ORACLE

Transaction Processing with MySQL HeatWave

Sriram Vrinda

Product Management – MySQL HeatWave

Agenda

- Introduction
- MySQL HeatWave: Fully Automated Database as a Service
- OLTP with MySQL HeatWave
  - Scalability
  - Data protection and durability
  - High Availability
  - Reliability
  - Security
  - Observability
- Summary

Introduction

Managing data can be complicated and expensive

High cost and risk to run and maintain

Reduce costs and risks

Barriers to innovation

Simplify and accelerate time to value

Is there a better way to meet business requirements?

High cost and risk to run and maintain

- Cost to upgrade and secure
- Cost to run and optimize
- Multiple database vendors and security models

Reduce costs and risks

- Automated operations without manual interventions
- Pay for what the business needs
- Secure and unified data architecture

Barriers to innovation

- Disparate systems for transactions, analytics, and ML slowing down modern app dev
- Time spent integrating data and building apps
- Highly distributed data and disconnected clouds

Simplify and accelerate time to value

- Ability to support multiple workload types
- Productive low-code/no-code development tools
- Integrated data eco-system and multi-cloud support

How should databases be managed in the future?

What if your cloud database could do the following:

- Make it **trivial** to patch and upgrade thousands of databases

- **Remove** need to track versions + one-off fixes for every database

- **Automatically** deploy critical security bug fixes into production databases as soon as they are available

- **Simplify** planning of hardware capacity for workloads to meet all future business requirements

- **Simplify** maintaining and testing disaster-recovery infrastructure

- Fully **automate** processes for database lifecycle operations

- Provide **24x7 support** for every database availability issue

- **Automatically** file service requests + gather all diagnostics information for every database issue

- Significantly **reduce** operational and licensing costs

MySQL HeatWave

Fully Automated MySQL Database as a Service
- Eliminate system and database administration with a fully managed database service
- Customize operational policies to meet governance requirements

Complete automation and management
- Automatically configure, secure, update, tune, and scale databases

Workload optimizations
- Unified platform for transactions and analytics with built-in ML

Efficient database lifecycle management
- Eliminate infrastructure management by offloading it to Oracle
- Increase administrator productivity with user-controlled cloud automation
  - Web and API-driven lifecycle operations
  - Provisioning, updates, backups, etc.

Built-in Observability
- Database management service for expanded database metrics and query performance diagnostics

OLTP with MySQL HeatWave

MySQL HeatWave: fully managed database service
100% developed, managed, and supported by Oracle

	Automation	MySQL HeatWave
Database	High Availability	✅
	Read Replicas	✅
	Backup	✅
	Query Acceleration	✅
	AutoPilot	✅
	AutoML	✅
	Security Patch & Upgrade	✅
	Provision & Configure	✅
OS	OS Security Patch & Upgrade	✅
	OS Installation	✅
Server	Hardware Provisioning & Maintenance	✅
Storage	Storage Provisioning & Maintenance	✅
Data Center	Rack & Space	✅
	Power, HVAC, Networking	✅

OLTP with MySQL HeatWave
Server side capabilities

InnoDB transactional storage engine

ACID compliant

Data integrity through foreign key constraints

Stored Procedures to improve developer productivity.

Triggers to enforce complex business rules at the database level.

Views to ensure sensitive information is not compromised.

SQL Optimizer

Cost-based optimizer

Common Table Expressions also known as WITH queries

Window Functions to reduce code complexity and help developers be more productive

Develop and run modern apps

Document Store for developing both SQL and NoSQL document applications

Native JSON data type for managing unstructured data

Enhanced GIS to support geography and Spatial Reference Systems (SRS).

Ability to manage by exception

OpenSSL as the default TLS/SSL library in MySQL

Performance Schema with queries that are up to 30x faster.

Invisible Indexes to better manage software upgrades and database changes for applications that run 24x7

MySQL HeatWave Components

MySQL DB System: Interface to automate the management of tasks such as provisioning, backup and restore, monitoring, etc.

- A compute instance (with resources defined by the associated shape)
  - Two default configurations for most of the shapes:
    - Standalone: Optimized for standalone DB systems and read replicas
    - HA: Optimized for highly available DB systems
  - Oracle Linux Operating System
  - MySQL Server Enterprise Edition version 8.0 or higher
- Choose from two categories of shapes: ECPU and OCPU
- Virtual Network Interface Card (VNIC) that attaches the DB system to a subnet of the Virtual Cloud Network (VCN).
- Network-attached block storage
  - Uses the OCI Block Volume service Higher Performance option over iscsi
  - Provides a linear performance scale of 75 IOPS/GB up to a maximum of 50,000 IOPS per volume
  - Throughput scales at the rate 600 KB/s/GB up to a maximum of 680 MB/s per volume

