Database Services

Foreword

- After learning basic compute, storage, and networking services on Huawei Cloud, let's move on to database services.

Objectives

- After completing this lesson, you will be able to understand:

  ▫ Basic database concepts

  ▫ Characteristics of Huawei Cloud relational and non-relational database services

  ▫ Differences between relational and non-relational databases

  ▫ How to use database services to set up a service architecture

  ▫ How to use Data Admin Service (DAS)

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1. **Introduction to Database Services**

2. Relational Database Services

3. Non-Relational Database Services

4. Data Admin Service (DAS)

Besides OBS, EVS, and SFS, are there any other services that can be used to store data?

Object Storage Service
OBS
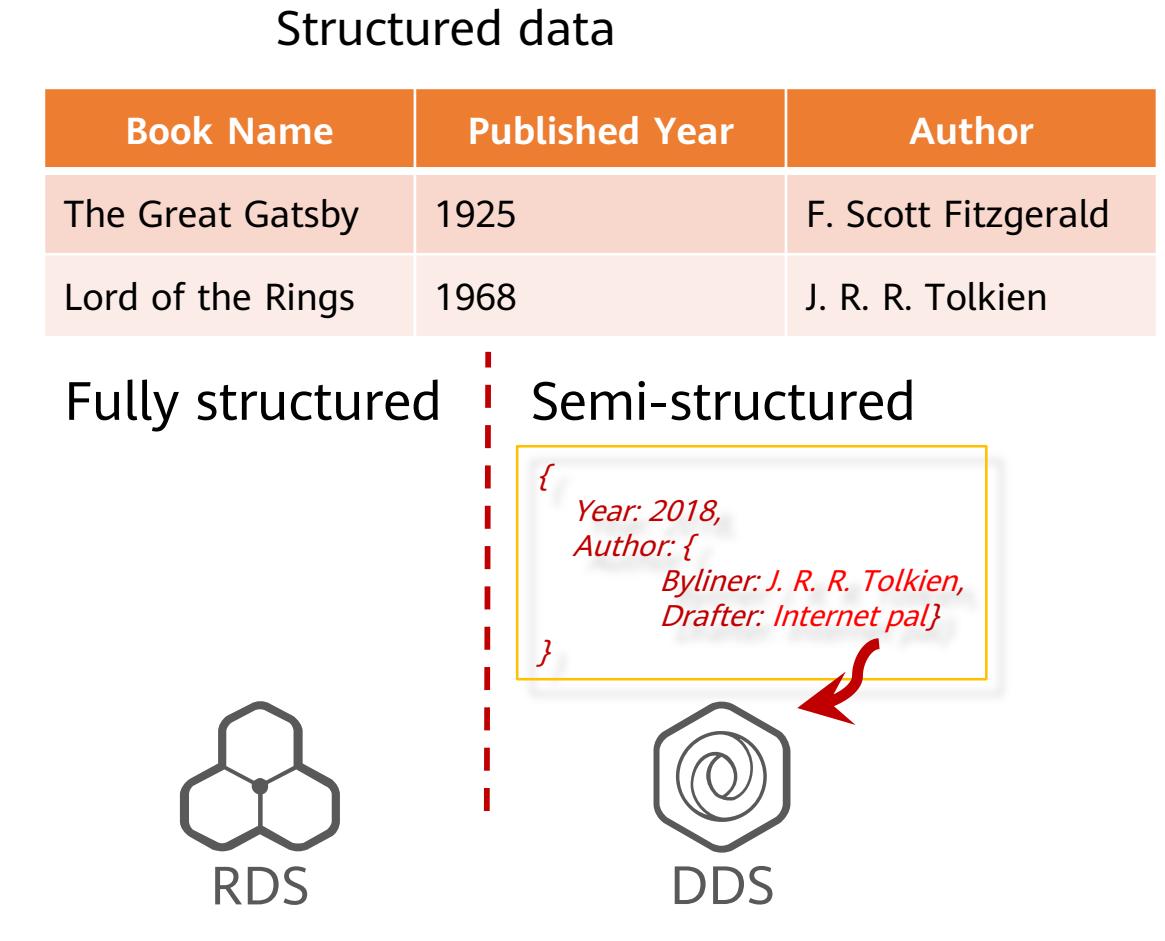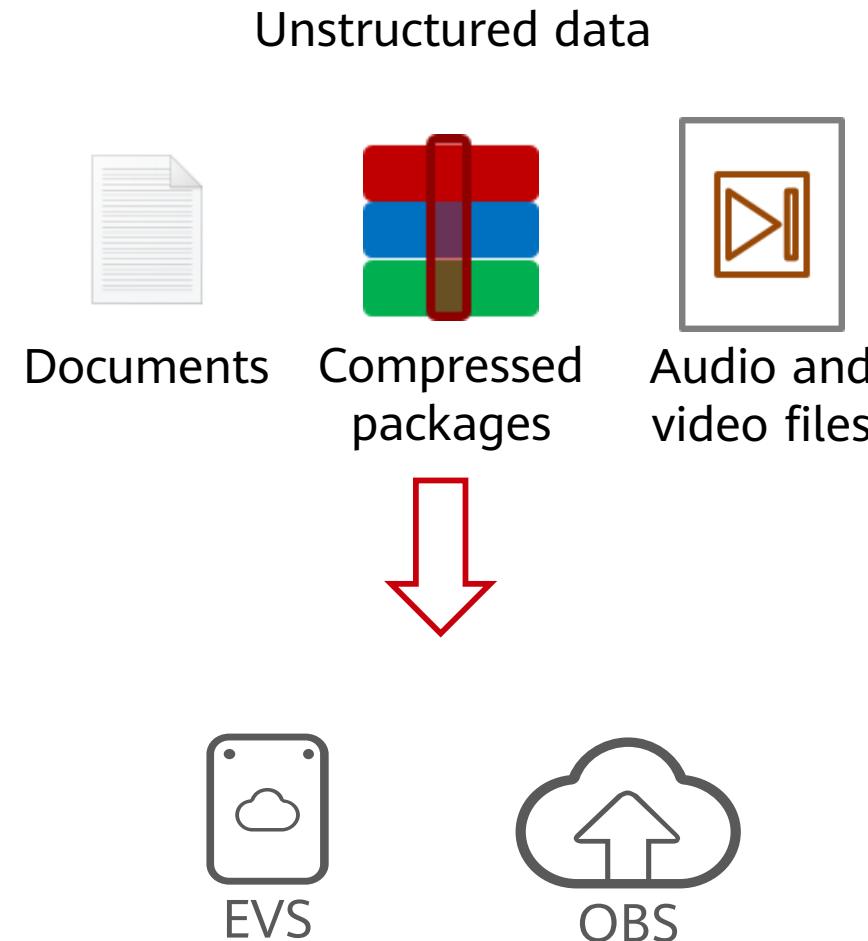
Elastic Volume Service
EVS

Scalable File Service
SFS

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Different Data Types

Unstructured data

Documents

Compressed packages

Audio and video files

EVS

OBS

Structured data

Book Name	Published Year	Author
The Great Gatsby	1925	F. Scott Fitzgerald
Lord of the Rings	1968	J. R. R. Tolkien

Fully structured

Semi-structured

```
{
        Year: 2018,
        Author: {
                Byliner: J. R. R. Tolkien,
                Drafter: Internet pal}
}
```


RDS

DDS

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Relational Database vs Non-Relational Database

	Relational Database	Non-Relational Database
Application model	Traditional applications require databases that can process transactions, complex queries, and joint queries, and maintain data integrity.	New Internet applications require databases that can store massive data and handle a large number of concurrent requests.
Access performance	10 ms-level Depending on query complexity and the amount of stored data	ms-level Irrelevant to the amount of stored data
Data types	Fully structured	Semi-structured (key-value pairs and documents)
Scalability	Vertical scaling Horizontal scaling: primary instance + read replicas	Vertical scaling Horizontal scaling: cluster + read replicas
Data consistency	Strong consistency	Depending on database configurations Strong consistency or eventual consistency
Storage space limit	Depending on the DB engine	Depending on the upper limit of DB nodes in different scaling modes

