TDSQL for MySQL

Security White Paper

Product Documentation

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Security Isolation

The networks of different regions are fully isolated from each other, and Tencent Cloud services in different regions cannot communicate with each other over the private network by default. In addition, security groups and VPCs are also used for network isolation.

- **Security group**: it is a stateful virtual firewall capable of packet filtering. As an important means for network security isolation provided by Tencent Cloud, it can be used to set network access controls for one or more Tencent Cloud services.
  You can control the access permissions of a TDSQL for MySQL instance in the following ways:
  - Create multiple security groups and specify different rules for them.
  - Assign one or multiple security groups to the TDSQL for MySQL instance and use the security group rules to determine what traffic can access the instance and what resources can be accessed by the instance.
  - Configure a security group to allow only specified IP addresses to access the TDSQL for MySQL instance.
- **VPC**: it is a logically isolated network space defined in Tencent Cloud. Even in the same region, different VPCs cannot communicate with each other over the private network by default.

Authentication

Cloud Access Management (CAM) is a web-based Tencent Cloud service that helps you securely manage and control access permissions to your Tencent Cloud resources. Using CAM, you can create, manage, and terminate users (groups), and control the Tencent Cloud resources that can be used by the specified user through identity and policy management.

When using CAM, you can associate a policy with a user or user group to allow or forbid them to use specified resources to complete specified tasks.

If you use multiple Tencent Cloud services such as CVM, VPC, and TencentDB that are managed by different users sharing your Tencent Cloud account key, you may face the following problems:

- Your key is shared by multiple users, leading to high risk of compromise.
- You cannot limit the access permissions of other users, which poses a security risk due to potential faulty operations.

You can allow different users to manage different services through sub-accounts so as to avoid the above problems. By default, a sub-account does not have permission to use a Tencent Cloud service or related resources. Therefore, you need to create a policy to grant the required permission to the sub-account.

Transfer Encryption

The TDSQL for MySQL Console supports the HTTPS transfer protocol and standard network access protocols, guaranteeing your access security and meeting your needs for sensitive data encryption and transfer.

Tenant Security Features

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This document describes tenant security features such as MAR, auto failover, and data security encryption.

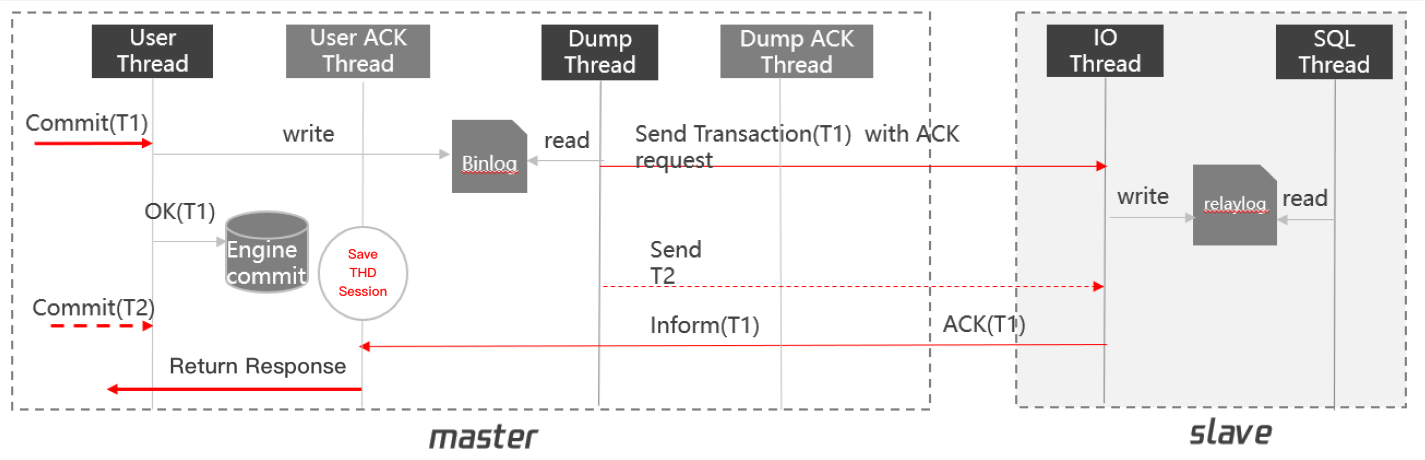
Multi-thread Async Replication (MAR)

Background

As a database records data in it, to switch between multiple databases, the data in them must be in sync. Therefore, data sync is the foundation of database high availability scheme.
Currently, the open-source MySQL database supports async and semi-sync data replication modes. However, in both modes, if a node failure occurs, the data may be lost, incorrect, or messy; plus, the replication is serial, which has a low performance.

