RDS for MySQL

Best Practices

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This chapter describes best practices for working with RDS for MySQL and provides operational guidelines that you can follow when using this service.

Table 1-1 RDS for MySQL best practices

Reference	Description	
Migrating Data from Self- Managed MySQL Databases to RDS for MySQL	Describes how to migrate data from self-managed MySQL databases to RDS for MySQL.	
Configuring Remote Single- Active DR for an RDS for MySQL Instance Using DRS	Describes how to use DRS to establish a remote single- active DR relationship for an RDS for MySQL instance.	
Migrating MySQL Databases from Other Clouds to RDS for MySQL	Describes how to migrate data from MySQL databases on other clouds to RDS for MySQL.	
Using RDS for MySQL to Set Up WordPress	Describes how to set up WordPress in a LAMP environment using Huawei Cloud Virtual Private Cloud (VPC), Elastic Cloud Server (ECS), and RDS for MySQL.	
Using RDS for MySQL to Set Up Discuz!	Describes how to set up Discuz! in a LAMP environment using Huawei Cloud Virtual Private Cloud (VPC), Elastic Cloud Server (ECS), and RDS for MySQL.	
Description of innodb_flush_log_ at_trx_commit and sync_binlog	Describes the impact of the innodb_flush_log_at_trx_commit and sync_binlog parameters on performance and security.	

Reference	Description
How Do I Improve the Query Speed of My RDS for MySQL Instance?	Describes how to improve the query speed of an RDS for MySQL instance.
Handling RDS for MySQL Long Transactions	Describes how to locate and kill long-running transactions.
Security Best Practices	Provides guidance on RDS for MySQL security configurations.

2 Migrating Data from Self-Managed MySQL Databases to RDS for MySQL

2.1 Overview

Scenarios

This chapter includes the following content:

How to migrate data from self-managed MySQL databases to RDS for MySQL instances

RDS for MySQL Advantages

• More Services at Lower Costs

You pay for only RDS instances. There is no hardware or management investment needed.

- Ultimate User Experience
 - Fully compatible with MySQL
 - Excellent performance for high concurrency
 - Support for a great number of connections and quicker response
- High Security
 - End-to-end database security, including network isolation, access control, transmission encryption, storage encryption, and anti-DDoS
 - Highest-level certification by the NIST-CSF, with 108 key security capabilities
- High Reliability

Multiple deployment and DR solutions, including data backup, data restoration, dual-host hot standby, remote DR, and intra-city DR

Service List

- Virtual Private Cloud (VPC)
- Elastic Cloud Server (ECS)
- RDS
- Data Replication Service (DRS)

Notes on Usage

- The resource planning in this best practice is for demonstration only. Adjust it as needed.
- All settings in this best practice are for reference only. For more information about MySQL migration, see **From MySQL to MySQL**.

Prerequisites

- You have registered with Huawei Cloud.
- Your account balance is greater than or equal to \$0 USD.

2.2 Resource Planning

Category	Subcategor y	Planned Value	Remarks
RDS	RDS instance name	rds-mysql	Customize a name for easy identification.
	DB engine version	MySQL 5.7	-
	Instance type	Single	In this practice, select a single instance.
			To improve service reliability, selecting a primary/standby instance is recommended.
	Storage type	Cloud SSD	-
	AZ	AZ3	In this practice, select a single instance.
			To improve service reliability, create a primary/standby instance and then deploy them in two different AZs.
	Specification s	General-purpose 4 vCPUs 8 GB	-

 Table 2-1 Resource planning description

Category	Subcategor y	Planned Value	Remarks
DRS	Task name	DRS-mysql	Custom
migration task	Source DB engine	MySQL	In this practice, the source is a MySQL database built on an ECS.
	Destination DB engine	MySQL	In this practice, the destination is an RDS for MySQL instance.
	Network type	VPC	In this practice, select the VPC network.

2.3 Operation Process

The following figure shows the process of creating a MySQL database on an ECS, buying an RDS for MySQL instance, and migrating data from the MySQL database to the RDS instance.

Figure 2-1 Flowchart



2.4 Cloud Migration

2.4.1 Creating an RDS for MySQL Instance

Create an RDS for MySQL instance that is in the same VPC and security group as the self-managed MySQL database.

- Step 1 Go to the Buy DB Instance page.
- **Step 2** Configure basic information for the instance. Select **CN-Hong Kong** for **Region**.

Figure 2-2 Basic information

ick Config Custom Config				
Basic Settings				
Billing Mode (?)				
Yearly/Monthly Pay-per-use				
Region				
•	~			
Regions are geographic areas isolated from	each other. For low network latency and	d quick resource access, select the r	nearest region.	
Engine Ontions				
TaurusDB	MySQL	PostgreSQL	Microsoft SQL Server	MariaDB
DB Engine Version				
DB lastana Tura				
Primap/Standby Single				
Primary/standby HA architecture is suitable	for production databases in large- and n	nedium-sized enterprises, or for appl	lications in Internet. IoT. retail e-commerce.	logistics, and gaming industries.
Storage Type	,			·
Cloud SSD Extreme SSD				
Primary AZ				
cn-north-4a AZ7 cn-n	orth-4b cn-north-4c			
	011010110			

Step 3 Select an instance class and retain the default values for other parameters.

stance Configuration				
istance Class				
Dedicated General-purp	ose Kunpeng general-enhanced			
vCPUs Memory		Recommended Connections	TPS QPS ⑦ IPv6	
2 vCPUs 4 GB		4,000	580 11,597 Supported	
2 vCPUs 8 GB		6,000	590 11,804 Supported	
2 vCPUs 16 GB		8,000	841 16,859 Not supported	
4 vCPUs 8 GB		6,000	1,196 23,914 Supported	
O 4 vCPUs 16 GB		8,000	1,357 27,159 Supported	
4 vCPUs 32 GB		10,000	1,435 28,701 Supported	
B Instance Specifications rds.my	sql.x1.large.2.ha 2 vCPUs 4 GB (Dedicated)	, Recommended Connections: 4,000, TPS QPS: 580 11,597		
torage Space 💿				
)		- 40 +	GB	
0	830 1620	2410 4000		
ackup Space				
RDS provides 40 GB of free backup	storage, the same size as your purchased sto	age space.		
After the free backup space is used up, you will be billed for the additional space. After an instance is created, an automated backup will be created and saved for seven days. Backup Space Billing 🕐				
Deable autoscaing				
Enable autoscaling	Addional storage will be billed. Learn more 🖸			
Enable autoscaling dditional storage will be billed. Learn	n more 🖸			

Figure 2-3 Instance class

Step 4 Click Next.

Step 5 Confirm the settings.

- To modify your settings, click **Previous**.
- If you do not need to modify your settings, click **Submit**.

Step 6 Return to the instance list.

If the instance status becomes available, the instance has been created.

----End

2.4.2 Creating a Migration Task

This topic describes how to create a DRS migration task to migrate the **loadtest** database from the self-managed MySQL server to an RDS for MySQL instance.

Pre-migration Check

Before creating a migration task, check the migration environment to ensure smooth migration.

This example describes how to migrate data from a self-managed MySQL database to an RDS for MySQL instance. For more information, see **From MySQL** to MySQL.

Procedure

Migrate the **loadtest** database from a self-managed MySQL server to an RDS for MySQL instance.

- **Step 1** Go to the **Create Migration Task** page.
- **Step 2** Configure parameters as needed.
 - 1. Specify a migration task name. Select the region where the target instance is located, for example, **CN-Hong Kong**.

Figure 2-4 Migration task

Region	• • • • • • • • • • • • • • • • • • •	r Passuras en egico-quark and canad bu used across rejors through internal relation's connections. For the relation latercy and quark resource access, select the reasent enging
Project	Y	
* Task Name	DRS-Mysql	0
Description		0
	02	56

2. Configure replication instance information.

Select the instance created in **Creating an RDS for MySQL Instance** as the destination instance.

Figure 2-5 Replication instance details

Replication Instance D	etails ()
The following information cannot be mo	tified after you go to the next page.
* Data Flow	To the cloud Out of the cloud
	The destination database must be a database in the current cloud. If you want to migrate data between databases, select To the cloud.
* Source DB Engine	MySQL MongoDB MySQL schema and logic table Single-Node or Master/Standby Redis Redis cluster
* Destination DB Engine	MySQL DDM TaurusDB
* Network Type	VPC
* Destination DB Instance	C Vew DB Instance Vew Unselectable DB Instance During the full synchronization of a DRS task, a bit of binlogs are generated. These binlogs may be temporarily stored locally, which may cause the storage space to be used up. You are advised to enable storage autoscaling for the RDS DB instance. During the DRS task, set an appropriate local retention period for RDS binlogs. You can also clear binlogs exceeding the specified retention period with unit a few crites.
* Replication Instance Subnet	default_subnet(192.168.0.024) V The IP address is allocated automatically but it can Image: The IP address is allocated automatically but it can
* Migration Type	Full+Incremental Full
	This migration type is suitable for scenarios where services can be interrupted. It migrates database objects and data, in a non-system database, to a destination database all at the same time. After the data migration complete, the task automatically slops.
* Destination DB Instance Access	Read-only Read/Write
	During the migration, the destination DB instance can be configured to be writable, but if the data being migrated is modified, there may be data conflicts or other errors, and the migration task cannot be resumed.
* Enable Binlog Cleanup	0 0

- 3. Select default for Enterprise Project.
- Step 3 Click Create Now.

It takes about 5 to 10 minutes to create a replication task.

- **Step 4** Configure task information and click **Next**.
 - 1. Configure source database information.
 - 2. Click **Test Connection**.

If a successful test message is returned, login to the source is successful.

Figure 2-6 Source database settings

Source Database	
Select Connection	
DRS migrates only some key parameters to the	destination database. For the other parameters that cannot be migrated, you need to use parameter templates to configure them on the destination database.
Database Type	sell-built database RDS DB instance
DB Instance Name	✓ View DB Instance View Unselectable DB Instance
Database Username	root
Database Password	
SSL Connection	
	Test Cornection • Test successful

3. Specify a username and password for the destination database.

4. Click Test Connection.

If a successful test message is returned, login to the destination is successful.

Figure 2-7 Destination database settings

Destination Database		
DB Instance Name		
Database Username	root	
Database Password		\$
Migrate Definer to User	● Yes ⑦ ○ No ⑦	
SSL Connection		
	Test Connection 🤡 Test successful	

Step 5 On the **Set Task** page, select the accounts and objects to be migrated, and click **Next**.

Select All for Migration Object.

For more information, see From MySQL to MySQL.

Step 6 On the **Check Task** page, check the migration task.

If the check is complete and the check success rate is 100%, click Next.

- **Step 7** On the **Compare Parameters** page, click **Next** in the lower right corner to skip the comparison.
- Step 8 On the Confirm Task page, specify Start Time, Send Notifications, SMN Topic, Delay Threshold (s), and Stop Abnormal Tasks After, confirm that the configured information is correct, and click Submit to submit the task.
- **Step 9** After the task is submitted, view and manage it on the **Online Migration Management** page.

----End

2.4.3 Confirming Migration Results

You can check migration results with either of the following methods:

Automatic: **Viewing Migration Results on the DRS Console**. DRS automatically compares migration objects, users, and data of source and destination databases and provides migration results.

Manual: Viewing Migration Results on the RDS Console. You can log in to the destination instance to check whether the databases, tables, and data are migrated.

Viewing Migration Results on the DRS Console

Step 1 Log in to the **management console**.

Step 2 Click ⁽²⁾ in the upper left corner and select **CN-Hong Kong**.

- Step 3 Click the service list icon on the left and choose Databases > Data Replication Service.
- **Step 4** Click the name of the DRS migration task.
- Step 5 In the navigation pane, choose Migration Comparison.
- **Step 6** By default, the **Object-Level Comparison** tab page is displayed. Click **Compare** and check the comparison results of the items such as databases, tables, and indexes between the source and destination databases.

Figure 2-8 Migration comparison

Object-Level Comparison Data-Leve	I Comparison Account-Level Compar	ison Periodic Comparison		
Only the migration objects that you have selected Comparison Time:May 30, 2024 12:34:21 GMT+C	for comparison are displayed here. (?) 18:00			Compare Cancel Comparison
Item	Source Database	Destination Database	Result	Operation
Database	1	1	Consistent	View Details
Index	1	1	Consistent	View Details
Table	1	1	Consistent	View Details
Table sorting rules	1	1	Consistent	View Details

Step 7 Click the **Data-Level Comparison** tab, create a comparison task, and check the data comparison results between the source and destination databases.

If any check fails, rectify the fault by referring to **Solutions to Failed Check Items**.

----End

Viewing Migration Results on the RDS Console

- Step 1 Log in to the management console.
- **Step 2** Click ¹ in the upper left corner and select **CN-Hong Kong**.
- **Step 3** Click the service list icon on the left and choose **Databases** > **Relational Database Service**.
- Step 4 Locate the required RDS instance and click Log In in the Operation column.
- **Step 5** In the displayed dialog box, enter the password and click **Test Connection**.
- **Step 6** After the connection test is successful, click **Log In**.
- **Step 7** Check and confirm the destination database name and table name. Check whether the data migration is complete.

----End

3 Configuring Remote Single-Active DR for an RDS for MySQL Instance Using DRS

3.1 Overview

Scenarios

This best practice involves two tasks:

- Create an RDS for MySQL instance.
- Use DRS to establish a remote single-active DR relationship for the RDS for MySQL instance.

Prerequisites

- You have registered with Huawei Cloud.
- Your account balance is greater than or equal to \$0 USD.

How Cross-Region DR Works

RDS for MySQL instances are deployed in the production and DR data centers. DRS replicates data from the production center to the DR center, keeping data synchronous between your primary instance and the DR instance.

Service List

- Virtual Private Cloud (VPC)
- Elastic IP (EIP)
- Relational Database Service (RDS)
- Data Replication Service (DRS)

Notes on Usage

• The resource planning in this best practice is for demonstration only. Adjust it as needed.

• All settings in this best practice are for reference only. For more information about RDS for MySQL instance DR, see From MySQL to MySQL (Single-Active DR).