Diversified Huawei Cloud Databases

Relational
For traditional database workloads

RDS

| RDS for MySQL |
| RDS for PostgreSQL |
| RDS for MariaDB |
| RDS for SQL Server |

GaussDB

| TaurusDB |
| GaussDB |

Non-Relational
For fast-growing workloads

GeminiDB

| GeminiDB Mongo API |
| GeminiDB Cassandra API |
| GeminiDB Influx API |
| GeminiDB Redis API |

DDS

Database ecosystem
Building complete database solutions

DRS   DAS   DBSS   UGO

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Advantages of Cloud Native

Traditional DC deployment	Deployed on cloud servers	Cloud native
Database optimization	Database optimization	Database optimization
Database development	Database development	Database development
Backup and restoration	Backup and restoration	Backup and restoration
High availability	High availability	High availability
Database engine management	Database engine management	Database engine management
Patch and configuration management	Patch and configuration management	Patch and configuration management
Software system	Software system	Software system
OS	OS	OS
Physical device maintenance	Physical device maintenance	Physical device maintenance
Power supply, cooling, and cabinets	Power supply, cooling, and cabinets	Power supply, cooling, and cabinets
Buildings, locations	Buildings, locations	Buildings, locations
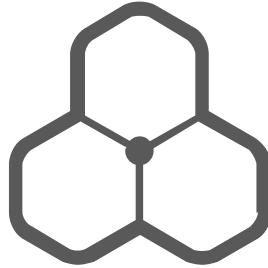
Legend: Green: Huawei Cloud's responsibilities | Blue: Customer's responsibilities

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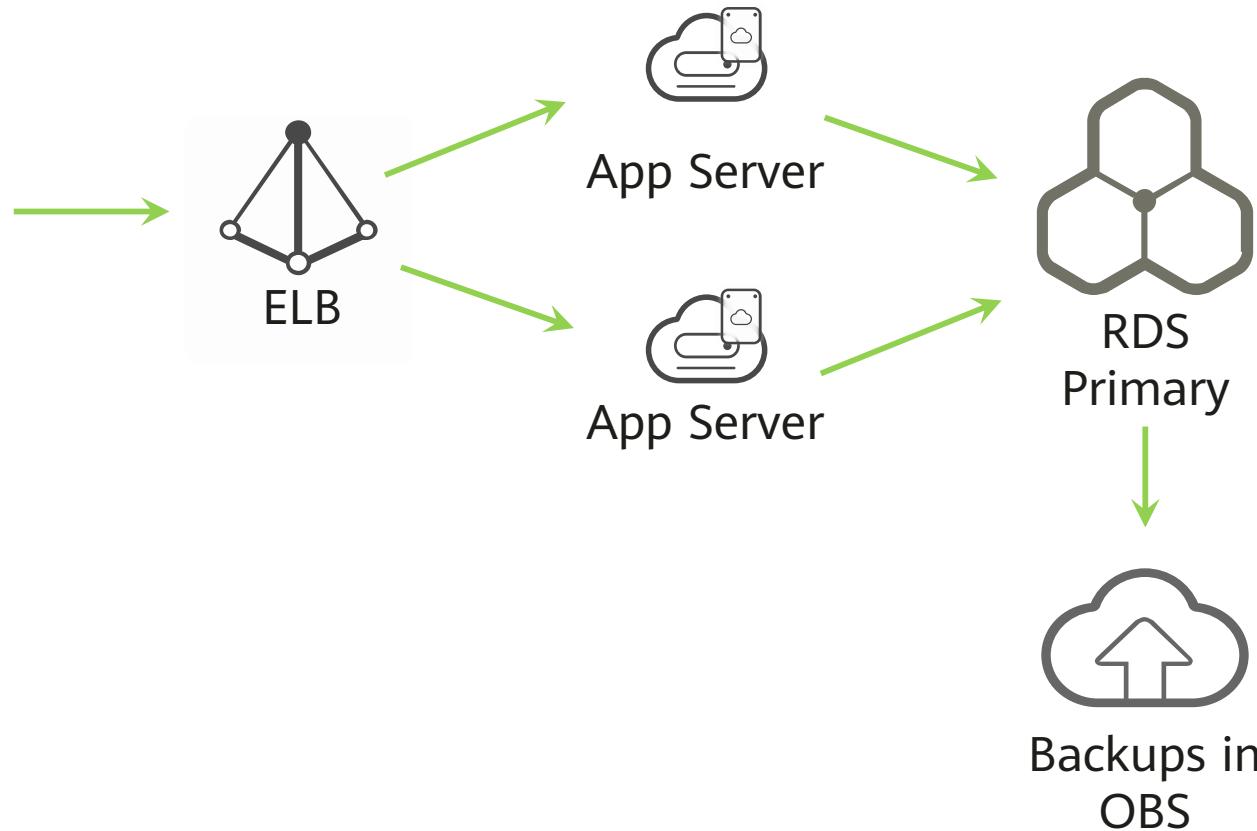
# Relational Database Service (RDS)

RDS
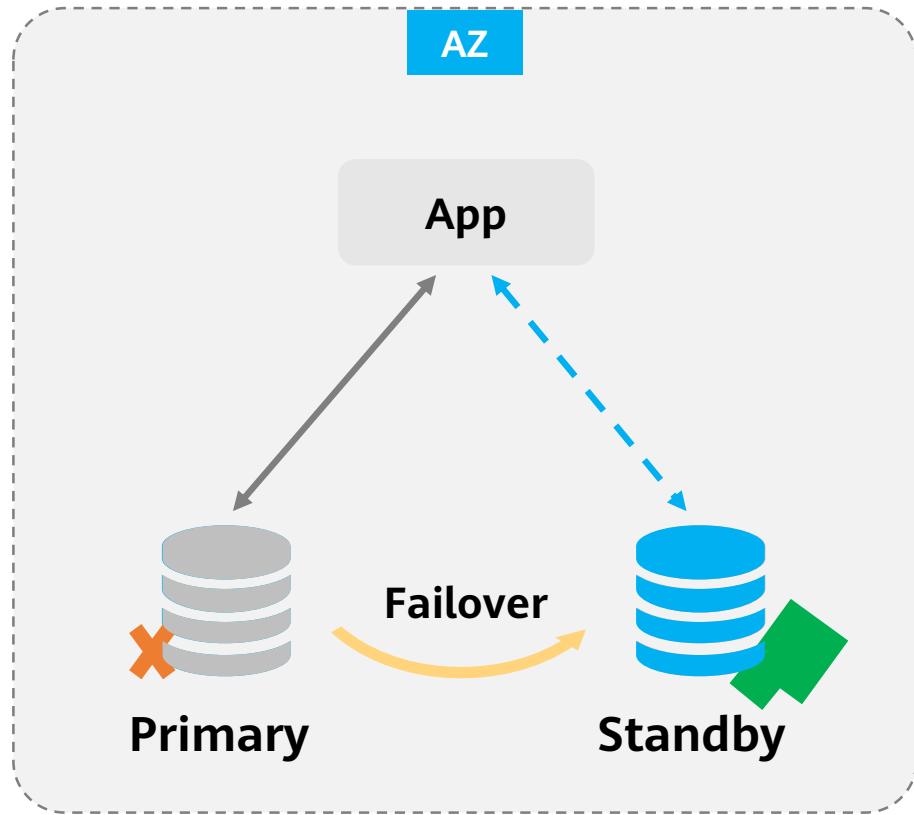
- A service that manages database engines and resources

- Compatible with mainstream relational database engines

  MySQL, PostgreSQL, SQL Server

- A cloud-native service that is easy to maintain

- Built-in automated backup and patching

- HA configuration and automatic switchover/failover within seconds

- Multiple read replicas supported

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Building a Simplified Architecture

