



Conceptos y Comandos básicos del particionamiento en bases de datos NoSQL
&
Pruebas de particionamiento de bases de datos NoSQL

Asignatura

Bases de Datos Avanzadas

Presenta

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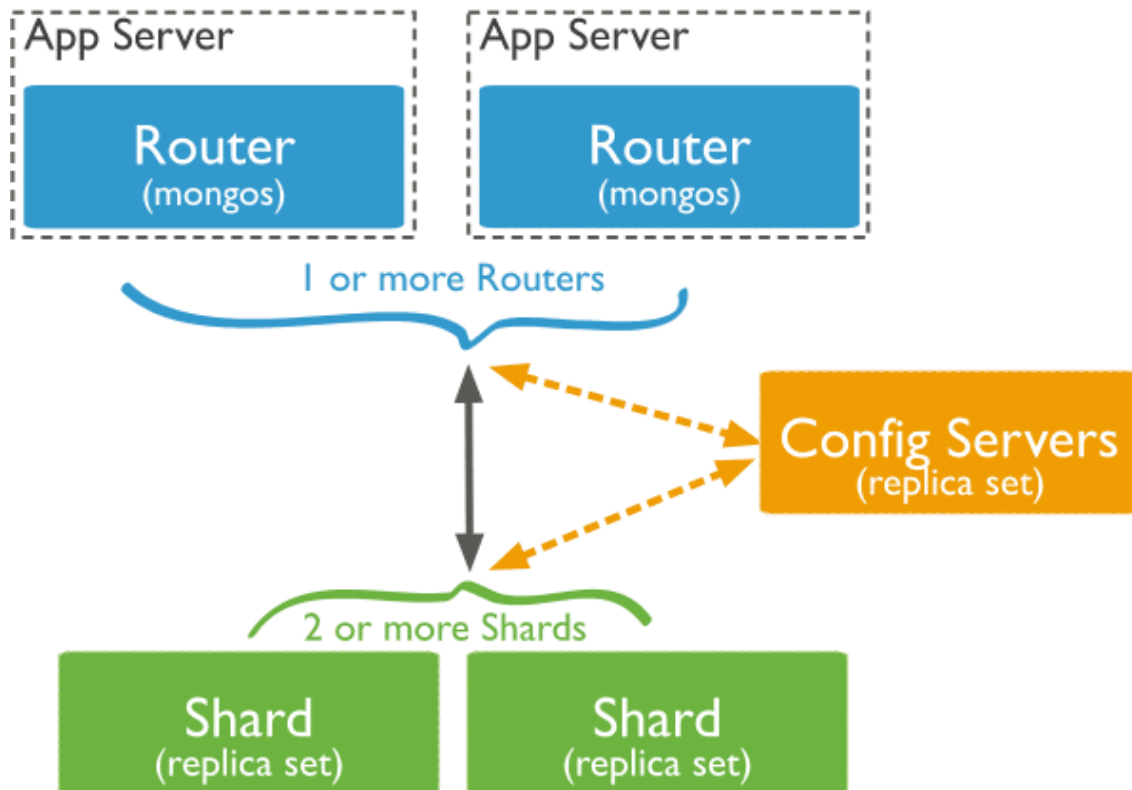
Ipiales – Nariño

2024

Requerimientos No Funcionales

- ✓ El sistema de particionamiento debe poseer como mínimo 2 bases de replicación.
- ✓ Cada una de las réplicas asignadas, deberán poseer como mínimo 3 nodos y con diferentes puertos configurados, para su conexión.
- ✓ Todos los nodos configurados poseerán el mismo hostname o ip, para la comunicación entre estos.
- ✓ Se tendrá la necesidad de ocupar un servidor de configuración, que contenga así mismo 3 nodos, que ocupen los datos, para la transmisión de estos.
- ✓ Se debe ocupar de un enrutador para el manejo sobre los nodos de configuración.
- ✓ Se deben fragmentar la base de datos, una de las colecciones y las réplicas configuradas.

Diagrama del particionamiento usado en forma horizontal



- Para iniciar necesitamos que cada uno de los servidores de configuración le sean creados directorios de almacenamiento o carpetas, esto gracias al modo de que cada uno tendra el objetivo de guardar y organizar los datos.

> Este equipo > Disco local (C:) > data > config

Nombre	Fecha de modificación	Tipo	Tamaño
Nodo1	27/01/2022 20:09	Carpeta de archivos	
Nodo2	27/01/2022 19:47	Carpeta de archivos	
Nodo3	27/01/2022 19:47	Carpeta de archivos	

> Este equipo > Disco local (C:) > data > repl >

Nombre	Fecha de modificación	Tipo	Tamaño
Nodo2	28/01/2022 16:03	Carpeta de archivos	
Nodo3	28/01/2022 16:03	Carpeta de archivos	
Nodo4	28/01/2022 16:03	Carpeta de archivos	
Nodo5	28/01/2022 16:03	Carpeta de archivos	
Nodo6	28/01/2022 16:03	Carpeta de archivos	
NodoPrincipal	28/01/2022 16:03	Carpeta de archivos	

- Ahora procederemos a activar cada servidor de configuración. Para que funcione en una única máquina, hay que darlo de alta en la misma IP de la máquina en la que se ha dado de alta el replica set esto gracias al comando - -bind_ip:

Activamos el servidor 1 con el puerto 27022

```
Administrador Símbolo del sistema - mongod --port 27022 --replSet rs0 --dbpath "C:\data\config\Node1" --config --bind_ip localhost

C:\Program Files\MongoDB\Server\4.2\bin>mongod --port 27022 --replSet rs0 --dbpath="C:\data\config\Node1" --configsvr --bind_ip localhost
2022-01-27T20:59:51.940-0500 I CONTROL [main] Automatically disabling TLS 1.0, to force-enable [LS 1.0, to force-enable [LS 1.0 specify --sslDisabledProtocols 'none'
2022-01-27T20:59:51.943-0500 W ASIO [main] No TransportLayer configured during NetworkInterface startup
2022-01-27T20:59:51.944-0500 I CONTROL [initandlisten] MongoDB starting : pid=7596 port=27022 dbpath=C:\data\config\Node1 64-bit host=DESKTOP-20941NA
2022-01-27T20:59:51.945-0500 I CONTROL [initandlisten] targetMinOS: Windows 7/Windows Server 2008 R2
2022-01-27T20:59:51.945-0500 I CONTROL [initandlisten] db version v4.2.6
2022-01-27T20:59:51.945-0500 I CONTROL [initandlisten] git version: 20364840b8f1af16917e4c23c1b5f5efdb8b352f8
2022-01-27T20:59:51.945-0500 I CONTROL [initandlisten] allocator: tcmalloc
2022-01-27T20:59:51.945-0500 I CONTROL [initandlisten] modules: none
2022-01-27T20:59:51.945-0500 I CONTROL [initandlisten] build environment:
2022-01-27T20:59:51.945-0500 I CONTROL [initandlisten] distmod: 2012plus
2022-01-27T20:59:51.945-0500 I CONTROL [initandlisten] distarch: x86_64
2022-01-27T20:59:51.945-0500 I CONTROL [initandlisten] target_arch: x86_64
2022-01-27T20:59:51.945-0500 I CONTROL [initandlisten] options: { net: { bindip: "localhost", port: 27022 }, replication: { replSet: "rs0" }, sharding: { clusterRole: '
2022-01-27T20:59:51.949-0500 I STORAGE [initandlisten] Detected data files in C:\data\config\Node1 created by the 'wiredTiger' storage engine, so setting the active st
WiredTiger
2022-01-27T20:59:51.949-0500 I STORAGE [initandlisten] wiredtiger_open config: create,cache_size=6630M,cache_overflow=(file_max=0M),session_max=33000,eviction=(threads
,config_base=false,statistics=(fast),log=(enabled=true,archive=true,path=journal,compressor=snappy),file_manager=(close_idle_time=100000,close_scan_interval=10,close_han
istics_log=(wait=0),verbose=(recovery_progress,checkpoint_progress),
2022-01-27T20:59:52.048-0500 I STORAGE [initandlisten] WiredTiger message [1643335192:47871][7596:140712841139536], txn-recover: Recovering log 2 through 3
2022-01-27T20:59:52.102-0500 I STORAGE [initandlisten] WiredTiger message [1643335192:101874][7596:140712841139536], txn-recover: Recovering log 3 through 3
2022-01-27T20:59:52.166-0500 I STORAGE [initandlisten] WiredTiger message [1643335192:165879][7596:140712841139536], txn-recover: Main recovery loop: starting at 2/6656
2022-01-27T20:59:52.268-0500 I STORAGE [initandlisten] WiredTiger message [1643335192:267885][7596:140712841139536], txn-recover: Recovering log 2 through 3
2022-01-27T20:59:52.348-0500 I STORAGE [initandlisten] WiredTiger message [1643335192:348325][7596:140712841139536], txn-recover: Recovering log 3 through 3
2022-01-27T20:59:52.401-0500 I STORAGE [initandlisten] WiredTiger message [1643335192:401328][7596:140712841139536], txn-recover: Set global recovery timestamp: (0, 0)
2022-01-27T20:59:52.723-0500 I RECOVERY [initandlisten] WiredTiger recoveryTimestamp. Ts: Timestamp(0, 0)
2022-01-27T20:59:52.865-0500 I STORAGE [initandlisten] Timestamp monitor starting
2022-01-27T20:59:52.906-0500 I CONTROL [initandlisten]
2022-01-27T20:59:52.906-0500 I CONTROL [initandlisten] ** WARNING: Access control is not enabled for the database.
2022-01-27T20:59:52.906-0500 I CONTROL [initandlisten] ** Read and write access to data and configuration is unrestricted.
2022-01-27T20:59:52.906-0500 I CONTROL [initandlisten]
2022-01-27T20:59:52.965-0500 I SHARDING [initandlisten] Marking collection local.system.replset as collection version: <unsharded>
2022-01-27T20:59:52.968-0500 I STORAGE [initandlisten] Flow Control is enabled on this deployment.
2022-01-27T20:59:52.968-0500 I SHARDING [initandlisten] Marking collection admin.system.roles as collection version: <unsharded>
2022-01-27T20:59:52.968-0500 I SHARDING [initandlisten] Marking collection admin.system.version as collection version: <unsharded>
2022-01-27T20:59:52.971-0500 I SHARDING [initandlisten] Marking collection local.startup_log as collection version: <unsharded>
2022-01-27T20:59:53.262-0500 W FTDC [initandlisten] Failed to initialize Performance Counters for FTDC: WindowsPdhError: PdhExpandCounterPathW failed with 'El objeto
encontró en el equipo.' for counter '\\Processor(Total)\\% Idle Time'
2022-01-27T20:59:53.262-0500 I FTDC [initandlisten] Initializing full-time diagnostic data capture with directory 'C:\data\config\Node1\diagnostic.data'
2022-01-27T20:59:53.263-0500 I SHARDING [thread1] creating distributed lock ping thread for process ConfigServer (sleeping for 30000ms)
```

Activamos el servidor 2 con el puerto 27023

```
Administrador Símbolo del sistema - mongod --port 27023 --replSet rs0 --dbpath "C:\data\config\Node2" --config --bind_ip localhost

C:\Program Files\MongoDB\Server\4.2\bin>mongod --port 27023 --replSet rs0 --dbpath="C:\data\config\Node2" --configsvr --bind_ip localhost
2022-01-27T21:00:24.922-0500 I CONTROL [main] Automatically disabling TLS 1.0, to force-enable [LS 1.0, to force-enable [LS 1.0 specify --sslDisabledProtocols 'none'
2022-01-27T21:00:24.933-0500 W ASIO [main] No TransportLayer configured during NetworkInterface startup
2022-01-27T21:00:24.994-0500 I CONTROL [initandlisten] MongoDB starting : pid=14644 port=27023 dbpath=C:\data\config\Node2 64-bit host=DESKTOP-20941NA
2022-01-27T21:00:24.995-0500 I CONTROL [initandlisten] targetMinOS: Windows 7/Windows Server 2008 R2
2022-01-27T21:00:24.995-0500 I CONTROL [initandlisten] db version v4.2.6
2022-01-27T21:00:24.995-0500 I CONTROL [initandlisten] git version: 20364840b8f1af16917e4c23c1b5f5efdb8b352f8
2022-01-27T21:00:24.995-0500 I CONTROL [initandlisten] allocator: tcmalloc
2022-01-27T21:00:24.995-0500 I CONTROL [initandlisten] modules: none
2022-01-27T21:00:24.995-0500 I CONTROL [initandlisten] build environment:
2022-01-27T21:00:24.995-0500 I CONTROL [initandlisten] distmod: 2012plus
2022-01-27T21:00:24.995-0500 I CONTROL [initandlisten] distarch: x86_64
2022-01-27T21:00:24.995-0500 I CONTROL [initandlisten] target_arch: x86_64
2022-01-27T21:00:24.999-0500 I CONTROL [initandlisten] options: { net: { bindip: "localhost", port: 27023 }, replication: { replSet: "rs0" }, sharding: { clusterRole: 'c
2022-01-27T21:00:24.999-0500 I STORAGE [initandlisten] Detected data files in C:\data\config\Node2 created by the 'wiredTiger' storage engine, so setting the active stor
2022-01-27T21:00:24.999-0500 I STORAGE [initandlisten] wiredtiger_open config: create,cache_size=6630M,cache_overflow=(file_max=0M),session_max=33000,eviction=(threads_m
ed=true,archive=true,path=journal,compressor=snappy),file_manager=(close_idle_time=100000,close_scan_interval=10,close_handle_minimum=250),statistics_log=(wait=0),verbose=
2022-01-27T21:00:24.213-0500 I STORAGE [initandlisten] WiredTiger message [1643335224:213003][14644:140712841139536], txn-recover: Recovering log 2 through 3
2022-01-27T21:00:24.270-0500 I STORAGE [initandlisten] WiredTiger message [1643335224:270007][14644:140712841139536], txn-recover: Recovering log 3 through 3
2022-01-27T21:00:24.334-0500 I STORAGE [initandlisten] WiredTiger message [1643335224:334011][14644:140712841139536], txn-recover: Main recovery loop: starting at 2/7808
2022-01-27T21:00:24.435-0500 I STORAGE [initandlisten] WiredTiger message [1643335224:435018][14644:140712841139536], txn-recover: Recovering log 2 through 3
2022-01-27T21:00:24.530-0500 I STORAGE [initandlisten] WiredTiger message [1643335224:530116][14644:140712841139536], txn-recover: Recovering log 3 through 3
2022-01-27T21:00:24.581-0500 I STORAGE [initandlisten] WiredTiger message [1643335224:581119][14644:140712841139536], txn-recover: Set global recovery timestamp: (0, 0)
2022-01-27T21:00:24.880-0500 I RECOVERY [initandlisten] WiredTiger recoveryTimestamp. Ts: Timestamp(0, 0)
2022-01-27T21:00:25.016-0500 I STORAGE [initandlisten] Timestamp monitor starting
2022-01-27T21:00:25.046-0500 I CONTROL [initandlisten]
2022-01-27T21:00:25.046-0500 I CONTROL [initandlisten] ** WARNING: Access control is not enabled for the database.
2022-01-27T21:00:25.047-0500 I CONTROL [initandlisten] ** Read and write access to data and configuration is unrestricted.
2022-01-27T21:00:25.047-0500 I CONTROL [initandlisten]
2022-01-27T21:00:25.114-0500 I SHARDING [initandlisten] Marking collection local.system.replset as collection version: <unsharded>
2022-01-27T21:00:25.116-0500 I STORAGE [initandlisten] Flow Control is enabled on this deployment.
2022-01-27T21:00:25.116-0500 I SHARDING [initandlisten] Marking collection admin.system.roles as collection version: <unsharded>
2022-01-27T21:00:25.117-0500 I SHARDING [initandlisten] Marking collection admin.system.version as collection version: <unsharded>
2022-01-27T21:00:25.118-0500 I SHARDING [initandlisten] Marking collection local.startup_log as collection version: <unsharded>
2022-01-27T21:00:25.415-0500 W FTDC [initandlisten] Failed to initialize Performance Counters for FTDC: WindowsPdhError: PdhExpandCounterPathW failed with 'El objeto
(Total)\\% Idle Time'
```