3.2 Resource Planning

Table 3-1 Resource planning

Categor y	Subcategor y	Planned Value	Description
VPC in the	VPC name	vpс-01	Specify a name that is easy to identify.
producti on center	Region	CN-Hong Kong	To achieve lower network latency, select the region nearest to you.
	AZ	AZ2	-
	Subnet	192.168.0.0/24	Select a subnet with sufficient network resources.
	Subnet name	subnet-3c29	Specify a name that is easy to identify.
VPC in the DR	VPC name	vpc-DR	Specify a name that is easy to identify.
center	Region	AP-Singapore	To achieve lower network latency, select the region nearest to you.
	AZ	AZ1	-
	Subnet	192.168.0.0/24	Select a subnet with sufficient network resources.
	Subnet name	subnet-ac27	Specify a name that is easy to identify.
RDS for MySQL	Instance name	rds-database-01	Specify a name that is easy to identify.
instance in the producti on	Region	CN-Hong Kong	To achieve lower network latency, select the region nearest to you.
center	DB engine version	MySQL 8.0	-

Categor y	Subcategor y	Planned Value	Description
	Instance type	Single	A single instance is used in this example.
			To improve service reliability, select a primary/standby instance.
	Storage type	Ultra-high I/O	-
	AZ	AZ2	AZ2 is selected in this example. To improve service reliability, select the primary/standby instance type and deploy the primary and standby instances in different AZs.
	Instance specification s	General-enhanced 2 vCPUs 4 GB	-
RDS for MySQL	Instance name	rds-DR	Specify a name that is easy to identify.
instance in the DR center	Region	AP-Singapore	To achieve lower network latency, select the region nearest to you.
	DB engine version	MySQL 8.0	-
	Instance type	Single	A single instance is used in this example.
			To improve service reliability, select a primary/standby instance.
	Storage type	Cloud SSD	-
	AZ	AZ1	AZ1 is selected in this example.
			To improve service reliability, select the primary/standby instance type and deploy the primary and standby instances in different AZs.
	Instance specification s	General-purpose 2 vCPUs 8 GB	-
DRS DR task	DR task name	DRS-DR-Task	Specify a name that is easy to identify.

Categor y	Subcategor y	Planned Value	Description
	Source DB engine	MySQL	In this example, the primary instance created in CN-Hong Kong is used as the source database.
	Destination DB engine	MySQL	In this example, the DR instance created in AP-Singapore is used as the destination database.
	Network type	Public network	Public network is used in this example.

3.3 Operation Process

You can create a single RDS instance and a DR instance and migrate data from the single instance to the DR instance.



3.4 Configuring an RDS for MySQL Instance in the Production Center

3.4.1 Creating a VPC and Security Group

Create a VPC and security group for a DB instance in the production center.

Creating a VPC

- **Step 1** Go to the **Create VPC** page.
- **Step 2** On that page, select **CN-Hong Kong** for **Region**, and configure the basic information, subnet, and IP address.

Figure 3-2 Creating a VPC

< Create VPC ③		
Basic Information		
Region	v	
Name	vpc-lodb	
IPv4 CIDR Block	192 - 198 - 0 - 0 / 15 - 0	
	Recommended to 0.0 08-24 (Select) 172 16.0.012-24 (Select) 192 168.0.016-24 (Select)	
	The CDR block 192, 168,8 0/16 overlaps with a CDR block of another VPC in the current region. If you intend to enable communication between VPCs or between a VPC and an on-premises data center, change the CDR block. Vev. VPC CDR blocks in current region	
Enterprise Project	default ✓ O: Create Enterprise Project (2)	
 Advanced Settings (Option Tow 	na)	
Tag Description		
Subnet Setting1		🗍 Delete
Subnet Name	subret-broa	
AZ	AZ1	
IPv4 CIDR Block		
	Available IP Addresses: 251	
	The CDR block cannot be modified after the subnet has been created	

Step 3 Click Create Now.

----End

Creating a Security Group

- **Step 1** Log in to the **management console**.
- **Step 2** Click ⁽²⁾ in the upper left corner and select **CN-Hong Kong**.
- **Step 3** Under the service list, choose **Networking** > **Virtual Private Cloud**.
- **Step 4** In the navigation pane on the left, choose **Access Control** > **Security Groups**.
- Step 5 Click Create Security Group.

Figure 3-3 Creating a security group

< Create Security	Group
Summary	
Region	
	Regions are geographic areas loalated from each other. Resources are region-specific and cannot be used across regions through internal network connections. For low network latency and quick resource access, select the nearest region.
Name	Ip-datases
Enterprise Project	default v O Q Create Entreprise Project (?
Tag (Optional)	TMS's prototined tags are recommended for adding the same lags to different cloud resources. Create productined lags (2)
	+ Add Tag Yea can add 30 mere tags.
Description (Optional)	0753.4
Manage Rules 💿	
For optimal perfo Some security gr If you select IP an	mene area to the lash should y page dee not cachen more har bit dels. angle value to the lash and the CSC shall and the page default should be and the cache and the cach
Preset Rule	Zation rule 🗸 🗸
Inhound Dular	Sulface Date

Step 6 Click Create Now.

----End

3.4.2 Creating an EIP

Create an EIP for your source DB instance. Using the EIP, external systems can access your application and DRS can connect to the source DB instance.

Procedure

- **Step 1** Go to the **Buy EIP** page.
- **Step 2** On that page, select **CN-Hong Kong** for **Region**, and configure the basic information and bandwidth as prompted.

Figure 3-4 Buying an EIP



- Step 3 Click Next.
- Step 4 Confirm the information and click Submit.

----End

3.4.3 Creating an RDS for MySQL Instance

Create an RDS for MySQL instance (source database), and select the VPC and EIP you configured for the instance.

Procedure

- Step 1 Go to the Buy DB Instance page.
- Step 2 Select CN-Hong Kong for Region. Configure instance information and click Buy.

Figure 3-5 Selecting a DB engine

ick Config Custom Config				
Basic Settings				
Billing Mode 🕥				
Yearly/Monthly Pay-per-use				
Region				
•	~			
Regions are geographic areas isolated fro	om each other. For low network latency and	I quick resource access, select the n	earest region.	
Engine Options				
Engine Options				
DB Engine				
TaurusDB	MySQL	PostgreSQL	Microsoft SQL Server	MariaDB
DB Engine Version				
8.0 ~				
DB Instance Type				
DB Instance Type Primary/Standby Single				
DB Instance Type Primary/Standby Single Primary/standby HA architecture is suitab	ve for production databases in large- and m	edium-sized enterprises, or for appli	cations in Internet, IoT, retail e-commerce,	logistics, and gaming industries.
DB Instance Type Primary/Standby Single Primary/standby HA architecture is suitab Storage Type	le for production databases in large- and m	edium-sized enterprises, or for appli	cations in Internet, IoT, retail e-commerce,	logistics, and gaming industries.
DB Instance Type Primary/Standby Single Primary/standby HA architecture is suitab Storage Type Cloud SSD Extreme SSD	Ne for production databases in large- and m	edium-sized enterprises, or for appli	cations in Internet, IoT, retail e-commerce,	logistics, and garning industries.
DB Instance Type Primary/Standby Single Primary/standby HA architecture is suitab Storage Type Cloud SSD Extreme SSD Primary AZ	e for production databases in large- and m	edium-sized enterprises, or for appli	cations in Internet, IoT, retail e-commerce,	logistics, and garning industries.

Figure 3-6 Selecting specifications

Dedicated General-purp	oose Kunpeng general-enhanced		
Solitated Solitated parp	tanpong general emaneea		
vCPUs Memory		Recommended Connections	TPS QPS ⑦ IPv6
2 vCPUs 4 GB		4,000	580 11,597 Supported
2 vCPUs 8 GB		6,000	590 11,804 Supported
2 vCPUs 16 GB		8,000	841 16,859 Not supported
4 vCPUs 8 GB		6,000	1,196 23,914 Supported
4 vCPUs 16 GB		8,000	1,357 27,159 Supported
4 vCPUs 32 GB		10,000	1,435 28,701 Supported
Instance Specifications rds.my	sql.x1.large.2.ha 2 vCPUs 4 GB (Dedicated)	Recommended Connections: 4,000, TPS QPS: 580 11,597	
orage Space 💿			
		- 40 +	GB
· · · · · · · · · · · · · · · · · · ·	830 1620	2410 4000	
ickup Space			
ckup Space RDS provides 40 GB of free backup	> storage, the same size as your purchased stor	age space.	
ckup Space RDS provides 40 GB of free backup for the free backup space is used u	a storage, the same size as your purchased stor p, you will be billed for the additional space. Afte	age space. rr an instance is created, an automated backup will be created and s	aved for seven days Backup Space Billing 🕑
ckup Space RDS provides 40 GB of free backup er the free backup space is used u Enable autoscaling	o storage, the same size as your purchased stor p, you will be billed for the additional space. Afte	age space. If an instance is created, an automated backup will be created and s	aved for seven days.Backup Space Billing [2]
ckup Space RDS provides 40 GB of free backup er the free backup space is used u Enable autoscaling ditional storage will be billed. Lean	o storage, the same size as your purchased stor p, you will be billed for the additional space. Afte 1 more ℃	age space.	aved for seven days Backup Space Billing (2

Basic Settings	
DB Instance Name 💿	
rds-9812	
If you buy multiple DB instances at a time, they will be named with four digits appended in the format "DB instance name-SN". For example, if the DB instance name is "instance", the first instance will be named "instance-d001", the second "instance and so on.	-0002",
Password	
Skip Configure	
To log in, you will have to reset the password later on the Basic Information page for this instance.	
Connectivity	
VPC ()	
vpc-a336 v Q Create VPC [2	
The VPC an RDS instance is deployed in cannot be changed later. ECSs in different VPCs cannot communicate with each other by default.	
Subnet	
subnet-a389(192, 168, 0.0/24) V Q	
IPv6 CIDR block:2407:c080:1200:217e::/64	
An EIP is required if you want to access DB instances through a public network. View EIP 🕐	
IPv4 Address	
· · ·	
Addresses available: 251 View In-use IP Addresses	
Database Port	
Default port: 3306	
Security Group ?	
onutations of V View Service 12	
Ensure that port 3306 of the security group allows traffic from your server IP address to the DB instance. Create Security Group	
Security Group Rules A	

Figure 3-7 Configuring network information as planned

Figure 3-8 Additional options

Additional Options	
Enterprise Project (?)	
default	✓ Q Create Enterprise Project I ²
Parameter Template	
Default-HighPerformance-Edition-MySQL-8.0	V View Parameter Template [2]
▲ Using a high-performance template tends to result in lost dat details, see the user guide. View Details	a and replication exceptions after an instance recovers from a crash. There may also be out of memory (OOM) errors with small instance classes in high concurrency scenarios. For
Time Zone	
(UTC+08:00) Beijing, Chongqing, Hong Kong, Urumqi	v
Table Name 💿	
Case sensitive Case insensitive	
Tag	
TMS's predefined tags are recommended for adding the same tag to	different cloud resources. Create predefined tags 🖸 🔾
+ Add Tag	
You can add 20 more tags.	
Read Replica	
Skip Create	
Required Duration and Quantity	
Quantity	
- 1 +	
You can create 50 more instances (read replicas included). Increase	Quota

Step 3 Confirm the settings.

- To modify your settings, click **Previous**.
- If there is no need to modify your settings, click **Submit**.

Step 4 Bind an EIP to the created instance.

1. On the **Instances** page, click the instance name to go to the **Overview** page.

Figure 3-9 Locating your instance in the list



- 2. In the navigation pane on the left, choose **Connectivity & Security**. In the **Connection Information** area, click **Bind** next to the **EIP** field.
- 3. In the displayed dialog box, all unbound EIPs are listed. Select the EIP you have created for the instance and click **OK**.

Figure 3-10 Binding an EIP

< 🔿 rds-cc78 o	Available	
Overview		
Backups & Restorations	Connection Inform	nation
Connectivity & Security	Floating IP Address	192.168.0.250 C Change
Accounts		
Databases	EIP	No EIP bound Bind
Logs		
SQL Audits	Database Port	3306 Change
Parameters		

----End

3.5 Configuring an RDS for MySQL Instance in the DR Center

3.5.1 Creating a VPC and Security Group

Create a VPC and security group for the DR instance to be configured, ensuring that it is in a different region from the instance created for production center.

Creating a VPC

- **Step 1** Go to the **Create VPC** page.
- **Step 2** On that page, select **AP-Singapore** for **Region**, and configure the basic information, subnet, and IP address.

Figure 3-11 Creating a VPC

Create VPC 💿		
sasic information		
legion		
ame	vpo-DR	
Pv4 CIDR Block	192 · 196) · 0 · 0 / 16 · 0	
	Recommended 10.0.05/24 (Select) 172:16:0.072-24 (Select) 172:16:0.0712-24 (Select)	
	The CDR block 192 168 & 015 eventaps with a CDR block of another VPC in the current region. If you intend to enable communication between VPCs of between VPCs of between a VPC and an expression data certify, change the CDR block. You VPC CDR block in current region.	
nterprise Project	default V 3 🗘 Create Enterprise Project 🖸	
 Advanced Settings (Opti Tag: - Description: - Bubnet Setting1 		Ê D
Advanced Settings (Opti Tag = Description: = Bubnet Setting1 ubnet Name	bonu) bulkere-ectio	î D
 Advanced Settings (Opti Tag: - Description: - Subnet Setting1 Bubnet Name NZ 	iona)	ĝ D
Advanced Settings (Opti Tag - Description: - Subnet Setting1 Jubnet Name 42 Pv4 CIDR Block	Image: State and State	î D

Step 3 Click Create Now.

----End

Creating a Security Group

- **Step 1** Log in to the **management console**.
- **Step 2** Click ^(Q) in the upper left corner of the management console and select **AP-Singapore**.
- **Step 3** Under the service list, choose **Networking** > **Virtual Private Cloud**.
- **Step 4** In the navigation pane on the left, choose **Access Control** > **Security Groups**.
- Step 5 Click Create Security Group.