Solution

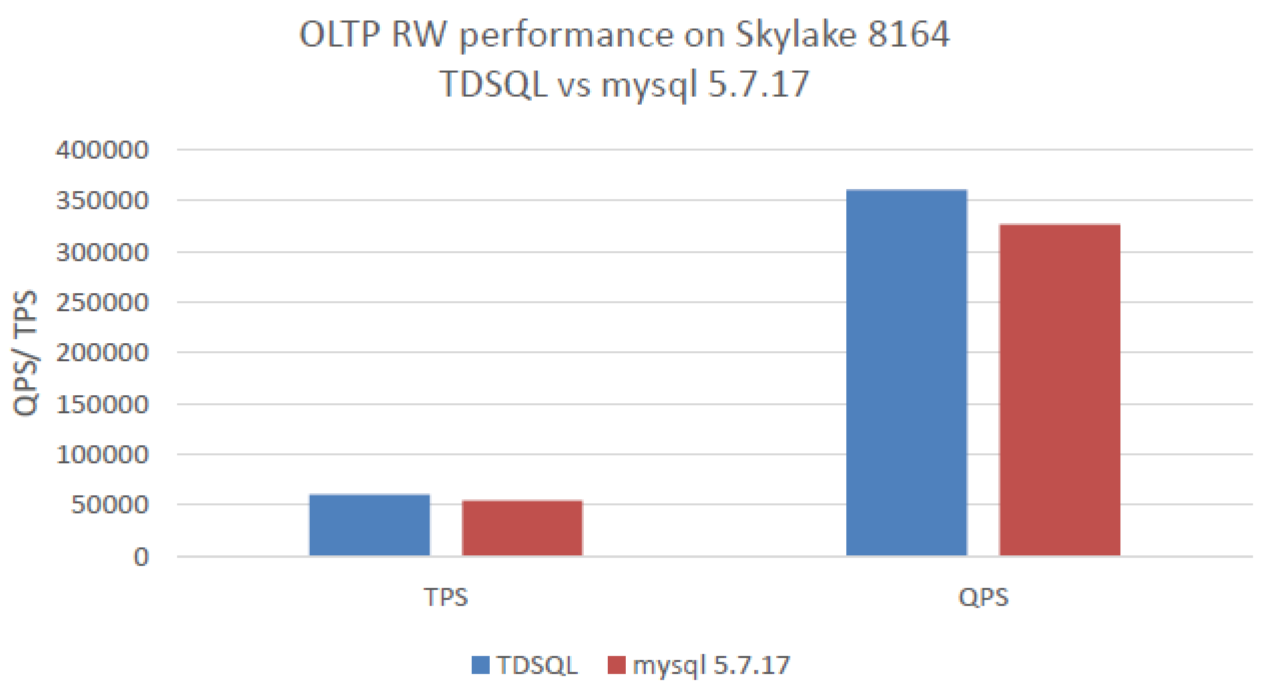
In Tencent Cloud's proprietary parallel multi-thread asynchronous replication (MAR, aka strong sync) scheme based on the MySQL protocol, when a request is initiated at the application layer, only after a secondary node successfully returns a message can the primary node respond to the application layer with a request success, ensuring that the primary and the secondary nodes have completely the same data.



When you perform MAR, the primary database will be hanged if it is disconnected from the secondary database or the secondary database fails. In this case, if there is only one primary or secondary database, the high availability scheme will be unavailable, because if only one single server is used, part of data will be lost completely when a failure occurs, which does not meet the requirements for finance-level data security.

