resource costs (compared to AWS)
- Db2 pureScale on Azure is ~~in active development~~ 
  - With
    - Automated deployment
    - additional Day 2 management planned
  - Launch in 2025!



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## db2cm – Cluster manager utility

- Introduced in v11.5.4.0 (HADR with Pacemaker beta)
  - Started as a bash script
- All the Highly Available deployments for Db2 Linux with Pacemaker use db2cm
- In v12.1, db2cm is a C++ executable
  - Shared infrastructure with Db2 engine
- New security model in v12.1



# Security Model for the db2cm command

- The db2cm command
  - main interface into Db2® cluster services
  - acts on both the cluster manager and shared file system cluster provided for the IBM® Db2 pureScale® Feature.
- The db2cm command options that are available to a user depend on the user's authority.
- Security model for the db2cm command has 2 user groups
  - System Administrator
  - Cluster Administrator

# System Administrator

- The System Administrator is the root user
  - or any user that is authorized to run as root (via sudo).
- Users in this group have no requirements to access data in the database
- Administrative role used for:
  - Installation and configuration of the Db2 cluster services
  - Maintaining clustered instances in the cluster domain
  - maintaining the shared file system cluster
- System Administrator performs administrative tasks that affect Db2 cluster services as a whole
  - across all clustered instances on all hosts in the cluster domain.

# System Administrator

- The System Administrator can perform maintenance-related tasks
  - putting hosts into maintenance mode, using the `-enter` option, or
  - committing changes or updates to the cluster manager, using the `-commit` option.
- This user can also perform advanced maintenance operations on the cluster domain
  - Creating domain
  - Deleting domain
  - Starting or stopping the domain
  - Adding or removing hosts.
- Note: *Certain Db2® cluster administrative commands require `DB2INSTANCE` environment variable to be set.*

# Cluster Administrator

- User with Cluster Administrator privilege can use db2cm to
  - keep the instance up and running
  - perform some administrative tasks on the cluster manager
- Cluster Admin can
  - list resources,
  - enable and disable resources,
  - import and export,
  - create and delete cluster resources
  - repair the cluster manager resource model.
- Note that System Administrator user (root user) can perform Cluster Administrator tasks that do not require access to the database.

# Special handling of Cluster Administrator Setup

- For pureScale (or DPF HA),
  - instance owner is automatically granted Cluster Administrator privilege when the cluster domain is created
  - the instance owner user is available on all the hosts.

# db2cm – no need for CRM Shell

- In v11.5, the Db2 Pacemaker stack (db2pcmk) included CRM shell
  - Provided a simpler interface to display key Pacemaker information
- CRM Shell tied most operations to the root user
- db2cm provides information to the Cluster Administrator
  - Typically Db2 instance user
- CRM Shell is no longer bundled with Db2 LUW





# Oversight of Db2 pureScale status

## db2instance -list

- Familiar utility to show cluster status
- Critical for maintenance
- No visible changes for v12.1 (compared to v11.5)

ID	TYPE	STATE	HOME_HOST	CURRENT_HOST	ALERT	PARTITION_NUMBER	LOGICAL_
0	MEMBER	STARTED	pures-srv-3	pures-srv-3	NO	0	
1	MEMBER	STARTED	pures-srv-4	pures-srv-4	NO	0	
128	CF	STARTED	pures-srv-1	pures-srv-1	NO	-	
129	CF	STARTED	pures-srv-2	pures-srv-2	NO	-	

HOSTNAME	STATE	INSTANCE_STOPPED	ALERT
pures-srv-1	ACTIVE	NO	NO
pures-srv-2	ACTIVE	NO	NO
pures-srv-3	ACTIVE	NO	NO
pures-srv-4	ACTIVE	NO	NO

# db2cm -list

HA Model: pureScale

## Domain Information:

Domain name = db2domain  
Cluster Manager = Corosync  
Cluster Manager Version = 3.1.7  
Resource Manager = Pacemaker  
Resource Manager Version = 2.1.6-4.db2pcmk.e19  
Current domain leader = ps-srv-2  
Number of nodes = 4  
Number of resources = 15

## Host Information:

HOSTNAME	STATE
ps-srv-1	ONLINE
ps-srv-2	ONLINE
ps-srv-3	ONLINE
ps-srv-4	ONLINE

## Fencing Information:

Fencing Configured: Configured  
Fencing Agent: db2fence\_ps

## Quorum Information:

Quorum Type: Majority  
Total Votes: 4  
Quorum Votes: 3  
Quorum Nodes:

-----  
ps-srv-1  
ps-srv-2  
ps-srv-3  
ps-srv-4

## Resource Information:

Resource Name	= db2_cf_db2inst1_128
State	= Online
Managed	= True
Resource Type	= CF
Current Host	=
Instance	= db2inst1
Node Number	= 128

