MySQL High Availability and Disaster Recovery

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15+ DC Exit to Cloud

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800+ Cloud Certifications

500+ Global Talent Pool

250+ Cloud/DB Engineers

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25 Specializations

INFOLOB

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OUTSTANDING PARTNER TEAMMATE AWARD
2018, 2019 & 2020

ORACLE PartnerNetwork Excellence Awards
Global Finalist 2022 - Game Changer Tech Service Delivery Partner
APAC Finalist 2023 - Solution Innovation Partner, India
EMEA Finalist 2023 - Innovation Partner, Middle East, Africa, Turkiye

First Oracle Partner having OCI DRCC Expertise (Oman)

ORACLE Cloud Solutions Provider Expertise (CSP)

Launch Partner for OCI FSDRS

MySQL ORACLE WW Customer Advisory Board Member

Member for APAC — Oracle Partner Advisory Board

OCI Managed Services Partner
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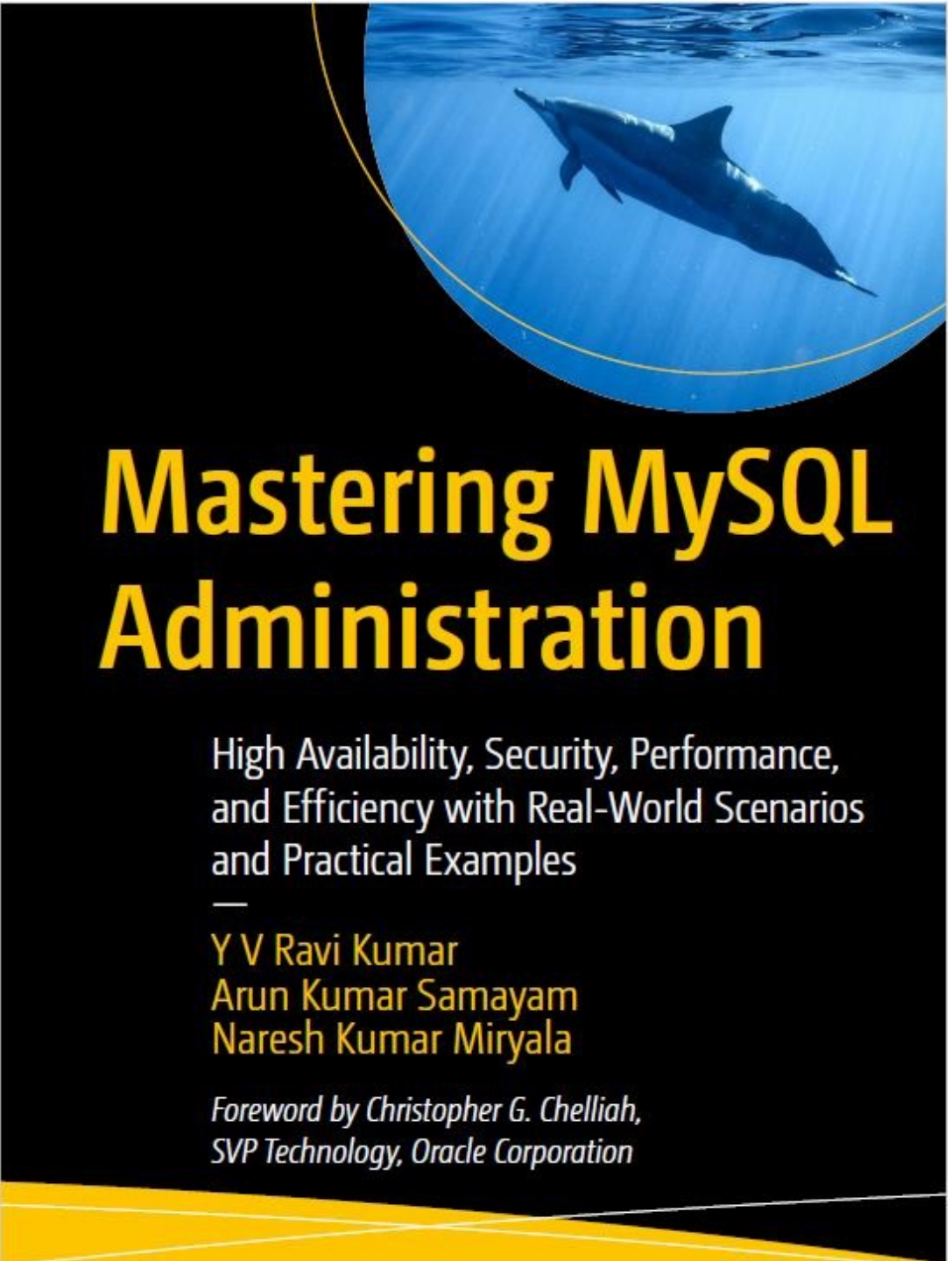
INFOLOB is the "ONE and ONLY" first Oracle partner to complete leading Oracle MySQL certifications including MySQL Heatwave.

- *MySQL Heatwave Implementation Certified Associate*
- *Oracle Certified Professional, MySQL 8.0 Database Administrator*
- *MySQL 2021 Certified Implementation Specialist*
- *Solution Engineering Specialist - Oracle MySQL*
- *Solution Engineering Specialist - Oracle MySQL Heatwave*



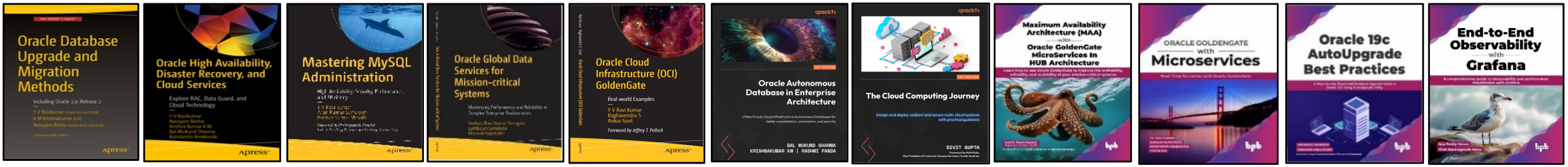
Introducing our book

This book offers step-by-step guidance on installing, upgrading, and establishing robust high availability and disaster recovery capabilities for MySQL databases. It also covers high availability with InnoDB and NDB clusters, MySQL routers and enterprise MySQL tools, and robust security design and performance techniques.

