

# Создание и тестирование высоконагруженного отказоустойчивого кластера PostgreSQL на базе Patroni

PostgreSQL для администраторов  
баз данных и разработчиков



**Меня хорошо видно  
& слышно?**



# Защита проекта

## Тема: Создание и тестирование высоконагруженного отказоустойчивого кластера PostgreSQL на базе Patroni



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# План защиты

Цель и задачи проекта

Какие технологии использовались

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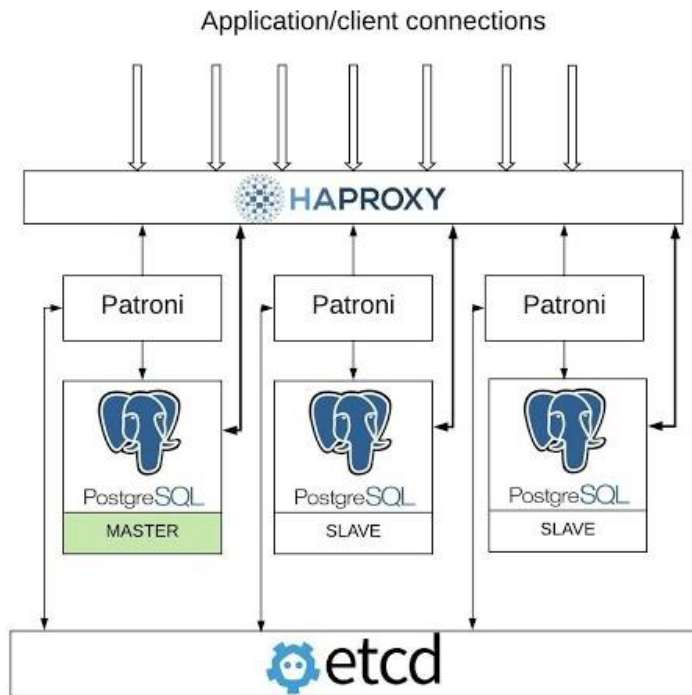
# Цель и задачи проекта

Цель проекта: развернуть и протестировать кластер PostgreSQL на базе Patroni

1. Развернуть три виртуальные машины VMWare с ОС Ubuntu
2. На каждую VM установить и настроить ETCD и объединить в кластер
3. На каждую VM установить и настроить PostgreSQL
4. На каждую VM установить и настроить Patroni и объединить в кластер
5. На одну VM установить и настроить HAProxy
6. Протестировать работу стенда



# Какие технологии использовались



Ubuntu 24.04.2 LTS

ETCD Version: 3.4.30

PostgreSQL 16.9

Patroni 4.0.6

HAProxy version 2.8.5

# Что получилось

[HTTPS://https://github.com/Bukhanoval/pgsql2025\\_otus](https://github.com/Bukhanoval/pgsql2025_otus)

