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1.0 EDB Postgres High Availability & Horizontal Read Scaling Architecture

1.1 Architecture Overview

Since high-availability and read scalability are not part of the core feature set of EDB Postgres Advanced Server, Advanced Server relies on external tools to provide this functionality. This document will focus on functionality provided by EDB Failover Manager and Pgpool-II and discuss the implications of a high-availability architecture formed around these tools. We will demonstrate how to best configure Failover Manager and Pgpool to leverage the benefits they provide for Advanced Server. Using the reference architecture described in the Architecture section, you can learn how to achieve high availability by implementing an automatic failover mechanism (with Failover Manager) while scaling the system for larger workloads and a high number of concurrent clients with read-intensive or mixed workloads to achieve horizontal scaling/read-scalability (with Pgpool).

The architecture described in this document has been developed and tested for EFM 4.0, EDB pgPool, and Advanced Server 12.

Documentation for Advanced Server and Failover Manager are available from EnterpriseDB at:

https://www.enterprisedb.com/resources/product-documentation

Documentation for pgPool-II can be found at:

http://www.pgpool.net/docs/latest/en/html

Failover Manager Overview

Failover Manager is a high-availability module that monitors the health of a Postgres streaming replication cluster and verifies failures quickly. When a database failure occurs, Failover Manager can automatically promote a streaming replication standby node into a writable primary node to ensure continued performance and protect against data loss with minimal service interruption.

Basic EFM Architecture Terminology

A Failover Manager cluster is comprised of EFM processes that reside on the following hosts on a network:

- A **Primary node** is the primary database server that is servicing database clients.

- One or more **Standby nodes** are streaming replication servers associated with the primary node.

- The **Witness node** confirms assertions of either the Primary or a Standby in a failover scenario. A cluster does not need a dedicated witness node if the cluster contains three or more nodes. If you do not have a third cluster member that is a database host, you can a dedicated Witness node; a cluster may include more than one witness node.

PgPool-II Overview

Pgpool-II (Pgpool) is an open source application that provides connection pooling and load balancing for horizontal scalability of `SELECT` queries on multiple standbys in EPAS and community Postgres clusters. Pgpool can be configured to use a `backend_weight` parameter to prevent read traffic to be directed to the primary node. In such cases, data modification language (DML) queries (i.e., `INSERT` , `UPDATE` , and `DELETE`) are always sent to the primary node, while read queries are load-balanced to the standbys, providing scalability with mixed and read-intensive workloads.

EnterpriseDB supports the following Pgpool functionality:

- Load balancing
- Connection pooling
- High availability
- Connection limits

PCP Overview

Pgpool provides an interface called PCP for administrators that performs management operations such as retrieving the status of Pgpool or terminating Pgpool processes remotely. PCP commands are UNIX commands that manipulate Pgpool via the network.

Pgpool Watchdog

`watchdog` is an optional sub process of Pgpool that provides a high availability feature. Features added by `watchdog` include:

- Health checking of the pgpool service
- Mutual monitoring of other watchdog processes
- Changing active/standby state if certain faults are detected
- Automatic virtual IP address assigning synchronous to server switching
- Automatic registration of a server as a standby during recovery

More information about the `Pgpool watchdog` component can be found at:

http://www.pgpool.net/docs/latest/en/html/tutorial-watchdog.html

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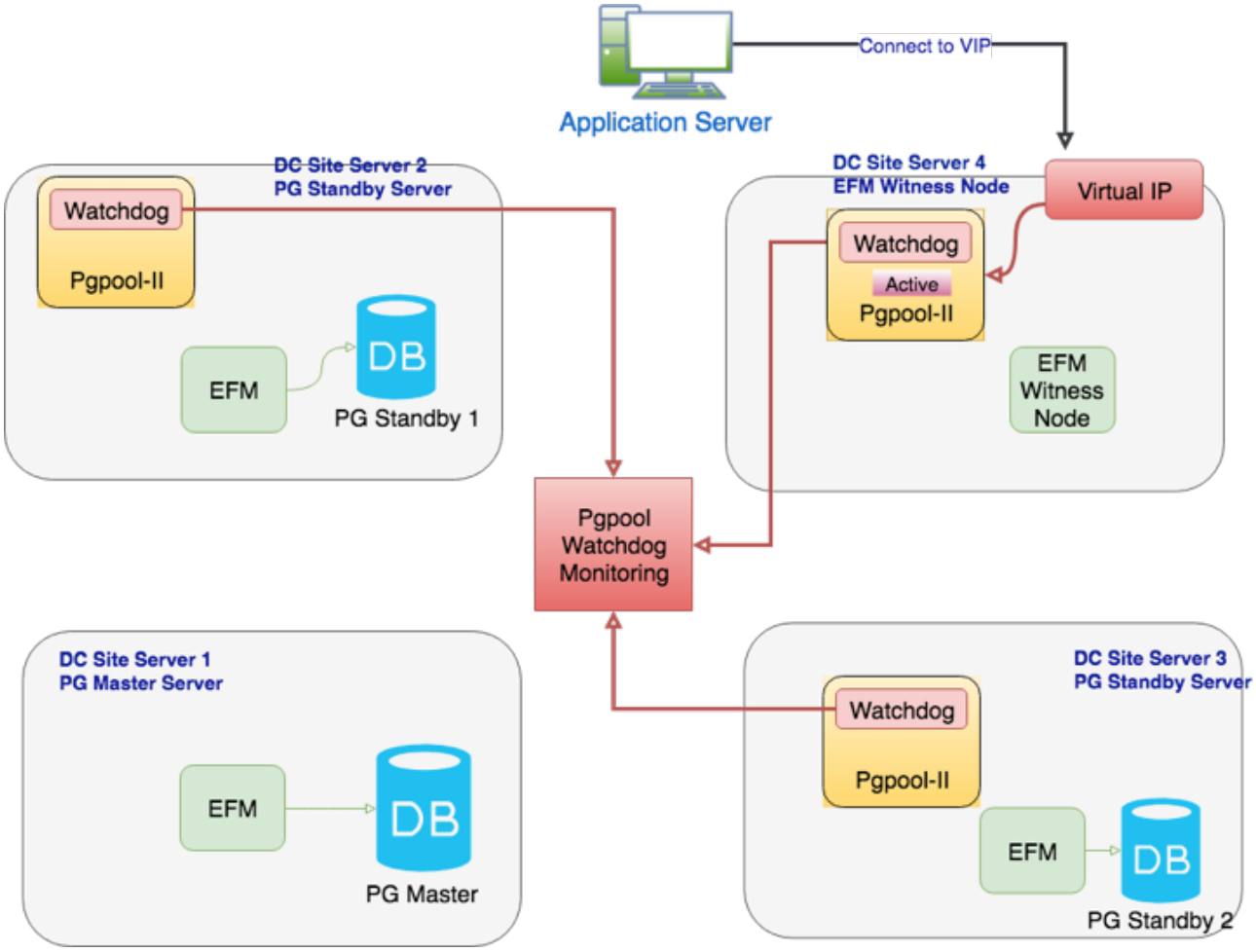
1.2 Architecture



The sample architecture diagram shows four nodes as described in the table below:

Scenario	Components
Server 1	Primary node, running Advanced Server and Failover Manager with Postgres Streaming Replication
Server 2 & Server 3	Standby nodes running Failover Manager (Pgpool-II optional). This is a Streaming Replication stand
Server 4	Optional witness node running Pgpool-II and Failover Manager. This server is set up with no active

This architecture:

- Achieves maximum availability by providing two standbys in case of primary node failure.
- Achieves maximum performance with mixed and read-intensive workloads by introducing increased read scalability with more than one standby for load balancing.
- Reduces load on the primary node by performing load balancing and not running Pgpool on the primary.
- Avoids single point of failure of Pgpool by configuring Pgpool in high-availability mode using `watchdog` .
- Runs Pgpool primary/active instance on the least-burdened node (the witness node) to boost performance while sharing resources with Failover Manager (to reduce TCO).

If one or more standbys are configured with synchronous replication, users can achieve near-zero data loss in a failure event.

With this architecture, you can expect the following behavior:

Scenario
Switchover/Switchback: This is a planned down-time taken for some OS/DB level activities and when promoting any of th **Failover:** This is unplanned downtime which can occur, making the primary database inaccessible to an Application (Prima

1.3 Implementing High Availability with PgPool

Failover Manager monitors the health of Postgres nodes; in the event of a primary node failure, Failover Manager performs an automatic failover to a standby node. Note that Pgpool does not monitor the health of backend nodes and will not perform failover to any standby nodes.

Beginning with version 3.2, a Failover Manager agent can be configured to use Pgpool's PCP interface to detach the failed node from Pgpool load balancing after performing failover of the standby node. More details about the necessary configuration file changes and relevant scripts will be discussed in the sections that follow.

Configuring Failover Manager

Failover Manager provides functionality that will remove failed database nodes from Pgpool load balancing; Failover Manager can also re-attach nodes to Pgpool when returned to the Failover Manager cluster. To configure this behavior, you must identify the load balancer *attach* and *detach* scripts in the `efm.properties` file in the following parameters:

- `script.load.balancer.attach=/path/to/load_balancer_attach.sh %h`
- `script.load.balancer.detach=/path/to/load_balancer_detach.sh %h`

The script referenced by `load.balancer.detach` is called when Failover Manager decides that a database node has failed. The script detaches the node from Pgpool by issuing a PCP interface call. You can verify a successful execution of the `load.balancer.detach` script by calling `SHOW NODES` in a `psql` session attached to the Pgpool port. The call to `SHOW NODES` should return that the node is marked as `down`; Pgpool will not send any queries to a downed node.

The script referenced by `load.balancer.attach` is called when a `resume` command is issued to the `efm` command-line interface to add a downed node back to the Failover Manager cluster. Once the node rejoins the cluster, the script referenced by `load.balancer.attach` is invoked, issuing a PCP interface call, which adds the node back to the Pgpool cluster. You can verify a successful execution of the `load.balancer.attach` script by calling `SHOW NODES` in a `psql` session attached to the Pgpool port; the command should return that the node is marked as `up`. At this point, Pgpool will resume using this node as a load balancing candidate. Sample scripts for each of these parameters are provided in Appendix B.

Configuring Pgpool

You must provide values for the following configuration parameters in the `pgpool.conf` file on the Pgpool host:

```
follow_master_command = '/path/to/follow_primary.sh %d %P'
load_balance_mode = on
master_slave_mode = on
master_slave_sub_mode = 'stream'
fail_over_on_backend_error = off
health_check_period = 0
failover_if_affected_tuples_mismatch = off
failover_command = ''
failback_command = ''
search_primary_node_timeout = 3
backend_hostname0='primary'
backend_port0=5433
backend_flag0='ALLOW_TO_FAILOVER'
backend_hostname1='standby1'
backend_port1=5433
backend_flag1='ALLOW_TO_FAILOVER'
backend_hostname2='standby2'
backend_port2=5433
backend_flag2='ALLOW_TO_FAILOVER'
```

```
sr_check_period = 10
sr_check_user = 'enterprisedb'
sr_check_password = 'edb'
sr_check_database = 'edb'
health_check_user = 'enterprisedb'
health_check_password = 'edb'
health_check_database = 'edb'
```

When the primary/master node is changed in Pgpool (either by failover or by manual promotion) in a non-Failover Manager setup, Pgpool detaches all standby nodes from itself, and executes the `follow_master_command` for each standby node, making them follow the new primary node. Since Failover Manager reconfigures the standby nodes *before* executing the post-promotion script (where a standby is promoted to primary in Pgpool to match the Failover Manager configuration), the `follow_master_command` merely needs to reattach standby nodes to Pgpool.

Note that the load-balancing is turned on to ensure read scalability by distributing read traffic across the standby nodes

Note also that the health checking and error-triggered backend failover have been turned off, as Failover Manager will be responsible for performing health checks and triggering failover. It is not advisable for Pgpool to perform health checking in this case, so as not to create a conflict with Failover Manager, or prematurely perform failover.

Finally, `search_primary_node_timeout` has been set to a low value to ensure prompt recovery of Pgpool services upon an Failover Manager-triggered failover.

pgpool_backend.sh

In order for the attach and detach scripts to be successfully called, a `pgpool_backend.sh` script must be provided. `pgpool_backend.sh` is a helper script for issuing the actual PCP interface commands on Pgpool. Nodes in Failover Manager are identified by IP addresses, while PCP commands refer to a node ID. `pgpool_backend.sh` provides a layer of abstraction to perform the IP address to node ID mapping transparently.

1.4 Optional Components

Virtual IP Addresses

Both Pgpool-II and Failover Manager provide functionality to employ a virtual IP for seamless failover. While both provide this capability, it must be noted that Failover Manager associates a virtual IP to the primary database node while Pgpool associates a virtual IP to the currently-active Pgpool host (in a multi-Pgpool watchdog setup).

Note that if an active instance of Pgpool (Server 4 in our sample architecture) goes down, any available standby Pgpool instance (according to watchdog priority) will take charge as the active Pgpool instance.

Pgpool Watchdog

Watchdog provides high availability for Pgpool nodes. This section lists the configuration parameters required to configure watchdog on each Pgpool node.

Common Watchdog Configuration Parameters for All Pgpool Nodes

```
use_watchdog = on # enable watchdog
wd_port = 9000 # watchdog port, can be changed
delegate_IP = ‘Virtual IP address’
wd_lifecheck_method = 'heartbeat'
wd_interval = 10 # we can lower this value for quick detection
wd_life_point = 3
# virtual IP control
if_cmdconfig_path = '/sbin' # ifconfig command path
```

```
if_up_cmd = 'ifconfig eth0:0 inet $_IP_$ netmask 255.255.255.0'
# startup delegate IP command
if_down_cmd = 'ifconfig eth0:0 down' #shutdown DIP
arping_path = '/usr/sbin' # arping command path
arping_cmd = 'arping -U $_IP_$ -w 1' # arping command
```

Custom Watchdog Configuration Parameters for Each Pgpool Node

The following configuration parameters must be set on each Pgpool node. The interval and retry values can be adjusted depending upon the requirements and testing results.

```
other_pgpool_hostname0 = '<server# IP/hostname>'
other_pgpool_port0 = 9999
other_wd_port0 = 9000
other_pgpool_hostname1 = '<server# IP/hostname>'
other_pgpool_port1 = 9999
other_wd_port1 = 9000
wd_priority = <any integer>
```

Note that `wd_priority` can be used to elevate the local watchdog node priority in the elections to select primary watchdog node. The node with the higher `wd_priority` value will get selected as primary watchdog node when cluster will be electing its new primary node at the time of cluster startup or in the event of old primary watchdog node failure.

1.5 Appendix

Appendix A: Supported Failover Scenarios

A summary of supported failover scenarios is provided below. Please note that the list is not comprehensive; you should consult the Failover Manager documentation for detailed information about how Failover Manager handles each failover/failure scenario.

Appendix B: Integration Scripts

load_balancer_detach.sh

```
#!/bin/bash
#%h host name
output_file=/tmp/efm-scripts/pp_log
pool_backend=/tmp/efm-scripts/pgpool/pgpool_backend.sh
node_address=$1
current_date_time="`date +"%Y-%m-%d %H:%M:%S"`";
echo $current_date_time >>$output_file
echo "node address to detach = $node_address". >>$output_file
$pool_backend detach $node_address >>$output_file
echo "--------------------".>>$output_file
exit 0
```

load_balancer_attach.sh

```
#!/bin/bash
#%h host name
output_file=/tmp/efm-scripts/pp_log
pool_backend=/tmp/efm-scripts/pgpool/pgpool_backend.sh
node_address=$1
current_date_time="`date +"%Y-%m-%d %H:%M:%S"`";
echo $current_date_time >>$output_file
echo "node address to attach = $node_address". >>$output_file
$pool_backend attach $1 >>$output_file
echo "--------------------".>>$output_file
exit 0
```

follow_master.sh

```
#! /bin/sh
PCP_USER= # PCP user name
PCP_PORT= # PCP port number as in pgpool.conf
PCP_HOST= # hostname of Pgpool-II
PGPOOL_PATH= # Pgpool-II installed path
export PCPPASSFILE= # Path to PCPPASS file
# Execute command by failover.
# special values: %d = node id
# %h = host name
# %p = port number
# %D = database cluster path
# %m = new master node id
# %M = old master node id
# %H = new master node host name
# %P = old primary node id
# %R = new master database cluster path
# %r = new master port number
# %% = '%' character
detached_node_id=$1
old_master_id=$2
echo detached_node_id $1
echo old_master_id $2
## If $detached_node_id is equal to $old_master_id,
## then do nothing, since the old master is no longer
## supposed to be part of the cluster.
if [ $detached_node_id -ne $old_master_id ]; then
sleep 10
$PGPOOL_PATH/pcp_attach_node -w -U $PCP_USER -h $PCP_HOST -p
$PCP_PORT $detached_node_id
fi
```

pgpool_backend.sh

```
#!/bin/bash
#
# pgpool-II backend node configuration driver.
#
# usage: promote_standby.sh hostname [port]
#
# set the following variables according to your setup
PCP_USER= # PCP user name
PCP_PORT= # PCP port number as in pgpool.conf
PCP_HOST= # hostname of Pgpool-II
PGPOOL_PATH= # Pgpool-II installed path
export PCPPASSFILE= # Path to PCPPASS file
# function returns the Pgpool-II backend node-id for the given
hostname
# and port number, And if the node-id is not found 255 is returned
# Arguments:
# 1- Hostname
# 2- Port (optional) if not provided, node-id of first matching
# hostname will be returned
#
function get_pgpool_nodeid_from_host {
if [ -z "$1" ]; then
echo "hostname not provided"
return 255
fi
#Now get the total number of nodes configured in Pgpool-II
```

```
node_count=`$PGPOOL_PATH/pcp_node_count -U $PCP_USER -h $PCP_HOST -p
$PCP_PORT -w\`
echo searching node-id for $1:$2 from $node_count configured backends
i=0
while [ $i -lt $node_count ];
do
nodeinfo=`$PGPOOL_PATH/pcp_node_info -U $PCP_USER -h $PCP_HOST -p
$PCP_PORT -w $i\`
hostname=`echo $nodeinfo \| awk -v N=1 '{print $N}'\`
port=`echo $nodeinfo \| awk -v N=2 '{print $N}'\`
#if port number is <= 0 we just need to compare hostname
if [ "$hostname" == $1 ] && ( [ -z "$2" ] \|\| [ $port -eq $2 ] );
then
echo "$1:$2 has backend node-id = $i in Pgpool-II"
return $i
fi
let i=i+1
done
return 255
}
# function returns 1 if Pgpool-II backend node for the given hostname
# and port number is the primary node in Pgpool-II
# returns 0 for the standby node and 255 if no node exist for the
hostname
# Arguments:
# 1- Hostname
# 2- Port (optional) if not provided, node-id of first matching
# hostname will be returned
#
function is_host_is_primary_pgpool_node {
if [ -z "$1" ]; then
echo "hostname not provided"
return 255
fi
#Now get the total number of nodes configured in Pgpool-II
node_count=`$PGPOOL_PATH/pcp_node_count -U $PCP_USER -h $PCP_HOST -p
$PCP_PORT -w\`
echo searching node-id for $1:$2 from $node_count configured backends
i=0
while [ $i -lt $node_count ];
do
nodeinfo=`$PGPOOL_PATH/pcp_node_info -U $PCP_USER -h $PCP_HOST -p
$PCP_PORT -w $i\`
hostname=`echo $nodeinfo \| awk -v N=1 '{print $N}'\`
port=`echo $nodeinfo \| awk -v N=2 '{print $N}'\`
role=`echo $nodeinfo \| awk -v N=6 '{print $N}'\`
#if port numbner is <= 0 we just need to compare hostname
if [ "$hostname" == $1 ] && ( [ -z "$2" ] \|\| [ $port -eq $2 ] );
then
echo "$1:$2 has backend node-id = $i in Pgpool-II"
# check if the node role is primary
if [ "$role" == "primary" ]; then
return 1
else
return 0
fi
fi
let i=i+1
done
return 255
}
```

```
# Function promotes the node-id to the new master node
# Arguments:
# 1- node-id: Pgpool-II backend node-id of node to be promoted to
master
function promote_node_id_to_master {
if [ -z "$1" ]; then
echo "node-id not provided"
return 255
fi
$PGPOOL_PATH/pcp_promote_node -w -U $PCP_USER -h $PCP_HOST -p
$PCP_PORT $1
return $?
}
# Function attach the node-id to the Pgpool-II
# Arguments
# 1- node-id: Pgpool-II backend node-id to be attached
function attach_node_id {
if [ -z "$1" ]; then
echo "node-id not provided"
return 255
fi
$PGPOOL_PATH/pcp_attach_node -w -U $PCP_USER -h $PCP_HOST -p
$PCP_PORT $1
return $?
}
# Function detach the node-id from the Pgpool-II
# Arguments
# 1- node-id: Pgpool-II backend node-id to be detached
function detach_node_id {
if [ -z "$1" ]; then
echo "node-id not provided"
return 255
fi
$PGPOOL_PATH/pcp_detach_node -w -U $PCP_USER -h $PCP_HOST -p
$PCP_PORT $1
return $?
}
# function promotes the standby node identified by hostname:port
# to the master node in Pgpool-II
# Arguments:
# 1- Hostname
# 2- Port (optional) if not provided, node-id of first matching
# hostname will be promoted
#
function promote_standby_to_master {
get_pgpool_nodeid_from_host $1 $2
node_id=$?
if [ $node_id -eq 255 ]; then
echo unable to find Pgpool-II backend node id for $1:$2
return 255
else
echo promoting node-id: $node_id to master
promote_node_id_to_master $node_id
return $?
fi
}
# function attaches the backend node identified by hostname:port
# to Pgpool-II
# Arguments:
# 1- Hostname
# 2- Port (optional) if not provided, node-id of first matching
```

```
# hostname will be promoted
#
function attach_node {
get_pgpool_nodeid_from_host $1 $2
node_id=$?
if [ $node_id -eq 255 ]; then
echo unable to find Pgpool-II backend node id for $1:$2
return 255
else
echo attaching node-id: $node_id to Pgpool-II
attach_node_id $node_id
return $?
fi
}
# function detaches the backend node identified by hostname:port
# from Pgpool-II
# Arguments:
# 1- Hostname
# 2- Port (optional) if not provided, node-id of first matching
# hostname will be promoted
#
function detach_node {
get_pgpool_nodeid_from_host $1 $2
node_id=$?
if [ $node_id -eq 255 ]; then
echo unable to find Pgpool-II backend node id for $1:$2
return 255
else
echo detaching node-id: $node_id from Pgpool-II
detach_node_id $node_id
return $?
fi
}
function print_usage {
echo "usage:"
echo " $(basename $0) operation hostname [port]".
echo " operations:".
echo " check_primary: check if node has a primary role".
echo " promote: promote node".
echo " attach: attach node".
echo " detach: detach node".
}
# script entry point
if [ -z "$1" ] \|\| [ -z "$2" ]; then
echo "ERROR: operation not provided"
print_usage
exit 1
fi
shopt -s nocasematch
case "$1" in
"check_primary" )
is_host_is_primary_pgpool_node $2 $3
;;
"promote" ) echo "promote"
promote_standby_to_master $2 $3
;;
"attach" ) echo "attach"
attach_node $2 $3;;
"detach" ) echo "detach"
detach_node $2 $3;;
"watchdog" ) echo "detach"
```

```
$PGPOOL_PATH/pcp_watchdog_info -w -U $PCP_USER -h $PCP_HOST -p
$PCP_PORT -v;;
\*) echo "invalid operation $1".
print_usage;;
esac
exit $?
```

2.0 Creating a Failover Manager Cluster

EDB Postgres Failover Manager (Failover Manager) is a high-availability module from EnterpriseDB that enables a Postgres Primary node to automatically failover to a Standby node in the event of a software or hardware failure on the Primary.

