Alibaba Cloud Log Service

Product Introduction

Issue: 20181008

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Generic conventions

Table -1: Style conventions

Style	Description	Example
	This warning information indicates a situation that will cause major system changes, faults, physical injuries, and other adverse results.	 **Danger:** Resetting will result in the loss of user configuration data.
	This warning information indicates a situation that may cause major system changes, faults, physical injuries, and other adverse results.	 **Warning:** Restarting will cause business interruption. About 10 minutes are required to restore business.
	This indicates warning information, supplementary instructions, and other content that the user must understand.	 **Note:** Take the necessary precautions to save exported data containing sensitive information.
	This indicates supplemental instructions, best practices, tips, and other content that is good to know for the user.	 **Note:** You can use **Ctrl** + **A** to select all files.
>	Multi-level menu cascade.	**Settings** > **Network** > **Set network type**
Bold	It is used for buttons, menus, page names, and other UI elements.	Click **OK**.
`Courier font`	It is used for commands.	Run the `cd /d C:/windows` command to enter the Windows system folder.
Italics	It is used for parameters and variables.	`bae log list --instanceid` *Instance_ID*
[] or [a|b]	It indicates that it is a optional value, and only one item can be selected.	`ipconfig` *[-all|-t]*
{} or {a|b}	It indicates that it is a required value, and only one item can be selected.	`swich` *{stand | slave}*

Contents

1 What is Log Service

As a one-stop service for log data, Log Service (Log for short) experiences massive big data scenarios of Alibaba Group. Log Service allows you to quickly complete the collection, consumption, shipping, query, and analysis of log data without the need for development, which improves the Operation & Maintenance (O&M) efficiency and the operational efficiency, and builds the processing capabilities to handle massive logs in the DT (data technology) era.

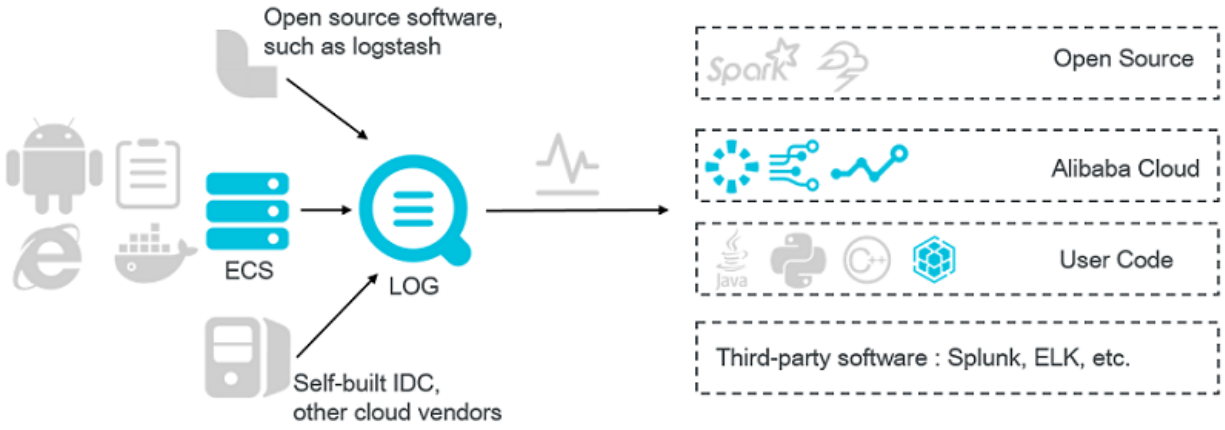
Log Service learning path

Real-time log collection and consumption (LogHub)

Functions:

- Use Elastic Compute Service (ECS), containers, mobile terminals, open-source softwares, and JS to access real-time log data (such as Metric, Event, BinLog, TextLog, and Click data).
- A real-time consumption interface is provided to interconnect with real-time computing and service.

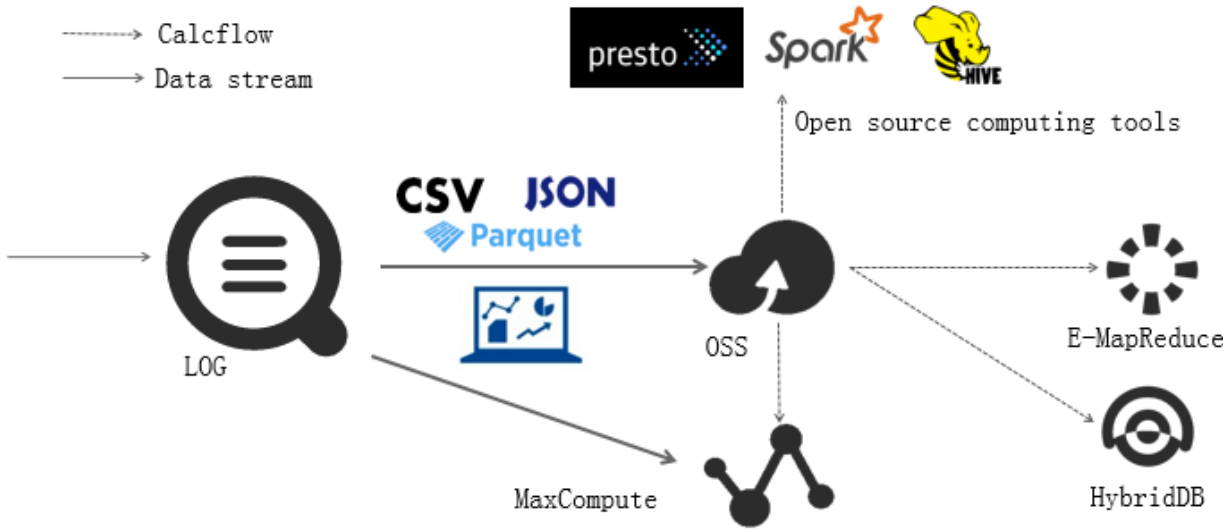
Purposes: ETL, Stream Compute, monitoring and alarm, machine learning, and iterative computing.



