ORACLE

MySQL Belgian Days 2024

MySQL Router

Explore The Secrets

Miguel Araújo
Senior Principal Software Engineer
MySQL, Oracle
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$ whoami && history

```
~/belgian_days_24
$ whoami
miguel_araujo
```

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$ history -E

20.09.2015    MySQL Router 1st labs release
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18.07.2023    8.1.0: Support for InnoDB Cluster Read Replicas, Statement tracing
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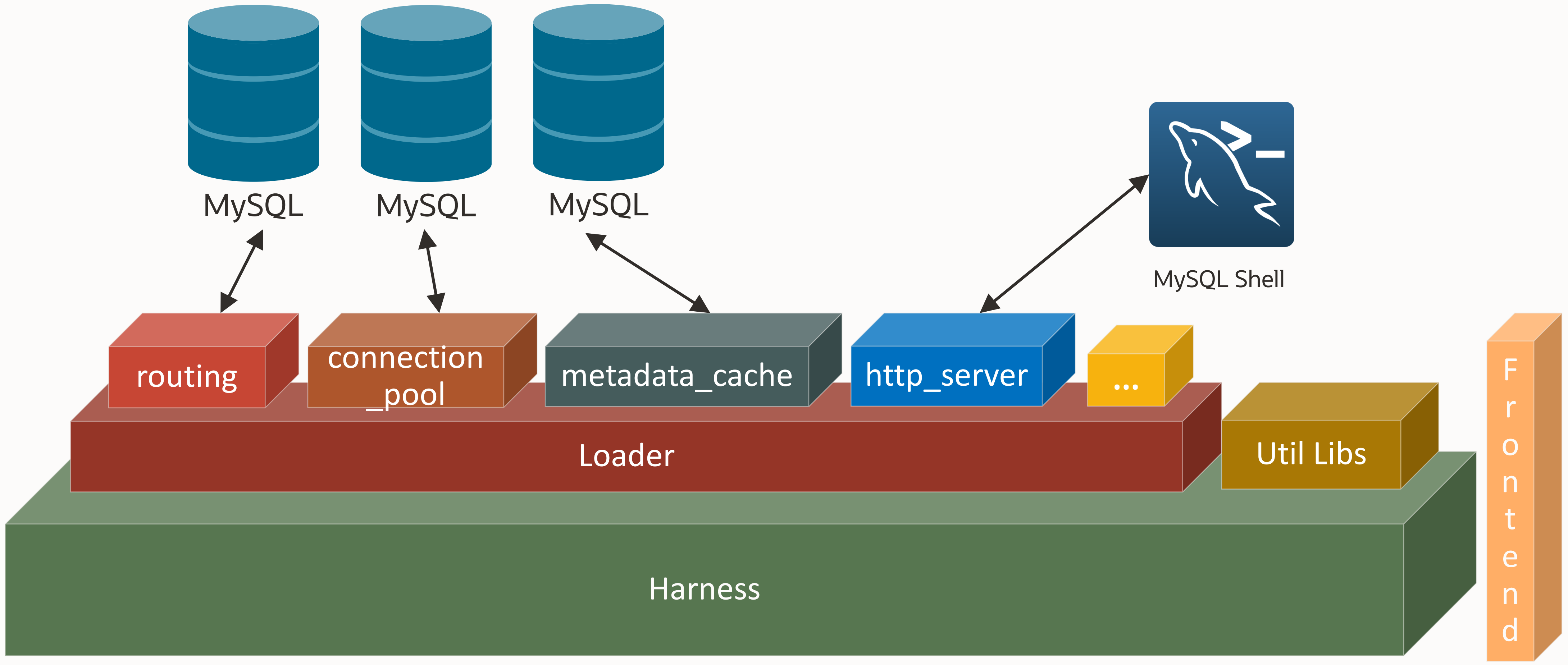
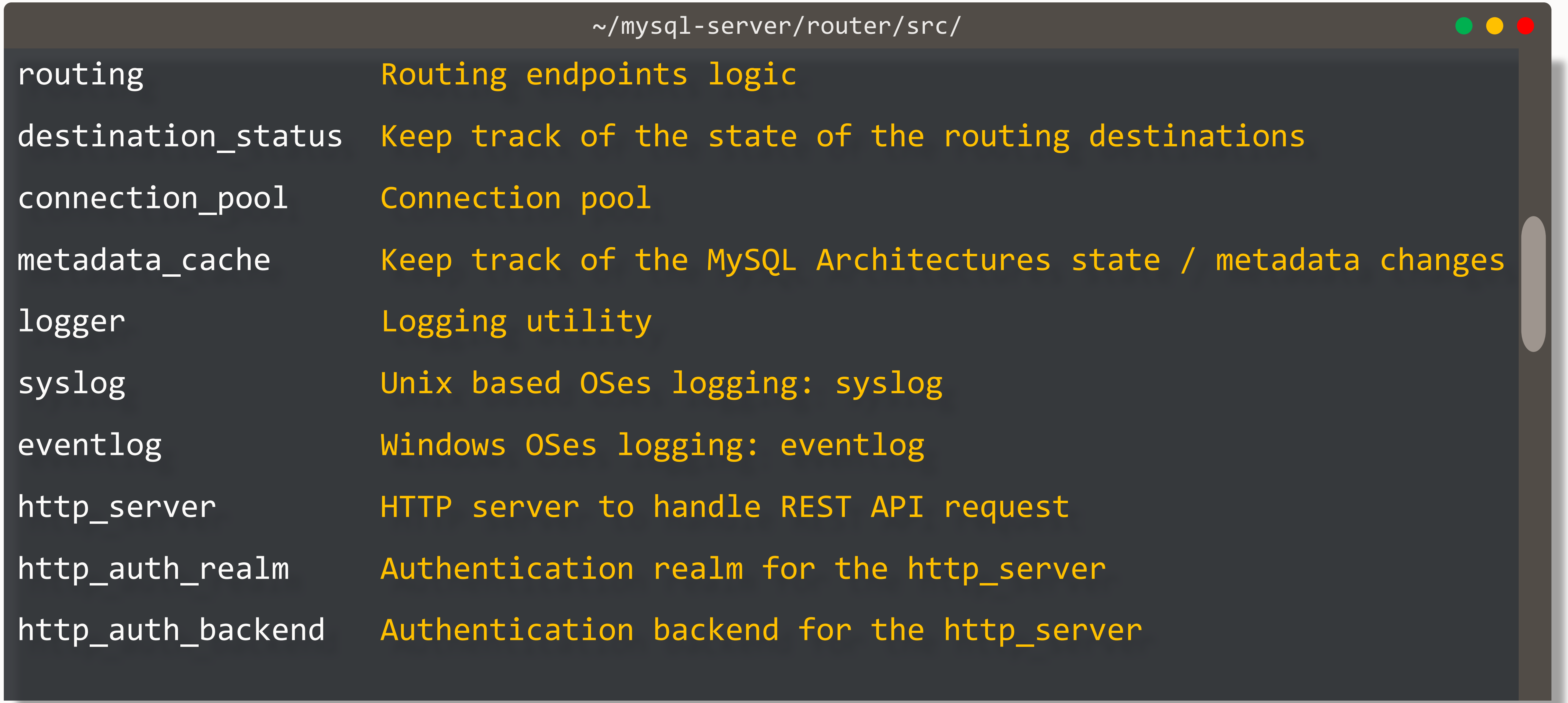
18.07.2023    8.1.0: Support for InnoDB Cluster Read Replicas, Statement tracing
25.10.2023    8.2.0: R/W Splitting
```

Technicalities

Architecture

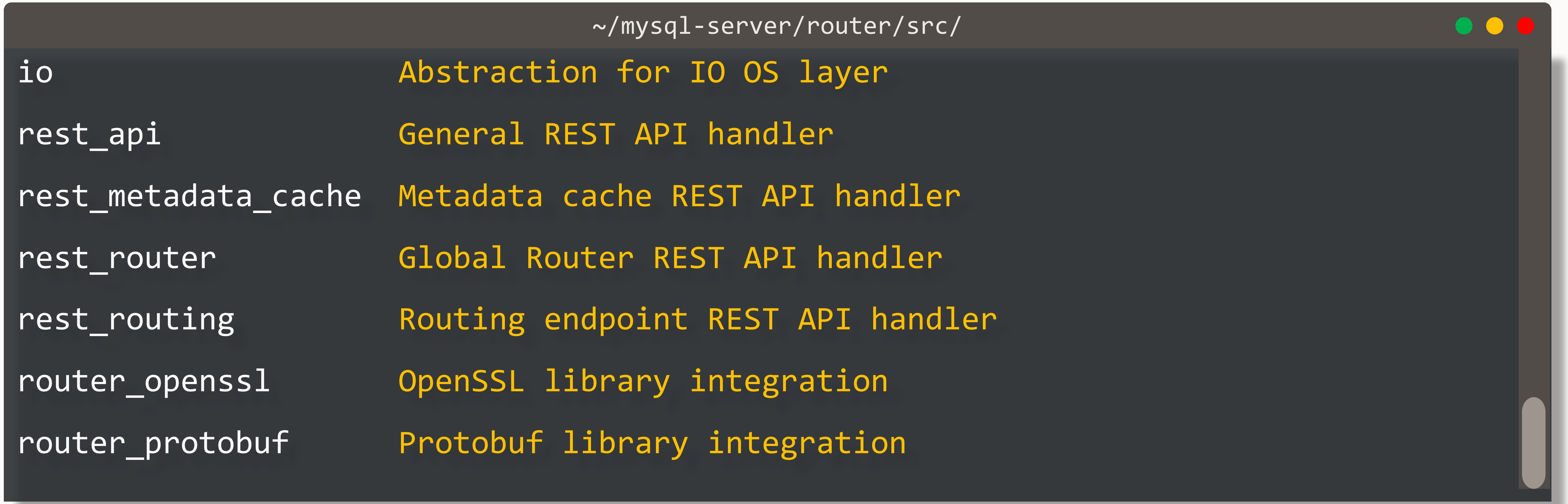


Built-in plugins