Figure 3-12 Creating a security group

< Create Security	Group
Summary	
Region	• •
	Regions are geographic areas lotated from each other. Resources are region-specific and cannot be used across regions through internal metwork connections. For low network latency and guick resource access, select the nearest region.
Name	80qs
Enterprise Project	default V O Q. Create Enterprise Project (2
Tag (Optional)	TMS's predefined lags are recommended for adding the same lag to different cloud resources. Ciesta predefined lags 👸 📿
	+ Add Tag Yao can add 28 more tags.
Description (Optional)	
Manage Rules 💿	
For optimal performance Some security groups If you select IP actions If actions If you select IP actions IF actions IF actions If you select IP actions If you you	marea, amos for data) accurato program de not occurato non tener 10 más. Importante al tata data accurato for Scanta accurato processionas. Lan marca deres for Source, you can enter multyle IP Sedensses, separated with commas (.). Each IP address represents a different security group nole.
Preset Rule	Lation rule V
Inhound Dulor	National Protoc

Step 6 Click Create Now.

----End

3.5.2 Creating an RDS for MySQL Instance

Create an RDS for MySQL instance as a DR instance and select the VPC you configured for the instance.

Procedure

- Step 1 Go to the Buy DB Instance page.
- **Step 2** Select **AP-Singapore** for **Region**. Configure instance information and click **Buy**.

ck Config Custom Config								
Bacic Sattings								
Billion Mada								
Billing Mode (2)								
reany/monthly Pay-per-use								
Region								
•	~							
Regions are geographic areas isolated fro	om each other. For low network latency	and quick resource access, select the ne	arest region.					
Engine Options								
DD Facility								
DB Engine								
TaurusDB	MySQL	PostgreSQL	Microsoft SQL Server	MariaDB				
DB Engine Version)							
8.0 ~								
DB lostere Tree								
DB Instance Type								
Primary/Standby Single								
Primary/standby HA architecture is suitabl	le for production databases in large- an	d medium-sized enterprises, or for applic	ations in Internet, IoT, retail e-commerce	, logistics, and gaming industries.				
Storage Type								
Cloud SSD Extreme SSD								
Primary AZ								

Figure 3-13 Selecting a DB engine

Figure 3-14 Selecting specifications

Instance Configuration				
Instance Class Dedicated General-purpose	Kunpeng general-enhanced			
vCPUs Memory		Recommended Connections	TPS QPS ⑦	IPv6
2 vCPUs 4 GB		4,000	580 11,597	Supported
2 vCPUs 8 GB		6,000	590 11,804	Supported
2 vCPUs 16 GB		8,000	841 16,859	Not supported
○ 4 vCPUs 8 GB		6,000	1,196 23,914	Supported
○ 4 vCPUs 16 GB		8,000	1,357 27,159	Supported
4 vCPUs 32 GB		10,000	1,435 28,701	Supported
DB Instance Specifications rds.mysql.x1.la	arge.2.ha 2 vCPUs 4 GB (Dedicate	d), Recommended Connections: 4,000, TPS QPS: 58	D 11,597	
Storage Space ⑦	830 1620	2410 4000	40 + GB	
Backup Space				
RDS provides 40 GB of free backup storage	e, the same size as your purchased s	storage space.		
After the free backup space is used up, you w	vill be billed for the additional space.	After an instance is created, an automated backup will b	e created and saved for seven days.Backup Space Bil	ling 🖸
Enable autoscaling				
Additional storage will be billed. Learn more (8			
Disk Encryption				
Enabling disk encryption improves the securit	ty of data, but may slightly affect the	database read/write performance.		

Basic Settings
DB Instance Name 💿
rds-9a78
If you buy multiple DB instances at a time, they will be named with four digits appended in the format 'DB instance name-SN'. For example, if the DB instance name is 'instance', the first instance will be named 'instance-0001', the second 'instance-0002 and so on.
Password
Skip Configure
To log in, you will have to reset the password later on the Basic Information page for this instance.
Connectivity
VPC ①
vpc-DR v Q Create VPC (2
The VPC an RDS instance is deployed in cannot be changed later. ECSs in different VPCs cannot communicate with each other by default.
Subnet
subnet-mysql(192.168.0.0/24) V Q
An EIP is required if you want to access DB instances through a public network View EIP (?
IPv4 Address
· · ·
Addresses available: 251 View In-use IP Addresses
Database Port
Security Group 🕥
sp DR X V Q. View Security Group C
sp-DR X Q View Security Group [2] Ensure that port 3306 of the security group allows traffic from your server IP address to the DB instance. Create Security Group
Security Group Rules A

Figure 3-15 Configuring network information as planned

Figure 3-16 Additional options

Enterprise Project 💿	
default	V Q Create Enterprise Project [2]
Parameter Template	
Default-HighPerformance-Edition-MySQL-8.0	View Parameter Template []
Using a high-performance template tends to result in lo details, see the user guide. View Details	st data and replication exceptions after an instance recovers from a crash. There may also be out of memory (OOM) errors with small instance classes in high concurrency scenarios. For
Time Zone	
(UTC+08:00) Beijing, Chongqing, Hong Kong, Urumqi	v
Table Name 💿	
Case sensitive Case insensitive	
ag	
" "MS's predefined tags are recommended for adding the same	tag to different cloud resources. Create predefined tags []
+ Add Tag	
You can add 20 more tags.	
Paad Banlica	
Skip Create	
Required Duration and Quantity	
Quantity	
- 1 +	

Step 3 Confirm the settings.

- To modify your settings, click **Previous**.
- If there is no need to modify your settings, click Submit.

----End

3.6 Configuring Remote Disaster Recovery

3.6.1 Creating a DRS Disaster Recovery Task

Create a DRS disaster recovery task in the same region as the RDS for MySQL instance configured for the DR center.

Procedure

- Step 1 Go to the Create Disaster Recovery Task page.
- **Step 2** Select **AP-Singapore** for **Region**. Set **Disaster Recovery Relationship** to **Current cloud as standby**, and **DR DB Instance** to the RDS for MySQL DR instance created in the AP-Singapore region, and click **Create Now**.

-	5
Billing Mode	Yearly/Monthly Pay-per-use
Region	CN-Hong Kong
	Regions are geographic areas isolated from each other. For low network latency and quick resource access, select the nearest region.
Project	CN-Hong Kong V
* Task Name	DRS-DR-Task (2)
Description	0
	0/256 1/2
Disaster Recovery Inst	ance Details
The following information cannot be mode	fied after you go to the next page.
* Disaster Recovery Relationship	Current cloud as standby Current cloud as active
* Service DB Engine	MySQL DDM TaurusDB
* DR DB Engine	MySQL TaurusDB
* Network Type	Public network v 0
	ORS will automatically bind the specified EIP to the DRS instance and unbind the EIP after the task is complete. For details about the data transmission fee when an EIP is specified, see the pricing details of the EIP service.
* DR DB Instance	View DB Instance View Unselectable DB Instance

Figure 3-17 Setting DR instance information

Step 3 Return to the **Disaster Recovery Management** page and check the status of the task.

----End

3.6.2 Configuring the Disaster Recovery Task

Configure the disaster recovery task, including setting the source and destination databases.

Procedure

- **Step 1** On the **Disaster Recovery Management** page, locate the created disaster recovery task and click **Edit** in the **Operation** column.
- **Step 2** Add the EIP of the DRS instance to the inbound rule of the security group associated with the RDS for MySQL instance in the production center, select TCP, and set the port number to that of the RDS for MySQL instance of the production center.

Figure 3-18 Adding a security group rule

() solutions Summary Information En Summary Information En									
	000001010000	103							
 Some security group rule 	is will not take effect for ECSs with	certain specifications. Learn more					×		
Add Rule Fast-Add	Rule Delete Allos	v Common Ports Inbound Rules	3 View Security Group Configuration Exa	imples (2)					
Q. Select a property or enter	a keyword.						00		
Priority	Action	Туре	Protocol & Port	Source	Description	Last Modified	Operation		
0 1	Allow	IPv4	TCP : 3306		DR-Tøsk	Aug 14, 2024 15:57:32 GMT	Modify Replicate Delete		
0 1	Allow	IPv6	AI	sg-database (3)		Aug 14, 2024 15:35:31 GMT	Modify Replicate Delete		
0 1	Allow	IPv4	AI .	sg-database ()		Aug 14, 2024 15:35:31 GMT	Modify Replicate Delete		
Total Records: 3 10 V	< 1 >								

In the **Source Database** area, set **IP Address or Domain Name** and **Port** to the EIP and port of the RDS for MySQL instance in the production center. When the connection test is successful, click **Next**.

Figure 3-19 Editing a disaster recovery task

Source Database

Database Type	Self-built on ECS	RDS DB instance	
IP Address or Domain Name			
Port			
Database Username			
Database Password		۵	
SSL Connection			
	Test Connection	This button is available onl	y after the replication instance is created successful

Step 3 Configure the flow control and click **Next**.

Figure 3-20 Configuring flow control			
Flow Control	Yes	No	?
Migrate Definer to User	• Yes 🕜	○ No ⑦	

- **Step 4** Check the disaster recovery task. When the check success rate reaches 100%, click **Next**.
- **Step 5** Configure parameters and click **Next**.

Figure 3-21 Configuring parameters

Parameter Type Common parameters Performance parameters										
Select the destination database parameters whose values you want to change to be the same as those in the source database. Some changes take effect only after you restart the destination database. You are advised to restart the destination database before or after the migration.										
Save Change			C							
Parameter Name	Source Database Value	Destination Database Value	Result							
connect_timeout	10	10	O Consistent							
explicit_defaults_for_timestamp	OFF	OFF	Ocnsistent							
() innodb_flush_log_at_trx_commit	1	1	 Consistent 							
() innodb_lock_wait_timeout	50	50	Consistent							
max_connections	6000	2500	Inconsistent							
③ net_read_timeout	30	30	 Consistent 							
③ net_write_timeout	50	60	Consistent							
tr_isolation	REPEATABLE-READ	REPEATABLE-READ	O Consistent							

Step 6 Configure Start Time and click Submit.



* Start Time	Start upon task creation	Start at a specified time	0
Send Notifications	0		
* SMN Topic		v 0 0	
Delay Threshold (s)	0		
RTO Delay Threshold (s)	0		
RPO Delay Threshold (s)	0		
* Stop Abnormal Tasks After	14 🧿 Abno	ormal tasks run longer than the perio	d you set (unit: day) will automatically stop.

Step 7 On the Disaster Recovery Management page, check the task status. The status is Disaster recovery in progress.

For a task that is in the **Disaster recovery in progress** state, you can use **data comparison** to check whether data is consistent before and after the disaster recovery.

----End

3.6.3 Performing a Primary/Standby Switchover

If the source database in the production center is faulty, manually switch the DR instance to the read/write state. Then, data is written to the DR instance and synchronized to the source database.

Procedure

- **Step 1** Find that the source database in the production center is faulty. For example, the source database cannot be connected, the source database execution is slow, or the CPU usage is high.
- Step 2 Receive an SMN email notification.
- **Step 3** Check the delay of the DR task.
- **Step 4** Check that the services of the source database have been stopped. For details, see **How Do I Ensure that All Services on the Database Are Stopped?**
- **Step 5** Select the task, click the **Batch Operations** drop-down box in the upper left corner and select **Primary/Standby Switchover**.

Figure 3-23 Primary/standby switchover

Disa	aster Recovery Managemer	nt ⊙									🙂 Fee	idback	Create Disaster Re	ecovery Task
(Batch Operations View	w Abnormal Tasks	Export											
	Delete													C
	Stop		Status 🖯	Delay	Billing \varTheta	Disas 😣	DB Engine \varTheta	Created 😔	Ne 🖯	Billing M \varTheta	Description	En \varTheta	Operation	
	Pause													
	Resume	757	Stopped Stopped	-	No No	Current cl	DDM	Apr 25, 2024 11:14:	VPN or	Pay-per-use	-	default	Delete	
	Configure Exception Notification	065-	Configuration	-	No No	Current cl	MySQL	Apr 25, 2024 10:44:	VPN or	Pay-per-Use Created on A		default	Edit Stop Speed	1
	CRS-337/	071 :	C Disaster recovery in progress	Incremental delay	😥 Yes	Dual-active Instance	MySQL	Apr 25, 2024 10:08:	VPN or	Pay-per-use	-	default	Stop More ~	

Step 6 Change the database IP address on your application and use it to connect to the database. Then data is properly read from and written to the database.

----End

4 Migrating MySQL Databases from Other Clouds to RDS for MySQL

4.1 Overview

Scenarios

This best practice includes the following tasks:

- Create an RDS for MySQL instance.
- Migrate data from a MySQL database on other clouds to RDS for MySQL.

Prerequisites

- You have registered with Huawei Cloud.
- Your account balance is greater than or equal to \$0 USD.

Service List

- Virtual Private Cloud (VPC)
- RDS
- Data Replication Service (DRS)

Before You Start

- The resource planning in this best practice is for demonstration only. Adjust it as needed.
- All settings in this best practice are for reference only. For more information about MySQL migration, see **From MySQL to MySQL**.

4.2 Resource Planning

Categor y	Subcatego ry	Planned Value	Description
VPC	VPC name	vpc-src-172	Specify a name that is easy to identify.
	Region	Test region	To achieve lower network latency, select the region nearest to you.
	AZ	AZ3	-
	Subnet	172.16.0.0/16	Select a subnet with sufficient network resources.
	Subnet name	subnet-src-172	Specify a name that is easy to identify.
MySQL on another cloud	Database version	MySQL 5.7	-
	IP address	10.154.217.42	Enter an IP address.
	Port	3306	-
RDS for MySQL instance	Instance name	rds-mysql	Specify a name that is easy to identify.
	DB engine version	MySQL 5.7	-
	Instance type	Single	A single instance is used in this example. To improve service reliability, select a primary/ standby instance.
	Storage type	Cloud SSD	-
	AZ	AZ1	AZ1 is selected in this example. To improve service reliability, select the primary/standby instance type and deploy the primary and standby instances in different AZs.
	Instance class	General-purpose 2 vCPUs 8 GB	-

Table 4-1 Resource planning

Categor y	Subcatego ry	Planned Value	Description
DRS migratio n task	Task name	DRS-mysql	Specify a name that is easy to identify.
	Source DB engine	MySQL	-
	Destinatio n DB engine	MySQL	-
	Network type	Public network	Public network is used in this example.

4.3 Operation Process



4.4 Creating a VPC and Security Group

Create a VPC and security group for an RDS for MySQL instance
Creating a VPC

- **Step 1** Go to the **Create VPC** page.
- **Step 2** Configure the basic information, subnet, and IP address.