MySQL DB System abstraction

Client Applications

MySQL DB System

Read/Write Endpoint

→ Read and Write
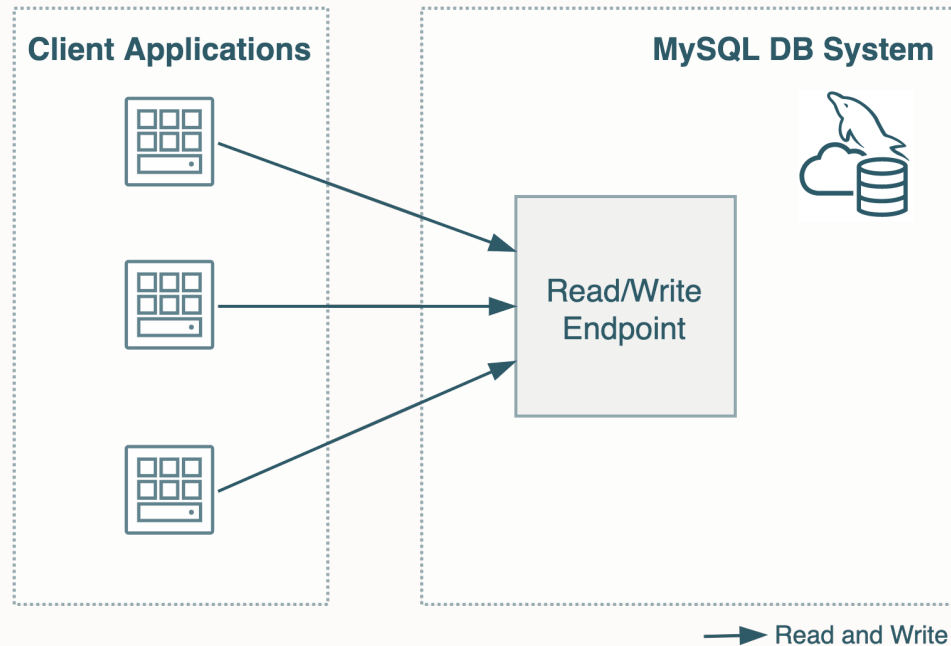
Choose from two categories of shapes: ECPU and OCPU

- Connect effortlessly via **endpoints**, bypassing architectural complexities.
- Use the best **architecture** for your needs, optimizing key non-functional requirements without application changes.
- Embrace **tomorrow's demands**, ensuring adaptability, performance, security, scalability, and cost-efficiency.

MySQL HeatWave Scalability

MySQL HeatWave Scalability
## Read replicas
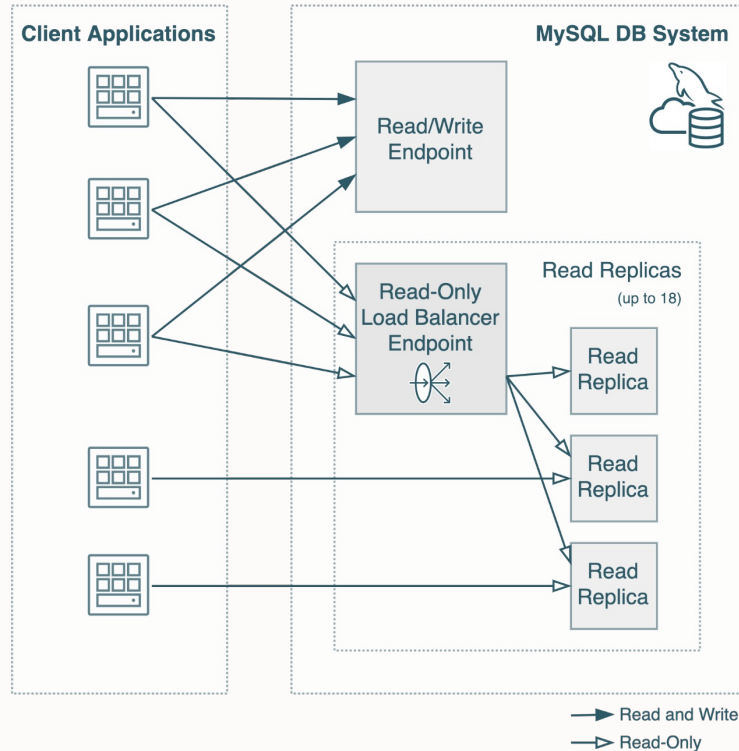
- Increase capacity for read-intensive workloads
- Add and remove Read Replicas for horizontal read elasticity
- Easy to deploy and maintain
- You can create a maximum of 18 read replicas of a DB system
- Built-in Load Balancer for the read-only endpoint
- 5-Tuple Hash Load Balancing Policy: source IP and port, destination IP and port, protocol
- HA Cluster continues reliable and ready for switchover or failover