LogShipper

Stable and reliable log shipping ships LogHub data to storage services for storage and big data analysis. Supports various storage methods such as compression, user-defined partitions, row storage, and column storage.

Purposes: Data warehouse + data analysis, audit, recommendation system, and user profiling.

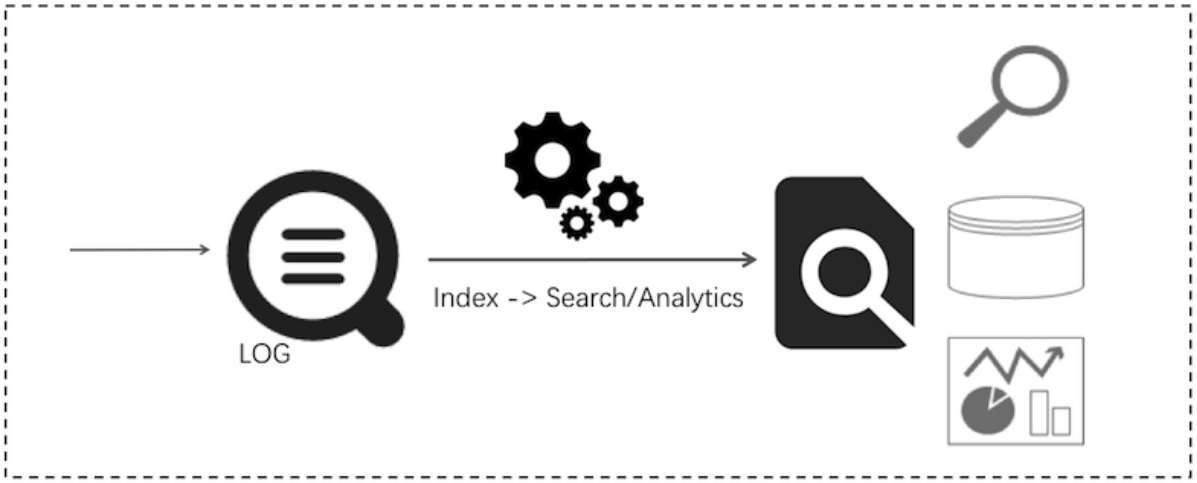


Query and real-time analysis (Search/Analytics)

Index, query, and analyze data in real time.

- Query: Keyword, fuzzy match, context, and range.
- Statistics: Rich query methods such as SQL aggregation.
- Visualization: Dashboard and report functions.
- Interconnection: Grafana and JDBC/SQL92.

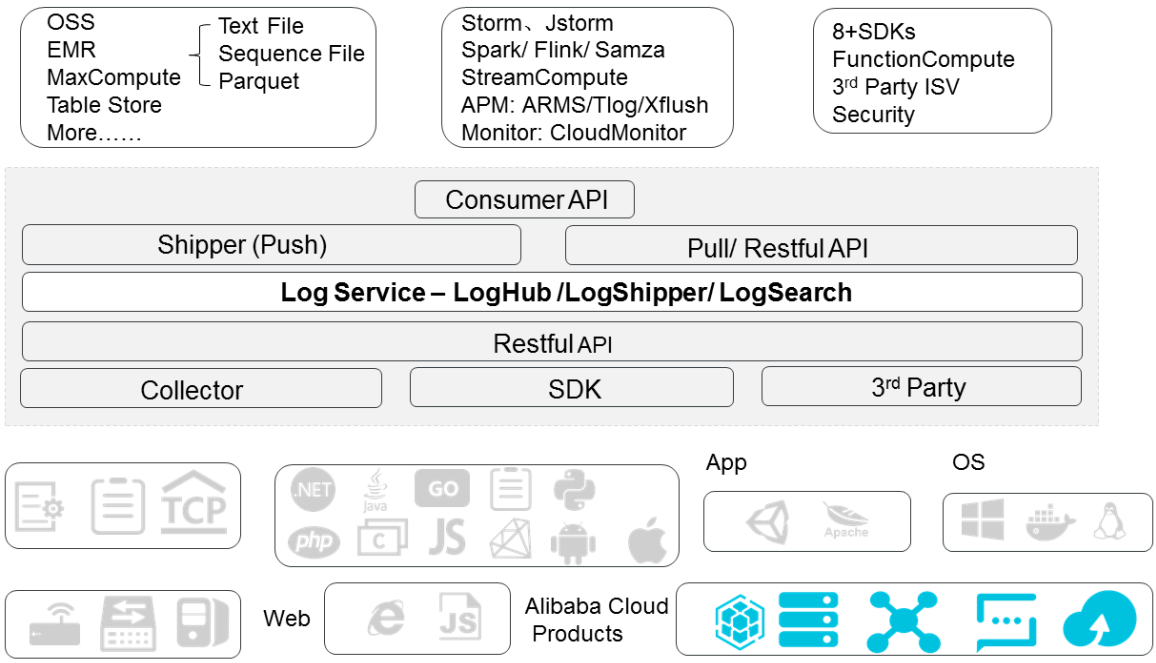
Purposes: DevOps/online O&M, real-time log data analysis, security diagnosis and analysis, and operation and customer service systems.



2 Architecture

The Log Service system architecture is as follows.

Figure 2-1: Architecture



Logtail

Logtail is an agent that helps you quickly collect logs and has the following features:

- Non-invasive log collection based on log files
  - Only read files.
  - Non-invasion during the reading process.
- Secure and reliable
  - Supports file rotation, so no loss of data.
  - Supports local caching.
  - Provides network exception retry mechanism.
- Convenient management
  - Management on Web.
  - Supports visualization configuration.
- Comprehensive self-protection

- Monitors the CPU and memory consumed by the process in real time.
- Restricts the upper limit of memory usage.