Activamos el servidor 3 con el puerto 27024

```
Administrador: Símbolo del sistema - mongod --port 27024 --replSet rs0 --dbpath "C:\data\config\Nodo3" --configsvr --bind_ip localhost

C:\Program Files\MongoDB\Server\4.2\bin>mongod --port 27024 --replSet rs0 --dbpath="C:\data\config\Nodo3" --configsvr --bind ip localhost
2022-01-27T21:00:51.033-0500 I CONTROL [main] Automatically disabling TLS 1.0, to force-enable TLS 1.0 specify --sslDisabledProtocols 'none'
2022-01-27T21:00:51.419-0500 W ASIO [main] No TransportLayer configured during NetworkInterface startup
2022-01-27T21:00:51.420-0500 I CONTROL [initandlisten] MongoDB starting : pid=9936 port=27024 dbpath=C:\data\config\Nodo3 64-bit host=DESKTOP-2Q941NA
2022-01-27T21:00:51.420-0500 I CONTROL [initandlisten] targetMinOS: Windows 7/Windows Server 2008 R2
2022-01-27T21:00:51.420-0500 I CONTROL [initandlisten] db version v4.2.6
2022-01-27T21:00:51.420-0500 I CONTROL [initandlisten] git version: 20364840b8f1af16917e4c23c1b5f5efd8b352f8
2022-01-27T21:00:51.420-0500 I CONTROL [initandlisten] allocator: tcmalloc
2022-01-27T21:00:51.420-0500 I CONTROL [initandlisten] modules: none
2022-01-27T21:00:51.420-0500 I CONTROL [initandlisten] build environment:
2022-01-27T21:00:51.420-0500 I CONTROL [initandlisten] distmod: 2012plus
2022-01-27T21:00:51.420-0500 I CONTROL [initandlisten] distarch: x86_64
2022-01-27T21:00:51.420-0500 I CONTROL [initandlisten] target_arch: x86_64
2022-01-27T21:00:51.420-0500 I CONTROL [initandlisten] options: { net: { bindip: "localhost", port: 27024 }, replication: { replSet: "rs0" }, sharding: {
2022-01-27T21:00:51.424-0500 I STORAGE [initandlisten] Detected data files in C:\data\config\Nodo3 created by the 'wiredTiger' storage engine, so setting
wiredTiger'.
2022-01-27T21:00:51.424-0500 I STORAGE [initandlisten] wiredtiger_open config: create,cache_size=6630M,cache_overflow=(file_max=0M),session_max=33000,evic
,config_base=false,statistics=(fast),log=(enabled=true,archive=true,path=journal,compressor=snappy),file_manager=(close_idle_time=100000,close_scan_interval
istics_log=(wait=0),verbose=[recovery_progress,checkpoint_progress]),
2022-01-27T21:00:51.512-0500 I STORAGE [initandlisten] WiredTiger message [1643335251:511781][9936:140712841139536], txn-recover: Recovering log 1 through
2022-01-27T21:00:51.577-0500 I STORAGE [initandlisten] WiredTiger message [1643335251:576784][9936:140712841139536], txn-recover: Recovering log 2 through
2022-01-27T21:00:51.645-0500 I STORAGE [initandlisten] WiredTiger message [1643335251:644789][9936:140712841139536], txn-recover: Main recovery loop: star
2022-01-27T21:00:51.746-0500 I STORAGE [initandlisten] WiredTiger message [1643335251:746797][9936:140712841139536], txn-recover: Recovering log 1 through
2022-01-27T21:00:51.837-0500 I STORAGE [initandlisten] WiredTiger message [1643335251:836817][9936:140712841139536], txn-recover: Recovering log 2 through
2022-01-27T21:00:51.887-0500 I STORAGE [initandlisten] WiredTiger message [1643335251:886822][9936:140712841139536], txn-recover: Set global recovery time
2022-01-27T21:00:52.088-0500 I RECOVERY [initandlisten] WiredTiger recoveryTimestamp. Ts: Timestamp(0, 0)
2022-01-27T21:00:52.213-0500 I STORAGE [initandlisten] Timestamp monitor starting
2022-01-27T21:00:52.237-0500 I CONTROL [initandlisten]
2022-01-27T21:00:52.237-0500 I CONTROL [initandlisten] ** WARNING: Access control is not enabled for the database.
2022-01-27T21:00:52.237-0500 I CONTROL [initandlisten] ** Read and write access to data and configuration is unrestricted.
2022-01-27T21:00:52.237-0500 I CONTROL [initandlisten]
2022-01-27T21:00:52.305-0500 I SHARDING [initandlisten] Marking collection local.system.replset as collection version: <unsharded>
2022-01-27T21:00:52.309-0500 I STORAGE [initandlisten] Flow Control is enabled on this deployment.
2022-01-27T21:00:52.309-0500 I SHARDING [initandlisten] Marking collection admin.system.roles as collection version: <unsharded>
2022-01-27T21:00:52.309-0500 I SHARDING [initandlisten] Marking collection admin.system.version as collection version: <unsharded>
2022-01-27T21:00:52.314-0500 I SHARDING [initandlisten] Marking collection local.startup_log as collection version: <unsharded>
```