ELB

App Server

App Server

RDS Primary

Backups in OBS
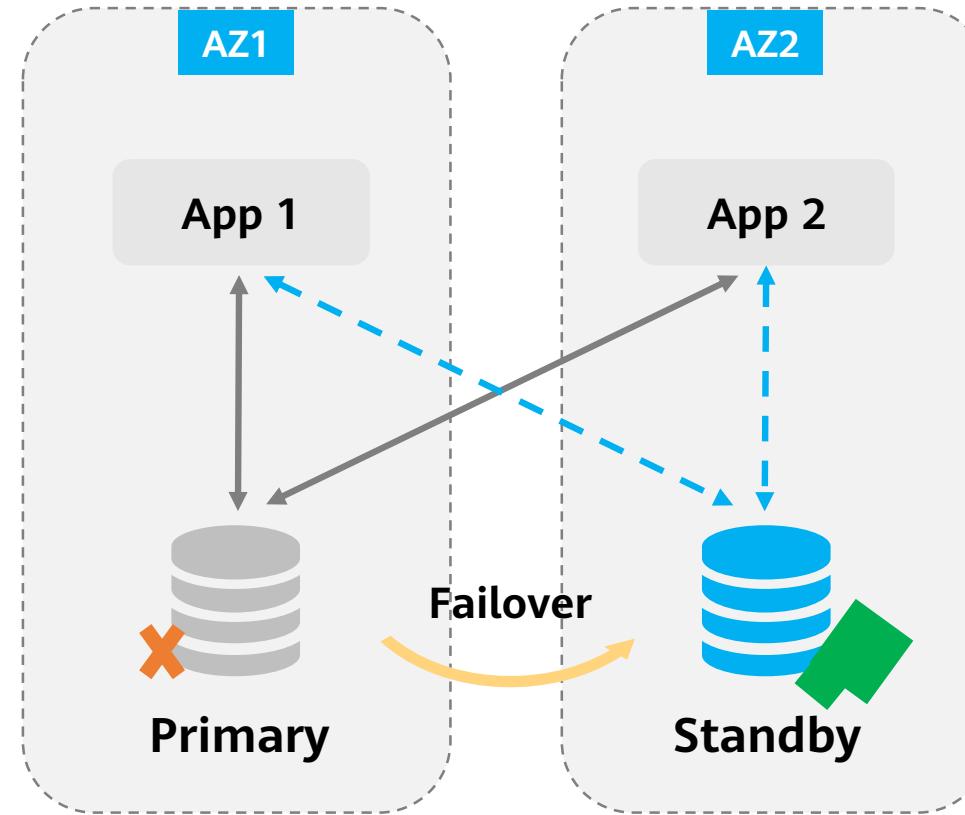
- A database service, for example, RDS functions as a database resource manager.

- Applications access the database using IP addresses, the same way as before.

- DB engines and versions are selected while you are creating databases.

- However, this architecture has service availability issues.

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High Availability of RDS
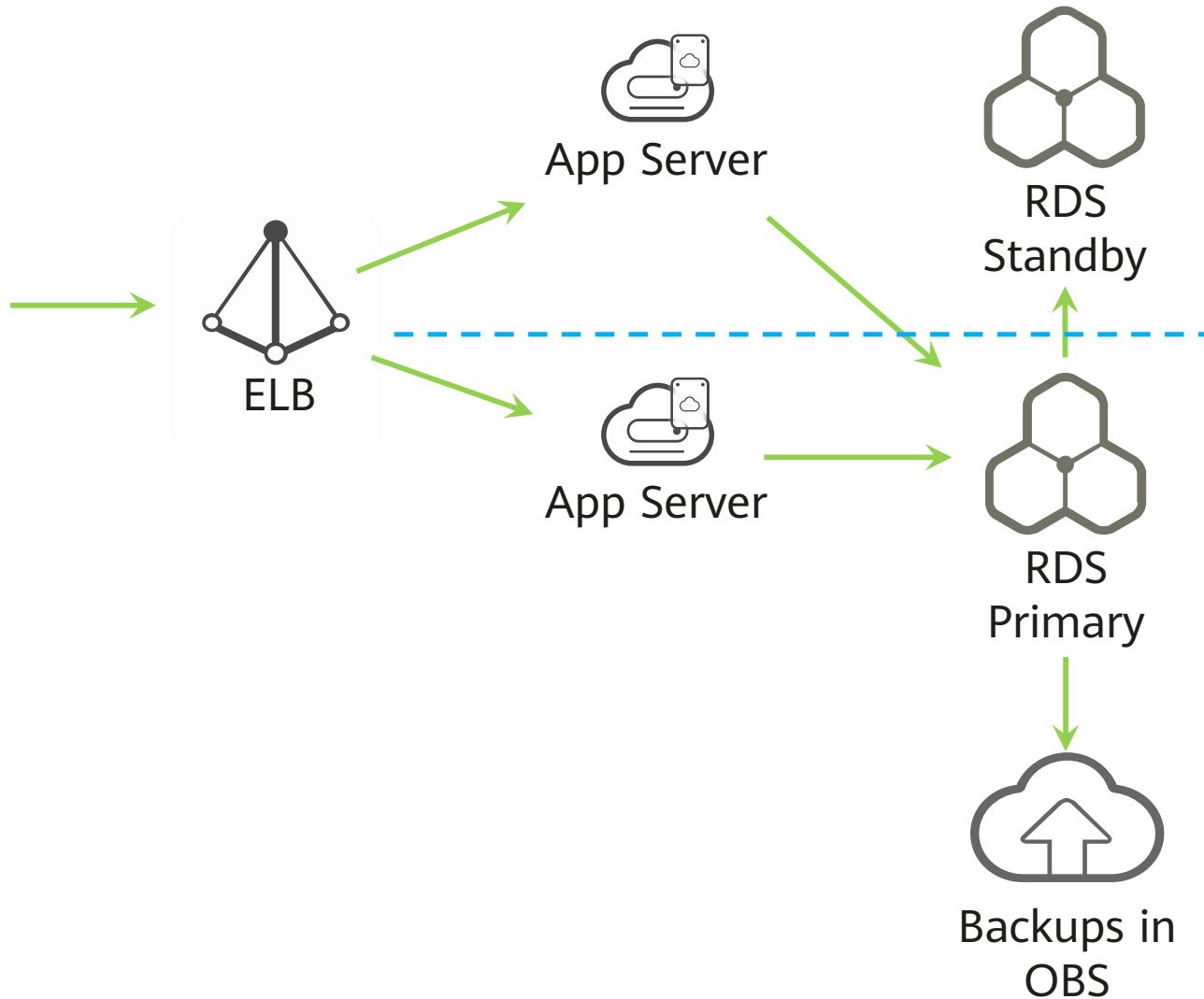
Primary/standby deployment within an AZ

Primary/standby deployment across AZs
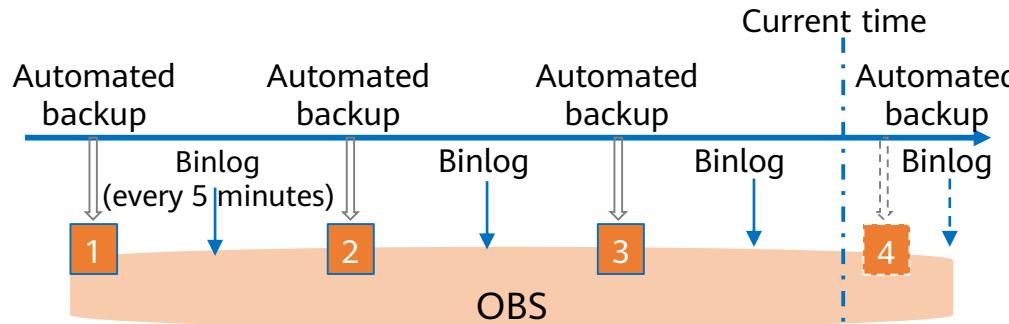
Building an HA Architecture

App Server

App Server

ELB

RDS
Standby

RDS
Primary

Backups in
OBS
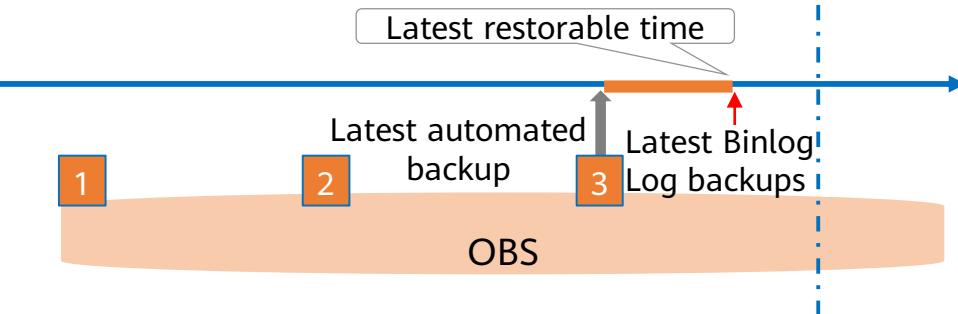
- Databases are deployed in different AZs to ensure high availability.