Frontend servers

Frontend servers are the frontend machines built with LVS + Nginx and have the following features:

- HTTP and REST protocols
- Horizontal scaling
  - Supports horizontal scaling when traffic increases.
  - Frontend servers can be added to quickly improve processing capabilities.
- High throughput and low latency
  - Pure asynchronous processing. A single request exception does not affect other requests.
  - Adopts the Lz4 compression, which is specially for logs, to increase the processing capabilities of individual machines and reduce network bandwidth.

Backend servers

The backend is a distributed process deployed on multiple machines. It provides real-time Logstore data persistence, index, query, and shipping to MaxCompute. The features of the overall backend service are as follows:

- High data security
  - Each log you write is saved in triplicate.
  - Data is automatically replicated and repaired if a disk is damaged or the machine hardware/software has a system error.
- Stable service
  - Logstores are automatically migrated if the process is crashed or the machine does not have a response for a long time.
  - Automatic Server Load Balancer makes sure that traffic is distributed evenly among different machines.
  - Strict quota limits that prevent abnormal behavior of a single user from affecting other users.
- Horizontal scaling
  - Horizontal scaling is performed by using shards as the unit.
  - You can dynamically add shards as needed to increase throughput.

3 Benefits

Fully managed service

- Easy to use. You can access the service for usage in five minutes and use Agents to collect data in any network environment.
- LogHub has all the functions of Kafka, provides complete functional data, such as monitoring and alarms, and supports auto scaling (by PB/day). The use cost is less than 50% of the self-built cost.
- LogSearch/Analytics provides the functions of saving queries, dashboard, and alarm. The use cost is less than 20% of the self-built cost.
- Log Service has more than 30 Access Methods, and interconnects with cloud products (such as Object Storage Service (OSS), E-MapReduce, MaxCompute, Table Store, MNS, CDN, and ARMS) and open-source softwares (Storm and Spark) seamlessly.

Rich ecosystem

- LogHub supports over 30 collectors, including Logstash and Fluent, and can be easily accessed by using embedded devices, Web pages, servers, and programs. It can also be interconnected with consumption systems such as Spark Streaming, Storm, CloudMonitor, and ARMS.
- LogShipper Supports rich data formats (textfile, sequencefile, parquet, etc.), custom partition , data can be taken directly by presto, hive, spark, hadoop, e-mapreduce, maxcompute, hybridgedb, etc. processing.
- LogSearch/Analytics has complete query and analysis syntaxes and is compatible with SQL-92 . Supports interconnecting with Grafana by using JDBC protocol.

Strong real-timeliness

- LogHub: Data can be used after being written. Logtail (collection agent) can collect and transfer data in real time to the server side within one second (in 99.9% cases).
- LogSearch/Analytics: Data can be queried and analyzed after being written. When multiple query conditions are used, billions of data pieces can be queried within one second. When multiple aggregation conditions are used, hundreds of millions of data pieces can be analyzed within one second.

Complete API/SDK

- Easily supports user-defined management and secondary development.

- All functions can be implemented by using APIs/SDKs. SDKs for multiple languages are provided. Services and millions of devices can be managed in an easy way.
- The query and analysis syntax is simple (compatible with SQL-92). The interfaces can be used to interconnect with the ecological softwares (supports Grafana interconnection solution).

4 Scenarios

Typical scenarios of Log Service include data collection, real-time computing, data warehousing and offline analysis, product operation and analysis, and Operation & Maintenance (O& M) and management. This document introduces some typical scenarios. For more scenarios, see Best practices.