MySQL HeatWave Scalability
Cross Region Read replicas
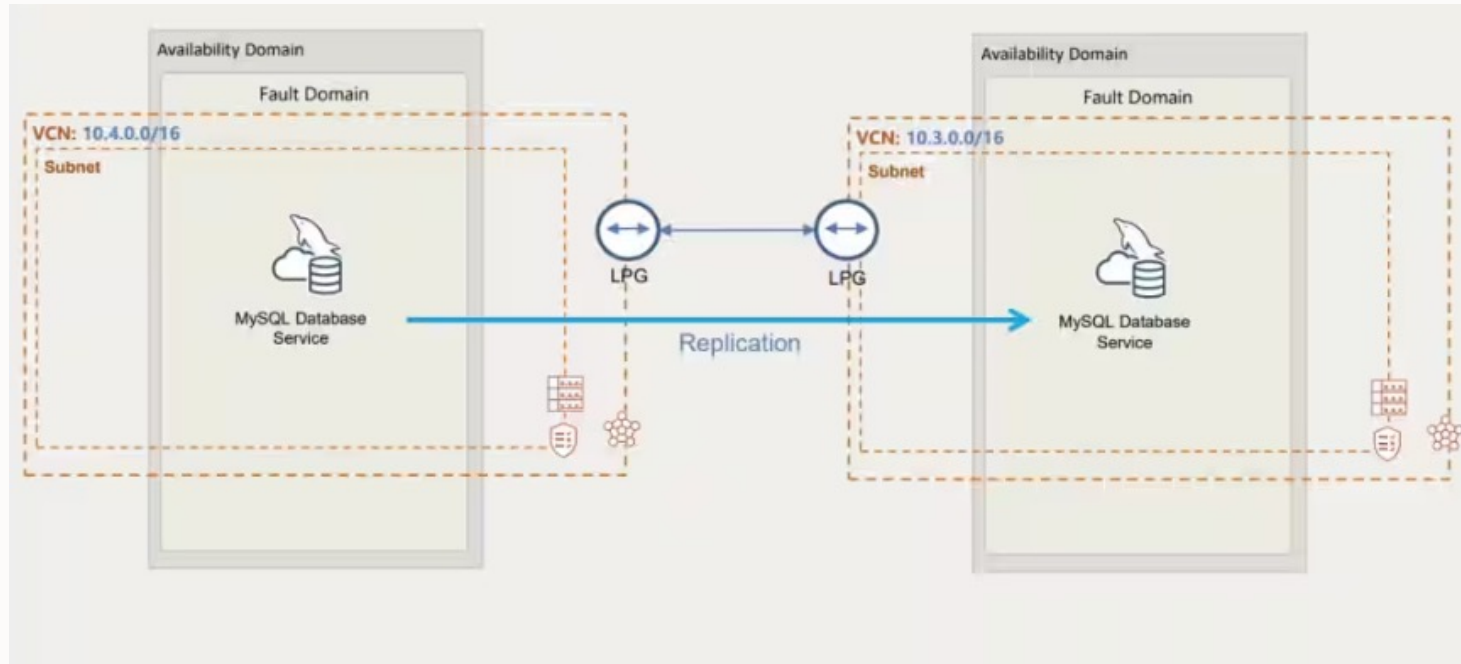
- Hybrid deployments
- Disaster Recovery
- Cross-region deployments
  - DB system to DB system

- Outbound replication can be used to copy transactions from a DB system to another OCI region
- This is not a managed functionality, you are responsible for configuring and maintaining the channel

MySQL HeatWave data protection and durability

MySQL HeatWave data protection and durability
Backups

Automatic backup:

Created automatically at a time selected while creating the DB system.

Define the retention period between 1 and 35 days

- Default retention period is 7 days

For a high availability DB system, the automatic backups are created on the primary instance

Manual backup:

Create a manual backup by an action in the Console, or a request through the REST API

Retain the manual backup for a minimum of 1 day and a maximum of 365 days

Operator backup:

MySQL Support team creates this backup to assist in investigating potential issues with your service.

MySQL HeatWave data protection and durability

Point-In-Time Recovery

Restore data from a DB system to a new DB system at the latest available point-in-time or a specific point-in-time

Pre-requisites

- Enable automatic backups and enable point-in-time recovery on the backup plan of the DB system

MySQL HeatWave Service takes an initial full backup (Backup type: Full, Creation Type: automatic) and incremental backups thereafter

DB system operations such as stop, start, restart, or upgrade does not impact the point-in-time recovery operation

Provides Recovery Point Objective (RPO) of approximately five minutes for an active DB system, while the daily backup provides you a RPO of 24 hours

Cross-Region Backup Copy
Coming soon!

B

ACTIVE

TestDbSystemBackup_IAD

Restore to new DB system   Edit   Move resource   Copy to another region   More actions ▾

Backup information   Tags

OCID: ...vkydazwucq Show Copy

Description: DB system backup in IAD region.