- DB engines ensure failover within seconds.

- Using primary/standby deployment can avoid service interruptions during maintenance.

- If the primary instance fails, workloads can be smoothly switched over to the standby instance.

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Backup Characteristics of RDS

Full data backup + Binlog backup

Current time

Automated backup | Automated backup | Automated backup | Automated backup

Binlog (every 5 minutes) | Binlog | Binlog | Binlog

| 1 | 2 | 3 | 4 |

OBS

PITR

Latest restorable time

Latest automated backup

Latest Binlog Log backups

| 1 | 2 | 3 |

OBS

01

Backups are stored in OBS and can be restored to the customer's on-premises data center.

02
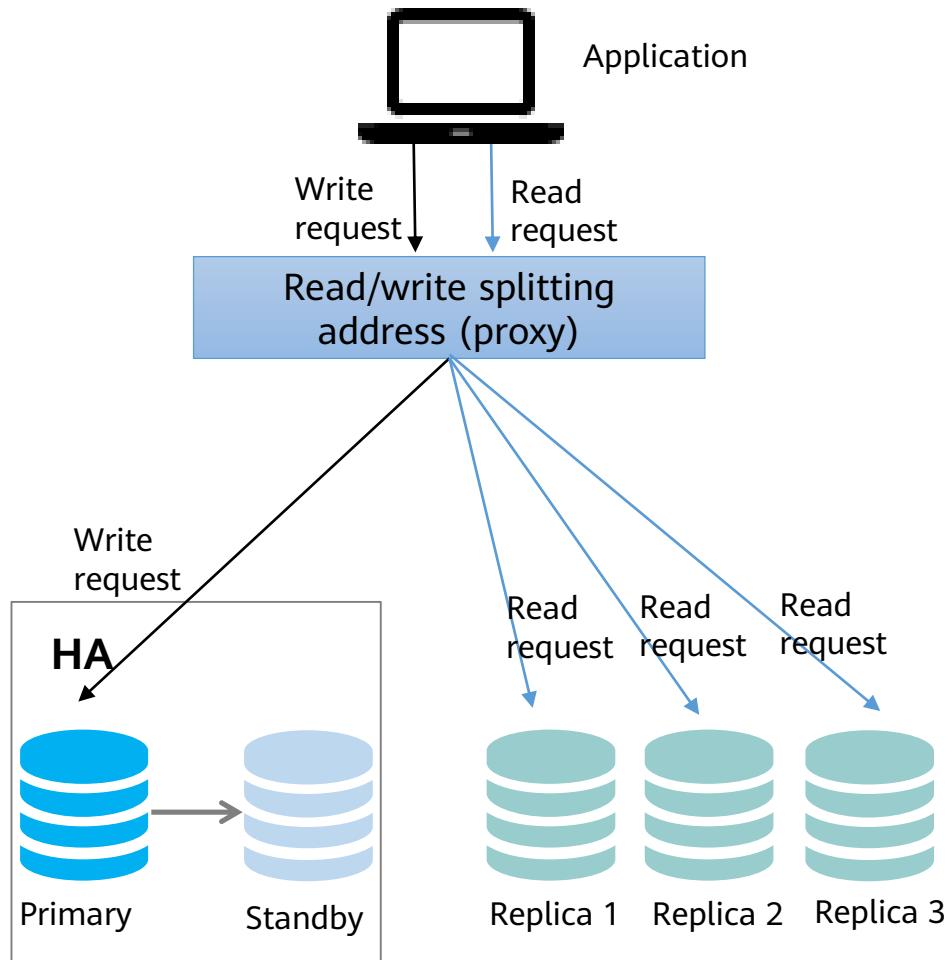
Automated binlog backup and manual backup are supported.

03

Binlog backups can be restored to a specific point in time.

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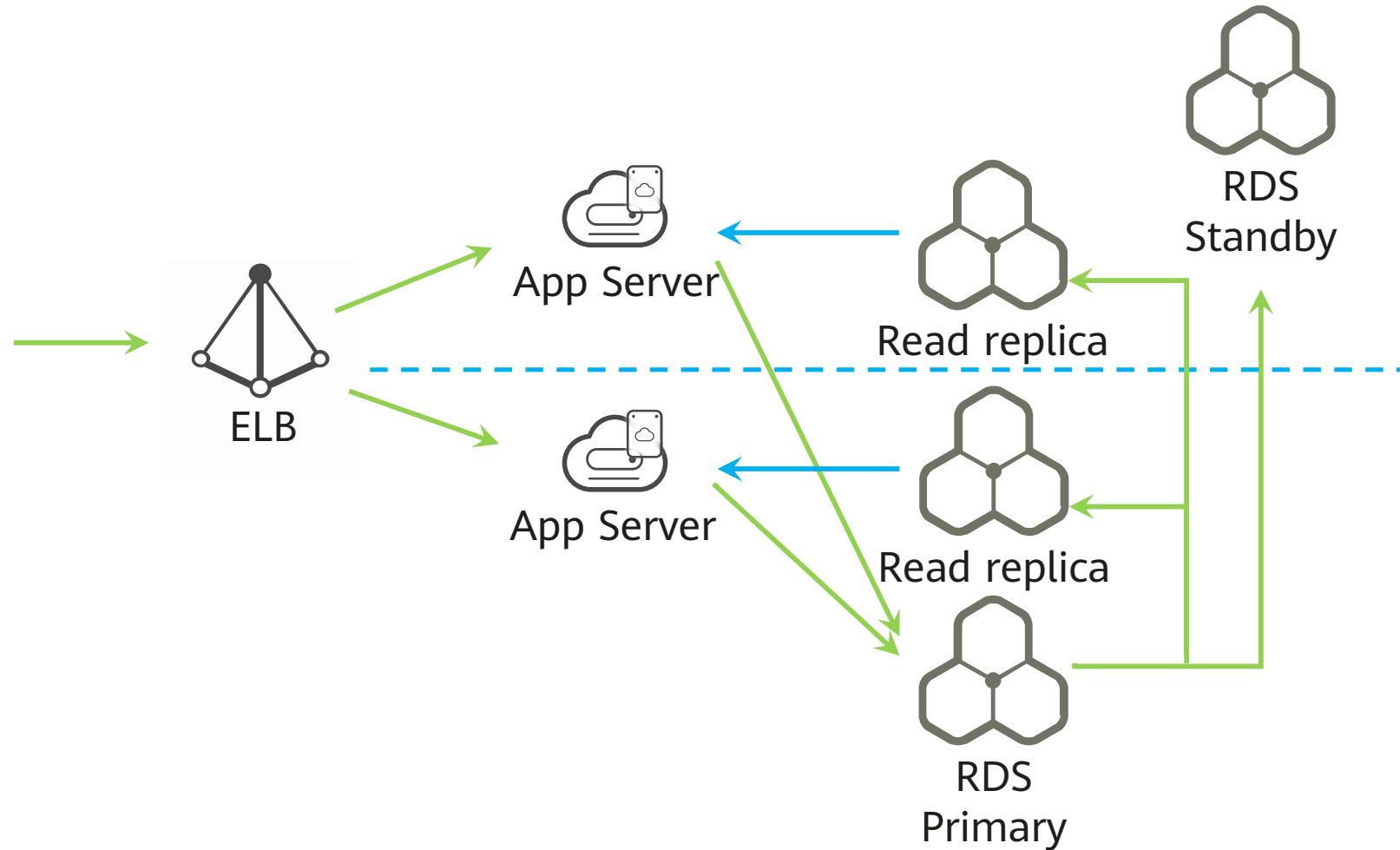
# RDS Read/Write Splitting

