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Standard Operating Procedure (SOP) for PostgreSQL 17 HA Cluster with Patroni, Etcd, HAProxy, and Keepalived

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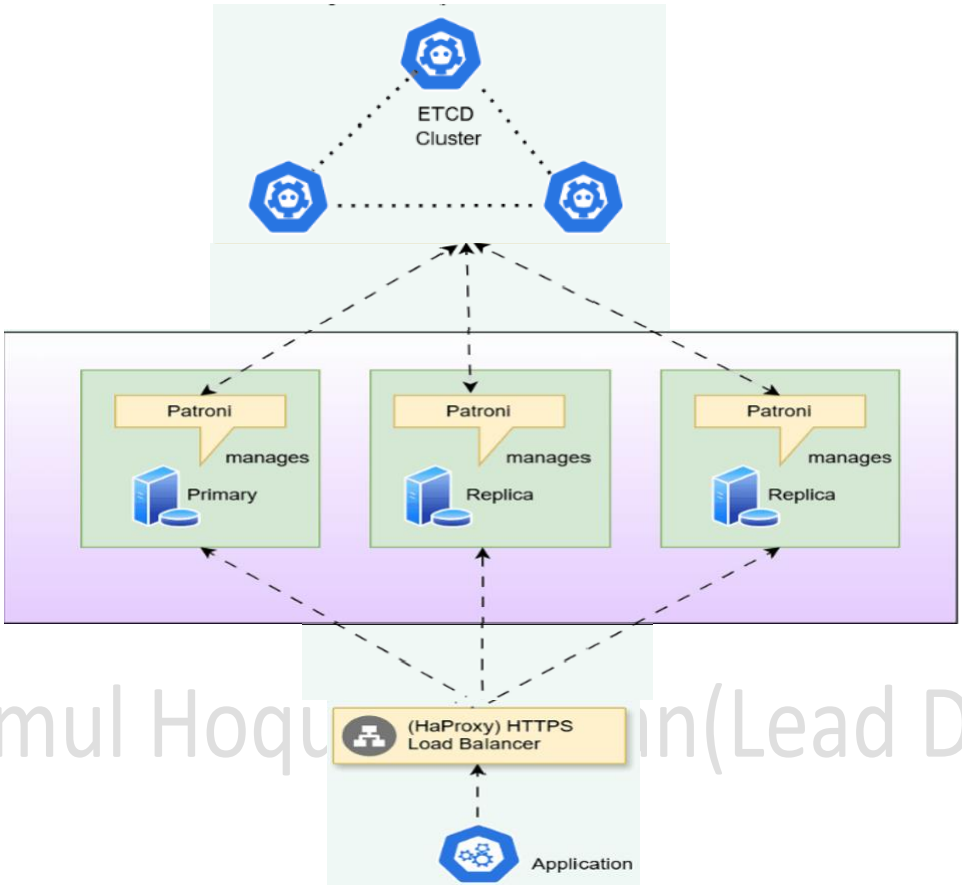

1. Overview

This SOP provides a step-by-step guide to setting up a highly available PostgreSQL 17 cluster using Patroni, Etcd, HAProxy, and Keepalived. The architecture ensures automatic failover, load balancing, and seamless replication.

Architecture Overview

- **Etcd Cluster**: Manages cluster state and configuration.
- **Patroni**: Controls PostgreSQL high availability (HA), failover, and replication.
- **HAProxy**: Load balances traffic across PostgreSQL nodes.
- **Keepalived**: Provides a floating Virtual IP (VIP) for seamless failover.

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Cluster Details:

Hostname	IP Address	Purpose
Node1	192.168.56.114	etcd, HAProxy, Keepalived, Patroni, PostgreSQL
Node2	192.168.56.118	etcd, HAProxy, Keepalived, Patroni, PostgreSQL
Node3	192.168.56.119	etcd, HAProxy, Keepalived, Patroni, PostgreSQL
HAProxy VIP	192.168.56.121	High-Availability Virtual IP

2. Pre-requisites

2.1 Create PostgreSQL User on All Machines

useradd postgres

passwd postgres

echo "postgres ALL=(ALL) NOPASSWD:ALL" >> /etc/sudoers

2.2 Set Hostnames and Update Hosts File

hostnamectl set-hostname node1 # Repeat for node2 and node3

Edit /etc/hosts on all nodes:

192.168.56.114 node1

192.168.56.118 node2

192.168.56.119 node3

2.3 Disable SELinux and Firewall

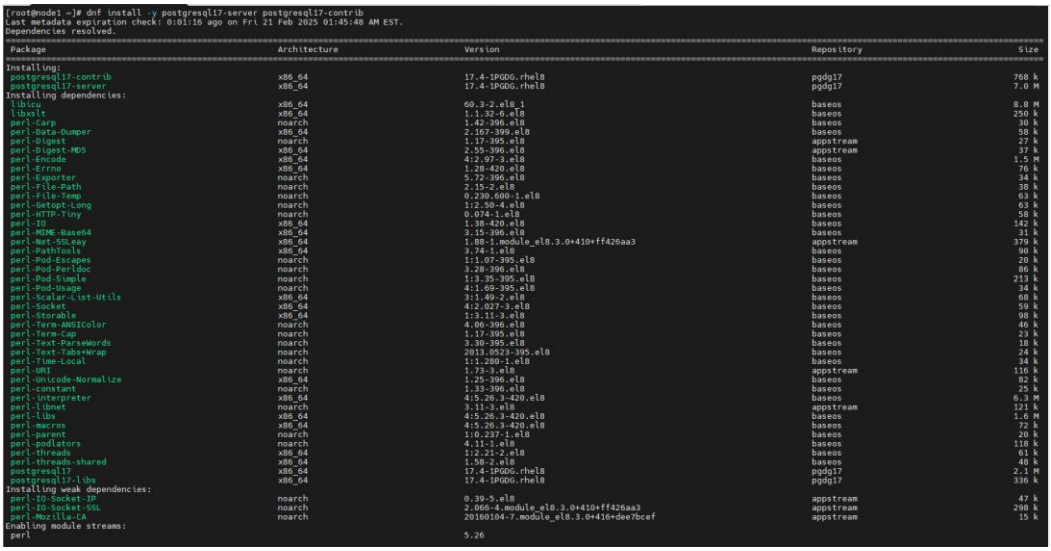
vi /etc/selinux/config # Set SELINUX=disabled