```
~/mysql-server/router/src/

routing             Routing endpoints logic
destination_status  Keep track of the state of the routing destinations
connection_pool     Connection pool
metadata_cache      Keep track of the MySQL Architectures state / metadata changes
logger              Logging utility
syslog              Unix based OSes logging: syslog
eventlog            Windows OSes logging: eventlog
http_server         HTTP server to handle REST API request
http_auth_realm     Authentication realm for the http_server
http_auth_backend   Authentication backend for the http_server
```

Built-in plugins

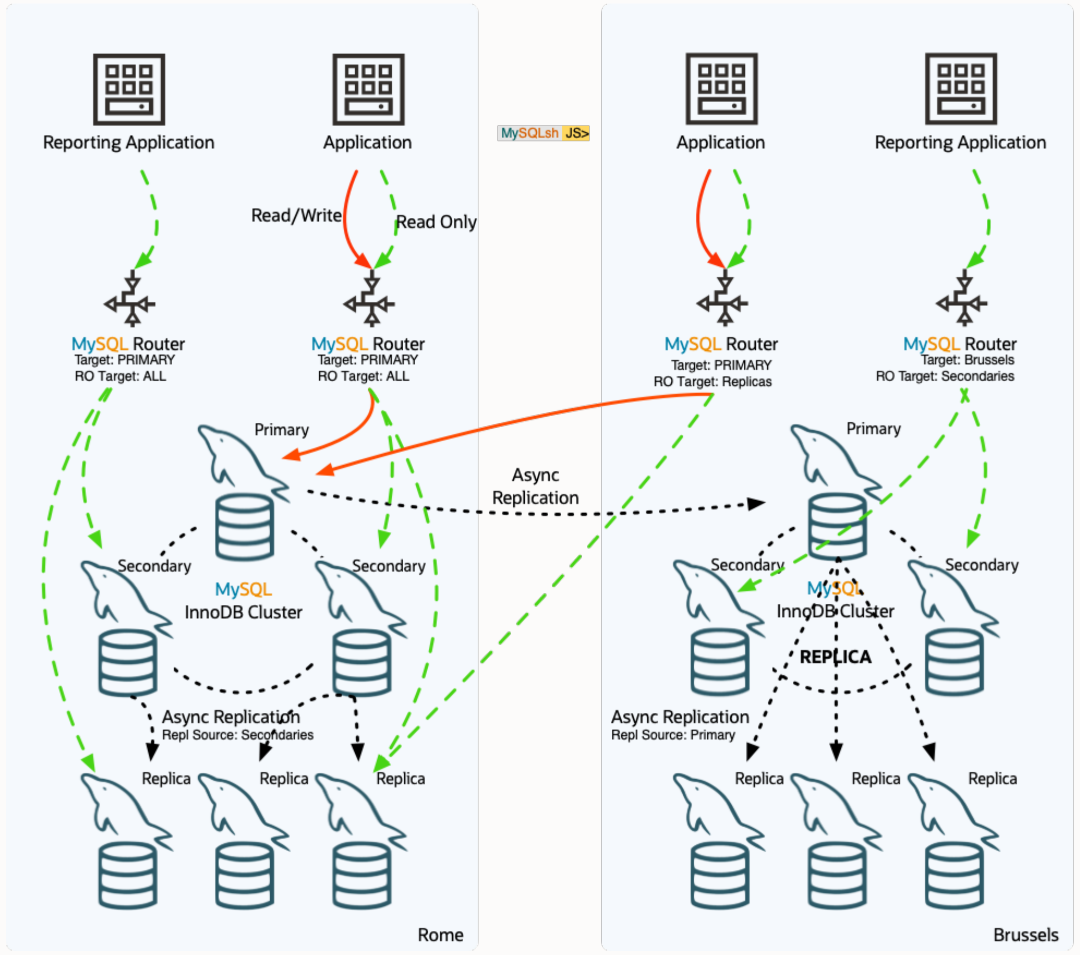


~/mysql-server/router/src/

```
io                  Abstraction for IO OS layer
rest_api            General REST API handler
rest_metadata_cache Metadata cache REST API handler
rest_router         Global Router REST API handler
rest_routing        Routing endpoint REST API handler
router_openssl      OpenSSL library integration
router_protobuf     Protobuf library integration
```

Router and MySQL Architectures

Core component of MySQL Architectures



Transparent access to Database Architecture

- Transparent client connection routing
  - Load balancing
  - Application connection failover
  - Little to no configuration needed
- Stateless design
  - Part of the application stack
- Full integration into MySQL Architectures
  - InnoDB Cluster
  - InnoDB ReplicaSet
  - InnoDB ClusterSet
  - InnoDB Cluster Read Replicas **New in 8.1.0 !**
- 3 TCP Ports:
  - PRIMARY traffic
  - SECONDARY traffic
  - RW splitting **New in 8.2.0 !**

Bootstrapping

Auto-configuration for the MySQL Architecture

- Fetches the topology Metadata information from one of the servers
- Stores it in a dynamic file (`data/state.json`)
- Registers itself in the Metadata schema
- Creates a configuration file ready to be used
- Creates daemon start/stop scripts

MySQL Router

Manual configuration

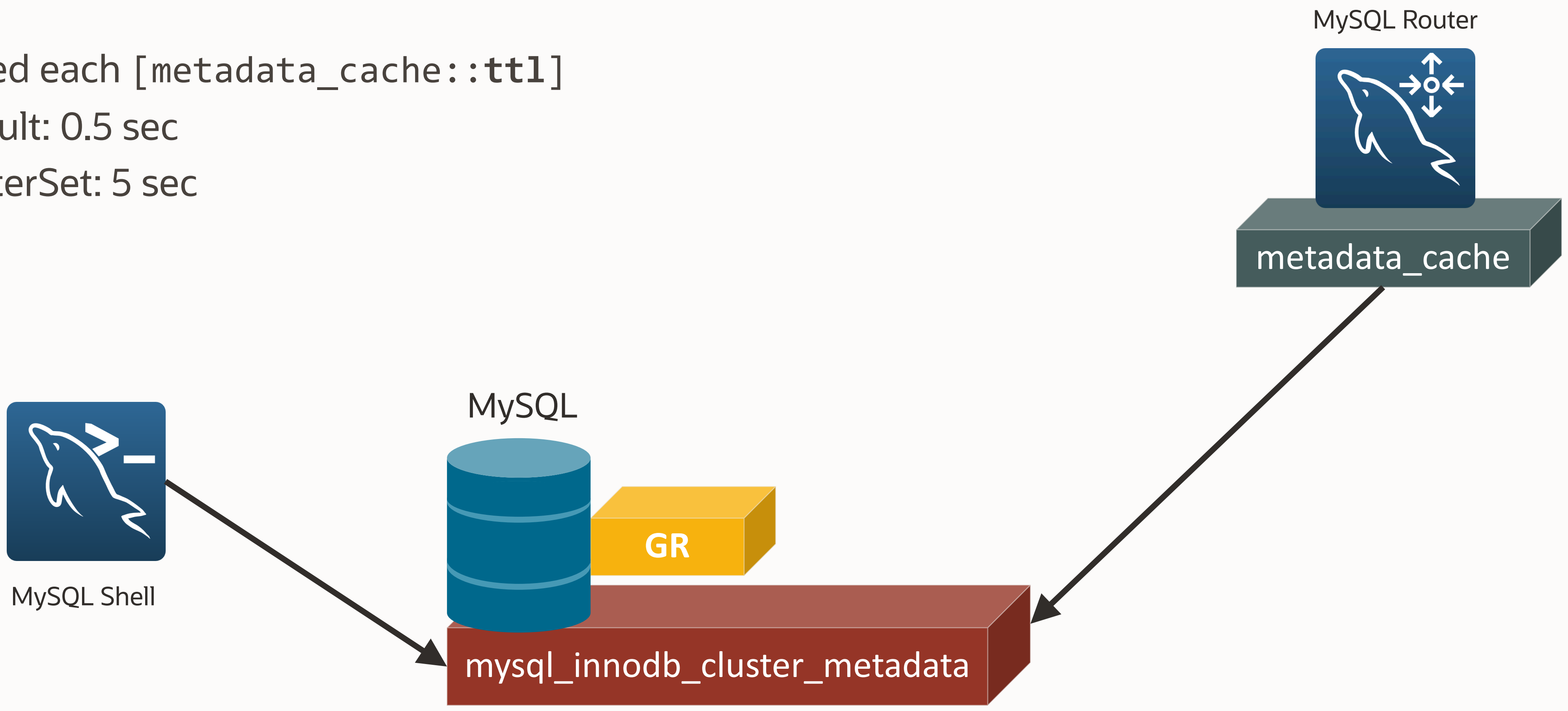
It’s possible to use Router without bootstrapping, however…

~/testbase/router/my.conf

