LogStore: Architecting Log Storage System for Cloud-Native Database

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***Abstract*—With the prevalence of cloud computing, more and more companies move their applications to cloud infrastructures. Key advantages are highly scalability and availability with a lower cost. For enterprises who use cloud-based services to run their applications, they are expected to work stably, efficiently and securely. But traditional database server are usually under-utilized much of time. The key to achieve it is to architect a cost-effective log storage for cloud applications, which also can help users better understand the status of their applications running on the cloud. Traditional log processing systems cannot satisfy all these requirements.**

There are some disadvantages of traditional log systems. So we choose the cloud-native log database, LogStore. It combines shared-nothing and shared-data architecture, and utilizes highly scalable and low-cost cloud object storage, while overcoming the bandwidth limitations and high latency of using remote storage when writing a large number of logs.

***Index Terms*—LogStore, Cloud native, Distributed database**

I. Introduction

The target of our project is to implement a system with cloud native features such as distribution, where logs are instances for this system. So far, a structure of log storage system based on Windows os has been architeected in spite of some bugs. The graph of the system is as Fig 1.

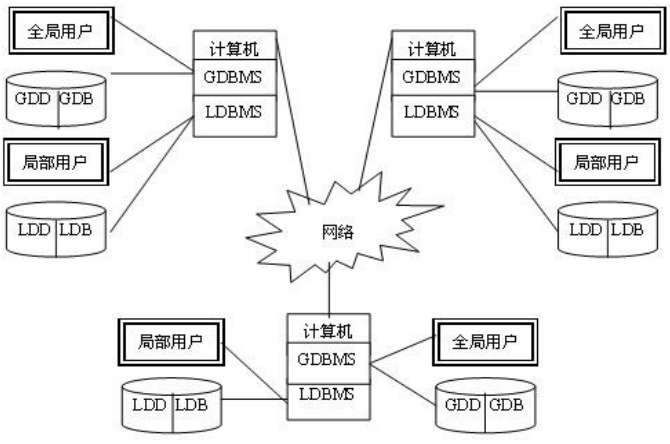

Fig. 1. LogStorage architecture []

II. Project Proccess

The Log Storage System consists of three main components, LogStorage, DBMS and Server, which function together to help users storage their logs of application in cloud.

The LogStorage is the name of our log storage system, which has connection to the BDMS layer. Users can import this component and use the functions inside to store logs to the data center.

The layer of database management software locates between the user and the operating system. Its main functions are: data definition function (DDL); data organization, storage and management; data manipulation function (DML); database transaction management; operation management; database establishment; maintenance functions and other functions. In our project, the DBMS is used for the creation of database, the creation and delete of files and data table, and the insert, query, modification and delete of data.

When running the operations in the BDMS, the BDMS layer will interact with thee server and request for process. After that, ther server will do the same operation with the data in the data center, and then return the operation result. The data center will be upgraded gradually, from a single PC to multiple PCs, and the storage space is also upgrading from single disk to multi disks. As a result, the target of saving logs into a distributed database is completed.

III. Description

A. LogStore Design [8] [10]

The key to the log storage system includes file operations, get the string of the current time and processing of variable parameter functions. There are three main components: file pointer, file status and mutex. The file status can be obtained by judging whether the file pointer is empty, but this process is frequently used, and the form of function call will cause stack pops and excessive stack operations. Each thread tries to lock the resource before operating it and the lock can only be operated if it is successfully locked; additionally, the operation is completed and unlocked. But through the ”lock”, resource access becomes a mutually exclusive operation, and then time-related errors will no longer occur; thus, the mutex is used.

In the project, the log system consistes of two files excluding definitive files, one of which defines the functions or APIs to

be used by users. The other defines functions about thread and mutex. The UML graphs of log system is as Fig 2.

B. DBMS

Database management system (DBMS) [7] is a layer of data management software between the user and the operating system. Its main functions include: data definition function (DDL); Data organization, storage and management; Data manipulation function (DML); Database transaction management and operation management; Database establishment and maintenance functions and so on. [11] Traditional row-oriented RDBMS can be used for log storage.