systemctl stop firewalld && systemctl disable firewalld

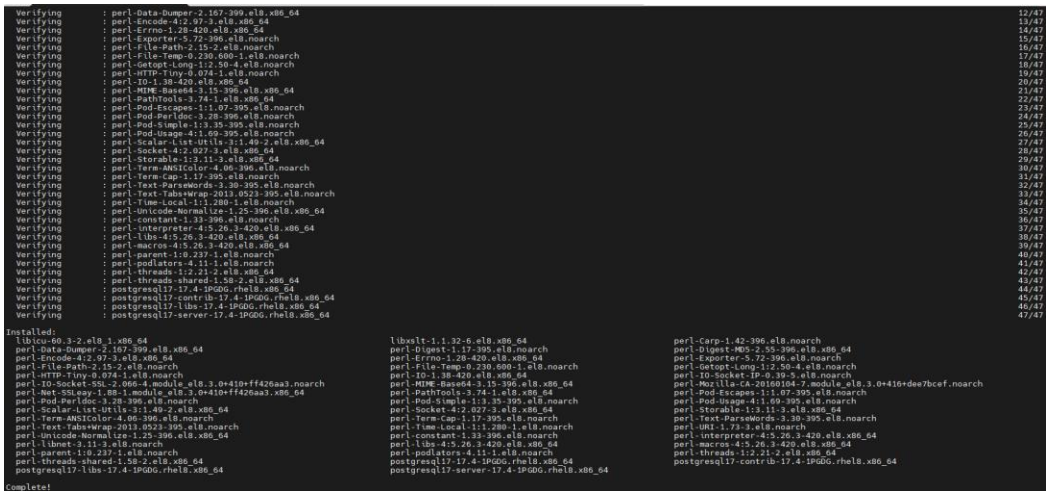
reboot

2.4 Install PostgreSQL 17

dnf install -y postgresql17-server postgresql17-contrib



```
[root@node1 ~]# dnf install -y postgresql17-server postgresql17-contrib
Last metadata expiration check: 0:01:16 ago on Fri 21 Feb 2025 01:45:48 AM EST.
Dependencies resolved.
================================================================================
 Package                 Architecture  Version                    Repository  Size
================================================================================
Installing:
 postgresql17-contrib    x86_64        17.4-1PGDG.rhel8           pgdg17     768 k
 postgresql17-server     x86_64        17.4-1PGDG.rhel8           pgdg17     7.0 M
Installing dependencies:
 libicu                  x86_64        60.3-2.el8_1               baseos     8.8 M
 libxslt                 x86_64        1.1.32-6.el8               baseos     250 k
 perl-Carp               noarch        1.42-396.el8               baseos      30 k
 perl-Data-Dumper        x86_64        2.167-399.el8              baseos      58 k
 perl-Digest             noarch        1.17-395.el8               appstream   27 k
 perl-Digest-MD5         x86_64        2.55-396.el8               appstream   37 k
 perl-Encode             x86_64        4:2.97-3.el8               baseos     1.5 M
 perl-Errno              x86_64        1.28-420.el8               baseos      76 k
 perl-Exporter           noarch        5.72-396.el8               baseos      34 k
 perl-File-Path          noarch        2.15-2.el8                 baseos      38 k
 perl-File-Temp          noarch        0.230.600-1.el8            baseos      63 k
 perl-Getopt-Long        noarch        1:2.50-4.el8               baseos      63 k
 perl-HTTP-Tiny          noarch        0.074-1.el8                baseos      58 k
 perl-IO                 x86_64        1.38-420.el8               baseos     142 k
 perl-MIME-Base64        x86_64        3.15-396.el8               baseos      31 k
 perl-Net-SSLeay         x86_64        1.88-1.module_el8.3.0+410+ff426aa3 appstream 379 k
 perl-PathTools          x86_64        3.74-1.el8                 baseos      90 k
 perl-Pod-Escapes        noarch        1:1.07-395.el8             baseos      20 k
 perl-Pod-Perldoc        noarch        3.28-396.el8               baseos      86 k
 perl-Pod-Simple         noarch        1:3.35-395.el8             baseos     213 k
 perl-Pod-Usage          noarch        4:1.69-395.el8             baseos      34 k
 perl-Scalar-List-Utils  x86_64        3:1.49-2.el8               baseos      68 k
 perl-Socket             x86_64        4:2.027-3.el8              baseos      59 k
 perl-Storable           x86_64        1:3.11-3.el8               baseos      98 k
 perl-Term-ANSIColor     noarch        4.06-396.el8               baseos      46 k
 perl-Term-Cap           noarch        1.17-395.el8               baseos      23 k
 perl-Text-ParseWords    noarch        3.30-395.el8               baseos      18 k
 perl-Text-Tabs+Wrap     noarch        2013.0523-395.el8          baseos      24 k
 perl-Time-Local         noarch        1:1.280-1.el8              baseos      34 k
 perl-URI                noarch        1.73-3.el8                 appstream  116 k
 perl-Unicode-Normalize  x86_64        1.25-396.el8               baseos      82 k
 perl-constant           noarch        1.33-396.el8               baseos      25 k
 perl-interpreter        x86_64        4:5.26.3-420.el8           baseos     6.3 M
 perl-libnet             noarch        3.11-3.el8                 appstream  121 k
 perl-libs               x86_64        4:5.26.3-420.el8           baseos     1.6 M
 perl-macros             x86_64        4:5.26.3-420.el8           baseos      72 k
 perl-parent             noarch        1:0.237-1.el8              baseos      20 k
 perl-podlators          noarch        4.11-1.el8                 baseos     118 k
 perl-threads            x86_64        1:2.21-2.el8               baseos      61 k
 perl-threads-shared     x86_64        1.58-2.el8                 baseos      48 k
 postgresql17            x86_64        17.4-1PGDG.rhel8           pgdg17     2.1 M
 postgresql17-libs       x86_64        17.4-1PGDG.rhel8           pgdg17     336 k
Installing weak dependencies:
 perl-IO-Socket-IP       noarch        0.39-5.el8                 appstream   47 k
 perl-IO-Socket-SSL      noarch        2.066-4.module_el8.3.0+410+ff426aa3 appstream 298 k
 perl-Mozilla-CA         noarch        20160104-7.module_el8.3.0+416+dee7bcef appstream 15 k
Enabling module streams:
 perl                                  5.26
```



3. Set Up Etcd

3.1 Install Etcd

wget https://github.com/etcd-io/etcd/releases/download/v3.5.10/etcd-v3.5.10-linux-amd64.tar.gz

tar -xvf etcd-v3.5.10-linux-amd64.tar.gz

mv etcd-v3.5.10-linux-amd64/etcd* /usr/local/bin/

mkdir -p /etc/etcd /var/lib/etcd


```
[root@node1 ~]# wget https://github.com/etcd-io/etcd/releases/download/v3.5.10/etcd-v3.5.10-linux-amd64.tar.gz
--2025-02-21 01:57:34--  https://github.com/etcd-io/etcd/releases/download/v3.5.10/etcd-v3.5.10-linux-amd64.tar.gz
Resolving github.com (github.com)... 20.205.243.166
Connecting to github.com (github.com)|20.205.243.166|:443... connected.
HTTP request sent, awaiting response... 302 Found
Location: https://objects.githubusercontent.com/github-production-release-asset-2e65be/11225014/05fd2993-25ce-40b0-91f0-6088bd797753?X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=releaseassetproduction%2F20250221%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Date=20250221T065734Z&X-Amz-Expires=300&X-Amz-Signature=1c168cee51854dd191dc9c6b2c73bae289dc7f1deefe5a261e678229961 0e69d&X-Amz-SignedHeaders=host&response-content-disposition=attachment%3B%20filename%3Detcd-v3.5.10-linux-amd64.tar.gz&response-content-type=application%2Foctet-stream [following]
--2025-02-21 01:57:34--  https://objects.githubusercontent.com/github-production-release-asset-2e65be/11225014/05fd2993-25ce-40b0-91f0-6088bd797753?X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-Credential=releaseassetproduction%2F20250221%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-Date=20250221T065734Z&X-Amz-Expires=300&X-Amz-Signature=1c168cee51854dd191dc9c6b2c73bae289dc7f1deefe5a261e678229961 0e69d&X-Amz-SignedHeaders=host&response-content-disposition=attachment%3B%20filename%3Detcd-v3.5.10-linux-amd64.tar.gz&response-content-type=application%2Foctet-stream
Resolving objects.githubusercontent.com (objects.githubusercontent.com)... 185.199.111.133, 185.199.109.133, 185.199.110.133, ...
Connecting to objects.githubusercontent.com (objects.githubusercontent.com)|185.199.111.133|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 20011305 (19M) [application/octet-stream]
Saving to: 'etcd-v3.5.10-linux-amd64.tar.gz'

etcd-v3.5.10-linux-amd64.tar.gz                  100%[=============================================================================================================>]  19.08M  2.38MB/s    in 8.6s

2025-02-21 01:57:45 (2.21 MB/s) - 'etcd-v3.5.10-linux-amd64.tar.gz' saved [20011305/20011305]

[root@node1 ~]# tar -xvf etcd-v3.5.10-linux-amd64.tar.gz
etcd-v3.5.10-linux-amd64/
etcd-v3.5.10-linux-amd64/README.md
etcd-v3.5.10-linux-amd64/README-etcdctl.md
etcd-v3.5.10-linux-amd64/etcdutl
etcd-v3.5.10-linux-amd64/etcdctl
etcd-v3.5.10-linux-amd64/Documentation/
etcd-v3.5.10-linux-amd64/Documentation/README.md
etcd-v3.5.10-linux-amd64/Documentation/dev-guide/
etcd-v3.5.10-linux-amd64/Documentation/dev-guide/apispec/
etcd-v3.5.10-linux-amd64/Documentation/dev-guide/apispec/swagger/
etcd-v3.5.10-linux-amd64/Documentation/dev-guide/apispec/swagger/v3election.swagger.json
etcd-v3.5.10-linux-amd64/Documentation/dev-guide/apispec/swagger/rpc.swagger.json
etcd-v3.5.10-linux-amd64/Documentation/dev-guide/apispec/swagger/v3lock.swagger.json
etcd-v3.5.10-linux-amd64/README-etcdutl.md
etcd-v3.5.10-linux-amd64/README-etcdctl.md
etcd-v3.5.10-linux-amd64/etcd
[root@node1 ~]# mv etcd-v3.5.10-linux-amd64/etcd* /usr/local/bin/
[root@node1 ~]# etcd --version
etcd Version: 3.5.10
Git SHA: 0223ca52b
Go Version: go1.20.10
Go OS/Arch: linux/amd64
[root@node1 ~]# etcdctl version
etcdctl version: 3.5.10
API version: 3.5
[root@node1 ~]#
```

