



Cómputo de Alto Desempeño

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Instalar Galera 4 Cluster con MariaDB en Linux

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Reporte

El trabajo tiene como objetivo **instalar, configurar y evaluar el desempeño de Galera4 en MariaDB** sobre **Ubuntu Server 24.04 LTS**, empleando la herramienta **Sysbench** para la ejecución de pruebas de carga. Se comparan configuraciones de **2 y 3 nodos**, con distintos números de hilos y cores, con el fin de analizar el impacto en el rendimiento y obtener conclusiones sobre la eficiencia y tolerancia a fallos del sistema.

Instalación del entorno:

- Se desplegó **Ubuntu Server 24.04 LTS** en máquinas virtuales.
- Se configuró acceso remoto vía **SSH (puerto 22)** y se instalaron los paquetes necesarios para MariaDB y Galera4.

Configuración del clúster:

- Se inicializó el clúster con el comando `galera_new_cluster`.
- Se verificó la correcta comunicación entre nodos.
- Se configuraron redes en modo puente para interconexión entre máquinas virtuales.

Herramienta de pruebas:

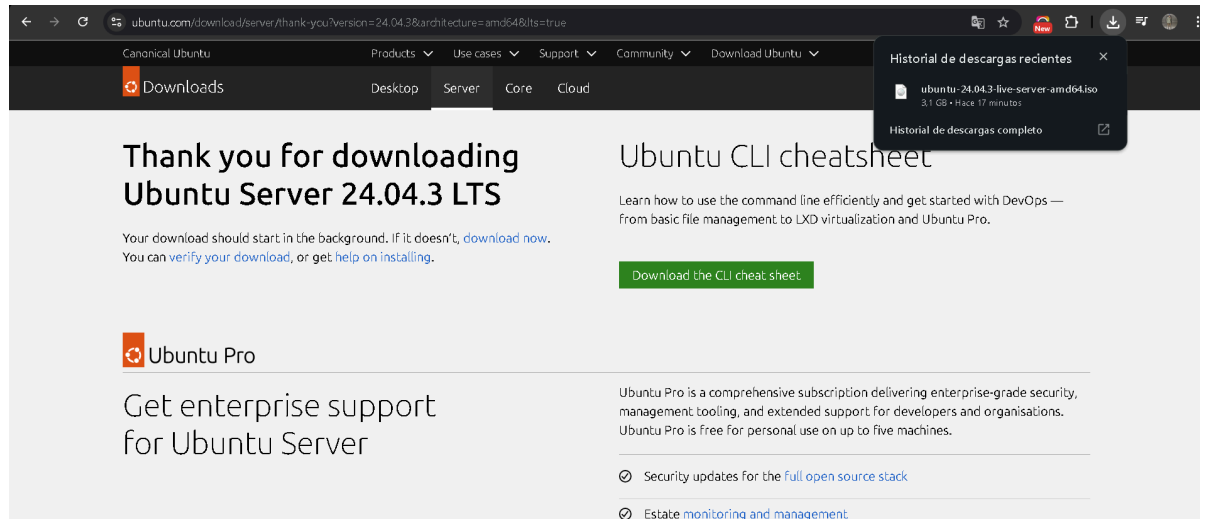
- Se utilizó **Sysbench** para evaluar el rendimiento de operaciones OLTP.
- Se creó una base de datos de prueba con **10,000 registros iniciales**.
- Se realizaron pruebas con **1 y 2 hilos**, en configuraciones de **1 y 2 cores**, tanto con 2 nodos como con 3 nodos.

Tipos de prueba realizadas:

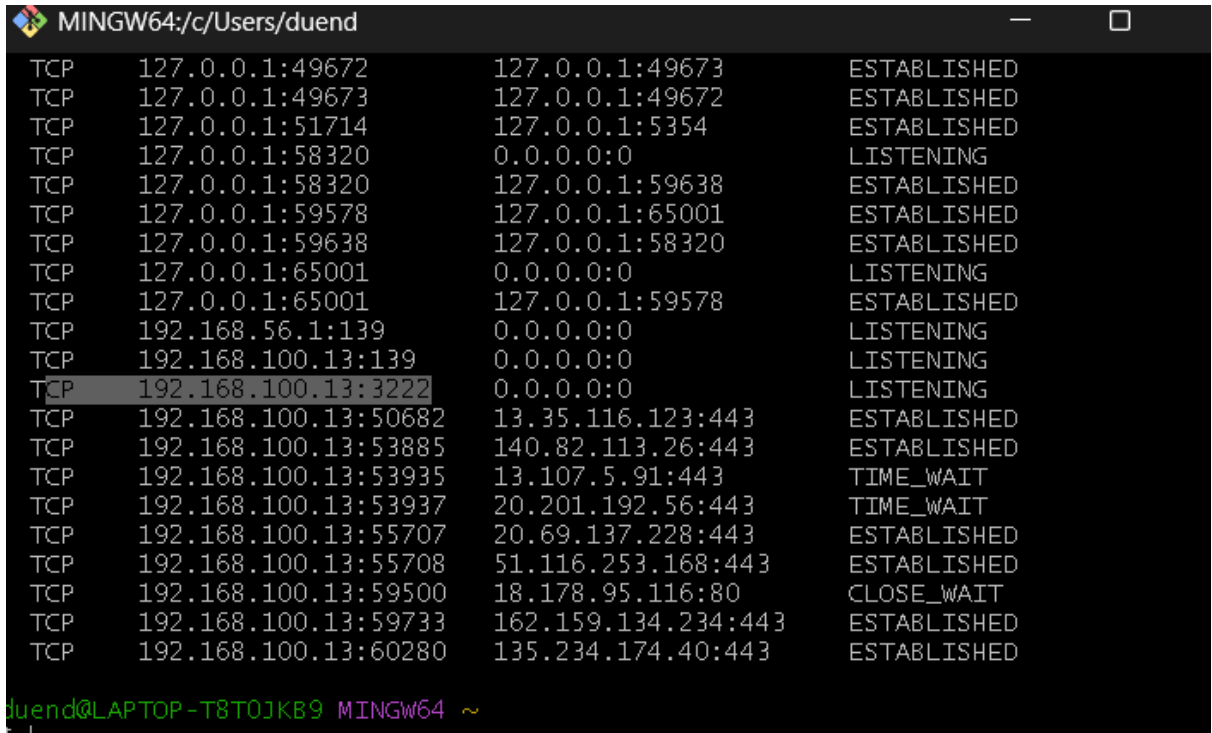
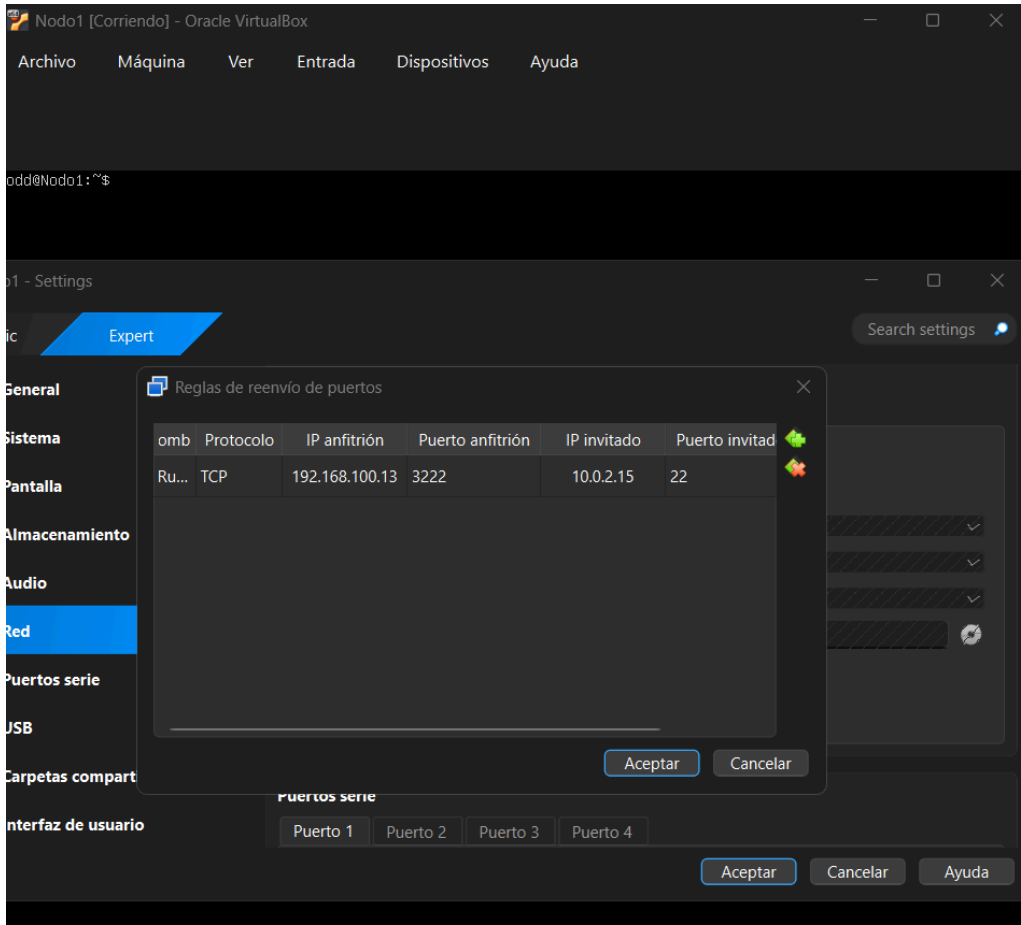
1. `bulk_insert`
2. `oltp_delete`