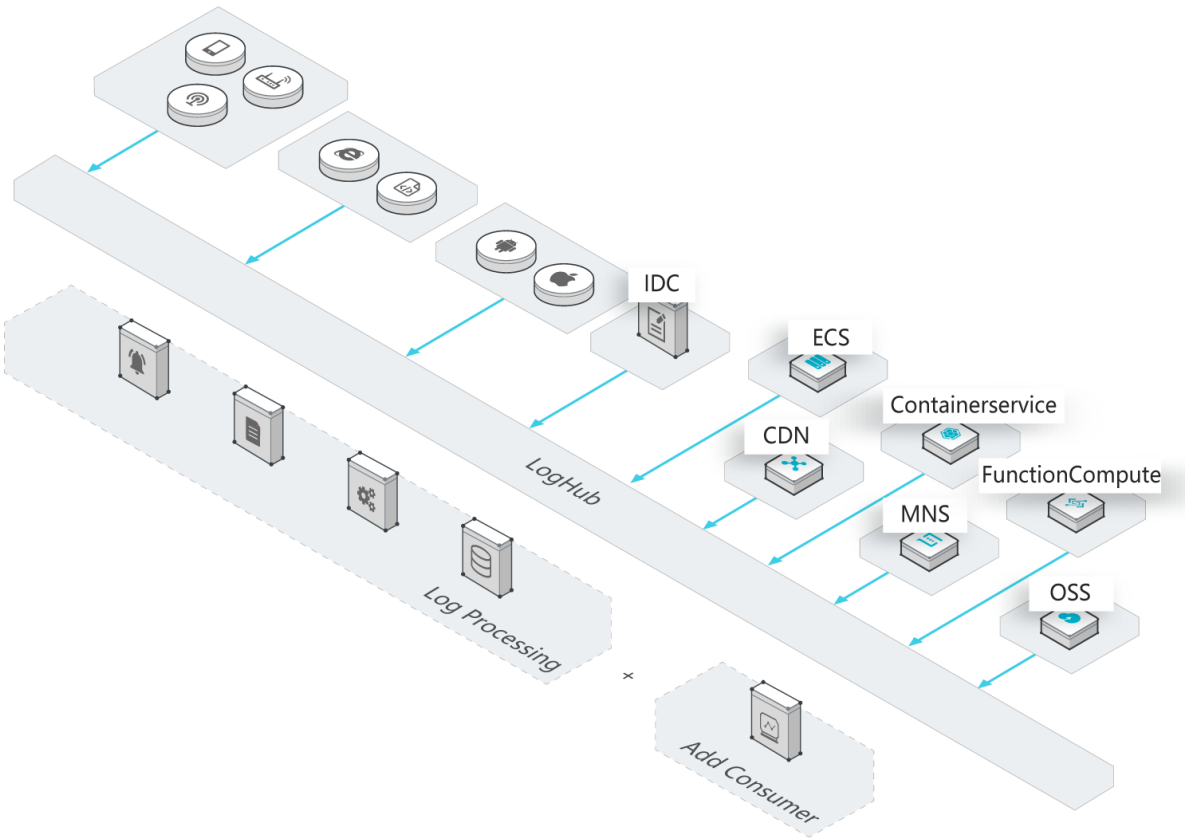
Data collection and consumption

The LogHub function of Log Service enables access to massive real-time log data (including Metric, Event, BinLog, TextLog, and Click data) at the lower costs.

Advantages of the solution:

- Easy to use: Over 30 real-time data collection methods are provided for you to quickly build your platform. The powerful configuration and management capabilities can ease O&M workload. Nodes are available across China and the rest of the world.
- Auto scaling: It helps easily cope with traffic peaks and business growth.

Figure 4-1: Data collection and consumption

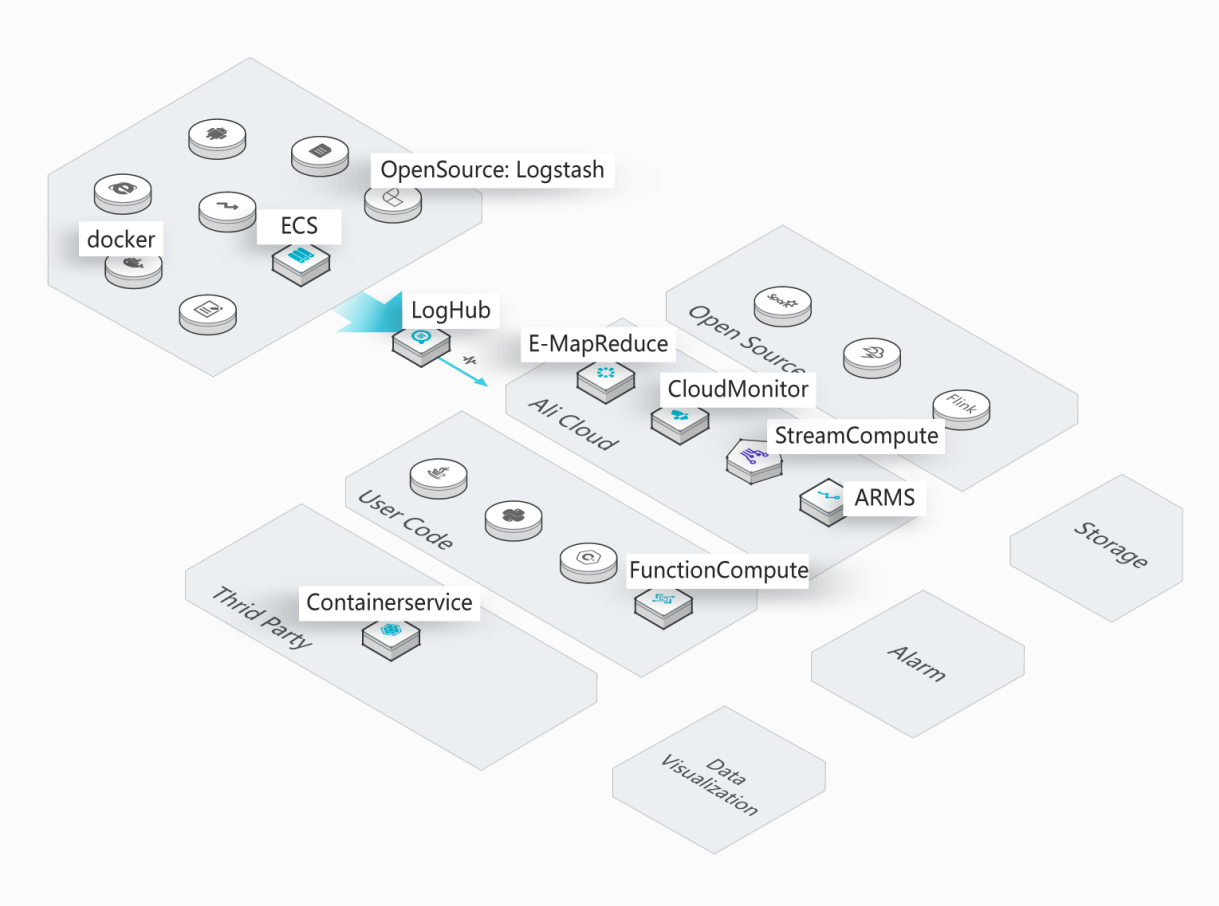


ETL/Stream Processing

LogHub can interconnect with various real-time computing and services, provides complete progress monitoring and alarm notification functions, and supports SDK/API-based custom consumption.

- Easy to operate: It provides various SDKs and programming frameworks and can interconnect with various stream computing engines seamlessly.
- Comprehensive functions: Rich monitoring data and delay alarm functions are provided.
- Auto scaling: PB-grade elasticity and zero latency.