**ver-ps-01**



Виртуальная машина VMWare 01,

Ubuntu 24.04.2 LTS,

etcd Version: 3.4.30,

psql (PostgreSQL) 16.9,

patroni 4.0.6,

HAProxy version 2.8.5,

IP 192.168.79.10

**ver-ps-02**



Виртуальная машина VMWare 02,

Ubuntu 24.04.2 LTS,

etcd Version: 3.4.30,

psql (PostgreSQL) 16.9,

patroni 4.0.6,

IP 192.168.79.20

**ver-ps-03**



Виртуальная машина VMWare 03,

Ubuntu 24.04.2 LTS,

etcd Version: 3.4.30,

psql (PostgreSQL) 16.9,

patroni 4.0.6,

IP 192.168.79.30



# Что получилось

[HTTPS://github.com/Bukhanoval/pgsql2025\\_otus](https://github.com/Bukhanoval/pgsql2025_otus)

```
(patroni) root@ver-ps-01:/home/ver# sudo systemctl status patroni.service
● patroni.service - Runners to orchestrate a high-availability PostgreSQL
   Loaded: loaded (/etc/systemd/system/patroni.service; enabled; preset: enabled)
   Active: active (running) since Sun 2025-06-08 15:22:40 MSK; 5h 0min ago
     Main PID: 8254 (patroni)
        Tasks: 15 (limit: 4546)
      Memory: 171.2M (peak: 353.6M)
         CPU: 53.141s
    CGroup: /system.slice/patroni.service
           └─ 8254 /opt/patroni/bin/python3 /opt/patroni/bin/patroni /etc/patroni/config.yaml
             14131 /usr/lib/postgresql/16/bin/postgres -D /data/16 --config-file=/data/16/postgresql.conf
             14132 "postgres: patroni_cluster: logger"
             14133 "postgres: patroni_cluster: checkpoint"
             14134 "postgres: patroni_cluster: background writer"
             14135 "postgres: patroni_cluster: startup recovering 0000000F0000000000000000"
             14140 "postgres: patroni_cluster: postgres postgres [local] idle"
             14142 "postgres: patroni_cluster: postgres postgres [local] idle"
             14155 "postgres: patroni_cluster: walreceiver streaming 0/501FB28"

Jun 08 17:52:17 ver-ps-01 patroni[13353]: server signaled
Jun 08 18:05:10 ver-ps-01 patroni[13808]: server signaled
Jun 08 18:05:10 ver-ps-01 patroni[13810]: server promoting
Jun 08 18:05:11 ver-ps-01 patroni[13818]: server signaled
Jun 08 18:10:35 ver-ps-01 patroni[14131]: 2025-06-08 18:10:35.560 MSK [14131] LOG: 00000: redirecting log o
Jun 08 18:10:35 ver-ps-01 patroni[14131]: 2025-06-08 18:10:35.560 MSK [14131] HINT: Future log output will
Jun 08 18:10:35 ver-ps-01 patroni[14131]: 2025-06-08 18:10:35.560 MSK [14131] LOCATION: SysLogger_Start, sy
Jun 08 18:10:35 ver-ps-01 patroni[14136]: /var/run/postgresql:5432 - accepting connections
Jun 08 18:10:35 ver-ps-01 patroni[14138]: /var/run/postgresql:5432 - accepting connections
Jun 08 18:10:42 ver-ps-01 patroni[14151]: server signaled
lines 1-28/28 (END)
```

```
(patroni) root@ver-ps-01:/home/ver# patronictl -c /etc/patroni/config.yaml list
+ Cluster: patroni_cluster (7513519607520752540) -----+-----+
| Member   | Host           | Role    | State   | TL | Lag in MB |
+-----+-----+-----+-----+-----+-----+
| ver-ps-01 | 192.168.79.10 | Replica | streaming | 15 | 0 |
| ver-ps-02 | 192.168.79.20 | Leader  | running  | 15 |  |
| ver-ps-03 | 192.168.79.30 | Sync Standby | streaming | 15 | 0 |
+-----+-----+-----+-----+-----+-----+
(patroni) root@ver-ps-01:/home/ver#
```

```
(patroni) root@ver-ps-01:/home/ver# sudo systemctl status etcd.service
● etcd.service - etcd - highly-available key value store
   Loaded: loaded (/usr/lib/systemd/system/etcd.service; enabled; preset: enabled)
   Active: active (running) since Sun 2025-06-08 12:00:20 MSK; 8h ago
     Docs: https://etcd.io/docs
          man:etcd
     Main PID: 3335 (etcd)
        Tasks: 9 (limit: 4546)
      Memory: 26.8M (peak: 45.9M)
         CPU: 5min 16.755s
    CGroup: /system.slice/etcd.service
           └─ 3335 /usr/bin/etcd

Jun 08 18:10:35 ver-ps-01 etcd[3335]: raft2025/06/08 18:10:35 INFO: 5b76766db1015112 received MsgVoteResp fr
Jun 08 18:10:35 ver-ps-01 etcd[3335]: raft2025/06/08 18:10:35 INFO: 5b76766db1015112 [logterm: 12429, index:
Jun 08 18:10:35 ver-ps-01 etcd[3335]: raft2025/06/08 18:10:35 INFO: 5b76766db1015112 [logterm: 12429, index:
Jun 08 18:10:35 ver-ps-01 etcd[3335]: raft2025/06/08 18:10:35 INFO: 5b76766db1015112 received MsgVoteResp re
Jun 08 18:10:35 ver-ps-01 etcd[3335]: raft2025/06/08 18:10:35 INFO: 5b76766db1015112 has received 1 MsgVoteR
Jun 08 18:10:39 ver-ps-01 etcd[3335]: raft2025/06/08 18:10:39 INFO: 5b76766db1015112 [term: 12433] ignored a
Jun 08 18:10:41 ver-ps-01 etcd[3335]: raft2025/06/08 18:10:41 INFO: 5b76766db1015112 [term: 12433] received
Jun 08 18:10:41 ver-ps-01 etcd[3335]: raft2025/06/08 18:10:41 INFO: 5b76766db1015112 became follower at term
Jun 08 18:10:41 ver-ps-01 etcd[3335]: raft2025/06/08 18:10:41 INFO: 5b76766db1015112 [logterm: 12429, index:
Jun 08 18:10:41 ver-ps-01 etcd[3335]: raft2025/06/08 18:10:41 INFO: raft.node: 5b76766db1015112 elected lead
lines 1-22/22 (END)
```

```
(patroni) root@ver-ps-01:/home/ver# etcdctl member list
f719a27f43a4f40, started, ver-ps-02, http://ver-ps-02:2380, http://ver-ps-02:2379, false
5b76766db1015112, started, core, http://ver-ps-01:2380, http://ver-ps-01:2379, false
f4a0aae97d284f06, started, ver-ps-03, http://ver-ps-03:2380, http://ver-ps-03:2379, false
(patroni) root@ver-ps-01:/home/ver#
```



