#### ORACLE

# 99.99% SLAs with MySQL HA

#### Name

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#### Who Am I?



#### Luis Soares

<ul> <li>Born and raised in Portug</li> <li>Sports: Football, Basket, K</li> <li>Physics, Astronomy</li> <li>Fault-Tolerance, High Ava</li> <li>Read, Travel, Engage Peop</li> <li>Long time MySQLer (15+</li> </ul>	gal Karate, Running, Bikir nilability, Computers ple years)	١g

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#### Agenda

- Background
- MySQL InnoDB Cluster, ReplicaSets and ClusterSets
- MySQL Heatwave Service High Availability
- MySQL Heatwave Service Replication
- MySQL Heatwave Service Scale Out
- Considerations
- Conclusion



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#### Subhead goes here


#### Faults, Failures and Errors: RPO, RTO and SLAs

#### Concepts

RTO: Recovery Time Objective

How long does it take to recover from a single failure

**RPO: Recovery Point Objective** 

- How much data can be lost when a failure occurs
- SLA: Service Level Agreement
- RTO and RPO heavily influence SLAs

#### **Types of Failure**

High Availability:

- Single Server Failure, Network Partition <u>Disaster Recovery</u>:
- Full Region/Network Failure <u>Human Error</u>:
- Little Bobby Tables



#### **Well-Estabilished Foundation**



#### MySQL 3.23.15 (Released in May 2000)

• MySQL Replication is released.

#### Proven Replication Technology

- Logical events describing changes
- Global Transaction Identifiers make any topology change super-easy and automatic
- Full flexibility

#### Not only Replication

- Capture Data Change
- Data Integration
- Distributed Recovery

#### **MySQL Everywhere**

Observe, Automate, Operate

#### Observe

- Instrument, emit
- Learn, understand, diagnose
- Trends and historical data
- Robots first, then Humans

#### Automate

- Balance
- Predict
- Self-heal
- Stabilize

#### Operate

- Plan
- Troubleshoot
- Press buttons, turn nods, flip switches

Observe, Automate, Operate

- MySQL is used everywhere and handles different workload patterns
- The toolset makes it remarkably easier to run it yourself
  - InnoDB Cluster (HA, resilient, fault-tolerant)
  - InnoDB ReplicaSet (Asynchronous)
  - InnoDB ClusterSet (Across clusters, Across regions)

#### MySQL Server

Durability

Storage

Clone

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•

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#### **MySQL Router**

- Application failover
- MySQL Shell
  - Automation •
  - Improved UX
  - Standard recipes



#### **MySQL Group Replication**

- Automation
- Self-healing
- Distributed recovery •



- Auto Membership
- Automated server failover





Observe, Automate, Operate

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  - InnoDB ReplicaSet (Asynchronous)
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#### • The need to run, monitor, operate and manage:

- At scale
- Heterogeneous workloads
- Under transiently unreliable networks
- With multiple versions of the world (split-brain)
- While undergoing maintenance

Observed, Automated, Operated, Managed

- MySQL is used everywhere and handles different workload patterns
- MySQL Heatwave Service
  - HA, resilient, fault-tolerant
  - Replicate between DB Systems (even across regions)
  - Backup and Restore (to a point in time)
- The need to run, monitor, operate and manage:
  - At scale
  - Heterogeneous workloads
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  - With multiple versions of the world (split-brain)
  - While undergoing maintenance

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Name		
mysql-ocw		
The user-friendly name for the DB System. It Description Optional	does not have to be unique.	
User-provided data about the DB System.		
Standalone	High Availability	HeatWave
Single-Instance DB System	Run a DB system with 3 MySQL instances providing automatic failover and zero data loss	DB System that allows you to en- able HeatWave for accelerated query processing, suitable for running both OLTP and OLAP workloads
Create Administrator cr	redentials	
Username (i)		

#### **Heatwave Service**



Observed, Automated, Operated, Managed

- MySQL is used everywhere and handles different workload patterns
- MySQL Heatwave Service
  - HA, resilient, fault-tolerant
  - Replicate between DB Systems (even across regions)
  - Backup and Restore (to a point in time)