This quick start guide describes configuring a Failover Manager cluster in a test environment. You should read and understand the EDB Failover Manager User's Guide before configuring Failover Manager for a production deployment.

You must perform some basic installation and configuration steps before performing this tutorial:

- You must install and initialize a database server on one primary and one or two standby nodes; for information about installing Advanced Server, visit:

  https://www.enterprisedb.com/edb-docs/p/edb-postgres-advanced-server

- Postgres streaming replication must be configured and running between the primary and standby nodes. For detailed information about configuring streaming replication, visit:

  https://www.postgresql.org/docs/current/warm-standby.html#STREAMING-REPLICATION.

- You must also install Failover Manager on each primary and standby node. During Advanced Server installation, you configured an EnterpriseDB repository on each database host. You can use the EnterpriseDB repository and the `yum install` command to install Failover Manager on each node of the cluster:

  ```
  yum install edb-efm40
  ```

During the installation process, the installer will create a user named `efm` that has sufficient privileges to invoke scripts that control the Failover Manager service for clusters owned by `enterprisedb` or `postgres`. The example that follows creates a cluster named `efm`.

Start the configuration process on a primary or standby node. Then, copy the configuration files to other nodes to save time.

Step 1: Create Working Configuration Files

Copy the provided sample files to create EFM configuration files, and correct the ownership:

```
cd /etc/edb/efm-4.0

cp efm.properties.in efm.properties

cp efm.nodes.in efm.nodes

chown efm:efm efm.properties

chown efm:efm efm.nodes
```

Step 2: Create an Encrypted Password

Create the encrypted password needed for the properties file:

```
/usr/edb/efm-4.0/bin/efm encrypt efm
```

Follow the onscreen instructions to produce the encrypted version of your database password.

Step 3: Update the efm.properties File

The `<cluster_name>.properties` file (efm.properties file in this example) contains parameters that specify connection properties and behaviors for your Failover Manager cluster. Modifications to property settings are applied when Failover Manager starts.

The properties mentioned in this tutorial are the minimal properties required to configure a Failover Manager cluster. If you are configuring a production system, please review the *EDB Failover Manager Guide* for detailed information about Failover Manager options.

Provide values for the following properties on all cluster nodes:

Property	Description
`db.user`	The name of the database user.
`db.password.encrypted`	The encrypted password of the database user.
`db.port`	The port monitored by the database.
`db.database`	The name of the database.
`db.service.owner`	The owner of the `data` directory (usually `postgres` or `enterprisedb`). Required
`db.service.name`	The name of the database service (used to restart the server). Required only if the databas
`db.bin`	The path to the `bin` directory (used for calls to `pg_ctl`).
`db.recovery.dir`	The `data` directory in which EFM will find or create the `recovery.conf` file or the `s`
`user.email`	An email address at which to receive email notifications (notification text is also in the ager
`bind.address`	The local address of the node and the port to use for EFM. The format is: `bind.address`
`is.witness`	`true` on a witness node and `false` if it is a primary or standby.
`ping.server.ip`	If you are running on a network without Internet access, set `ping.server.ip` to an add
`auto.allow.hosts`	On a test cluster, set to `true` to simplify startup; for production usage, consult the user's
`stable.nodes.file`	On a test cluster, set to `true` to simplify startup; for production usage, consult the user's

Step 4: Update the efm.nodes File

The `<cluster_name>.nodes` file (efm.nodes file in this example) is read at startup to tell an agent how to find the rest of the cluster or, in the case of the first node started, can be used to simplify authorization of subsequent nodes. Add the addresses and ports of each node in the cluster to this file. One node will act as the membership coordinator; the list should include at least the membership coordinator's address. For example:

```
1.2.3.4:7800
1.2.3.5:7800
1.2.3.6:7800
```

Please note that the Failover Manager agent will not verify the content of the `efm.nodes` file; the agent expects that some of the addresses in the file cannot be reached (e.g. that another agent hasn't been started yet).

Step 5: Configure the Other Nodes

Copy the `efm.properties` and `efm.nodes` files to the `/etc/edb/efm-4.0` directory on the other nodes in your sample cluster. After copying the files, change the file ownership so the files are owned by `efm:efm` . The `efm.properties` file can be the same on every node, except for the following properties:

- Modify the `bind.address` property to use the node's local address.
- Set `is.witness` to `true` if the node is a witness node. If the node is a witness node, the properties relating to a local database installation will be ignored.

Step 6: Start the EFM Cluster

On any node, start the Failover Manager agent. The agent is named `edb-efm-4.0` ; you can use your platform-specific service command to control the service. For example, on a CentOS/RHEL 7.x or CentOS/RHEL 8.x host use the command:

```
systemctl start edb-efm-4.0
```

On a a CentOS or RHEL 6.x host use the command:

```
service edb-efm-4.0 start
```

After the agent starts, run the following command to see the status of the single-node cluster. You should see the addresses of the other nodes in the `Allowed node host` list.

```
/usr/edb/efm-4.0/bin/efm cluster-status efm
```

Start the agent on the other nodes. Run the `efm cluster-status efm` command on any node to see the cluster status.

If any agent fails to start, see the startup log for information about what went wrong:

```
cat /var/log/efm-4.0/startup-efm.log
```

Performing a Switchover

If the cluster status output shows that the primary and standby(s) are in sync, you can perform a switchover with the following command:

```
/usr/edb/efm-4.0/bin/efm promote efm -switchover
```

The command will promote a standby and reconfigure the primary database as a new standby in the cluster. To switch back, run the command again.

For quick access to online help, you can invoke the following command:

```
/usr/edb/efm-4.0/bin/efm --help
```

3.0 EDB Failover Manager

EDB Failover Manager

EDB Postgres (EFM) is a high-availability module from EnterpriseDB that enables a Postgres primary node to automatically failover to a Standby node in the event of a software or hardware failure on the primary.

This guide provides information about installing, configuring and using . For information about the platforms and versions supported by , visit the EnterpriseDB website at:

https://www.enterprisedb.com/services-support/edb-supported-products-and-platforms#efm

This document uses Postgres to mean either the PostgreSQL or EDB Postgres Advanced Server database.

3.1 What's New

The following changes have been made to EDB Postgres to create version 4.0:

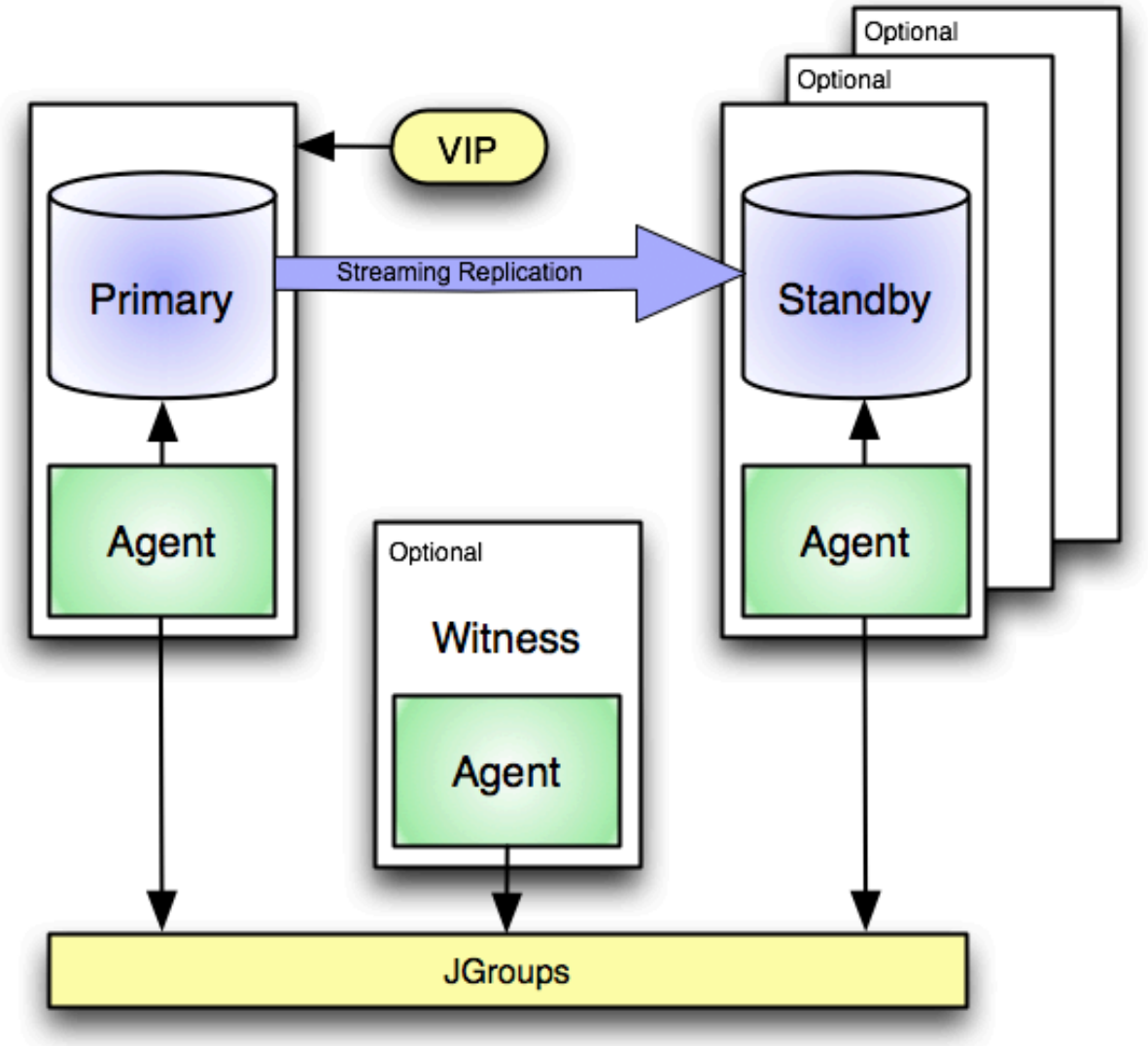
- Encryption for database password has been improved. Encryption has also been enabled for communication between the agents.
- Standby servers are no longer stopped while selecting the new primary. This enhancement significantly speeds up the promotion process.
- To be consistent with community naming guidelines, the term `Master` has been replaced with `Primary` in the Failover Manager product and documentation. The `upgrade-conf` tool will handle the task of renaming the impacted properties post-upgrade. The load balancer scripts such as `script.load.balancer.attach` , `script.load.balancer.detach` will now accept character `p` instead of character `m` as an argument.
- Support has been added to delay the restart of standbys after a promotion. You can increase the availability by staggering the restart of standbys.
- A Primary agent now attempts to resume health monitoring in a situation where the agent can not reach its local database but other agents can.

3.2.0 Failover Manager Overview

An EDB Postgres (EFM) cluster is comprised of Failover Manager processes that reside on the following hosts on a network:

- A Primary node - The Primary node is the primary database server that is servicing database clients.
- One or more Standby nodes - A Standby node is a streaming replication server associated with the Primary node.
- A Witness node - The Witness node confirms assertions of either the Primary or a Standby in a failover scenario. A cluster does not need a dedicated witness node if the cluster contains three or more nodes. If you do not have a third cluster member that is a database host, you can add a dedicated Witness node. A cluster may include more than one witness node.

Traditionally, a *cluster* is a single instance of Postgres managing multiple databases. In this document, the term cluster refers to a cluster. A cluster consists of a Primary agent, one or more Standby agents, and an optional Witness agent that reside on servers in a cloud or on a traditional network and communicate using the JGroups toolkit.



When a non-witness agent starts, it connects to the local database and checks the state of the database:

- If the agent cannot reach the database, it will start in idle mode.
- If it finds that the database is in recovery, the agent assumes the role of standby;
- If the database is not in recovery, the agent assumes the role of primary.

In the event of a failover, attempts to ensure that the promoted standby is the most up-to-date standby in the

cluster; please note that data loss is possible if the standby node is not in sync with the primary node.

JGroups provides technology that allows to create clusters whose member nodes can communicate with each other and detect node failures.

The figure shown above illustrates a cluster that employs a virtual IP address. You can use a load balancer in place of a `virtual IP address <using_vip_addresses>` if you provide your own `script <cluster_properties>` to re-configure the load balancer in the event of a failure.

3.2.1 Prerequisites

Before configuring a cluster, you must satisfy the prerequisites described below.

Install Java 1.8 (or later)

Before using , you must first install Java (version 1.8 or later). is tested with OpenJDK, and we strongly recommend installing that version of Java. Installation instructions for Java are platform specific.

Provide an SMTP Server

You can receive notifications from as specified by a user-defined notification script, by email, or both.

- If you are using email notifications, an SMTP server must be running on each node of the scenario.
- If you provide a value in the script.notification property, you can leave the user.email field blank; an SMTP server is not required.

If an event occurs, invokes the script (if provided), and sends a notification email to any email addresses specified in the user.email parameter of the cluster properties file. For more information about using an SMTP server, visit:

https://access.redhat.com/site/documentation

Configure Streaming Replication

requires that PostgreSQL streaming replication be configured between the Primary node and the Standby node or nodes. does not support other types of replication.

On database versions 11 (or prior), unless specified with the `-sourcenode` option, a `recovery.conf` file is copied from a random standby node to the stopped primary during switchover. You should ensure that the paths within the `recovery.conf` file on your standby nodes are consistent before performing a switchover. For more information about the `-sourcenode` option, please see Promoting a Failover Manager Node.

On database version 12, the `primary_conninfo` and `restore_command` properties are copied to the stopped primary during switchover (unless otherwise specified with the `-sourcenode` option.

Modify the pg_hba.conf File

You must modify the `pg_hba.conf` file on the Primary and Standby nodes, adding entries that allow communication between the all of the nodes in the cluster. The following example demonstrates entries that might be made to the pg_hba.conf file on the Primary node:

```
# access for itself
host fmdb efm 127.0.0.1/32 md5
# access for standby
host fmdb efm 192.168.27.1/32 md5
# access for witness
host fmdb efm 192.168.27.34/32 md5
```

Where:

`efm` specifies the name of a valid database user.

`fmdb` specifies the name of a database to which the efm user may connect.

By default, the `pg_hba.conf` file resides in the `data` directory, under your Postgres installation. After modifying the `pg_hba.conf` file, you must reload the configuration file on each node for the changes to take effect. You can use the following command:

```
# systemctl reload edb-as-x
```

Where `x` specifies the Postgres version.

Using Autostart for the Database Servers

If a Primary node reboots, may detect the database is down on the Primary node and promote a Standby node to the role of Primary. If this happens, the agent on the (rebooted) Primary node will not get a chance to write the `recovery.conf` file; the `recovery.conf` file prevents the database server from starting. If this happens, the rebooted Primary node will return to the cluster as a second Primary node.

To prevent this, start the agent before starting the database server. The agent will start in idle mode, and check to see if there is already a primary in the cluster. If there is a primary node, the agent will verify that a `recovery.conf` or `standby.signal` file exists, and the database will not start as a second primary.

Ensure Communication Through Firewalls

If a Linux firewall (i.e. iptables) is enabled on the host of a Failover Manager node, you may need to add rules to the firewall configuration that allow tcp communication between the processes in the cluster. For example:

```
# iptables -I INPUT -p tcp --dport 7800:7810 -j ACCEPT
/sbin/service iptables save
```

The command shown above opens a small range of ports (7800 through 7810). will connect via the port that corresponds to the port specified in the cluster properties file.

Ensure that the Database user has Sufficient Privileges

The database user specified by the `db.user` property in the `efm.properties` file must have sufficient privileges to invoke the following functions on behalf of :

`pg_current_wal_lsn()`

`pg_last_wal_replay_lsn()`

`pg_wal_replay_resume()`

`pg_wal_replay_pause()`

`pg_reload_conf()`

The `pg_reload_conf()` privilege is required only if you have the `reconfigure.num.sync` or `reconfigure.sync.primary` property set to `true` .

For detailed information about each of these functions, please see the PostgreSQL core documentation.

The user must also have permissions to read the values of configuration variables; a database superuser can use the PostgreSQL `GRANT` command to provide the permissions needed:

```
GRANT pg_read_all_settings TO user_name;
```

For more information about `pg_read_all_settings` , please see the PostgreSQL core documentation.

3.3 Installing Failover Manager

To request credentials that allow you to access an EnterpriseDB repository, visit the EDB website at:

https://info.enterprisedb.com/rs/069-ALB-3images/Repository%20Access%2004-09-2019.pdf

RedHat, CentOS, or OEL Host

After receiving your credentials, you must create the EnterpriseDB repository configuration file on each node of the cluster, and then modify the file to enable access. The following steps provide detailed information about accessing the EnterpriseDB repository; the steps must be performed on each node of the cluster:

1. To create the repository configuration file, assume superuser privileges, and invoke the following command:

- On RHEL or CentOS 7:

```
yum -y install https://yum.enterprisedb.com/edb-repo-rpms/edb-repo-latest.noarch.rpm
```

- On RHEL or CentOS 8:

```
dnf -y install https://yum.enterprisedb.com/edb-repo-rpms/edb-repo-latest.noarch.rpm
```

The repository configuration file is named `edb.repo`. The file resides in `/etc/yum.repos.d`.

1. After creating the `edb.repo` file, use your choice of editor to ensure that the value of the enabled parameter is `1`, and replace the `username` and `password` placeholders in the `baseurl` specification with the name and password of a registered EnterpriseDB user.

```
[edb]
name=EnterpriseDB RPMs $releasever - $basearch
baseurl=https://<username>:<password>@yum.enterprisedb.com/edb/redhat/rhel-
$releasever-$basearch
enabled=1
gpgcheck=1
gpgkey=file:///etc/pki/rpm-gpg/ENTERPRISEDB-GPG-KEY
```

1. After saving your changes to the configuration file, install the EPEL repository:

```
dnf -y install epel-release
```

1. If you are using RHEL or CentOS 8.x, you must enable the PowerTools repository:

```
dnf config-manager --set-enabled PowerTools``
```

1. Now you can use the following command to install Failover Manager:

- On RHEL or CentOS 7:

```
yum install edb-efm40
```

- On RHEL or CentOS 8:

```
dnf install edb-efm40
```

When you install an RPM package that is signed by a source that is not recognized by your system, yum may ask for your permission to import the key to your local server. If prompted, and you are satisfied that the packages come from a trustworthy source, enter `y`, and press `Return` to continue.

During the installation, yum may encounter a dependency that it cannot resolve. If it does, it will provide a list of the required dependencies that you must manually resolve.

must be installed by root. During the installation process, the installer will also create a user named `efm` that has sufficient privileges to invoke scripts that control the Failover Manager service for clusters owned by `enterprisedb` or `postgres`.

If you are using to monitor a cluster owned by a user other than `enterprisedb` or `postgres`, see `Extending Failover Manager Permissions <extending_efm_permissions>`.

After installing on each node of the cluster, you must:

1. Modify the `cluster properties file <cluster_properties>` on each node.
2. Modify the `cluster members file <cluster_members>` on each node.
3. If applicable, configure and test virtual IP address settings and any scripts that are identified in the cluster properties file.

4. Start the agent on each node of the cluster. For more information about controlling the service, see Section 5.

Installation Locations

components are installed in the following locations:

Component	Location
Executables	/usr/edb/efm-/bin
Libraries	/usr/edb/efm-/lib
Cluster configuration files	/etc/edb/efm-
Logs	/var/log/efm-
Lock files	/var/lock/efm-
Log rotation file	/etc/logrotate.d/efm-
sudo configuration file	/etc/sudoers.d/efm-40
Binary to access VIP without sudo	/usr/edb/efm-/bin/secure

Debian or Ubuntu Host

To install , you must have credentials that allow access to the EnterpriseDB repository. To request credentials for the repository, visit the EnterpriseDB website at:

https://www.enterprisedb.com/repository-access-request

Follow the links in the EDB table to request credentials.

The following steps will walk you through using the EnterpriseDB apt repository to install . When using the commands, replace the *username* and *password* with the credentials provided by EnterpriseDB.