Figure 4-2: Data cleaning and Flow Calculation



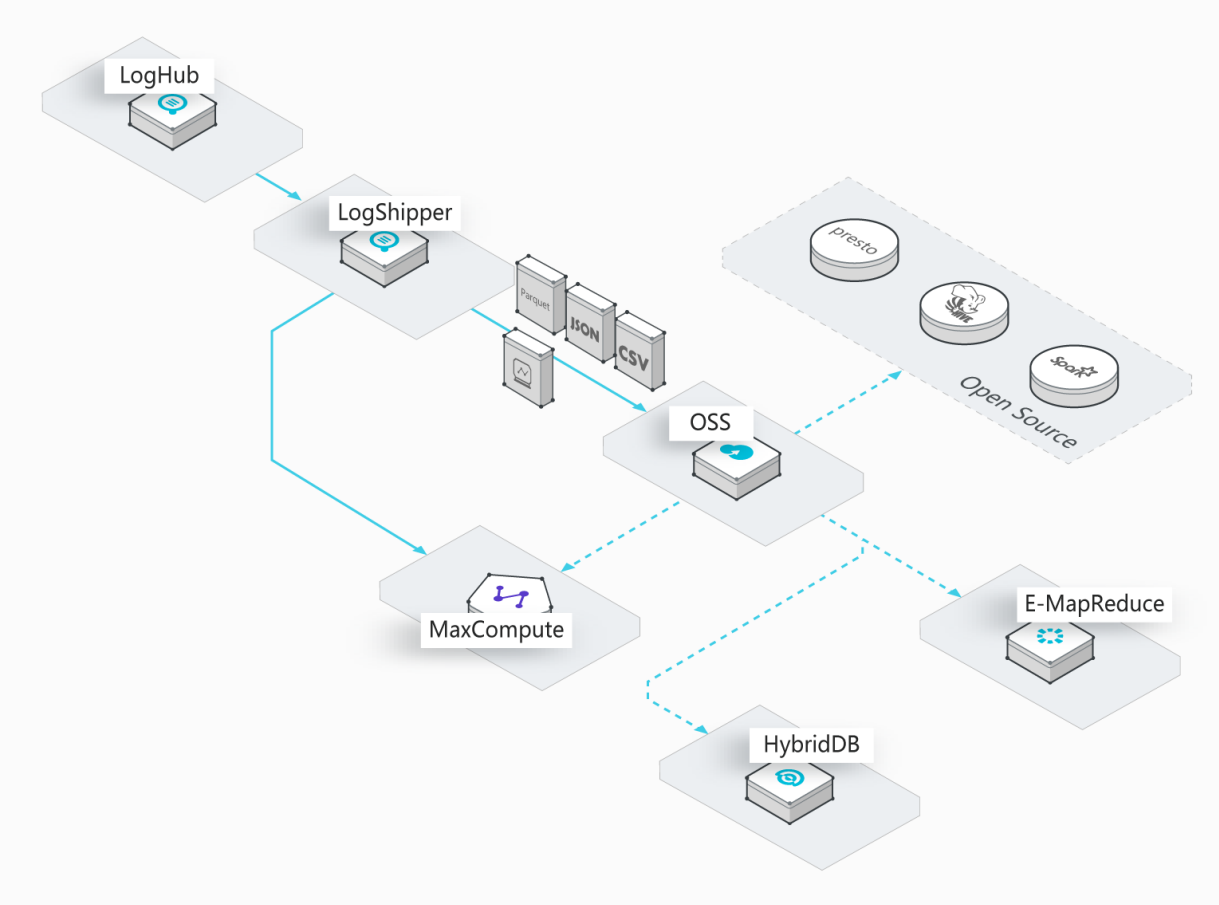
Data warehouse

LogShipper ships LogHub data to storage services and supports various storage formats such as compression, user-defined partitions, row storage, and column storage.

- Massive data: No upper limit is configured for the amount of data.

- Rich storage formats: Various storage formats are supported, such as row storage, column storage, and TextFile.
- Flexible configuration: Configurations such as user-defined partitions are supported.