Basic functions
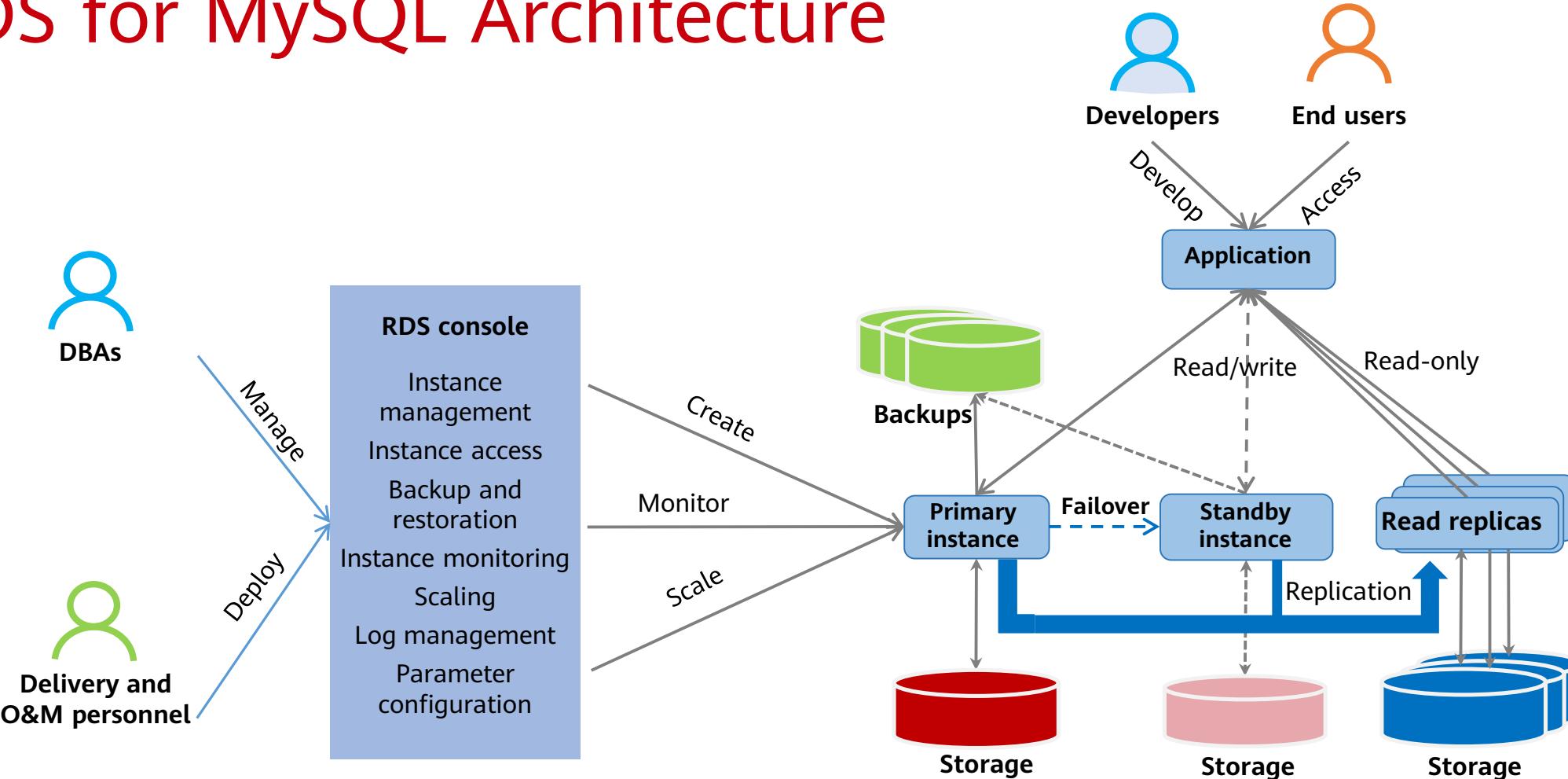
- A unified read/write splitting address is provided, transparent to applications.

- Read weights are configurable for each node.

- If a health check detects that a read replica fails or the I/O latency of a read replica goes beyond your preset threshold, read requests are no longer distributed to the read replica.

Scaling Out Using Read Replicas
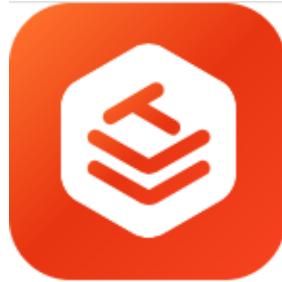
- Read replicas can be added or deleted as needed.

- The number of read replicas supported per DB instance varies by DB engine type. A DB instance supports up to 10 read replicas.

- Data can be replicated across AZs within a given region.

RDS for MySQL Architecture
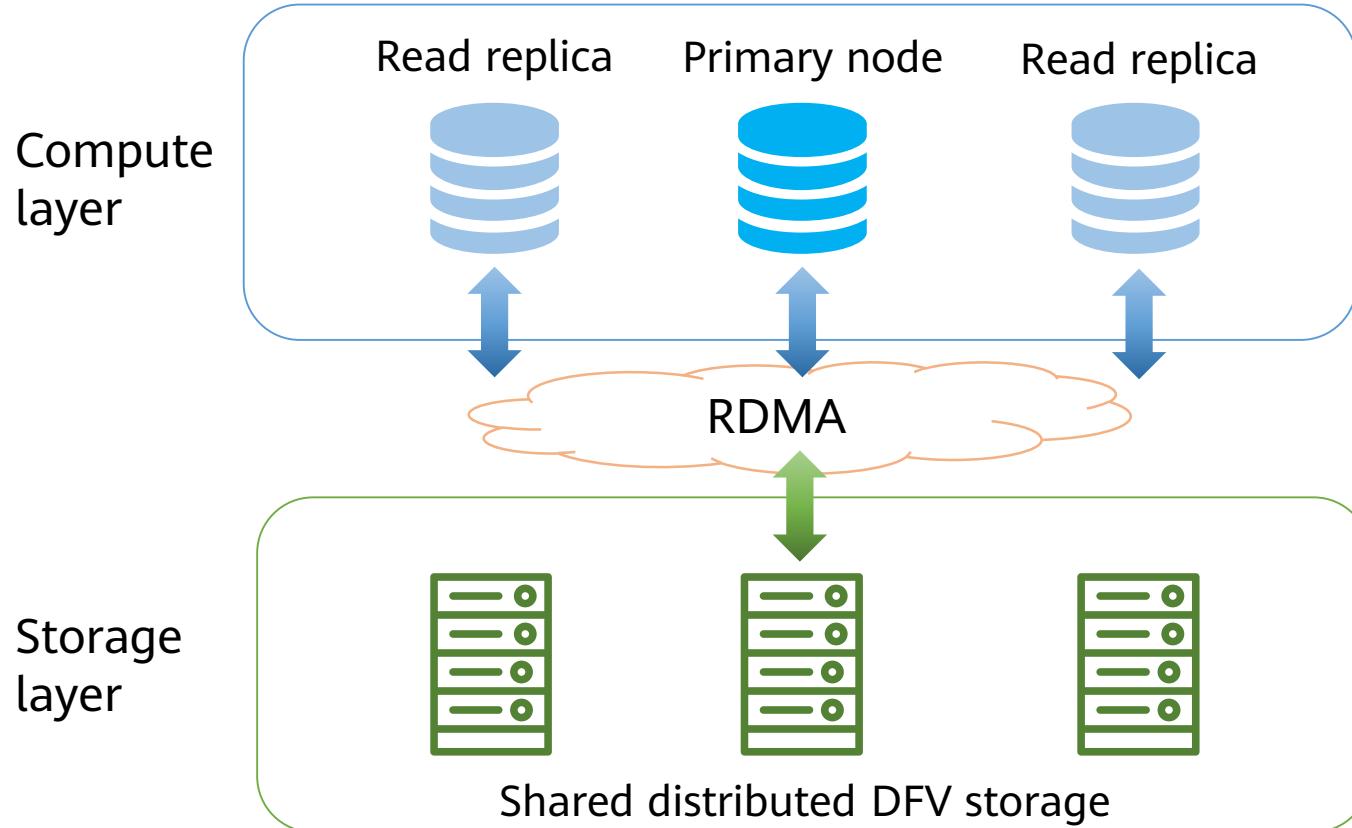
Other Huawei Database Services