Compartment: mysqldbaastest (root)/canary/compute

Shape: VM.Standard.E2.1

MySQL version: 8.3.0 - Innovation

Retention days: 1 *(Thu, Feb 8, 2024, 10:27:39 UTC)*

State: Active

Backup type: Full backup

Creation type: Manual

Backup size: 1 GB

Storage size: 50 GB ⓘ

Created: Wed, Feb 7, 2024, 10:27:39 UTC

Last updated: Wed, Feb 7, 2024, 10:29:32 UTC

Resources

DB system

Work requests

DB system

General information

Name: TestDbSystem_IAD

Backup

Automatic backups: Disabled

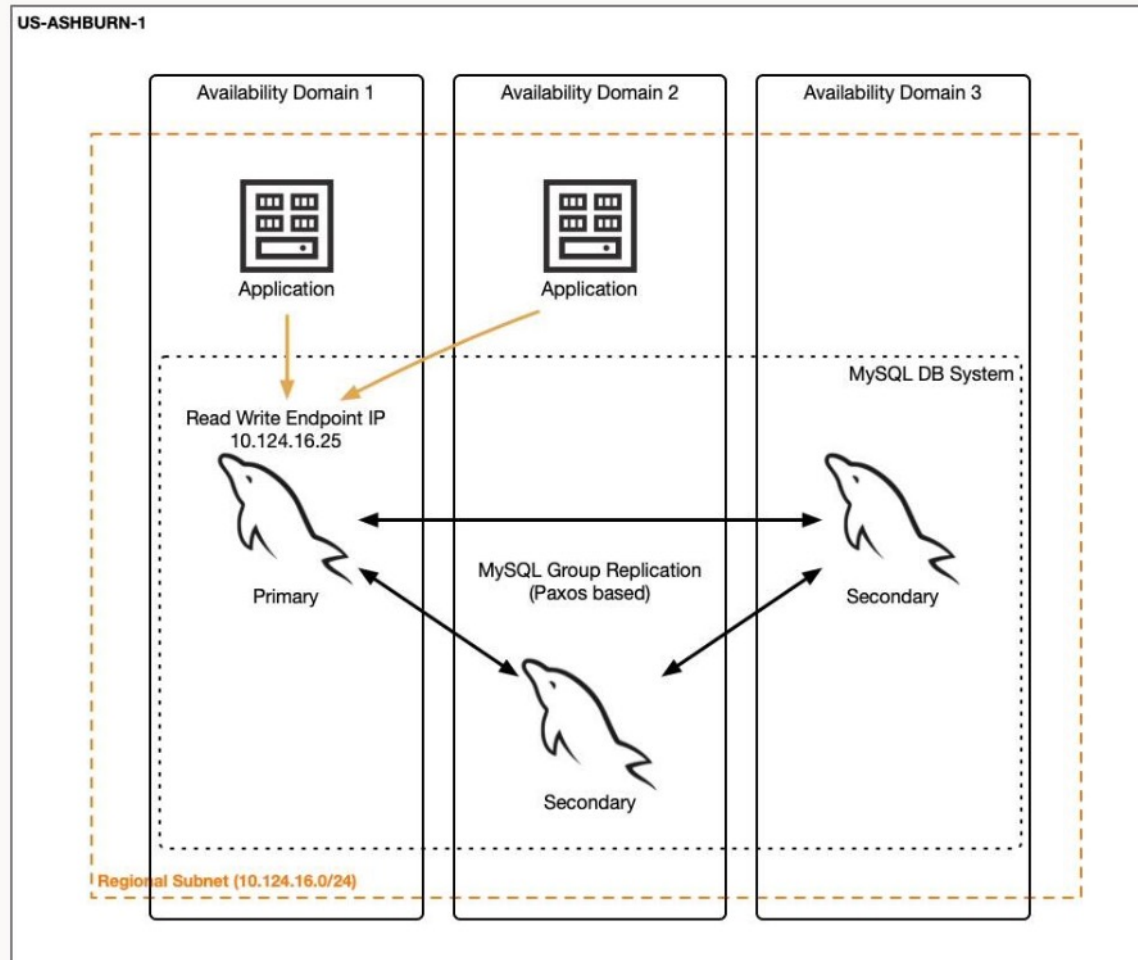# MySQL HeatWave High Availability

MySQL HeatWave High Availability
Higher uptime and zero data loss tolerance
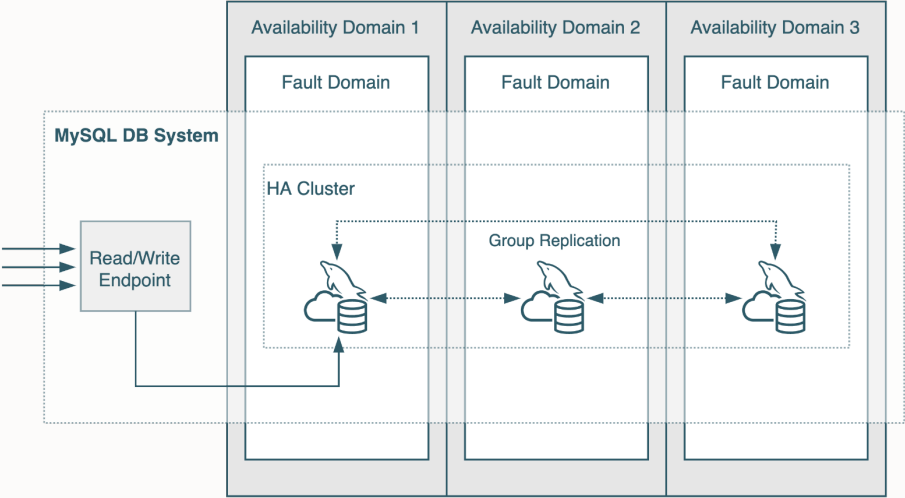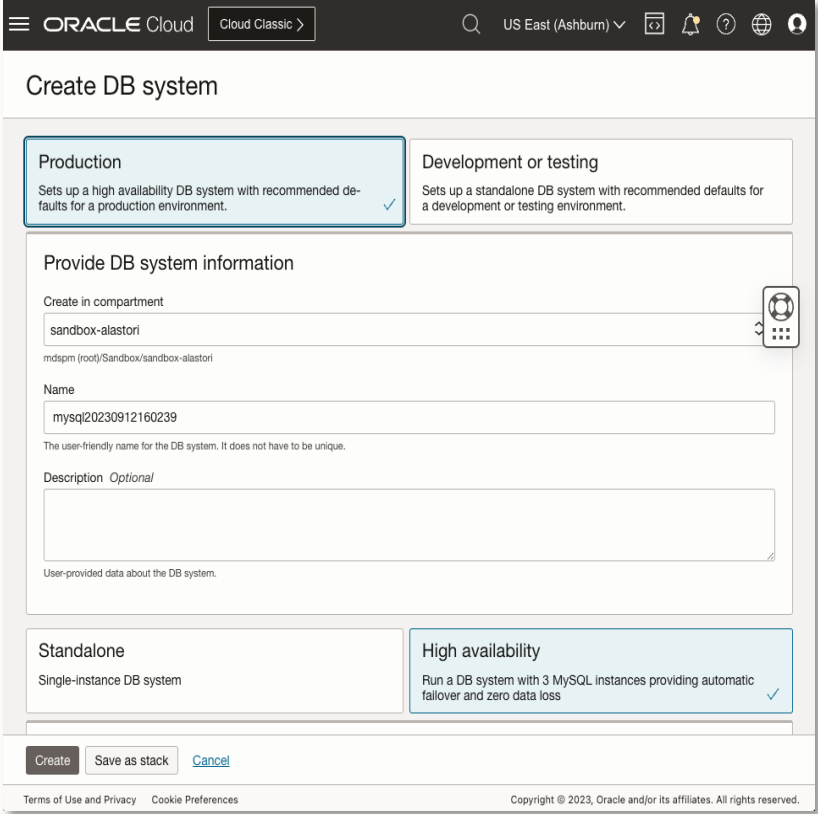
MySQL HeatWave High Availability
Higher uptime and zero data loss tolerance

A high availability DB system is made up of three MySQL instances: a primary instance and two secondary instances

Provisioned across different availability or fault domains

The primary instance functions as a read/write endpoint

Automatic or Manual Promotion of a Secondary Instance