Figure 4-2 Creating a VPC

< Create VPC ③		
Basic Information		
Region	v v	
Name	vpc-bolb	
IPv4 CIDR Block	192 - 193 - 0 - 0 / 15 - 0	
	Recommended 10.0.0/b24(Select) 172.16.0/12.24(Select) 192.160.0/16-24(Select)	
	A The CIDR block 192 168 8 01% overlaps with a CIDR block of another VPC in the current region. If you related to enable communication between VPCs or between a VPC and as on semitises, data contex, thange the CIDR block. Your VPC CIDR blocks	
Enterprise Project	default v 🛞 Q. Create Enterprise Project [2]	
 Advanced Settings (Option 		
Tag: Description:		
Subnet Setting1		🗍 Delete
Subnet Name	subnet-boas	
AZ	[A21	
IPv4 CIDR Block		
	Avsilable IP Addresses: 251	
	The CIDR block cannot be modified after the subnet has been created.	

Step 3 Click Create Now.

Step 4 Return to the VPC list and check whether the VPC is created.

If the VPC status becomes available, the VPC has been created.

----End

Creating a Security Group

- **Step 1** Log in to the management console.
- Step 2 Click ⁽²⁾ in the upper left corner of the management console and select CN-Hong Kong.
- **Step 3** Under the service list, choose **Networking** > **Virtual Private Cloud**.
- **Step 4** In the navigation pane, choose **Access Control** > **Security Groups**.
- Step 5 Click Create Security Group.
- **Step 6** Configure parameters as needed.

Figure 4-3 Creating a security group

< Create Security	/ Group
Summary	
Region	
Name	Regions are geographic areas isolitide from each other. Resources are region-specific and cannot be used access regions through internal network connections. For law network latency and quick resource access, select the meaned ingion.
Enterprise Project	default v () Q. Create Enterprise Project (2
Tag (Optional)	TMS's predefined tags are recommended for adding the same tag to different cloud resources. Cleate predefined tags 22 Q
	+ Add Tag Yao cin dd 20 more tags.
Description (Optional)	
Manage Rules ③	
For optimal perfection optima	omerov, ensure that exch security group does not contain more than 50 rules. Tong Lines will not take effect for CCDs will not exchange or contain security and the contain the effect of CCDs will not exchange of the contain the effect of the contain the contained of the contain
Preset Rule	Contan rule v
Inhound Dulas	Puthouse Ruize

- Step 7 Click Create Now.
- **Step 8** Return to the security group list and click the security group name.
- **Step 9** Click the **Inbound Rules** tab, and then click **Add Rule**.
- **Step 10** Configure an inbound rule to allow access from database port **3306**.

Figure 4-4 Inbound rules

< g-database					@ Feedback	Import Rule	Export Rule
Summary Inbound Rules Outbound Rules Associated	Instances Tag						
Some security group rules will not take effect for ECSs with certain spe-	acifications. Learn more						×
Add Rule Fast-Add Rule Delete Allow Common	Ports Inbound Rules: 3 View	Security Group Configuration Example	es (2				
Q. Select a property or enter a keyword.							00
Priority Action	Туре	Protocol & Port	Source	Description	Last Modified	Operation	
1 Allow	IPv4	TCP : 3306		DR-Task	Aug 14, 2024 15:57:32 GMT	Modify Replicate	Delete
1 Allow	IPv6	Al	sg-database 💿		Aug 14, 2024 15:35:31 GMT	Modify Replicate	Delete
1 Allow	IPv4	Al .	sg-database ()		Aug 14, 2024 15:35:31 GMT	Modify Replicate	Delete
Total Records: 3 10 V < 1 >	Total Records 3 10 V (1)						

----End

4.5 Creating an RDS for MySQL Instance

Create an RDS for MySQL instance, and select the VPC and security group you configured for the instance.

- Step 1 Go to the Buy DB Instance page.
- **Step 2** Configure basic information for the instance. Select **CN-Hong Kong** for **Region**.

Figure 4-5 Basic information

ick Config Custom Config				
Basic Settings				
Billing Mode ⑦				
Yearly/Monthly Pay-per-use				
Region				
•	~			
Regions are geographic areas isolated fro	om each other. For low network latency a	nd quick resource access, select the n	earest region.	
Engine Options				
DB Engine				
TaurusDB	MySQL	PostgreSQL	Microsoft SQL Server	MariaDB
DB Engine Version				
8.0 ~				
DB Instance Type				
Primary/Standby Single				
Primary/standby HA architecture is suitable	le for production databases in large- and	medium-sized enterprises, or for appli	cations in Internet, IoT, retail e-commerce,	logistics, and gaming industries.
Storage Type				
Cloud SSD Extreme SSD				
Primary AZ				
, _				

Step 3 Select an instance class.

Instance Configuration				
Instance Class				
Dedicated General-purpose	Kunpeng general-enhanced			
vCPUs Memory		Recommended Connections	TPS QPS ③ IPv6	
2 vCPUs 4 GB		4,000	580 11,597 Supported	
2 vCPUs 8 GB		6,000	590 11,804 Supported	
2 vCPUs 16 GB		8,000	841 16,859 Not supported	
4 vCPUs 8 GB		6,000	1,196 23,914 Supported	
4 vCPUs 16 GB		8,000	1,357 27,159 Supported	
4 vCPUs 32 GB		10,000	1,435 28,701 Supported	
DB Instance Specifications rds.mysql.x1.l	arge.2.ha 2 vCPUs 4 GB (Dedicated) , Re	commended Connections: 4,000, TPS QPS: 580 11,597		
Storage Space (?)				
0		- 40 +	GB	
40	830 1620	2410 4000		
Backup Space				
RDS provides 40 GB of free backup storag	e, the same size as your purchased storage	space.		
After the free backup space is used up, you will be billed for the additional space. After an instance is created, an automated backup will be created and saved for seven days. Backup Space Billing 🖸				
Deable autoscaing				
Addional storage will be billed. Learn more 🖸				
Disk Encryption				
Enabling disk encryption improves the securi	ty of data, but may slightly affect the databa	se read/write performance.		

Figure 4-6 Instance class

Step 4 Select a VPC and security group for the instance and configure the database port.The VPC and security group have been created in Creating a VPC and Security Group.

DB Instance Name 🕝	
rds-9812	
If you buy multiple DB instances at a time, they will be named with four digits appende and so on.	ed in the format "DB instance name-SN". For example, if the DB instance name is "instance", the first instance will be named "instance-0001", the second "instance-000
Password	
Skip Configure	
To log in, you will have to reset the password later on the Basic Information page for t	this instance.
Connectivity	
VPC 💿	
vpc-a33b v	Q Create VPC [2]
The VPC an RDS instance is deployed in cannot be changed later. ECSs in different	VPCs cannot communicate with each other by default.
Subnet	
subnet-a389(192.168.0.0/24)	Q
IPv6 CIDR block:2407:c080:1200:217e::/64	
An EIP is required if you want to access DB instances through a public network. View	EIP 🕐
IPv4 Address	
Addresses available: 251 View In-use IP Addresses	
Database Port	
Default port: 3306	
Security Group	
Security Group ()	

Figure 4-7 Network configurations

Step 5 Complete advanced settings.

Figure 4-8 Additional options

Additional Options	
Enterprise Project 💮	
default	✓ Q. Create Enterprise Project [2]
Parameter Template	
Default-HighPerformance-Edition-MySQL-8.0	V View Parameter Template [2]
▲ Using a high-performance template tends to result in lost details, see the user guide. View Details	data and replication exceptions after an instance recovers from a crash. There may also be out of memory (OOM) errors with small instance classes in high concurrency scenarios. For
Time Zone	
(UTC+08:00) Beijing, Chongqing, Hong Kong, Urumqi	v
Table Name 💿	
Case sensitive Case insensitive	
Tag	
TMS's predefined tags are recommended for adding the same tag	g to different cloud resources. Create predefined tags 🕐 📿
+ Add Tag	
You can add 20 more tags.	
Read Replica	
Skip Create	
Required Duration and Quantity	
Quantity	
- 1 +	

Step 6 Click Next.

- **Step 7** Confirm the settings.
 - To modify your settings, click **Previous**.
 - If you do not need to modify your settings, click **Submit**.
- **Step 8** Return to the instance list. If the instance status becomes available, the instance has been created.

----End

4.6 Configuring a MySQL Instance on Another Cloud

Prerequisites

- You have purchased a MySQL instance from another cloud vendor platform.
- Your account has the migration permissions listed in **Permission Requirements**.

Permission Requirements

Table 4-2 lists the permissions required for migrating data from a MySQL instance on another cloud to RDS for MySQL using DRS. For details about the permissions, see **Which MySQL Permissions Are Required for DRS?**

Table 4-2	Migration	permissions
-----------	-----------	-------------

Database	Full Migration Permission	Full+Incremental Migration Permission
Source database (MySQL)	SELECT, SHOW VIEW, and EVENT	SELECT, SHOW VIEW, EVENT, LOCK TABLES, REPLICATION SLAVE, and REPLICATION CLIENT

Network Configuration

You need to enable public accessibility for the source database.

Whitelist Settings

The EIP of the DRS replication instance must be on the whitelist of the source database for the connectivity between the DRS replication instance and the source database. To obtain the EIP of the DRS replication instance, see **Step 3** in **Creating a DRS Migration Task**. This method of configuring a whitelist varies depending on the cloud database vendors. For details, see their official documents.

4.7 Cloud Migration

4.7.1 Creating a DRS Migration Task

Creating a Migration Task

- **Step 1** Go to the **Create Migration Task** page.
- **Step 2** Configure parameters as needed.
 - 1. Enter the migration task name. Select the region hosting the destination DB instance for **Region**.

Figure 4-9 Migration task

Ragian	Pages are perpendic area isokiel for each other Resource are expin-specific and cannol is used access regions through internal network corrections. For four relator is latery and quick resource access, select the easered region.
Project	•
* Task Name	085415
Description	0
	0255

2. Configure the replication instance information.

Select the RDS instance created in **Creating an RDS for MySQL Instance** as the destination database.

Figure 4-10	Replication	instance	details
-------------	-------------	----------	---------

Replication Instance Details 💿			
The following information cannot be mo	utified after you go to the next page.		
* Data Flow	To the cloud Out of the cloud The destination database must be a database in the current cloud. If you want to migrate data between databases, select To the cloud.		
* Source DB Engine	MySQL MongoDB MySQL schema and logic table Single-Node or Master/Standby Redis Redis cluster		
* Destination DB Engine	MySQL DDM TaurusDB		
* Network Type	VPC ✓ Ø		
* Destination DB Instance	C Vew DB Instance Vew Unselectable DB Instance During the full synchronization of a DRS task, a lot of binlogs are generated. These binlogs may be temporarily stored locally, which may cause the storage space to be used up. You are advised to enable storage autoscalary for the ROS DB Instance. During the DRS task, set an appropriate local retention period for ROS binlogs. You can also clear brinlogs exceeding the specified retention period with just a lew clubs.		
* Replication Instance Subnet	default_subnet(192.168.0.0/24) V The IP address is allocated automatically but it can 📎 View Subnets View Occupied IP Address		
* Migration Type	Full+Incremental Full This migration type is suitable for scenarios where services can be interrupted. It migrates database objects and data, in a non-system database, to a destination database all at the same time. After the data migration is complete, the task automatically stops.		
* Destination DB Instance Access	Read-only Read-Write During the migration, the destination DB instance can be configured to be writable, but if the data being migrated is modified, there may be data conflicts or other errors, and the migration task cannot be resurned.		
* Enable Binlog Cleanup			

Step 3 Click Create Now.

It takes about 5 to 10 minutes to create a replication instance. After the replication instance is created, you can obtain its EIP.

O The replication instance is created. Its EIP is 122.9.214.142. Add this EIP to the source database whitelist so that it can access the source database.

Step 4 Configure the source and destination database information.

Source Database	
DRS migrates only some key parameters to	the destination database. For the other parameters that cannot be migrated, you need to use parameter templates to configure them on the destination database.
IP Address or Domain Name	
Port	
Database Username	root
Database Password	
SSL Connection	
	Test Connection O Test successful
Destination Database	
DB Instance Name	rds-bff6 (192.168.0.17)
Database Username	root
Database Password	······
Migrate Definer to User	● Yes ⑦ ○ No ⑦
	Test Connection 0 Test successful

Figure 4-11 Configuring the source and destination databases

Step 5 Click Next.

- **Step 6** On the **Set Task** page, configure parameters as required.
 - Set Flow Control to No.
 - Set Migration Object to All.
- **Step 7** Click **Next**. On the **Check Task** page, check the migration task.
 - If any check fails, review the cause and rectify the fault. After the fault is rectified, click **Check Again**.
 - If all check items are successful, click Next.
- Step 8 Compare source and destination database parameters.
 - If you do not want to compare the parameters, click **Next** to skip this step.
 - If there are inconsistent common parameter values, click **Save Change** to change the destination database values to match those of the source database.
- Step 9 Click Submit to submit the task.

Return to the **Online Migration Management** page and check the migration task status.

It takes several minutes to complete.

If the status changes to **Completed**, the migration task is complete.

----End

4.7.2 Checking Migration Results

You can use either of the following methods to check the migration results:

- 1. Use DRS to compare migration objects, users, and data of source and destination databases and obtain the migration results. For details, see **Checking the Migration Results on the DRS Console**.
- 2. Log in to the destination instance to check whether the databases, tables, and data are migrated. For details, see **Checking the Migration Results on the RDS Console**.

Checking the Migration Results on the DRS Console

- **Step 1** Log in to the management console.
- **Step 2** Click ^(Q) in the upper left corner and select your region.
- **Step 3** Under the service list, choose **Databases** > **Data Replication Service**.
- **Step 4** Click the DRS instance name.
- Step 5 Click Migration Comparison in the navigation pane. Under the Object-Level Comparison tab, click Compare to check whether all objects have been migrated to the destination instance.
- **Step 6** Click the **Data-Level Comparison** tab. On the displayed page, click **Create Comparison Task** to check whether the databases and tables of the source and destination instances are the same.
- **Step 7** Click **Account-Level Comparison** and check whether the accounts and permissions of the source and destination instances are the same.