TaurusDB

- Huawei DB engine

- Compatible with MySQL clients

- Decoupled storage and compute

- Cross-AZ HA

- Three copies stored to ensure reliability

- Scale-out and scale-up

Decoupled Storage and Compute

Compute layer

Read replica   Primary node   Read replica

RDMA

Storage layer
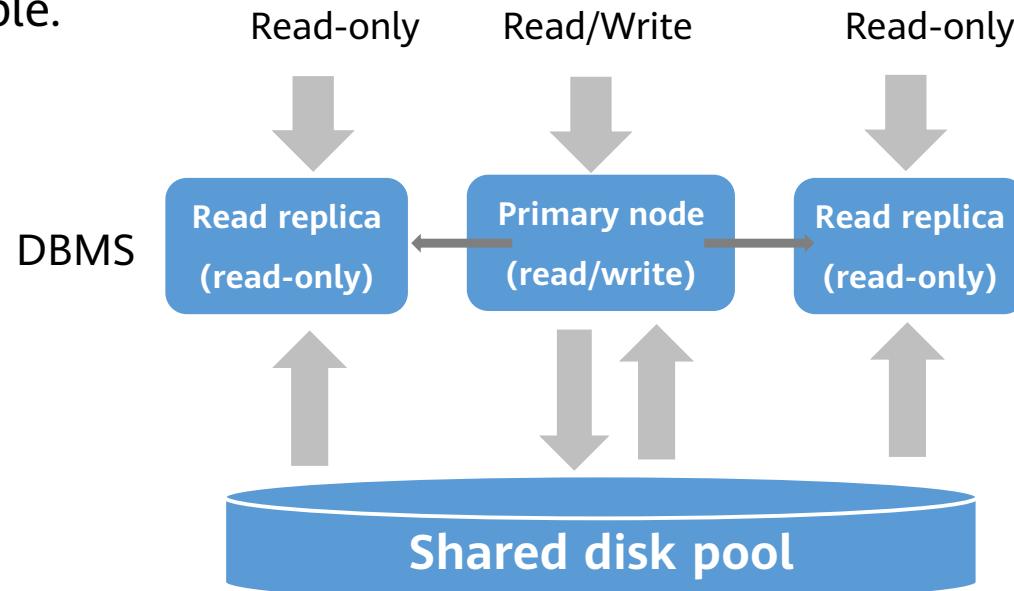
Shared distributed DFV storage

- Compute and storage are decoupled, improving performance to several times that of open-source MySQL.

- RDMA is used for database transmission, eliminating I/O performance bottlenecks.

- With DFV distributed storage, TaurusDB supports up to 128 TB of storage.

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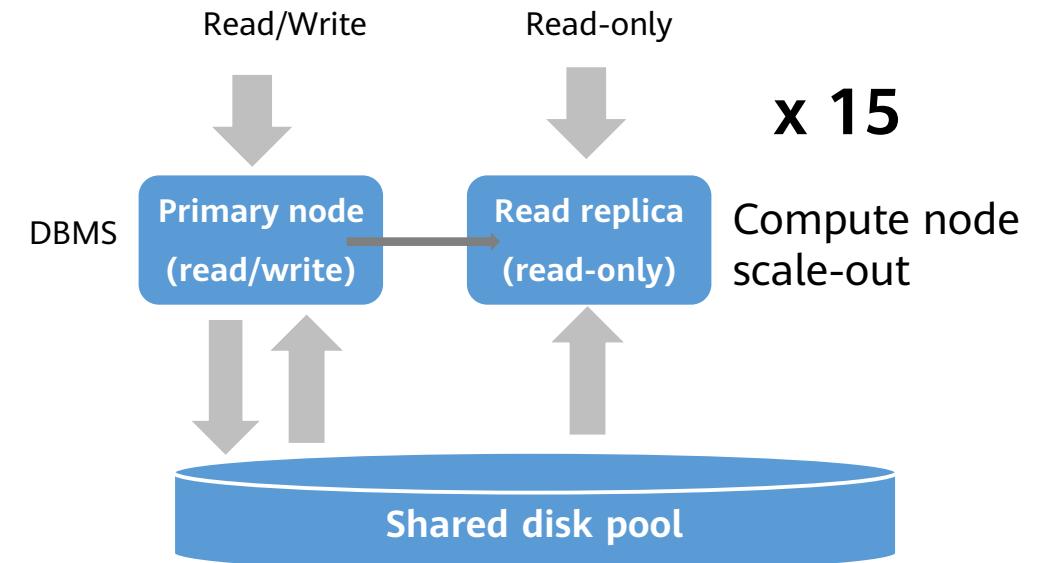
# High Reliability: Zero Data Loss and Fast Fault Recovery

- Cross-AZ deployment and cross-region backup, improving instance DR capabilities

  - Compute layer: When the primary node is faulty, a read replica is automatically promoted to primary, achieving a zero RPO.

  - Storage layer: Three data copies are stored for fault tolerance. Services will remain uninterrupted even if one copy becomes inaccessible.

Multi-Dimensional Scaling and Mass Storage

- Bidirectional scaling of compute nodes

  - As the nodes are virtual resources, their specifications can be changed.

  - There can be one primary node and up to 15 read replicas for a DB instance.

- Storage pooling

  - Up to 128 TB of storage is supported per instance.

  - Adding compute nodes does not increase storage costs.

  - Storage is billed on a pay-per-use basis and can be easily scaled up with no downtime.

Read/Write   Read-only

x 15

DBMS

Primary node (read/write)   **Read replica (read-only)**   Compute node scale-out