Therefore, based on MAR, TDSQL for MySQL provides a downgradable strong sync scheme, which is similar to the semi-sync technology of Google but has a different implementation scheme.

In addition, TDSQL for MySQL MAR parallelizes the serial sync threads and introduces the worker thread capabilities, which greatly improve the performance. In the same cross-AZ (IDC with a latency of around 10–20 ms) test, the technical performance of MAR is around 5 times that of semi-sync replication on MySQL 5.6 and 1.5 times that of MariaDB Galera Cluster. In OLTP RW (mix read/write in primary/secondary architecture), its performance is 1.2 times that of async replication on MySQL 5.7. The comparison of the specific performance tested by the Intel® technical team is as shown below:



Auto Failover and Recovery

In production systems, high availability schemes are often required to ensure uninterrupted system operations. As the core of system data storage and services, the availability requirement for the database is higher than that for computing service resources.

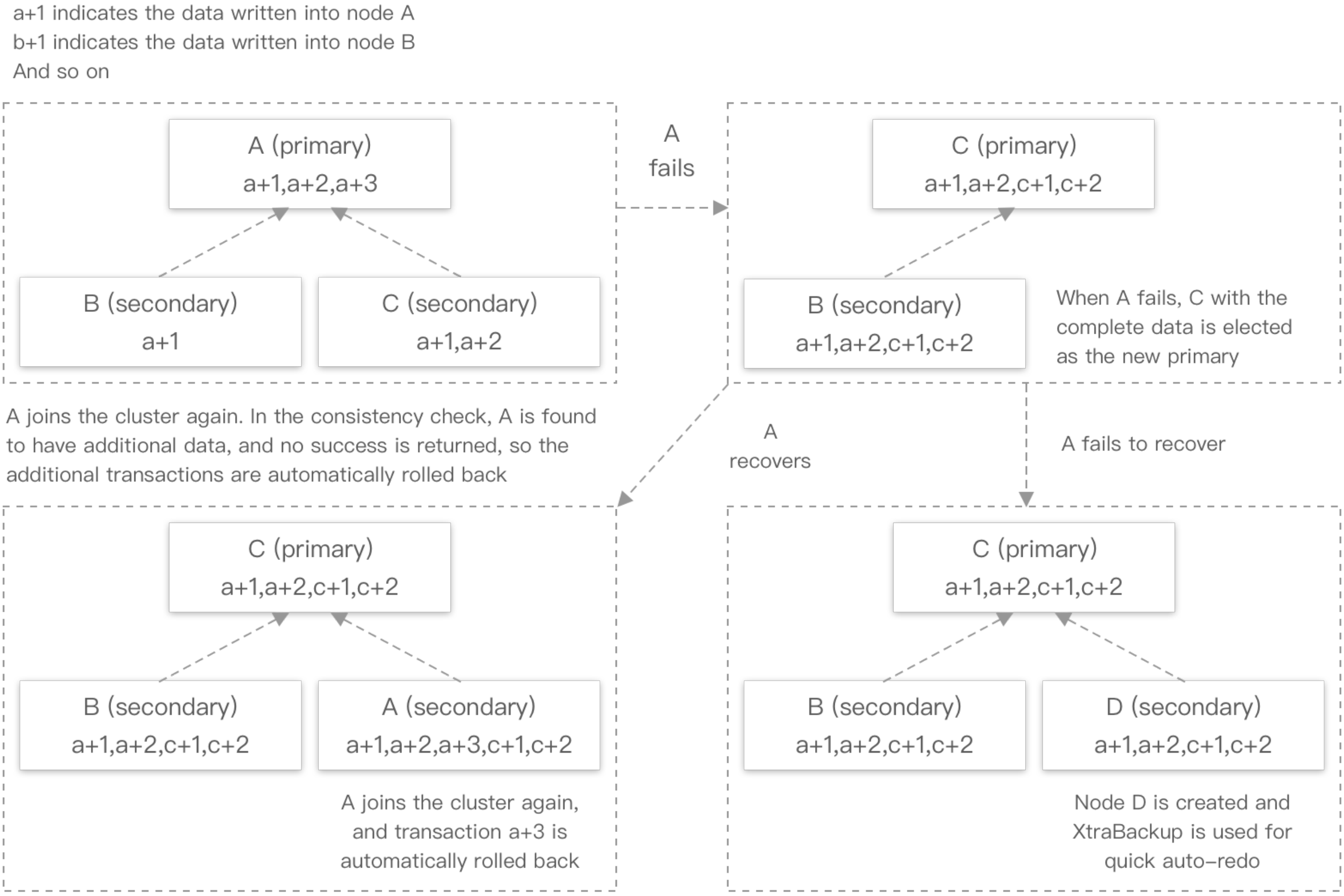
The high availability scheme of TDSQL for MySQL works by allowing the collaboration of multiple database services. In this way, if a database fails, another server will immediately take over its tasks, so the service will not be interrupted or be interrupted only for a very short period of time. This scheme is also called primary/secondary high availability.