MySQL HeatWave High Availability
Higher uptime and zero data loss tolerance

Online change of shape and configuration of a high availability DB system and read replicas with minimal downtime
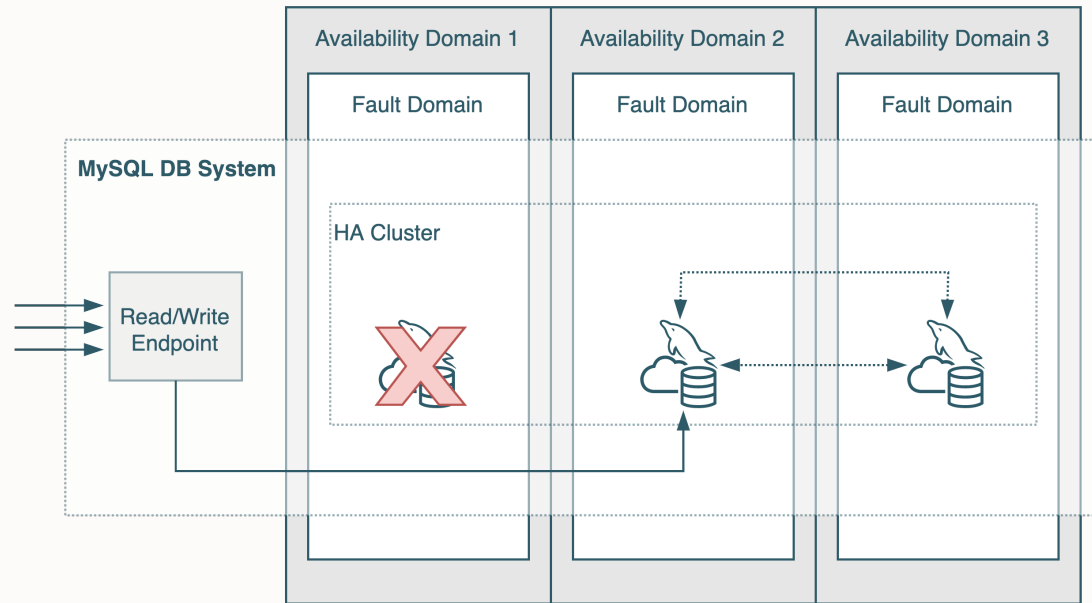
- SLA 99.99%

- Automatic failover

- Manual switchover

- Rolling upgrades during maintenance

  - Less than 30 seconds impact
  - MySQL version upgrades and OS security patches

High Availability RTO/RPO Matrix

Recovery Time (RTO) and Potential Data Loss (RPO) service SLO

Failure and Maintenance Events	Downtime (RTO)	Potential Data Loss (RPO)
Periodic software and hardware maintenance updates	Seconds to minutes	Zero
Localized, per instance events, including: • Storage connectivity failures • Network connectivity failures • Full database failures	Minutes	Zero
• Availability or fault domain failures (depending on high availability type) • Complete storage failures	Minutes	Zero

MySQL HeatWave supports crash recovery, which ensures durability and enables data recovery in the event of an unexpected server exit.