3.2 Configure Etcd

Edit /etc/etcd/etcd.conf:

```
ETCD_NAME="node1"
ETCD_DATA_DIR="/var/lib/etcd/node1"
ETCD_LISTEN_PEER_URLS="http://192.168.56.114:2380"
ETCD_LISTEN_CLIENT_URLS="http://192.168.56.114:2379"
ETCD_INITIAL_CLUSTER="node1=http://192.168.56.114:2380,node2=http://192.168.56.118:2380,node3=http://192.168.56.119:2380"
ETCD_INITIAL_CLUSTER_STATE="new"
```

3.3 Create Etcd Systemd Service

vi /etc/systemd/system/etcd.service

```
[Unit]
Description=etcd
After=network.target

[Service]
Type=notify
EnvironmentFile=/etc/etcd/etcd.conf
ExecStart=/usr/local/bin/etcd
Restart=always
RestartSec=10s
LimitNOFILE=40000

[Install]
WantedBy=multi-user.target
```



```
systemctl daemon-reload
systemctl enable etcd
systemctl start etcd
```

```
[root@node1 ~]# systemctl status etcd
● etcd.service - etcd
     Loaded: loaded (/etc/systemd/system/etcd.service; enabled; vendor preset: disabled)
     Active: active (running) since Fri 2025-02-21 02:09:15 EST; 11s ago
   Main PID: 5102 (etcd)
      Tasks: 7 (limit: 11401)
     Memory: 35.7M
     CGroup: /system.slice/etcd.service
             └─5102 /usr/local/bin/etcd

Feb 21 02:09:15 node1 etcd[5102]: {"level":"info","ts":"2025-02-21T02:09:15.294718-0500","caller":"api/capability.go:75","msg":"enabled capabilities for version","cluster-version":"3.0"}
Feb 21 02:09:15 node1 etcd[5102]: {"level":"info","ts":"2025-02-21T02:09:15.295341-0500","caller":"etcdserver/server.go:2062","msg":"published local member to cluster through raft","local-member-id":"b9743
Feb 21 02:09:15 node1 etcd[5102]: {"level":"info","ts":"2025-02-21T02:09:15.295472-0500","caller":"embed/serve.go:103","msg":"ready to serve client requests"}
Feb 21 02:09:15 node1 etcd[5102]: {"level":"info","ts":"2025-02-21T02:09:15.296104-0500","caller":"embed/serve.go:187","msg":"serving client traffic insecurely; this is strongly discouraged!","traffic":"gr
Feb 21 02:09:15 node1 etcd[5102]: {"level":"info","ts":"2025-02-21T02:09:15.296244-0500","caller":"embed/serve.go:103","msg":"ready to serve client requests"}
Feb 21 02:09:15 node1 etcd[5102]: {"level":"info","ts":"2025-02-21T02:09:15.296395-0500","caller":"etcdmain/main.go:44","msg":"notifying init daemon"}
Feb 21 02:09:15 node1 etcd[5102]: {"level":"info","ts":"2025-02-21T02:09:15.296433-0500","caller":"etcdmain/main.go:50","msg":"successfully notified init daemon"}
Feb 21 02:09:15 node1 etcd[5102]: {"level":"info","ts":"2025-02-21T02:09:15.296678-0500","caller":"embed/serve.go:187","msg":"serving client traffic insecurely; this is strongly discouraged!","traffic":"gr
Feb 21 02:09:15 node1 systemd[1]: Started etcd.
Feb 21 02:09:17 node1 etcd[5102]: {"level":"info","ts":"2025-02-21T02:09:17.112464-0500","caller":"membership/cluster.go:576","msg":"updated cluster version","cluster-id":"52052a4ccb483169","local-member-i
lines 1-19/19 (END)
```