Resource Name	= db2_cf_db2inst1_129
State	= Online
Managed	= True
Resource Type	= CF
Current Host	=
Instance	= db2inst1
Node Number	= 129

Resource Name	= db2_cfprimary_db2inst1
State	= Online
Managed	= True
Resource Type	= CF Primary
Current Host	=
Instance	= db2inst1

# db2cm -verify

Check 1: Verifying cluster manager resources. result: PASS

Check 2: Verifying cluster file system configuration. result: PASS

Check 3: Verifying cluster topology. result: PASS

Check 4: Verifying SSH configuration. result: PASS

Check 5: Verifying RDMA connectivity. result: SKIPPED

Check 6: Verifying db2ssh configuration. result: NOT APPLICABLE

RoCE checks are done only on RDMA clusters

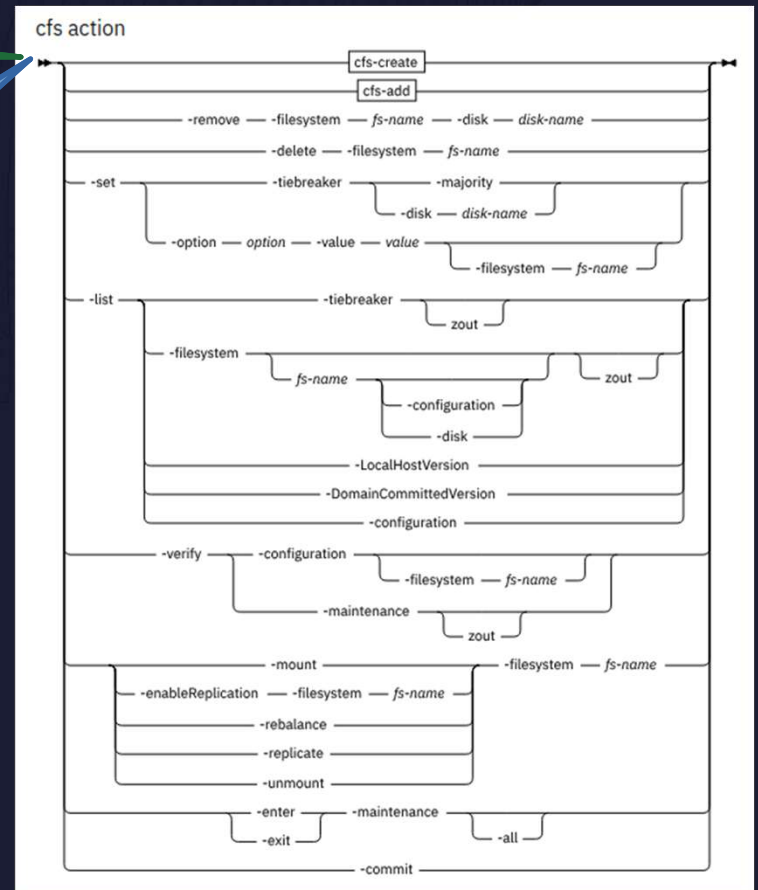
Db2locssh configuration is verified here

# IBM Storage Scale (formerly GPFS)

- All the commands previously available via
  - db2cluster -cfs ...
- Are exactly replicated with
  - db2cm -cfs ...

db2cm

db2cluster



## After v12.1 GA: What's next?

- v12.1 GA marks the first Db2 pureScale with Pacemaker release
- All of the following items are under investigation or actively in development
  - Actual arrival in v12.1 modpacks will be determined based on successfully passing the required feature and quality checks
  - *This is not a guarantee that these features will ship!*

# EFA

- Db2 pureScale on AWS currently supports TCP/IP private network
  - Does not scale as well as RDMA-based solutions
- EFA v2 is Amazon's new high performance RDMA solution
  - Requires new RDMA implementation for pureScale
  - Similar to the existing RDMA Verbs API implementation
- Anticipating better scale-out due to
  - Shorter lock times, faster page invalidation, less contention across members



# After v12.1 GA: Replication integration

- Multiple technologies are often deployed with a pureScale cluster
  - Some of these technologies require co-location or other relationships to be used effectively
- Data replication needs a reliable active member
  - CDC
  - QRep
- Developing Pacemaker resource models to align Data Replication with an active member
  - Needs to cope with planned and unplanned outages
  - Must ensure data integrity

# Online Drop Member

- In v12.1 GA, the following topology changes can be done online
  - Add / Drop CF
  - Add member
- Online Drop Member will significantly simplify handling
  - Failed hardware
  - Changing cluster size for economic / power usage requirements

# Online Index REBUILD

- In v12.1 GA, Db2 pureScale indexes maintenance supports
  - RECLAIM EXTENTS
  - CLEANUP
- Expect to see REBUILD supported in upcoming v12.1 modpacks





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2024 EMEA Db2 Tech Conference

## The all new TSA-less pureScale with Pacemaker on Linux

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