- Ahora sera importante continuar con la activación de nuestro enrutador sobre la misma dirección Ip, anteriormente mencionada, y adicionalmente asignando los servidores sobre este.

```
Administrador: Símbolo del sistema - mongos --configdb localhost:27022,localhost:27023,localhost:27024 --port 27021 --bind_ip localhost

2022-01-27T21:24:38.308-0500 I ASIO [shard-registry-reload] Killing all outstanding egress activity.
2022-01-27T21:24:38.308-0500 I CONTROL [consoleTerminate] shutting down with code:12

C:\Program Files\MongoDB\Server\4.2\bin>mongos --configdb rs0/localhost:27022,localhost:27023,localhost:27024 --port 27021 --bind ip localhost
2022-01-27T21:37:34.776-0500 I CONTROL [main] Automatically disabling TLS 1.0, to force-enable TLS 1.0 specify --sslDisabledProtocols 'none'
2022-01-27T21:37:34.781-0500 I CONTROL [main]
2022-01-27T21:37:34.781-0500 I CONTROL [main] ** WARNING: Access control is not enabled for the database.
2022-01-27T21:37:34.781-0500 I CONTROL [main] ** Read and write access to data and configuration is unrestricted.
2022-01-27T21:37:34.781-0500 I CONTROL [main]
2022-01-27T21:37:34.782-0500 I SHARDING [mongosMain] mongos version v4.2.6
2022-01-27T21:37:34.782-0500 I CONTROL [mongosMain] db version v4.2.6
2022-01-27T21:37:34.782-0500 I CONTROL [mongosMain] git version: 20364840b8f1af16917e4c23c1b5f5efd8b352f8
2022-01-27T21:37:34.782-0500 I CONTROL [mongosMain] allocator: tcmalloc
2022-01-27T21:37:34.782-0500 I CONTROL [mongosMain] modules: none
2022-01-27T21:37:34.782-0500 I CONTROL [mongosMain] build environment:
2022-01-27T21:37:34.782-0500 I CONTROL [mongosMain] distmod: 2012plus
2022-01-27T21:37:34.782-0500 I CONTROL [mongosMain] distarch: x86_64
2022-01-27T21:37:34.782-0500 I CONTROL [mongosMain] target_arch: x86_64
2022-01-27T21:37:34.782-0500 I CONTROL [mongosMain] options: { net: { bindip: "localhost", port: 27021 }, sharding: { configDB: "rs0/localhost:27022,localhost:27023,localhost:27024"
2022-01-27T21:37:34.786-0500 I SHARDING [thread] creating distributed lock ping thread for process DESKTOP-2Q941NA:27021:1643337454:-1167867155519733117 (sleep
2022-01-27T21:37:34.786-0500 I SHARDING [ReplicaSetMonitor-TaskExecutor] Connecting to localhost:27024
2022-01-27T21:37:34.787-0500 I CONNPOOL [ReplicaSetMonitor-TaskExecutor] Connecting to localhost:27023
2022-01-27T21:37:34.787-0500 I CONNPOOL [ReplicaSetMonitor-TaskExecutor] Connecting to localhost:27022
2022-01-27T21:37:34.797-0500 I NETWORK [ReplicaSetMonitor-TaskExecutor] Confirmed replica set for rs0 is rs0/localhost:27022,localhost:27023,localhost:27024
2022-01-27T21:37:34.797-0500 I SHARDING [Sharding-Fixed-0] Updating replica set with confirmed set rs0/localhost:27022,localhost:27023,localhost:27024
2022-01-27T21:37:34.801-0500 I SHARDING [ShardRegistry] Received reply from config server node (unknown) indicating config server optime term has increased, prev
1), t: 1 }
2022-01-27T21:37:34.818-0500 W FTDC [mongosMain] FTDC is disabled because neither '--logpath' nor set parameter 'diagnosticDataCollectionDirectoryPath' are s
2022-01-27T21:37:34.901-0500 W SHARDING [replSetDistlockPinger] ping failed for distributed lock pinger :: caused by :: LockStateChangeFailed: findAndModify o
2022-01-27T21:37:35.200-0500 W FTDC [mongosMain] Failed to initialize Performance Counters for FTDC: WindowsPdhError: PdhExpandCounterPathW failed with 'El o
otal)\X Idle Time'
2022-01-27T21:37:35.201-0500 I FTDC [mongosMain] Initializing full-time diagnostic data capture with directory ''
2022-01-27T21:37:35.202-0500 I NETWORK [listener] Listening on 127.0.0.1
2022-01-27T21:37:35.202-0500 I NETWORK [listener] waiting for connections on port 27021
2022-01-27T21:37:35.217-0500 I SH. REFR [ConfigServerCatalogCacheLoader-0] Refresh for database config from version {} to version { uuid: UUID("14034af5-eba3-4b2
2022-01-27T21:37:35.218-0500 I CONTROL [LogicalSessionCacheRefresh] Sessions collection is not set up; waiting until next sessions refresh interval: Collection
2022-01-27T21:37:35.218-0500 I CONTROL [LogicalSessionCacheReap] Sessions collection is not set up; waiting until next sessions reap interval: Collection confi
```

- Ahora necesitaremos añadir el replica set inicial que se ha configurado como un shard. Se ejecuta el puerto del enrutador para dar de alta el replica set como un shard del clúster, siendo así la validación exitosa de la activación del enrutador y funcionamiento de este.

```
Administrador: Símbolo del sistema - mongo --port 27021 --host localhost
C:\Windows>cd..
C:\>cd Program Files\MongoDB\Server\4.2\bin
C:\Program Files\MongoDB\Server\4.2\bin>mongo --port 27021 --host localhost
MongoDB shell version v4.2.6
connecting to: mongodb://localhost:27021/?compressors=disabled&gssapiServiceName=mongodb
Implicit session: session { "id" : UUID("31bedc29-ff85-4cdf-9149-6a553445368e") }
MongoDB server version: 4.2.6
Server has startup warnings:
2022-01-27T21:37:34.781-0500 I CONTROL [main] ** WARNING: Access control is not enabled for the database.
2022-01-27T21:37:34.781-0500 I CONTROL [main] **          Read and write access to data and configuration is unrestricted.
2022-01-27T21:37:34.781-0500 I CONTROL [main]
mongos> sh.status()
```

Ahora debemos verificar el estado inicial de nuestro shard, ya que encontraremos que se encuentra vacío sin ningún replica set, para luego poder añadirsele.

```
mongos> sh.status()
--- Sharding Status ---
  sharding version: {
    "_id" : 1,
    "minCompatibleVersion" : 5,
    "currentVersion" : 6,
    "clusterId" : ObjectId("61f3563ad856566458254e93")
  }
  shards:
  active mongoses:
  autosplit:
    Currently enabled: yes
  balancer:
    Currently enabled: yes
    Currently running: no
    Failed balancer rounds in last 5 attempts: 0
    Migration Results for the last 24 hours:
      No recent migrations
  databases:
    { "_id" : "config", "primary" : "config", "partitioned" : true }
```

Para cuando le hayamos añadido el replica set sobre nuestro shard, tendremos:

```
mongos> sh.addShard("rs0/localhost:27017,127.0.0.1:27027,127.0.0.1:27037")
{
  "shardAdded" : "rs0",
  "ok" : 1,
  "operationTime" : Timestamp(1643340546, 1),
  "$clusterTime" : {
    "clusterTime" : Timestamp(1643340546, 1),
    "signature" : {
      "hash" : BinData(0,"AAAAAAAAAAAAAAAAAAAAAAAAAAAA="),
      "keyId" : NumberLong(0)
    }
  }
}
mongos> sh.status()
--- Sharding Status ---
  sharding version: {
    "_id" : 1,
    "minCompatibleVersion" : 5,
    "currentVersion" : 6,
    "clusterId" : ObjectId("61f3563ad85666458254e93")
  }
  shards:
  [ { "_id" : "rs0", "host" : "rs0/127.0.0.1:27027,127.0.0.1:27037,localhost:27017", "state" : 1 } ]
  active mongoses:
    "4.2.6" : 1
  autosplit:
    Currently enabled: yes
  balancer:
    Currently enabled: yes
    Currently running: no
    Failed balancer rounds in last 5 attempts: 0
    Migration Results for the last 24 hours:
      No recent migrations
  databases:
  [ { "_id" : "TorneoDeportivoFutsal", "primary" : "rs0", "partitioned" : false, "version" : { "uuid" : UUID("ad6d56cb-9a29-49a2-8c52-6eedbd3684e7"), "lastMod" : 1 } } ]
  [ { "_id" : "config", "primary" : "config", "partitioned" : true } ]
```

Así mismo ocuparemos el uso de nuestra base de datos, sobre el shard ya configurado, en base de la replica añadida.