MySQL HeatWave Reliability

MySQL HeatWave Reliability

Maximize reliability with automated upgrades and patching

1 **No customer actions required**

No need to schedule patches, track patch contents or request one-off patches

2 **Minimal downtime**

Existing connections to the primary are closed and no new connections are permitted.

3 **Always up-to-date security fixes**

Frequent patches to meet compliance requirements

4 **Full-stack patching**

Includes database and all cloud infrastructure

5 **Continuous delivery of new cloud features**

Multiple new features available every month

ORACLE CLOUD
Infrastructure

MySQL™
HeatWave

Example: zero-effort, zero-downtime automatic hardware upgrades

If you manage your own database servers:

1. Procure new hardware and install in data center
2. Test and validate hardware and networking
3. Install database software and configure database environment
4. Validate sizing and performance
5. Create and test migration strategy
6. Schedule and execute production migration (with downtime?)

If you run MySQL HeatWave:

Zero-effort hardware upgrades: Hardware refreshes occur transparently during regularly scheduled maintenance windows

- No hardware planning or testing
- No database downtime
- No extra cost

Maintenance

Maintenance window start: Monday 06:55 Edit

MySQL HeatWave Security

MySQL HeatWave Security

Simplified access management

Sign-On with flexible authentication options: support for federated, social, and delegated sign-on.

User Assessment

Assesses the database and highlights accounts that could pose a risk.

Activity Auditing

Audit service automatically records calls to MySQL HeatWave API endpoints as log events.

Simplified certificate management (BYOC)

Easily create, deploy, and manage Secure Sockets Layer/Transport Layer Security (SSL/TLS) certificates available in Oracle Cloud.

Connection control

Remove brute force attacks attempting to guess MySQL login credentials

Advanced security

Built-in, server-side features to implement additional security measures

- **Asymmetric encryption with key generation and digital signatures**: to increase the protection of confidential data using both public and private keys and implement digital signatures to confirm the identity of people signing documents.

- **Data masking and deidentification**: to help protect private data against external attacks and malicious employees.

- **Database firewall**: protecting against database-specific attacks, such as SQL injections.

- **Compliance – attestations & certifications:**
  - Global: PCI DSS, SOC 1 2 3, CSA STAR, ISO/IEC 27001/27017/27018/27701, etc.
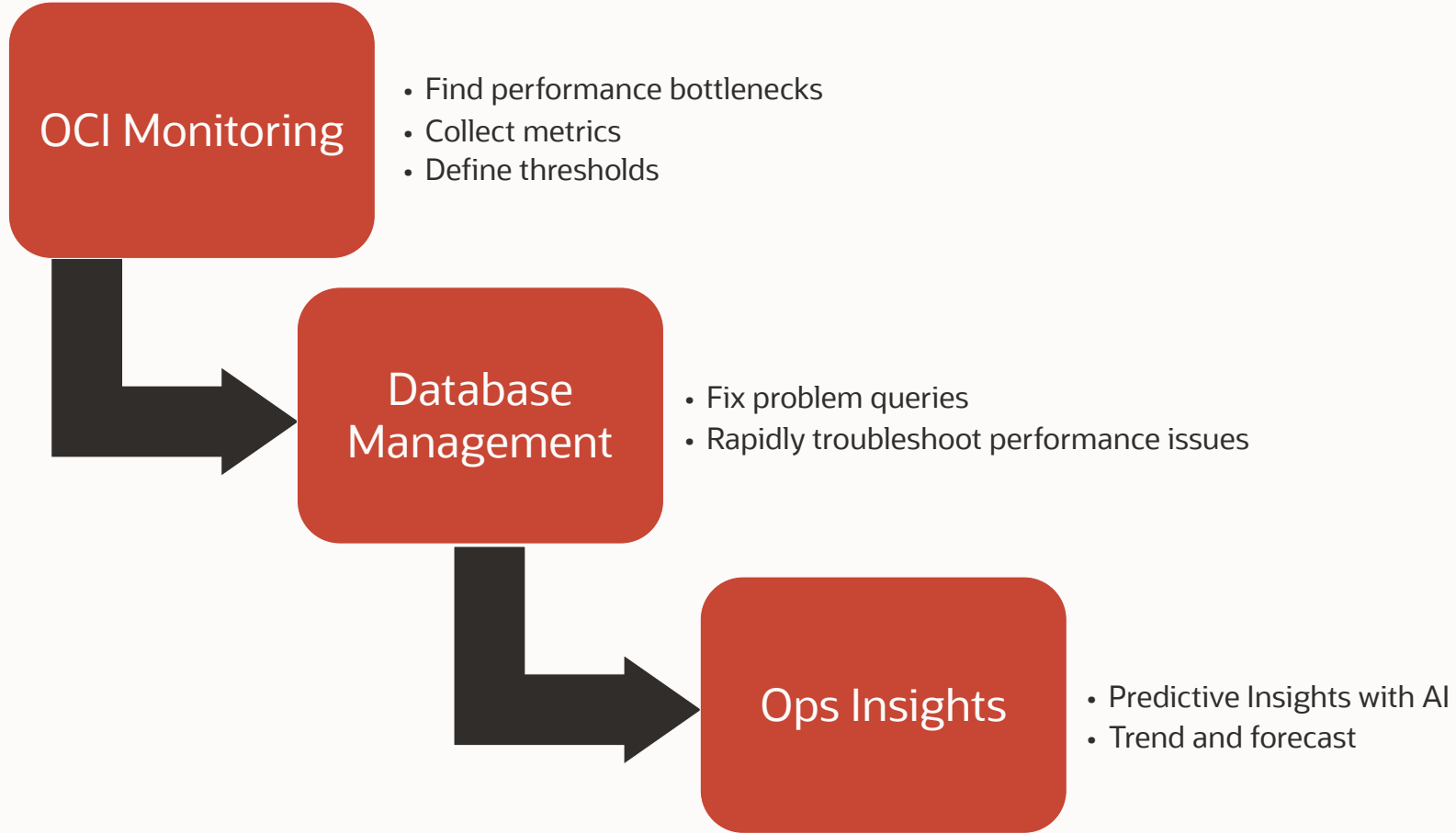 - Regional: HIPAA, CSF, HITRUST, EU CoC, ENS, C5, MTCS, IRAP, ISMS, MeitY, etc.