# Что получилось

HTTPS://https://github.com/Bukhanoval/pgsql2025\_otus

ver-ps-01



```
(patroni) root@ver-ps-01:/home/ver# sudo systemctl status haproxy.service
● haproxy.service - HAProxy Load Balancer
   Loaded: loaded (/usr/lib/systemd/system/haproxy.service; enabled; preset: enabled)
   Active: active (running) since Sun 2025-06-08 17:49:32 MSK; 2h 36min ago
     Docs: man:haproxy(1)
           file:/usr/share/doc/haproxy/configuration.txt.gz
   Main PID: 13191 (haproxy)
    Status: "Ready."
     Tasks: 3 (limit: 4546)
  Memory: 6.9M (peak: 7.4M)
     CPU: 5.542s
   CGroup: /system.slice/haproxy.service
           └─13191 /usr/sbin/haproxy -Ws -f /etc/haproxy/haproxy.cfg -p /run/haproxy.pid -S /run/haproxy-pid
             └─13193 /usr/sbin/haproxy -Ws -f /etc/haproxy/haproxy.cfg -p /run/haproxy.pid -S /run/haproxy-pid

Jun 08 17:49:34 ver-ps-01 haproxy[13193]: [WARNING] (13193) : Server primary/ver-ps-03 is DOWN, reason: Layer4
Jun 08 17:52:04 ver-ps-01 haproxy[13193]: [WARNING] (13193) : Server primary/ver-ps-02 is DOWN, reason: Layer4
Jun 08 17:52:04 ver-ps-01 haproxy[13193]: [ALERT] (13193) : proxy 'primary' has no server available!
Jun 08 17:52:20 ver-ps-01 haproxy[13193]: [WARNING] (13193) : Server primary/ver-ps-03 is UP, reason: Layer4
Jun 08 18:04:57 ver-ps-01 haproxy[13193]: [WARNING] (13193) : Server primary/ver-ps-03 is DOWN, reason: Layer4
Jun 08 18:04:57 ver-ps-01 haproxy[13193]: [ALERT] (13193) : proxy 'primary' has no server available!
Jun 08 18:05:16 ver-ps-01 haproxy[13193]: [WARNING] (13193) : Server primary/ver-ps-01 is UP, reason: Layer4
Jun 08 18:10:37 ver-ps-01 haproxy[13193]: [WARNING] (13193) : Server primary/ver-ps-01 is DOWN, reason: Layer4
Jun 08 18:10:37 ver-ps-01 haproxy[13193]: [ALERT] (13193) : proxy 'primary' has no server available!
Jun 08 18:10:46 ver-ps-01 haproxy[13193]: [WARNING] (13193) : Server primary/ver-ps-02 is UP, reason: Layer4
lines 1-24/24 (END)
```

Statistics Report for HAP: x

Not Secure http://ver-ps-01:7000/#primary/ver-ps-03

Statistics Report for pid 13193

> General process information

pid = 13193 (process #1, nbproc = 1, nbthread = 2)  
uptime = 0d 0h 21m 18s, warnings = 8  
system limits: memmax = unlimited, ulimit-n = 257  
maxsock = 257, maxconn = 100, reached = 0, maxpipes = 0  
current conns = 2, current pipes = 0/0, conn rate = 0/sec, bit rate = 0.543 kbps  
Running tasks: 0/20, idle = 100 %

active UP  
active UP, going down  
active DOWN, going up  
active or backup DOWN  
active or backup DOWN for maintenance (MAINT)  
active or backup SOFT STOPPED for maintenance  
Note: "NOLB'DRAIN" = UP with load-balancing disabled.