- Desde este punto ocupamos ya dentro de nuestra estructura de particionamiento, los nodos de configuración y los nodos de una replica set ya definida, ahora necesitamos crear un nuevo replica set para añadir a nuestro shard y estaríamos manejando 2 shard para nuestra base de datos.

```
Administrador Símbolo del sistema - mongod --port 27018 --dbpath="C:\data\rep1\nodo4" --replSet rs1 --shardsvr
Microsoft Windows [Versión 10.0.19042.1466]
(c) Microsoft Corporation. Todos los derechos reservados.

C:\WINDOWS\system32>cd..
C:\Windows>cd..
C:\>cd Program Files\MongoDB\Server\4.2\bin
C:\Program Files\MongoDB\Server\4.2\bin>mongod --port 27018 --dbpath="C:\data\rep1\nodo4" --replSet rs1 --shardsvr
2022-01-27T23:04:34.761-0500 I CONTROL [main] Automatically disabling TLS 1.0, to force-enable TLS 1.0 specify --sslDisabledProtocols 'none'
2022-01-27T23:04:35.163-0500 W ASIO [main] No TransportLayer configured during NetworkInterface startup
2022-01-27T23:04:35.164-0500 I CONTROL [initandlisten] MongoDB starting : pid=15424 port=27018 dbpath=C:\data\rep1\nodo4 64-bit host=DESKTOP-2Q941INA
2022-01-27T23:04:35.164-0500 I CONTROL [initandlisten] targetMinOS: Windows 7/Windows Server 2008 R2
2022-01-27T23:04:35.165-0500 I CONTROL [initandlisten] db version v4.2.6
2022-01-27T23:04:35.165-0500 I CONTROL [initandlisten] git version: 20364840b8f1af16917e4c23c1b5f5efd8b352f8
2022-01-27T23:04:35.165-0500 I CONTROL [initandlisten] allocator: tcmalloc
2022-01-27T23:04:35.165-0500 I CONTROL [initandlisten] modules: none
2022-01-27T23:04:35.165-0500 I CONTROL [initandlisten] build environment:
2022-01-27T23:04:35.165-0500 I CONTROL [initandlisten] distmod: 2012plus
2022-01-27T23:04:35.165-0500 I CONTROL [initandlisten] distarch: x86_64
2022-01-27T23:04:35.165-0500 I CONTROL [initandlisten] target_arch: x86_64
2022-01-27T23:04:35.165-0500 I CONTROL [initandlisten] options: { net: { port: 27018 }, replication: { replSet: "rs1" }, sharding: { clusterRole: "shardsvr" }, storage: {
2022-01-27T23:04:35.166-0500 I STORAGE [initandlisten] wiredtiger_open config: create,cache_size=6630M,cache_overflow=(file_max=0M),session_max=33000,eviction=(threads_m
ed=true,archive=true,path=journal,compressor=snappy),file_manager=(close_idle_time=100000,close_scan_interval=10,close_handle_minimum=250),statistics_log=(wait=0),verbose=[
2022-01-27T23:04:35.352-0500 I STORAGE [initandlisten] WiredTiger message [1643342675:352102][15424:140712841139536], txn-recover: Set global recovery timestamp: (0, 0)
2022-01-27T23:04:35.520-0500 I RECOVER [initandlisten] WiredTiger recoveryTimestamp. Ts: Timestamp(0, 0)
2022-01-27T23:04:35.686-0500 I STORAGE [initandlisten] Timestamp monitor starting
2022-01-27T23:04:35.753-0500 I CONTROL [initandlisten]
```



```

Administrador: Símbolo del sistema - mongod --port 27028 --dbpath="C:\data\repl\nodo5" --replSet rs1 --shardsvr
Microsoft Windows [Versión 10.0.19042.1466]
(c) Microsoft Corporation. Todos los derechos reservados.

C:\WINDOWS\system32>cd..
C:\Windows>cd..
C:\>cd Program Files\MongoDB\Server\4.2\bin
C:\Program Files\MongoDB\Server\4.2\bin>mongod --port 27028 --dbpath="C:\data\repl\nodo5" --replSet rs1 --shardsvr
2022-01-27T23:21:18.947-0500 I CONTROL [main] Automatically disabling TLS 1.0, to force-enable TLS 1.0 specify --sslDisabledProtocols 'none'
2022-01-27T23:21:18.447-0500 W ASIO [main] No TransportLayer configured during NetworkInterface startup
2022-01-27T23:21:18.448-0500 I CONTROL [initandlisten] MongoDB starting : pid=9716 port=27028 dbpath=C:\data\repl\nodo5 64-bit host=DESKTOP-2Q941NA
2022-01-27T23:21:18.448-0500 I CONTROL [initandlisten] targetMinOS: Windows 7/Windows Server 2008 R2
2022-01-27T23:21:18.448-0500 I CONTROL [initandlisten] db version v4.2.6
2022-01-27T23:21:18.448-0500 I CONTROL [initandlisten] git version: 20364840b8f1af16917e4c23c1b5f5fd8b352f8
2022-01-27T23:21:18.448-0500 I CONTROL [initandlisten] allocator: tcmalloc
2022-01-27T23:21:18.448-0500 I CONTROL [initandlisten] modules: none
2022-01-27T23:21:18.448-0500 I CONTROL [initandlisten] build environment:
2022-01-27T23:21:18.448-0500 I CONTROL [initandlisten] distmod: 2012plus
2022-01-27T23:21:18.448-0500 I CONTROL [initandlisten] distarch: x86_64
2022-01-27T23:21:18.448-0500 I CONTROL [initandlisten] target_arch: x86_64
2022-01-27T23:21:18.448-0500 I CONTROL [initandlisten] options: { net: { port: 27028 }, replication: { replSet: "rs1" }, sharding: { clusterRole: "shardsvr" }, storage:
2022-01-27T23:21:18.449-0500 I STORAGE [initandlisten] wiredtiger_open config: create,cache_size=6630M,cache_overflow=(file_max=0M),session_max=33000,eviction=(threads
2022-01-27T23:21:18.768-0500 I STORAGE [initandlisten] WiredTiger message [1643343678:760366][9716:140712841139536], txn-recover: Set global recovery timestamp: (0, 0)
2022-01-27T23:21:19.028-0500 I RECOVERY [initandlisten] WiredTiger recoveryTimestamp. Ts: Timestamp(0, 0)
2022-01-27T23:21:19.242-0500 I STORAGE [initandlisten] Timestamp monitor starting
2022-01-27T23:21:19.319-0500 I CONTROL [initandlisten]
2022-01-27T23:21:19.319-0500 I CONTROL [initandlisten] ** WARNING: Access control is not enabled for the database.
2022-01-27T23:21:19.321-0500 I CONTROL [initandlisten] ** Read and write access to data and configuration is unrestricted.