MySQL HeatWave Observability

MySQL HeatWave Observability
OCI monitoring and Database Management

OCI Monitoring

- Find performance bottlenecks
- Collect metrics
- Define thresholds

Database Management

- Fix problem queries
- Rapidly troubleshoot performance issues

Ops Insights

- Predictive Insights with AI
- Trend and forecast

MySQL Autopilot indexing (Coming soon)
Recommends secondary indexes for OLTP workloads

Queries DMLs idx

MySQL
Autopilot
Data-driven
Query-driven
ML automation

Advisor · System setup · Data load · Query execution · Failure handling · Automated

CREATE /
DROP
Indexes

idx

Rows
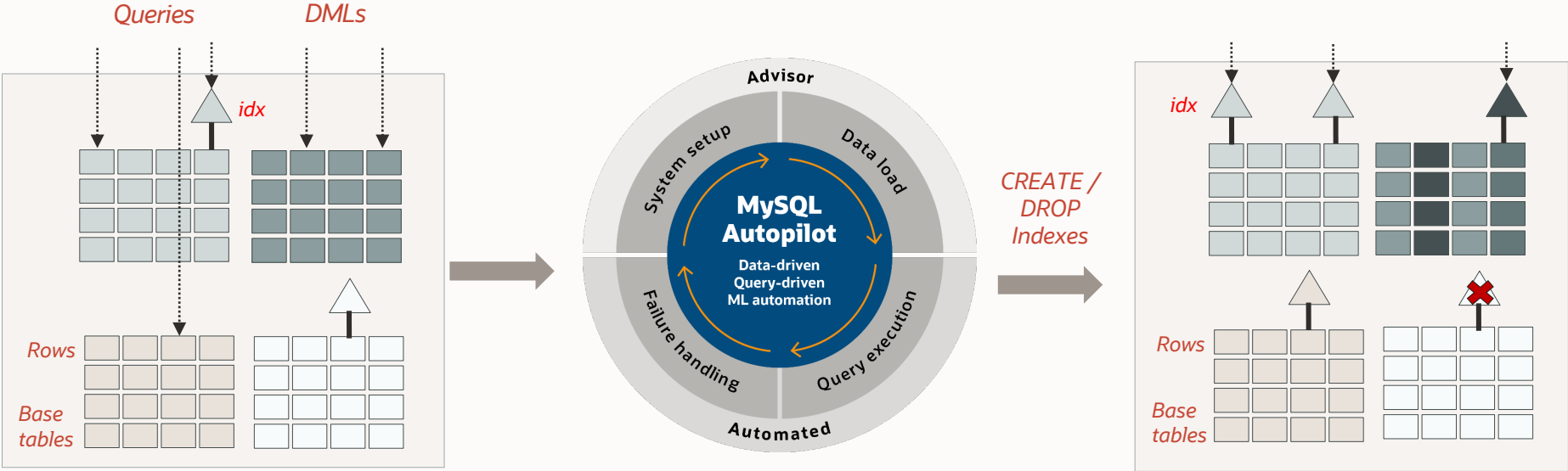
Base
tables

Autopilot Indexing (Coming soon)
ML automation with MySQL HeatWave

Features

- ML-based feature designed to help optimize database systems for better cost and performance

- Considers both query and DML performance

- Recommends CREATE and DROP of indexes

- Generates DDLs for index creation/drop

- Provides performance prediction

- Provides storage prediction

- Continuous learning and adapting

Benefits

- DBAs no longer need to manually identify the secondary indexes for the database workload.