3. oltp_insert
4. oltp_point_select
5. oltp_read_only
6. oltp_read_write
7. oltp_update_index
8. oltp_update_non_index
9. oltp_write_only
10. select_random_points
11. select_random_ranges

1. Descargar e instalar Ubuntu Server (versión 24.04 LTS) en una máquina virtual.



2.Configurar el acceso por red (puerto 22 mapeado al host).



```
$ ssh todd@127.0.0.1 -p 3222
The authenticity of host '[127.0.0.1]:3222 ([127.0.0.1]:3222)' can't be established.
ED25519 key fingerprint is SHA256:TaIREmaQgYy+hHUoPkWfBiA3zgw3PR6ZXl5iI7fo0iE.
This key is not known by any other names.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Please type 'yes', 'no' or the fingerprint: alumno
Please type 'yes', 'no' or the fingerprint: yes
Warning: Permanently added '[127.0.0.1]:3222' (ED25519) to the list of known hosts.
todd@127.0.0.1's password:
Welcome to Ubuntu 24.04.3 LTS (GNU/Linux 6.8.0-83-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/pro

System information as of Wed Sep 17 01:53:36 AM UTC 2025

System load:          0.05
Usage of /:           27.7% of 23.45GB
Memory usage:         2%
Swap usage:           0%
Processes:            102
Users logged in:      0
IPv4 address for enp0s3: 10.0.2.15
IPv6 address for enp0s3: fd17:625c:f037:2::a00:27ff:fe47:902d
```

3. Instalación de paquetes en Ubuntu Server.

```
root@nodo1:/home/todd# apt -y install net-tools
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
net-tools is already the newest version (2.10-0.1ubuntu4.4).
0 upgraded, 0 newly installed, 0 to remove and 10 not upgraded.

root@nodo1:/home/todd# apt install mariadb-server mariadb-client galera-4
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  libcgi-fast-perl libcgi-pm-perl libclone-perl libconfig-inifiles-perl libdbd-mysql-perl
  libdbi-perl libencode-locale-perl libfcgi-bin libfcgi-perl libfcgi0t64
  libhtml-parser-perl libhtml-tagset-perl libhtml-template-perl libhttp-date-perl
  libhttp-message-perl libio-html-perl liblwp-mediatypes-perl libmariadb3 libmysqlclient21
  libsnappy1v5 libtimedate-perl liburi-perl liburing2 mariadb-client-core mariadb-common
0 upgraded, 0 newly installed, 0 to remove and 8 not upgraded.

root@nodo1:/home/todd# apt -y install mariadb-server mariadb-client galera-4
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
mariadb-server is already the newest version (1:10.11.13-0ubuntu0.24.04.1).
mariadb-client is already the newest version (1:10.11.13-0ubuntu0.24.04.1).
galera-4 is already the newest version (26.4.16-2build4).
0 upgraded, 0 newly installed, 0 to remove and 8 not upgraded.
root@nodo1:/home/todd# apt -y install galera-arbitrator-4
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
```

```

root@nodo1:/home/todd# apt -y install mariadb-client libmariadb3
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
mariadb-client is already the newest version (1:10.11.13-0ubuntu0.24.04.1).
libmariadb3 is already the newest version (1:10.11.13-0ubuntu0.24.04.1).
libmariadb3 set to manually installed.
0 upgraded, 0 newly installed, 0 to remove and 8 not upgraded.
root@nodo1:/home/todd# systemctl stop mysql
root@nodo1:/home/todd# netstat -tln
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State       PID/Program name
tcp        0      0 0.0.0.0:22              0.0.0.0:*               LISTEN      1/init
tcp        0      0 127.0.0.54:53           0.0.0.0:*               LISTEN      545/systemd-
tcp        0      0 127.0.0.53:53           0.0.0.0:*               LISTEN      545/systemd-
tcp6       0      0 :::22                   :::*                    LISTEN      1/init
root@nodo1:/home/todd#