```
[DEFAULT]
...
[routing:primary]
bind_address = localhost
bind_port = 3331
destinations = myserver_xyz:3306
routing_strategy = first-available
[routing:secondaries]
bind_address = localhost
bind_port = 3332
destinations = myserver_foo:3306, myserver_bar:3306
routing_strategy = round-robin-with-fallback
```

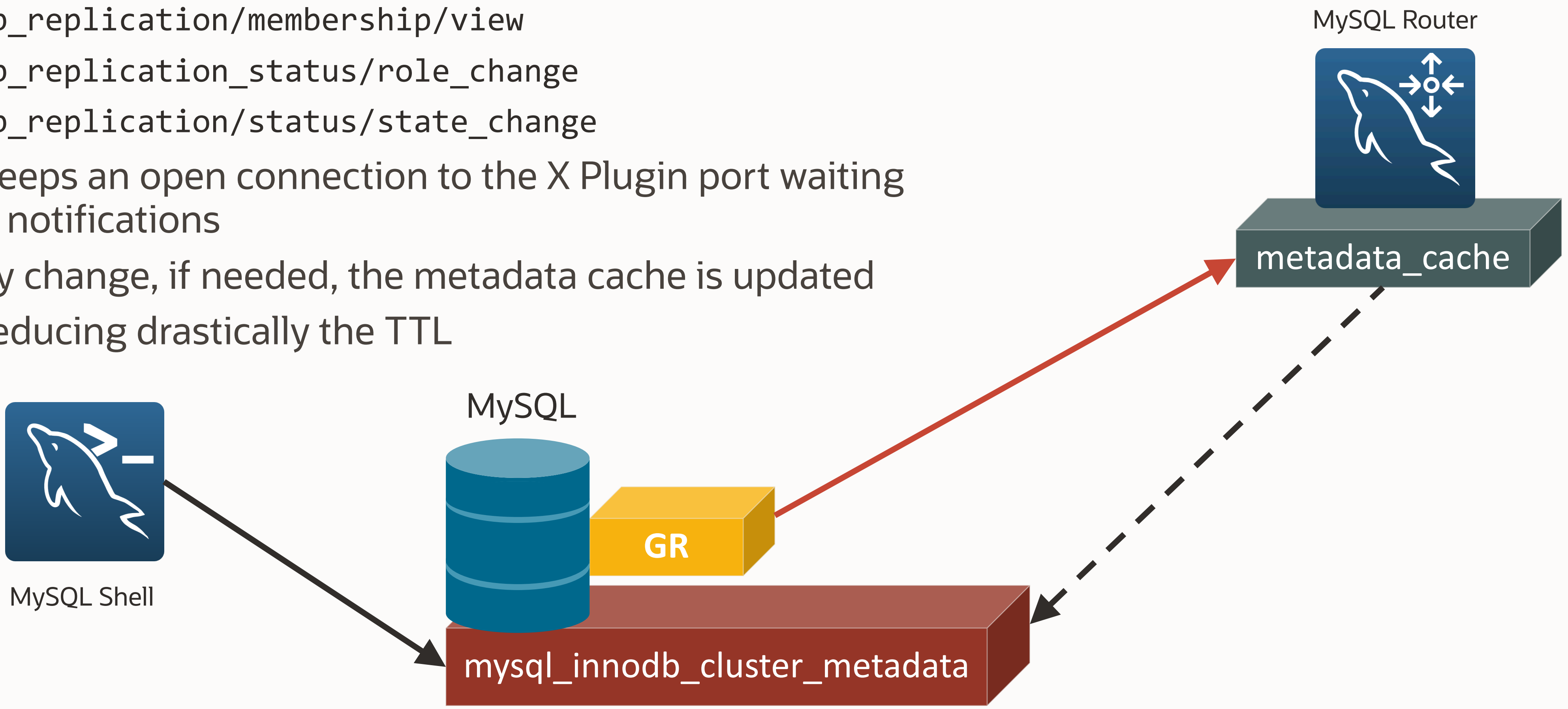
Metadata Cache

- Needed to route queries to the appropriate backend of the topology
- Refreshed each `[metadata_cache::ttl]`
    - Default: 0.5 sec
    - ClusterSet: 5 sec



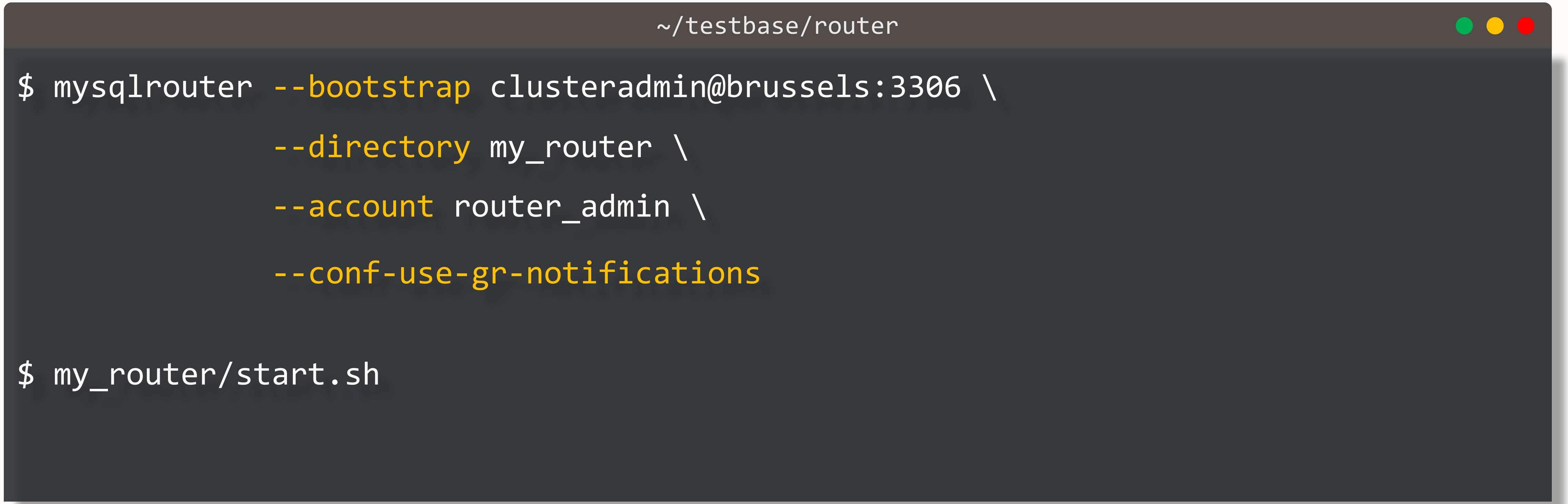
GR Notifications

- Push notifications sent via X protocol:
  - `group_replication/membership/quorum_loss`
  - `group_replication/membership/view`
  - `group_replication_status/role_change`
  - `group_replication/status/state_change`
- Router keeps an open connection to the X Plugin port waiting for push notifications
- For every change, if needed, the metadata cache is updated
- Allows reducing drastically the TTL



Deploying MySQL Router

1. Install MySQL Router
2. Bootstrap
3. Start it!



~/testbase/router

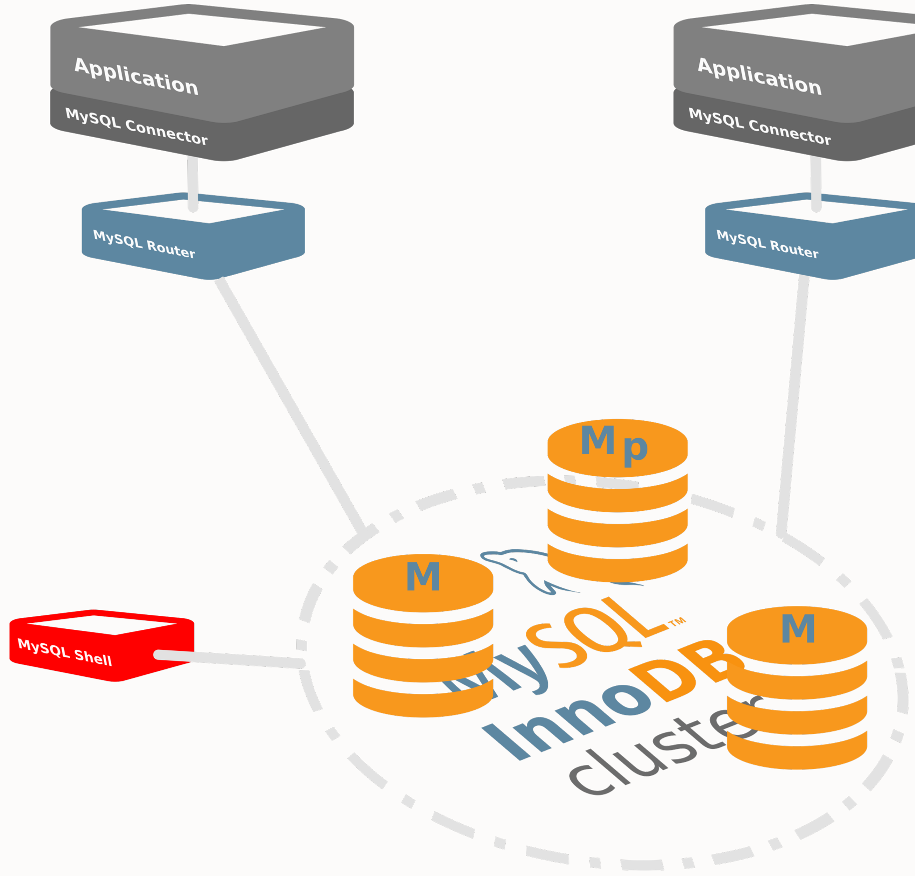
```
$ mysqlrouter --bootstrap clusteradmin@brussels:3306 \
              --directory my_router \
              --account router_admin \
              --conf-use-gr-notifications