1. Assume superuser privileges:

```
sudo su -
```

1. Configure the EnterpriseDB apt repository:

```
sh -c 'echo “deb https://<username>:<password>@apt.enterprisedb.com/$(lsb_release -cs)-edb/ $(lsb_release -cs) main” > /etc/apt/sources.list.d/edb-$(lsb_release -cs).list'
```

1. Add support to your system for secure APT repositories:

```
apt-get install apt-transport-https
```

1. Add the EDB signing key:

```
wget -q -O - https://<username>:<password>@apt.enterprisedb.com/edb-deb.gpg.key | apt-key add -
```

1. Update the repository meta data:

```
apt-get update
```

1. Install :

```
apt-get -y install edb-efm40
```

SLES Host

To install , you must have credentials that allow access to the EnterpriseDB repository. To request credentials for the repository, visit the EnterpriseDB website at:

https://www.enterprisedb.com/repository-access-request

You can use the zypper package manager to install a agent on an SLES 12 host. zypper will attempt to satisfy package dependencies as it installs a package, but requires access to specific repositories that are not hosted at EnterpriseDB.

1. You must assume superuser privileges and stop any firewalls before installing . Then, use the following commands to add EnterpriseDB repositories to your system:

```
zypper addrepo https://zypp.enterprisedb.com/suse/edb-sles.repo
```

2. The commands create the repository configuration files in the `/etc/zypp/repos.d` directory. Then, use the following command to refresh the metadata on your SLES host to include the EnterpriseDB repository:

```
zypper refresh
```

When prompted, provide credentials for the repository, and specify a to always trust the provided key, and update the metadata to include the EnterpriseDB repository.

3. You must also add SUSEConnect and the SUSE Package Hub extension to the SLES host, and register the host with SUSE, allowing access to SUSE repositories. Use the commands:

```
zypper install SUSEConnect
SUSEConnect -r <registration_number> -e <user_id>
SUSEConnect -p PackageHub/12.4/x86_64
SUSEConnect -p sle-sdk/12.4/x86_64
```

1. Install SUSEConnect to register the host with SUSE, allowing access to SUSE repositories:

```
zypper addrepo https://download.opensuse.org/repositories/Apache:/Modules/SLE_12_SP4/Apache:Mod
```

1. Install OpenJDK (version 1.8) for Java based components:

```
zypper -n install java-1_8_0-openjdk
```

6. Now you can use the zypper utility to install a agent:

```
zypper -n install edb-efm40
```

For detailed information about registering a SUSE host, visit:

https://www.suse.com/support/kb/doc/?id=7016626

3.4.0 Configuring Failover Manager

Configurable properties are specified in two user-modifiable files:

- `efm.properties <cluster_properties>`
- `efm.nodes <cluster_members>`

3.4.1.0 The Cluster Properties File

Each node in a cluster has a properties file (by default, named `efm.properties`) that contains the properties of the individual node on which it resides. The installer creates a file template for the properties file named `efm.properties.in` in the `/etc/edb/efm-4.0` directory.

After completing the installation, you must make a working copy of the template before modifying the file contents:

cp /etc/edb/efm-/efm.properties.in /etc/edb/efm-/efm.properties

After copying the template file, change the owner of the file to `efm` :

```
# chown efm:efm efm.properties
```

Please note: : By default, expects the cluster properties file to be named `efm.properties` . If you name the properties file something other than `efm.properties` , you must modify the service script or unit file to instruct to use a different name.

After creating the cluster properties file, add (or modify) configuration parameter values as required. For detailed information about each property, see Specifying Cluster Properties.

The property files are owned by `root` . The service script expects to find the files in the `/etc/edb/efm-4.0 directory` . If you move the property file to another location, you must create a symbolic link that specifies the new location.

Please note: : All user scripts referenced in the properties file will be invoked as the user.

Specifying Cluster Properties

You can use the properties listed in the cluster properties file to specify connection properties and behaviors for your cluster. Modifications to property settings will be applied when starts. If you modify a property value you must restart to apply the changes.

Property values are case-sensitive. Note that while Postgres uses quoted strings in parameter values, does not allow quoted strings in property values. For example, while you might specify an IP address in a Postgres configuration parameter as:

```
listen_addresses='192.168.2.47'
```

requires that the value *not* be enclosed in quotes:

```
bind.address=192.168.2.54:7800
```

Use the properties in the `efm.properties` file to specify connection, administrative, and operational details for .

Legends: In the following table:

- `A` : Required on Agent node
- `W` : Required on Witness node
- `Y` : Yes

Cluster Properties

Use the following properties to specify connection details for the cluster:

```
# The value for the password property should be the output from
# 'efm encrypt' -- do not include a cleartext password here. To
# prevent accidental sharing of passwords among clusters, the
# cluster name is incorporated into the encrypted password. If
# you change the cluster name (the name of this file), you must
# encrypt the password again with the new name.
# The db.port property must be the same for all nodes.
db.user=
db.password.encrypted=
db.port=
db.database=
```

The `db.user` specified must have sufficient privileges to invoke selected PostgreSQL commands on behalf of . For more information, please see `Prerequisites <prerequisites>` .

For information about encrypting the password for the database user, see `Encrypting Your Database Password <enc` .

Use the `db.service.owner` property to specify the name of the operating system user that owns the cluster that is being managed by Failover Manager. This property is not required on a dedicated witness node.

```
# This property tells EFM which OS user owns the $PGDATA dir for
# the 'db.database'. By default, the owner is either 'postgres'
# for PostgreSQL or 'enterprisedb' for EDB Postgres Advanced
# Server. However, if you have configured your db to run as a
# different user, you will need to copy the /etc/sudoers.d/efm-XX
# conf file to grant the necessary permissions to your db owner.
#
# This username must have write permission to the
# 'db.data.dir' specified below.
db.service.owner=
```

Specify the name of the database service in the `db.service.name` property if you use the service or systemctl command when starting or stopping the service.

```
# Specify the proper service name in order to use service commands
# rather than pg_ctl to start/stop/restart a database. For example, if
# this property is set, then 'service <name> restart' or 'systemctl
# restart <name>'
# (depending on OS version) will be used to restart the database rather
# than pg_ctl.
# This property is required if running the database as a service.
db.service.name=
```

You should use the same service control mechanism (pg_ctl, service, or systemctl) each time you start or stop the database service. If you use the `pg_ctl` program to control the service, specify the location of the `pg_ctl` program in the `db.bin` property.

```
# Specify the directory containing the pg_controldata/pg_ctl commands,
# for example:
# /usr/edb/as11/bin. Unless the db.service.name property is used, the
# pg_ctl command is used to start/stop/restart databases as needed
# after a failover or switchover. This property is required.
db.bin=
```

Use the `db.data.dir` property to specify the location to which a recovery file will be written on the Primary node of the cluster during promotion. This property is required on primary and standby nodes; it is not required on a dedicated witness node.

```
# For database version 12 and up, this is the directory where a
# standby.signal file will exist for a standby node. For previous
# versions, this is the location of the db recovery.conf file on
# the node.
# After a failover, the recovery.conf files on remaining standbys are
# changed to point to the new primary db (a copy of the original is made
# first). On a primary node, a recovery.conf file will be written during
# failover and promotion to ensure that the primary node can not be
# restarted as the primary database.
# This corresponds to database environment variable PGDATA and should
# be same as the output of query 'show data_directory;' on respective
# database.
db.data.dir=
```

Use the `db.config.dir` property to specify the location of database configuration files if they are not stored in the same directory as the `recovery.conf` or `standby.signal` file. This should be the value specified by the `config_file` parameter directory of your Advanced Server or PostgreSQL installation. This value will be used as the location of the Postgres `data` directory when stopping, starting, or restarting the database.

```
# Specify the location of database configuration files if they are
# not contained in the same location as the recovery.conf or
# standby.signal file. This is most likely the case for Debian
# installations. The location specified will be used as the -D value
# (the location of the data directory for the cluster) when calling
# pg_ctl to start or stop the database. If this property is blank,
# the db.data.dir location specified by the db.data.dir property will
# be used. This corresponds to the output of query 'show config_file;'
# on respective database.
db.config.dir=
```

For more information about database configuration files, visit the PostgreSQL website.

Use the `jdbc.sslmode` property to instruct to use SSL connections; by default, SSL is disabled.

```
# Use the jdbc.sslmode property to enable ssl for EFM
# connections. Setting this property to anything but 'disable'
```

```
# will force the agents to use 'ssl=true' for all JDBC database
# connections (to both local and remote databases).
# Valid values are:
#
# disable - Do not use ssl for connections.
# verify-ca - EFM will perform CA verification before allowing
# the certificate.
# require - Verification will not be performed on the server
# certificate.
jdbc.sslmode=disable
```

Note

If you set the value of `jdbc.sslmode` to `verify-ca` and you want to use Java trust store for certificate validation, you need to set the following value:

```
jdbc.properties=sslfactory=org.postgresql.ssl.DefaultJavaSSLFactory
```

For information about configuring and using SSL, please see:

https://www.postgresql.org/docs/current/static/ssl-tcp.html

and

https://jdbc.postgresql.org/documentation/head/ssl.html

Use the `user.email` property to specify an email address (or multiple email addresses) that will receive any notifications sent by Failover Manager.

```
# Email address(es) for notifications. The value of this
# property must be the same across all agents. Multiple email
# addresses must be separated by space. If using a notification
# script instead, this property can be left blank.
user.email=
```

The `from.email` property specifies the value that will be used as the sender's address on any email notifications from . You can:

- leave `from.email` blank to use the default value (`efm@localhost`).
- specify a custom value for the email address.
- specify a custom email address, using the `%h` placeholder to represent the name of the node host (e.g., example@%h). The placeholder will be replaced with the name of the host as returned by the Linux hostname utility.

For more information about notifications, see `Notifications <notifications>` .

```
# Use the from.email property to specify the from email address that
# will be used for email notifications. Use the %h placeholder to
# represent the name of the node host (e.g. example@%h). The
# placeholder will be replaced with the name of the host as returned
# by the hostname command.
# Leave blank to use the default, efm@localhost.
from.email=
```

Use the `notification.level` property to specify the minimum severity level at which will send user notifications or when a notification script is called. For a complete list of notifications, please see `Notifications <notifications>` .

```
# Minimum severity level of notifications that will be sent by
# the agent. The minimum level also applies to the notification
# script (below). Valid values are INFO, WARNING, and SEVERE.
# A list of notifications is grouped by severity in the user's
# guide.
notification.level=INFO
```

Use the `notification.text.prefix` property to specify the text to be added to the beginning of every notification.

```
# Text to add to the beginning of every notification. This could
# be used to help identify what the cluster is used for, the role
# of this node, etc. To use multiple lines, add a backslash \ to
# the end of a line of text. To include a newline use \n.
# Example:
# notification.text.prefix=Development cluster for Example dept.\n\
# Used by Dev and QA \
# See Example group for questions.
notification.text.prefix=
```

Use the `script.notification` property to specify the path to a user-supplied script that acts as a notification service; the script will be passed a message subject and a message body. The script will be invoked each time generates a user notification.

```
# Absolute path to script run for user notifications.
#
# This is an optional user-supplied script that can be used for
# notifications instead of email. This is required if not using
# email notifications. Either/both can be used. The script will
# be passed two parameters: the message subject and the message
# body.
script.notification=
```

The `bind.address` property specifies the IP address and port number of the agent on the current node of the cluster.

```
# This property specifies the ip address and port that jgroups
# will bind to on this node. The value is of the form
# <ip>:<port>.
# Note that the port specified here is used for communicating
# with other nodes, and is not the same as the admin.port below,
# used only to communicate with the local agent to send control
# signals.
# For example, <provide_your_ip_address_here>:7800
bind.address=
```

Use the `external.address` property to specify the IP address or hostname that should be used for communication with all other Failover Manager agents in a NAT environment.

```
# This is the ip address/hostname to be used for communication with all
# other Failover Manager agents. All traffic towards this address
# should be routed by the network to the bind.address of the node.
# The value is in the ip/hostname format only. This address will be
# used in scenarios where nodes are on different networks and broadcast
# an IP address other than the bind.address to the external world.
external.address=
```

Use the `admin.port` property to specify a port on which listens for administrative commands.

```
# This property controls the port binding of the administration
# server which is used for some commands (ie cluster-status). The
# default is 7809; you can modify this value if the port is
# already in use.
admin.port=7809
```

Set the `is.witness` property to true to indicate that the current node is a witness node. If is.witness is true, the local agent will not check to see if a local database is running.

```
# Specifies whether or not this is a witness node. Witness nodes
# do not have local databases running.
is.witness=
```

The Postgres `pg_is_in_recovery()` function is a boolean function that reports the recovery state of a database. The function returns `true` if the database is in recovery, or false if the database is not in recovery. When an agent starts, it connects to the local database and invokes the `pg_is_in_recovery()` function.

If the server responds true, the agent assumes the role of standby; if the server responds false, the agent assumes the role of primary. If there is no local database, the agent will assume an idle state.

Note

If `is.witness` is `true`, will not check the recovery state.

The following properties specify properties that apply to the local server:

- The `local.period` property specifies how many seconds between attempts to contact the database server.
- The `local.timeout` property specifies how long an agent will wait for a positive response from the local database server.
- The `local.timeout.final` property specifies how long an agent will wait after the final attempt to contact the database server on the current node. If a response is not received from the database within the number of seconds specified by the local.timeout.final property, the database is assumed to have failed.

For example, given the default values of these properties, a check of the local database happens once every 10 seconds. If an attempt to contact the local database does not come back positive within 60 seconds, makes a final attempt to contact the database. If a response is not received within 10 seconds, declares database failure and notifies the administrator listed in the user.email property. These properties are not required on a dedicated witness node.

```
# These properties apply to the connection(s) EFM uses to monitor
# the local database. Every 'local.period' seconds, a database
# check is made in a background thread. If the main monitoring
# thread does not see that any checks were successful in
# 'local.timeout' seconds, then the main thread makes a final
# check with a timeout value specified by the
# 'local.timeout.final' value. All values are in seconds.
# Whether EFM uses single or multiple connections for database
# checks is controlled by the 'db.reuse.connection.count'
# property.
local.period=10
local.timeout=60
local.timeout.final=10
```

If necessary, you should modify these values to suit your business model.

Use the `remote.timeout` property to specify how many seconds an agent waits for a response from a remote database server (i.e., how long a standby agent waits to verify that the primary database is actually down before performing failover).

```
# Timeout for a call to check if a remote database is responsive.
# For example, this is how long a standby would wait for a
# DB ping request from itself and the witness to the primary DB
# before performing failover.
remote.timeout=10
```

Use the `node.timeout` property to specify the number of seconds that an agent will wait for a response from a node when determining if a node has failed. The node.timeout property value specifies a timeout value for agent-to-agent communication; other timeout properties in the cluster properties file specify values for agent-to-database communication.

```
# The total amount of time in seconds to wait before determining
# that a node has failed or been disconnected from this node.
#
# The value of this property must be the same across all agents.
node.timeout=50
```

Use the `encrypt.agent.messages` property to specify if the messages sent between agents should be encrypted.

```
# Set to true to encrypt messages that are sent between agents.
# This property must be the same on all agents or else the agents
# will not be able to connect.
```

```
encrypt.agent.messages=false
```

Use the `stop.isolated.primary` property to instruct to shut down the database if a primary agent detects that it is isolated. When true (the default), will stop the database before invoking the script specified in the `script.primary.isolated` property.

```
# Shut down the database after a primary agent detects that it has
# been isolated from the majority of the efm cluster. If set to
# true, efm will stop the database before running the
# 'script.primary.isolated' script, if a script is specified.
stop.isolated.primary=true
```

Use the `stop.failed.primary` property to instruct to attempt to shut down a primary database if it can not reach the database. If `true` , will run the script specified in the `script.db.failure` property after attempting to shut down the database.

```
# Attempt to shut down a failed primary database after EFM can no
# longer connect to it. This can be used for added safety in the
# case a failover is caused by a failure of the network on the
# primary node.
# If specified, a 'script.db.failure' script is run after this attempt.
stop.failed.primary=true
```

Use the `primary.shutdown.as.failure` parameter to indicate that any shutdown of the agent on the primary node should be treated as a failure. If this parameter is set to `true` and the primary agent stops (for any reason), the cluster will attempt to confirm if the database on the primary node is running:

- If the database is reached, a notification will be sent informing you of the agent status.
- If the database is not reached, a failover will occur.

```
# Treat a primary agent shutdown as a failure. This can be set to
# true to treat a primary agent shutdown as a failure situation,
# e.g. during the shutdown of a node, accidental or otherwise.
# Caution should be used when using this feature, as it could
# cause an unwanted promotion in the case of performing primary
# database maintenance.
# Please see the user's guide for more information.
primary.shutdown.as.failure=false
```

The `primary.shutdown.as.failure` property is meant to catch user error, rather than failures, such as the accidental shutdown of a primary node. The proper shutdown of a node can appear to the rest of the cluster like a user has stopped the primary agent (for example to perform maintenance on the primary database). If you set the `primary.shutdown.as.failure` property to `true` , care must be taken when performing maintenance.

To perform maintenance on the primary database when `primary.shutdown.as.failure` is `true` , you should stop the primary agent and wait to receive a notification that the primary agent has failed but the database is still running. Then it is safe to stop the primary database. Alternatively, you can use the `efm stop-cluster` command to stop all of the agents without failure checks being performed.

Use the `update.physical.slots.period` property to define the slot advance frequency for database version 12 and above. When `update.physical.slots.period` is set to a non-zero value, the primary agent will read the current `restart_lsn` of the physical replication slots after every `update.physical.slots.period` seconds, and send this information with its `pg_current_wal_lsn` and `primary_slot_name` (If it is set in the postgresql.conf file) to the standbys. If physical slots do not already exist, setting this parameter to a non-zero value will create the slots and then update the `restart_lsn parameter` for these slots. A non-promotable standby will not create new slots but will update them if they exist.

```
# Period in seconds between having the primary agent update promotable
# standbys with physical replication slot information so that
```

```
# the cluster will continue to use replication slots after a failover.
# Set to zero to turn off.
update.physical.slots.period=0
```

Use the `ping.server.ip` property to specify the IP address of a server that can use to confirm that network connectivity is not a problem.

```
# This is the address of a well-known server that EFM can ping
# in an effort to determine network reachability issues. It
# might be the IP address of a nameserver within your corporate
# firewall or another server that *should* always be reachable
# via a 'ping' command from each of the EFM nodes.
#
# There are many reasons why this node might not be considered
# reachable: firewalls might be blocking the request, ICMP might
# be filtered out, etc.
#
# Do not use the IP address of any node in the EFM cluster
# (primary, standby, or witness) because this ping server is meant
# to provide an additional layer of information should the EFM
# nodes lose sight of each other.
#
# The installation default is Google's DNS server.
ping.server.ip=8.8.8.8
```

Use the `ping.server.command` property to specify the command used to test network connectivity.

```
# This command will be used to test the reachability of certain
# nodes.
#
# Do not include an IP address or hostname on the end of
# this command - it will be added dynamically at runtime with the
# values contained in 'virtual.ip' and 'ping.server.ip'.
#
# Make sure this command returns reasonably quickly - test it
# from a shell command line first to make sure it works properly.
ping.server.command=/bin/ping -q -c3 -w5
```

Use the `auto.allow.hosts` property to instruct the server to use the addresses specified in the .nodes file of the first node started to update the allowed host list. Enabling this property (setting auto.allow.hosts to true) can simplify cluster start-up.

```
# Have the first node started automatically add the addresses
# from its .nodes file to the allowed host list. This will make
# it faster to start the cluster when the initial set of hosts
# is already known.
auto.allow.hosts=false
```

Use the `stable.nodes.file` property to instruct the server to not rewrite the nodes file when a node joins or leaves the cluster. This property is most useful in clusters with unchanging IP addresses.

```
# When set to true, EFM will not rewrite the .nodes file whenever
# new nodes join or leave the cluster. This can help starting a
# cluster in the cases where it is expected for member addresses
# to be mostly static, and combined with 'auto.allow.hosts' makes
# startup easier when learning failover manager.
stable.nodes.file=false
```

The `db.reuse.connection.count` property allows the administrator to specify the number of times reuses the same database connection to check the database health. The default value is 0, indicating that will create a fresh connection each time. This property is not required on a dedicated witness node.

```
# This property controls how many times a database connection is
# reused before creating a new one. If set to zero, a new
# connection will be created every time an agent pings its local
```

```
# database.
db.reuse.connection.count=0
```

The `auto.failover` property enables automatic failover. By default, auto.failover is set to true.

```
# Whether or not failover will happen automatically when the primary
# fails. Set to false if you want to receive the failover notifications
# but not have EFM actually perform the failover steps.
# The value of this property must be the same across all agents.
auto.failover=true
```

Use the `auto.reconfigure` property to instruct to enable or disable automatic reconfiguration of remaining Standby servers after the primary standby is promoted to Primary. Set the property to `true` to enable automatic reconfiguration (the default) or `false` to disable automatic reconfiguration. This property is not required on a dedicated witness node. If you are using Advanced Server or PostgreSQL version 11 or earlier, the `recovery.conf` file will be backed up during the reconfiguration process.

```
# After a standby is promoted, Failover Manager will attempt to
# update the remaining standbys to use the new primary. For database
# versions before 12, Failover Manager will back up recovery.conf.
# Then it will change the host parameter of the primary_conninfo entry
# in recovery.conf or postgresql.auto.conf, and restart the database.
# The restart command is contained in either the efm_db_functions or
# efm_root_functions file; default when not running db as an os
# service is: "pg_ctl restart -m fast -w -t <timeout> -D <directory>"
# where the timeout is the local.timeout property value and the
# directory is specified by db.data.dir. To turn off
# automatic reconfiguration, set this property to false.
auto.reconfigure=true
```

Please note: : `primary_conninfo` is a space-delimited list of keyword=value pairs.