Shared disk pool

Three copies of a shared disk pool can support 15 nodes at the upper layer.
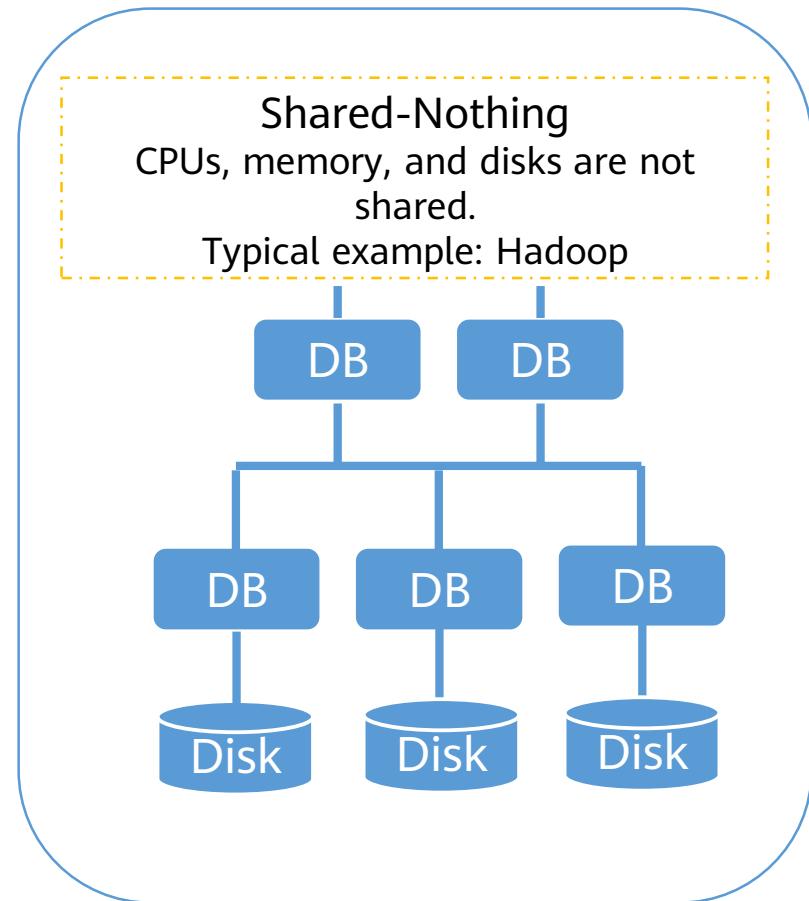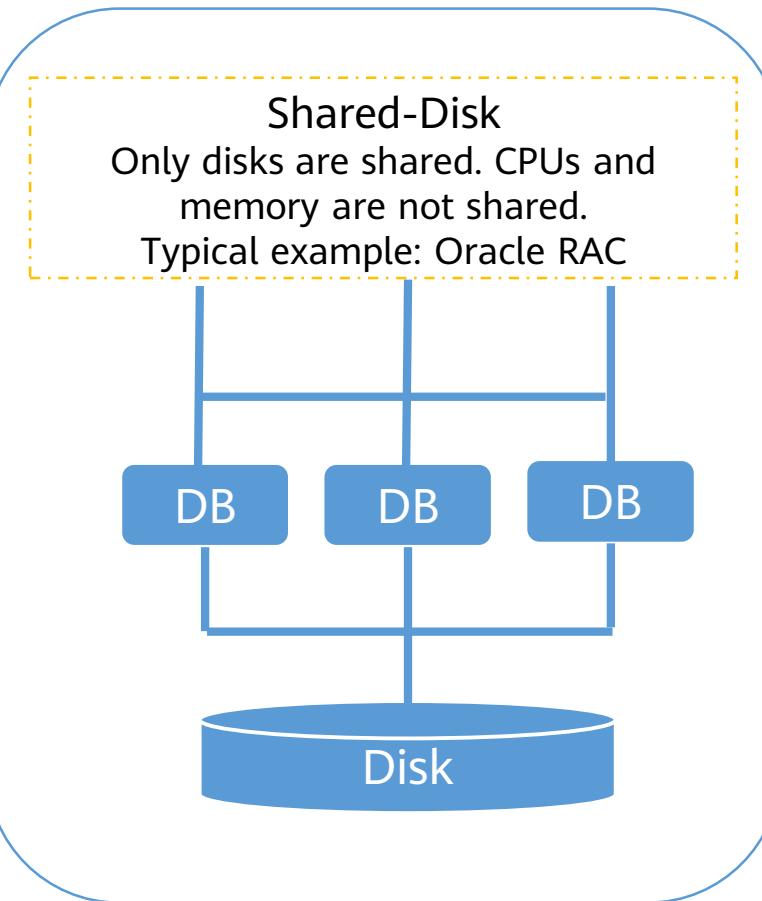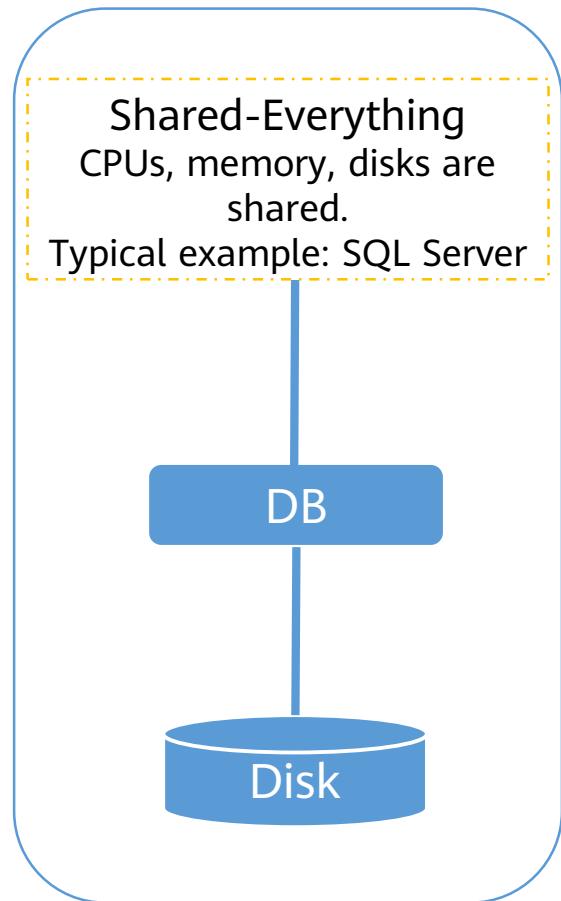
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A More Powerful Huawei Database Service

GaussDB

- Independent innovation from Huawei

- A distributed relational database

- Primary/Standby instances supported

- Intra-city cross-AZ deployment

- Up to 1,000+ nodes

- Petabytes of storage

GaussDB Uses a Shared-Nothing (Sharding) Architecture

Shared-Everything
CPUs, memory, disks are shared.
Typical example: SQL Server

DB

Disk

Shared-Disk
Only disks are shared. CPUs and memory are not shared.
Typical example: Oracle RAC

DB   DB   DB

Disk

Shared-Nothing
CPUs, memory, and disks are not shared.
Typical example: Hadoop

DB   DB

DB   DB   DB

Disk   Disk   Disk

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What will happen if there is a
lot of concurrent data?