$ my_router/start.sh
```

Deploying MySQL Router

It's **recommended** to deploy Router on the **same host** as the application and **enable GR notifications**. That allows:

- Using sockets instead of TCP/IP
- Decreasing network latency
- Fine-grained account access
- Scaling-out!



Deploying MySQL Router

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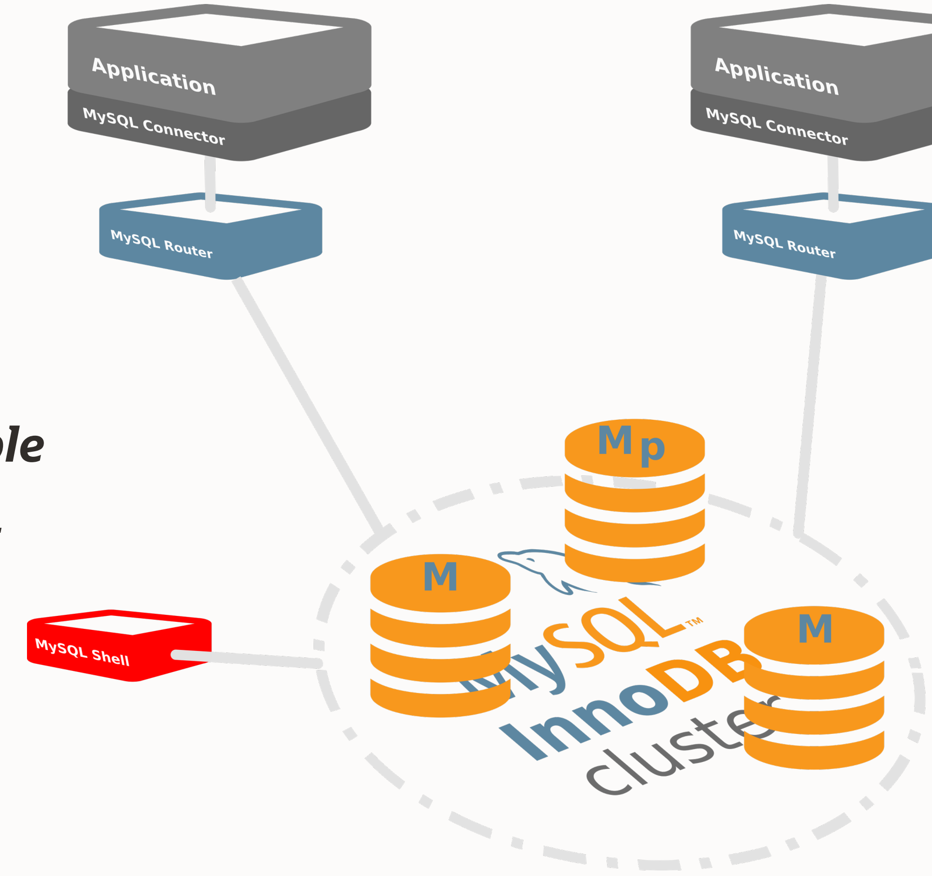
- Using sockets instead of TCP/IP
- Decreasing network latency
- Fine-grained account access
- Scaling-out!

*Alternatively, it’s possible to deploy **multiple** Routers in **multiple** machines under a **VIP**.*



Connection Sharing and Reuse

Connection Sharing and Reuse

- Based on a **Connection Pool**
- **Re-use** server-side connections that the client wanted to close, saving the setup costs of establishing new ones
- **Share** server-side connections where the client is idling on an active connection, to reduce the number of open server-side connections freeing up resources bound to those idle connections

MySQL Router

Connection Sharing and Reuse

- Configurable with
  - **`connection_sharing`** (disabled by default)
  - **`connection_sharing_delay`** (1 by default)
    - Seconds to wait before moving an idle connection to the pool
  - **`idle_timeout`** (5 by default)
    - How many seconds to keep a connection in the pool after the client disconnects
  - **`max_idle_server_connections`** (disabled by default)
    - How many open connections can be kept in the pool after the client disconnects