```

Confirmamos que mariadb está instalado.

```

root@nodo1:/home/todd# systemctl status mysql
o mariadb.service - MariaDB 10.11.13 database server
   Loaded: loaded (/usr/lib/systemd/system/mariadb.service; enabled; preset: enabled)
   Active: inactive (dead) since Wed 2025-09-17 02:41:06 UTC; 2min 38s ago
     Duration: 39min 12.533s
    Docs: man:mariabdb(8)
          https://mariadb.com/kb/en/library/systemd/
   Process: 2484 ExecStart=/usr/sbin/mariabdb $MYSQLD_OPTS $WSREP_NEW_CLUSTER $WSREP_START>
  Main PID: 2484 (code=exited, status=0/SUCCESS)
    Status: "MariaDB server is down"
     CPU: 982ms

Sep 17 02:41:06 nodo1 mariabdb[2484]: 2025-09-17 2:41:06 0 [Note] /usr/sbin/mariabdb (initia>
Sep 17 02:41:06 nodo1 mariabdb[2484]: 2025-09-17 2:41:06 0 [Note] InnoDB: FTS optimize thre>
Sep 17 02:41:06 nodo1 mariabdb[2484]: 2025-09-17 2:41:06 0 [Note] InnoDB: Starting shutdown>
Sep 17 02:41:06 nodo1 mariabdb[2484]: 2025-09-17 2:41:06 0 [Note] InnoDB: Dumping buffer po>
Sep 17 02:41:06 nodo1 mariabdb[2484]: 2025-09-17 2:41:06 0 [Note] InnoDB: Buffer pool(s) du>
Sep 17 02:41:06 nodo1 mariabdb[2484]: 2025-09-17 2:41:06 0 [Note] InnoDB: Removed temporary>
Sep 17 02:41:06 nodo1 mariabdb[2484]: 2025-09-17 2:41:06 0 [Note] InnoDB: Shutdown complete>
Sep 17 02:41:06 nodo1 mariabdb[2484]: 2025-09-17 2:41:06 0 [Note] /usr/sbin/mariabdb: Shutd>
Sep 17 02:41:06 nodo1 systemd[1]: mariadb.service: Deactivated successfully.
Sep 17 02:41:06 nodo1 systemd[1]: Stopped mariadb.service - MariaDB 10.11.13 database server.

```

```

root@nodo1:/home/todd# cd /etc/mysql/
root@nodo1:/etc/mysql# ls -al
total 32
drwxr-xr-x  4 root root 4096 Sep 17 02:01 .
drwxr-xr-x 109 root root 4096 Sep 17 02:04 ..
drwxr-xr-x  2 root root 4096 Sep 17 02:01 conf.d
-rw-r--r--  1 root root  544 Sep 17 02:01 debian.cnf
-rwxr-xr-x  1 root root 1768 May 23 23:20 debian-start
-rw-r--r--  1 root root 1126 May 23 23:20 mariadb.cnf
drwxr-xr-x  2 root root 4096 Sep 17 02:01 mariadb.conf.d
-rwxrwxrwx  1 root root  24 Oct 20 2020 my.cnf -> /etc/alternati
-rw-r--r--  1 root root 839 Oct 20 2020 my.cnf.fallback
root@nodo1:/etc/mysql# cd mariadb.conf.d/
root@nodo1:/etc/mysql/mariadb.conf.d# ls -al
total 48
drwxr-xr-x 2 root root 4096 Sep 17 02:01 .
drwxr-xr-x 4 root root 4096 Sep 17 02:01 ..
-rw-r--r-- 1 root root  575 May 23 23:20 50-client.cnf
-rw-r--r-- 1 root root  231 May 23 23:20 50-mysql-clients.cnf
-rw-r--r-- 1 root root  927 May 23 23:20 50-mysqld_safe.cnf
-rw-r--r-- 1 root root 3759 May 23 23:20 50-server.cnf
-rw-r--r-- 1 root root  570 May 23 23:20 60-galera.cnf
-rw-r--r-- 1 root root   76 May 23 21:07 provider_bzip2.cnf
-rw-r--r-- 1 root root   72 May 23 21:07 provider_lz4.cnf
-rw-r--r-- 1 root root   74 May 23 21:07 provider_lzma.cnf
-rw-r--r-- 1 root root   72 May 23 21:07 provider_lzo.cnf
-rw-r--r-- 1 root root   78 May 23 21:07 provider_snappy.cnf
root@nodo1:/etc/mysql/mariadb.conf.d# |

```

Lo siguiente es configurar mariadb.

```

todd@nodo1: /etc/mysql/mariadb.conf.d
mysql>
binlog_format=ROW
default-storage-engine=innodb
innodb_autoinc_lock_mode=2
bind-address=0.0.0.0

#Galera Provider Configuration
wsrep_on=ON
wsrep_provider=/usr/lib/galera/libgalera_smm.so

# Galera Cluster Configuration
wsrep_cluster_name="test_cluster"
wsrep_cluster_address="gcomm://192.168.56.101"

# Galera Synchronization Configuration
wsrep_sst_method=rsync

# Galera Node Configuration
wsrep_node_address="192.168.56.101"
wsrep_node_name="nodo1"

~
~
~
~
~
~
~
"60-galera.cnf" [readonly] 21L, 464B
1:1 All

```

verificamos si está la conexión con "galera_new_cluster"

```
root@nodol:/home/todd# galera_new_cluster
root@nodol:/home/todd# netstat -tln
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State       PID/Program name
tcp        0      0 0.0.0.0:4567          0.0.0.0:*               LISTEN      1784/mariadb
tcp        0      0 0.0.0.0:22            0.0.0.0:*               LISTEN      1/init
tcp        0      0 127.0.0.53:53         0.0.0.0:*               LISTEN      545/systemd-resolve
tcp        0      0 127.0.0.54:53         0.0.0.0:*               LISTEN      545/systemd-resolve
tcp        0      0 0.0.0.0:3306          0.0.0.0:*               LISTEN      1784/mariadb
tcp6       0      0 :::22                 :::*                    LISTEN      1/init
```

si todo sale bien mostrará el siguiente resultado.

```
root@nodol:/home/todd# mysql -u root -p -e "SHOW STATUS LIKE 'wsrep_cluster_size'"
Enter password:
+-----+-----+
| Variable_name | Value |
+-----+-----+
| wsrep_cluster_size | 1     |
+-----+-----+
```

Instalamos sysbench

```
root@nodol:/home/todd# apt install sysbench
Reading package lists... Done
Building dependency tree... Done
Reading state information... Done
The following additional packages will be installed:
  liblua5.1-2 liblua5.1-common libpq5
The following NEW packages will be installed:
  liblua5.1-2 liblua5.1-common libpq5 sysbench
0 upgraded, 4 newly installed, 0 to remove and 11 not upgraded.
Need to get 584 kB of archives.
After this operation, 1,650 kB of additional disk space will be used.
Do you want to continue? [Y/n] y
Get:1 http://archive.ubuntu.com/ubuntu noble/universe amd64 liblua5.1-common all 2.1-20230410-1build1 [48.6 kB]
Get:2 http://archive.ubuntu.com/ubuntu noble/universe amd64 liblua5.1-2 amd64 2.1-20230410-1build1 [277 kB]
Get:3 http://archive.ubuntu.com/ubuntu noble-updates/main amd64 libpq5 amd64 16.10-0ubuntu0.24.04.1 [144 kB]
Get:4 http://archive.ubuntu.com/ubuntu noble/universe amd64 sysbench amd64 1.0.2
```

Crear la base de datos para las pruebas y Creamos la base de datos e insertamos 10 mil registros.

```
root@nodol:/home/todd# mysql -uroot -p -e "create database sbtest"
Enter password:
root@nodol:/home/todd# sysbench --threads=1 --db-driver=mysql --mysql-user=root --events=0 oltp_read_only prepare
sysbench 1.0.20 (using system LuaJIT 2.1.0-beta3)

Creating table 'sbtest1'...
Inserting 10000 records into 'sbtest1'
Creating a secondary index on 'sbtest1'...
root@nodol:/home/todd#
```