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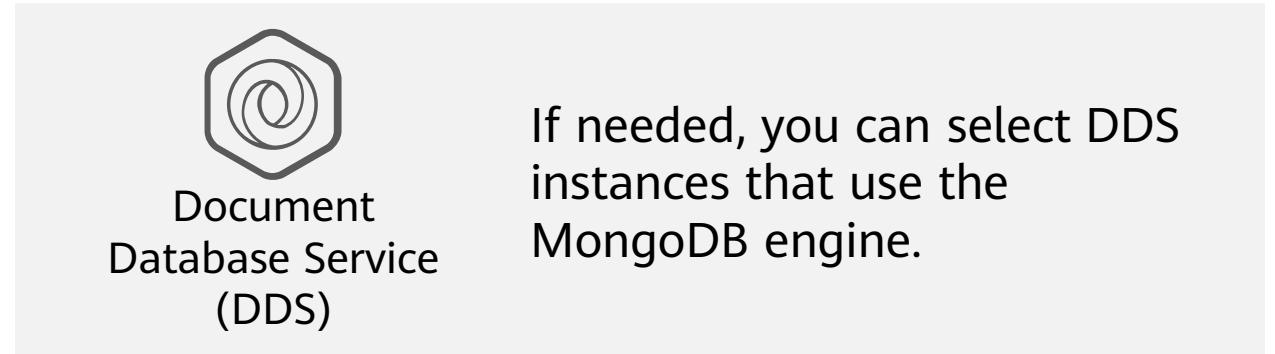
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GeminiDB Features
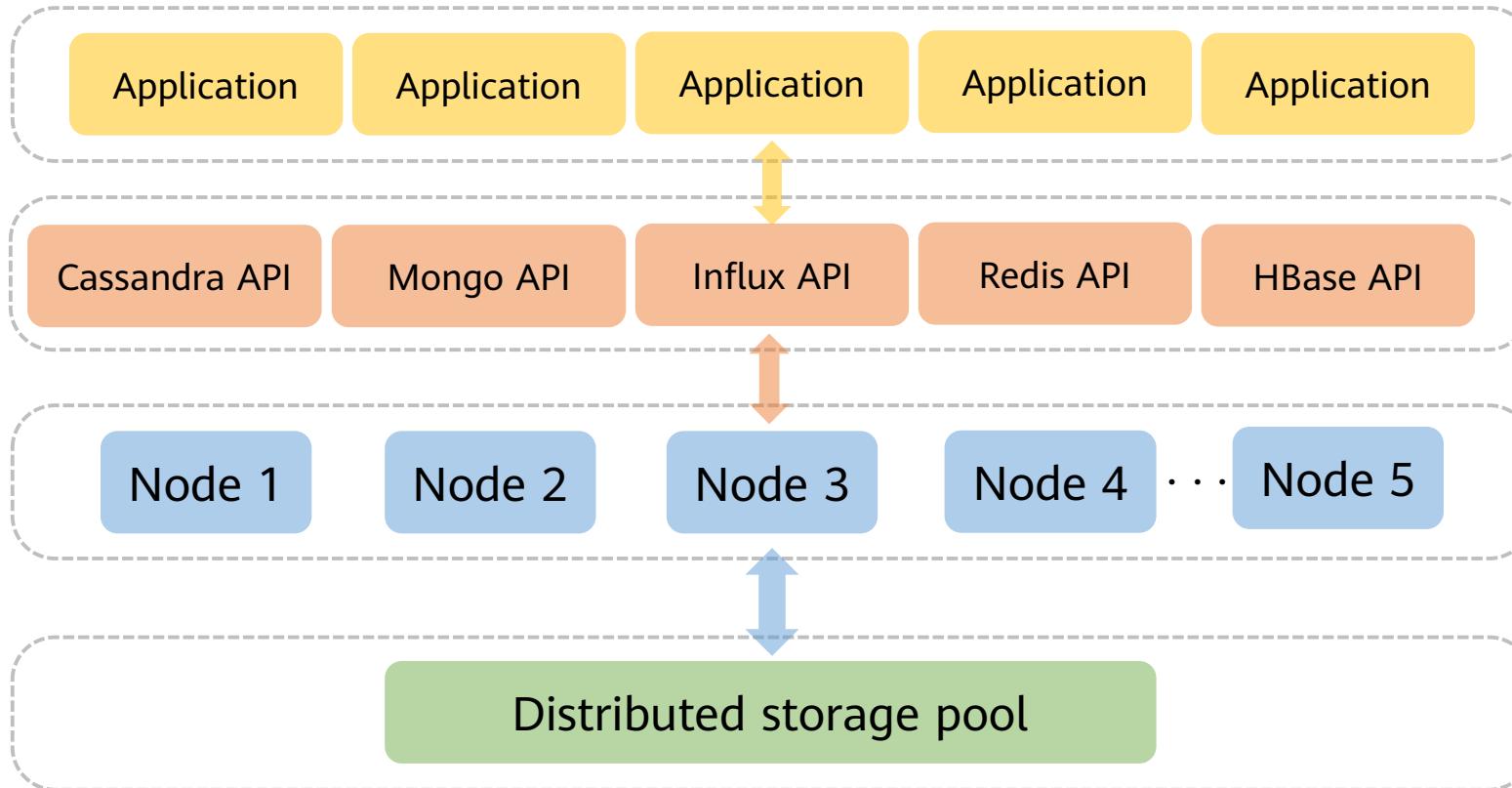
GeminiDB

- Huawei-developed DB engine

- Distributed multi-model NoSQL database service

- Compatible with mainstream NoSQL APIs of Cassandra, DynamoDB, MongoDB, InfluxDB, Redis, and HBase

- Decoupled storage and compute

- Compute resources scaled within minutes and storage within seconds

Document Database Service (DDS)

If needed, you can select DDS instances that use the MongoDB engine.

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GeminiDB Architecture

| Application | Application | Application | Application | Application |

| Cassandra API | Mongo API | Influx API | Redis API | HBase API |

| Node 1 | Node 2 | Node 3 | Node 4 ··· Node 5 |

Distributed storage pool

- **High availability**
  - □ If a compute node fails, workloads can be switched over within seconds.
  - □ Three copies of data are stored, so the system can run fine if a storage node fails.

- **Unlimited scalability**
  - □ Compute nodes are stateless and can be quickly scaled out.
  - □ Shared storage means you can add nodes in a click or two and without interrupting services.

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Features of Non-Relational Databases

01

Each data record is a structured document.

02

There are no logical relationships between the data records in a collection.

03

Users can locate data using key values rather than through complex queries.

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Precautions for Using Non-Relational Databases

- Define data keys and indexes so there is no need to scan entire collections, and data can be located faster.

  - Do not use hot keys.

  - Keep records simple.

  - Data can be located in milliseconds no matter how much data there is.

- If necessary, use optimistic locks for transactions at the application layer.

- If there is a lot of traffic, use clusters.

  - Select an appropriate sharding algorithm to locate data.

  - Distribute data access across all cluster nodes and avoid hot partitions.
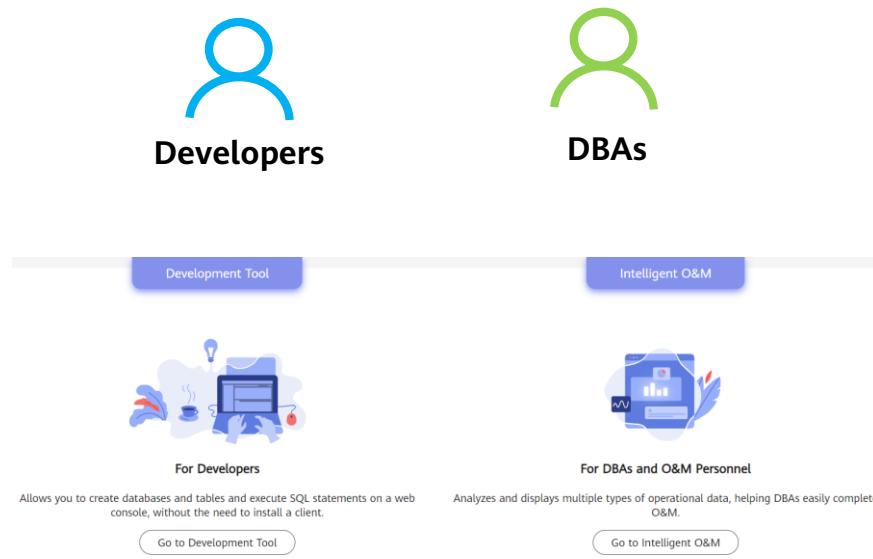
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4. **Data Admin Service (DAS)**

Data Admin Service (DAS)

- Data Admin Service (DAS) is a one-stop database management platform that allows you to manage Huawei Cloud databases on a web console. DAS offers database development, O&M, and intelligent diagnosis, making it easier to use and maintain databases on the cloud.

- No client required
- Visual operations
- Online access
- Databases and table creation, SQL statement execution.

Developers

DBAs

Development Tool

Intelligent O&M

For Developers

Allows you to create databases and tables and execute SQL statements on a web console, without the need to install a client.

Go to Development Tool

For DBAs and O&M Personnel

Analyzes and displays multiple types of operational data, helping DBAs easily complete O&M.

Go to Intelligent O&M

- O&M functions
- Host and instance performance data analysis
- Slow and full SQL statement analysis
- Real-time database performance diagnosis and analysis
- Historical data analysis

Summary

- Have a good command of basic concepts of databases.

- Have understood the characteristics of Huawei Cloud relational and non-relational database services.

- Have understood the differences between relational and non-relational databases.

- Have understood how to use databases to set up a service architecture.

- Have learned how to use DAS to manage your databases.

❓ Quiz

Which of the following are the advantages of Relational Database Service (RDS) over on-premises databases?

    A. High availability

    B. Elastic scaling and fast upgrade

    C. Easy O&M

    D. Low initial investment

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Acronyms and Abbreviations

- AZ: availability zone

- DAS: Data Admin Service

- DRS: Data Replication Service

- ECS: Elastic Cloud Server

- EVS: Elastic Volume Service

- OBS: Object Storage Service

- SFS: Scalable File Service

- EIP: Elastic IP

- VPC: Virtual Private Cloud

- RDS: Relational Database Service

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Recommendations

- Huawei Cloud websites

  - Huawei Cloud: https://www.huaweicloud.com/intl/en-us/

  - Huawei Cloud Developer Institute: https://edu.huaweicloud.com/intl/en-us/

Huawei Cloud
Developer Institute

Thank You.

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EVERYTHING AS A SERVICE

www.huaweicloud.com