Use the `promotable` property to indicate that a node should not be promoted. The `promotable` property is ignored when a primary agent is started. This simplifies switching back to the original primary after a switchover or failover. To override the setting, use the efm set-priority command at runtime; for more information about the efm set-priority command, see `Using the efm Utility <using_efm_utility>` .

```
# A standby with this set to false will not be added to the
# failover priority list, and so will not be available for
# promotion. The property will be used whenever an agent starts
# as a standby or resumes as a standby after being idle. After
# startup/resume, the node can still be added or removed from the
# priority list with the 'efm set-priority' command. This
# property is required for all non-witness nodes.
promotable=true
```

If the same amount of data has been written to more than one standby node, and a failover occurs, the `use.replay.tiebreaker` value will determine how selects a replacement primary. Set the `use.replay.tiebreaker` property to `true` to instruct to failover to the node that will come out of recovery faster, as determined by the log sequence number. To ignore the log sequence number and promote a node based on user preference, set `use.replay.tiebreaker` to `false` .

```
# Use replay LSN value for tiebreaker when choosing a standby to
# promote before using failover priority. Set this property to true to
# consider replay location as more important than failover priority
# (as seen in cluster-status command) when choosing the "most ahead"
# standby to promote.
use.replay.tiebreaker=true
```

Use the `standby.restart.delay` property to specify the time in seconds that the standby should wait before it gets reconfigured (stopped/started) to follow the new primary after a promotion.

```
# Time in seconds for this standby to delay restarting to follow the
```

```
# primary after a promotion. This can be used to have standbys restart
# at different times to increase availability. Caution should be used
# when using this feature, as a delayed standby will not be following
# the new primary and care must be taken that the new primary retains
# enough WAL for the standby to follow it.
# Please see the user's guide for more information.
standby.restart.delay=0
```

You can use the `application.name` property to provide the name of an application that will be copied to the `primary_conninfo` parameter before restarting an old primary node as a standby.

```
# During a switchover, recovery settings are copied from a standby
# to the original primary. If the application.name property is set,
# Failover Manager will replace the application_name portion of the
# primary_conninfo entry with this property value before starting
# the original primary database as a standby. If this property is
# not set, Failover Manager will remove the parameter value
# from primary_conninfo.
application.name=
```

Please note: You should set the `application.name` property on the primary and any promotable standby; in the event of a failover/switchover, the primary node could potentially become a standby node again.

Use the `restore.command` property to instruct to update the `restore_command` when a new primary is promoted. `%h` represents the address of the new primary; will replace `%h` with the address of the new primary. `%f` and `%p` are placeholders used by the server. If the property is left blank, will not update the `restore_command` values on the standbys after a promotion.

See the PostgreSQL documentation for more information about using a restore_command.

```
# If the restore_command on a standby restores directly from the
# primary node, use this property to have Failover Manager change
# the command when a new primary is promoted.
#
# Use the %h placeholder to represent the address of the new primary.
# During promotion it will be replaced with the address of the new
# primary.
#
# If not specified, failover manager will not change the
# restore_command value, if any, on standby nodes.
#
# Example:
# restore.command=scp <db service owner>@%h:/var/lib/edb/as12/data/archive/%f %p
restore.command=
```

The database parameter `synchronous_standby_names` on the primary node specifies the names and count of the synchronous standby servers that will confirm receipt of data, to ensure that the primary nodes can accept write transactions. When `reconfigure.num.sync` property is set to true, will reduce the number of synchronous standby servers and reload the configuration of the primary node to reflect the current value.

```
# Reduce num_sync when the number of synchronous standbys drops
# below the value required by the primary database. If set to true,
# Failover Manager will reduce the number of standbys needed
# in the primary's synchronous_standby_names property and reload
# the primary configuration.
# Failover Manager will not reduce the number below 1, taking
# the primary out of synchronous replication, unless the
# reconfigure.sync.primary property is also set to true.
reconfigure.num.sync=false
```

Set the `reconfigure.sync.primary` property to `true` to take the primary database out of synchronous replication mode if the number of standby nodes drops below the level required. Set

`reconfigure.sync.primary` to `false` to send a notification if the standby count drops, but not interrupt synchronous replication.

```
# Take the primary database out of synchronous replication mode when
# needed. If set to true, Failover Manager will clear the
# synchronous_standby_names configuration parameter on the primary
# if the number of synchronous standbys drops below the required
# level for the primary to accept writes.
# If set to false, Failover Manager will detect the situation but
# will only send a notification if the standby count drops below the
# required level.
#
# CAUTION: TAKING THE PRIMARY DATABASE OUT OF SYNCHRONOUS MODE MEANS
# THERE MAY ONLY BE ONE COPY OF DATA. DO NOT MAKE THIS CHANGE UNLESS
# YOU ARE SURE THIS IS OK.
reconfigure.sync.primary=false
```

Use the `minimum.standbys` property to specify the minimum number of standby nodes that will be retained on a cluster; if the standby count drops to the specified minimum, a replica node will not be promoted in the event of a failure of the primary node.

```
# Instead of setting specific standbys as being unavailable for
# promotion, this property can be used to set a minimum number
# of standbys that will not be promoted. Set to one, for
# example, promotion will not happen if it will drop the number
# of standbys below this value. This property must be the same on
# each node.
minimum.standbys=0
```

Use the `recovery.check.period` property to specify the number of seconds that will wait before checks to see if a database is out of recovery.

```
# Time in seconds between checks to see if a promoting database
# is out of recovery.
recovery.check.period=2
```

Use the `restart.connection.timeout` property to specify the number of seconds that will attempt to connect to a newly reconfigured primary or standby node while the database on that node prepares to accept connections.

```
# Time in seconds to keep trying to connect to a database after a
# start or restart command returns successfully but the database
# is not ready to accept connections yet (a rare occurance). This
# applies to standby databases that are restarted when being
# reconfigured for a new primary, and to primary databases that
# are stopped and started as standbys during a switchover.
# This retry mechanism is unrelated to the auto.resume.period
# parameter.
restart.connection.timeout=60
```

Use the `auto.resume.period` property to specify the number of seconds (after a monitored database fails, and an agent has assumed an idle state, or when starting in IDLE mode) during which an agent will attempt to resume monitoring that database.

```
# Period in seconds for IDLE agents to try to resume monitoring
# after a database failure or when starting in IDLE mode. Set to
# 0 for agents to not try to resume (in which case the
# 'efm resume <cluster>' command is used after bringing a
# database back up).
auto.resume.period=0
```

provides support for clusters that use a virtual IP. If your cluster uses a virtual IP, provide the host name or IP address in the `virtual.ip` property; specify the corresponding prefix in the `virtual.ip.prefix` property. If `virtual.ip` is left blank, virtual IP support is disabled.

Use the `virtual.ip.interface` property to provide the network interface used by the VIP.

The specified virtual IP address is assigned only to the primary node of the cluster. If you specify `virtual.ip.single=true` , the same VIP address will be used on the new primary in the event of a failover. Specify a value of false to provide a unique IP address for each node of the cluster.

For information about using a virtual IP address, see `Using Failover Manager with Virtual IP Addresses <usin`
.

```
# These properties specify the IP and prefix length that will be
# remapped during failover. If you do not use a VIP as part of
# your failover solution, leave the virtual.ip property blank to
# disable Failover Manager support for VIP processing (assigning,
# releasing, testing reachability, etc).
#
# If you specify a VIP, the interface and prefix are required.
#
# If you specify a host name, it will be resolved to an IP address
# when acquiring or releasing the VIP. If the host name resolves
# to more than one IP address, there is no way to predict which
# address Failover Manager will use.
#
# By default, the virtual.ip and virtual.ip.prefix values must be
# the same across all agents. If you set virtual.ip.single to
# false, you can specify unique values for virtual.ip and
# virtual.ip.prefix on each node.
#
# If you are using an IPv4 address, the virtual.ip.interface value
# should not contain a secondary virtual ip id (do not include
# ":1", etc).
virtual.ip=
virtual.ip.interface=
virtual.ip.prefix=
virtual.ip.single=true
```

Please note: : If a primary agent is started and the node does not currently have the VIP, the EFM agent will acquire it. Stopping a primary agent does not drop the VIP from the node.

Set the `check.vip.before.promotion` property to false to indicate that will not check to see if a VIP is in use before assigning it to a a new primary in the event of a failure. Please note that this could result in multiple nodes broadcasting on the same VIP address; unless the primary node is isolated or can be shut down via another process, you should set this property to true.

```
# Whether to check if the VIP (when used) is still in use before
# promoting after a primary failure. Turning this off may allow
# the new primary to have the VIP even though another node is also
# broadcasting it. This should only be used in environments where
# it is known that the failed primary node will be isolated or
# shut down through other means.
check.vip.before.promotion=true
```

Use the following properties to provide paths to scripts that reconfigure your load balancer in the event of a switchover or primary failure scenario. The scripts will also be invoked in the event of a standby failure. If you are using these properties, they should be provided on every node of the cluster (primary, standby, and witness) to ensure that if a database node fails, another node will call the detach script with the failed node's address.

Provide a script name after the `script.load.balancer.attach` property to identify a script that will be invoked when a node should be attached to the load balancer. Use the `script.load.balancer.detach` property to specify the name of a script that will be invoked when a node should be detached from the load balancer. Include the `%h` placeholder to represent the IP address of the node that is being attached or removed from the cluster. Include the `%t` placeholder to instruct to include an p (for a primary node) or an s (for a standby node) in the string.

```
# Absolute path to load balancer scripts
# The attach script is called when a node should be attached to
# the load balancer, for example after a promotion. The detach
# script is called when a node should be removed, for example
# when a database has failed or is about to be stopped. Use %h to
# represent the IP/hostname of the node that is being
# attached/detached. Use %t to represent the type of node being
# attached or detached: the letter m will be passed in for primary nodes
#and the letter s for standby nodes.
#
# Example:
# script.load.balancer.attach=/somepath/attachscript %h %t
script.load.balancer.attach=
script.load.balancer.detach=
```

`script.fence` specifies the path to an optional user-supplied script that will be invoked during the promotion of a standby node to primary node.

```
# absolute path to fencing script run during promotion
#
# This is an optional user-supplied script that will be run
# during failover on the standby database node. If left blank,
# no action will be taken. If specified, EFM will execute this
# script before promoting the standby.
#
# Parameters can be passed into this script for the failed primary
# and new primary node addresses. Use %p for new primary and %f
# for failed primary. On a node that has just been promoted, %p
# should be the same as the node's efm binding address.
#
# Example:
# script.fence=/somepath/myscript %p %f
#
# NOTE: FAILOVER WILL NOT OCCUR IF THIS SCRIPT RETURNS A NON-ZERO EXIT
# CODE.
script.fence=
```

Use the `script.post.promotion` property to specify the path to an optional user-supplied script that will be invoked after a standby node has been promoted to primary.

```
# Absolute path to fencing script run after promotion
#
# This is an optional user-supplied script that will be run after
# failover on the standby node after it has been promoted and
# is no longer in recovery. The exit code from this script has
# no effect on failover manager, but will be included in a
# notification sent after the script executes.
#
# Parameters can be passed into this script for the failed primary
# and new primary node addresses. Use %p for new primary and %f
# for failed primary. On a node that has just been promoted, %p
# should be the same as the node's efm binding address.
#
# Example:
# script.post.promotion=/somepath/myscript %f %p
script.post.promotion=
```

Use the `script.resumed property` to specify an optional path to a user-supplied script that will be invoked when an agent resumes monitoring of a database.

```
# Absolute path to resume script
#
# This script is run before an IDLE agent resumes
```

```
# monitoring its local database.
script.resumed=
```

Use the `script.db.failure` property to specify the complete path to an optional user-supplied script that will invoke if an agent detects that the database that it monitors has failed.

```
# Absolute path to script run after database failure
# This is an optional user-supplied script that will be run after
# an agent detects that its local database has failed.
script.db.failure=
```

Use the `script.primary.isolated` property to specify the complete path to an optional user-supplied script that will invoke if the agent monitoring the primary database detects that the primary is isolated from the majority of the cluster. This script is called immediately after the VIP is released (if a VIP is in use).

```
# Absolute path to script run on isolated primary
# This is an optional user-supplied script that will be run after
# a primary agent detects that it has been isolated from the
# majority of the efm cluster.
script.primary.isolated=
```

Use the `script.remote.pre.promotion` property to specify the path and name of a script that will be invoked on any agent nodes not involved in the promotion when a node is about to promote its database to primary.

Include the %p placeholder to identify the address of the new primary node.

```
# Absolute path to script invoked on non-promoting agent nodes
# before a promotion.
#
# This optional user-supplied script will be invoked on other
# agents when a node is about to promote its database. The exit
# code from this script has no effect on Failover Manager, but
# will be included in a notification sent after the script
# executes.
#
# Pass a parameter (%p) with the script to identify the new
# primary node address.
#
# Example:
# script.remote.pre.promotion=/path_name/script_name %p
script.remote.pre.promotion=
```

Use the `script.remote.post.promotion` property to specify the path and name of a script that will be invoked on any non-primary nodes after a promotion occurs.

Include the %p placeholder to identify the address of the new primary node.

```
# Absolute path to script invoked on non-primary agent nodes
# after a promotion.
#
# This optional user-supplied script will be invoked on nodes
# (except the new primary) after a promotion occurs. The exit code
# from this script has no effect on Failover Manager, but will be
# included in a notification sent after the script executes.
#
# Pass a parameter (%p) with the script to identify the new
# primary node address.
#
# Example:
# script.remote.post.promotion=/path_name/script_name %p
script.remote.post.promotion=
```

Use the `script.custom.monitor` property to provide the name and location of an optional script that will be invoked on regular intervals (specified in seconds by the `custom.monitor.interval` property).

Use `custom.monitor.timeout` to specify the maximum time that the script will be allowed to run; if script execution does not complete within the time specified, will send a notification.

Set `custom.monitor.safe.mode` to `true` to instruct to report non-zero exit codes from the script, but not promote a standby as a result of an exit code.

```
# Absolute path to a custom monitoring script.
#
# Use script.custom.monitor to specify the location and name of
# an optional user-supplied script that will be invoked
# periodically to perform custom monitoring tasks. A non-zero
# exit value means that a check has failed; this will be treated
# as a database failure. On a primary node, script failure will
# cause a promotion. On a standby node script failure will
# generate a notification and the agent will become IDLE.
#
# The custom.monitor.\* properties are required if a custom
# monitoring script is specified:
#
# custom.monitor.interval is the time in seconds between executions
# of the script.
#
# custom.monitor.timeout is a timeout value in seconds for how
# long the script will be allowed to run. If script execution
# exceeds the specified time, the task will be stopped and a
# notification sent. Subsequent runs will continue.
#
# If custom.monitor.safe.mode is set to true, non-zero exit codes
# from the script will be reported but will not cause a promotion
# or be treated as a database failure. This allows testing of the
# script without affecting EFM.
#
script.custom.monitor=
custom.monitor.interval=
custom.monitor.timeout=
custom.monitor.safe.mode=
```

Use the `sudo.command` property to specify a command that will be invoked by when performing tasks that require extended permissions. Use this option to include command options that might be specific to your system authentication.

Use the `sudo.user.command` property to specify a command that will be invoked by when executing commands that will be performed by the database owner.

```
# Command to use in place of 'sudo' if desired when efm runs
# the efm_db_functions or efm_root_functions, or efm_address
# scripts.
# Sudo is used in the following ways by efm:
#
# sudo /usr/edb/efm-<version>/bin/efm_address <arguments>
# sudo /usr/edb/efm-<version>/bin/efm_root_functions <arguments>
# sudo -u <db service owner> /usr/edb/efm-<version>/bin/efm_db_functions <arguments>
#
# 'sudo' in the first two examples will be replaced by the value
# of the sudo.command property. 'sudo -u <db service owner>' will
# be replaced by the value of the sudo.user.command property.
# The '%u' field will be replaced with the db owner.
sudo.command=sudo
sudo.user.command=sudo -u %u
```

Use the `lock.dir` property to specify an alternate location for the lock file; the file prevents from starting multiple (potentially orphaned) agents for a single cluster on the node.

```
# Specify the directory of lock file on the node. Failover
```

```
# Manager creates a file named <cluster>.lock at this location to
# avoid starting multiple agents for same cluster. If the path
# does not exist, Failover Manager will attempt to create it. If
# not specified defaults to '/var/lock/efm-<version>'
lock.dir=
```

Use the `log.dir` property to specify the location to which agent log files will be written; will attempt to create the directory if the directory does not exist.

```
# Specify the directory of agent logs on the node. If the path
# does not exist, Failover Manager will attempt to create it. If
# not specified defaults to '/var/log/efm-<version>'. (To store
# Failover Manager startup logs in a custom location, modify the
# path in the service script to point to an existing, writable
# directory.)
# If using a custom log directory, you must configure
# logrotate separately. Use 'man logrotate' for more information.
log.dir=
```

After enabling the UDP or TCP protocol on a host, you can enable logging to syslog. Use the `syslog.protocol` parameter to specify the protocol type (UDP or TCP) and the `syslog.port` parameter to specify the listener port of the syslog host. The `syslog.facility` value may be used as an identifier for the process that created the entry; the value must be between LOCAL0 and LOCAL7.

```
# Syslog information. The syslog service must be listening on
# the port for the given protocol, which can be UDP or TCP.
# The facilities supported are LOCAL0 through LOCAL7.
syslog.host=localhost
syslog.port=514
syslog.protocol=UDP
syslog.facility=LOCAL1
```

Use the `file.log.enabled` and `syslog.enabled` properties to specify the type of logging that you wish to implement. Set `file.log.enabled` to `true` to enable logging to a file; enable the UDP protocol or TCP protocol and set `syslog.enabled` to `true` to enable logging to syslog. You can enable logging to both a file and syslog.

```
# Which logging is enabled.
file.log.enabled=true
syslog.enabled=false
```

For more information about configuring syslog logging, see Enabling syslog Log File Entries.

Use the `jgroups.loglevel` and `efm.loglevel` parameters to specify the level of detail logged by . The default value is INFO. For more information about logging, see `Controlling Logging <controlling_logging>` .

```
# Logging levels for JGroups and EFM.
# Valid values are: TRACE, DEBUG, INFO, WARN, ERROR
# Default value: INFO
# It is not necessary to increase these values unless debugging a
# specific issue. If nodes are not discovering each other at
# startup, increasing the jgroups level to DEBUG will show
# information about the TCP connection attempts that may help
# diagnose the connection failures.
jgroups.loglevel=INFO
efm.loglevel=INFO
```

Use the `jvm.options` property to pass JVM-related configuration information. The default setting specifies the amount of memory that the agent will be allowed to use.

```
# Extra information that will be passed to the JVM when starting
# the agent.
```

```
jvm.options=-Xmx128m
```

3.4.1.1 Encrypting Your Database Password

requires you to encrypt your database password before including it in the cluster properties file. Use the efm utility (located in the `/usr/edb/efm-4.0/bin` directory) to encrypt the password. When encrypting a password, you can either pass the password on the command line when you invoke the utility, or use the `EFMPASS` environment variable.

To encrypt a password, use the command:

```
# efm encrypt <cluster_name> [ --from-env ]
```

Where `<cluster_name>` specifies the name of the cluster.

If you include the `--from-env` option, you must export the value you wish to encrypt before invoking the encryption utility. For example:

```
export EFMPASS=password
```

If you do not include the `--from-env` option, will prompt you to enter the database password twice before generating an encrypted password for you to place in your cluster property file. When the utility shares the encrypted password, copy and paste the encrypted password into the cluster property files.

Please note: : Many Java vendors ship their version of Java with full-strength encryption included, but not enabled due to export restrictions. If you encounter an error that refers to an illegal key size when attempting to encrypt the database password, you should download and enable a Java Cryptography Extension (JCE) that provides an unlimited policy for your platform.

The following example demonstrates using the encrypt utility to encrypt a password for the `acctg` cluster:

efm encrypt acctg This utility will generate an encrypted password for you to place in your EFM cluster property file: /etc/edb/efm-/acctg.properties Please enter the password and hit enter: Please enter the password again to confirm: The encrypted password is: 516b36fb8031da17cfbc010f7d09359c Please paste this into your acctg.properties file db.password.encrypted=516b36fb8031da17cfbc010f7d09359c

Please note: : The utility will notify you if a properties file does not exist.

After receiving your encrypted password, paste the password into the properties file and start the service. If there is a problem with the encrypted password, the service will not start:

[witness@localhost ~]# service edb-efm- start Starting local edb-efm- service: [FAILED]

If you receive this message when starting the service, please see the startup log (located in `/var/log/efm-4.0/startup-`) for more information.

If you are using RHEL/CeonOS 7.x or RHEL/CentOS 8.x, startup information is also available with the following command:

systemctl status edb-efm-

To prevent a cluster from inadvertently connecting to the database of another cluster, the cluster name is incorporated into the encrypted password. If you modify the cluster name, you will need to re-encrypt the database password and update the cluster properties file.

Using the EFMPASS Environment Variable

The following example demonstrates using the --from-env environment variable when encrypting a password. Before invoking the `efm encrypt` command, set the value of `EFMPASS` to the password (`1safepassword`):

```
# export EFMPASS=1safepassword
```

Then, invoke `efm encrypt` , specifying the `--from-env` option:

efm encrypt acctg --from-env # 7ceecd8965fa7a5c330eaa9e43696f83

The encrypted password (`7ceecd8965fa7a5c330eaa9e43696f83`) is returned as a text value; when using a script, you can check the exit code of the command to confirm that the command succeeded. A successful execution returns `0` .

3.4.2 Encrypting Your Database Password

requires you to encrypt your database password before including it in the cluster properties file. Use the efm utility (located in the `/usr/edb/efm-4.0/bin` directory) to encrypt the password. When encrypting a password, you can either pass the password on the command line when you invoke the utility, or use the `EFMPASS` environment variable.

To encrypt a password, use the command:

```
# efm encrypt <cluster_name> [ --from-env ]
```

Where `<cluster_name>` specifies the name of the cluster.