MySQL Router

TLS Session Caching

TLS Session Caching

New in 8.1.0 !

- TLS handshakes are slow

- **Cache and resume TLS sessions** from:
  - Client to Router
  - Router to Server
- **Saves time and resources** by reducing the connection handshake
  - Enabled by default

- **Client** and **Server** side caches, configurable with:
  - `_ssl_session_cache_mode`: enable/disable
  - `_ssl_session_cache_size`: max number of cached sessions
  - `_ssl_session_cache_timeout`: cache timeout

MySQL Router

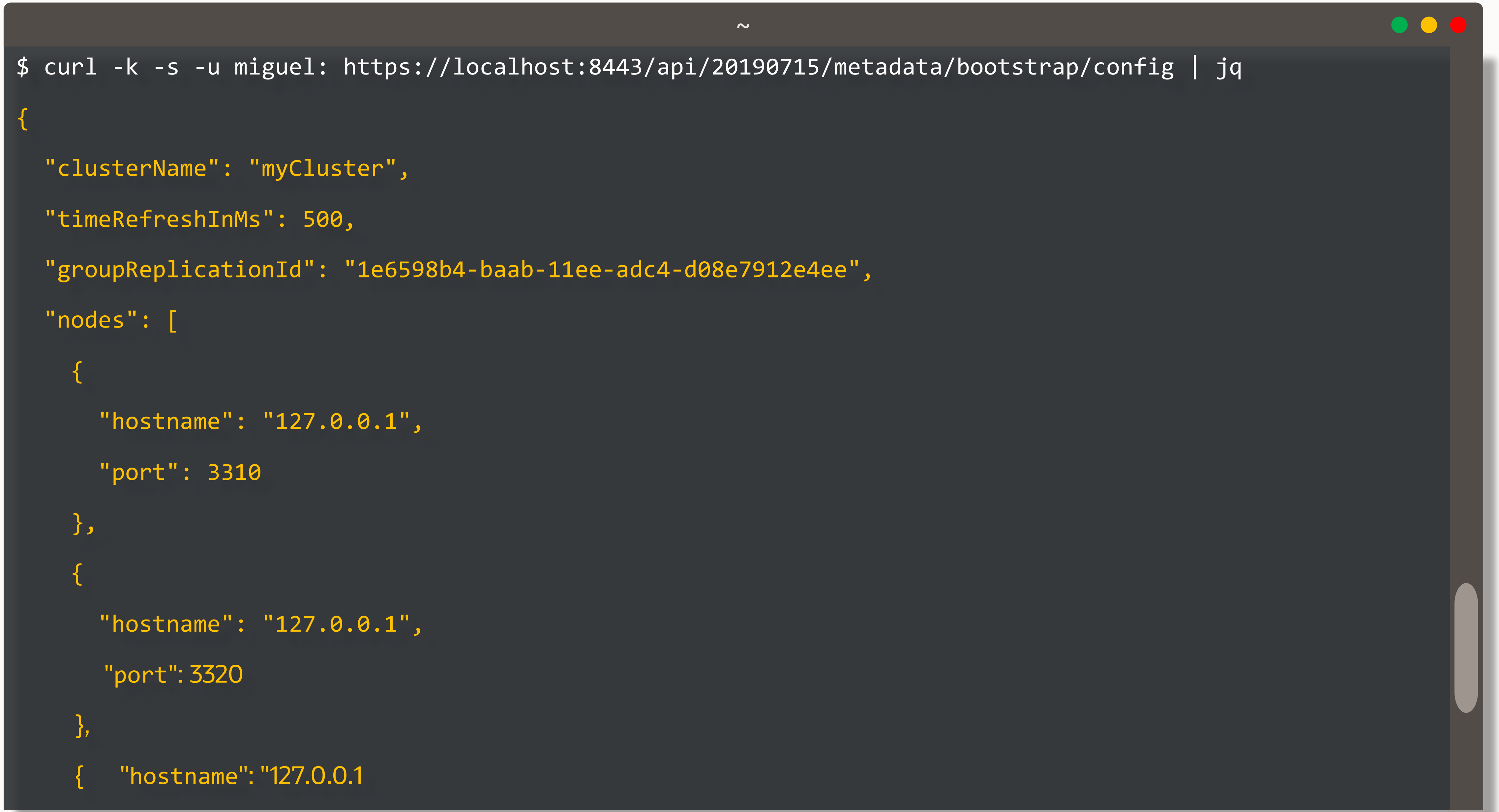
REST API

REST API

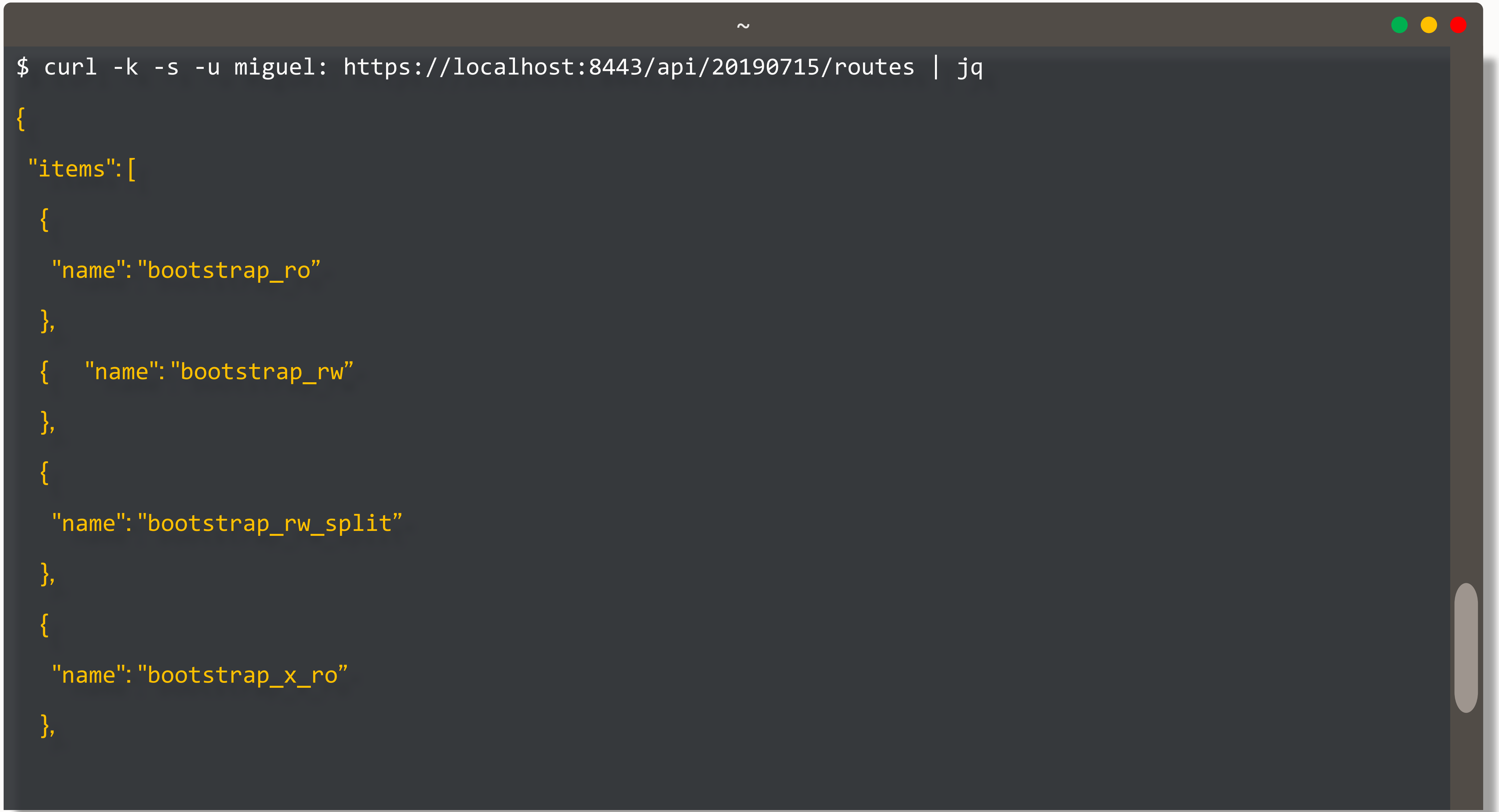
- Built on top of the **HTTP Server plugin**

- Follows the OPENAPI 2.0 spec

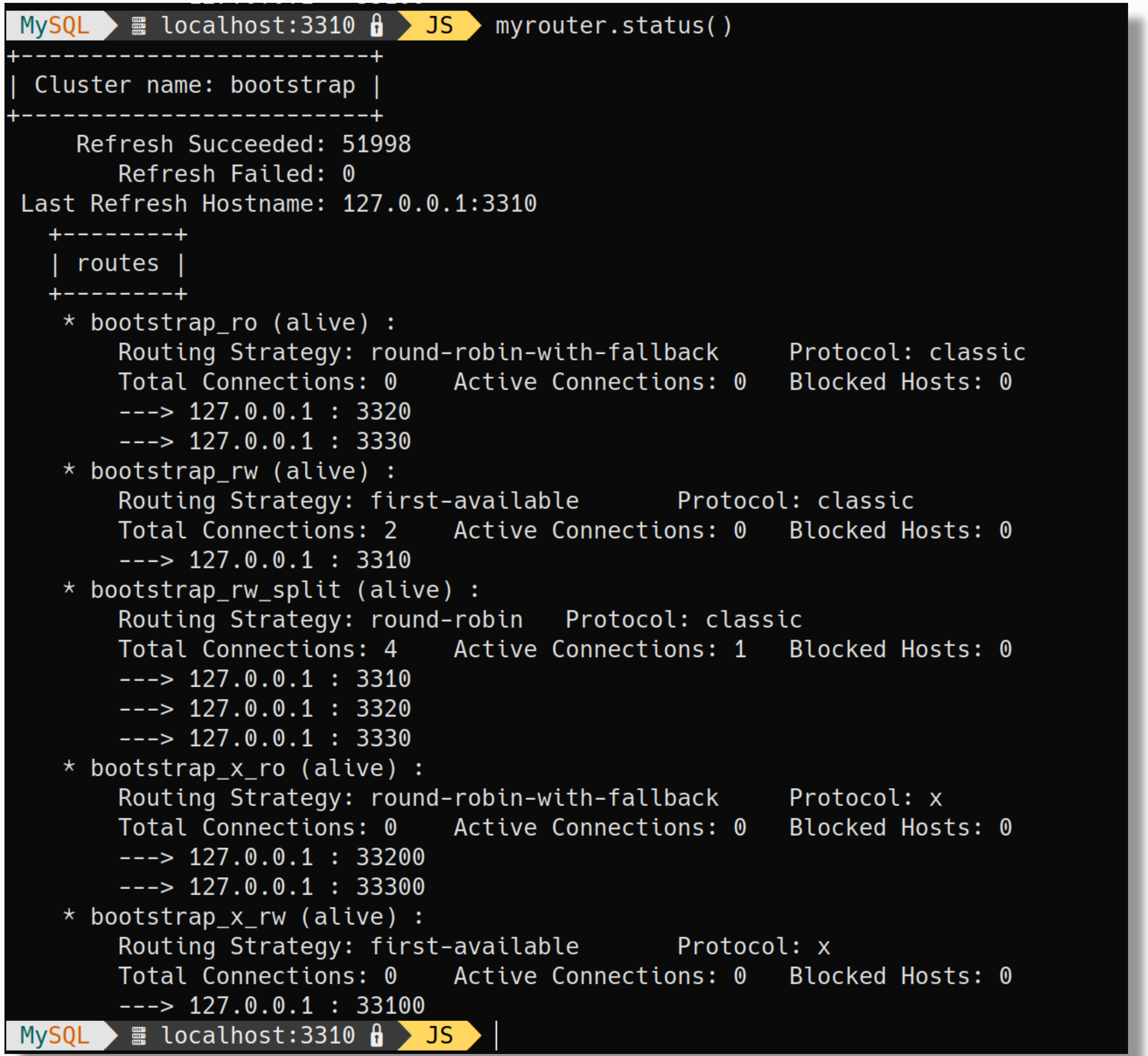
- Exposes a **Swagger** file to describe the REST API:
  - ✓ Metadata cache config
  - ✓ Metadata cache status
  - ✓ Metadata cache instances list
  - ✓ Router status
  - ✓ Routing plugin status
  - ✓ Routes config / status / health / destination / connections
  - ✓ Routes list
  - ✓ Blocked hosts



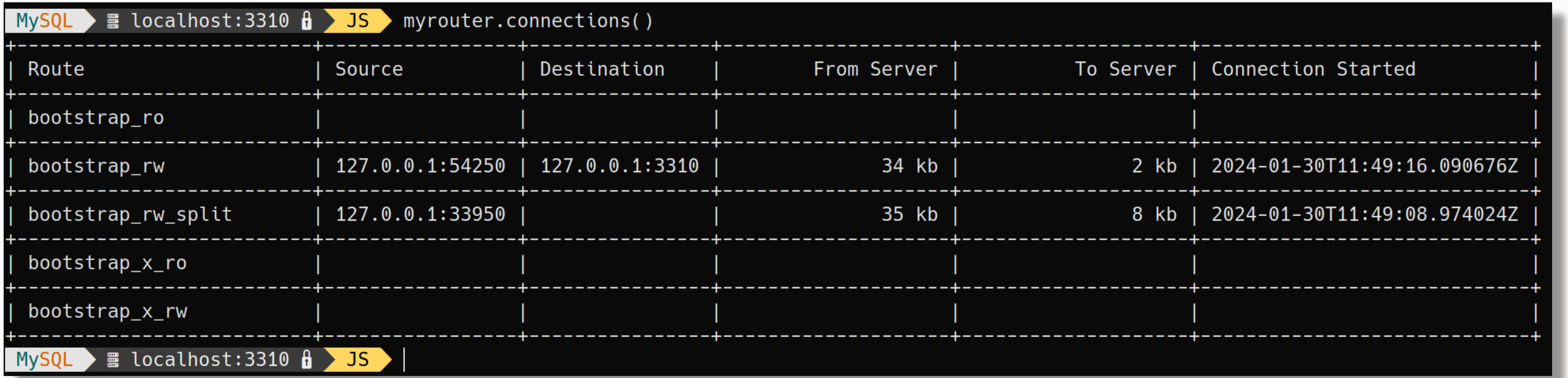
```
$ curl -k -s -u miguel: https://localhost:8443/api/20190715/metadata/bootstrap/config | jq
{
  "clusterName": "myCluster",
  "timeRefreshInMs": 500,
  "groupReplicationId": "1e6598b4-baab-11ee-adc4-d08e7912e4ee",
  "nodes": [
    {
      "hostname": "127.0.0.1",
      "port": 3310
    },
    {
      "hostname": "127.0.0.1",
      "port": 3320
    },
    {   "hostname": "127.0.0.1
```