----End

Checking the Migration Results on the RDS Console

- **Step 1** Log in to the management console.
- **Step 2** Click ⁽²⁾ in the upper left corner and select your region.
- Step 3 Click the service list icon on the left and choose Databases > Relational Database Service.
- **Step 4** Locate the destination instance and click **Log In** in the **Operation** column.
- **Step 5** In the displayed dialog box, enter the password and click **Test Connection**.
- **Step 6** After the connection test is successful, click **Log In**.
- **Step 7** Check whether the databases and tables of the source instance have been migrated.

----End

Performing a Performance Test

After the migration is complete, you can perform a performance test as required.

5 Using RDS for MySQL to Set Up WordPress

WordPress is a blog platform developed based on PHP. It is usually used with RDS for MySQL database servers to help users build websites. This section describes how to set up WordPress in the Linux, Apache, MySQL and PHP (LAMP) environment using Huawei Cloud VPC, ECS, and RDS for MySQL.

- 1. Configuring Network Information
- 2. Buying an ECS
- 3. Setting Up the LAMP Environment
- 4. Buying and Configuring an RDS DB Instance
- 5. Installing WordPress

Preparations

During the setup, you will use the following services or tools:

- Cloud services: Huawei Cloud ECS and RDS for MySQL.
- MySQL client: a database configuration tool
- PuTTY: a remote login tool

NOTE

The previous software is provided by third-party websites. The information is just for your reference and not for commercial use.

Configuring Network Information

- **Step 1** Log in to the **management console**.
- **Step 2** Click **O** in the upper left corner and select a region.
- **Step 3** Choose **Networking > Virtual Private Cloud**.
- **Step 4** On the displayed page, click **Create VPC** to create a VPC, such as vpc-01.
- **Step 5** On the displayed page, enter a VPC name, set **IPv4 CIDR Block** to **192.168**, select an AZ as required, and add a subnet. Retain the default settings for other

parameters. Then, click **Create Now**. After the VPC is created, return to the network console.

- **Step 6** On the network console, choose **Access Control** > **Security Groups** and click **Create Security Group**. The following uses sg-01 as an example.
- **Step 7** On the **Security Groups** page, locate the target security group and click **Manage Rules** in the **Operation** column.
- Step 8 Click Add Rule and add an inbound rule for the EIP bound to the ECS.

----End

Buying an ECS

Step 1 Log in to the management console.

- **Step 2** Click \bigcirc in the upper left corner and select a region.
- **Step 3** Choose **Compute > Elastic Cloud Server**. The **Elastic Cloud Server** page is displayed.
- **Step 4** On the ECS console, buy an ECS.
 - 1. Configure basic settings: Select the pay-per-use billing mode, a region, and an image. Retain the default settings for other parameters.

The public image **CentOS7.4 64bit for P2v(40GB)** is used as an example, as shown in **Figure 5-1**.

Figure 5-1 Selecting an image

Image	Public image	Private	image	Shared image
	CentOS	-	CentOS 7.	4 64bit for P2v(40GB)

- 2. Configure network: Select a VPC and security group, and purchase an EIP. Retain the default settings for other parameters.
 - a. Select the created VPC vpc-01.
 - b. Select the created security group sg-01.
 - c. Select **Auto assign** for **EIP**.
- 3. Configure advanced settings: Enter an ECS name and password, and click **Next: Confirm**.
 - a. Enter an ECS name, such as *ecs-01*.
 - b. Enter a password.
- 4. Confirm: Confirm the information and click **Next**.
- **Step 5** After the ECS is created, view and manage it on the ECS console.

----End

Setting Up the LAMP Environment

Step 1 Download the PuTTY client.

- **Step 2** Decompress the package, locate **putty** from the extracted files and double-click it.
- Step 3 In the displayed PuTTY configuration dialog box, choose Session and specify basic options for your PuTTY session in the right pane. Then, click Open as shown in Figure 5-2.
 - 1. Enter the EIP of your ECS in the Host Name (or IP address) text box.
 - Enter a session name in the Saved Sessions text box and click Save. Wordpress is used as an example. Retain the default settings for other parameters.

🕵 PuTTY Configuration		×
Category:		
Session	Basic options for your PuTTY se	ssion
	Specify the destination you want to conne	ct to
	Host Name (or IP address)	Port
Bell	1	22
Features	Connection type:	
Window	🔘 Raw 🛛 Telnet 🔘 Rlogin 💿 SSH	l 🔘 Serial
Appearance Behaviour Translation Selection Colours Connection Data Proxy Telnet Rlogin SSH	Load, save or delete a stored session Saved Sessions Wordpress Default Settings Discuz Wordpress	Load Save Delete
Serial	Close window on exit: Always Never Only on cl	ean exit
About	Open	Cancel

Figure 5-2 Configuring PuTTY

- **Step 4** In the displayed login window, enter the ECS username and password to log in to ECS.
- Step 5 Obtain the root permissions so that you can enter commands in PuTTY.

Enter commands to install MySQL, PHP or other software. For example, run the following command to install PHP:

yum install -y httpd php php-fpm php-server php-mysql mysql

The installation is complete if the following command output is displayed: Complete

Step 6 Run the following command to install a decompression software:

yum install -y unzip

Step 7 Run the following command to download and decompress the WordPress installation package:

wget -c https://wordpress.org/wordpress-4.9.1.tar.gz

tar xzf wordpress-4.9.1.tar.gz -C /var/www/html

chmod -R 777 /var/www/html

Step 8 After the installation is complete, run the following commands to start related services in sequence:

systemctl start httpd.service

systemctl start php-fpm.service

Step 9 Enable automatic start of the service during system startup.

systemctl enable httpd.service

----End

Buying and Configuring an RDS DB Instance

- Step 1 Buy a DB instance as required.
 - DB instance rds-01 is used as an example. Select MySQL 5.7.
 - Ensure that the RDS DB instance uses the same security group as the ECS so that you can access the RDS DB instance through the ECS.
 - Set the root user password and keep the password secure. The system cannot retrieve your password.
- **Step 2** Go to the RDS console. On the **Instances** page, click the target DB instance rds-01. The **Overview** page is displayed.
- **Step 3** Choose **Databases** in the navigation pane on the left and click **Create Database**. In the displayed dialog box, enter a database name, such as *wordpress*, select a character set, and authorize permissions for database users. Then, click **OK**.

Database Name	wordpress ()			,
Character Set	● utf8	🔵 utf8mb	4 More	
User	User Not Authorized 0	0	Authorized User	0 / 0
	C Enter a keyword.		Q Enter a keyword.	
	Name Permission		Name	Permission
	No data available		No c	lata available
Remarks	0/512			
If you require fined-	grained authorization, log in to the database.			OK Cancel

Figure 5-3 Creating a database

Step 4 Choose **Accounts** in the navigation pane on the left and click **Create Account**. In the displayed dialog box, enter the database username, such as *tony*, authorize permissions for database *wordpress* created in **Step 3**, enter the password, and confirm the password. Then, click **OK**.

Create Accou	nt				×
Username	tony	0			
Host IP Address	10.10.10.%	0			
Database	Database Not Authorized		0/0	Database Authorized	0/1
	Q Enter a keyword.			Q Enter a keyword.	
	Name	Permission		Name	Permission
				wordpress	Read onlyRead and write
	No data a	vailable			
Password		\$			
Confirm Password	•••••	8			
If you require fined-gra	ained authorization, log in to the da	atabase.			
					OK Cancel

Figure 5-4 Creating an account

----End

Installing WordPress

- **Step 1** On the **Elastic Cloud Server** page, locate the target ECS and click **Remote Login** in the **Operation** column.
- Step 2 In the Internet Explorer, enter http://*EIP*/wordpress in the address box and click Let's go!

In the preceding URL, *EIP* indicates the EIP automatically assigned when you purchase the ECS in **Buying an ECS**.

Figure 5-5 Visiting WordPress



Step 3 Enter database connection information and click Submit.

- The database name is *wordpress*.
- The username is *tony*.
- The password is the one that you set for *tony*.
- The database host is the floating IP address of DB instance rds-01.

Figure 5-6 Entering database connection information

Below you should enter	your database connection details. If y	ou're not sure about these, contact your host.
Database Name	wordpress	The name of the database you want to use with WordPress.
Username		Your database username.
Password		Your database password.
Database Host		You should be able to get this info from your web host, if localhost doesn't work.
Table Prefix	wp_	If you want to run multiple WordPress installations in a single database, change this.
Submit		

Step 4 After the database connection details are verified, click **Run the installation**.

Figure 5-7 Running the installation

← → C 0 //wordpress/wp	-admin/setup-config.php?step-2	☆] :
	All right, sparkyl You/ve made it through this part of the installation. WordPress can now communicate with your database. If you are ready, time now to Run the installation	

Step 5 Set **Site Title**, **Username**, and **Password** for logging in to your blog. Then, click **Install WordPress**.

Figure 5-8 Setting basic information

← → C 0 /wor	dpress/wp-admin/install.p	php?language=en_US	0 7 ☆
	Welcome to the famou be on your way to usin Information n Please provide the follo	us five-minute WordPress installation process! Just fill in the information below and you'll ng the most extendable and powerful personal publishing platform in the world. needed	
	Site Title	RecEnded Blog	
	Username	admin Usernames can have only alphanumeric characters, spaces, underscores, hyphens, periods, and the @ combol.	
	Password	Medium	
	Your Email	Important: You will need this password to log in. Please store it in a secure location.	
	Search Engine Visibility	Discourage search engines from indexing this site It is up to search engines to honor this request.	
	Install WordPress		

Step 6 Click Log In after WordPress has been successfully installed.

Figure 5-9 Successful installation

\leftrightarrow \forall \bigcirc \bigcirc \bigcirc /wordpress/wp-	admin/install.php?step=2	⁰•☆:
	Success!	
	WordPress has been installed. Thank you, and enjoy!	
	Username admin	
	Password Your chosen possword.	
	Log In	

Step 7 Enter the username and password on the displayed login page. Then, click **Log In**.

← → C O //wordpress/wp-login.php		 아☆ :
	Herrome er Empil Address	
	admin	
	Password	
	•••••	
	Remember Me	
	Lost your password?	
	← Back to Blog	

Figure 5-10 Logging in

Step 8 Check that WordPress has been deployed successfully.



Figure 5-11 Verification

----End

6 Using RDS for MySQL to Set Up Discuz!

Crossday Discuz! Board (Discuz! for short) is a universal community forum software system. You can set up a customized forum with comprehensive functions and strong load capability on the Internet through simple installation and settings. This section describes how to set up Discuz! in the LAMP environment using Huawei Cloud VPC, ECS, and RDS for MySQL.

- 1. Configuring Network Information
- 2. Creating an ECS
- 3. Setting Up the LAMP Environment
- 4. Buying and Configuring an RDS DB Instance
- 5. Installing Discuz!

Preparations

During the setup, you will use the following services or tools:

- Cloud services: ECS and RDS on Huawei Cloud
- PuTTY: a remote login tool
- Installation packages
 - Apache Http Server 2.4.6
 - MySQL 5.4.16
 - PHP 5.4.16

D NOTE

The previous software is provided by third-party websites. The information is just for your reference and not for commercial use.

Configuring Network Information

Step 1 Log in to the **management console**.

Step 2 Click O in the upper left corner and select a region.

Step 3 Choose **Networking > Virtual Private Cloud**.

- **Step 4** On the displayed page, click **Create VPC** to create a VPC, such as vpc-01.
- **Step 5** On the displayed page, enter a VPC name, set **IPv4 CIDR Block** to **192.168**, select an AZ as required, and add a subnet. Retain the default settings for other parameters. Then, click **Create Now**. After the VPC is created, return to the network console.
- **Step 6** On the network console, choose **Access Control** > **Security Groups** and click **Create Security Group**. The following uses sg-01 as an example.
- **Step 7** On the **Security Groups** page, locate the target security group and click **Manage Rules** in the **Operation** column.
- **Step 8** Click **Add Rule** and add an inbound rule for the **EIP** bound to the ECS.

----End

Buying an ECS

- **Step 1** Log in to the management console.
- **Step 2** Click ¹ in the upper left corner and select a region.
- **Step 3** Choose **Compute** > **Elastic Cloud Server**. The **Elastic Cloud Server** page is displayed.
- **Step 4** On the ECS console, buy an ECS.
 - 1. Configure basic settings: Select the pay-per-use billing mode, a region, and an image. Retain the default settings for other parameters.

The public image **CentOS7.4 64bit for P2v(40GB)** is used as an example, as shown in **Figure 6-1**.

Figure 6-1 Selecting an image

mage	Public image	Private image	Shared image
	CentOS	✓ CentOS 7.	4 64bit for P2v(40GB)

- 2. Configure network: Select a VPC and security group, and purchase an EIP. Retain the default settings for other parameters.
 - a. Select the created VPC vpc-01.
 - b. Select the created security group sg-01.
 - c. Select **Auto assign** for **EIP**.
- 3. Configure advanced settings: Enter an ECS name and password, and click **Next: Confirm**.
 - a. Enter an ECS name, such as *ecs-01*.
 - b. Enter a password.
- 4. Confirm: Confirm the information and click **Next**.
- **Step 5** After the ECS is created, view and manage it on the ECS console.

----End

Setting Up the LAMP Environment

- **Step 1** Download the PuTTY client.
- Step 2 Decompress the package, locate putty from the extracted files and double-click it.
- Step 3 In the displayed PuTTY configuration dialog box, choose Session and specify basic options for your PuTTY session in the right pane. Then, click Open as shown in Figure 6-2.
 - 1. Enter the EIP of your ECS in the Host Name (or IP address) text box.
 - 2. Enter a session name in the **Saved Sessions** text box and click **Save**. **Discuz** is used as an example. Retain the default settings for other parameters.

RuTTY Configuration	8
Category:	
	Basic options for your PuTTY session
	Specify the destination you want to connect to
Keyboard	Host Name (or IP address) Port
Bell	22
····· Features	Connection type: Raw Telnet Rlogin SSH Serial
Appearance Behaviour Translation Selection Colours Connection Data Proxy Telnet Rlogin ENCOMPARENT	Load, save or delete a stored session Saved Sessions Discuz Default Settings Discuz Save Delete
Serial	Close window on exit: Always Never Only on clean exit
About	Open Cancel

Figure 6-2 Configuring PuTTY

- **Step 4** In the displayed login window, enter the ECS username and password to log in to ECS.
- **Step 5** Install Apache, MySQL, PHP and other software.