- Considers both the query performance and the cost of maintaining the indexes

- Predicts expected improvement without creating the indexes

- Provides explanation for the recommendations

- Oriented by performance objectives: throughput, latency, storage

Maximizing reliability with automated proactive monitoring
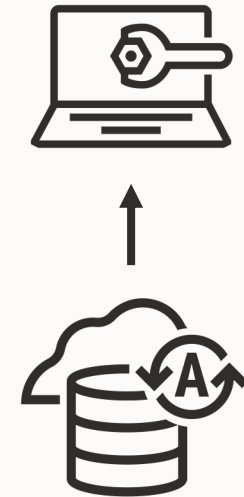MySQL HeatWave service finds the problems before you do

Oracle Cloud Operations uses continuous monitoring for each database:
8000+ metrics and 1500+ alarms
- Much broader than any on-premises customer
- Consolidated monitoring of entire stack: infrastructure, load balancer, connection manager, database

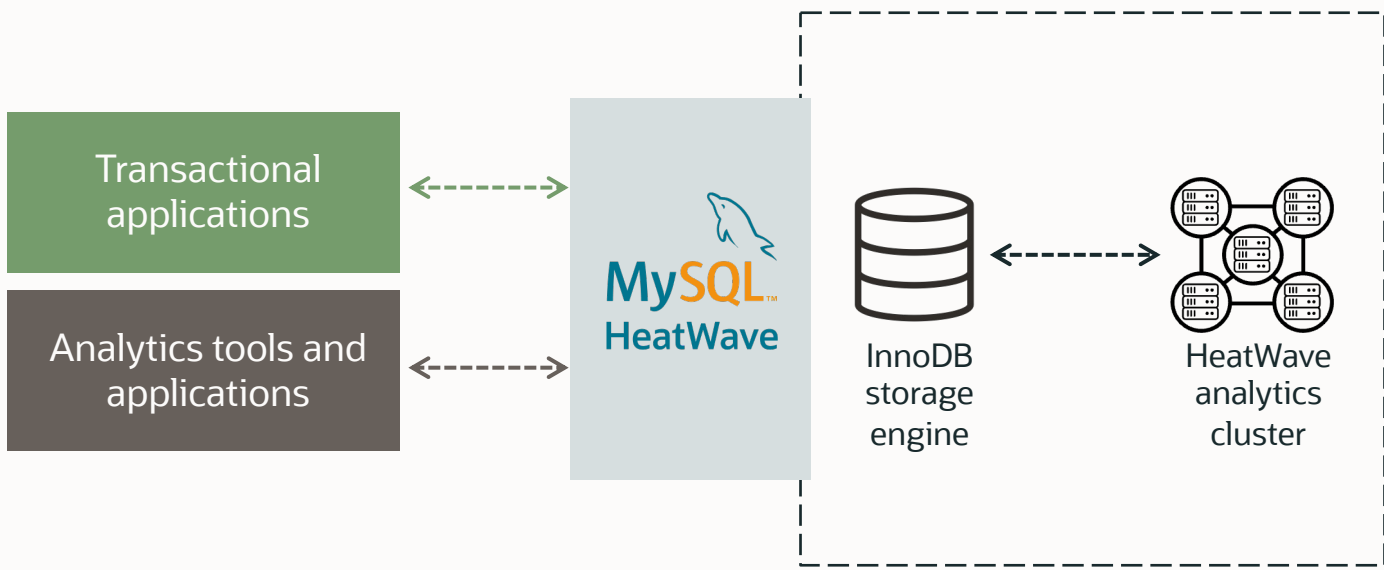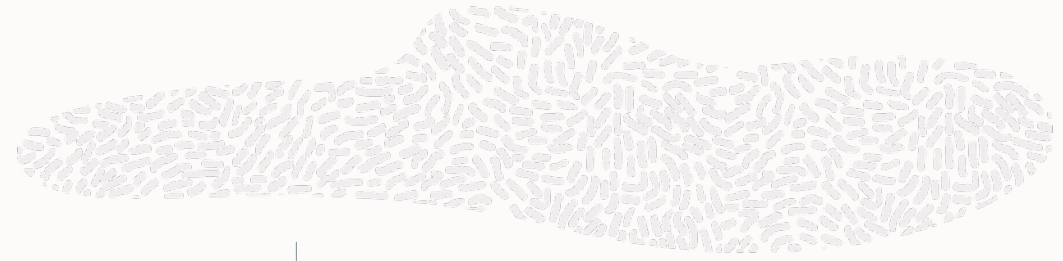**Automatic service requests** are generated for each deviation
- Immediate investigation and resolution by cloud ops
- Root cause analysis for every issue
- Zero customer actions required

Summary

One database is better than two

Transactional applications

Analytics tools and applications

MySQL HeatWave

InnoDB storage engine

HeatWave analytics cluster

One service for OTLP & OLAP

No ETL duplication

Unmatched performance, at a fraction of the cost

Real-time analytics

Improved security

Applications work without changes

1>2 with MySQL HeatWave

MySQL HeatWave

Fully-managed, cloud native, Database as a Service

Reduce costs and risks

Auto-patching, auto-backups, auto-configuration

Elastic auto-scale with enterprise business continuity

Always-on security and compliance

Simplify and accelerate time to value

Unified platform for transactions and analytics with built-in ML

Built-in low-code/no-code development tools

Deep integration with multi-cloud ecosystem