Prueba de un hilo a 10 segundos

```
A[SQL statistics:
  queries performed:
    read:          112420
    write:         0
    other:         16060
    total:         128480
  transactions:    8030 (802.88 per sec.)
  queries:         128480 (12846.06 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

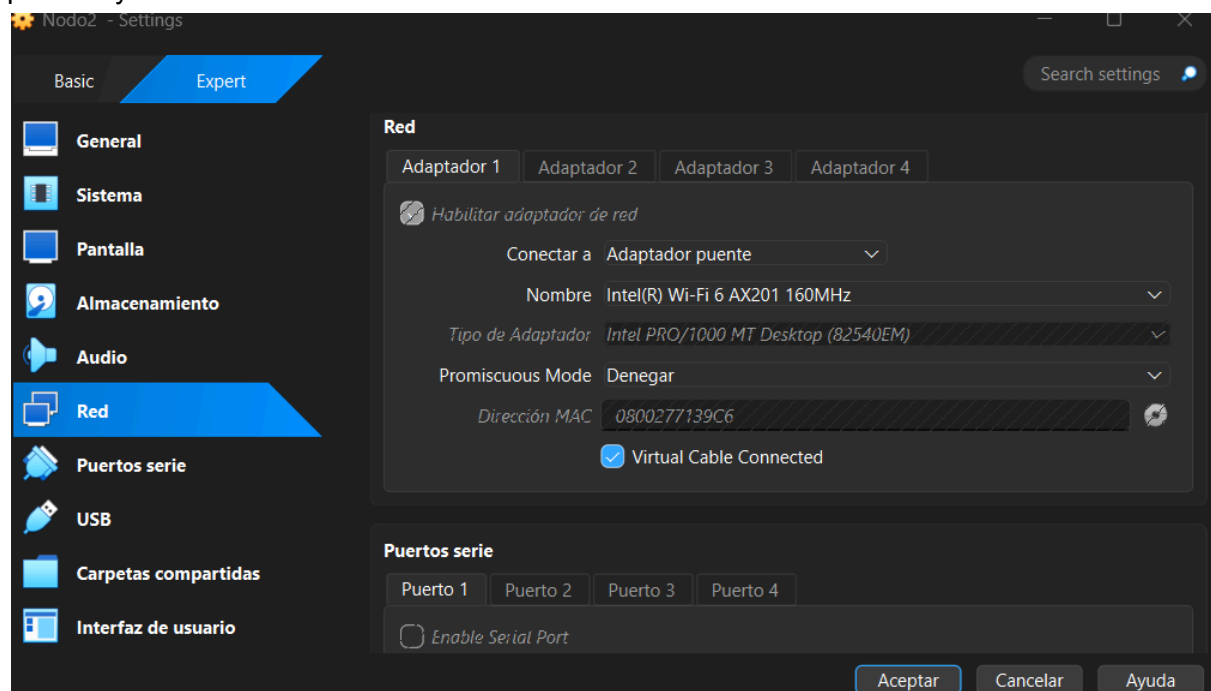
General statistics:
  total time:      10.0003s
  total number of events: 8030

Latency (ms):
  min:            0.86
  avg:            1.24
  max:            10.67
  95th percentile: 3.25
  sum:            9987.11

Threads fairness:
  events (avg/stddev): 8030.0000/0.00
  execution time (avg/stddev): 9.9871/0.00
```

INTERCONECTAR LOS NODOS.

Al clonar el primer nodo, solo debemos cambiar la configuración de red a “adaptador puente” y marcar la casilla de cable conectado.



Después abrimos el archivo .yaml con “nano /etc/netplan/00-installer-config.yaml” y ponemos los siguiente.

```
GNU nano 7.2 /etc/mysql/mariadb.conf.d/60-galera.cnf
[mysqld]
binlog_format=ROW
default_storage_engine=InnoDB
innodb_autoinc_lock_mode=2
bind-address=0.0.0.0

# Galera
wsrep_on=ON
wsrep_provider=/usr/lib/galera/libgalera_smm.so
wsrep_cluster_name="mariadb_galera_cluster"
wsrep_cluster_address="gcomm://192.168.100.24,192.168.100.26,192.168.100.27"
wsrep_node_address="192.168.100.27"
wsrep_node_name="nodo3"
wsrep_sst_method=rsync
```

como resultado nos debe de mostrar que hay 3 clusters.

```
root@nodo1:/home/todd# mysql -u root -p -e "SHOW STATUS LIKE 'wsrep_cluster_size';"
Enter password:
+-----+-----+
| Variable_name | Value |
+-----+-----+
| wsrep_cluster_size | 3 |
+-----+-----+
```

Creamos una base de datos simple usamos el comando “mysql -u root -p”

```
MariaDB [(none)]> CREATE DATABASE empresa;
Query OK, 1 row affected (0.019 sec)

MariaDB [(none)]> SHOW DATABASES;
+-----+
| Database |
+-----+
| empresa |
| information_schema |
| mysql |
| performance_schema |
| sbtest |
| sys |
+-----+
5 rows in set (0.003 sec)

MariaDB [(none)]> USE empresa;
Database changed
MariaDB [empresa]>
MariaDB [empresa]> CREATE TABLE empleados (
-> id INT AUTO_INCREMENT PRIMARY KEY,
-> nombre VARCHAR(100)
```

```

MariaDB [empresa]> SELECT * FROM empleados;
+-----+-----+-----+-----+
| id | nombre      | puesto      | salario |
+-----+-----+-----+-----+
| 1  | Ana López   | Gerente     | 25000.00 |
| 2  | Juan Pérez  | Programador | 15000.00 |
| 3  | María Torres | Diseñadora  | 18000.00 |
+-----+-----+-----+-----+
3 rows in set (0.001 sec)

MariaDB [empresa]> |

```

PREPARAR SYSBENCH EN CADA NODO.

instalarla sysbench en cada nodo después creamos una base de datos de prueba

```

root@nodo1:/home/todd# preparar datos
preparar: command not found
root@nodo1:/home/todd# mysql -u root -p -e "CREATE DATABASE sbtest;"
Enter password:
-----
CREATE DATABASE sbtest
-----

```

PRUEBAS SYSBENCH CON 3 NODOS, 1 CORE Y 2 CORE.