- *Chapter 1: MySQL Installation and Upgrade*
- *Chapter 2: MySQL Utilities*
- *Chapter 3: MySQL Server Administration*
- *Chapter 4: MySQL Tablespace Management and Partitioning*
- *Chapter 5: MySQL High Availability, Replication, and Scalability*
- *Chapter 6: MySQL InnoDB Cluster and Cluster Set*
- *Chapter 7: MySQL NDB Cluster*
- *Chapter 8: MySQL Logical Backup*
- *Chapter 9: MySQL Enterprise Backup and Recovery*
- *Chapter 10: MySQL Security*
- *Chapter 11: MySQL Performance Tuning*
- *Chapter 12: MySQL Enterprise Monitor*
- *Chapter 13: Monitoring MySQL Using Oracle Enterprise Manager Cloud Control 13c*
- *Chapter 14: MySQL Troubleshooting*

Y V Ravi Kumar

- 26+ years of industry experience
- EB1-A "Einstein Green Card" Recipient from United States
- Oracle Certified Master (OCM)
- Published x(11) books on Oracle Technology
  - *Co-author of (x6) books*
  - *Technical Reviewer of (x5) books*
- Published 100+ Oracle Technology Network (OTN) - English, Portuguese & Spanish
- Speaker 4x @Oracle Open/Cloud World, US
- Multi-Cloud Certified Architect



Agenda

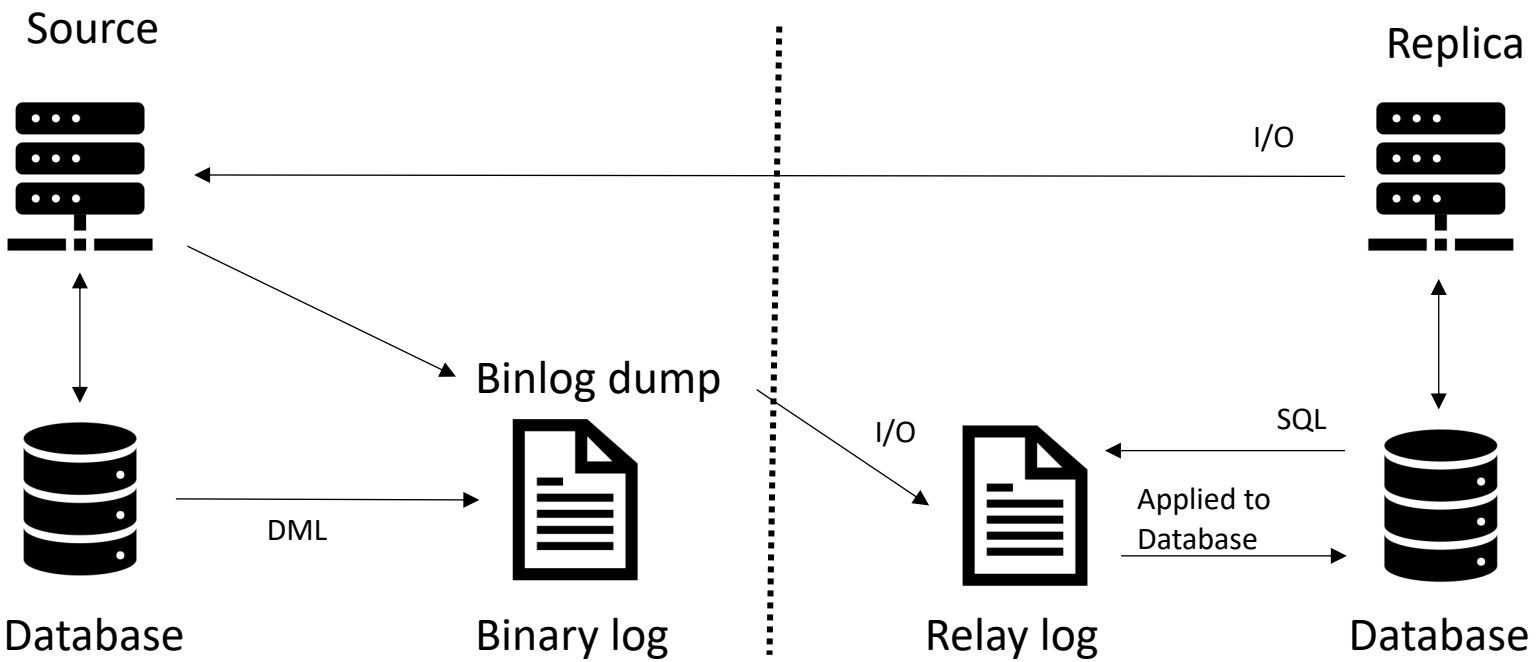
- Introduction
- Architecture of MySQL InnoDB Cluster
- MySQL Group Replication Plug-In
- How MySQL Group Replication will help in the InnoDB Cluster
- Role of MySQL Shell in InnoDB Cluster
- MySQL Router and its usage
- InnoDB Clusterset Architecture and configuration
- InnoDB Cluster and Clusterset scenarios