If you include the `--from-env` option, you must export the value you wish to encrypt before invoking the encryption utility. For example:

```
export EFMPASS=password
```

If you do not include the `--from-env` option, will prompt you to enter the database password twice before generating an encrypted password for you to place in your cluster property file. When the utility shares the encrypted password, copy and paste the encrypted password into the cluster property files.

Please note: : Many Java vendors ship their version of Java with full-strength encryption included, but not enabled due to export restrictions. If you encounter an error that refers to an illegal key size when attempting to encrypt the database password, you should download and enable a Java Cryptography Extension (JCE) that provides an unlimited policy for your platform.

The following example demonstrates using the encrypt utility to encrypt a password for the `acctg` cluster:

efm encrypt acctg This utility will generate an encrypted password for you to place in your EFM cluster property file: /etc/edb/efm-/acctg.properties Please enter the password and hit enter: Please enter the password again to confirm: The encrypted password is: 516b36fb8031da17cfbc010f7d09359c Please paste this into your acctg.properties file db.password.encrypted=516b36fb8031da17cfbc010f7d09359c

Please note: : The utility will notify you if a properties file does not exist.

After receiving your encrypted password, paste the password into the properties file and start the service. If there is a problem with the encrypted password, the service will not start:

[witness@localhost ~]# service edb-efm- start Starting local edb-efm- service: [FAILED]

If you receive this message when starting the service, please see the startup log (located in `/var/log/efm-4.0/startup-`) for more information.

If you are using RHEL/CeonOS 7.x or RHEL/CentOS 8.x, startup information is also available with the following command:

systemctl status edb-efm-

To prevent a cluster from inadvertently connecting to the database of another cluster, the cluster name is incorporated into the encrypted password. If you modify the cluster name, you will need to re-encrypt the database password and update the cluster properties file.

Using the EFMPASS Environment Variable

The following example demonstrates using the --from-env environment variable when encrypting a password. Before invoking the `efm encrypt` command, set the value of `EFMPASS` to the password (`1safepassword`):

```
# export EFMPASS=1safepassword
```

Then, invoke `efm encrypt` , specifying the `--from-env` option:

efm encrypt acctg --from-env # 7ceecd8965fa7a5c330eaa9e43696f83

The encrypted password (`7ceecd8965fa7a5c330eaa9e43696f83`) is returned as a text value; when using a script, you can check the exit code of the command to confirm that the command succeeded. A successful execution returns `0` .

3.4.3 The Cluster Members File

Each node in a cluster has a cluster members file (by default, named efm.nodes) that contains a list of the current Failover Manager cluster members. When an agent starts, it uses the file to locate other cluster members. The installer creates a file template for the cluster members file named `efm.nodes.in` in the `/etc/edb/efm-4.0` directory.

After completing the installation, you must make a working copy of the template:

cp /etc/edb/efm-/efm.nodes.in /etc/edb/efm-/efm.nodes

After copying the template file, change the owner of the file to `efm` :

```
chown efm:efm efm.nodes
```

By default, expects the cluster members file to be named `efm.nodes` . If you name the cluster members file something other than `efm.nodes` , you must modify the service script to instruct to use the new name.

The cluster members file on the first node started can be empty; this node will become the Membership Coordinator. On each subsequent node, the cluster member file must contain the address and port number of the Membership Coordinator. Each entry in the cluster members file must be listed in an address:port format, with multiple entries separated by white space.

The Membership Coordinator will update the contents of the `efm.nodes` file to match the current members of the cluster. As agents join or leave the cluster, the `efm.nodes` files on other agents are updated to reflect the current cluster membership. If you invoke the efm stop-cluster command, does not modify the file.

If the Membership Coordinator leaves the cluster, another node will assume the role. You can use the efm cluster-status command to find the address of the Membership Coordinator. If a node joins or leaves a cluster while an agent is down, you must manually ensure that the file includes at least the current Membership Coordinator.

If you know the IP addresses and ports of the nodes that will be joining the cluster, you can include the addresses in the cluster members file at any time. At startup, any addresses that do not identify cluster members will be ignored unless the `auto.allow.hosts` property (in the cluster properties file) is set to `true` .

If the `stable.nodes.file` property (located in the cluster properties file) is set to `true` , the Membership Coordinator will not update the `.nodes` file when cluster members join or leave the cluster; this behavior is most useful when the IP addresses of cluster members do not change often.

3.4.4 Extending Failover Manager Permissions

During the installation, the installer creates a user named `efm` . `efm` does not have sufficient privileges to perform management functions that are normally limited to the database owner or operating system superuser.

- When performing management functions requiring database superuser privileges, `efm` invokes the `efm_db_functions` script.
- When performing management functions requiring operating system superuser privileges, `efm` invokes the `efm_root_functions` script.
- When assigning or releasing a virtual IP address, efm invokes the `efm_address script` .

The `efm_db_functions` or `efm_root_functions` scripts perform management functions on behalf of the `efm` user.

The sudoers file contains entries that allow the user `efm` to control the service for clusters owned by `postgres` or `enterprisedb` . You can modify a copy of the sudoers file to grant permission to manage Postgres clusters owned by other users to `efm` .

The `efm-40` file is located in `/etc/sudoers.d` , and contains the following entries:

Copyright EnterpriseDB Corporation, 2014-2020. All Rights Reserved. # # Do not edit this file. Changes to the file may be overwritten # during an upgrade. # # This file assumes you are running your efm cluster as user # 'efm'. If not, then you will need to copy this file. # Allow user 'efm' to sudo efm_db_functions as either 'postgres' # or 'enterprisedb'. If you run your db service under a # non-default account, you will need to copy this file to grant # the proper permissions and specify the account in your efm # cluster properties file by changing the 'db.service.owner' # property.

efm ALL=(postgres) NOPASSWD: /usr/edb/efm-/bin/efm_db_functions efm ALL=(enterprisedb) NOPASSWD: /usr/edb/efm-/bin/efm_db_functions

Allow user 'efm' to sudo efm_root_functions as 'root' to # write/delete the PID file, validate the db.service.owner # property, etc. efm ALL=(ALL) NOPASSWD: /usr/edb/efm-/bin/efm_root_functions # Allow user 'efm' to sudo efm_address as root for VIP tasks. efm ALL=(ALL) NOPASSWD: /usr/edb/efm-/bin/efm_address # relax tty requirement for user 'efm' Defaults:efm !requiretty

If you are using to monitor clusters that are owned by users other than `postgres` or `enterprisedb` , make a copy of the `efm-40` file, and modify the content to allow the user to access the `efm_functions` script to manage their clusters.

If an agent cannot start because of permission problems, make sure the default `/etc/sudoers` file contains the following line at the end of the file:

```
## Read drop-in files from /etc/sudoers.d (the # here does not # mean a comment)
#includedir /etc/sudoers.d
```

Running Failover Manager without sudo

By default, uses sudo to securely manage access to system functionality. If you choose to configure to run without sudo access, please note that root access is still required to:

- install the RPM.
- perform setup tasks.

To run without sudo, you must select a database process owner that will have privileges to perform management functions on behalf of . The user could be the default database superuser (for example, enterprisedb or postgres) or another privileged user. After selecting the user:

1. Use the following command to add the user to the `efm` group:

   ```
   usermod -a -G efm enterprisedb
   ```

   This should allow the user to write to `/var/run/efm-4.0` and `/var/lock/efm-4.0` .

2. If you are reusing a cluster name, remove any previously created log files; the new user will not be able to write to log files created by the default (or other) owner.
3. Copy the cluster properties template file and the nodes template file:

su - enterprisedb

cp /etc/edb/efm-/efm.properties.in <directory/cluster_name>.properties

cp /etc/edb/efm-/efm.nodes.in <directory>/<cluster_name>.nodes

Then, modify the cluster properties file, providing the name of the user in the `db.service.owner` property. You must also ensure that the `db.service.name` property is blank; without sudo, you cannot run services without root access.

After modifying the configuration, the new user can control Failover Manager with the following command:

/usr/edb/efm-/bin/runefm.sh startIstop <directory/cluster_name>.properties

Where `<directory/cluster_name.properties>` specifies the full path of the cluster properties file. Please note that the user must ensure that the full path to the properties file must be provided whenever the non-default user is controlling agents or using the efm script.

To allow the new user to manage as a service, you must provide a custom script or unit file.

uses a binary named `manage-vip` that resides in `/usr/edb/efm-4.0/bin/secure/` to perform VIP management operations without sudo privileges. This script uses setuid to acquire with the privileges needed to manage Virtual IP addresses.

- This directory is only accessible to root and users in the `efm` group.
- The binary is only executable by root and the `efm` group.

For security reasons, we recommend against modifying the access privileges of the `/usr/edb/efm-4.0/bin/secure/` directory or the `manage-vip` script.

For more information about using without sudo, visit:

https://www.enterprisedb.com/blog/running-edb-postgres-failover-manager-without-sudo

---

3.4.5 Using Failover Manager with Virtual IP Addresses

uses the `efm_address` script to assign or release a virtual IP address.

Please note: Virtual IP addresses are not supported by many cloud providers. In those environments, another mechanism should be used (such as an Elastic IP Address on AWS), which can be changed when needed by a fencing or post-promotion script.

By default, the script resides in:

```
/usr/edb/efm-4.0/bin/efm_address
```

Use the following command variations to assign or release an IPv4 or IPv6 IP address.

To assign a virtual IPv4 IP address:

```
# efm_address add4 <interface_name> <IPv4_addr>/<prefix>
```

To assign a virtual IPv6 IP address:

```
# efm_address add6 <interface_name> <IPv6_addr>/<prefix>
```

To release a virtual address:

```
# efm_address del <interface_name> <IP_address/prefix>
```

Where:

`<interface_name>` matches the name specified in the `virtual.ip.interface` property in the cluster properties file.

`<IPv4_addr>` or `<IPv6_addr>` matches the value specified in the `virtual.ip` property in the cluster properties file.

`prefix` matches the value specified in the `virtual.ip.prefix` property in the cluster properties file.

For more information about properties that describe a virtual IP address, see The Cluster Properties File.

You must invoke the `efm_address` script as the root user. The `efm` user is created during the installation, and is granted privileges in the sudoers file to run the `efm_address` script. For more information about the sudoers file, see `Extending Failover Manager Permissions <extending_efm_permissions>` .

Please note: : If a VIP address (or any address other than the `bind.address`) is assigned to a node, the operating system can choose the source address used when contacting the database. Be sure that you modify the `pg_hba.conf` file on all monitored databases to allow contact from all addresses within your replication scenario.

Testing the VIP

When using a virtual IP (VIP) address with , it is important to test the VIP functionality manually before starting failover manager. This will catch any network-related issues before they cause a problem during an actual failover. The following steps test the actions that will take. The example uses the following property values:

```
virtual.ip=172.24.38.239
virtual.ip.interface=eth0
virtual.ip.prefix=24
ping.server.command=/bin/ping -q -c3 -w5
```

Please note: : The `virtual.ip.prefix` specifies the number of significant bits in the virtual Ip address.

When instructed to ping the VIP from a node, use the command defined by the `ping.server.command` property.

1. Ping the VIP from all nodes to confirm that the address is not already in use:

```
# /bin/ping -q -c3 -w5 172.24.38.239
PING 172.24.38.239 (172.24.38.239) 56(84) bytes of data.
--- 172.24.38.239 ping statistics ---
4 packets transmitted, 0 received, +3 errors, 100% packet loss,
 time 3000ms
```

You should see 100% packet loss.

2. Run the `efm_address add4` command on the Primary node to assign the VIP and then confirm with ip address:

```
# efm_address add4 eth0 172.24.38.239/24
# ip address
<output truncated>
eth0 Link encap:Ethernet HWaddr 36:AA:A4:F4:1C:40
inet addr:172.24.38.239 Bcast:172.24.38.255
...
```

3. Ping the VIP from the other nodes to verify that they can reach the VIP:

```
# /bin/ping -q -c3 -w5 172.24.38.239
PING 172.24.38.239 (172.24.38.239) 56(84) bytes of data.
--- 172.24.38.239 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 1999ms
rtt min/avg/max/mdev = 0.023/0.025/0.029/0.006 ms
```

You should see no packet loss.

4. Use the `efm_address del` command to release the address on the primary node and confirm the node has been released with ip address:

```
# efm_address del eth0 172.24.38.239/24
# ip address
eth0 Link encap:Ethernet HWaddr 22:00:0A:89:02:8E
inet addr:10.137.2.142 Bcast:10.137.2.191
...
```

The output from this step should not show an eth0 interface

5. Repeat step 3, this time verifying that the Standby and Witness do not see the VIP in use:

```
# /bin/ping -q -c3 -w5 172.24.38.239
PING 172.24.38.239 (172.24.38.239) 56(84) bytes of data.
--- 172.24.38.239 ping statistics ---
4 packets transmitted, 0 received, +3 errors, 100% packet loss,
```

```
time 3000ms
```

You should see 100% packet loss. Repeat this step on all nodes.

6. Repeat step 2 on all Standby nodes to assign the VIP to every node. You can ping the VIP from any node to verify that it is in use.

```
# efm_address add4 eth0 172.24.38.239/24
# ip address
<output truncated>
eth0 Link encap:Ethernet HWaddr 36:AA:A4:F4:1C:40
inet addr:172.24.38.239 Bcast:172.24.38.255
...
```

After the test steps above, release the VIP from any non-Primary node before attempting to start .

Please note: : The network interface used for the VIP does not have to be the same interface used for the agent's `bind.address` value. The primary agent will drop the VIP as needed during a failover, and will verify that the VIP is no longer available before promoting a standby. A failure of the bind address network will lead to primary isolation and failover.

If the VIP uses a different interface, you may encounter a timing condition where the rest of the cluster checks for a reachable VIP before the primary agent has dropped it. In this case, EFM will retry the VIP check for the number of seconds specified in the `node.timeout` property to help ensure that a failover happens as expected.

3.5 Using Failover Manager

offers support for monitoring and failover of clusters with one or more Standby servers. You can add or remove nodes from the cluster as your demand for resources grows or shrinks.

If a primary node reboots, may detect the database is down on the Primary node and promote a Standby node to the role of Primary. If this happens, the agent on the (rebooted) Primary node will not get a chance to write the `recovery.conf` file (for server version 11 or prior) or `standby.signal` file (for server version 12 or later); the rebooted Primary node will return to the cluster as a second Primary node. To prevent this, start the agent before starting the database server. The agent will start in idle mode, and check to see if there is already a primary in the cluster. If there is a primary node, the agent will verify that a `recovery.conf` or `standby.signal` file exists, and the database will not start as a second primary.

Managing a Failover Manager Cluster

Once configured, a cluster requires no regular maintenance. The following sections provide information about performing the management tasks that may occasionally be required by a Failover Manager Cluster.

By default, `some of the efm commands <using_efm_utility>` must be invoked by `efm` or an OS superuser; an administrator can selectively permit users to invoke these commands by adding the user to the `efm` group. The commands are:

- efm allow-node
- efm disallow-node
- efm promote
- efm resume
- efm set-priority
- efm stop-cluster
- efm upgrade-conf

Starting the Failover Manager Cluster

You can start the nodes of a cluster in any order.

To start the cluster on RHEL 6.x or CentOS 6.x, assume superuser privileges, and invoke the command:

service edb-efm- start

To start the cluster on RHEL/CentOS 7.x or RHEL/CentOS 8.x, assume superuser privileges, and invoke the command:

systemctl start edb-efm-

If the cluster properties file for the node specifies that `is.witness` is `true` , the node will start as a Witness node.

If the node is not a dedicated Witness node, will connect to the local database and invoke the `pg_is_in_recovery()` function. If the server responds `false` , the agent assumes the node is a Primary node, and assigns a virtual IP address to the node (if applicable). If the server responds `true` , the agent assumes that the node is a Standby server. If the server does not respond, the agent will start in an idle state.

After joining the cluster, the agent checks the supplied database credentials to ensure that it can connect to all of the databases within the cluster. If the agent cannot connect, the agent will shut down.

If a new primary or standby node joins a cluster, all of the existing nodes will also confirm that they can connect to the database on the new node.

Note

If you are running `/var/lock` or `/var/run` on `tmpfs` (Temporary File System), make sure that the systemd service file for Failover Manager has a dependency on `systemd-tmpfiles-setup.service` .

Adding Nodes to a Cluster

You can add a node to a cluster at any time. When you add a node to a cluster, you must modify the cluster to allow the new node, and then tell the new node how to find the cluster. The following steps detail adding a node to a cluster:

1. Unless `auto.allow.hosts` is set to `true` , use the `efm allow-node` command, to add the IP address of the new node to the Failover Manager allowed node host list. When invoking the command, specify the cluster name and the IP address of the new node:

   ```
   efm allow-node <cluster_name ip_address>
   ```

   For more information about using the `efm allow-node` command or controlling a service, see Using the EFM Utility.

   Install a agent and configure the cluster properties file on the new node. For more information about modifying the properties file, see `The Cluster Properties File <cluster_properties>` .

2. Configure the cluster members file on the new node, adding an entry for the Membership Coordinator. For more information about modifying the cluster members file, see `The Cluster Members File <cluster_members>` .

3. Assume superuser privileges on the new node, and start the Failover Manager agent. To start the cluster on RHEL 6.x or CentOS 6.x, assume superuser privileges, and invoke the command:

service edb-efm- start

To start the cluster on RHEL/CentOS 7.x or RHEL/CentOS 8.x, assume superuser privileges, and invoke the command:

systemctl start edb-efm-

When the new node joins the cluster, will send a notification to the administrator email provided in the `user.email` property, and/or will invoke the specified notification script.

Please note: : To be a useful Standby for the current node, the node must be a standby in the PostgreSQL Streaming Replication scenario.

Changing the Priority of a Standby

If your cluster includes more than one Standby server, you can use the `efm set-priority` command to influence the promotion priority of a Standby node. Invoke the command on any existing member of the cluster, and specify a priority value after the IP address of the member.

For example, the following command instructs that the `acctg` cluster member that is monitoring `10.0.1.9` is the primary Standby `(1)` :

```
efm set-priority acctg 10.0.1.9 1
```

You can set the priority of a standby to `0` to make the standby non-promotable. Setting the priority of a standby to a value greater than `0` overrides a property value of `promotable=false` .

For example, if the properties file on node `10.0.1.10` includes a setting of `promotable=false` and you use `efm set-priority` to set the promotion priority of `10.0.1.10` to be the standby used in the event of a failover, the value designated by the `efm set-priority` command will override the value in the property file:

```
efm set-priority acctg 10.0.1.10 1
```

In the event of a failover, will first retrieve information from Postgres streaming replication to confirm which Standby node has the most recent data, and promote the node with the least chance of data loss. If two Standby nodes contain equally up-to-date data, the node with a higher user-specified priority value will be promoted to Primary unless use.replay.tiebreaker is set to `false` . To check the priority value of your Standby nodes, use the command:

```
efm cluster-status <cluster_name>
```

Please note: : The promotion priority may change if a node becomes isolated from the cluster, and later re-joins the cluster.

Promoting a Failover Manager Node

You can invoke `efm promote` on any node of a cluster to start a manual promotion of a Standby database to Primary database.

Manual promotion should only be performed during a maintenance window for your database cluster. If you do not have an up-to-date Standby database available, you will be prompted before continuing. To start a manual promotion, assume the identity of `efm` or the OS superuser, and invoke the command:

```
efm promote <cluster_name> [-switchover] [-sourcenode <address>] [-quiet] [-noscripts]
```

Where:

`<cluster_name>` is the name of the cluster.

Include the `-switchover` option to reconfigure the original Primary as a Standby. If you include the `-switchover` keyword, the cluster must include a primary node and at least one standby, and the nodes must be in sync.

Include the `-sourcenode` keyword to specify the node from which the recovery settings will be copied to the primary.

Include the `-quiet` keyword to suppress notifications during switchover.

Include the `-noscripts` keyword to prevent instruct to not invoke fencing and post-promotion scripts.

During switchover:

- For server versions 11 and prior, the `recovery.conf` file is copied from an existing standby to the primary node. For server version 12 and later, the `primary_conninfo` and `restore_command` parameters are copied and stored in memory.
- The primary database is stopped.
- If you are using a VIP, the address is released from the primary node.
- A standby is promoted to replace the primary node, and acquires the VIP.
- The address of the new primary node is added to the `recovery.conf` file or the `primary_conninfo` details are stored in memory.

- If the `application.name` property is set for this node, the application_name property will be added to the `recovery.conf` file or the `primary_conninfo` information will be stored in memory.
- If you are using server version 12 or later, the recovery settings that have been stored in memory are written to the `postgresql.auto.conf` file.
- The old primary is started; the agent will resume monitoring it as a standby.

During a manual promotion, the Primary agent releases the virtual IP address before creating a `recovery.conf` file in the directory specified by the `db.data.dir` property. The `recovery.conf` file is created on all server versions, and is used to prevent the old primary database from starting until the file is removed, preventing the node from starting as a second primary in the cluster.

The Primary agent remains running, and assumes a status of `Idle` .

The Standby agent confirms that the virtual IP address is no longer in use before pinging a well-known address to ensure that the agent is not isolated from the network. The Standby agent runs the fencing script and promotes the Standby database to Primary. The Standby agent then assigns the virtual IP address to the Standby node, and runs the post-promotion script (if applicable).

Please note that this command instructs the service to ignore the value specified in the `auto.failover` parameter in the cluster properties file.

To return a node to the role of primary, place the node first in the promotion list:

```
efm set-priority <cluster_name> <ip_address> <priority>
```

Then, perform a manual promotion:

```
efm promote <cluster_name> -switchover
```

For more information about the efm utility, see `Using the EFM Utility <using_efm_utility>` .

Stopping a Failover Manager Agent

When you stop an agent, will remove the node's address from the cluster members list on all of the running nodes of the cluster, but will not remove the address from the Allowed node host list.