Based on the general primary/secondary high availability, TDSQL for MySQL further supports the following advanced features:

- Auto failover, cluster member control, and node removal from cluster are supported. For instance-level primary-secondary switch, the virtual IP (VIP) will remain unchanged. The MAR policy ensures complete primary/secondary data consistency in case of primary/secondary failover, fully meeting the finance-level requirements for data consistency.
- Automatic recovery is supported. If a physical node carrying shards fails, the scheduling system will automatically try to recover the node. If the node cannot be recovered, it will automatically apply for new resources within 30 minutes, rebuild the node from backups, and automatically add the node to the cluster to ensure the complete high availability architecture of the instance in the long run.
- Each node contains a complete replica of the data and can be switched according to the needs specified on the database management page.
- Do-not-switch configuration is supported, that is, failover will not be performed during the specified period of time.
- x86 PCs are supported, and there is no need to share storage devices.
- Cross-AZ deployment is supported. Even if the primary and secondary instances are in different data centers (no matter whether they are in the same region), the data can be replicated through Direct Connect in real time. If the local node is the primary and the remote node is the secondary, the local node will be accessed first, and if it fails or becomes unreachable, the remote instance will be accessed. In addition, with the aid of Tencent Cloud VPC, a intra-region active-active architecture can be implemented, that is, the business system can directly read/write the database in both data centers.
  This feature provides TDSQL for MySQL with multi-AZ disaster recovery capabilities, eliminating the operational risks with single-IDC deployment.

All TDSQL for MySQL shards support the MAR-based high availability scheme. If the primary database fails, the system will automatically select the optimal secondary database immediately to take over the tasks. The switch process is imperceptible to users, the access IP remains unchanged, and 24/7 continuous monitoring is provided for the databases and underlying physical devices.
If a failure occurs, the system will automatically restart the database and relevant processes. If a node crashes and cannot be recovered, it will be automatically rebuilt from its backup files as shown

below:


a+1 indicates the data written into node A
b+1 indicates the data written into node B
And so on
A (primary)
a+1,a+2,a+3
B (secondary)
a+1
C (secondary)
a+1,a+2
A fails
C (primary)
a+1,a+2,c+1,c+2
B (secondary)
a+1,a+2,c+1,c+2
When A fails, C with the complete data is elected as the new primary
A joins the cluster again. In the consistency check, A is found to have additional data, and no success is returned, so the additional transactions are automatically rolled back
A recovers
A fails to recover
C (primary)
a+1,a+2,c+1,c+2
B (secondary)
a+1,a+2,c+1,c+2
A (secondary)
a+1,a+2,a+3,c+1,c+2
A joins the cluster again, and transaction a+3 is automatically rolled back
C (primary)
a+1,a+2,c+1,c+2
B (secondary)
a+1,a+2,c+1,c+2
D (secondary)
a+1,a+2,c+1,c+2
Node D is created and XtraBackup is used for quick auto-redo

Chinese and International Certifications

TDSQL for MySQL complies with applicable Chinese information security standards and has earned many Chinese and international certifications on behalf of TencentDB.