3.4 Verify Etcd Cluster

vi .bash_profile

node1=192.168.56.114

node2=192.168.56.118

node3=192.168.56.119

ENDPOINTS=$node1:2379,$node2:2379,$node3:2379

. .bash_profile

Check Etcd cluster status:

etcdctl endpoint status --write-out=table --endpoints=$ENDPOINTS

```
[root@node2 ~]# vim .bash_profile
[root@node2 ~]# . ./.bash_profile
[root@node2 ~]# etcdctl endpoint status --write-out=table --endpoints=$ENDPOINTS
+--------------------+------------------+---------+---------+-----------+------------+-----------+------------+--------------------+--------+
|      ENDPOINT      |        ID        | VERSION | DB SIZE | IS LEADER | IS LEARNER | RAFT TERM | RAFT INDEX | RAFT APPLIED INDEX | ERRORS |
+--------------------+------------------+---------+---------+-----------+------------+-----------+------------+--------------------+--------+
| 192.168.56.114:2379 | b9743cec79f270a0 |  3.5.10 |   20 kB |     false |      false |         2 |          9 |                  9 |        |
| 192.168.56.118:2379 | 9acf666898a77230 |  3.5.10 |   20 kB |      true |      false |         2 |          9 |                  9 |        |
| 192.168.56.119:2379 | 7fe540e391278451 |  3.5.10 |   20 kB |     false |      false |         2 |          9 |                  9 |        |
+--------------------+------------------+---------+---------+-----------+------------+-----------+------------+--------------------+--------+
[root@node2 ~]#
```

dnf -y install keepalived

4.2 Enable IP non-local binding:

vi /etc/sysctl.conf

net.ipv4.ip_nonlocal_bind = 1

net.ipv4.ip_forward = 1

4.3 Apply the changes:

sysctl --system

sysctl -p

vi /etc/keepalived/keepalived.conf

```
vrrp_instance VI_1 {
  state MASTER
  interface enp0s8
  virtual_router_id 51
  priority 101
  advert_int 1
  virtual_ipaddress {
    192.168.56.121
  }
}
```

systemctl start keepalived

systemctl enable keepalived

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systemctl status keepalived

```
[root@node1 log]# systemctl restart keepalived
[root@node1 log]# systemctl enable keepalived
Created symlink /etc/systemd/system/multi-user.target.wants/keepalived.service → /usr/lib/systemd/system/keepalived.service.
[root@node1 log]# systemctl status keepalived
● keepalived.service - LVS and VRRP High Availability Monitor
   Loaded: loaded (/usr/lib/systemd/system/keepalived.service; enabled; vendor preset: disabled)
   Active: active (running) since Fri 2025-02-21 03:39:40 EST; 20s ago
 Main PID: 10447 (keepalived)
    Tasks: 2 (limit: 11401)
   Memory: 1.9M
   CGroup: /system.slice/keepalived.service
           ├─10447 /usr/sbin/keepalived -D
           └─10448 /usr/sbin/keepalived -D

Feb 21 03:39:44 node1 Keepalived_vrrp[10448]: Sending gratuitous ARP on enp0s8 for 192.168.56.121
Feb 21 03:39:44 node1 Keepalived_vrrp[10448]: Sending gratuitous ARP on enp0s8 for 192.168.56.121
Feb 21 03:39:44 node1 Keepalived_vrrp[10448]: Sending gratuitous ARP on enp0s8 for 192.168.56.121
Feb 21 03:39:44 node1 Keepalived_vrrp[10448]: Sending gratuitous ARP on enp0s8 for 192.168.56.121
Feb 21 03:39:49 node1 Keepalived_vrrp[10448]: (VI_1) Sending/queueing gratuitous ARPs on enp0s8 for 192.168.56.121
Feb 21 03:39:49 node1 Keepalived_vrrp[10448]: Sending gratuitous ARP on enp0s8 for 192.168.56.121
Feb 21 03:39:49 node1 Keepalived_vrrp[10448]: Sending gratuitous ARP on enp0s8 for 192.168.56.121
Feb 21 03:39:49 node1 Keepalived_vrrp[10448]: Sending gratuitous ARP on enp0s8 for 192.168.56.121
Feb 21 03:39:49 node1 Keepalived_vrrp[10448]: Sending gratuitous ARP on enp0s8 for 192.168.56.121
Feb 21 03:39:49 node1 Keepalived_vrrp[10448]: Sending gratuitous ARP on enp0s8 for 192.168.56.121
[root@node1 log]#
```

dnf -y install haproxy

vi /etc/haproxy/haproxy.cfg

```
global
  maxconn 1000
defaults
  mode tcp
  log global
  option tcplog
  retries 3
  timeout queue 1m
  timeout connect 4s
  timeout client 60m
  timeout server 60m
  timeout check 5s
  maxconn 900
listen stats
  mode http
  bind *:7000
  stats enable
  stats uri /
listen primary
  bind 192.168.56.121:5000
  option httpchk OPTIONS /master
  http-check expect status 200
  default-server inter 3s fall 3 rise 2 on-marked-down shutdown-sessions
  server node1 192.168.56.114:5432 maxconn 100 check port 8008
  server node2 192.168.56.118:5432 maxconn 100 check port 8008
  server node3 192.168.56.119:5432 maxconn 100 check port 8008
```