```

```

Administrador: Símbolo del sistema - mongod --port 27038 --dbpath="C:\data\repl\nodo6" --replSet rs1 --shardsvr
Microsoft Windows [Versión 10.0.19042.1466]
(c) Microsoft Corporation. Todos los derechos reservados.

C:\WINDOWS\system32>cd..
C:\Windows>cd..
C:\>cd Program Files\MongoDB\Server\4.2\bin
C:\Program Files\MongoDB\Server\4.2\bin>mongod --port 27038 --dbpath="C:\data\repl\nodo6" --replSet rs1 --shardsvr
2022-01-27T23:22:22.993-0500 I CONTROL [main] Automatically disabling TLS 1.0, to force-enable TLS 1.0 specify --sslDisabledProtocols 'none'
2022-01-27T23:22:23.384-0500 W ASIO [main] No TransportLayer configured during NetworkInterface startup
2022-01-27T23:22:23.385-0500 I CONTROL [initandlisten] MongoDB starting : pid=21804 port=27038 dbpath=C:\data\repl\nodo6 64-bit host=DESKTOP-2Q941NA
2022-01-27T23:22:23.385-0500 I CONTROL [initandlisten] targetMinOS: Windows 7/Windows Server 2008 R2
2022-01-27T23:22:23.385-0500 I CONTROL [initandlisten] db version v4.2.6
2022-01-27T23:22:23.385-0500 I CONTROL [initandlisten] git version: 20364840b8f1af16917e4c23c1b5f5fd8b352f8
2022-01-27T23:22:23.385-0500 I CONTROL [initandlisten] allocator: tcmalloc
2022-01-27T23:22:23.385-0500 I CONTROL [initandlisten] modules: none
2022-01-27T23:22:23.385-0500 I CONTROL [initandlisten] build environment:
2022-01-27T23:22:23.385-0500 I CONTROL [initandlisten] distmod: 2012plus
2022-01-27T23:22:23.385-0500 I CONTROL [initandlisten] distarch: x86_64
2022-01-27T23:22:23.385-0500 I CONTROL [initandlisten] target_arch: x86_64
2022-01-27T23:22:23.385-0500 I CONTROL [initandlisten] options: { net: { port: 27038 }, replication: { replSet: "rs1" }, sharding: { clusterRole: "shardsvr" }, storage:
2022-01-27T23:22:23.385-0500 I STORAGE [initandlisten] wiredtiger_open config: create,cache_size=6630M,cache_overflow=(file_max=0M),session_max=33000,eviction=(threads
2022-01-27T23:22:23.386-0500 I STORAGE [initandlisten] WiredTiger message [1643343743:756000][21804:140712841139536], txn-recover: Set global recovery timestamp: (0, 0)
2022-01-27T23:22:24.051-0500 I RECOVERY [initandlisten] WiredTiger recoveryTimestamp. Ts: Timestamp(0, 0)

```

- Ahora inicializamos nuestro nuevo conjunto de nodos sobre la replica nombrada “rs1”, para su posterior configuración sobre nuestro shard.

```

> rs.initiate( { _id: "rs1",members: [{ _id: 0, host: "localhost:27018" },{_id: 1, host: "localhost:27028" },{_id: 2, host: "localhost:27038" } ]})
{
  "ok" : 1,
  "$clusterTime" : {
    "clusterTime" : Timestamp(1643344035, 1),
    "signature" : {
      "hash" : BinData(0,"AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA"),
      "keyId" : NumberLong(0)
    },
    "operationTime" : Timestamp(1643344035, 1)
  }
}

```

Y luego le añadiremos al shard, quedandose así:

```
mongos> sh.addShard("rs1/localhost:27018,localhost:27028,localhost:27038")
{
  "shardAdded" : "rs1",
  "ok" : 1,
  "operationTime" : Timestamp(1643344145, 6),
  "$clusterTime" : {
    "clusterTime" : Timestamp(1643344145, 6),
    "signature" : {
      "hash" : BinData(0,"AAAAAAAAAAAAAAAAAAAAAAAAAAAA="),
      "keyId" : NumberLong(0)
    }
  }
}
mongos> sh.status()
--- Sharding Status ---
  sharding version: {
    "_id" : 1,
    "minCompatibleVersion" : 5,
    "currentVersion" : 6,
    "clusterId" : ObjectId("61f3563ad856566458254e93")
  }
  shards:
    { "_id" : "rs0", "host" : "rs0/127.0.0.1:27027,127.0.0.1:27037,localhost:27017", "state" : 1 }
    { "_id" : "rs1", "host" : "rs1/localhost:27018,localhost:27028,localhost:27038", "state" : 1 }
  active mongoses:
    "4.2.6" : 1
  autosplit:
    Currently enabled: yes
  balancer:
    Currently enabled: yes
    Currently running: no
    Failed balancer rounds in last 5 attempts: 0
    Migration Results for the last 24 hours:
      No recent migrations
  databases:
    { "_id" : "TorneoDeportivoFutsal", "primary" : "rs0", "partitioned" : false, "version" : { "uuid" : UUID("...") } }
    { "_id" : "config", "primary" : "config", "partitioned" : true }
    config.system.sessions
      shard key: { "_id" : 1 }
      unique: false
      balancing: true
      chunks:
        rs0    1
        { "_id" : { "$minKey" : 1 } } --> { "_id" : { "$maxKey" : 1 } } on : rs0 Timestamp(1, 0)
```

Casos de prueba

- Ahora necesitamos desarrollar la fragmentación de una de nuestras colecciones y poder validar que la configuración e implementación de particionamiento en forma horizontal, estara dispuesta a ejercer su labor correspondiente, es asi que antes de poder fragmentar una colección, primero se tendra que habilitar la fragmentación para la base de datos de nuestro torneo deportivo y de la colección que se vaya a elegir.

```
CA% Administrador: Símbolo del sistema - mongo --port 27021 --host localhost
mongos> sh.enableSharding("TorneoDeportivoFutsal")
{ "ok" : 1 }
```

- Luego de esto sera necesario crear un indice para la clave de fragmentación, esto debido para que la colección sea fragmentada y determine la clave de fragmento, logrando que se distribuyan los documentos entre los fragmentos configurados.

```
mongos> use TorneoDeportivoFutsal
switched to db TorneoDeportivoFutsal
mongos> db.arbitros.createIndex({number:1})
{ "ok" : 1 }
```

- Ahora si podremos empezar a fragmentar nuestra colección “arbitros” de nuestra base de datos, indicando siempre adiconalmente nuestra clave de fragmento anteriormente definida.

```
mongos>
mongos> sh.shardCollection("TorneoDeportivoFutsal.arbitros",{ "number":1})

{"collectionsharded":"TorneoDeportivoFutsal.arbitros","ok" : 1}
```