Common causes of IT disasters and system-wide outages

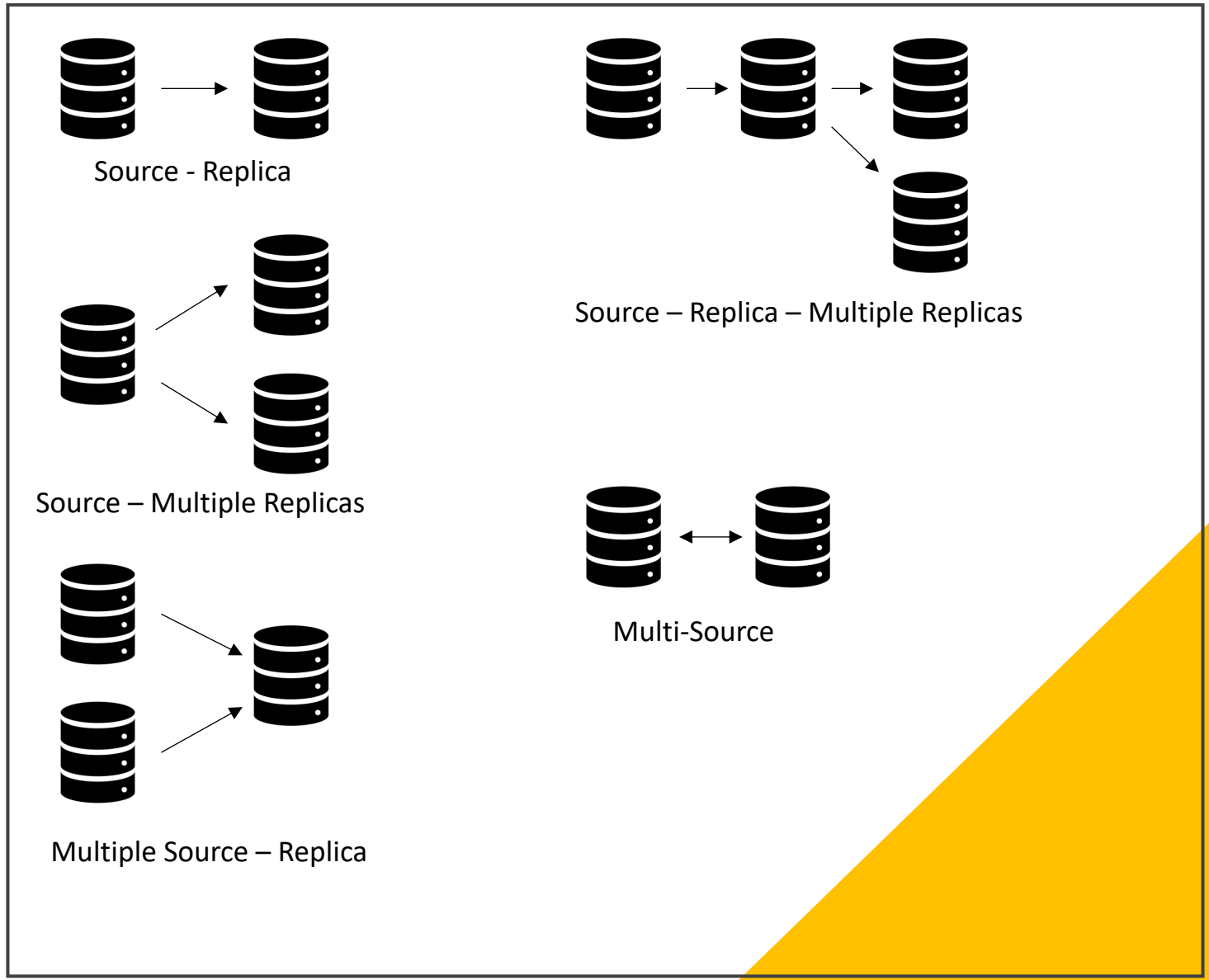
- Power outages
- Hardware failure
- Software issues
- Human error
- Network failures
- Natural disaster

MySQL Replication primer

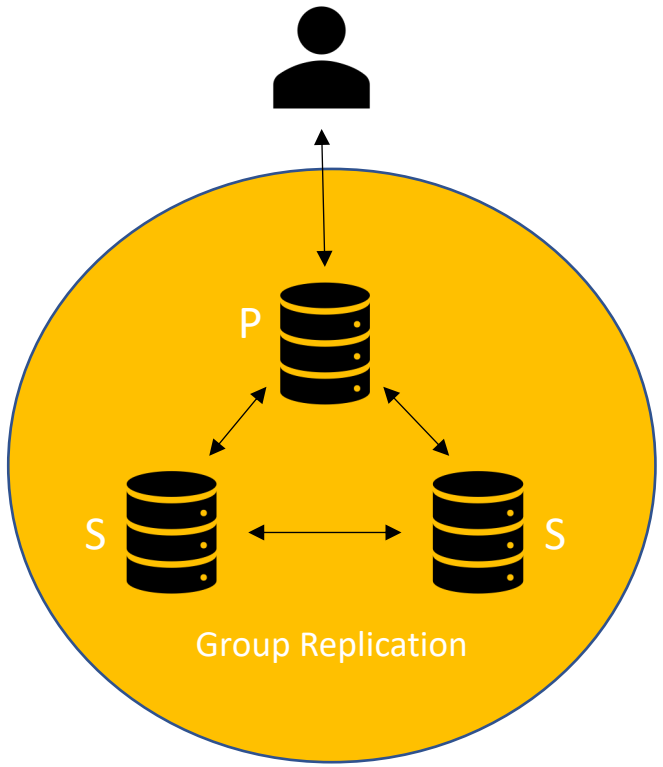
- Replica connects to Source
- I/O thread gets data
- Binlog dump sends data to the I/O thread
- SQL thread applies data
- Statement based vs. Row based vs. Mixed
- Asynchronous vs Semi Synchronous