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```
listen standby
  bind 192.168.56.121:5001
  balance roundrobin
  option httpchk OPTIONS /replica
  http-check expect status 200
  default-server inter 3s fall 3 rise 2 on-marked-down shutdown-sessions
  server node1 192.168.56.114:5432 maxconn 100 check port 8008
  server node2 192.168.56.118:5432 maxconn 100 check port 8008
  server node3 192.168.56.119:5432 maxconn 100 check port 8008
```

```
systemctl start haproxy
systemctl enable haproxy
systemctl status haproxy
```

```
[root@node3 ~]# dnf -y install haproxy
Last metadata expiration check: 1:34:03 ago on Fri 21 Feb 2025 01:49:25 AM EST.
Dependencies resolved.
================================================================================
 Package                Architecture          Version              Repository      Size
================================================================================
Installing:
 haproxy                x86_64                1.8.27-2.el8         appstream      1.4 M

Transaction Summary
================================================================================
Install  1 Package

Total download size: 1.4 M
Installed size: 4.2 M
Downloading Packages:
haproxy-1.8.27-2.el8.x86_64.rpm                  3.2 MB/s | 1.4 MB     00:00
--------------------------------------------------------------------------------
Total                                            3.2 MB/s | 1.4 MB     00:00
Running transaction check
Transaction check succeeded.
Running transaction test
Transaction test succeeded.
Running transaction
  Preparing        :                                                        1/1
  Running scriptlet: haproxy-1.8.27-2.el8.x86_64                            1/1
  Installing       : haproxy-1.8.27-2.el8.x86_64                            1/1
  Running scriptlet: haproxy-1.8.27-2.el8.x86_64                            1/1
  Verifying        : haproxy-1.8.27-2.el8.x86_64                            1/1

Installed:
  haproxy-1.8.27-2.el8.x86_64

Complete!
[root@node3 ~]# mv /etc/haproxy/haproxy.cfg /etc/haproxy/haproxy.cfg.orig
[root@node3 ~]# vi /etc/haproxy/haproxy.cfg
[root@node3 ~]#
[root@node3 ~]#
[root@node3 ~]#
[root@node3 ~]# systemctl start haproxy
[root@node3 ~]# systemctl status haproxy
● haproxy.service - HAProxy Load Balancer
   Loaded: loaded (/usr/lib/systemd/system/haproxy.service; disabled; vendor preset: disabled)
   Active: active (running) since Fri 2025-02-21 03:25:30 EST; 10s ago
  Process: 7397 ExecStartPre=/usr/sbin/haproxy -f $CONFIG -c -q $OPTIONS (code=exited, status=0/SUCCESS)
 Main PID: 7400 (haproxy)
    Tasks: 2 (limit: 11401)
   Memory: 2.2M
   CGroup: /system.slice/haproxy.service
           ├─7400 /usr/sbin/haproxy -Ws -f /etc/haproxy/haproxy.cfg -p /run/haproxy.pid
           └─7402 /usr/sbin/haproxy -Ws -f /etc/haproxy/haproxy.cfg -p /run/haproxy.pid

Feb 21 03:25:30 node3 systemd[1]: Starting HAProxy Load Balancer...
Feb 21 03:25:30 node3 haproxy[7400]: [WARNING] 051/032530 (7400) : config : log format ignored for proxy 'stats' since it has no log address.
Feb 21 03:25:30 node3 haproxy[7400]: [WARNING] 051/032530 (7400) : config : log format ignored for proxy 'primary' since it has no log address.
Feb 21 03:25:30 node3 haproxy[7400]: [WARNING] 051/032530 (7400) : config : log format ignored for proxy 'standby' since it has no log address.
Feb 21 03:25:30 node3 systemd[1]: Started HAProxy Load Balancer.
[root@node3 ~]#
```

6. Set Up Patroni

6.1 Install Patroni

dnf -y install patroni patroni-etcd watchdog

mkdir -p /etc/patroni

6.2 Configure Patroni

Edit /etc/patroni/patroni.yml:

```
scope: postgres
```

```
namespace: /db/
name: node1

restapi:
  listen: 192.168.56.114:8008
  connect_address: 192.168.56.114:8008

etcd3:
  hosts: 192.168.56.114:2379,192.168.56.118:2379,192.168.56.119:2379

bootstrap:
  dcs:
    ttl: 30
    loop_wait: 10
    retry_timeout: 10
    maximum_lag_on_failover: 1048576
    postgresql:
      use_pg_rewind: true
  pg_hba:
  - host replication replicator 192.168.56.114/0 md5
  - host replication replicator 192.168.56.118/0 md5
  - host replication replicator 192.168.56.119/0 md5
  - host replication all 0.0.0.0/0 md5
  - host all all 0.0.0.0/0 md5

postgresql:
  listen: 192.168.56.114:5432
  connect_address: 192.168.56.114:5432
  data_dir: /var/lib/pgsql/17/data
  bin_dir: /usr/pgsql-17/bin/
  authentication:
    replication:
      username: replicator
      password: replicator
    superuser:
      username: postgres
  password: postgres
  parameters:
```