Figure 4-3: Data Warehouse docking

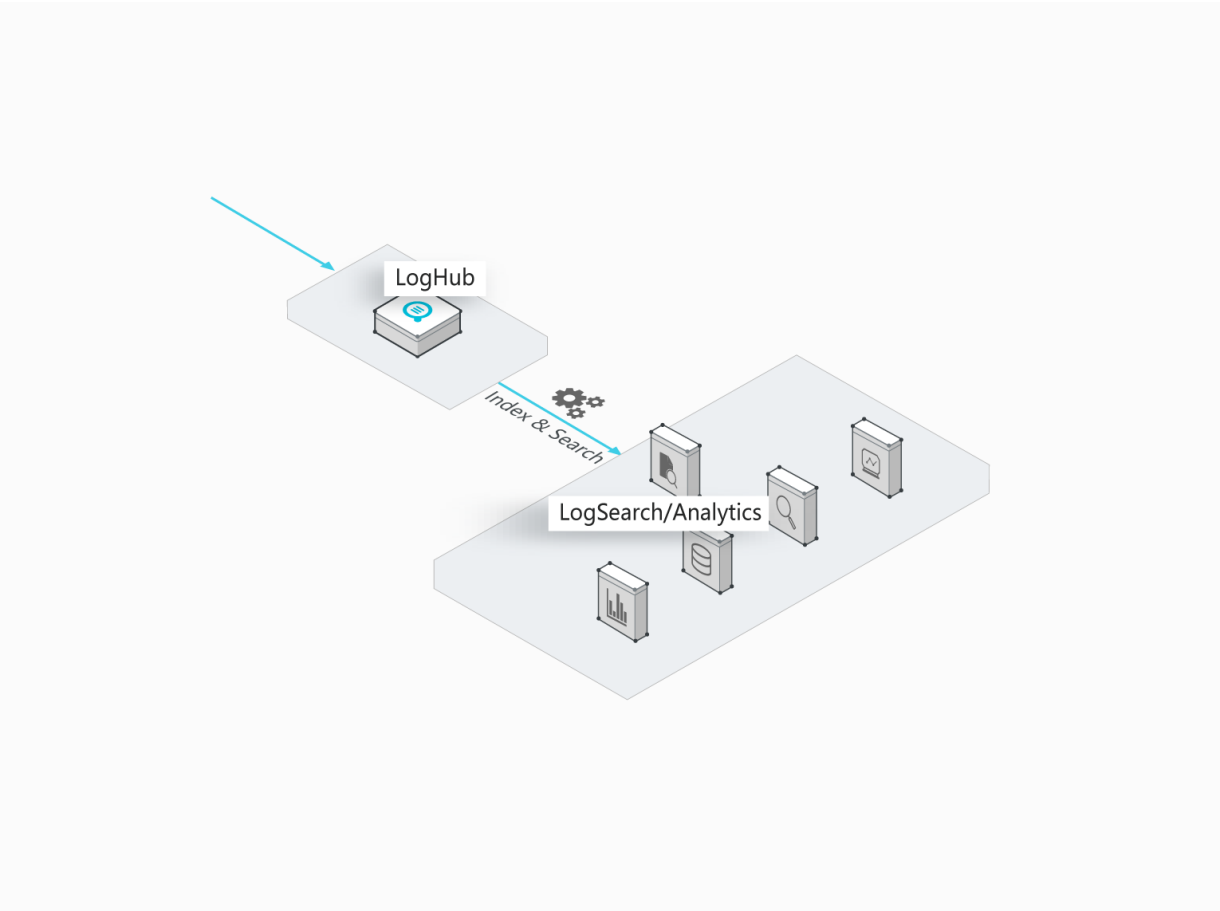


Real-time query and analysis of logs

LogAnalytics supports indexing LogHub data in real time and provides rich query methods such as keywords, fuzzy match, context, range, and SQL aggregation.

- Strong real-timeliness: Data can be queried after being written.
- Massive amount and low cost: Supports PB/day indexing capabilities, and the cost is 15% of the self-built solution.
- Strong analysis capabilities: Supports multiple query methods. Supports SQL aggregation and analysis. Visualization and alarm notification functions are provided.

Figure 4-4: Real-time query and analysis of logs



5 Basic concepts

5.1 Overview

Logs

Log is an abstraction of system changes during the running process. The log content is a time-ordered collection of some operations and the corresponding operation results of specified objects . LogFile, Event, BinLog, and Metric data are different carriers of logs. In LogFile, every log file is composed of one or more logs, and every log describes a single system event. A log is the minimum data unit processed in Log Service.

Log group

A log group is a collection of logs and the basic unit for writing and reading.

Log topic

Logs in a Logstore can be classified by log topics. Users can specify the topic when writing a log, and must specify the log topic when querying logs.

Project

A project is the Log Service's resource management unit, used to isolate and control resources . You can manage all the logs and the related log sources of an application by using projects. It manages all the Logstores of a user and configurations of log-collecting machines. It also serves as the portal by which users access the Log Service resources.

Logstore

The Logstore is a unit in Log Service for the collection, storage, and query of log data. Each Logstore belongs to a project, and each project can create multiple Logstores.

Partition

Each Logstore is divided into several shards and each shard is composed of an MD5 left-closed, right-open interval. These intervals do not overlap and the range of all intervals is the entire MD5 value range.

5.2 Log

Half a century ago, the term “log” was associated with a thick notebook written by a ship captain or operator. Nowadays, with the advent of computers, logs are generated and used everywhere

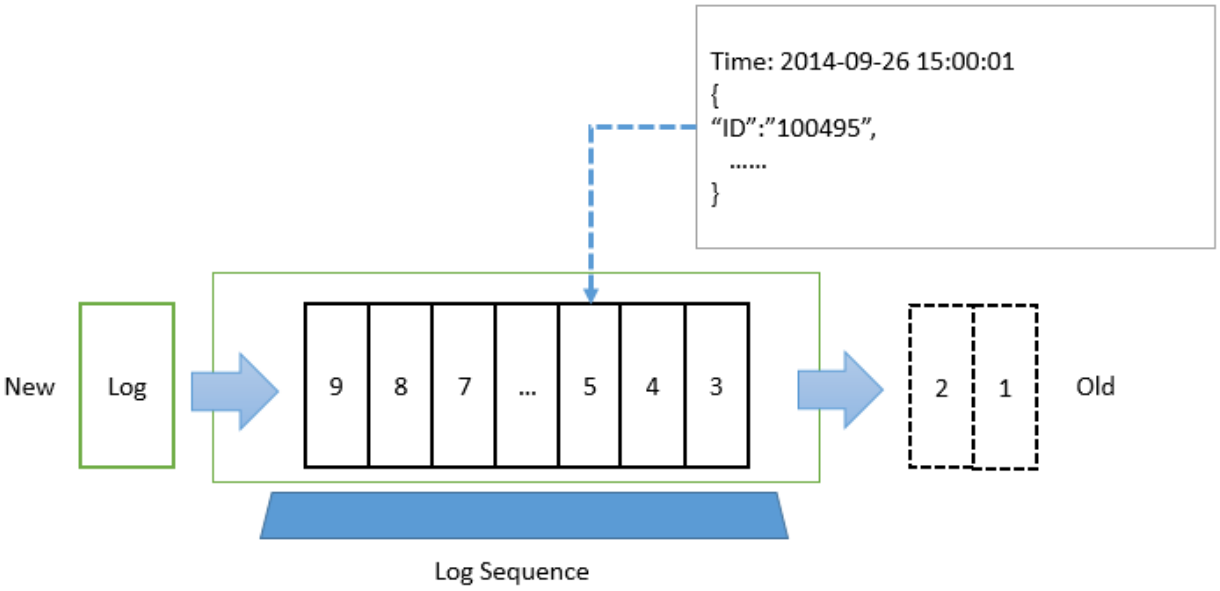
. Servers, routers, sensors, GPS devices, orders, and various IoT devices describe the world we live from different angles by generating and using logs. With the computing power, we continuously update our recognition to the whole world and system by collecting, processing, and using logs.