MySQL Replication topologies



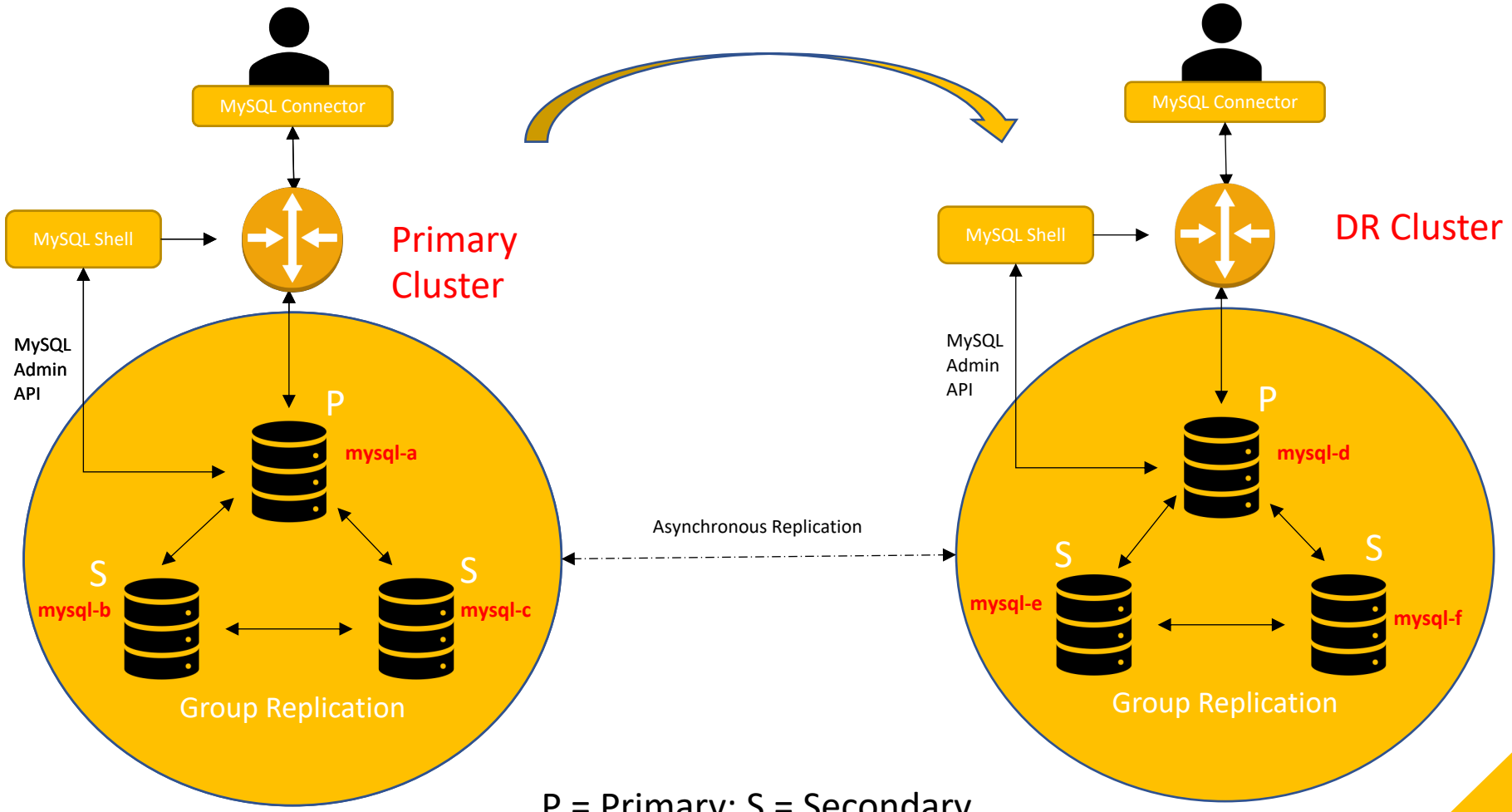
MySQL Group Replication



P = Primary; S = Secondary

- An elastic, highly-available, fault-tolerant replication topology
- Offered as a plugin to MySQL server
- Operates in a single primary mode with automatic primary election
- Built-in group membership service to guarantee database service availability
- Client connections need to be redirected or failed over if the primary becomes unavailable

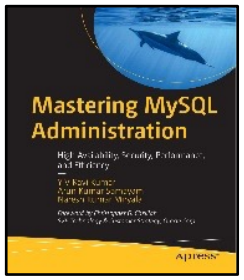
Primary Cluster with DR Cluster

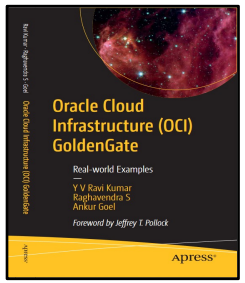


P = Primary; S = Secondary

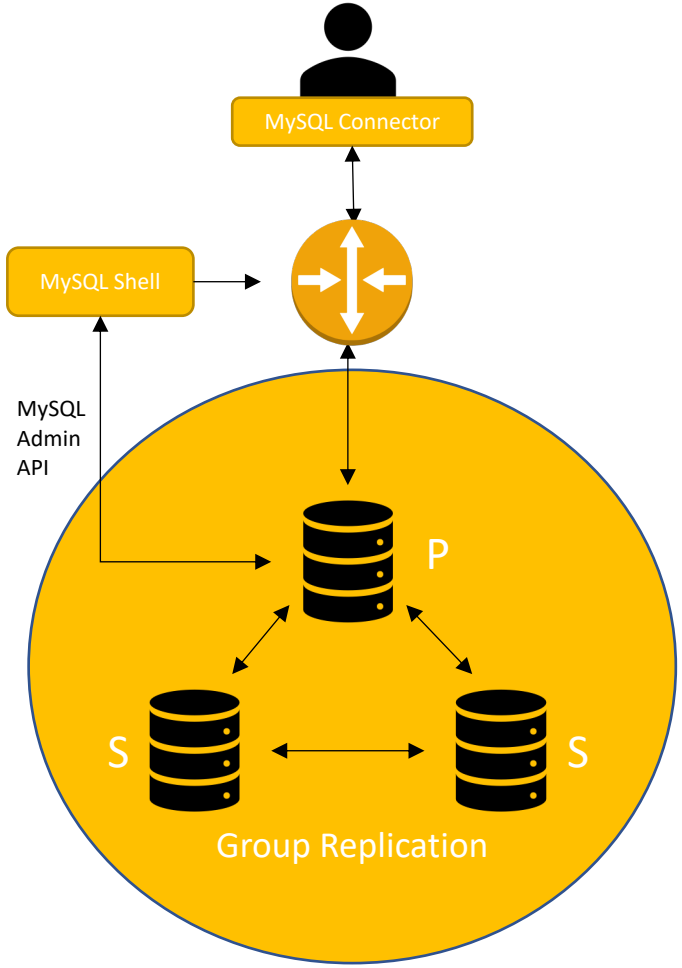
Arun Samayam

- 15+ years of experience with different database platforms as a DBA and Architect
- Multi-cloud certified professional
- Co-author: Mastering MySQL Administrator
- Technical reviewer: Oracle Cloud Infrastructure (OCI) Goldengate
- Speaker(x2): Oracle OpenWorld





MySQL InnoDB Cluster



- Provides a highly available and scalable solution
- Key components
  - MySQL Server
  - MySQL Group Replication
  - MySQL Shell
  - MySQL Router
- MySQL Group Replication: replicate data between all the servers in the cluster with automatic failover management
- MySQL Shell: Advanced client and code editor provides scripting capabilities in Python and JavaScript
- MySQL Router: Transparent client connection routing between the application and the cluster