```
    unix_socket_directories: '/run/postgresql/'

watchdog:
  mode: required
  device: /dev/watchdog
  safety_margin: 5

tags:
  nofailover: false
  noloadbalance: false
  clonefrom: false
  nosync: false

systemctl start patroni
systemctl enable patroni
systemctl status patroni
```

```
[root@node2 ~]# systemctl status patroni
● patroni.service - Runners to orchestrate a high-availability PostgreSQL
   Loaded: loaded (/usr/lib/systemd/system/patroni.service; disabled; vendor preset: disabled)
   Active: active (running) since Fri 2025-02-21 06:32:37 EST; 1h 13min ago
 Main PID: 39366 (patroni)
    Tasks: 18 (limit: 11401)
   Memory: 184.9M
   CGroup: /system.slice/patroni.service
           ├─39366 /usr/bin/python3 /usr/bin/patroni /etc/patroni/patroni.yml
           ├─39387 /usr/pgsql-17/bin/postgres -D /var/lib/pgsql/17/data --config-file=/var/lib/pgsql/17/data/postgresql.conf --listen_addresses=192.168.56.118 --port=5432 --cluster_name=postgres --wal_leve>
           ├─39388 postgres: postgres: logger
           ├─39391 postgres: postgres: checkpointer
           ├─39392 postgres: postgres: background writer
           ├─39406 postgres: postgres postgres 192.168.56.118(42954) idle
           ├─39433 postgres: postgres: postgres 192.168.56.118(42982) idle
           ├─39467 postgres: postgres: walwriter
           ├─39468 postgres: postgres: autovacuum launcher
           ├─39469 postgres: postgres: archiver failed on 00000003.history
           ├─39470 postgres: postgres: logical replication launcher
           └─39473 postgres: postgres: walsender replicator 192.168.56.114(34740) streaming 0/F000168

Feb 21 07:44:25 node2 patroni[39366]: 2025-02-21 07:44:25,013 INFO: no action. I am (node2), the leader with the lock
Feb 21 07:44:34 node2 patroni[39366]: 2025-02-21 07:44:34,998 INFO: no action. I am (node2), the leader with the lock
Feb 21 07:44:45 node2 patroni[39366]: 2025-02-21 07:44:45,005 INFO: no action. I am (node2), the leader with the lock
Feb 21 07:44:55 node2 patroni[39366]: 2025-02-21 07:44:55,051 INFO: no action. I am (node2), the leader with the lock
Feb 21 07:45:04 node2 patroni[39366]: 2025-02-21 07:45:04,995 INFO: no action. I am (node2), the leader with the lock
Feb 21 07:45:14 node2 patroni[39366]: 2025-02-21 07:45:14,991 INFO: no action. I am (node2), the leader with the lock
Feb 21 07:45:25 node2 patroni[39366]: 2025-02-21 07:45:25,012 INFO: no action. I am (node2), the leader with the lock
Feb 21 07:45:34 node2 patroni[39366]: 2025-02-21 07:45:34,993 INFO: no action. I am (node2), the leader with the lock
Feb 21 07:45:45 node2 patroni[39366]: 2025-02-21 07:45:45,000 INFO: no action. I am (node2), the leader with the lock
Feb 21 07:45:54 node2 patroni[39366]: 2025-02-21 07:45:54,994 INFO: no action. I am (node2), the leader with the lock
lines 1-30/30 (END)
```

6.3 Verify Patroni Cluster

patronictl -c /etc/patroni/patroni.yml list

```
[root@node2 ~]# patronictl -c /etc/patroni/patroni.yml list
+ Cluster: postgres (7473782722216189073) ------+----+-----------+
| Member | Host           | Role    | State     | TL | Lag in MB |
+--------+----------------+---------+-----------+----+-----------+
| node1  | 192.168.56.114 | Leader  | running   |  1 |           |
| node2  | 192.168.56.118 | Replica | streaming |  1 |         0 |
| node3  | 192.168.56.119 | Replica | streaming |  1 |         0 |
+--------+----------------+---------+-----------+----+-----------+
[root@node2 ~]#
```

7. Failover and Testing

7.1 Test Switchover

patronictl -c /etc/patroni/patroni.yml switchover