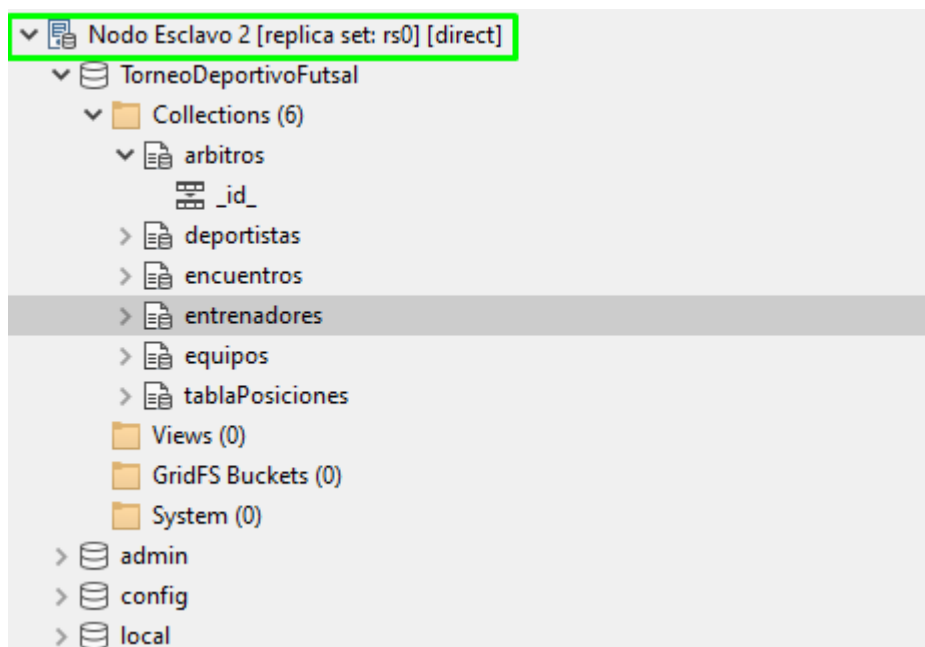
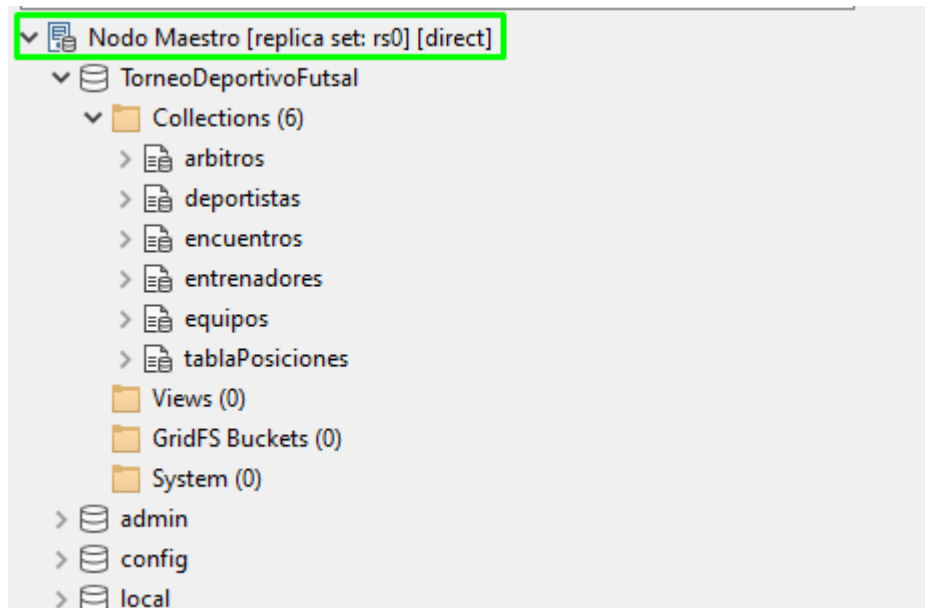
- El sistema ahora habra distribuido los documentos y podremos validar que se haya ejecutado de manera correcta el flujo de partición sobre los datos que poseemos actualmente en nuestra colección “arbitros”, en primer lugar lograremos visualizar el equilibrio que poseen nuestras replicas, nodos y fragmentos, es asi que:

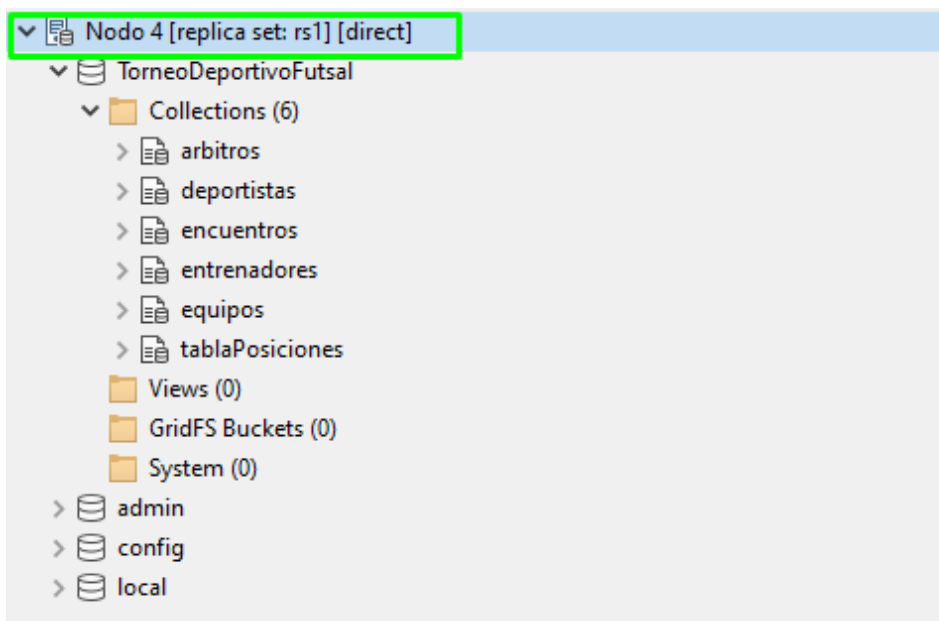
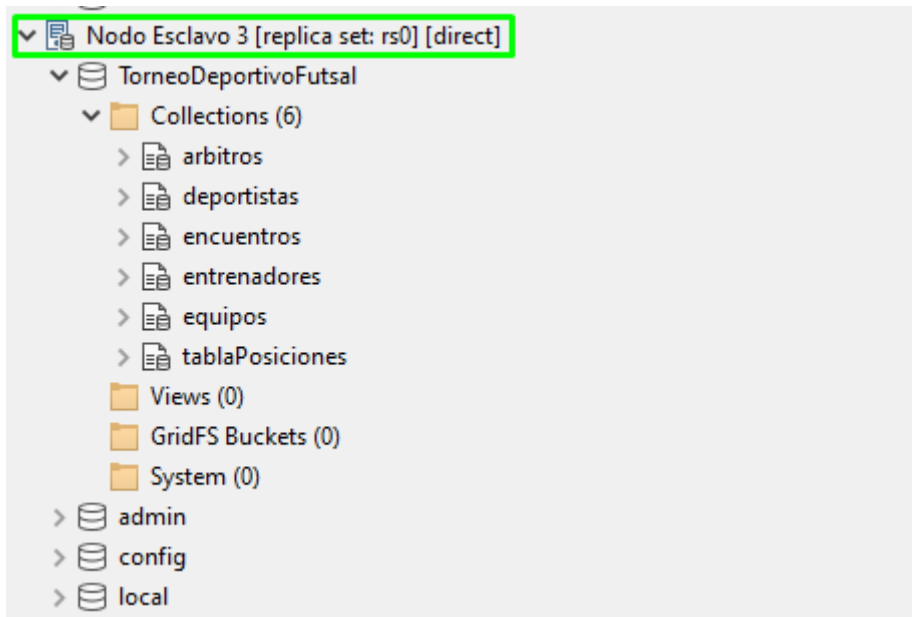
```
mongos>
mongos> {
  "raw" : {
    ...
    "rs0/localhost:27017,127.0.0.1:27027,127.0.0.1:27037" : {
      "db" : "TorneoDeportivoFutsal",
      "collections" : 1,
      "views" : 0,
      "objects" : 640545,
      "avgObjSize" : 70.83200339949052,
      "dataSize" : 45370913,
      "storageSize" : 50438144,
      "numExtents" : 0,
      "indexes" : 2,
      "indexSize" : 24502272,
      "ok" : 1,
      "$gleStats" : {
        "electionId" : ObjectId("61d783e7f5563ceee5822cfa")
      }
    },
    ...
    "rs1/localhost:27018,localhost:27028,localhost:27038" : {
      "db" : "TorneoDeportivoFutsal",
      "collections" : 1,
      "views" : 0,
      "objects" : 359455,
      "avgObjSize" : 70.83259935179647,
      "dataSize" : 25461132,
      "storageSize" : 8630272,
      "numExtents" : 0,
      "indexes" : 2,
      "indexSize" : 8151040,
      "ok" : 1,
      "$gleStats" : {
        "electionId" : ObjectId("61d74ced33c9f0547630c562")
      }
    },
    ...
  },
  "objects" : 1000000,
  "avgObjSize" : 70,
```