What is a log?

Consider an example of a ship captain's log. In addition to a recorded timestamp, a log can contain almost all sorts of information, such as a text record, an image, weather conditions, and the sailing course. After centuries passed, now the "ship captain's log" has been expanded to various areas such as orders, payment records, user accesses, and database operations.

The reason why logs are widely used and enduring is that logs are the simplest storage abstraction. Logs are a collection of chronological records that can only be added. The following figure is what logs (time-series data) look like.

Figure 5-1: Log



We can add a record to the end of a log and read the log records from left to right. Each record has a unique log record number with a sequence.

The log sequence is determined by "time". From the preceding figure, we can see that the log time sequence is from right to left. The new event is recorded, and the old event is gradually out of sight. But a log is a record of events. This is the foundation of recognition and reasoning to computers, humans, and the whole world.

Logs in Log Service

A log is an abstraction of system changes during the running process. The log content is a time-ordered collection of some operations and the corresponding operation results of specified objects . LogFile, Event, BinLog, and Metric data are different carriers of logs. In LogFile, every log file is composed of one or more logs, and every log describes a single system event. A log is the minimum data unit processed in Log Service

Log Service defines a log by using the semi-structured data mode. This mode includes the following four data fields: Topic, Time, Content, and Source.

Meanwhile, Log Service has different format requirements for different log fields. For more information, see the following table.

Data field	Meaning	Format
Topic	A custom field used to mark multiple logs. For example, access logs can be marked according to sites.	Any string up this field is a
Time	A reserved field in the log used to indicate the log generation time. Generally this field is generated directly based on the time in the log.	An integer in seconds. Th 1970-1-1 00:
Content	A field used to record the specific log content. The log content is composed of one or more content items, and each content item is a key-value pair.	The key is a contain letter a number or • `__time_` • `__source` • `__topic_` • `__parti` • `_extrac` • `__extra` The value ca
Source	A field used to indicate the source of the log. For example, the IP address of the machine where the log is generated.	Any string up

Various log formats are used in actual usage scenarios. For better understanding, the following example describes how to map an original Nginx access log to the Log Service log data model.

Assume that the IP address of your Nginx server is 10.249.201.117 . The following is an original log of this server.

```
10.1.168.193 - - [01/Mar/2012:16:12:07 +0800] "GET /Send? AccessKeyId=
8225105404 HTTP/1.1" 200 5 "-" "Mozilla/5.0 (X11; Linux i686 on x86_64
; rv:10.0.2) Gecko/20100101 Firefox/10.0.2"
```

Map the original log to the Log Service log data model as follows:

Data field	Content	Description
Topic	“”	Use the default value (null string).
Time	1330589527	The precise log generation time, indicating the number of seconds since 1970-1-1 00:00:00 UTC. The time is converted from the timestamp of the original log.
Content	Key-value pair	Specific log content.
Source	“10.249.201.117”	Use the IP address of the server as the log source.

You can decide how to extract the original log contents and combine them into key-value pairs. The following table is shown as an example.

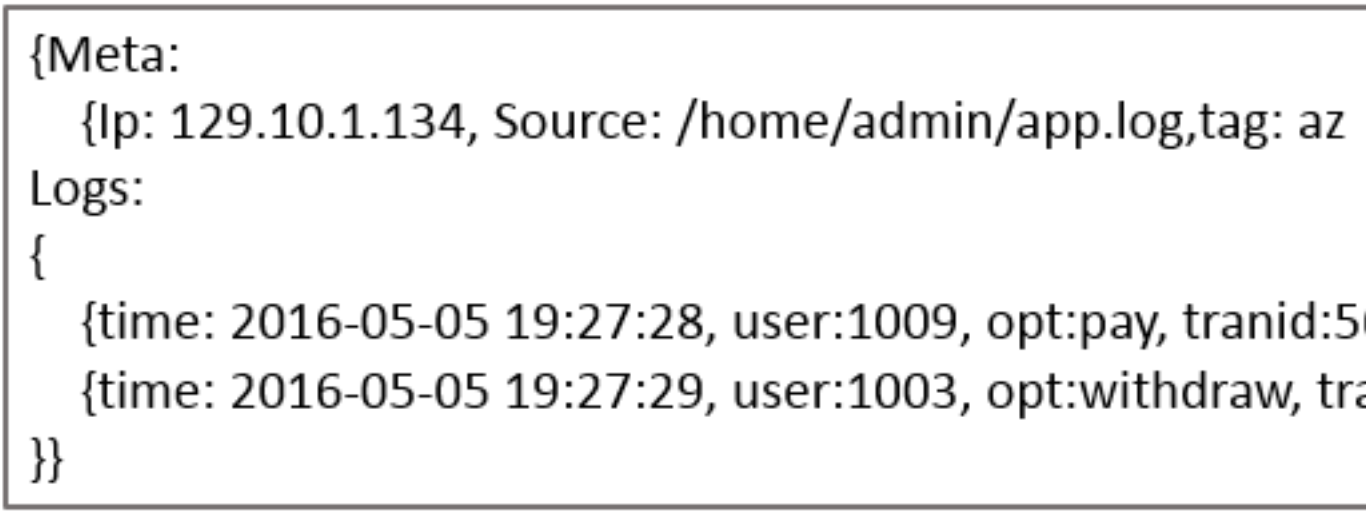
Key	Value
ip	“10.1.168.193”
method	“GET”
Status	“200”
length	“5”
ref_url	“-“
browser	“Mozilla/5.0 (X11; Linux i686 on x86_64; rv:10.0.2) Gecko/20100101 Firefox/10.0.2”

Log Group

A log group is a collection of logs and is the basic unit for writing and reading.