1.- Bulk_Insert.

```

SQL statistics:
  queries performed:
    read:                0
    write:               287
    other:               0
    total:               287
  transactions:         8453217 (140440.95 per sec.)
  queries:              287    (4.77 per sec.)
  ignored errors:       0      (0.00 per sec.)
  reconnects:          0      (0.00 per sec.)

General statistics:
  total time:           60.1895s
  total number of events: 8453217

Latency (ms):
  min:                  0.00
  avg:                  0.01
  max:                  1012.56
  95th percentile:     0.00
  sum:                  58460.86

Threads fairness:
  events (avg/stddev):  8453217.0000/0.00
  execution time (avg/stddev): 58.4609/0.00

```

2 Hilos

```
SQL statistics:
  queries performed:
    read:          0
    write:         70
    other:         0
    total:         70
  transactions:    2227434 (36206.88 per sec.)
  queries:         70 (1.14 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

General statistics:
  total time:      61.5167s
  total number of events: 2227434

Latency (ms):
  min:             0.00
  avg:             0.05
  max:            5684.31
  95th percentile: 0.00
  sum:            120072.01

Threads fairness:
  events (avg/stddev): 1113717.0000/29125.00
  execution time (avg/stddev): 60.0360/0.53
```

2.- oltp_delete

1 HILO.

```
Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         0
    other:        1207620
    total:        1207620
  transactions:    1207620 (20126.04 per sec.)
  queries:         1207620 (20126.04 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

General statistics:
  total time:      60.0017s
  total number of events: 1207620

Latency (ms):
  min:             0.03
  avg:             0.05
  max:            52.75
  95th percentile: 0.06
  sum:            59376.86

Threads fairness:
  events (avg/stddev): 1207620.0000/0.00
  execution time (avg/stddev): 59.3769/0.00

root@nodo1:/home/todd# |
```

2 HILO

```
Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         0
    other:        1241480
    total:        1241480
  transactions:    1241480 (20690.72 per sec.)
  queries:         1241480 (20690.72 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

General statistics:
  total time:      60.0007s
  total number of events: 1241480

Latency (ms):
  min:             0.03
  avg:             0.10
  max:            24.96
  95th percentile: 0.11
  sum:            119386.83

Threads fairness:
```

3.- oltp_insert

1 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         8149
    other:         0
    total:         8149
  transactions:    8149 (135.80 per sec.)
  queries:         8149 (135.80 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:     0 (0.00 per sec.)

General statistics:
  total time:      60.0051s
  total number of events: 8149

Latency (ms):
  min:            3.76
  avg:            7.36
  max:            51.58
  95th percentile: 11.04
  sum:            59943.34

Threads fairness:
  events (avg/stddev): 8149.0000/0.00
  execution time (avg/stddev): 59.9433/0.00

root@nodo1: /home/todd#
```

2 hilo

```
root@nodo1: /home/todd#
Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         11951
    other:         0
    total:         11951
  transactions:    11951 (199.16 per sec.)
  queries:         11951 (199.16 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:     0 (0.00 per sec.)

General statistics:
  total time:      60.0061s
  total number of events: 11951

Latency (ms):
  min:            4.09
  avg:            10.03
  max:            40.21
  95th percentile: 13.95
  sum:            119921.11

Threads fairness:
  events (avg/stddev): 5975.5000/14.50
  execution time (avg/stddev): 59.9606/0.00

root@nodo1: /home/todd#
```

4.- oltp_point_select

1 Hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:          1043945
    write:         0
    other:         0
    total:         1043945
  transactions:   1043945 (17398.63 per sec.)
  queries:        1043945 (17398.63 per sec.)
  ignored errors: 0        (0.00 per sec.)
  reconnects:     0        (0.00 per sec.)

General statistics:
  total time:      60.0003s
  total number of events: 1043945

Latency (ms):
  min:            0.03
  avg:            0.06
  max:            12.11
  95th percentile: 0.07
  sum:            59431.16

Threads fairness:
  events (avg/stddev): 1043945.0000/0.00
  execution time (avg/stddev): 59.4312/0.00
```

2 HILO

```
Threads started!

SQL statistics:
  queries performed:
    read:          1051899
    write:         0
    other:         0
    total:         1051899
  transactions:   1051899 (17530.47 per sec.)
  queries:        1051899 (17530.47 per sec.)
  ignored errors: 0        (0.00 per sec.)
  reconnects:     0        (0.00 per sec.)

General statistics:
  total time:      60.0030s
  total number of events: 1051899

Latency (ms):
  min:            0.03
  avg:            0.11
  max:            27.56
  95th percentile: 0.13
  sum:            119413.70

Threads fairness:
  events (avg/stddev): 525949.5000/8.50
  execution time (avg/stddev): 59.7069/0.00

root@node1: /home/todd# |
```

5.- oltp_read_only

1 HILO

```
Threads started!

SQL statistics:
  queries performed:
    read:          764148
    write:         0
    other:         109164
    total:         873312
  transactions:    54582 (909.64 per sec.)
  queries:         873312 (14554.28 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

General statistics:
  total time:      60.0026s
  total number of events: 54582

Latency (ms):
  min:             0.67
  avg:             1.10
  max:             15.54
  95th percentile: 3.13
  sum:             59873.33

Threads fairness:
  events (avg/stddev): 54582.0000/0.00
  execution time (avg/stddev): 59.8733/0.00

root@node1: /home/todd#
```

2 HILO

```
Threads started!

SQL statistics:
  queries performed:
    read:          767340
    write:         0
    other:         109620
    total:         876960
  transactions:    54810 (913.45 per sec.)
  queries:         876960 (14615.26 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

General statistics:
  total time:      60.0020s
  total number of events: 54810

Latency (ms):
  min:             0.69
  avg:             2.19
  max:             25.11
  95th percentile: 6.32
  sum:             119873.71

Threads fairness:
  events (avg/stddev): 27405.0000/12.00
  execution time (avg/stddev): 59.9369/0.00
```

6.- oltp_read_write

1 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:                106386
    write:               26206
    other:               19388
    total:               151980
  transactions:         7599 (126.64 per sec.)
  queries:              151980 (2532.75 per sec.)
  ignored errors:       0 (0.00 per sec.)
  reconnects:           0 (0.00 per sec.)

General statistics:
  total time:           60.0048s
  total number of events: 7599

Latency (ms):
  min:                  5.35
  avg:                   7.89
  max:                   24.66
  95th percentile:     10.09
  sum:                   59964.93

Threads fairness:
  events (avg/stddev):  7599.0000/0.00
  execution time (avg/stddev): 59.9649/0.00

root@node1: /home/todd# |
```

2 hilo


```

Threads started!

SQL statistics:
  queries performed:
    read:          115668
    write:         29832
    other:         19740
    total:         165240
  transactions:    8262   (137.67 per sec.)
  queries:         165240 (2753.50 per sec.)
  ignored errors:  0      (0.00 per sec.)
  reconnects:      0      (0.00 per sec.)

General statistics:
  total time:      60.0098s
  total number of events: 8262

Latency (ms):
  min:             6.93
  avg:             14.52
  max:             34.04
  95th percentile: 20.37
  sum:             119949.09

Threads fairness:
  events (avg/stddev): 4131.0000/3.00
  execution time (avg/stddev): 59.9745/0.00

```

7.- oltp_update_index

1 Hilo

```

Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         10598
    other:         1518
    total:         12116
  transactions:    12116 (201.92 per sec.)
  queries:         12116 (201.92 per sec.)
  ignored errors:  0      (0.00 per sec.)
  reconnects:      0      (0.00 per sec.)