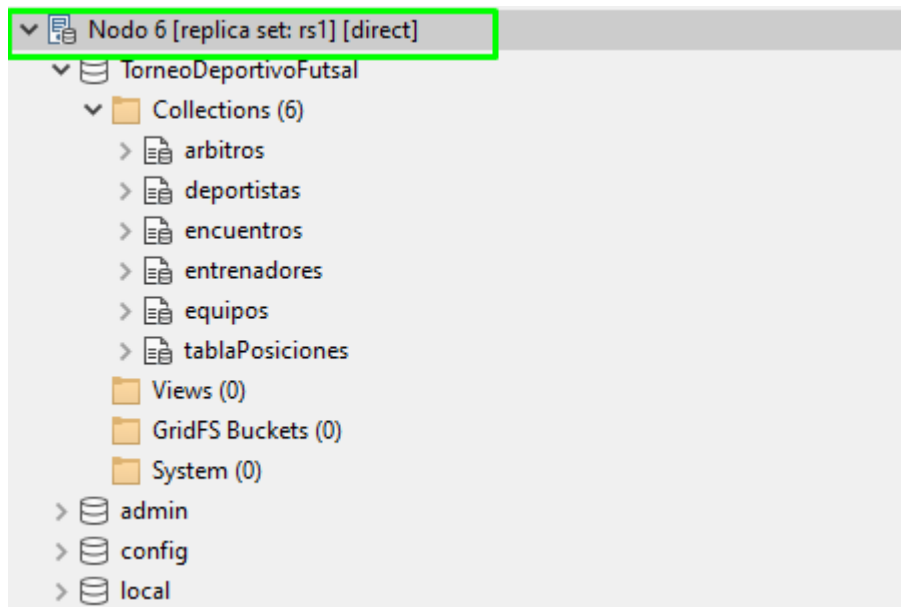
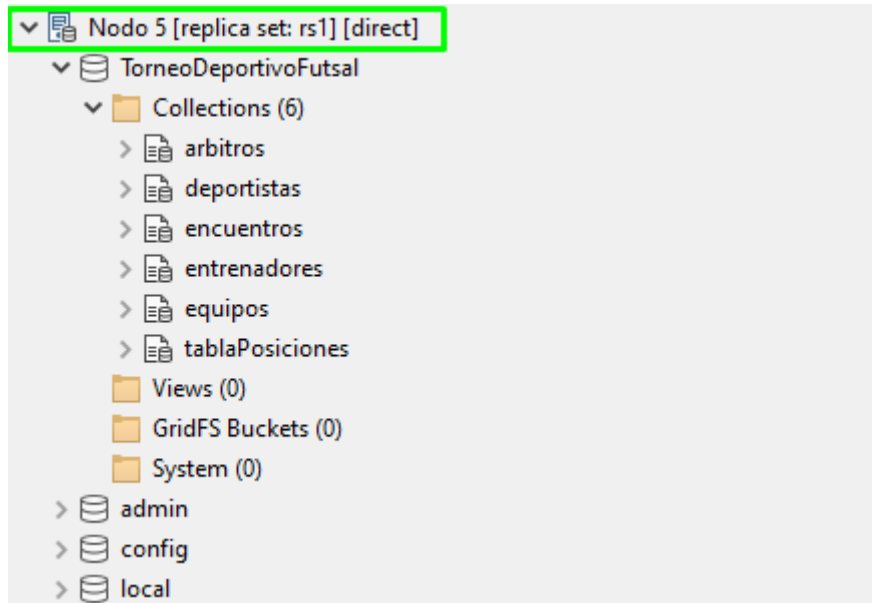
Ahora detallaremos el equilibrio para el particionamiento de nuestra colección, desde otro tipo de comando, para conocer cada uno de los estados en los que se encuentra nuestra fragmentación, de tal forma se muestr que:

```
mongos>
mongos> --- Sharding Status ---
... sharding version: {
...   "_id" : 1,
...   "minCompatibleVersion" : 5,
...   "currentVersion" : 6,
...   "clusterId" : ObjectId("61f3563ad856566458254e93")
... }
... shards:
...   { "_id" : "rs0", "host" : "rs0/localhost:27017,127.0.0.1:27027,127.0.0.1:27037", "state" : 1 }
...   { "_id" : "rs1", "host" : "rs1/localhost:27018,localhost:27028,localhost:27038", "state" : 1 }
... active mongoses:
...   "4.2.6" : 1
... autosplit:
...   Currently enabled: yes
... balancer:
...   Currently enabled: yes
...   Currently running: yes
...   Collections with active migrations:
...     test.test_collection started at Mon Nov 05 2018 15:16:45 GMT-0500
... Failed balancer rounds in last 5 attempts: 0
... Migration Results for the last 24 hours:
...   1 : Success
... databases:
...   { "_id" : "TorneoDeportivoFutsal", "primary" : "rs0", "partitioned" : true }
...     TorneoDeportivoFutsal.arbitros
...       shard key: { "number" : 1 }
...       unique: false
...       balancing: true
...       chunks:
...         rs0    5
...         rs1    1
...         { "number" : { "$minKey" : 1 } } --> { "number" : 1195 } on : rs1 Timestamp(2, 0)
...         { "number" : 1195 } --> { "number" : 2394 } on : rs0 Timestamp(2, 1)
...         { "number" : 2394 } --> { "number" : 3596 } on : rs0 Timestamp(1, 5)
...         { "number" : 3596 } --> { "number" : 4797 } on : rs0 Timestamp(1, 6)
...         { "number" : 4797 } --> { "number" : 9588 } on : rs0 Timestamp(1, 1)
...         { "number" : 9588 } --> { "number" : { "$maxKey" : 1 } } on : rs0 Timestamp(1, 2)
```

- Por ultimo graficamente podemos observar la distribución de nuestra base de datos sobre nuestras 2 replicas y cada uno de sus nodos definidos.







Bibliografia

- Sarasa, A. (2016). Introducción a las bases de datos NoSQL usando MongoDB. Editorial UOC.
- <https://docs.mongodb.com/manual/sharding/>