P = Primary; S = Secondary

MySQL InnoDB Cluster Architecture

- Relies on MySQL Group replication which is installed on each server instance
- Group replication enables you to create elastic replication topologies
- Has the ability to reconfigure itself automatically if a server within the cluster goes offline
- Atleast 3 servers to form a group
- Operates in a single-primary mode or multi-primary mode
- Group replication plugin was introduced in 5.7 but it is tricky to work with directly
- MySQL InnoDB cluster introduced new components that are integrated tightly which made it easier to set up and administer

MySQL InnoDB Cluster creation

- Pre-check instance configuration for InnoDB Cluster usage

  MySQL localhost:33060+ ssl JS > **dba.checkInstanceConfiguration**('mysqlclusteradmin@localhost:3306')

- Create a cluster named

  MySQL localhost:33060+ ssl JS > **dba.createCluster**("myPrimaryCluster")

- Create a variable named "cluster"

  MySQL localhost:33060+ ssl JS > **var cluster**=dba.getCluster()

- Add an instance to the cluster

  MySQL localhost:33060+ ssl JS > **cluster.addInstance**('mysqlclusteradmin@mysql-b:3306',{recoveryMethod:'clone'})

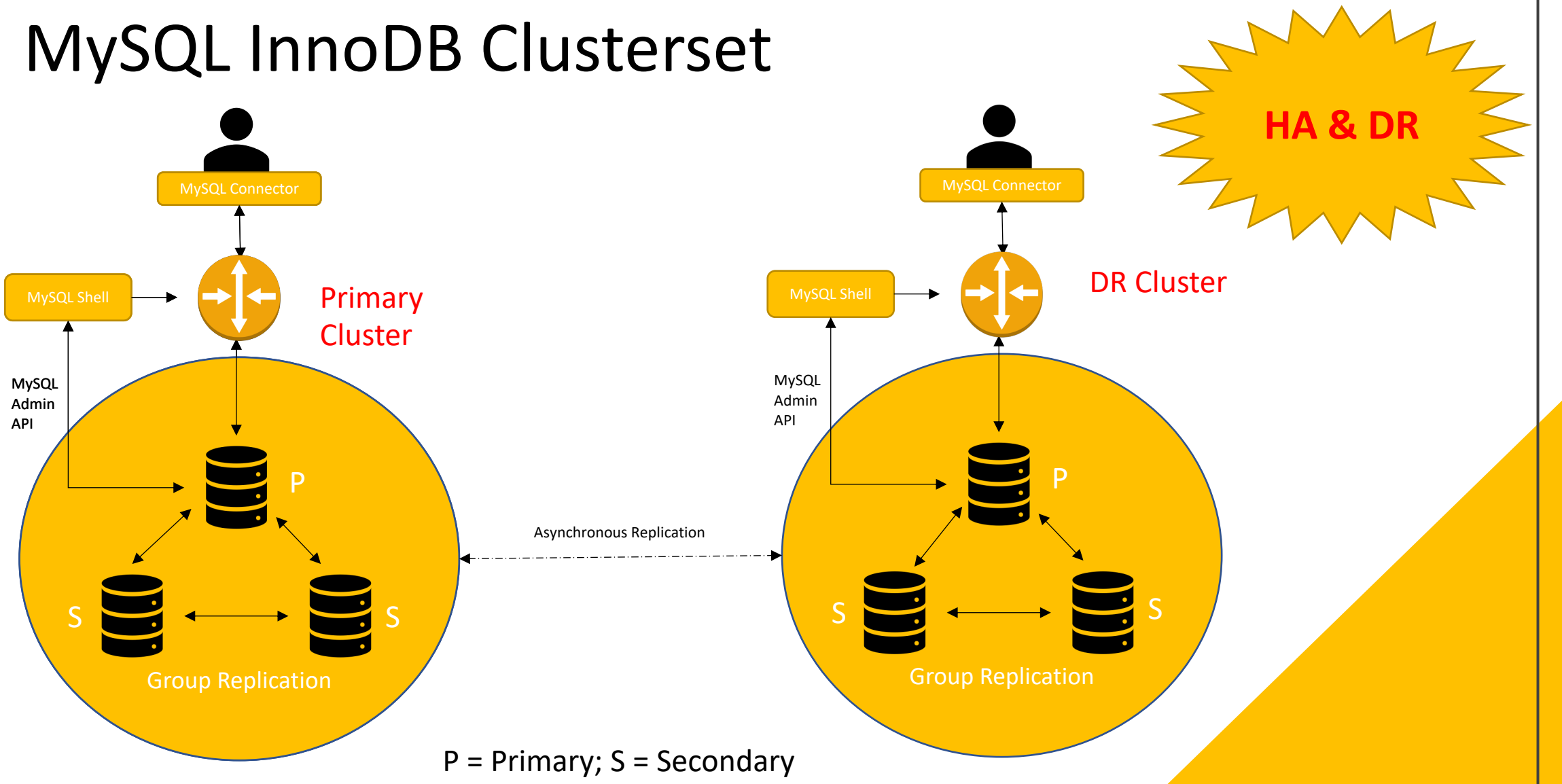
- Check cluster status

  MySQL localhost:33060+ ssl JS > **cluster.status()**

MySQL localhost:33060+ ssl JS > **cluster.status()**


```
{
    "clusterName": "myPrimaryCluster",
    "defaultReplicaSet": {
        "name": "default",
        "primary": "mysql-a:3306",
        "ssl": "REQUIRED",
        "status": "OK",
        "statusText": "Cluster is ONLINE and can tolerate up to ONE failure.",
        "topology": {
            "mysql-a:3306": {
                "address": "mysql-a:3306",
                "memberRole": "PRIMARY",
                "mode": "R/W",
                "readReplicas": {},
                "replicationLag": "applier_queue_applied",
                "role": "HA",
                "status": "ONLINE",
                "version": "8.0.34"
            },
            "mysql-b:3306": {
                "address": "mysql-b:3306",
                "memberRole": "SECONDARY",
                "mode": "R/O",
                "readReplicas": {},
                "replicationLag": "applier_queue_applied",
                "role": "HA",
                "status": "ONLINE",
                "version": "8.0.34"
            },
            "mysql-c:3306": {
                "address": "mysql-c:3306",
                "memberRole": "SECONDARY",
                "mode": "R/O",
                "readReplicas": {},
                "replicationLag": "applier_queue_applied",
                "role": "HA",
                "status": "ONLINE",
                "version": "8.0.34"
            }
        },
        "topologyMode": "Single-Primary"
    },
    "groupInformationSourceMember": "mysql-a:3306"
}
```