```
$ curl -k -s -u miguel: https://localhost:8443/api/20190715/routes | jq
{
 "items":[
  {
   "name":"bootstrap_ro”
  },
  {   "name":"bootstrap_rw”
  },
  {
   "name":"bootstrap_rw_split”
  },
  {
   "name":"bootstrap_x_ro”
  },
```



```
MySQL  localhost:3310  JS  myrouter.status()
+-------------------------+
| Cluster name: bootstrap |
+-------------------------+
     Refresh Succeeded: 51998
        Refresh Failed: 0
 Last Refresh Hostname: 127.0.0.1:3310
   +---------+
   | routes |
   +---------+
    * bootstrap_ro (alive) :
      Routing Strategy: round-robin-with-fallback     Protocol: classic
      Total Connections: 0     Active Connections: 0   Blocked Hosts: 0
      ---> 127.0.0.1 : 3320
      ---> 127.0.0.1 : 3330
    * bootstrap_rw (alive) :
      Routing Strategy: first-available       Protocol: classic
      Total Connections: 2     Active Connections: 0   Blocked Hosts: 0
      ---> 127.0.0.1 : 3310
    * bootstrap_rw_split (alive) :
      Routing Strategy: round-robin   Protocol: classic
      Total Connections: 4     Active Connections: 1   Blocked Hosts: 0
      ---> 127.0.0.1 : 3310
      ---> 127.0.0.1 : 3320
      ---> 127.0.0.1 : 3330
    * bootstrap_x_ro (alive) :
      Routing Strategy: round-robin-with-fallback     Protocol: x
      Total Connections: 0     Active Connections: 0   Blocked Hosts: 0
      ---> 127.0.0.1 : 33200
      ---> 127.0.0.1 : 33300
    * bootstrap_x_rw (alive) :
      Routing Strategy: first-available       Protocol: x
      Total Connections: 0     Active Connections: 0   Blocked Hosts: 0
      ---> 127.0.0.1 : 33100
MySQL  localhost:3310  JS  |
```



```
MySQL  localhost:3310  JS  myrouter.connections()
+------------------------+-----------------+----------------+-----------------+-----------------+-----------------------------+
| Route                  | Source          | Destination    |     From Server |       To Server | Connection Started          |
+------------------------+-----------------+----------------+-----------------+-----------------+-----------------------------+
| bootstrap_ro           |                 |                |                 |                 |                             |
+------------------------+-----------------+----------------+-----------------+-----------------+-----------------------------+
| bootstrap_rw           | 127.0.0.1:54250 | 127.0.0.1:3310 |           34 kb |            2 kb | 2024-01-30T11:49:16.090676Z |
+------------------------+-----------------+----------------+-----------------+-----------------+-----------------------------+
| bootstrap_rw_split     | 127.0.0.1:33950 |                |           35 kb |            8 kb | 2024-01-30T11:49:08.974024Z |
+------------------------+-----------------+----------------+-----------------+-----------------+-----------------------------+
| bootstrap_x_ro         |                 |                |                 |                 |                             |
+------------------------+-----------------+----------------+-----------------+-----------------+-----------------------------+
| bootstrap_x_rw         |                 |                |                 |                 |                             |
+------------------------+-----------------+----------------+-----------------+-----------------+-----------------------------+
MySQL  localhost:3310  JS
```

MySQL Rest Service (MRS)

Key takeaways

- Fast and powerful way to serve data to client applications via a **HTTPS REST interface**
- Implemented as a **MySQL Router feature**
- Built on the concepts of ORDS, focusing on **the strengths of MySQL**
  - Not as powerful as ORDS (PL/SQL based)
  - Focus on MySQL performance
  - Focus on MySQL scalability
  - Using MySQL/HeatWave as metadata storage, not depending on an OracleDB instance
- **Auto REST** for tables, views, and procedures
- **GUI Frontend** with MySQL Shell for VSCode

MySQL REST Service

Key takeaways

RESTful Web Services

- Auto REST for tables, views, procedures and functions
- {JSON} responses with paged results
- Developer support (GUI, CLI, API)
- Support for popular OAuth2 services

Full SQL Support & SDK API

- Fully manageable through SQL
- CREATE REST DUALITY VIEW statements
- Tailored SDK for all RESTful Endpoints
- Popular, Prisma-like API, live prototyping

JSON/Relational Duality

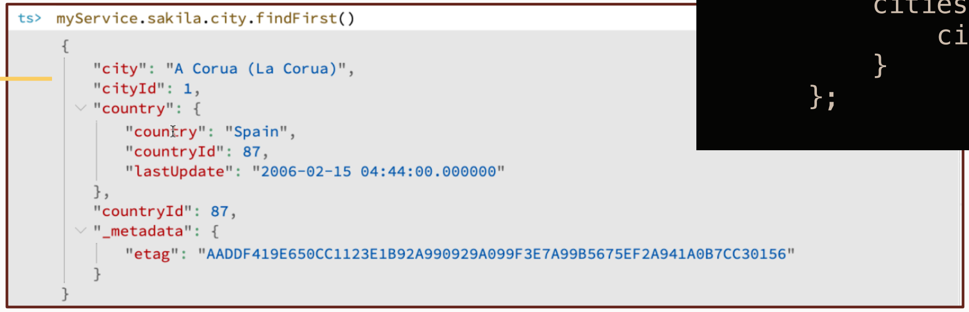
- Full support SQL support for JSON/Relational REST endpoints
- Visual Duality Editor - Build complex JSON structures with a few clicks
- SQL & SDK interface preview