The entire application system is deployed on MySQL. MySQL is a frequent, multi-threaded, multi-user relational database server, which currently is the most widely used and popular open source database. The default InnoDB storage engine, and high concurrency support are constructive for LogStore. Its features are as follows :

- Supports transactions, conforms to ACID, has plug-in storage engines, and supports a variety of storage engine formats
- Database deployment can be completed promptly by compiling and installing the database
- Using standard and simple SQL statements for database management, with favourable concurrency performance
- There are a number of open source monitoring tools available to monitor and record database status through command line and graphical interfaces, such as Zabbix, Nagios, Cacti, Lepus
- Logical mapping and splitting are carried out in the middle of horizontal splitting proxy to expand the concurrency and throughput of MySQL database
- Use tools such as mysqldump and Xtrabackup to backup the log Storage

The experiment simulated the database creation, deletion (folder), data table creation, deletion and data increase, query, modify and delete, through the basic MySQL language to operate.

C. Server and Client

C/S model, is the client and server model, which has oversimplified structure. [9] Supporting a distributed and concurrent environment, it can effectively improve resource utilization and sharing. The server is centralized in managing resources, which is beneficial for permission control and system security. And the client and server can be upgraded separately, with good scalability. The C/S model is characterized by servers providing services and clients requesting services.

The communication between the client and the server is as shown in Fig1: The server first starts the listener, monitors the specified port, and waits to receive the connection request from the client. A client initiator that requests a specified port to connect to the server; After receiving the connection request from the client, the server establishes a socket connection with the client; The connection is established successfully.

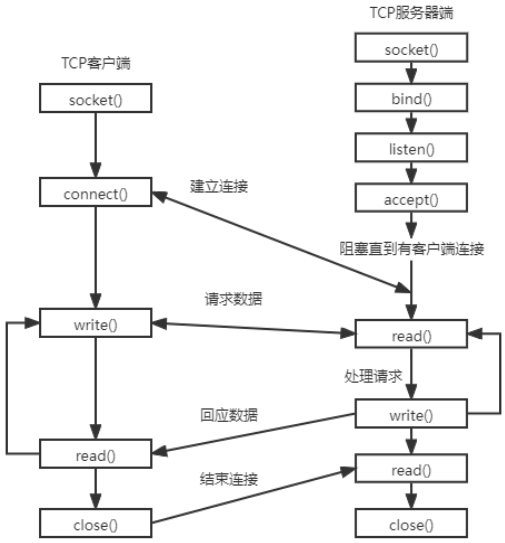

Fig. 2. serverUML [9]

The client and server open two streams respectively; The input stream of the client is connected to the output stream of the server, and the input stream of the server is connected to the output stream of the client; When the communication is complete, the client and server disconnect respectively.

D. Log System

The key of Log system: The file operations; get string of the current time; Processing of variable parameter functions.

There are 6 status of logs :

- UNUSED: Indicates that an online log has not been used.
- CURRENT: indicates the CURRENT redo log.
- ACTIVE: The log is activated but not the current log.
- CLEARING: The log file is rebuilt. UNUSED after completion.
- LEARING_CURRENT: The current log is cleared.
- INACTIVE: The log is useless for instance recovery. Possible for block recovery.

Log system include The file pointer, file status, and the mutex. File status can be get by to determine whether a file pointer is empty, but this process is used frequently, in the form of a function call will make too much pressure, stack operation.

IV. Schedule for Next Stage

First, the current system should be completed without any bugs, and our expectation is that, the user runs his programs on his personal computer, and then the logs of the programs will be stored in the computer for storage.

In addition to the current performance of the log storage system, it needs to be put on cloud, which is to better manage the layer structures of the data center, such as seperating the computing layer and storage layer, splitting disks and adding multiple computers for storage.

Finally, our test method is to use two computer for storage and two or more computers as client, and comparethe running time before and after using cloud native techniques.

A.

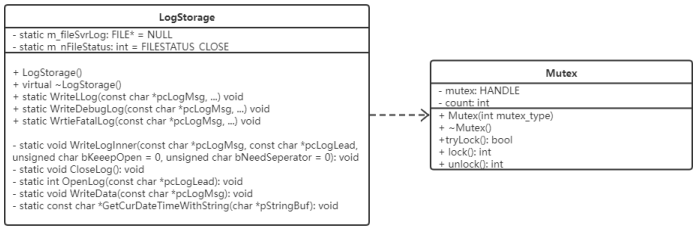

Fig. 3. UML of the LogStorage System [10]

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