Display option:  
Scope:   
Hide DOWN servers  
Refresh now  
CSV export  
JSON export (schema)

External resources:  
Primary logs  
Updates (v2.8)  
Online manual

state

	Queue		Session rate		Sessions		Bytes		Denied		Errors		Warnings		Status		Server								
	Cur	Max	Limit	Cur	Max	Limit	Total	LibTot	Last	In	Out	Req	Resp	Req	Conn	Retr	Redis	LastChk	Wght	Act	Bck	Chk	Dwn	Downtm	Thrtle
Frontend	0	0	0	1	-	1	2	100	7	15 899	1 122 706	0	0	2	0	0	0	OPEN							
Backend	0	0	0	0	0	0	10	0	0	15 899	1 122 706	0	0	0	0	0	0	21m18s UP		0/0	0	0	0		

primary

	Queue		Session rate		Sessions		Bytes		Denied		Errors		Warnings		Status		Server									
	Cur	Max	Limit	Cur	Max	Limit	Total	LibTot	Last	In	Out	Req	Resp	Req	Conn	Retr	Redis	LastChk	Wght	Act	Bck	Chk	Dwn	Downtm	Thrtle	
Frontend	0	0	0	1	-	1	2	100	11	1 297	2 836	0	0	0	0	0	0	OPEN								
ver-ps-01	0	0	-	0	1	0	1	100	4	4m56s	518	1 133	0	0	0	0	0	13s DOWN	L7STS/503 in 3ms	1/1	Y	-	4	2	15m57s	-
ver-ps-02	0	0	-	0	0	0	0	100	0	0	?	0	0	0	0	0	0	4s UP	L7OK/200 in 3ms	1/1	Y	-	3	1	18m42s	-
ver-ps-03	0	0	-	0	1	0	1	100	9	7	5m55s	779	1 703	0	1	0	2	5m53s DOWN	L7STS/503 in 3ms	1/1	Y	-	4	2	8m39s	-
Backend	0	0	0	1	1	2	10	11	11	4m56s	1 297	2 836	0	0	1	0	2	0	4s UP		1/1	1	0	3	44s	



# Что получилось

[HTTPS://https://github.com/Bukhanoval/pgsql2025\\_otus](https://github.com/Bukhanoval/pgsql2025_otus)

ver-ps-01



```
(patroni) root@ver-ps-01:/home/ver# patronictl -c /etc/patroni/config.yaml list
+ Cluster: patroni_cluster (7513519607520752540) -----+-----+-----+
| Member   | Host           | Role         | State   | TL | Lag in MB |
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| ver-ps-02 | 192.168.79.20 | Leader       | running  | 15 |  |
| ver-ps-03 | 192.168.79.30 | Sync Standby | streaming | 15 | 0 |
+-----+-----+-----+-----+-----+-----+
(patroni) root@ver-ps-01:/home/ver#
```

```
(patroni) root@ver-ps-03:/home/ver# psql -U postgres -h ver-ps-01 -p 5000 -t -c "select inet_server_addr()"
Password for user postgres:
192.168.79.20

(patroni) root@ver-ps-03:/home/ver#
```

# Выводы

1. Был настроен и протестирован отказоустойчивый кластер PostgreSQL на базе Patroni. Цель достигнута.
2. Ориентировочно всё заняло 5 рабочих дней.
3. В ходе выполнения проекта было изучено несколько полноценных гайдов и официальная документация. Но в ряде случаев все равно пришлось разбираться экспериментальным путем.
4. Проектная работа была очень полезна, кроме основной цели был подтянут навык администрирования ОС Ubuntu.



# Вопросы и рекомендации



если есть вопросы



если вопросов нет



**Спасибо за внимание!**