Obtain the **root** permissions so that you can enter commands in PuTTY.

Enter commands to install software. For example, run the following command to install PHP:

yum install -y httpd php php-fpm php-server php-mysql mysql

The installation is complete if the following command output is displayed:

Complete

Step 6 After the installation is complete, start related services in sequence.

systemctl start httpd.service

systemctl start php-fpm.service

----End

Buying and Configuring an RDS DB Instance

Step 1 Buy a DB instance as required.

- DB instance rds-01 is used as an example. Select MySQL 5.7.
- Ensure that the RDS DB instance uses the same security group as the ECS so that you can access the RDS DB instance through the ECS.
- Set the root user password and keep the password secure. The system cannot retrieve your password.
- **Step 2** After the RDS DB instance is created, view or manage it on the **management console**.

----End

Installing Discuz!

- **Step 1** Download the **Discuz! installation package**.
- **Step 2** Upload the installation package to the ECS using a data transfer tool.
 - Run the following command to decompress the Discuz! installation package: unzip Discuz_X3.3_SC_UTF8.zip
 - Run the following command to copy all files in upload to /var/www/html/.
 cp -R upload/* /var/www/html/
 - Run the following command to grant write permissions to other users. chmod -R 777 /var/www/html
- **Step 3** Enter **http://***EIP***/install** in the address box in a local Windows browser and install Discuz! following the guidance.

In the preceding URL, *EIP* indicates the EIP automatically assigned when you purchase the ECS in **Buying an ECS**. The **install** must be lowercase.

- 1. Confirm the agreement and click **I Agree**.
- 2. After the installation starts, check the installation environment and click Next.
- 3. Set the running environment and click **Next**.
- 4. Enter the database information and click **Next** to complete the installation.
 - The database address is the floating IP address of DB instance rds-01.
 - The database password is the root user password of DB instance rds-01.
 - Enter administrator information.

Step 4 After Discuz! is installed, enter **http://***EIP***/forum.php** in the browser address bar. If the forum homepage is displayed, the website is successfully built.

----End

7 Description of innodb_flush_log_at_trx_commit and sync_binlog

The **innodb_flush_log_at_trx_commit** and **sync_binlog** are key parameters for controlling the disk write policy and data security of RDS for MySQL. Different parameter values have different impacts on performance and security.

Table 7-1	Parameter	description
-----------	-----------	-------------

Parameter	Allowed Values	Description
innodb_flush_log_at_trx_ commit	0, 1, and 2	Controls the balance between strict ACID compliance for commit operations, and higher performance that is possible when commit-related I/O operations are rearranged and done in batches. The default value is 1 . For details, see Parameter Description .
sync_binlog	0 to 4, 294, 967, 295	Sync binlog (RDS for MySQL flushes binary logs to disks or relies on the OS).

Parameter Description

- innodb_flush_log_at_trx_commit:
 - D: The log buffer is written out to the log file once per second and the flush to disk operation is performed on the log file, but nothing is done at a transaction commit.
 - 1: The log buffer is written out to the log file at each transaction commit and the flush to disk operation is performed on the log file.

 2: The log buffer is written out to the file at each commit, but the flush to disk operation is not performed on it. However, the flushing on the log file takes place once per second.

- A value of **0** is the fastest choice but less secure. Any mysqld process crash can erase the last second of transactions.
- A value of **1** is the safest choice because in the event of a crash you lose at most one statement or transaction from the binary log. However, it is also the slowest choice.
- A value of **2** is faster and more secure than **0**. Only an operating system crash or a power outage can erase the last second of transactions.

• sync_binlog=1 or N

By default, the binary log is not every time synchronized to disk. In the event of a crash, the last statement in the binary log may get lost.

To prevent this issue, you can use the **sync_binlog** global variable (**1** is the safest value, but also the slowest) to synchronize the binary log to disk after N binary log commit groups.

Recommended Configurations

innodb_flush_log_at_ trx_commit	sync_binlog	Description
1	1	High data security and strong disk write capability
1	0	High data security and insufficient disk write capability. Standby lagging behind or no replication is allowed.
2	0/N (0 < N < 100)	Low data security. A small amount of transaction log loss and replication delay is allowed.
0	0	Limited disk write capability. No replication or long replication delay is allowed.

 Table 7-2 Recommended configurations

D NOTE

- When both **innodb_flush_log_at_trx_commit** and **sync_binlog** are set to **1**, the security is the highest but the write performance is the lowest. In the event of a crash you lose at most one statement or transaction from the binary log. This is also the slowest choice due to the increased number of disk writes.
- When **sync_binlog** is set to *N* (*N* > 1) and **innodb_flush_log_at_trx_commit** is set to **2**, the RDS for MySQL write operation achieves the optimal performance.

8 How Do I Improve the Query Speed of My RDS for MySQL Instance?

The following are some suggestions provided for you to improve the database query speed:

- View the slow query logs to check if there are any slow queries, and review their performance characteristics (if any) to locate the cause. For details about how to view RDS for MySQL logs, see Viewing and Downloading Slow Query Logs.
- View the CPU usage of your RDS DB instance to facilitate troubleshooting. For details, see **Configuring Displayed Metrics**.
- Create read replicas to offload read pressure on the primary DB instance. For details, see **Introducing Read Replicas**.
- **Enable read/write splitting** after read replicas are created. Write requests are automatically routed to the primary DB instance and read requests are routed to read replicas by user-defined weights.
- Increase the CPU or memory specifications for DB instances with high load.
 For details, see Changing a DB Instance Class. To temporarily reduce the load, you can kill sessions. For details, see Managing Real-Time Sessions.
- Add indexes for associated fields in multi-table association queries.
- Specify a field or add a WHERE clause, which will prevent full table scanning triggered by the SELECT statement.

9 Handling RDS for MySQL Long Transactions

Potential Impacts of Long Transactions

- 1. Long transactions lock resources and usually increase metadata locks and row locks. As a result, other transactions cannot access these resources, reducing the database concurrency.
- 2. Long transactions may occupy a large amount of memory.
- 3. Long transactions may cause too large log files and high storage usage.

Identifying Long Transactions

• Connect to your DB instance and check long transactions and their session IDs.

After connecting to the DB instance, run the following command to view the ID of any transaction that has been executing for more than 3,000s, the executed SQL statement, and the corresponding session ID.

mysql> SELECT trx_id, trx_state, trx_started, trx_mysql_thread_id, trx_query, trx_rows_modified FROM information_schema.innodb_trx WHERE TIME_TO_SEC(timediff(now(),trx_started)) >3000;

Parameter	Description
trx_id	Transaction ID.
trx_state	Transaction status, which can be RUNNING, LOCK WAIT , or ROLLING BACK .
trx_started	Time when the transaction was started.
trx_mysql_thread_id	ID of the MySQL session to which the transaction belongs.

 Table 9-1 Parameter description

Parameter	Description
trx_query	SQL statement executed by the transaction.
trx_rows_modified	Number of rows modified by the transaction.

- Check monitoring metrics for long transactions.
 - a. Log in to the management console.
 - b. Click in the upper left corner of the page and choose **Databases** > **Relational Database Service**.
 - c. On the **Instances** page, locate the target DB instance and click **View Metrics** in the **Operation** column.
 - d. Check the long transaction metric **rds_long_transaction**. If the metric increases linearly to a large value, there are long transactions.

Killing Long Transactions

1. Obtain the thread IDs corresponding to long transactions.

Run the SQL statement in **Connect to your DB instance to check long transactions and their session IDs** to obtain the session ID of the transaction whose execution time exceeds a certain period (for example, 3,000s).

mysql> SELECT trx_mysql_thread_id FROM information_schema.innodb_trx WHERE TIME_TO_SEC(timediff(now(),trx_started)) >3000;

2. After obtaining the session ID, run the **kill** command to kill the transaction.

mysql> kill trx_mysql_thread_id

NOTICE

Killing a long transaction will cause the transaction to roll back. Evaluate the impact before running this command.

Configuring Long Transaction Alarms

- 1. View the configured alarms.
 - a. Log in to the management console.
 - b. Click in the upper left corner of the page and choose Management & Governance > Cloud Eye.
 - c. Choose Alarm Management > Alarm Rules.

Figure 9-1 Viewing alarm rules

									_	
Cloud Eye	Alarm Rules 💿							😳 Feedback 🍞	Usage Guide	Create Alarm Rule
Overview Dashboards	Enable Disable	Delete More •								C 🕸
Resource Groups	NameID	Resource Type	Monitored Object	Alarm Policy	Status	Notification Group/Topic	Alarm Maski	Alarm Masking Duration	Operation	
Alarm Management Alarm Rufes Alarm Records Alarm Templates Alarm Notifications	AUTO_CES_ALARM_R al1633682248814990007	Relational Database Se	MySQL Instances Specific resources	Trigger an aism if Connection Usage Avg. >= 80% for 5 consecutive periods of 5 minutes. Trigger the aitem viol conce work Toxing the aitem paratisk. Or Trigger an aitem if Storage Space Usage Avg. >= 80% for 5 connective periods of 5 minutes. Trigger the aitem only conce even though the aitem periods.	S Enabled		Not mask	**	View Details Mor	dily More 👻
One-Click Monitoring Alarm Masking Server Monitoring • Cloud Service Monitoring • Custom Monitoring	AUTO_CES_ALARM_R at1675675190954mcOay	Relational Database Se	PostgreSQL Instances Specific resources	Trigger an alarm if CPU Usage Avg. >= 80% for 5 consectors periods of 5 minute. Trigger the alarm only once even thoogh the alarm paratist, ann alarm of connector Usage Avg. >= 80 each for 5 constances periods of 5 minute. Trigger the alarm only once even thoogh the alarm periods.	S Enabled		Not mask	-	View Details Mor	dify More 👻
Website Monitoring										

- 2. Configure long transaction alarms.
 - a. Click in the upper left corner of the page and choose **Databases** > **Relational Database Service**.
 - b. On the **Instances** page, locate the target DB instance and click **View Metrics** in the **Operation** column.
 - c. View the **Long Transaction** metric.

Figure 9-2 Viewing metrics

Name/ID $_{\forall}$	Description	D8 Instance T., $\frac{\scriptscriptstyle A}{\scriptscriptstyle \nabla}$	DB Engine Version $\frac{4}{\pi}$	Status 🛓	Billing Mode	Floating IP Add	Created	Storage Type	Operation
nts-3923 2010066649554880965511695652248bin01		Single 2 vCPUs 8 GB	MySQL57.41	ə Available	Pay-per-Use Created on Jul		Jul 03, 2023 11:11	Cloud SSD	View Metric Log In More +

d. Click + in the upper right corner of the **Long Transaction** metric.

Figure 9-3 Long Transaction

Long Transaction (?)	+ 5
Second	Max Min
1.2	
0.9	
0.6	
0.3	
0	
16:15 16:20 16:25 16:30 16:35 16:40 16:45 16:50 16:55 17:00 17:05	17:10

e. On the displayed page, set parameters as required. For details about the parameters, see **Creating an Alarm Rule**.

10 Configuring a Scheduled Event for an RDS for MySQL Instance

When you need to execute scheduled or periodic tasks in an RDS for MySQL instance, such as scheduled data synchronization, regular expired data deletion, and periodic data insertion, you can enable the event scheduler and configure a scheduled event in Data Admin Service (DAS) to automatically execute events defined in the instance based on the scheduled plan. This section describes how to use DAS to configure a scheduled event for an RDS for MySQL instance.

Constraints

- The event scheduler can be enabled only for DB instances running MySQL 5.6.43.2 or later, 5.7.25.2 or later, and 8.0.17.4 or later. If your DB engine version is beyond the above range, to use this function, **upgrade the minor version** first.
- The event scheduler cannot be enabled for read replicas.

Step 1: Enable the Event Scheduler

- Step 1 Log in to the management console.
- **Step 2** Click O in the upper left corner and select a region.
- Step 3 Click in the upper left corner of the page and choose Databases > Relational Database Service.
- **Step 4** On the **Instances** page, click the DB instance name.
- **Step 5** On the **Overview** page, click **Enable** under **Event Scheduler**.

----End

Step 2: Configure a Scheduled Event

Step 1 On the **Instances** page, locate the DB instance and click **Log In** in the **Operation** column.

Figure 10-1 Logging in to an instance

Remov Useductor Change to Yearly/Monthly More > Esport > Q. DB Instance Name: rdd-fedt X. Add filter X (i) Q. (ii) X (iii) X (iii) X (iii)											
✓ Name/ID ⊕	Description 🖯	DB Insta 🖯	DB Engin 🖯	Status 🖯	Billing M \varTheta	Floating I \ominus	Database 😔	Storage T 🖯	Operation		
e82c69ba271d4345be84954c73ca6e4din01	-	Primary/Stan 2 vCPUs 4 GB	MySQL 8.0.28	O Available	Pay-per-use Created on M	192.168	3306	Cloud SSD	Log In View Metrics	More 🗸	
Total Records: 1										10 ~ <	1 >

Step 2 Enter root and its password, and click Log In.

Figure 10-2 Login page

Instance Login Information	1	×
DB Instance Name rds-test	DB Engine Version MySQL 8.0.28	
★ Login Username	root	
* Password	Test Connection Connection is successful. Remember Password Your password will be encrypted and stored securely.	
Description		
Show Executed SQL Statements ⑦	If not enabled, the executed SQL statements cannot be viewed, and you need to input each SQL statement manually.	
	Cancel Log In	

Step 3 Choose **SQL Operations** > **SQL Query**.

Step 4 In the SQL window, create a database named **db_test**. create database db_test;

Figure 10-3 Creating a database

• Execute SQL (F8)	E Format SQL (F9)	Plan (F6) SQL Favorites	eclipse \lor
1 create database db_	test;		
Executed SQL Statements	Messages		
Time	SQL Statement	Duration	Result
		No data availa	able.

Step 5 Create a table named **t_test** in the **db_test** database.

create table t_test(id int(4), name char(20), age int(4));

Figure 10-4 Creating a table

5	5			
Database: db_test ∨	Execute SQL (F8)	SQL (F9) (6 Execute SQL Plan (F6) SQL Favorites V eclip	se V
Tables Views	1 create table t_test(id int(4	<pre>\$ 1), name char(20), age int(4)); </pre>		
Please search by key Q				
	Executed SQL Statements Message	25		
No data.	Time	SQL Statement	Duration	Result
			No data available.	