- MariaDB Platinum member
- ACMUG and China Computer Industry Association - Open Source Database Committee (CCIA-ODC) Presidium member
- ISO 27001
- ISO 27001:2013
- ISO 20000
- ISO 20000-1:2011
- ISO 22301
- ISO 9001
- ISO 27018

- PCI DSS Level 1 Service Provider Qualification
- SOC Audit
- ITSS Cloud Service Advanced Certification
- Cybersecurity Classified Protection Level 3 Filling and Evaluation for Public Cloud
- Trusted Cloud Database Service Certification
- Trusted Cloud User Data Security Protection Capability Assessment
- Trusted Cloud Gold Class Operations Special Assessment
- ITSS Certification
- CSA STAR Gold certification and dual certification for information security management system from CNAS and UKAS

Data Security Encryption

TDSQL for MySQL supports tablespace encryption (transparent encryption) and connection encryption (SSL connection encryption). In scenarios where Tencent Cloud Key Management Service (KMS) is not utilized, TDSQL for MySQL supports the keyring service, enabling internal server components and plugins to securely store sensitive data for subsequent retrieval. This service provides a set of APIs for the encryption feature to call KMS.

SQL Firewall

SQL firewall is a security feature that filters out unauthorized SQL statements by analyzing the syntax of SQL statements sent by users. It works with SQL Engine to check whether an SQL statement is on the predefined list of unauthorized SQL statements so as to filter out and block it accordingly, which effectively prevents SQL injection attacks.

Note :

SQL firewall can be used together with Tencent Cloud services such as Web Application Firewall (WAF). Taking into account the business conditions and SQL complexity, there are no preset rules in TDSQL for MySQL firewall currently.

Comprehensive Security Audit

Security audit is one of the most important tracing methods; therefore, China's Cybersecurity Classified Protection Certification (Level 3) stipulates that an information system should support auditing. TDSQL for MySQL provides audit capabilities at the following three layers to deliver complete security protection:

- Security audit for OPS system, which is implemented by operation logs of the Chitu operation system.
- Security audit for database system, which is implemented by Tencent Cloud's proprietary database audit system.
- Security audit for server operating system, which is implemented by Tencent Cloud's proprietary Tiejiangjun system.

> **Note :**
>
> - In public cloud, all security audit features are configured by default.
> - In private cloud, system operation logging (Chitu system) is configured by default, while database SQL audit and server operation audit features are optional.

Kernel-Level Security Policies

TDSQL for MySQL provides various open-source security schemes at the database kernel level, some of which have earned the recognition of the community. The following are some kernel security measures:

- **Slow deletion**
  If you run the `drop table` or `alter table ... drop partition` command, the database will not delete the tablespace file immediately; instead, it will rename the file, gradually shrink it on the backend, and finally delete it. This feature can avoid system performance fluctuation caused by I/O load surges in the server's file system when a large tablespace file is deleted in one single request.
- **Accidental metadata deletion prevention**
  Only authorized users can log in to the system and delete metadata tables, which helps avoid business unavailability due to faulty operations.
- **Banning of plugin installation by unauthorized users**
  The database service provides standard APIs for users to implement custom features, but hackers usually exploit this vulnerability to launch attacks. Therefore, only specified admin users can mount plugins.
- **Banning of unauthorized user access to physical server file system**
  To prevent hackers from bypassing the security system by means such as file selection, file

injection, and path detection, unauthorized users are blocked from accessing the directory structure and file system of the physical server.

Data Termination

When you terminate your TDSQL for MySQL instance, all data (including backup data) stored in it will be destroyed. Tencent Cloud will not retain the data or actively recover your instance.

Suggestions on 1-DC Disaster Recovery Deployment

When deploying 1-DC disaster recovery, you should prevent the following failures for your database cluster:

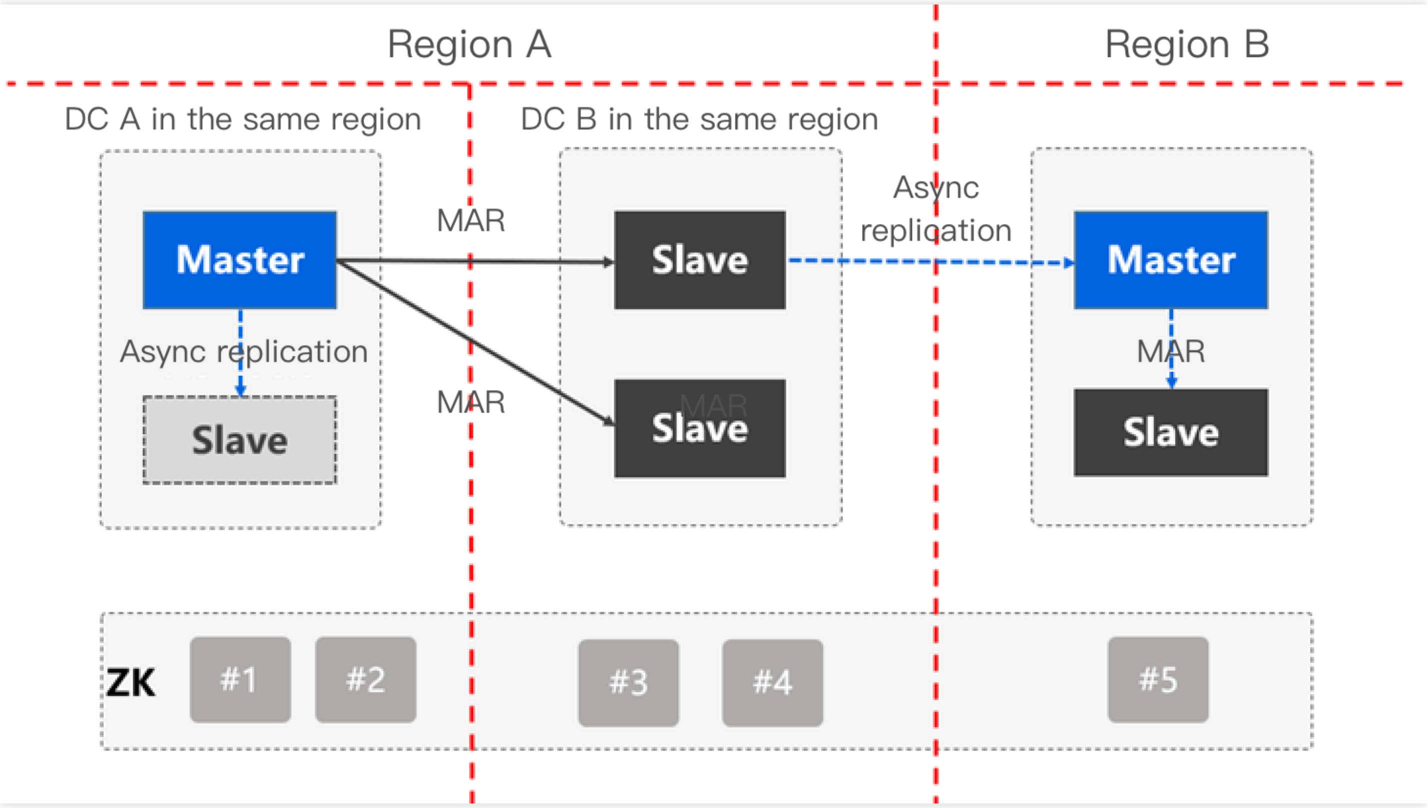
- Single points of failures on devices such as data center switch, load balancer, and ENI.
- Single points of failures on devices such as rack power, fan, and cooler.
- Single points of failures on database server hardware.

Therefore, we recommend you satisfy at least the following requirements for 1-DC disaster recovery deployment:

- Deploy at least active-active disaster recovery for network devices such as switch and load balancer.
- Deploy one primary and two secondaries for database server and management and scheduling system.
- Deploy different devices of the same module across racks.
- Deploy a data backup module.

Suggestions on 2-Region-3-DC Deployment

2-region-3-DC deployment is to add a disaster recovery center based on 1-region-2-DC deployment. The two disaster recovery instances are synced over a data communication network (DCN) to ensure data consistency.


Region A
Region B
DC A in the same region
DC B in the same region
Master
Async replication
Slave
MAR
MAR
Slave
Slave
Async replication
Master
MAR
Slave
ZK
#1
#2
#3
#4
#5