General statistics:
  total time:      60.0031s
  total number of events: 12116

Latency (ms):
  min:             0.04
  avg:             4.95
  max:             34.79
  95th percentile: 7.43
  sum:             59966.43

Threads fairness:
  events (avg/stddev): 12116.0000/0.00
  execution time (avg/stddev): 59.9664/0.00

root@nodo1: /home/todd# !

```

2 HILOS

```
Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         12034
    other:         1762
    total:         13796
  transactions:    13796 (229.91 per sec.)
  queries:         13796 (229.91 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

General statistics:
  total time:      60.0062s
  total number of events: 13796

Latency (ms):
  min:            0.04
  avg:            8.69
  max:            23.51
  95th percentile: 13.70
  sum:            119943.96

Threads fairness:
  events (avg/stddev): 6898.0000/14.00
  execution time (avg/stddev): 59.9720/0.00

root@node1:/home/todd# |
```

8.- oltp_update_non_index

1 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         10469
    other:         1465
    total:         11934
  transactions:    11934 (198.88 per sec.)
  queries:         11934 (198.88 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

General statistics:
  total time:      60.0040s
  total number of events: 11934

Latency (ms):
  min:            0.04
  avg:            5.02
  max:            121.71
  95th percentile: 7.30
  sum:            59966.04

Threads fairness:
  events (avg/stddev): 11934.0000/0.00
  execution time (avg/stddev): 59.9660/0.00

root@node1:/home/todd# |
```

2 hilo

```

Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         12158
    other:         1716
    total:         13874
  transactions:    13874 (231.20 per sec.)
  queries:         13874 (231.20 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

General statistics:
  total time:      60.0081s
  total number of events: 13874

Latency (ms):
  min:             0.04
  avg:             8.65
  max:             24.14
  95th percentile: 13.46
  sum:             119942.45

Threads fairness:
  events (avg/stddev): 6937.0000/35.00
  execution time (avg/stddev): 59.9712/0.01
root@node1: /home/todd# |

```

9.- oltp_write_only

1 hilo

```

Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         32849
    other:         21169
    total:         54018
  transactions:    9003 (150.04 per sec.)
  queries:         54018 (900.26 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

General statistics:
  total time:      60.0010s
  total number of events: 9003

Latency (ms):
  min:             3.72
  avg:             6.66
  max:             23.26
  95th percentile: 8.58
  sum:             59952.75

Threads fairness:
  events (avg/stddev): 9003.0000/0.00
  execution time (avg/stddev): 59.9528/0.00
root@node1: /home/todd# |

```

2hilo

```

Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         39676
    other:         24674
    total:         64350
  transactions:    10725 (178.72 per sec.)
  queries:         64350 (1072.34 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

General statistics:
  total time:      60.0077s
  total number of events: 10725

Latency (ms):
  min:            4.92
  avg:            11.18
  max:            43.82
  95th percentile: 16.12
  sum:            119938.21

Threads fairness:
  events (avg/stddev): 5362.5000/6.50
  execution time (avg/stddev): 59.9691/0.00
root@node1: /home/todd#

```

10.- select_random_points

1 hilo

```

Threads started!

SQL statistics:
  queries performed:
    read:          24249
    write:         0
    other:         0
    total:         24249
  transactions:    24249 (404.12 per sec.)
  queries:         24249 (404.12 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

General statistics:
  total time:      60.0028s
  total number of events: 24249

Latency (ms):
  min:            0.50
  avg:            2.47
  max:            18.34
  95th percentile: 5.00
  sum:            59927.20

Threads fairness:
  events (avg/stddev): 24249.0000/0.00
  execution time (avg/stddev): 59.9272/0.00
root@node1: /home/todd#

```

2 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:          548433
    write:         0
    other:         0
    total:         548433
  transactions:    548433 (9139.95 per sec.)
  queries:         548433 (9139.95 per sec.)
  ignored errors:  0      (0.00 per sec.)
  reconnects:     0      (0.00 per sec.)

General statistics:
  total time:      60.0007s
  total number of events: 548433

Latency (ms):
  min:            0.06
  avg:            0.22
  max:            25.57
  95th percentile: 0.28
  sum:            119426.04

Threads fairness:
  events (avg/stddev): 274216.5000/7245.50
  execution time (avg/stddev): 59.7130/0.00

root@node1: /home/tedd#
```

11.- select_random_ranges

1 hilo

```

Threads started!

SQL statistics:
  queries performed:
    read:          33030
    write:         0
    other:         0
    total:         33030
  transactions:    33030 (550.47 per sec.)
  queries:         33030 (550.47 per sec.)
  ignored errors:  0      (0.00 per sec.)
  reconnects:     0      (0.00 per sec.)

General statistics:
  total time:      60.0018s
  total number of events: 33030

Latency (ms):
  min:            0.24
  avg:            1.81
  max:            19.36
  95th percentile: 4.10
  sum:            59918.26

Threads fairness:
  events (avg/stddev): 33030.0000/0.00
  execution time (avg/stddev): 59.9183/0.00

root@node1:/home/todd# |

```

2 hilo

```

Threads started!

SQL statistics:
  queries performed:
    read:          546653
    write:         0
    other:         0
    total:         546653
  transactions:    546653 (9110.60 per sec.)
  queries:         546653 (9110.60 per sec.)
  ignored errors:  0      (0.00 per sec.)
  reconnects:     0      (0.00 per sec.)

General statistics:
  total time:      60.0007s
  total number of events: 546653

Latency (ms):
  min:            0.06
  avg:            0.22
  max:            27.34
  95th percentile: 0.27
  sum:            119405.17

Threads fairness:
  events (avg/stddev): 273326.5000/5608.50
  execution time (avg/stddev): 59.7026/0.01

root@node1:/home/todd# |

```

PRUEBAS SYSBENCH CON 2 NODOS, 1 CORE Y 2 CORE

```

root@nodo1:/home/todd# mysql -u root -p -e "SHOW STATUS LIKE 'wsrep_cluster_size';"
Enter password:
+-----+-----+
| Variable_name | Value |
+-----+-----+
| wsrep_cluster_size | 2 |
+-----+-----+
root@nodo1:/home/todd#

```

1.- Bulk_Insert.

Con un solo hilo

```

SQL statistics:
  queries performed:
    read: 0
    write: 232
    other: 0
    total: 232
  transactions: 6851342 (113952.42 per sec.)
  queries: 232 (3.86 per sec.)
  ignored errors: 0 (0.00 per sec.)
  reconnects: 0 (0.00 per sec.)

General statistics:
  total time: 60.1232s
  total number of events: 6851342

Latency (ms):
  min: 0.00
  avg: 0.01
  max: 1193.23
  95th percentile: 0.00
  sum: 58749.31

Threads fairness:
  events (avg/stddev): 6851342.0000/0.00
  execution time (avg/stddev): 58.7493/0.00

```

2 hilos

```

Threads started!

SQL statistics:
  queries performed:
    read: 0
    write: 249
    other: 0
    total: 249
  transactions: 7464114 (123468.46 per sec.)
  queries: 249 (4.12 per sec.)
  ignored errors: 0 (0.00 per sec.)
  reconnects: 0 (0.00 per sec.)