Step 6 On the homepage, click the database name.

Figure 10-5 Homepage

DB Instance Name:	DB Engine Version: MySQL 8.0.28			
Database List				
+ Create Database				User database V Enter a database name. Q C Refresh
Database Name	Table Quantity \$\overline\$	Table Siz e + lndex Siz e +	Character Set	Operation
db_test	-		utf8mb4	Manage Query SQL Statements Create Table Data Dictionary More⊻
15 / page 🗸 Total Records: 1 🗧	(1 >			

Step 7 On the displayed Objects page, choose Events. On the displayed page, click Create Event.

Figure 10-6 Objects

Objects Metadata Co	llection											
\rm Data records display	Data records displayed on this page are refreshed in real time (up to 10.000 records can be displayed), which consumes your database performance somewhat. Collect Now X											
Tables	+ Create Event Scheduled tasks	Enter an event name.	Q C Refresh									
Views	Event Name	Status	Comment	Operation								
Stored Procedures												
Events												
Triggers				()								
Functions				No data available.								

Step 8 Enter the event information and click **Create**.

Figure 10-7 Creating an event

Current Database: db_test Change 192 Objects Metadata Collection Create Event >	168.0.104:3306 Character Set: utf8mb4 Colla	tion: utf8mb4_0900_ai_ci SQL	Window Data	Dictionary	Auto Metadata Collection ③
3asic Information		Evenillen Time -	Fixed	Scheduled	
Dropped upon expiration		Execution miles.	* Interval :	1 MINUTE V	
Status : Enable trigger Disat	le trigger		Started :	2025-01-06 11:08:00	
Somment:			End Time :	2025-01-06 11:10:00	
* Event Definition Statements :					
<pre>1 begin 2 insert into t_test(id, name, age) values(2 3 end</pre>	, 'zhangsan', 30);				
		_			
		Create			

Table 10-1 Event description

Parameter	Description				
Event Name	Enter a custom event name.				
Dropped upon expiration	• If this option is deselected, the event is always retained.				
	 If you select this option, the event will be deleted upon expiration. 				
	 Events that are executed at a fixed time will be deleted once they are executed. 				
	 Events that are executed at a scheduled time will be deleted at the end time you specify. 				
Status	To execute an event, select Enable trigger .				
Comment	Enter comments for the event.				
Execution Time	• Fixed The event is executed only once at a fixed time.				
	 Scheduled The event is executed at an interval you specify between the start time and end time. 				
	For example, an event is executed every minute between 09:50 and 10:00.				
Event Definition Statements	Enter the statements to be executed when the event is triggered.				
	For example, to insert a data record into the t_test table, enter the following statements:				
	begin insert into t_test(id, name, age) values(1, 'zhangsan', 30); end				

- **Step 9** In the displayed dialog box, click **Execute** to execute the event at the specified time.
- **Step 10** In the object list, locate the table and click **Open**.

Figure 10-8 Opening a table

Objects Metadata Col	Xbjects Metadata Collection Alter Event test X									
Data records displayed on this page are refreshed in real time (up to 10.000 records can be displayed), which consumes your database performance somewhat. Collect Now X										
Tables	Tables + Create Table name. Q C Refresh									
Views	Statistics are read from system tables and are not updated in real time. X									
Stored Procedures		Table Name 🗘	Created \$	Rows(Estimated) ③ 🗘	Table Size(Estimated) $\textcircled{O} \stackrel{+}{\Rightarrow}$	Index Size(Estimated) ③ 🗘	Character Set	Operation		
Events Triggers	+	t_test	2025-01-06 1 1:03:12	0(Estimated)	16KB(Estimated)	0B(Estimated)	utf8mb4	Query SQL Statements Open Vi		
Functions	10 / pa	ige V Total Records	a: 1 < 1 >							

Step 11 Check the execution results of the event.

🛃 Cur	rent Database:	db_test	Change	192.168.0.	104:3306 Chara	cter Set: utf8mb4	Collation: utf8mb4_0900	10_ai_ci	SQL Window Data Dictionary			Auto Meta	data Collection	0
Objects	Metadata C	ollection	Alter Event te	est X	Open Table: t_test	×								
① Table wit	hout PK is une	ditable								Where Condition	Copy Row \vee 🖸 C	opy Column \vee	Column Setti	ngs ∨
		id				÷	name		;	age				÷
	1	1					zhangsan			30				
	2	1					zhangsan			30				
	3	1					zhangsan			30				
Current Pag	e: 1 Previous	Next	50 / page ∨	Go to 1	Go				Convert binary to hexadecimal	Refresh Row D	Add Row	Submit Dele	te Row Exp	xort A

Figure 10-9 Checking execution results

----End
1 1 Security Best Practices

Security is a shared responsibility between Huawei Cloud and you. Huawei Cloud is responsible for the security of cloud services to provide a secure cloud. As a tenant, you should properly use the security capabilities provided by cloud services to protect data, and securely use the cloud. For details, see **Shared Responsibilities**.

This section provides actionable guidance for enhancing the overall security of using RDS for MySQL. You can continuously evaluate the security status of your RDS for MySQL DB instances and enhance their overall security defense by combining different security capabilities provided by RDS for MySQL. By doing this, data stored in RDS for MySQL DB instances can be protected from leakage and tampering both at rest and in transit.

You can make security configurations from the following dimensions to match your workloads.

- Optimizing Database Connection Configurations to Reduce Network Attack Risks
- Properly Managing Database Accounts and Passwords to Reduce Data Leakage Risks
- Strengthening Permissions Management to Reduce Related Risks
- Enabling Database Audit for Post-Event Backtracking
- Configuring Data Backup to Ensure Data Reliability
- Encrypting Data Before Being Stored
- Hardening Parameter Configuration to Prevent Data Leakage
- Using the Latest Database Version for Better Experience and Security
- Using Other Cloud Services for Additional Data Security

Optimizing Database Connection Configurations to Reduce Network Attack Risks

1. Do not bind an EIP to your RDS for MySQL instance to prohibit unauthorized access and DDoS attacks from the Internet.

Do not deploy your instance on the Internet or in a demilitarized zone (DMZ). Instead, deploy it on an intranet and use routers or firewalls to control access to your instance. Do not bind an EIP to your instance to prohibit unauthorized

access and DDoS attacks from the Internet. If an EIP has been bound to your instance, **unbind it**. If you do need an EIP, configure security group rules to restrict the source IP addresses that can access your instance.

2. Do not use the default port number.

RDS for MySQL instances use the default port 3306, leaving your instance more vulnerable to malicious attacks. To avoid this risk, **change the port number** for your DB instance.

3. Restrict operations of a database user.

If there is no limit for the resources that a database user can use, the system may be overloaded when the user is attacked, causing a denial of service (DoS) on the system. Setting limitations can prevent excessive resource consumption due to over-utilization of resources. To prevent service availability from being affected in heavy-load scenarios, use the following SQL statements to restrict the number of operations that an individual database user can perform based on your service model:

alter user '<user>'@'<hostname>' with max_queries_per_hour <queries_num>; alter user '<user>'@'<hostname>' with max_user_connections <connections_num>; alter user '<user>'@'<hostname>' with max_updates_per_hour <updates_num>; alter user '<user>'@'<hostname>' with max_connections_per_hour <connections_per_hour>;

- <user> indicates the username of the account you want to set the limits for.
- *<hostname>* indicates the host name of the account.
- <queries_num> indicates the maximum number of queries allowed for the account per hour.
- <connections_num> indicates the maximum number of concurrent connections allowed for the account.
- *<updates_num>* indicates the maximum number of updates that the account can issue per hour.
- <connections_per_hour> indicates the maximum number of times the account can connect to the database server per hour.

4. Do not use the wildcard % for the host name.

A host name specifies which host is allowed to connect to your database. You can use the **host** field in the **user** table to specify the host. If you enter a wildcard % as the host name, your database is accessible to any IP address, increasing the risk of attacks. To minimize the attack risk, **set the host IP** address to a specific network segment or IP address.

5. Limit the waiting time of idle database connections.

Each connection to the MySQL server consumes memory, and the maximum number of connections supported is limited. If the MySQL server has a large number of idle connections, memory consumed by these connections is wasted and the maximum number of connections can be reached. Once the limit is reached, an error message "too many connections" is reported if a new connection is established. You need to set the waiting time for idle connections to ensure that idle connections are cleared in time. Change the values of **wait_timeout** and **interactive_timeout** by referring to **Modifying Parameters of an RDS for MySQL Instance**.

6. Ensure that SSL is enabled by default.

If SSL is not configured, data transmitted between a MySQL client and server is in plaintext, which is vulnerable to eavesdropping, tampering, and man-inthe-middle attacks. To improve data transmission security, specify the **REQUIRE SSL** attribute for a database account and **configure SSL**.

You can use the following SQL statements to require SSL connections for a specific account:

create user '<user>'@'<hostname>' REQUIRE SSL; alter user '<user>'@'<hostname>' REQUIRE SSL;

Properly Managing Database Accounts and Passwords to Reduce Data Leakage Risks

1. Periodically change the password of the administrator.

The default database administrator account **root** has high permissions. You are advised to periodically change the password of user **root** by referring to **Resetting the Administrator Password to Restore Root Access**.

2. Configure password complexity.

As a collector of information, a database system is easy to be the target of attacks. You need to keep your database account and password secure. In addition, configure the complexity of your password to avoid using weak passwords. For details, see "Setting Password Complexity" in **Database Account Security**.

3. Configure a password expiration policy.

Using the same password too long makes it easier for hackers to crack or guess your password. To prevent this, **configure a password expiration policy** to limit how long a password can be used.

Strengthening Permissions Management to Reduce Related Risks

1. Do not create stored procedures or functions as the administrator.

Stored procedures and functions are run as creators by default. If you create stored procedures and functions as the administrator, regular users can run them through privilege escalation, so do not use the administrator account to create stored procedures or functions.

2. Review and harden permission configurations.

Check whether the following permission configurations meet security requirements. If they do not meet security requirements, harden the security configuration.

- Ensure that only the administrator account can perform operations on the **mysql.user** table.
- Ensure that the **Process_priv** permission can be granted only to the administrator account.
- Ensure that the **Create_user_priv** permission can be granted only to the administrator account.
- Ensure that the **Grant_priv** permission can be granted only to the administrator account.
- Ensure that the **Reload_priv** permission can be granted only to the administrator account.

- Ensure that the replication account has only the replication slave permission.
- Ensure that the database metric monitoring account has only the **replication client** permission.

Example: If a non-administrator account has the **Process** permission, run the following SQL statement to revoke this permission:

revoke process on *.* from <your_account>;

In the preceding statement, *<your_account>* indicates the username of the account whose **Process** permission needs to be revoked.

Enabling Database Audit for Post-Event Backtracking

The database audit function records all user operations on the database in real time. This function logs, analyzes, and reports user activities in the database. Based on the audit logs, you can prepare compliance reports and track incidents, improving data asset security. For details, see **Enabling SQL Audit**.

Configuring Data Backup to Ensure Data Reliability

1. Enable data backup.

RDS for MySQL supports automated and manual backups. You can periodically back up databases. If a database is faulty or data is damaged, you can restore the database using backups to ensure data reliability. For details, see **Data Backups**.

2. Configure a binlog clearing policy.

Binlogs continuously increase as services run. You need to configure a clearing policy to prevent disk expansion. **Set a retention period for RDS for MySQL binlogs**.

Encrypting Data Before Being Stored

To improve data security, **enable server-side encryption**. After it is enabled, data will be encrypted on the server before being stored when you create a DB instance or scale up storage space. This reduces the risk of data leakage.

Hardening Parameter Configuration to Prevent Data Leakage

1. Set local_infile to OFF.

If **local_infile** is set to **ON**, a database client can use the **load data local** syntax to load local files to database tables. For example, when a web server functions as a database client to connect to a database, if the web server has an SQL injection vulnerability, an attacker can use the **load data local** command to load sensitive files on the web server to the database, causing information leakage. To prevent this, set **local_infile** to **OFF** by referring to **Modifying Parameters of an RDS for MySQL Instance**.

2. Set sql_mode to STRICT_ALL_TABLES.

When attempting to launch an attack, an attacker may enter various parameters in a trial-and-error manner. If the server adapts to incorrect statements, database data may be leaked. Therefore, **STRICT_ALL_TABLES** is recommended. Even if an error occurs in other rows than the first row, the

statement will be discarded once an invalid data value is found. This method maximally ensures that database information is not disclosed. You are advised to set sql_mode to STRICT_ALL_TABLES by referring to Modifying Parameters of an RDS for MySQL Instance.

Using the Latest Database Version for Better Experience and Security

The MySQL community irregularly discloses newly discovered vulnerabilities. RDS for MySQL evaluates the actual risks of database kernel versions and release new database kernel versions accordingly. To improve the usability and security of the database system, you are advised to use **the latest database version**.

Using Other Cloud Services for Additional Data Security

To obtain extended data security capabilities, you are advised to use **Database Security Service (DBSS)**.

12 MySQL Online DDL Tools

12.1 Introduction

In versions earlier than MySQL 5.6, DDL operations on the structure of a large table usually cause data manipulation language (DML) statements to be blocked and increase replication delay, so the database looks abnormal. This chapter introduces the DDL-based COPY and INPLACE algorithms of MySQL, the open-source tool gh-ost, and the INSTANT ADD COLUMN algorithm newly added in MySQL 8.0.

- The native COPY algorithm of MySQL adds a metadata write lock to the source table during data copy, causing DML statements to be blocked for a long time. This algorithm is no longer recommended.
- The INPLACE algorithm has great improvements over the COPY algorithm by making changes directly on the original table without generating temporary tables, so it occupies less space. In addition, the INPLACE operation holds metadata write locks for a short period of time, which does not cause long-term blocking of DML operations. However, modifying the structure of a large table still takes much time, and there will be a long replication delay when the standby instance replays the DDL statements.
- The open-source gh-ost splits a DDL operation into multiple small operations, reducing the time required for each operation to decrease replication delay. Reads and writes are briefly blocked only when the ghost table and original table are being renamed. gh-ost replays incremental data based on binlogs and maintains an extra heartbeat table to record the DDL execution process, supporting temporary suspension of the DDL process. gh-ost takes more time than the native DDL algorithm.
- The INSTANT ADD COLUMN algorithm proposed in MySQL 8.0 does not need to rebuild the entire table. It only records basic information about new columns in the metadata of the table. In this way, adding columns to a large table only takes several seconds. However, this algorithm applies only to a few DDL operations, such as adding columns, setting default values for columns, deleting default values from columns, and changing definitions of ENUM/SET columns.