MySQL InnoDB Clusterset



- Pre-check instance configuration for InnoDB Cluster usage

  MySQL localhost:33060+ ssl JS > **dba.checkInstanceConfiguration**('mysqlclusteradmin@localhost:3306')

- Create a primary cluster named

  MySQL localhost:33060+ ssl JS > **dba.createCluster**("myPrimaryCluster")

- Create a variable named "cluster"

  MySQL localhost:33060+ ssl JS > **var cluster**=dba.getCluster()

- Add an instance to the cluster

  MySQL localhost:33060+ ssl JS > **cluster.addInstance**('mysqlclusteradmin@mysql-b:3306',{recoveryMethod:'clone'})

- Check cluster status

  MySQL localhost:33060+ ssl JS > **cluster.status()**

- Create a clusterset named "myClusterset"

  MySQL localhost:33060+ ssl JS > clusterset=**cluster.createClusterSet**("myclusterset")

- Create a replica cluster named "mydrcluster"

  MySQL localhost:33060+ ssl JS > mydrcluster=**myclusterset.createReplicaCluster**("mysqlclusteradmin@mysql-d:3306", "mydrcluster", {recoveryProgress:1, timeout:10})

- Check Clusterset status

MySQL localhost:33060+ ssl JS > **myclusterset.status()**


```
{
   "clusters": {
      "myPrimaryCluster": {
         "clusterRole": "PRIMARY",
         "globalStatus": "OK",
         "primary": "mysql-a:3306"
      },
      "mydrcluster": {
         "clusterRole": "REPLICA",
         "clusterSetReplicationStatus": "OK",
         "globalStatus": "OK"
      }
   },
   "domainName": "myclusterset",
   "globalPrimaryInstance": "mysql-a:3306",
   "primaryCluster": "myPrimaryCluster",
   "status": "HEALTHY",
   "statusText": "All Clusters available."
}
```


MySQL localhost:33060+ ssl JS > **myclusterset.status({extended:1})**

- Setup MySQL Router

  MySQL localhost:33060+ ssl JS > **cluster.setupRouterAccount**("routeradmin")

- Create an OS user to run MySQL router and bootstrap MySQL Router

  # useradd **routeruser**

  # mysqlrouter **--bootstrap** root@localhost:3306 --directory /home/routeruser --conf-use-sockets --account routeradmin --user=routeruser –force

- Router configuration file default location: <router_home_directory>/**mysqlrouter.conf**
- Start router