#### **MySQL** Server

- Enterprise Edition
- Durability •
- Storage •



#### <u>User Experience</u>

- Console
- REST APIs
- Terraform •
- SDKs



 VCN Compute

</>

REST

- Endpoints
- Workflows
- Redundancy

Block Volume



#### **MySQL Group Replication**

- Automation •
- Self-healing
- Distributed recovery •
- Auto Membership ullet
- Automated server failover •



**Oracle Cloud Infrastructure** 



# MySQL InnoDB Cluster, ReplicaSets and

## ClusterSets

#### Deploy and Run your MySQL High Availability Setup

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#### **MySQL Solutions**

#### One Product: MySQL

- Technologies coming together
  - MySQL Server
    - Async Replication
    - Group Replication
  - MySQL Shell
  - MySQL Router
- Full stack testing

#### Easy to use!

- One client: MySQL Shell
- Transparent Access to Database
   Architecture: MySQL Router

#### User deploys and runs MySQL infrastructure.

• The technology helps.

#### Solution: MySQL InnoDB ReplicaSet



#### 'classic', 'asynchronous' Replication based Solution, fully integrated

- MySQL Shell
- MySQL Router
- MySQL Server
- MySQL Async Replication

- RPO != 0
- RTO = minutes or more (manual failover)

#### **Solution: MySQL InnoDB Cluster**



High Availability solution based on Group Replication, fully integrated

- MySQL Shell
- MySQL Router
  - Application failover
- MySQL Server
  - Group Replication providing:
    - Automatic Server Failover
    - Automatic membership changes
- RPO = 0
- RTO = seconds (automatic failover)

#### Solution: MySQL InnoDB ClusterSet



#### Disaster Tolerance Solution for InnoDB Clusters

- High Availability (Failure within a site)
  - RPO = 0
  - RTO = seconds (automatic failover)
- Disaster Recovery (Site Failure)
  - RPO != 0
  - RTO = minutes or more (manual failover)
- Easy to use: MySQL Shell
- Full integration of MySQL Router

MySQL Shell

MySQ	)L Heatwave	e Service: Hig	h Availability	
High Availat	oility in the MySQL Heatwa	ve Service on Oracle Cloud In	ofrastructure	

#### MySQL Heatwave Service

Observed, Automated, Operated, Managed

#### MySQL Replication powers key features:

- High Availability
- Inbound Replication
- Outbound Replication
- Managed Read Replicas
- Point-in-time Recovery

#### Simple, intuitive, one-click operations:

- Create DB Systems
- Create Read Replica
- Create Inbound Channel

#### The need to run, monitor and operate:

- At scale
- Exposed to **heterogeneous** workloads
- Coping with network **bursts** or packet **delays**
- Dealing with the "world" splitting



• Through maintenance

Create read replica	Q		
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Create must replice Cancel	Standalone Single-instance MySQL DB System	High Availability Run 3-node MySQL DB System providing automatic failover and zero data loss	



#### Features

- Latest releases of MySQL Enterprise Servers.
- Easy provisioning & SLA
- Automation via Terraform, CLI, SDK, API
- One click:
  - High Availability
  - Manual, Automatic Backups
  - Point-in-time Recovery
  - Inbound and Outbound Replication
  - OLAP and OLTP together in one database



#### Database

DB System

#### One-click **DB System** creation



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Create DB System	1	
Name		
mysql-ocw		
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Description Optional		
Standalone	High Availability	HeatWave
Standalone Single-instance DB System	High Availability Run a DB system with 3 MySQL instances providing automatic fallover and zero data loss	HeatWave DB System that allows you to en- able HeatWave for accelerated query processing, suitable for running both OLTP and OLAP workloads
Standalone Single-instance DB System Create Administrator	High Availability Run a DB system with 3 MySQL instances providing automatic failover and zero data loss	HeatWave DB System that allows you to en- able HeatWave for accelerated query processing, suitable for running both OLTP and OLAP workloads