```
sql> CONFIGURE REST METADATA;

sql> CREATE REST SERVICE /myService;

sql> CREATE REST SCHEMA /sakila FROM `sakila`;
```

```
sql> CREATE OR REPLACE REST DUALITY VIEW /country
     ON SERVICE /myService SCHEMA /sakila
     AS sakila.country {
         countryId: country_id @SORTABLE,
         country: country,
         lastUpdate: last_update,
         cities: sakila.city @INSERT @UPDATE @DELETE {
             city: city
         }
     };
```

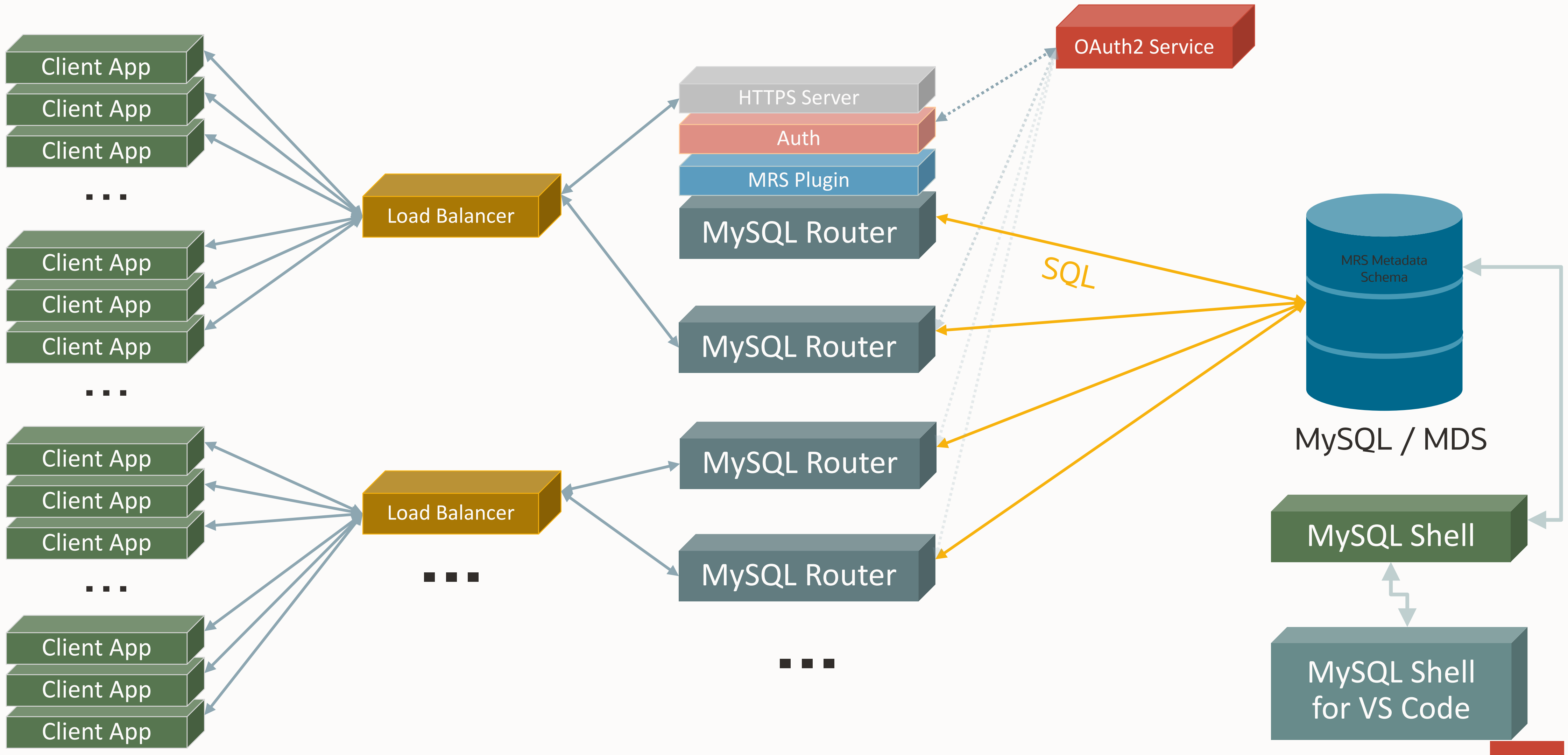


```
ts> myService.sakila.city.findFirst()
{
    "city": "A Corua (La Corua)",
    "cityId": 1,
    "country": {
        "country": "Spain",
        "countryId": 87,
        "lastUpdate": "2006-02-15 04:44:00.000000"
    },
    "countryId": 87,
    "_metadata": {
        "etag": "AADDF419E650CC1123E1B92A990929A099F3E7A99B5675EF2A941A0B7CC30156"
    }
}
```

TypeScript SDK API with live prototyping of REST queries

Full JSON/Relational Duality Support via SQL and GUI

MySQL REST Service
Architecture



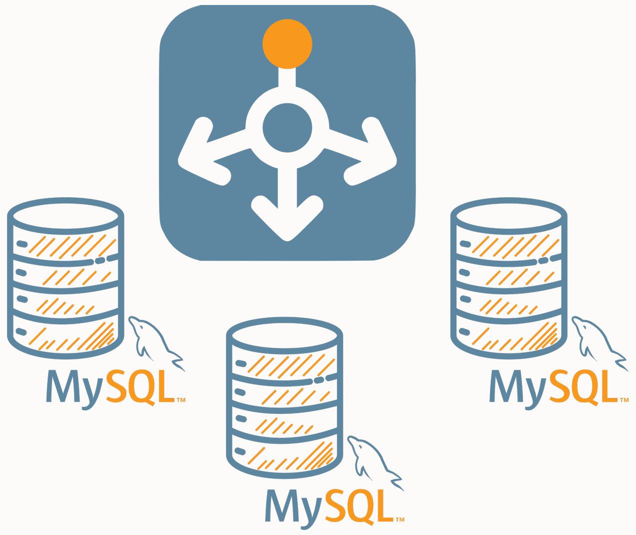
R/W Splitting

R/W Splitting

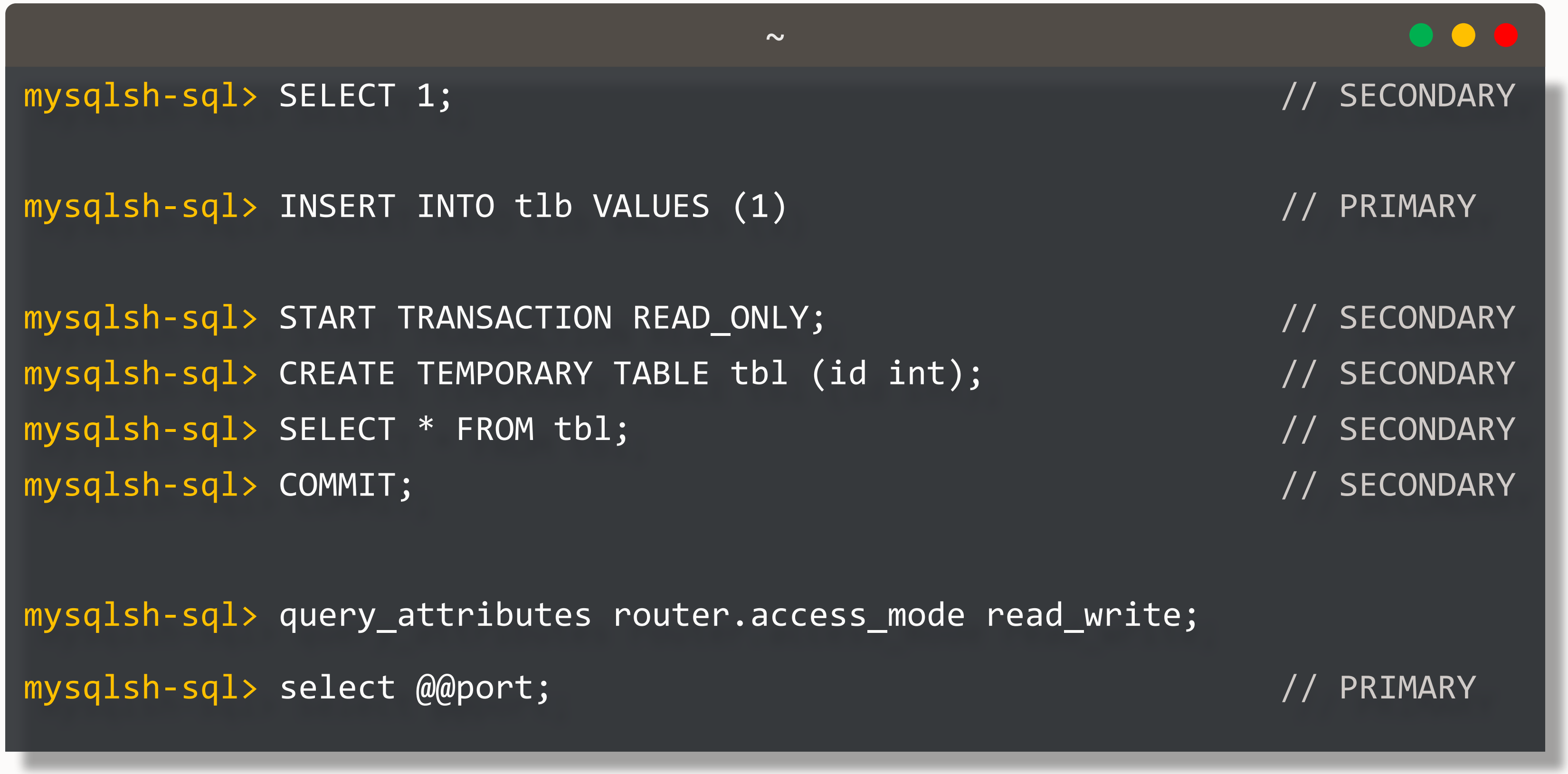
- **Motivation:**
  - **1 port to rule them all**
  - Up to now, the application had to be aware of the type of transaction to use either the RW or the RO port
  - It's performant, but limits the usage of Router

- **Work it works:**
  - Router classifies each query as **read** or **write automatically** and forwards to the appropriate backend
  - It's also possible to manually or programmatically to specify the type of query using
    - ROUTER SET
    - query_attributes

New in 8.2.0!



R/W Splitting