General statistics:
  total time: 60.4526s
  total number of events: 7464114

Latency (ms):
  min: 0.00
  avg: 0.02
  max: 1148.78
  95th percentile: 0.00
  sum: 118210.38

Threads fairness:
  events (avg/stddev): 3732057.0000/26215.00
  execution time (avg/stddev): 59.1052/0.16

```

2.- oltp_delete

1 hilo

```

Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         10137
    other:         531650
    total:         541787
  transactions:    541787 (9029.19 per sec.)
  queries:         541787 (9029.19 per sec.)
  ignored errors:  0      (0.00 per sec.)
  reconnects:      0      (0.00 per sec.)

General statistics:
  total time:      60.0028s
  total number of events: 541787

Latency (ms):
  min:             0.03
  avg:             0.11
  max:             15.24
  95th percentile: 0.09
  sum:             59730.79

Threads fairness:
  events (avg/stddev): 541787.0000/0.00
  execution time (avg/stddev): 59.7308/0.00

root@node1:/home/todd# |

```

2 hilo

```

Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         1680
    other:         1097443
    total:         1099123
  transactions:    1099123 (18317.61 per sec.)
  queries:         1099123 (18317.61 per sec.)
  ignored errors:  0      (0.00 per sec.)
  reconnects:      0      (0.00 per sec.)

General statistics:
  total time:      60.0026s
  total number of events: 1099123

Latency (ms):
  min:             0.03
  avg:             0.11
  max:             23.68
  95th percentile: 0.12
  sum:             119415.47

Threads fairness:
  events (avg/stddev): 549561.5000/2583.50
  execution time (avg/stddev): 59.7077/0.00

```

3.- oltp_insert

1 hilo


```

Threads started!

SQL statistics:
  queries performed:
    read:                0
    write:               18763
    other:               0
    total:               18763
  transactions:         18763 (312.70 per sec.)
  queries:              18763 (312.70 per sec.)
  ignored errors:       0      (0.00 per sec.)
  reconnects:           0      (0.00 per sec.)

General statistics:
  total time:           60.0028s
  total number of events: 18763

Latency (ms):
  min:                  2.03
  avg:                  3.19
  max:                  214.72
  95th percentile:     4.18
  sum:                  59926.79

Threads fairness:
  events (avg/stddev):  18763.0000/0.00
  execution time (avg/stddev): 59.9268/0.00

```

2 hilo

```

Threads started!

SQL statistics:
  queries performed:
    read:                0
    write:               21983
    other:               0
    total:               21983
  transactions:         21983 (366.34 per sec.)
  queries:              21983 (366.34 per sec.)
  ignored errors:       0      (0.00 per sec.)
  reconnects:           0      (0.00 per sec.)

General statistics:
  total time:           60.0057s
  total number of events: 21983

Latency (ms):
  min:                  2.30
  avg:                  5.45
  max:                  29.86
  95th percentile:     7.70
  sum:                  119898.12

Threads fairness:
  events (avg/stddev):  10991.5000/25.50
  execution time (avg/stddev): 59.9491/0.00

```

4.- oltp_point_select

1 hilo

```

Threads started!

SQL statistics:
  queries performed:
    read:          1162402
    write:         0
    other:         0
    total:         1162402
  transactions:   1162402 (19372.47 per sec.)
  queries:        1162402 (19372.47 per sec.)
  ignored errors: 0        (0.00 per sec.)
  reconnects:     0        (0.00 per sec.)

General statistics:
  total time:      60.0016s
  total number of events: 1162402

Latency (ms):
  min:            0.03
  avg:            0.05
  max:            9.23
  95th percentile: 0.06
  sum:            59479.18

Threads fairness:
  events (avg/stddev): 1162402.0000/0.00
  execution time (avg/stddev): 59.4792/0.00

```

2 hilo

```

Threads started!

SQL statistics:
  queries performed:
    read:          1118229
    write:         0
    other:         0
    total:         1118229
  transactions:   1118229 (18636.15 per sec.)
  queries:        1118229 (18636.15 per sec.)
  ignored errors: 0        (0.00 per sec.)
  reconnects:     0        (0.00 per sec.)

General statistics:
  total time:      60.0020s
  total number of events: 1118229

Latency (ms):
  min:            0.03
  avg:            0.11
  max:            23.58
  95th percentile: 0.12
  sum:            119467.08

Threads fairness:
  events (avg/stddev): 559114.5000/2174.50
  execution time (avg/stddev): 59.7335/0.01

root@nodo1:/home/todd# |

```

5.- oltp_read_only

1 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:          983248
    write:         0
    other:         140464
    total:         1123712
  transactions:    70232 (1170.45 per sec.)
  queries:         1123712 (18727.26 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

General statistics:
  total time:      60.0009s
  total number of events: 70232

Latency (ms):
  min:            0.55
  avg:            0.85
  max:            65.15
  95th percentile: 2.71
  sum:            59891.61

Threads fairness:
  events (avg/stddev): 70232.0000/0.00
  execution time (avg/stddev): 59.8916/0.00
```

2 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:          982296
    write:         0
    other:         140328
    total:         1122624
  transactions:    70164 (1169.35 per sec.)
  queries:         1122624 (18709.53 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

General statistics:
  total time:      60.0017s
  total number of events: 70164

Latency (ms):
  min:            0.57
  avg:            1.71
  max:            19.05
  95th percentile: 5.28
  sum:            119874.08

Threads fairness:
  events (avg/stddev): 35082.0000/226.00
  execution time (avg/stddev): 59.9370/0.00

root@nodo1:/home/todd# |
```

6.- oltp_read_write

1 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:          176008
    write:         41053
    other:         34379
    total:         251440
  transactions:    12572 (209.51 per sec.)
  queries:         251440 (4190.22 per sec.)
  ignored errors:  0      (0.00 per sec.)
  reconnects:      0      (0.00 per sec.)

General statistics:
  total time:      60.0030s
  total number of events: 12572

Latency (ms):
  min:             3.39
  avg:             4.77
  max:             20.23
  95th percentile: 5.99
  sum:             59961.11

Threads fairness:
  events (avg/stddev): 12572.0000/0.00
  execution time (avg/stddev): 59.9611/0.00
```

2 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:          186032
    write:         46126
    other:         33602
    total:         265760
  transactions:    13288 (221.44 per sec.)
  queries:         265760 (4428.88 per sec.)
  ignored errors:  0      (0.00 per sec.)
  reconnects:      0      (0.00 per sec.)

General statistics:
  total time:      60.0051s
  total number of events: 13288

Latency (ms):
  min:             4.09
  avg:             9.03
  max:             28.57
  95th percentile: 12.75
  sum:             119946.42

Threads fairness:
  events (avg/stddev): 6644.0000/8.00
  execution time (avg/stddev): 59.9732/0.00

root@nodo1:/home/todd# |
```

7.- oltp_update_index

1 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         18780
    other:         3600
    total:         22380
  transactions:    22380 (372.97 per sec.)
  queries:         22380 (372.97 per sec.)
  ignored errors:  0      (0.00 per sec.)
  reconnects:      0      (0.00 per sec.)

General statistics:
  total time:      60.0036s
  total number of events: 22380

Latency (ms):
  min:             0.04
  avg:             2.68
  max:             89.84
  95th percentile: 4.10
  sum:             59954.89

Threads fairness:
  events (avg/stddev): 22380.0000/0.00
  execution time (avg/stddev): 59.9549/0.00

root@nodo1: /home/todd# |
```

2 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         22016
    other:         4169
    total:         26185
  transactions:    26185 (436.39 per sec.)
  queries:         26185 (436.39 per sec.)
  ignored errors:  0      (0.00 per sec.)
  reconnects:      0      (0.00 per sec.)