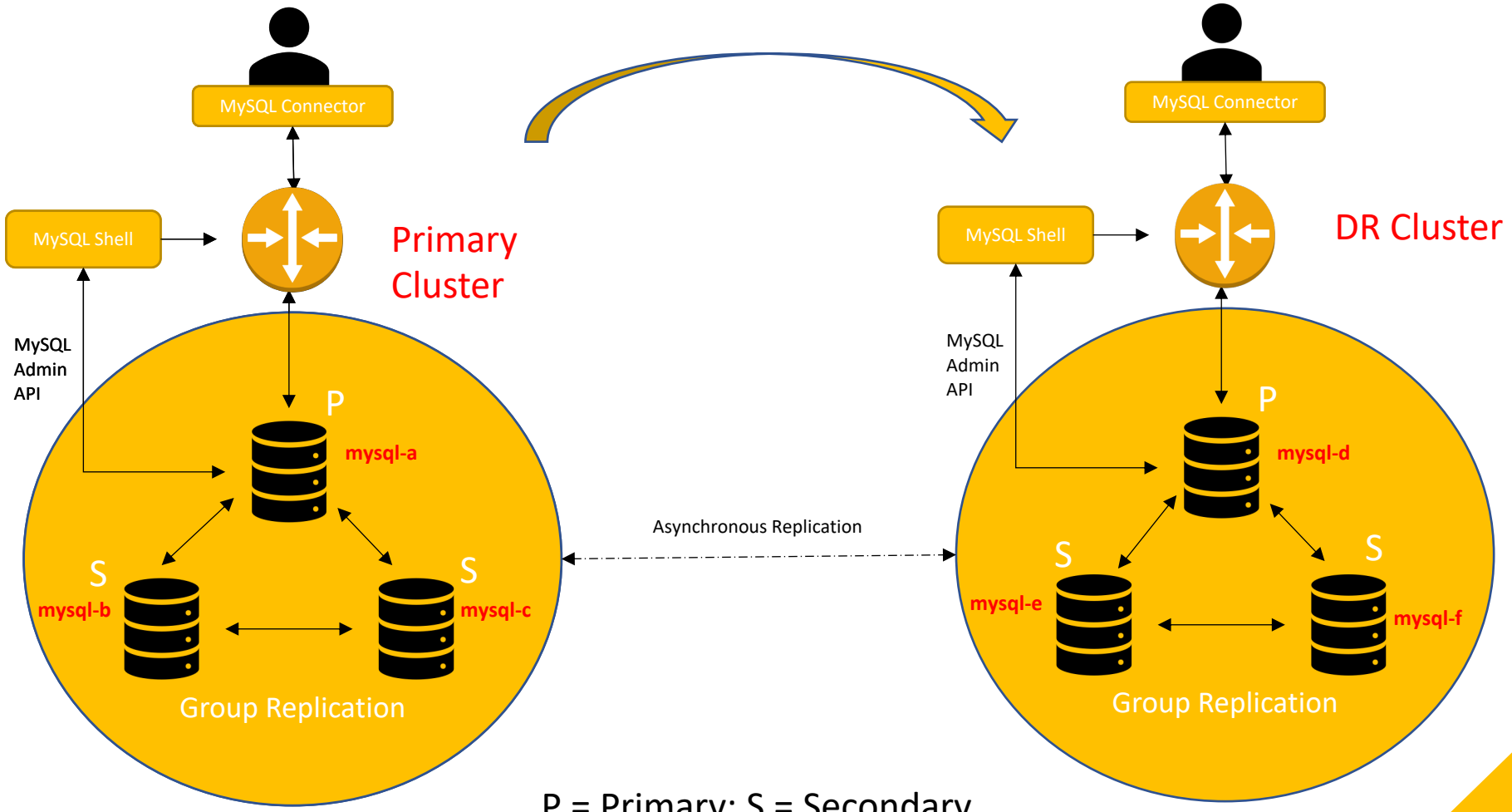
  # /home/routeruser/**start.sh**

- Check router status

  MySQL localhost:33060+ ssl JS > **cluster.listRouters()**

Demo

Scenario 1: Switchover



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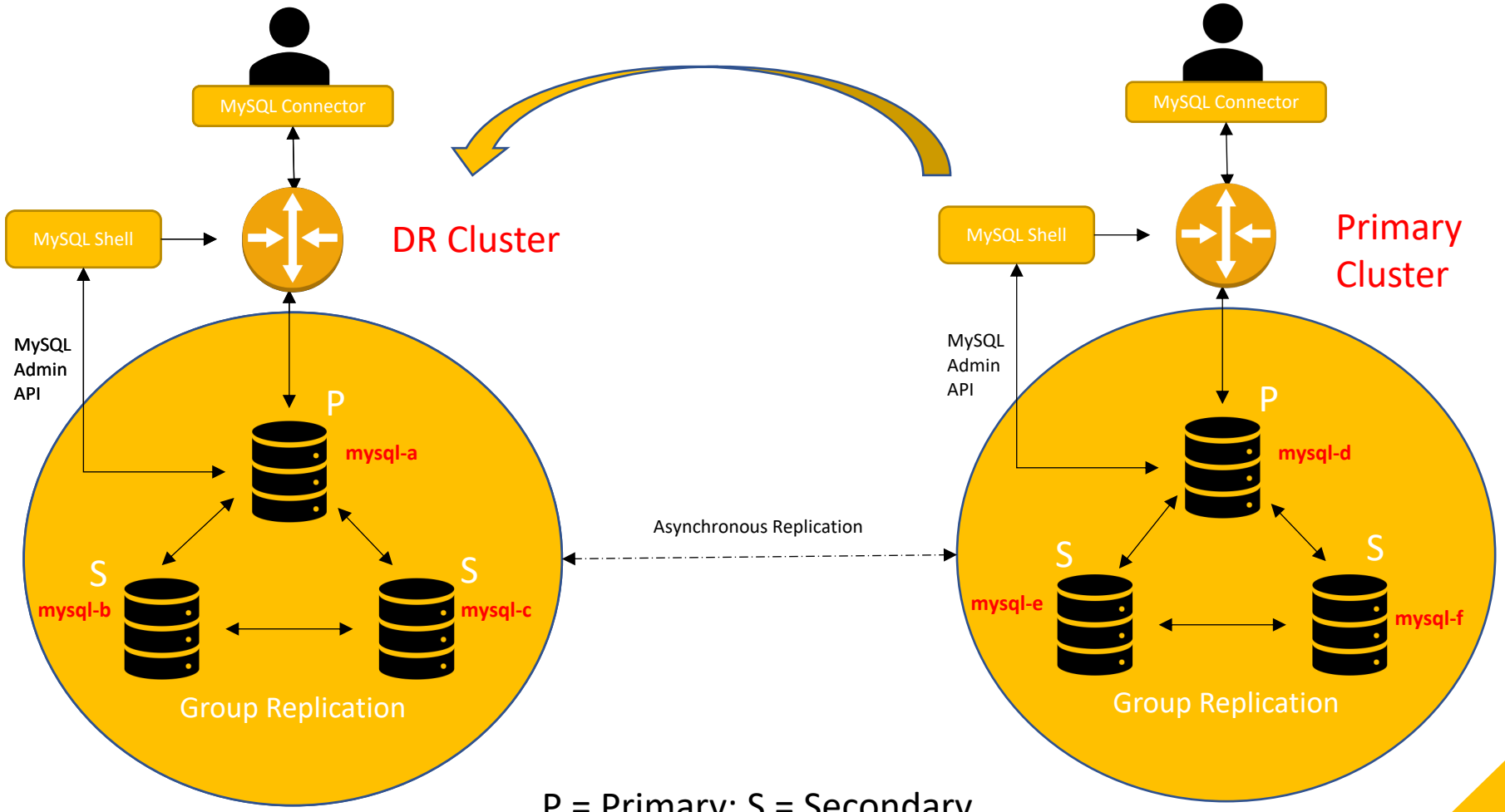
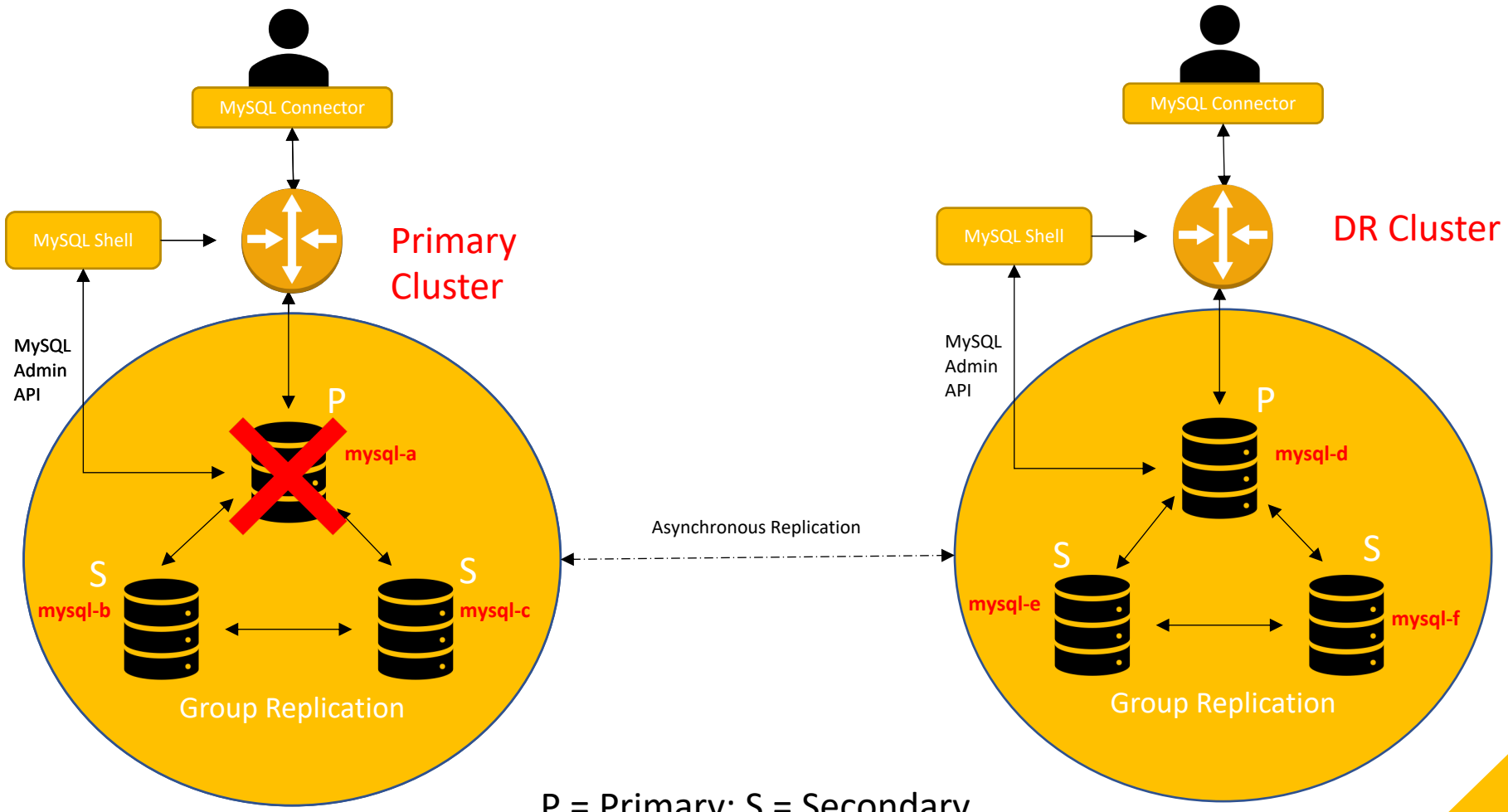
Scenario 1: After Switchover