#### **High Availability** Automatic Failover

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Name		
mysql-ocw-ha		
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		running both OLTP and OLAP
		Nonada -
Create Administrator	credentials	
Create Administrator	credentials	
Create Administrator	credentials	
Create Administrator Username () admin	credentials	



#### **High Availability**

Automatic Failover

- SLA 99.99%
- Automatic failover
- Manual switchover
- Rolling upgrades, shape and config changes
  - Just a **few seconds** impact



# MySQL Heatwave Service: Replication

#### Multi-cloud and On-premise Integration

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#### **Inbound and Outbound Replication**

Hybrid Deployments and Migrations

Hybrid deployments

- On-premise and multi-cloud
- OCI as your main site
- OCI as your Disaster Recovery site
- OCI for capacity bursting
- HeatWave for Analytics

#### Live Migrations

• Minimize downtime

**Cross-region replication** 

• DB System to DB System



#### **Inbound and Outbound Replication**

Disaster Recovery in Hybrid Environments



- Use OCI as DR or vice-versa
- Leverage MySQL HeatWave Service in OCI
- MySQL HeatWave Service Channels to do inbound replication, based on built-in asynchronous replication



MySQL Heatwave Service: Scale Out	

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#### **Managed Read Replicas**

Grow and Shrink Read Capacity Seamlessly

High performance by scaling your reads. Offload RW endpoint minimize gray failures.

- A single click creates a Read Replica
  - Provision
  - Launch
  - Setup Replication
  - Monitor and Manage
- Read Replicas are associated with a DB System
  - RO endpoints in the DB System
  - Up to 18 max per DB System
  - Requires a shape of 4 OCPUs or larger
  - CLI, SDK and Terraform support

(i) Create a rea	d replica for the DB system dbsystem
Name	
mysqlreadreplica20	230130171946
Description Optional	
Write a description	
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Deletion plan	and and a set of the s
Hide advanced of     Deletion plan     Delete protect     Protects the read     system, deselect	Tags ed replica and its associated DB system against delete operations. By default, read replicas and DB systems are not delete protected. If you want to delete either the read replica or its associate the option.
Hide advanced of     Deletion plan     Delete protect     Protects the read     system, deselect	Tags ed replica and its associated DB system against delete operations. By default, read replicas and DB systems are not delete protected. If you want to delete either the read replica or its associate the option.
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#### **Load Balancer**

Use Your Replicas Efficiently

When using Read Replicas a Load Balancer Endpoint is automatically provisioned in your DB System.

- Managed by the service
- Materializes as a Read-Only endpoint
- Round robins traffic across Read Replicas
- Manages Read Replica backends automatically

Endpoints								
							Q Search	
Endpoint	State	Modes	Туре	Hostname	Address	MySQL Port	MySQL X Protocol Port	
Read replica load balancer	Active	READ	Load balancer	-	100.101.74.228	3306	33060	:
mysqlreadreplica20230130171946	Active	READ	Read replica	-	100.101.74.146	3306	33060	:
DB system primary	Active	READ, WRITE	Primary DB system	-	100.101.74.80	3306	33060	:
							Showing 3 Items	< 1 of 1 >

# Considerations

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#### **Database User Advices**

Some tips...

- Know the **workload**.
  - Peaks times, sustained load, anticipate problems.
- Do capacity planning.
  - Avoid triggering your own gray failures due to constrained resources.
- Make applications aware of failures.
  - Utilize application retry logic for network problems and high availability
- Understand the technology limits.
  - Read and understand the limits of the technology.
  - Make sure your application does not run into the documented limits.
- **Embrace** the technology.
  - Observe best practices and it will just work.
  - In the rare cases it does not, seek help, work with the experts to either mitigate or fix the problem.

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#### Conclusion

- Solutions for everyone, everywhere:
  - On-prem
  - Cloud
  - Hybrid Deployments
- On-Premises, user managed, High Availability Solutions:
  - InnoDB Replica Sets
  - InnoDB Cluster
  - InnoDB Cluster Sets
- Cloud, Managed, Solution with well defined SLAs:
  - MySQL Heatwave Service



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