```
mysqlsh-sql> SELECT 1;                                            // SECONDARY

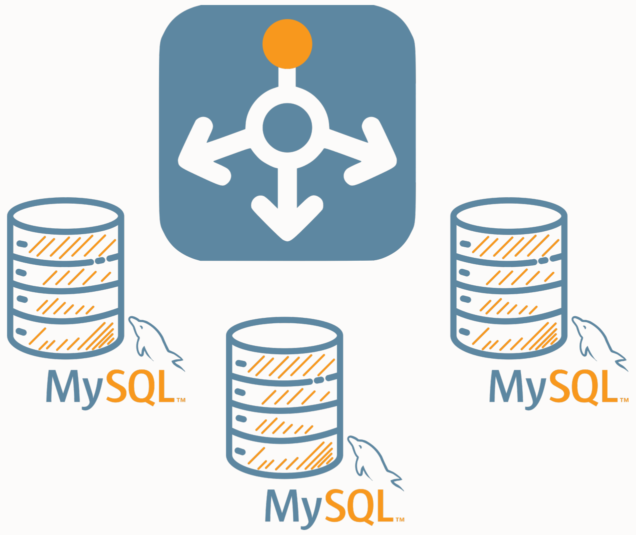
mysqlsh-sql> INSERT INTO tlb VALUES (1)                           // PRIMARY

mysqlsh-sql> START TRANSACTION READ_ONLY;                         // SECONDARY
mysqlsh-sql> CREATE TEMPORARY TABLE tbl (id int);                 // SECONDARY
mysqlsh-sql> SELECT * FROM tbl;                                   // SECONDARY
mysqlsh-sql> COMMIT;                                              // SECONDARY

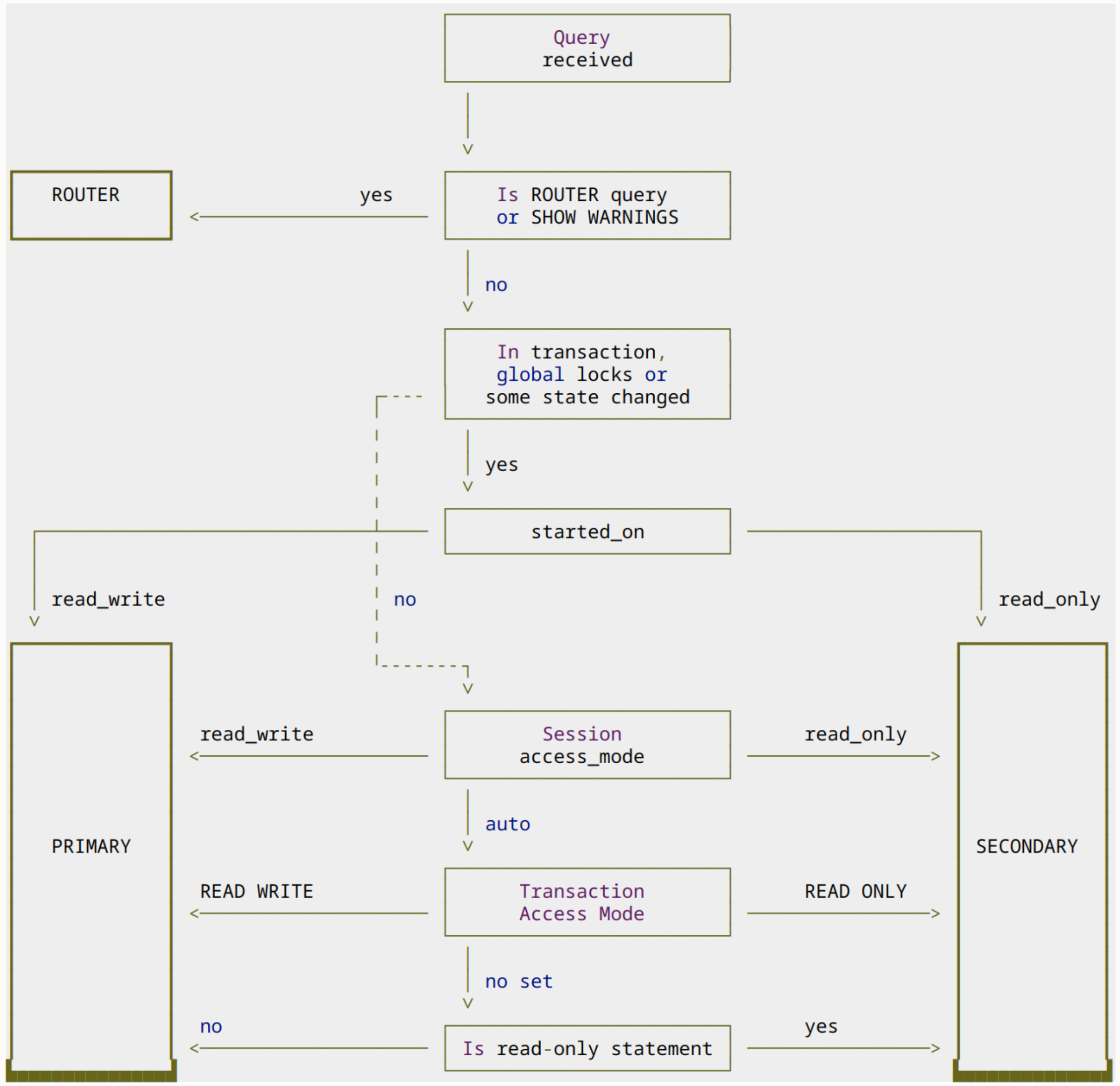

mysqlsh-sql> query_attributes router.access_mode read_write;

mysqlsh-sql> select @@port;                                       // PRIMARY
```

New in 8.2.0!



R/W Splitting



- The query is sent to the **`PRIMARY`** if the **`access_mode`** is **`read_write`**
- The query is sent to the **`SECONDARY`** if the **`access_mode`** is **`read_only`**
- If the **`access_mode`** is **`auto`**, a query is sent to a **`SECONDARY`** if:
  - Inside a **`READ_ONLY`** transaction, or
  - Router attribute for access mode set (**`router.access_mode`**), or
  - Outside a transaction, the connection allows sharing and the statement is a “read-only” statement
- If none of the above is met, the query is sent to the **`PRIMARY`**

Thank you!

Questions?

MySQL™ Belgian Days 2024

February 1 & 2

ICAB Incubator

4 Rue des Pères Blancs 1040 Bruxelles

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