To stop the agent on RHEL 6.x or CentOS 6.x, assume superuser privileges, and invoke the command:

service edb-efm- stop

To stop the agent on RHEL/CentOS 7.x or RHEL/CentOS 8.x, assume superuser privileges, and invoke the command:

systemctl stop edb-efm-

Until you invoke the `efm disallow-node` command (removing the node's address of the node from the Allowed node host list), you can use the `service edb-efm-4.0 start` command to restart the node at a later date without first running the `efm allow-node` command again.

Please note that stopping an agent does not signal the cluster that the agent has failed unless the primary.shutdown.as.failure property is set to `true` .

Stopping a Failover Manager Cluster

To stop a cluster, connect to any node of a Failover Manager cluster, assume the identity of `efm` or the OS superuser, and invoke the command:

```
efm stop-cluster <cluster_name>
```

The command will cause *all* agents to exit. Terminating the agents completely disables all failover functionality.

Please note: : When you invoke the `efm stop-cluster` command, all authorized node information is lost from the Allowed node host list.

Removing a Node from a Cluster

The `efm disallow-node` command removes the IP address of a node from the Allowed Node host list. Assume the identity of `efm` or the OS superuser on any existing node (that is currently part of the running cluster), and invoke the `efm disallow-node` command, specifying the cluster name and the IP address of the node:

```
efm disallow-node <cluster_name> <ip_address>
```

The `efm disallow-node` command will not stop a running agent; the service will continue to run on the node until you stop the agent. If the agent or cluster is subsequently stopped, the node will not be allowed to rejoin the cluster, and will be removed from the failover priority list (and will be ineligible for promotion).

After invoking the `efm disallow-node` command, you must use the efm allow-node <efm_allow_node> command to add the node to the cluster again.

Running Multiple Agents on a Single Node

You can monitor multiple database clusters that reside on the same host by running multiple Primary or Standby agents on that node. You may also run multiple Witness agents on a single node. To configure to monitor more than one database cluster, while ensuring that agents from different clusters do not interfere with each other, you must:

1. Create a cluster properties file for each member of each cluster that defines a unique set of properties and the role of the node within the cluster.
2. Create a cluster members file for each member of each cluster that lists the members of the cluster.
3. Customize the service script (on a RHEL or CentOS 6.x system) or the unit file (on a RHEL/CentOS 7.x or RHEL/CentOS 8.x system) for each cluster to specify the names of the cluster properties and the cluster members files.
4. Start the services for each cluster.

The examples that follow uses two database clusters (acctg and sales) running on the same node:

- Data for `acctg` resides in `/opt/pgdata1` ; its server is monitoring port `5444` .
- Data for `sales` resides in `/opt/pgdata2` ; its server is monitoring port `5445` .

To run a agent for both of these database clusters, use the `efm.properties.in` template to create two properties files. Each cluster properties file must have a unique name. For this example, we create `acctg.properties` and `sales.properties` to match the `acctg` and `sales` database clusters.

The following parameters must be unique in each cluster properties file:

`admin.port`

`bind.address`

`db.port`

`db.data.dir`

`virtual.ip` (if used)

`virtual.ip.interface` (if used)

Within each cluster properties file, the `db.port` parameter should specify a unique value for each cluster, while the `db.user` and `db.database` parameter may have the same value or a unique value. For example, the `acctg.properties` file may specify:

```
db.user=efm_user
```

```
db.password.encrypted=7c801b32a05c0c5cb2ad4ffbda5e8f9a
```

```
db.port=5444
```

```
db.database=acctg_db
```

While the `sales.properties` file may specify:

```
db.user=efm_user
```

```
db.password.encrypted=e003fea651a8b4a80fb248a22b36f334
```

```
db.port=5445
```

```
db.database=sales_db
```

Some parameters require special attention when setting up more than one cluster agent on the same node. If multiple agents reside on the same node, each port must be unique. Any two ports will work, but it may be easier to keep the information clear if using ports that are not too close to each other.

When creating the cluster properties file for each cluster, the `db.data.dir` parameters must also specify values that are unique for each respective database cluster.

The following parameters are used when assigning the virtual IP address to a node. If your cluster does not use a virtual IP address, leave these parameters blank.

```
virtual.ip
```

```
virtual.ip.interface
```

```
virtual.ip.prefix
```

This parameter value is determined by the virtual IP addresses being used and may or may not be the same for both `acctg.properties` and `sales.properties` .

After creating the `acctg.properties` and `sales.properties` files, create a service script or unit file for each cluster that points to the respective property files; this step is platform specific. If you are using RHEL 6.x or CentOS 6.x, see RHEL 6.x or CentOS 6.x; if you are using RHEL/CentOS 7.x or RHEL/CentOS 8.x, see RHEL/CentOS 7.x or RHEL/CentOS 8.x <rhel_or_centos_7>.

Please note: : If you are using a custom service script or unit file, you must manually update the file to reflect the new service name when you upgrade .

RHEL 6.x or CentOS 6.x

If you are using RHEL 6.x or CentOS 6.x, you should copy the `edb-efm-4.0` service script to new file with a name that is unique for each cluster. For example:

cp /etc/init.d/edb-efm- /etc/init.d/efm-acctg

cp /etc/init.d/edb-efm- /etc/init.d/efm-sales

Then edit the `CLUSTER` variable, modifying the cluster name from `efm` to `acctg` or `sales` .

After creating the service scripts, run:

```
# chkconfig efm-acctg on
```

```
# chkconfig efm-sales on
```

Then, use the new service scripts to start the agents. For example, you can start the `acctg` agent with the command:

```
# service efm-acctg start
```

RHEL/CentOS 7.x or RHEL/CentOS 8.x

If you are using RHEL/CentOS 7.x or RHEL/CentOS 8.x, you should copy the `edb-efm-4.0` unit file to new file with a name that is unique for each cluster. For example, if you have two clusters (named acctg and sales), the unit file names might be:

`/usr/lib/systemd/system/efm-acctg.service`

`/usr/lib/systemd/system/efm-sales.service`

Then, edit the `CLUSTER` variable within each unit file, changing the specified cluster name from `efm` to the new cluster name. For example, for a cluster named `acctg` , the value would specify:

`Environment=CLUSTER=acctg`

You must also update the value of the `PIDfile` parameter to specify the new cluster name. For example:

PIDFile=/var/run/efm-/acctg.pid

After copying the service scripts, use the following commands to enable the services:

`# systemctl enable efm-acctg.service`

`# systemctl enable efm-sales.service`

Then, use the new service scripts to start the agents. For example, you can start the `acctg` agent with the command:

`# systemctl start efm-acctg`

For information about customizing a unit file, please visit:

http://fedoraproject.org/wiki/Systemd#How_do_I_customize_a_unit_file.2F_add_a_custom_unit_file.3F

3.6 Monitoring a Failover Manager Cluster

You can use either the `efm cluster-status` command or the PEM Client graphical interface to check the current status of a monitored node of a cluster.

Reviewing the Cluster Status Report

The efm cluster-status cluster properties file command returns a report that contains information about the status of the cluster. To invoke the command, enter:

`# efm cluster-status <cluster_name>`

The following status report is for a cluster named edb that has three nodes running:

```
Agent Type  Address              Agent   DB        VIP
------------------------------------------------------------------------
Standby     172.19.10.2           UP     UP        192.168.225.190
Standby     172.19.12.163         UP     UP        192.168.225.190
Primary     172.19.14.9           UP     UP        192.168.225.190*


Allowed node host list:
172.19.14.9 172.19.12.163 172.19.10.2


Membership coordinator: 172.19.14.9


Standby priority host list:
172.19.12.163 172.19.10.2

Promote Status:

DB Type  Address         WAL Received LSN   WAL Replayed LSN   Info
---------------------------------------------------------------------
```

```
Primary  172.19.14.9                        0/4000638
Standby  172.19.12.163   0/4000638          0/4000638
Standby  172.19.10.2     0/4000638          0/4000638


Standby database(s) in sync with primary. It is safe to promote.
```

The cluster status section provides an overview of the status of the agents that reside on each node of the cluster:

```
Agent Type  Address              Agent   DB        VIP
-------------------------------------------------------------------------
Standby     172.19.10.2           UP     UP        192.168.225.190
Standby     172.19.12.163         UP     UP        192.168.225.190
Primary     172.19.14.9           UP     UP        192.168.225.190*
```

The asterisk (*) after the VIP address indicates that the address is available for connections. If a VIP address is not followed by an asterisk, the address has been associated with the node (in the properties file), but the address is not currently in use.

agents provide the information displayed in the Cluster Status section.

The `Allowed node host list` and `Standby priority host list` provide an easy way to tell which nodes are allowed to join the cluster, and the promotion order of the nodes. The IP address of the Membership coordinator is also displayed in the report:

```
Allowed node host list:
172.19.14.9 172.19.12.163 172.19.10.2
Membership coordinator: 172.19.14.9
Standby priority host list:
172.19.12.163 172.19.10.2
```

The `Promote Status` section of the report is the result of a direct query from the node on which you are invoking the cluster-status command to each database in the cluster; the query also returns the transaction log location of each database.

```
Promote Status:

DB Type  Address         WAL Received LSN   WAL Replayed LSN   Info
---------------------------------------------------------------------
Primary   172.19.14.9                       0/4000638
Standby  172.19.12.163   0/4000638          0/4000638
Standby  172.19.10.2     0/4000638          0/4000638
```

If a database is down (or if the database has been restarted, but the resume command has not yet been invoked), the state of the agent that resides on that host will be Idle. If an agent is idle, the cluster status report will include a summary of the condition of the idle node. For example:

```
Agent Type Address Agent DB VIP
-------------------------------------------------
Idle 172.19.18.105 UP UP 172.19.13.105
```

Exit Codes

The cluster status process returns an exit code that is based on the state of the cluster:

- An exit code of `0` indicates that all agents are running, and the databases on the Primary and Standby nodes are running and in sync.
- A non-zero exit code indicates that there is a problem. The following problems can trigger a non-zero exit code:

  A database is down or unknown (or has an idle agent).

  cannot decrypt the provided database password.

  There is a problem contacting the databases to get WAL locations.

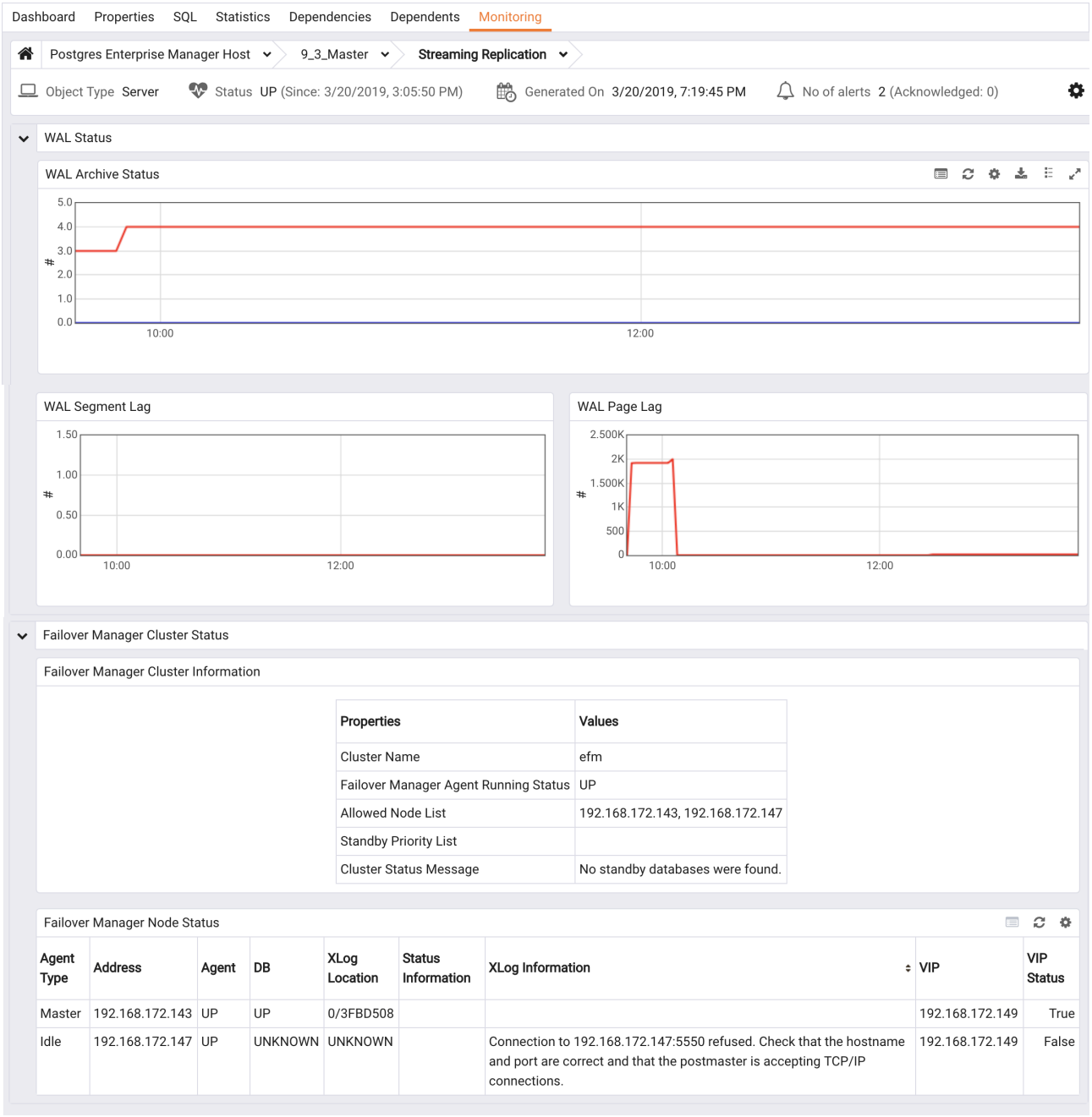
  There is no Primary agent.

There are no Standby agents.

One or more Standby nodes are not in sync with the Primary.

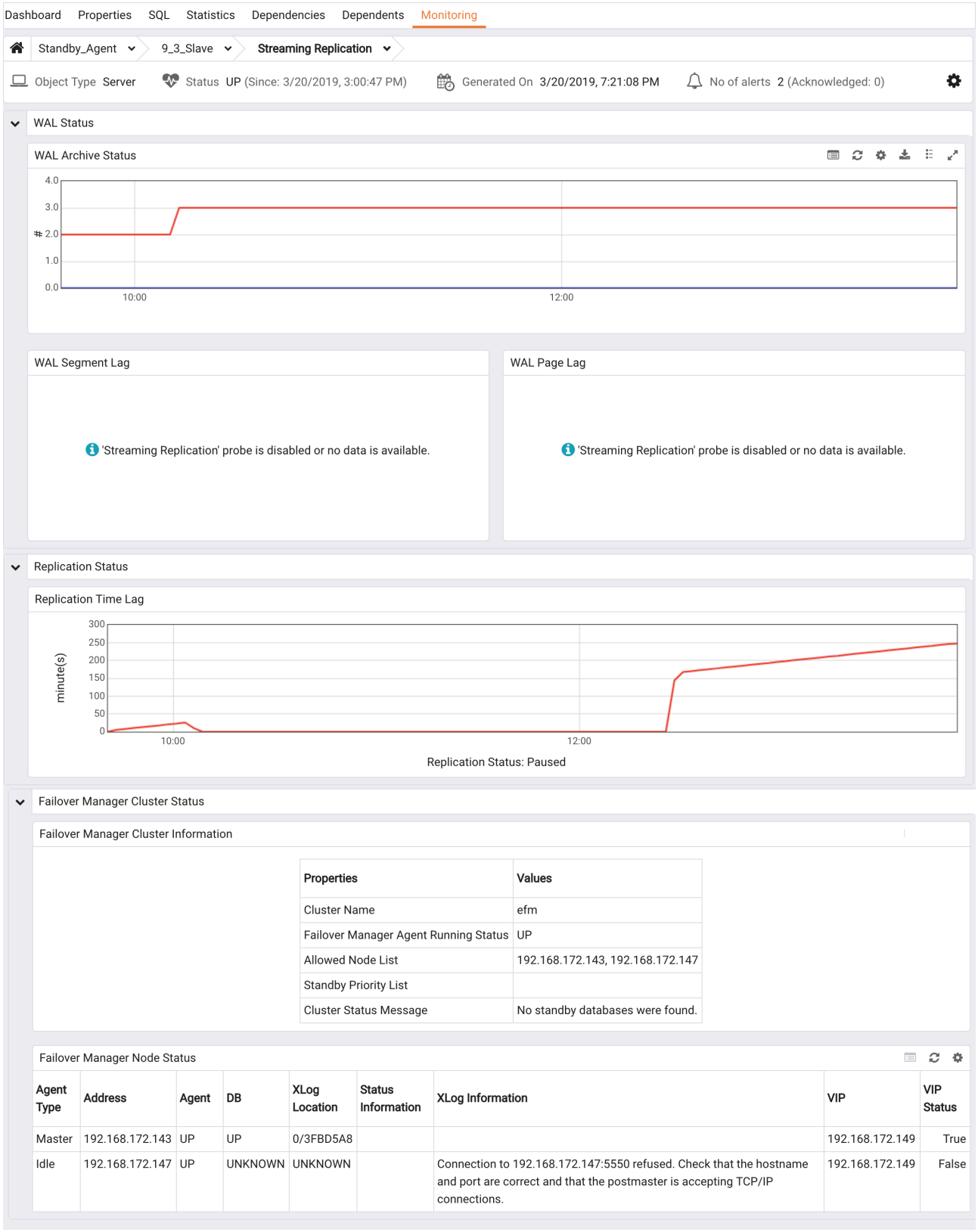
Monitoring Streaming Replication with Postgres Enterprise Manager

If you use Postgres Enterprise Manager (PEM) to monitor your servers, you can configure the Streaming Replication Analysis dashboard (part of the PEM graphical interface) to display the state of a Primary or Standby node that is part of a Streaming Replication scenario.



The Streaming Replication Analysis Dashboard displays statistical information about activity for any monitored server on which streaming replication is enabled. The dashboard header identifies the status of the monitored server (either Replication Primary or Replication Slave), and displays the date and time that the server was last started, the date and time that the page was last updated, and a current count of triggered alerts for the server.

When reviewing the dashboard for a Replication Slave (a Standby node), a label at the bottom of the dashboard confirms the status of the server.



By default, the PEM replication probes that provide information for the Streaming Replication Analysis dashboard are disabled.

To view the Streaming Replication Analysis dashboard for the Primary node of a replication scenario, you must enable the following probes:

- Streaming Replication
- WAL Archive Status

To view the Streaming Replication Analysis dashboard for the Standby node of a replication scenario, you must enable the following probes:

- Streaming Replication Lag Time

For more information about PEM, please visit the EnterpriseDB website at:

http://www.enterprisedb.com/products-services-training/products/postgres-enterprise-manager

---

3.7 Using the efm Utility

provides the efm utility to assist with cluster management. The RPM installer adds the utility to the `/usr/edb/efm-4.0/bin` directory when you install .

`efm allow-node <cluster_name>`

Invoke the `efm allow-node` command to allow the specified node to join the cluster. When invoking the command, provide the name of the cluster and the IP address of the joining node.

This command must be invoked by `efm` , a member of the `efm` group, or root.

`efm disallow-node <cluster_name> <ip_address>`

Invoke the `efm disallow-node` command to remove the specified node from the allowed hosts list, and prevent the node from joining a cluster. Provide the name of the cluster and the IP address of the node when calling the `efm disallow-node` command. This command must be invoked by `efm` , a member of the `efm` group, or root.

`efm cluster-status <cluster_name>`

Invoke the `efm cluster-status` command to display the status of a cluster. For more information about the status report, see `Monitoring a Failover Manager Cluster <monitoring_efm_cluster>` .

`efm cluster-status-json <cluster_name>`

Invoke the `efm cluster-status-json` command to display the status of a cluster in json format. While the format of the displayed information is different than the display generated by the efm cluster-status command, the information source is the same.

The following example is generated by querying the status of a healthy cluster with two nodes:

```
{
    "nodes": {
        "172.16.144.176": {
            "type": "Witness",
            "agent": "UP",
            "db": "N\/A",
            "vip": "",
            "vip_active": false
        },
        "172.16.144.177": {
            "type": "Primary",
            "agent": "UP",
            "db": "UP",
            "vip": "",
            "vip_active  :   false"
            "xlogReceive :   0/14001478"
            "xlog    :   0/14001478"
            "xloginfo    :"
        },
        "172.16.144.180": {
            "type": "Standby",
            "agent": "UP",
            "db": "UP",
```

```
            "vip": "",
            "vip_active  :   false"
            "xlogReceive :   0/14001478"
            "xlog    :   0/14001478"
            "xloginfo    :"
        }
    },
    "allowednodes": [
        "172.16.144.177",
        "172.16.144.160",
        "172.16.144.180",
        "172.16.144.176"
    ],
    "membershipcoordinator": "172.16.144.177",
    "failoverpriority": [
        "172.16.144.180"
    ],
    "minimumstandbys": 0,
    "missingnodes": [],
    "messages": []
}
```

`efm encrypt <cluster_name> [--from-env]`

Invoke the `efm encrypt` command to encrypt the database password before include the password in the cluster properties file. Include the `--from-env` option to instruct to use the value specified in the `EFMPASS` environment variable, and execute without user input. For more information, see `Encrypting Your Database Password <encrypting_database_password>` .

`efm promote cluster_name [-switchover [-sourcenode <address>][-quiet][-noscripts]`

The `efm promote` command instructs to perform a manual failover of standby to primary.

Manual promotion should only be attempted if the status command reports that the cluster includes a Standby node that is up-to-date with the Primary. If there is no up-to-date Standby, will prompt you before continuing.

Include the `-switchover` clause to promote a standby node, and reconfigure a primary node as a standby node. Include the `-sourcenode` keyword, and specify a node address to indicate the node whose recovery.conf file will be copied to the old primary node (making it a standby). Include the `-quiet` keyword to suppress notifications during the switchover process. Include the `-noscripts` keyword to instruct to not invoke fencing or post-promotion scripts.