P = Primary; S = Secondary

Scenario 2: Primary MySQL server in Primary Cluster fails



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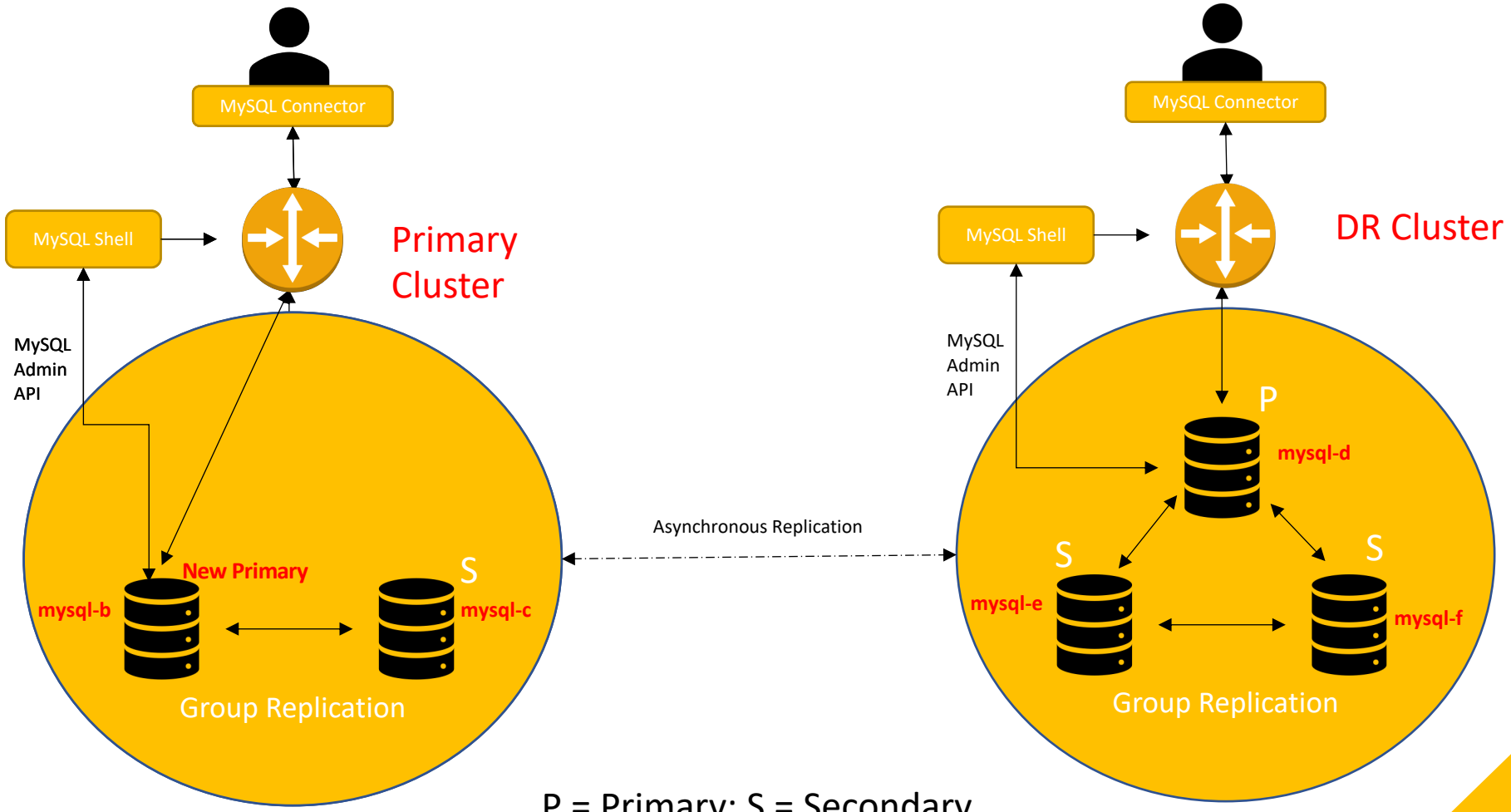
Scenario 2: Primary MySQL server in Primary Cluster fails



P = Primary; S = Secondary

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https://www.linkedin.com/in/asamayam/