General statistics:
  total time:      60.0026s
  total number of events: 26185

Latency (ms):
  min:             0.04
  avg:             4.58
  max:             24.74
  95th percentile: 7.56
  sum:             119937.53

Threads fairness:
  events (avg/stddev): 13092.5000/19.50
  execution time (avg/stddev): 59.9688/0.00

root@nodo1: /home/todd# |
```

8.- oltp_update_non_index

1 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         19197
    other:         3590
    total:         22787
  transactions:    22787 (379.76 per sec.)
  queries:         22787 (379.76 per sec.)
  ignored errors:  0      (0.00 per sec.)
  reconnects:      0      (0.00 per sec.)

General statistics:
  total time:      60.0028s
  total number of events: 22787

Latency (ms):
  min:             0.04
  avg:             2.63
  max:             208.57
  95th percentile: 4.03
  sum:             59954.53

Threads fairness:
  events (avg/stddev): 22787.0000/0.00
  execution time (avg/stddev): 59.9545/0.00

root@node1: /home/todd#
```

2 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         22222
    other:         4157
    total:         26379
  transactions:    26379 (439.61 per sec.)
  queries:         26379 (439.61 per sec.)
  ignored errors:  0      (0.00 per sec.)
  reconnects:      0      (0.00 per sec.)

General statistics:
  total time:      60.0049s
  total number of events: 26379

Latency (ms):
  min:             0.04
  avg:             4.55
  max:             79.65
  95th percentile: 7.43
  sum:             119934.39

Threads fairness:
  events (avg/stddev): 13189.5000/14.50
  execution time (avg/stddev): 59.9672/0.00

root@node1: /home/todd#
```

9.- oltp_write_only

1 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         60341
    other:         40771
    total:         101112
  transactions:    16852 (280.85 per sec.)
  queries:         101112 (1685.11 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

General statistics:
  total time:      60.0021s
  total number of events: 16852

Latency (ms):
  min:             2.28
  avg:             3.56
  max:             222.16
  95th percentile: 4.57
  sum:             59945.44

Threads fairness:
  events (avg/stddev): 16852.0000/0.00
  execution time (avg/stddev): 59.9454/0.00
```

2 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:          0
    write:         67931
    other:         43135
    total:         111066
  transactions:    18511 (308.49 per sec.)
  queries:         111066 (1850.93 per sec.)
  ignored errors:  0 (0.00 per sec.)
  reconnects:      0 (0.00 per sec.)

General statistics:
  total time:      60.0046s
  total number of events: 18511

Latency (ms):
  min:             2.47
  avg:             6.48
  max:             124.38
  95th percentile: 9.56
  sum:             119931.80

Threads fairness:
  events (avg/stddev): 9255.5000/3.50
  execution time (avg/stddev): 59.9659/0.00

root@node1: /home/todd# |
```

10.- select_random_points

1 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:                22349
    write:               0
    other:               0
    total:               22349
  transactions:         22349 (372.46 per sec.)
  queries:              22349 (372.46 per sec.)
  ignored errors:       0      (0.00 per sec.)
  reconnects:           0      (0.00 per sec.)

General statistics:
  total time:            60.0005s
  total number of events: 22349

Latency (ms):
  min:                   0.52
  avg:                   2.68
  max:                   13.07
  95th percentile:      5.09
  sum:                   59929.82

Threads fairness:
  events (avg/stddev):   22349.0000/0.00
  execution time (avg/stddev): 59.9298/0.00

root@nodo1:/home/todd# |
```

2 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:                556470
    write:               0
    other:               0
    total:               556470
  transactions:         556470 (9274.05 per sec.)
  queries:              556470 (9274.05 per sec.)
  ignored errors:       0      (0.00 per sec.)
  reconnects:           0      (0.00 per sec.)

General statistics:
  total time:            60.0018s
  total number of events: 556470

Latency (ms):
  min:                   0.06
  avg:                   0.21
  max:                   24.45
  95th percentile:      0.26
  sum:                   119471.85

Threads fairness:
  events (avg/stddev):   278235.0000/7554.00
  execution time (avg/stddev): 59.7359/0.01
```

11.- select_random_ranges

1 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:                25617
    write:               0
    other:               0
    total:               25617
  transactions:         25617 (426.94 per sec.)
  queries:              25617 (426.94 per sec.)
  ignored errors:       0      (0.00 per sec.)
  reconnects:           0      (0.00 per sec.)

General statistics:
  total time:           60.0008s
  total number of events: 25617

Latency (ms):
  min:                  0.34
  avg:                  2.34
  max:                  244.39
  95th percentile:     4.91
  sum:                  59861.75

Threads fairness:
  events (avg/stddev):  25617.0000/0.00
  execution time (avg/stddev): 59.8617/0.00
```

2 hilo

```
Threads started!

SQL statistics:
  queries performed:
    read:                511895
    write:               0
    other:               0
    total:               511895
  transactions:         511895 (8531.29 per sec.)
  queries:              511895 (8531.29 per sec.)
  ignored errors:       0      (0.00 per sec.)
  reconnects:           0      (0.00 per sec.)

General statistics:
  total time:           60.0009s
  total number of events: 511895

Latency (ms):
  min:                  0.06
  avg:                  0.23
  max:                  57.95
  95th percentile:     0.31
  sum:                  119447.61

Threads fairness:
  events (avg/stddev):  255947.5000/4302.50
  execution time (avg/stddev): 59.7238/0.01
```

Resultados y Análisis

Los resultados de las pruebas muestran un comportamiento diferenciado según el tipo de operación y la configuración:

- **Lecturas:** Operaciones como *point select* y *read only* escalan mejor al aumentar hilos y nodos, evidenciando la fortaleza de Galera en distribución de carga.
- **Escrituras:** En operaciones como *insert* y *update*, el rendimiento disminuye conforme aumenta el número de nodos, debido al costo de la replicación síncrona.
- **2 hilos vs 1 hilo:** Con 2 hilos se mejora el rendimiento en operaciones de lectura, mientras que en escrituras puede presentarse latencia adicional.
- **2 cores vs 1 core:** Se observa una mejora general en tiempos de ejecución y concurrencia al disponer de 2 cores por nodo.

Comparación 2 Nodos vs 3 Nodos

- **2 nodos:** Ofrecen menor latencia en escrituras, pero no garantizan disponibilidad total en caso de fallo de un nodo (no hay quórum).
- **3 nodos:** Aumentan la tolerancia a fallos y aseguran consistencia, aunque con ligera penalización en operaciones de escritura.
- En pruebas de carga mixta, los 3 nodos resultan más estables y confiables.

Conclusión

En conclusión, el despliegue de MariaDB con Galera4 en Ubuntu Server representa una alternativa eficiente para escenarios críticos, donde la disponibilidad y confiabilidad del sistema son más importantes que la optimización absoluta del rendimiento de escrituras.