This command must be invoked by `efm` , a member of the `efm` group, or root.

Please note: This command instructs the service to ignore the value specified in the `auto.failover` parameter in the cluster properties file.

`efm resume <cluster_name>`

Invoke the `efm resume` command to resume monitoring a previously stopped database. This command must be invoked by efm, a member of the efm group, or root.

`efm set-priority <cluster_name> <ip_address> <priority>`

Invoke the `efm set-priority` command to assign a failover priority to a standby node. The value specifies the order in which the new node will be used in the event of a failover. This command must be invoked by `efm` , a member of the `efm` group, or root.

priority is an integer value of 1 to *n*, where *n* is the number of standby nodes in the list. Specify a value of 1 to indicate that the new node is the primary standby, and will be the first node promoted

in the event of a failover. A priority value of 0 instructs to not promote the standby.

`efm stop-cluster <cluster_name>`

Invoke the `efm stop-cluster` command to stop on all nodes. This command instructs to connect to each node on the cluster and instruct the existing members to shut down. The command has no effect on running databases, but when the command completes, there is no failover protection in place.

Please note: When you invoke the `efm stop-cluster` command, all authorized node information is removed from the Allowed node host list.

This command must be invoked by `efm` , a member of the `efm` group, or root.

`efm upgrade-conf <cluster_name> [-source <directory>]`

Invoke the `efm upgrade-conf` command to copy the configuration files from an existing installation, and add parameters required by a installation. Provide the name of the previous cluster when invoking the utility. This command must be invoked with root privileges.

If you are upgrading from a configuration that does not use sudo, include the `-source` flag and specify the name of the *directory* in which the configuration files reside when invoking upgrade-conf.

`efm node-status-json <cluster_name>`

Invoke the `efm node-status-json` command to display the status of a local node in json format.

A successful execution of this command returns `0` as its exit code. In case of a database failure or an agent status becoming IDLE, the command returns `1` as exit code.

The following is an example output of the `efm node-status-json` command:

```
{
  "type":"Standby",
  "address":"172.16.144.130",
  "agent":"UP",
  "db":"UP",
  "vip":"",
  "vip_active":"false"
}
```

`efm --help`

Invoke the `efm --help` command to display online help for the Failover Manager utility commands.

3.8 Controlling the Failover Manager Service

Each node in a cluster hosts a agent that is controlled by a service script. By default, the service script expects to find:

- A configuration file named `efm.properties` that contains the properties used by the service. Each node of a replication scenario must contain a properties file that provides information about the node.
- A cluster members file named `efm.nodes` that contains a list of the cluster members. Each node of a replication scenario must contain a cluster members list.

Note that if you are running multiple clusters on a single node you will need to manually create configuration files with cluster-specific names and modify the service script for the corresponding clusters.

The commands that control the service are platform-specific.

Using the service Utility on RHEL 6.x and CentOS 6.x

On RHEL 6.x and CentOS 6.x, runs as a Linux service named (by default) edb-efm- that is located in /etc/init.d. Each database cluster monitored by will run a copy of the service on each node of the replication cluster.

Use the following service commands to control a agent that resides on a RHEL 6.x or CentOS 6.x host:

service edb-efm- start

The start command starts the agent on the current node. The local agent monitors the local database and communicates with on the other nodes. You can start the nodes in a cluster in any order. This command must be invoked by root.

service edb-efm- stop

Stop the on the current node. This command must be invoked by root.

service edb-efm- status

The status command returns the status of the agent on which it is invoked. You can invoke the status command on any node to instruct to return status information. For example:

[witness@localhost ~]# service edb-efm- status edb-efm- (pid 50836) is running...

service edb-efm- help

Display online help for the service script.

Using the systemctl Utility on RHEL/CentOS 7.x and RHEL/CentOS 8.x

On RHEL/CentOS 7.x and RHEL/CentOS 8.x, runs as a Linux service named (by default) `edb-efm-4.0.service` that is located in `/usr/lib/systemd/system` . Each database cluster monitored by Failover Manager will run a copy of the service on each node of the replication cluster.

Use the following systemctl commands to control a agent that resides on a RHEL/CentOS 7.x and RHEL/CentOS 8.x host:

systemctl start edb-efm-

The start command starts the agent on the current node. The local agent monitors the local database and communicates with on the other nodes. You can start the nodes in a cluster in any order. This command must be invoked by root.

systemctl stop edb-efm-

Stop the on the current node. This command must be invoked by root.

systemctl status edb-efm-

The status command returns the status of the agent on which it is invoked. You can invoke the status command on any node to instruct to return status and server startup information.

[root@ONE ~]}> systemctl status edb-efm-
edb-efm-.service - EnterpriseDB Failover Manager
Loaded: loaded (/usr/lib/systemd/system/edb-efm-.service; disabled; vendor preset: disabled) Active: active (running) since Wed 2013-02-14 14:02:16 EST; 4s ago

Process: 58125 ExecStart=/bin/bash -c /usr/edb/edb-efm-/bin/runefm.sh start ${CLUSTER} (code=exited, status=0/SUCCESS) Main PID: 58180 (java) CGroup: /system.slice/edb-efm-.service └─58180 /usr/lib/jvm/java-1.8.0-openjdk-1.8.0.161-0.b14.el7_4.x86_64/jre/bin/java -cp /usr/edb/edb-efm-/lib/EFM-.0.jar -Xmx128m -agentlib:jdwp=transport...

3.9 Controlling Logging

writes and stores one log file per agent and one startup log per agent in `/var/log/<cluster_name>-4.0` (where `<cluster_name>` specifies the name of the cluster).

You can control the level of detail written to the agent log by modifying the `jgroups.loglevel` and `efm.loglevel` parameters in the cluster properties file:

```
# Logging levels for JGroups and EFM.
# Valid values are: TRACE, DEBUG, INFO, WARN, ERROR
# Default value: INFO
# It is not necessary to increase these values unless debugging a
# specific issue. If nodes are not discovering each other at
# startup, increasing the jgroups level to DEBUG will show
# information about the TCP connection attempts that may help
# diagnose the connection failures.
jgroups.loglevel=INFO
efm.loglevel=INFO
```

The logging facilities use the Java logging library and logging levels. The log levels (in order from most logging output to least) are:

- `TRACE`
- `DEBUG`
- `INFO`
- `WARN`
- `ERROR`

For example, if you set the `efm.loglevel` parameter to `WARN`, Failover Manager will only log messages at the `WARN` level and above (`WARN` and `ERROR`).

By default, log files are rotated daily, compressed, and stored for a week. You can modify the file rotation schedule by changing settings in the log rotation file (`/etc/logrotate.d/efm-4.0`). For more information about modifying the log rotation schedule, consult the logrotate man page:

```
$ man logrotate
```

Enabling syslog Log File Entries

supports syslog logging. To implement syslog logging, you must configure syslog to allow UDP or TCP connections.

To allow a connection to syslog, edit the `/etc/rsyslog.conf` file and uncomment the protocol you wish to use. You must also ensure that the `UDPServerRun` or `TCPServerRun` entry associated with the protocol includes the port number to which log entries will be sent. For example, the following configuration file entries enable UDP connections to port 514:

```
# Provides UDP syslog reception
$ModLoad imudp
$UDPServerRun 514
```

The following configuration file entries enable TCP connections to port 514:

```
# Provides TCP syslog reception
$ModLoad imtcp
$InputTCPServerRun 514
```

After modifying the syslog configuration file, restart the `rsyslog` service to enable the connections:

```
systemctl restart rsyslog.service
```

After modifying the `rsyslog.conf` file on the host, you must modify the properties to enable logging. Use your choice of editor to modify the properties file (`/etc/edb/efm-4.0/efm.properties.in`) specifying the type of logging that you wish to implement:

```
# Which logging is enabled.
file.log.enabled=true
syslog.enabled=false
```

You must also specify syslog details for your system. Use the `syslog.protocol` parameter to specify the protocol type (UDP or TCP) and the `syslog.port` parameter to specify the listener port of the syslog host. The `syslog.facility` value may be used as an identifier for the process that created the entry; the value must be between `LOCAL0` and `LOCAL7` .

```
# Syslog information. The syslog service must be listening # on the
 port for the given protocol, which can be UDP or
# TCP. The facilities supported are LOCAL0 through LOCAL7.
# syslog.host=localhost
syslog.port=514
syslog.protocol=UDP
syslog.facility=LOCAL1
```

For more information about syslog, please see the syslog man page:

```
syslog man
```

3.10 Notifications

will send e-mail notifications and/or invoke a notification script when a notable event occurs that affects the cluster. If you have configured to send an email notification, you must have an SMTP server running on port 25 on each node of the cluster. Use the following parameters to configure notification behavior for :

```
user.email
script.notification
from.email
```

For more information about editing the configuration properties, see `Specifying Cluster Properties <cluster_pro`
.

The body of the notification contains details about the event that triggered the notification, and about the current state of the cluster. For example:

```
EFM node: 10.0.1.11
Cluster name: acctg
Database name: postgres
VIP: ip_address (Active|Inactive)
Database health is not being monitored.
```

The VIP field displays the IP address and state of the virtual IP if implemented for the node.

assigns a severity level to each notification. The following levels indicate increasing levels of attention required:

- `INFO` indicates an informational message about the agent and does not require any manual intervention (for example, has started or stopped). See List of INFO level notifications
- `WARNING` indicates that an event has happened that requires the administrator to check on the system (for example, failover has occurred). See List of WARNING level notifications
- `SEVERE` indicates that a serious event has happened and requires the immediate attention of the administrator (for example, failover was attempted, but was unable to complete). See List of SEVERE level notifications

The severity level designates the urgency of the notification. A notification with a severity level of `SEVERE` requires user attention immediately, while a notification with a severity level of `INFO` will call your attention to operational information about your cluster that does not require user action. Notification severity levels are not related to logging levels; all notifications are sent regardless of the log level detail specified in the configuration file.

You can use the notification.level property to specify the minimum severity level that will trigger a notification.

Please note: : In addition to sending notices to the administrative email address, all notifications are recorded in the cluster log file (`/var/log/efm-4.0/<cluster_name>.log`).

The conditions listed in the table below will trigger an `INFO` level notification:

The conditions listed in the table below will trigger a *WARNING* level notification:

The conditions listed in the table below will trigger a *SEVERE* notification:

3.11 Supported Failover and Failure Scenarios

monitors a cluster for failures that may or may not result in failover.

supports a very specific and limited set of failover scenarios. Failover can occur:

- if the Primary database crashes or is shutdown.
- if the node hosting the Primary database crashes or becomes unreachable.

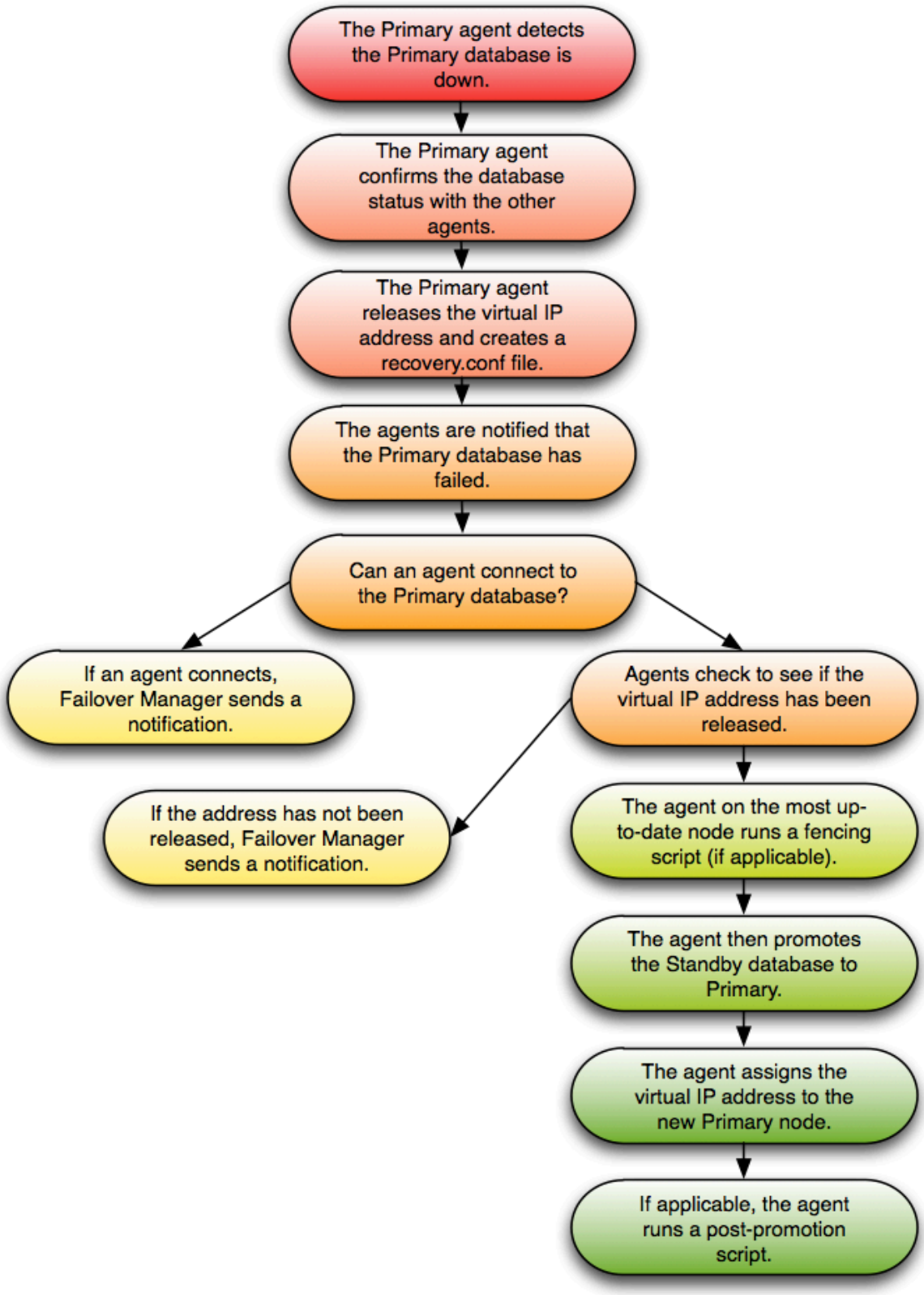
makes every attempt to verify the accuracy of these conditions. If agents cannot confirm that the Primary database or node has failed, will not perform any failover actions on the cluster.

also supports a *no auto-failover* mode for situations where you want to monitor and detect failover conditions, but not perform an automatic failover to a Standby. In this mode, a notification is sent to the administrator when failover conditions are met. To disable automatic failover, modify the cluster properties file, setting the auto.failover parameter to false.

will alert an administrator to situations that require administrator intervention, but that do not merit promoting a Standby database to Primary.

Primary Database is Down

If the agent running on the Primary database node detects a failure of the Primary database, begins the process of confirming the failure.



If the agent on the Primary node detects that the Primary database has failed, all agents attempt to connect directly to the Primary database. If an agent can connect to the database, sends a notification about the state of the Primary node. If no agent can connect, the Primary agent declares database failure and releases the VIP (if applicable).

If no agent can reach the virtual IP address or the database server, starts the failover process. The Standby agent on the most up-to-date node runs a fencing script (if applicable), promotes the Standby database to Primary database, and assigns the virtual IP address to the Standby node. Any additional Standby nodes are configured to replicate from the new primary unless auto.reconfigure is set to false. If applicable, the agent

runs a post-promotion script.

Returning the Node to the Cluster

To recover from this scenario without restarting the entire cluster, you should:

1. Restart the database on the original Primary node as a Standby database.
2. Invoke the `efm resume` command on the original Primary node.

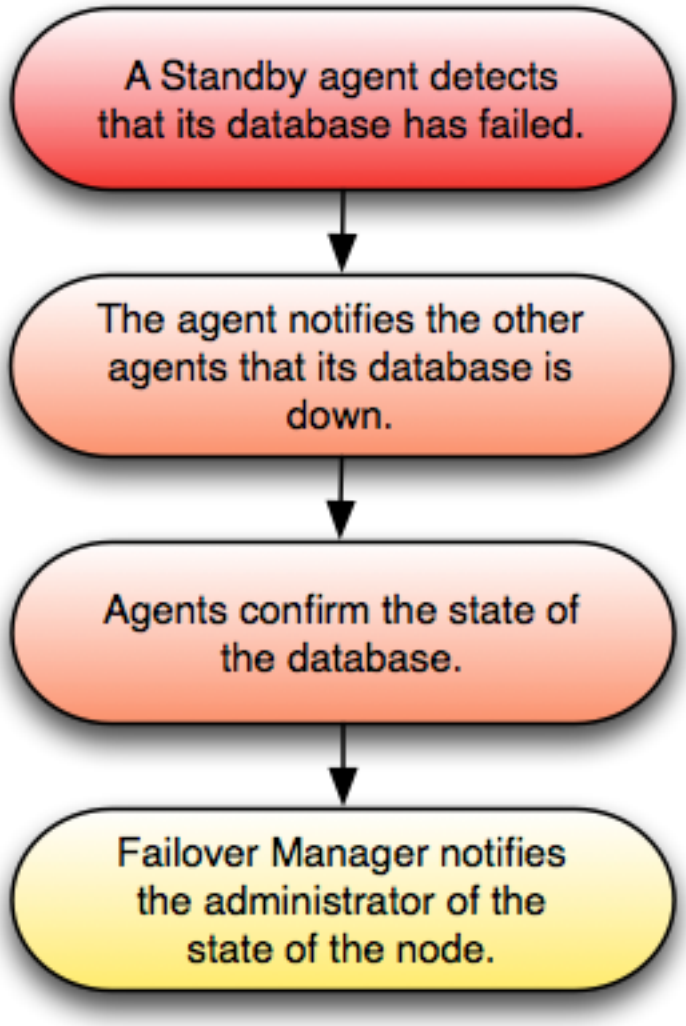
Returning the Node to the Role of Primary

After returning the node to the cluster as a Standby, you can easily return the node to the role of Primary:

1. If the cluster has more than one Standby node, use the `efm set-priority` command to set the node's failover priority to 1.
2. Invoke the efm promote -switchover command to promote the node to its original role of Primary node.

Standby Database is Down

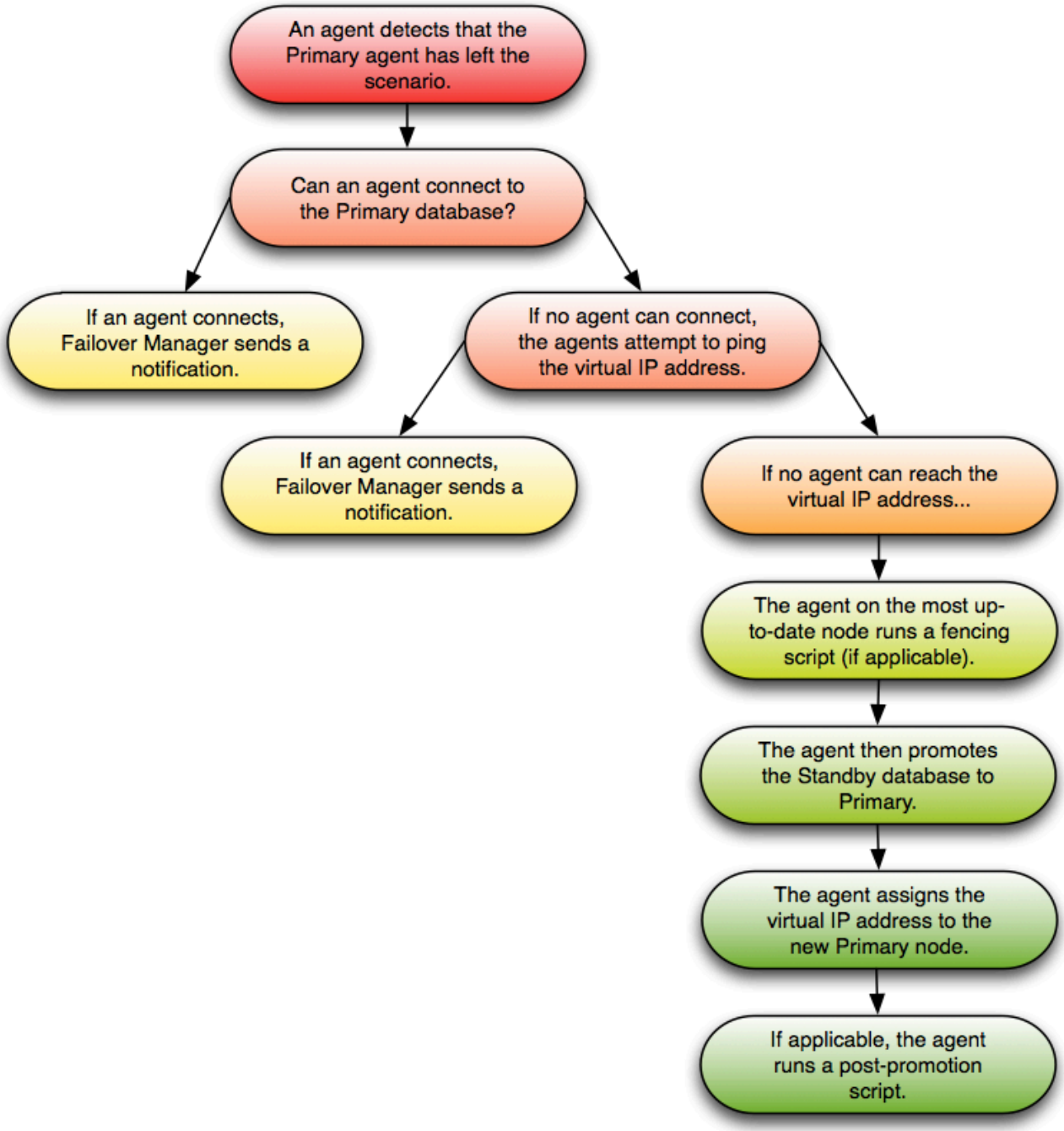
If a Standby agent detects a failure of its database, the agent notifies the other agents; the other agents confirm the state of the database.