Based on the characteristics of each algorithm and tool, you are advised to use the INSTANT algorithm to minimize the impact of DDL on your whole workload in

every possible case. In other cases, if your DB instance uses a primary/standby deployment or has read replicas and your workload is sensitive to replication delay, use gh-ost to perform DDL operations. If you need to quickly change a table structure and a short replication delay is acceptable, use INPLACE. The COPY algorithm, as it blocks DML operations for a long time, occupies a large amount of storage space, and takes a long time to execute, is not recommended when there is any other alternative.

ltem	MySQL COPY	MySQL INPLACE	gh-ost	INSTANT
Read operations during DDL execution	Allow	Allow	Allow	Allow
Write operations during DDL execution	Deny	Allow (deny for a short period of time)	Allow (deny for a short period of time)	Allow
Extra space occupied	Large	Small (slight increase if rebuild is required)	Large	Small
Execution duration	Very long	Long	Very long	Short
Replication delay	Long	Long	Short	Short

Table 12-1 DDL tools

12.2 Native DDL Tools

COPY Algorithm

- 1. It creates a temporary table based on the original table definition.
- 2. It adds a write lock to the original table (DML is prohibited).
- 3. It executes DDL statements in the temporary table created in **1**.
- 4. It copies the data in the original table to the temporary table.
- 5. It releases the write lock of the original table.
- 6. It deletes the original table and renames the temporary table as the original table.

When the COPY algorithm is used, the table needs to be locked and DML write operations are forbidden. If **Lock** is set to **Shared**, read operations are allowed but write operations are not allowed. If **Lock** is set to **Exclusive**, both read and write operations are forbidden. This algorithm can be used in almost all DDL scenarios.

INPLACE Algorithm

INPLACE modifies the original table without generating a temporary table or copying data. There are two types:

- rebuild: The table needs to be rebuilt (with the clustered index reorganized), for example, optimizing a table, adding an index, adding or deleting a column, and modifying the NULL/NOT NULL attribute of a column.
- no-rebuild: The table does not need to be rebuilt. Only the metadata of the table needs to be modified, for example, deleting an index, changing a column name, changing the default value of a column, and changing the auto-increment value of a column.

If rebuild is used, the DML statements to be executed during DDL execution are cached. After the DDL operations are complete, the DML statements are applied to tables. Since metadata write locks will be degraded to metadata read locks during data copy, DML operations are almost not blocked during DDL execution.

Constraints on the INPLACE Algorithm

The INPLACE algorithm supports most DDL operations. But it has the following constraints, so in a few scenarios only the COPY algorithm can be used:

- It does not allow you to delete a primary key or add two primary keys at the same time.
- It does not allow you to change the data types of fields.
- It does not allow you to extend the length of the VARCHAR columns from less than 256 bits to more than 256 bits, because doing so will change the occupied space from 1 byte to 2 bytes. It does not allow you to reduce the length of the VARCHAR columns.
- It does not allow you to change the order of virtual columns or stored columns.
- It does not allow you to add foreign key constraints when **foreign_key_checks** is set to **1**.
- It does not allow you to partition tables, or optimize or delete partitions.

12.3 gh-ost

Context

Percona offers an open-source DDL tool, pt-osc. It executes operations by using triggers to copy rows from the original table to the new table. Using triggers can speed up synchronization but causes a large overhead, affecting the performance of the primary database. In addition, data copies and data changes may be processed concurrently. If a table is frequently updated during migration, a large number of lock contention problems may occur.

gh-ost is an open-source online DDL tool provided by GitHub. Unlike pt-osc, ghost does not depend on triggers. Instead, it simulates the standby database to obtain incremental changes from binlogs in the row format and asynchronously applies the changes to the ghost table. It decouples the migration's write load from the workload of the primary server, avoiding the impact on the performance of the primary database. Asynchronously applying incremental changes also avoids lock contention caused by triggers. In addition, gh-ost maintains a heartbeat table to record each phase in the DDL process. When an exception occurs, data can be restored to the specified position based on the heartbeat log. This solves the problem that pt-osc needs to start from the beginning when an exception occurs.

Process



Three gh-ost Modes

- (Default mode) gh-ost connects to the standby database and performs a cutover in the primary database.
 - In the primary database, gh-ost creates the _xxx_gho table with the same structure as the original table and the _xxx_ghc table that records

the change status. The **_xxx_ghc** table is used to write the progress and time of online DDL operations.

- The structure of the **_xxx_gho** table is modified.
- The existing data of the original table is copied to **_xxx_gho** in the primary database.
- The incremental binlogs are obtained from the standby database and the incremental changes are applied to **_xxx_gho**.
- The original table is locked and the time in the _xxx_ghc table is checked to ensure that data is synchronized between the original table and _xxx_gho.
- The original table is replaced with **_xxx_gho**.
- gh-ost connects to the primary database and performs a cutover in the primary database.
 - The **_xxx_gho** and **_xxx_ghc** tables are created in the primary database.
 - The structure of the _**xxx_gho** table is modified.
 - The existing data of the original table is copied to _xxx_gho in the primary database.
 - The incremental binlogs are obtained from the primary database and the incremental changes are applied to **_xxx_gho**.
 - The original table is locked and the time in the _xxx_ghc table is checked to ensure that data is synchronized between the original table and _xxx_gho.
 - The original table is replaced with **_xxx_gho**.
- gh-ost performs a test and cutover on the standby database.

In this mode, gh-ost connects to the primary database. However, all operations are performed on the standby database and no modification is made to the primary database.

-migrate-on-replica means that gh-ost directly migrates the table on the standby database. It performs the cutover when replication of the standby database is running.

-test-on-replica indicates that the migration is only for test purposes. Replication is stopped before a cutover is performed. The original table and temporary table are swapped and then swapped back. The original table returns to its original place. Both of the tables are left with replication stopped. You may examine the two and compare data.

Common Parameters

For details about gh-ost parameters, see the official documentation.

Constraints

- Row-based binlogs must be used, and the value of **binlog_row_image** must be **FULL**.
- The required user permissions include SUPER, REPLICATION CLIENT, and REPLICATION SLAVE.
 - If the binlogs are in the row format, you can add -assume-rbr. In this case, the SUPER permission is not required.

- Tables with foreign key constraints are not supported.
- Tables with triggers are not supported.
- The tables before and after DDL execution must have the same primary key or non-null unique indexes.
- If the primary key or non-null unique index of a table to be migrated contains enumeration types, the migration efficiency will be greatly reduced.

Example

gh-ost -	max-load=Threads_running=	20 \

- -critical-load=Threads_running=100 \
- -chunk-size=2000 -user="temp"
- -password="test" -host=**.*.* \
- -allow-on-master -database="sbtest" -table="sbtest1" \
- -alter="engine=innodb" -cut-over=default \
- -exact-rowcount -concurrent-rowcount -default-retries=120 \
- -timestamp-old-table -assume-rbr -panic-flag-file=/tmp/ghost.panic.flag $\$

-execute

12.4 INSTANT ADD COLUMN

Context

Generally, DDL operations on large tables have great impact on workloads. They need to be performed during off-peak hours. MySQL 5.7 supports the native DDL tool COPY and INPLACE algorithms and the open-source DDL tool gh-ost, reducing blocked DML operations during DDL execution. But it still takes a long time to perform DDL operations on large tables.

INSTANT ADD COLUMN eliminates the need to rebuild the entire table when adding columns. It only needs to record the basic information about the new columns in the table metadata. However, only a limited number of DDL operations are supported.

Syntax

If **ALGORITHM=INSTANT** is added to the end of the ALTER statement, the INSTANT algorithm is used. Here is an example:

ALTER TABLE *tbl_name* ADD COLUMN *column_name* *column_definition*, ALGORITHM=INSTANT;

Constraints

This algorithm can only be used when you:

- Add, delete, or rename columns (for versions later than MySQL 8.0.28) in certain scenarios.
- Set or delete the default value of a column.
- Modify the definition of the ENUM or SET column.
- Change the index type (B-Tree | hash).
- Add or delete a virtual column.

• Rename a table.

Constraints on adding or deleting columns:

- An ALTER TABLE statement cannot combine the addition of a column with other actions that do not support the INSTANT algorithm.
- New columns are placed at the end and the column sequence cannot be changed. (In versions later than MySQL 8.0.29, columns can be added to any position.)
- Columns cannot be quickly added to or deleted from a table whose row format is COMPRESSED.
- Columns cannot be quickly added to or deleted from a table that has a full-text index.
- Columns cannot be quickly added to or deleted from a temporary table.

Constraints on renaming columns:

- Columns referenced by other tables cannot be renamed.
- The operation of renaming a column and the operation of generating or deleting a virtual column cannot be in the same statement.

Constraints on modifying the ENUM or SET column.

• The storage space occupied by the ENUM or SET column data type cannot be changed.

Constraints on adding or deleting virtual columns:

• Virtual columns cannot be added to or deleted from partitioned tables.

New Data Dictionary Information

When INSTANT ADD COLUMN is executed, MySQL saves the number of fields before INSTANT ADD COLUMN is executed for the first time and the default value of the column added each time to the **se_private_data** field in the **tables** system table.

- **dd::Table::se_private_data::instant_col**: indicates the number of columns in the table before INSTANT ADD COLUMN is executed for the first time.
- **dd::Column::se_private_data::default_null**: indicates whether the default value of the instant column is **NULL**.
- **dd::Column::se_private_data::default**: indicates the default value stored when the default value of the instant column is not **NULL**.

Importing Data Dictionary

When MySQL reads table definitions from system tables, it loads instant column information to the InnoDB table object **dict_table_t** and index object **dict_index_t**.

- dict_table_t::n_instant_cols: indicates the number of non-virtual fields (including system columns) before INSTANT ADD COLUMN is executed for the first time.
- **dict_index_t::instant_cols**: indicates whether there is an instant column.

- **dict_index_t::n_instant_nullable**: indicates the number of fields that can be null before INSTANT ADD COLUMN is executed for the first time.
- **dict_col_t::instant_default**: indicates the default value and length of the instant column.

Record Format

To support INSTANT ADD COLUMN, a new record format is introduced for the COMPACT and DYNAMIC types to record the number of fields.

- If INSTANT ADD COLUMN has not been performed, the row record format of the table remains unchanged.
- If INSTANT ADD COLUMN has been performed, a special flag is set for each new record, and the number of fields is stored in the records.

INSTANT_FLAG uses a bit in info bits. If a record is inserted after the first execution of INSTANT ADD COLUMN, the flag is set to **1**.





Query

The query process remains unchanged. For instant columns that are not stored in records, use the default value.

Insertion

After INSTANT ADD COLUMN is executed, the format of the old data does not change and the newly inserted data is stored in the new format. If a bit in the info bits of a new record is set to **REC_INFO_INSTANT_FLAG**, the record is created after INSTANT ADD COLUMN is executed.

12.5 DDL Tool Test Comparison

Test Procedure



vip` int(11) DEFAULT NULL, `vip_exp` int(11) DEFAULT NULL, `reg_channel` int(11) DEFAULT NULL, `guild_id` bigint(20) unsigned DEFAULT '0', `guild_open` tinyint(1) DEFAULT '0', `forbid_login_time` bigint(20) DEFAULT NULL, `forbid_talk_time` bigint(20) DEFAULT NULL, ctime` bigint(20) DEFAULT NULL, `mtime` datetime(3) DEFAULT NULL, `last offline time` bigint(20) DEFAULT NULL, `friend_open` tinyint(1) DEFAULT '0', `user_data_str` mediumblob, `name` varchar(64) DEFAULT NULL, `db_fix_version` int(10) DEFAULT '0', PRIMARY KEY (`rid`), KEY `idx_users_99_nid` (`nid`), KEY 'idx_users_99_level' ('level'), KEY 'idx_users_99_ctime' ('ctime'), KEY 'idx_users_99_mtime' ('mtime'), KEY `idx_users_99_last_offline_time` (`last_offline_time`), KEY `idx_users_99_name` (`name`)) ENGINE=InnoDB AUTO INCREMENT=4393751571200 DEFAULT CHARSET=utf8mb4:

- 2. Insert 30 million rows of data into each table.
- 3. Use the MySQL native COPY algorithm to add a column to table 1. During the execution, create a new session and perform the SELECT, UPDATE, and INSERT operations on 100,000 data records.
- 4. Use the MySQL native INPLACE algorithm to add a column to table 2. During the execution, create a new session and perform the SELECT, UPDATE, and INSERT operations on 100,000 data records.
- 5. Use gh-ost to add a column to table 3. During the execution, create a new session and perform the SELECT, UPDATE, and INSERT operations on 100,000 data records.
- 6. Record the execution durations of DDL and DML statements.

Operation	MySQL COPY	MySQL INPLACE	gh-ost
Adding a column	1294.29	755.52	1876.79
SELECT	1.35	1.29	1.29
UPDATE	1266.78	0.19	0.11
INSERT	1296.19	7.47	4.49

Table 12-2 Test data (unit: s)

Test Results

- 1. MySQL COPY: The UPDATE and INSERT statements are blocked, but the SELECT statement is executed properly.
- 2. MySQL INPLACE: DML statements are not blocked for a long time, and adding a column to a large table takes the shortest time.
- 3. gh-ost: It almost does not block DML statements. It takes a longer time to add a column than the two native MySQL algorithms.

Suggestions

INPLACE blocks DML operations only for a short time while performing DDL operations. If you have no strict requirements on the primary/standby replication delay, you are advised to use this algorithm to quickly change the table structure. If your workload is sensitive to primary/standby replication delay, gh-ost is recommended. If you use MySQL 8.0.12 or later and the INSTANT algorithm conditions are met, you can use INSTANT to minimize the impact on workloads.