```
[postgres@node1 ~]$ patronictl -c /etc/patroni/patroni.yml list
+ Cluster: postgres (7473782722216189073) ------+----+-----------+
| Member | Host           | Role    | State     | TL | Lag in MB |
+--------+----------------+---------+-----------+----+-----------+
| node1  | 192.168.56.114 | Leader  | running   |  1 |           |
| node2  | 192.168.56.118 | Replica | streaming |  1 |         0 |
| node3  | 192.168.56.119 | Replica | streaming |  1 |         0 |
+--------+----------------+---------+-----------+----+-----------+
[postgres@node1 ~]$ patronictl -c /etc/patroni/patroni.yml switchover
Current cluster topology
+ Cluster: postgres (7473782722216189073) ------+----+-----------+
| Member | Host           | Role    | State     | TL | Lag in MB |
+--------+----------------+---------+-----------+----+-----------+
| node1  | 192.168.56.114 | Leader  | running   |  1 |           |
| node2  | 192.168.56.118 | Replica | streaming |  1 |         0 |
| node3  | 192.168.56.119 | Replica | streaming |  1 |         0 |
+--------+----------------+---------+-----------+----+-----------+
Primary [node1]:
Candidate ['node2', 'node3'] []: node2
When should the switchover take place (e.g. 2025-02-21T04:48 )  [now]:
Are you sure you want to switchover cluster postgres, demoting current leader node1? [y/N]: y
2025-02-21 03:48:42.81668 Successfully switched over to "node2"
+ Cluster: postgres (7473782722216189073) ----+----+-----------+
| Member | Host           | Role    | State     | TL | Lag in MB |
+--------+----------------+---------+-----------+----+-----------+
| node1  | 192.168.56.114 | Replica | stopped   |    |   unknown |
| node2  | 192.168.56.118 | Leader  | running   |  1 |           |
| node3  | 192.168.56.119 | Replica | running   |  1 |         0 |
+--------+----------------+---------+-----------+----+-----------+
[postgres@node1 ~]$ patronictl -c /etc/patroni/patroni.yml list
```

7.2 Verify Primary Node

patronictl -c /etc/patroni/patroni.yml list

```
[postgres@node1 ~]$ patronictl -c /etc/patroni/patroni.yml switchover
Current cluster topology
+ Cluster: postgres (7473782722216189073) ------+----+-----------+
| Member | Host           | Role    | State     | TL | Lag in MB |
+--------+----------------+---------+-----------+----+-----------+
| node1  | 192.168.56.114 | Leader  | running   |  1 |           |
| node2  | 192.168.56.118 | Replica | streaming |  1 |         0 |
| node3  | 192.168.56.119 | Replica | streaming |  1 |         0 |
+--------+----------------+---------+-----------+----+-----------+
Primary [node1]:
Candidate ['node2', 'node3'] []: node2
When should the switchover take place (e.g. 2025-02-21T04:48 )  [now]:
Are you sure you want to switchover cluster postgres, demoting current leader node1? [y/N]: y
2025-02-21 03:48:42.81668 Successfully switched over to "node2"
+ Cluster: postgres (7473782722216189073) ----+----+-----------+
| Member | Host           | Role    | State   | TL | Lag in MB |
+--------+----------------+---------+---------+----+-----------+
| node1  | 192.168.56.114 | Replica | stopped |    |   unknown |
| node2  | 192.168.56.118 | Leader  | running |  1 |           |
| node3  | 192.168.56.119 | Replica | running |  1 |         0 |
+--------+----------------+---------+---------+----+-----------+
[postgres@node1 ~]$ patronictl -c /etc/patroni/patroni.yml list
+ Cluster: postgres (7473782722216189073) ------+----+-----------+
| Member | Host           | Role    | State     | TL | Lag in MB |
+--------+----------------+---------+-----------+----+-----------+
| node1  | 192.168.56.114 | Replica | streaming |  2 |         0 |
| node2  | 192.168.56.118 | Leader  | running   |  2 |           |
| node3  | 192.168.56.119 | Replica | streaming |  2 |         0 |
+--------+----------------+---------+-----------+----+-----------+
[postgres@node1 ~]$ psql -h 192.168.56.121 -p 5000
Password for user postgres:
psql (17.4)
Type "help" for help.

postgres=# \dt
            List of relations
 Schema |      Name      | Type  |  Owner
--------+----------------+-------+----------
 public | nazmul_bhuiyan | table | postgres
(1 row)

postgres=# select * from nazmul_bhuiyan;
 id | sal
----+-----
  1 | 100
(1 row)
```


7.3 Test Connectivity

psql -h 192.168.56.121 -p 5000 -U postgres

```
[postgres@node1 ~]$ psql -h 192.168.56.121 -p 5000
Password for user postgres:
psql (17.4)
Type "help" for help.

postgres=# \dt
            List of relations
 Schema |      Name      | Type  |  Owner
--------+----------------+-------+----------
 public | nazmul_bhuiyan | table | postgres
(1 row)

postgres=# select * from nazmul_bhuiyan;
 id | sal
----+-----
  1 | 100
(1 row)
```

7.4 Write test.

```
postgres=# \c nazmul;
You are now connected to database "nazmul" as user "postgres".
nazmul=# create table nazmul (id int);
CREATE TABLE
nazmul=# insert into nazmul values (1);
INSERT 0 1
nazmul=# select * from nazmul;
 id
----
  1
(1 row)

nazmul=# \dt
         List of relations
 Schema |  Name  | Type  |  Owner
--------+--------+-------+----------
 public | nazmul | table | postgres
(1 row)
```

8. Conclusion

This SOP provides a structured approach to setting up a PostgreSQL 17 HA cluster using Patroni, Etcd, HAProxy, and Keepalived.