After returning the Standby database to a healthy state, invoke the `efm resume` command to return the Standby to the cluster.

Primary Agent Exits or Node Fails

If the Primary agent crashes or the node fails, a Standby agent will detect the failure and (if appropriate) initiate a failover.



If an agent detects that the Primary agent has left, all agents attempt to connect directly to the Primary database. If any agent can connect to the database, an agent sends a notification about the failure of the Primary agent. If no agent can connect, the agents attempt to ping the virtual IP address to determine if it has been released.

If no agent can reach the virtual IP address or the database server, starts the failover process. The Standby agent on the most up-to-date node runs a fencing script (if applicable), promotes the Standby database to Primary database, and assigns the virtual IP address to the Standby node; if applicable, the agent runs a post-promotion script. Any additional Standby nodes are configured to replicate from the new primary unless auto.reconfigure is set to false.

If this scenario has occurred because the primary has been isolated from network, the Primary agent will detect the isolation and release the virtual IP address and create the recovery.conf file. will perform the previously listed steps on the remaining nodes of the cluster.

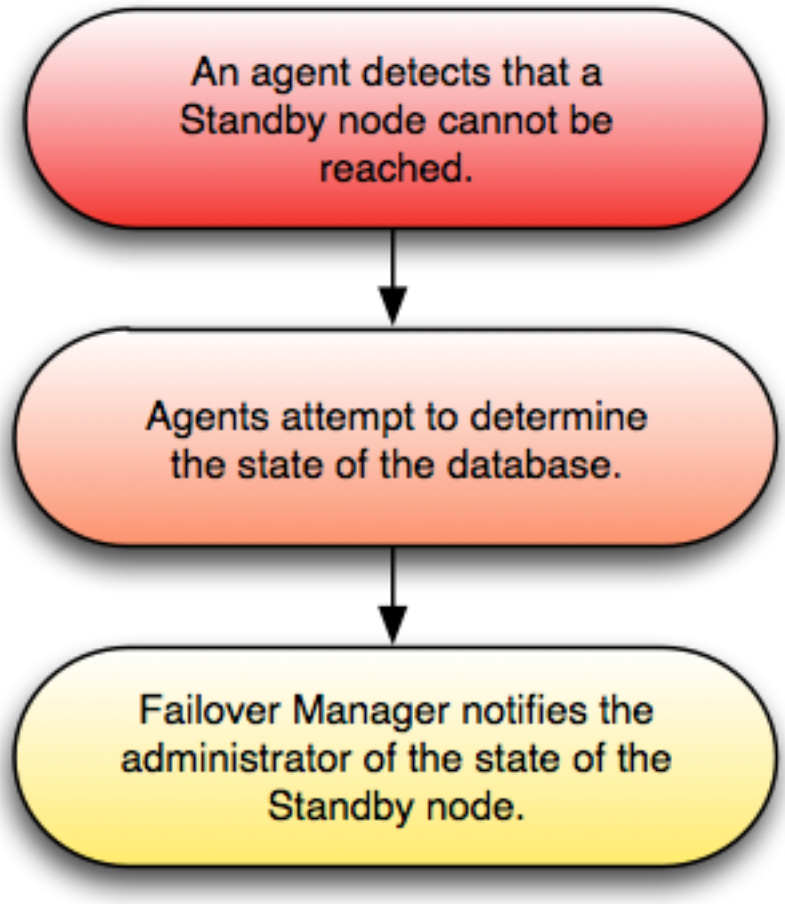
To recover from this scenario without restarting the entire cluster, you should:

1. Restart the original Primary node.
2. Bring the original Primary database up as a Standby node.
3. Start the service on the original Primary node.

Please note that stopping an agent does not signal the cluster that the agent has failed.

Standby Agent Exits or Node Fails

If a Standby agent exits or a Standby node fails, the other agents will detect that it is no longer connected to the cluster.

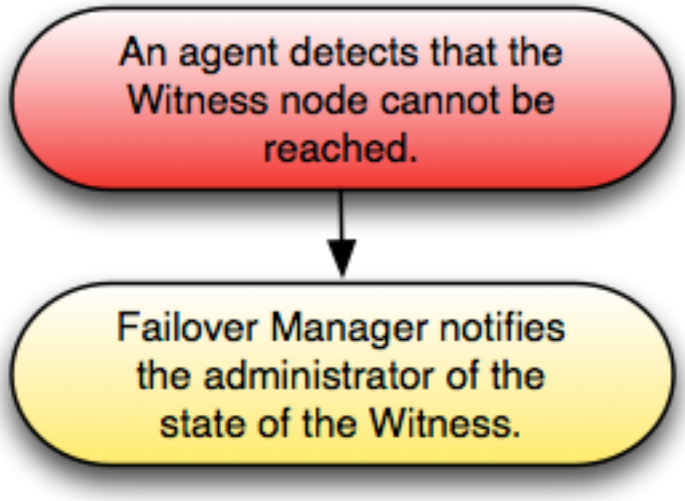


When the failure is detected, the agents attempt to contact the database that resides on the node; if the agents confirm that there is a problem, sends the appropriate notification to the administrator.

If there is only one Primary and one Standby remaining, there is no failover protection in the case of a Primary node failure. In the case of a Primary database failure, the Primary and Standby agents can agree that the database failed and proceed with failover.

Dedicated Witness Agent Exits / Node Fails

The following scenario details the actions taken if a dedicated Witness (a node that is not hosting a database) fails.

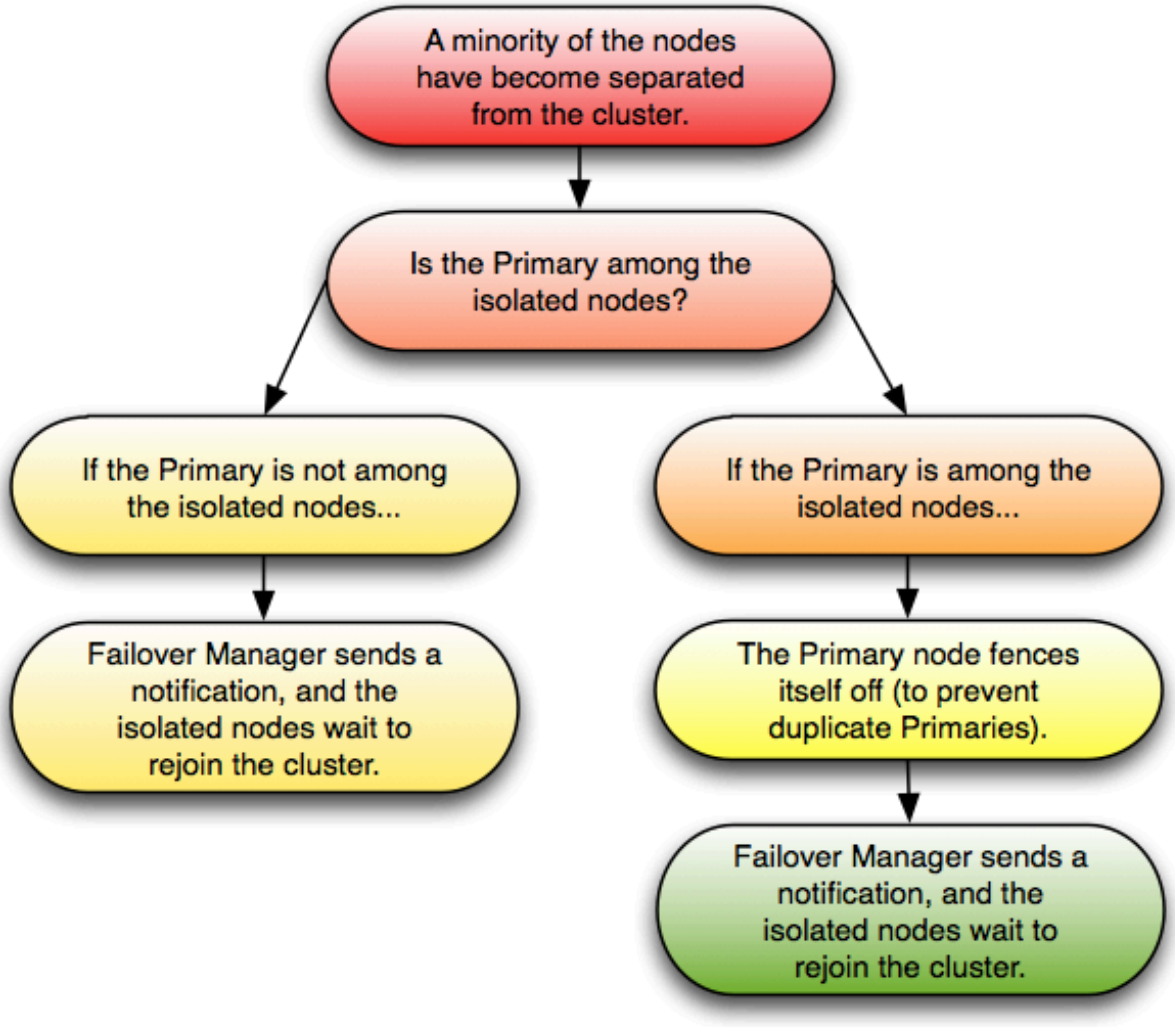


When an agent detects that the Witness node cannot be reached, Failover Manager notifies the administrator of the state of the Witness.

Note: If the witness fails and the cluster only has two nodes, then there is no failover protection because the standby node has no way to know if the primary failed or was disconnected. In a two node cluster, if the primary database fails but the nodes are still connected, failover will still occur since the standby can confirm the condition of the primary database.

Nodes Become Isolated from the Cluster

The following scenario details the actions taken if one or more nodes (a minority of the cluster) become isolated from the majority of the cluster.



If one or more nodes (but less than half of the cluster) become isolated from the rest of the cluster, the remaining cluster behaves as if the nodes have failed. The agents attempt to discern if the Primary node is among the isolated nodes; it is, the Primary fences itself off from the cluster, while a Standby node (from within the cluster majority) is promoted to replace it. Other Standby nodes are configured to replicate from the new primary unless `auto.reconfigure` is set to `false` .

then notifies an administrator, and the isolated nodes rejoin the cluster when they are able. When the nodes rejoin the cluster, the failover priority may change.

3.12 Upgrading an Existing Cluster

provides a utility to assist you when upgrading a cluster. To upgrade an existing cluster, you must:

1. Install on each node of the cluster. For detailed information about installing , see `Installing Failover Manager <` .
2. After installing , invoke the `efm upgrade-conf` utility to create the `.properties` and `.nodes` files for Failover Manager . The installer installs the upgrade utility (efm upgrade-conf) to the `/usr/edb/efm-4.0/bin directory` . To invoke the utility, assume root privileges, and invoke the command:

   ```
   efm upgrade-conf <cluster_name>
   ```

   The efm `upgrade-conf` utility locates the `.properties` and `.nodes` files of pre-existing clusters and copies the parameter values to a new configuration file for use by . The utility saves the updated

copy of the configuration files in the `/etc/edb/efm-4.0` directory.

3. Modify the `.properties` and `.nodes` files for EFM , specifying any new preferences.

   Use your choice of editor to modify any additional properties in the properties file (located in the `/etc/edb/efm-4.0` directory) before starting the service for that node. For detailed information about property settings, see `The Cluster Properties File <cluster_properties>` .

Note

As of version 3.6, `db.bin` is a required property. When modifying the properties file, ensure that the `db.bin` property specifies the location of the Postgres `bin` directory.

1. Use a version-specific command to stop the old cluster; for example, you can use the following command to stop a version 3.10 cluster:

   ```
   /usr/efm-3.10/bin/efm stop-cluster efm
   ```

2. Start the new `Failover manager service <controlling_efm_service>` (`edb-efm-4.0`) on each node of the cluster.

The following example demonstrates invoking the upgrade utility to create the `.properties` and `.nodes` files for a installation:

```
[root@localhost efm-4.0]# /usr/edb/efm-4.0/bin/efm upgrade-conf efm
Checking directory /etc/edb/efm-3.10
Processing efm.properties file

The following properties were added in addition to those in previous installed version:
notification.text.prefix
encrypt.agent.messages
standby.restart.delay

The following properties were renamed from those in previous installed version:
stop.failed.master => stop.failed.primary
master.shutdown.as.failure => primary.shutdown.as.failure
script.master.isolated => script.primary.isolated
stop.isolated.master => stop.isolated.primary
reconfigure.sync.master => reconfigure.sync.primary

Checking directory /etc/edb/efm-3.10
Processing efm.nodes file

db.password.encrypted re-encoded with stronger encryption.

Upgrade of files is finished. The owner and group for properties and nodes files have been set as 'e
[root@localhost efm-4.0]#
```

If you are using a Failover Manager configuration without sudo, include the `-source` flag and specify the name of the directory in which the configuration files reside when invoking `upgrade-conf` . If the directory is not the configuration default directory, the upgraded files will be created in the directory from which the `upgrade-conf` command was invoked.

Please note: : If you are using a custom service script or unit file, you must manually update the file to reflect the new service name when you perform an upgrade.

Un-installing Failover Manager

After upgrading to , you can use your native package manager to remove previous installations of . For example, use the following command to remove 3.10 and any unneeded dependencies:

- On RHEL or CentOS 6.x or 7.x:

  ```
  yum remove edb-efm310
  ```

- On RHEL or CentOS 8.x:

```
dnf remove edb-efm310
```

- On Debian or Ubuntu:

```
apt-get remove edb-efm310
```

- On SLES:

```
zypper remove edb-efm310
```

Performing a Database Update (Minor Version)

This section describes how to perform a quick minor database version upgrade. You can use the steps that follow to upgrade from one minor version to another (for example, from 10.1.5 to version 10.2.7), or to apply a patch release for a version.

You should first update the database server on each Standby node of the cluster. Then, perform a switchover, promoting a Standby node to the role of Primary within the cluster. Then, perform a database update on the old primary node.

On each node of the cluster you must perform the following steps to update the database server:

1. Stop the agent.
2. Stop the database server.
3. Update the database server.
4. Start the database service.
5. Start the agent.

For detailed information about controlling the Advanced Server service, or upgrading your version of Advanced Server, please see the EDB Postgres Advanced Server Guide, available at:

https://www.enterprisedb.com/resources/product-documentation

When your updates are complete, you can use the efm set-priority command to add the old primary to the front of the standby list, and then switchover to return the cluster to its original state.

3.13 Troubleshooting

Authorization file not found. Is the local agent running?

If you invoke an EFM cluster management command and EFM is not running on the node, the `efm` command will display an error:

```
Authorization file not found. Is the local agent running?
```

Not authorized to run this command. User '<os user>' is not a member of the 'efm' group.

You must have special privileges to invoke some of the `efm` commands documented in `Using the efm Utility <usin`

. If these commands are invoked by a user who isn't authorized to run them, the `efm` command will display an error:

```
Not authorized to run this command. User '<os user>' is not a member of the `efm` group.
```

Notification; Unexpected error message

If you receive a notification message about an unexpected error message, check the `|variable_prod_name| log file`

for an `OutOfMemory` message. runs with the default memory value set by this property:

```
# Extra information that will be passed to the JVM when starting the agent.
jvm.options=-Xmx128m
```

If you are running with less than 128 megabytes allocated, you should increase the value and restart the agent.

Confirming the OpenJDK version

is tested with OpenJDK; we strongly recommend using OpenJDK. You can use the following command to check the type of your Java installation:

```
# java -version
openjdk version "1.8.0_191"
OpenJDK Runtime Environment (build 1.8.0_191-b12)
OpenJDK 64-Bit Server VM (build 25.191-b12, mixed mode)
```

3.14 Configuring Streaming Replication

Configuring a replication scenario can be complex; for detailed information about configuration options, please see the PostgreSQL core documentation, available at:

https://www.postgresql.org/docs/current/static/warm-standby.html#streaming-replication

You may want to use a `.pgpass` file to enable md5 authentication for the replication user – this may or may not be the safest authentication method for your environment. For more information about the supported authentication options, please see the PostgreSQL core documentation at:

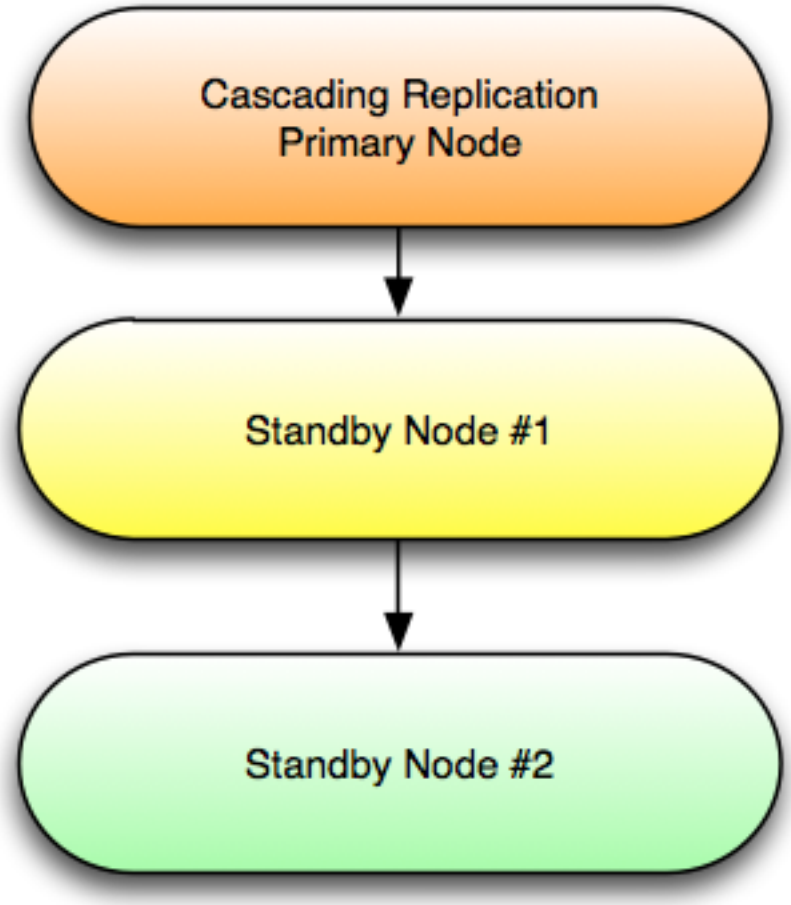
https://www.postgresql.org/docs/current/static/client-authentication.html

Note

From Version 3.10 onwards, EFM uses `pg_ctl` utility for standby promotion. You do not need to set the `trigger_file` or `promote_trigger_file` parameter for promotion of a standby server.

Limited Support for Cascading Replication

While does not provide full support for cascading replication, it does provide limited support for simple failover in a cascading replication scenario. Cascading replication allows a Standby node to stream to another Standby node, reducing the number of connections (and processing overhead) to the primary node.



For detailed information about configuring cascading replication, please see the PostgreSQL documentation at:

https://www.postgresql.org/docs/current/static/warm-standby.html#cascading-replication

To use in a cascading replication scenario, you should modify the cluster properties file, setting the following property values on Standby Node #2:

```
promotable=false
auto.reconfigure=false
```

In the event of a Failover, Standby Node #1 will be promoted to the role of Primary node. Should failover occur, Standby Node #2 will continue to act as a read-only replica for the new Primary node until you take actions to manually reconfigure the replication scenario to contain 3 nodes.

In the event of a failure of Standby Node #1, you will not have failover protection, but you will receive an email notifying you of the failure of the node.

Please note that performing a switchover and switch back to the original primary may not preserve the cascading replication scenario.

3.15 Configuring SSL Authentication on a Failover Manager Cluster

The following steps enable SSL authentication for . Please note that all connecting clients will be required to use SSL authentication when connecting to any database server within the cluster; you will be required to modify the connection methods currently used by existing clients.

To enable SSL on a cluster, you must:

1. Place a `server.crt` and `server.key` file in the `data` directory (under your Advanced Server installation). You can purchase a certificate signed by an authority, or create your own self-signed cer-

tificate. For information about creating a self-signed certificate, see the PostgreSQL core documentation at:

https://www.postgresql.org/docs/10/static/ssl-tcp.html#ssl-certificate-creation

2. Modify the `postgresql.conf` file on each database within the Failover Manager cluster, enabling SSL:

   ```
   ssl=on
   ```

   After modifying the postgresql.conf file, you must restart the server.

3. Modify the `pg_hba.conf` file on each node of the cluster, adding the following line to the beginning of the file:

   ```
   hostnossl all all all reject
   ```

   The line instructs the server to reject any connections that are not using SSL authentication; this enforces SSL authentication for any connecting clients. For information about modifying the pg_hba.conf file, see the PostgreSQL core documentation at:

   https://www.postgresql.org/docs/10/static/auth-pg-hba-conf.html

4. After placing the server.crt and server.key file in the data directory, convert the certificate to a form that Java understands; you can use the command:

   ```
   openssl x509 -in server.crt -out server.crt.der -outform der
   ```

   For more information, visit:

https://jdbc.postgresql.org/documentation/94/ssl-client.html

1. Then, add the certificate to the Java trusted certificates file:

   ```
   keytool -keystore $JAVA_HOME/lib/security/cacerts -alias <alias_name> -import -file serve
   ```

   Where

   `$JAVA_HOME` is the home directory of your Java installation.

   <alias_name> can be any string, but must be unique for each certificate.

   You can use the `keytool` command to review a list of the available certificates or retrieve information about a specific certificate. For more information about using the keytool command, enter:

   ```
   man keytool
   ```

   The certificate from each database server must be imported into the trusted certificates file of each agent. Note that the location of the cacerts file may vary on each system. For more information, visit:

https://jdbc.postgresql.org/documentation/94/ssl-client.html

1. Modify the efm.properties file on each node within the cluster, setting the `jdbc.sslmode` property.