The maximum capacity of a log group is up to 4096 logs or 10 MB.

Figure 5-2: Log Group



5.3 Project

The project is the resource management unit in Log Service and is used to isolate and control resources. You can manage all the logs and the related log sources of an application by using projects. Projects manage the information of all your Logstores and the log collection machine configuration, and serve as the portals where you can access the Log Service resources.

Specifically, projects provide the following functions:

- Projects help you organize and manage different Logstores. In actual use, you might use Log Service to centrally collect and store the logs of the different projects, products, or environments. You can classify different logs for management in different projects to facilitate subsequent usage, export, or index of logs. In addition, projects are the carriers of the log access permission management.
- Projects serve as the portals where you can access the Log Service resources. Log Service allocates a unique access point for each created project. The access point supports writing, reading, and managing logs by using the network.

5.4 Logstore

The Logstore is a unit in Log Service to collect, store, and query the log data. Each Logstore belongs to a project, and each project can create multiple Logstores. You can create multiple Logstores for a project according to your actual needs. Typically, an independent Logstore is created for each type of logs in an application. For example, you have a game application “big-game”, and three types of logs are on the server: operation_log, application_log, and access_log

. You can first create a project named “big-game”, and then create three Logstores under this project for these three types of logs to collect, store, and query logs respectively.

You must specify the Logstore for writing and querying logs. If you want to deliver log data to maxcompute for offline analysis, its data delivery is also based on the logstore as a unit for data synchronization, that is, The log data in the logstore is delivered to a maxcompute table.

Specifically, Logstores provide the following functions:

- Log collection, supports real-time logging.
- Log storage, supports real-time consumption.
- Index creation, supports real-time log query.
- Provides data channels delivered to maxcompute

5.5 Shard

Logstore read/write logs must be stored in a certain shard. Each Logstore is divided into several shards and each shard is composed of MD5 left-closed and right-open intervals. Each interval range does not overlap with others and the total range of all the intervals is the entire MD5 value range.

Range

You must specify the number of shards when creating a Logstore. Then, the entire MD5 range is automatically divided evenly according to the specified number of shards. Each shard has a range, which can be expressed in the MD5 mode and must be within the following value range: [00000000000000000000000000000000,ffffffffffffffffffffffffffffffff).

All of the shard ranges are left-closed and right-open intervals, and composed of the following keys:

- BeginKey: Indicates the start of the shard. This key is included in the shard range.
- EndKey: Indicates the end of the shard. This key is excluded from the shard range.

With the shard range, you can write logs by specifying Hash Key, split shards, and merge shards . To read data from a shard, you must specify the corresponding shard. To write data to a shard, you can use Server Load Balancer or specify the Hash Key. By using Server Load Balancer, each data packet is written to an available shard at random. By specifying the Hash Key, data is written to the shard whose range includes the specified key. To read data from a shard, you must specify the corresponding shard. To write data to a shard, you can use Server Load Balancer or specify the Hash Key. By using Server Load Balancer, each data packet is written to an available shard

at random. By specifying the Hash Key, data is written to the shard whose range includes the specified key.

For example, a Logstore has four shards and the MD5 value range of this Logstore is [00,FF). Each shard range is as follows.

Shard No.	Range
Shard0	[00,40)
Shard1	[40,80)
Shard2	[80,C0)
Shard3	[C0,FF)

If you specify the MD5 key as 5F by specifying the Hash If you specify the MD5 key as 5F by specifying the Hash Key when writing logs, the log data is written to Shard1 that contains the MD5 key 5F. If you specify the MD5 key as 8C, the log data is written to Shard2 that contains the MD5 key 8C.

Read/write capacities

Each shard has certain service capacities:

- Writing: 5 MB/s, 500 times/s
- Read: 10 MB/s, 100 times/s

We recommend that you plan the number of shards according to the actual data traffic. If the traffic exceeds the read/write capacities, split the shard in time to increase the number of shards so as to achieve greater read/write capacities. If the traffic is far less than the maximum read/write capacities of shards, we recommend that you merge the shards to reduce the number of shards so as to save the rental costs of shards.

For example, assume that you have two shards in readwrite status and can write data at 10 MB/s at maximum. If you write data at 14 MB/s in real time, we recommend that you split a shard to make the number of shards in readwrite status reach three. If you write data at only 3 MB/s in real time, we recommend that you merge these two shards because one shard can meet the needs.

Note:

- If the API consistently reports error 403 or 500 during the writing, see Log Service monitoring metrics to determine whether to increase the number of shards.

- For read/write operations that exceed the service capacities of shards, the system attempts to provide the needed services, but the service quality cannot be guaranteed.

Status

The shard status includes:

- readwrite: Supports reading and writing data.
- readonly: Only supports reading data.

When a shard is created, all the shards are in readwrite status. Split or merge operations change the shard status to readonly and generate a new shard in readwrite status. The shard status does not affect the performance of reading data. Shards in readwrite status maintain normal data writing performance, while shards in readonly status do not support writing data.

When splitting a shard, you must specify a ShardId in readwrite status and an MD5. The MD5 must be greater than the shard BeginKey and less than the shard EndKey. Split operations can split two other shards from one, that is, the number of shards is increased by 2 after the split. After the split, the status of the original shard specified to be split is changed from readwrite to readonly. Data can still be consumed, while new data cannot be written. The two newly generated shards are in readwrite status and arranged behind the original shard. The MD5 range of these two shards covers the range of the original shard.

When merging shards, you must specify a shard in readwrite status. Make sure the specified shard is not the last shard in readwrite status. The server automatically finds the adjacent shard at the right of the specified shard and merges these two shards. After the merge, the specified shard and the adjacent shard on the right are in readonly status. Data can still be consumed, while new data cannot be written. A new shard in readwrite status is generated and its MD5 range covers the total range of the original two shards.

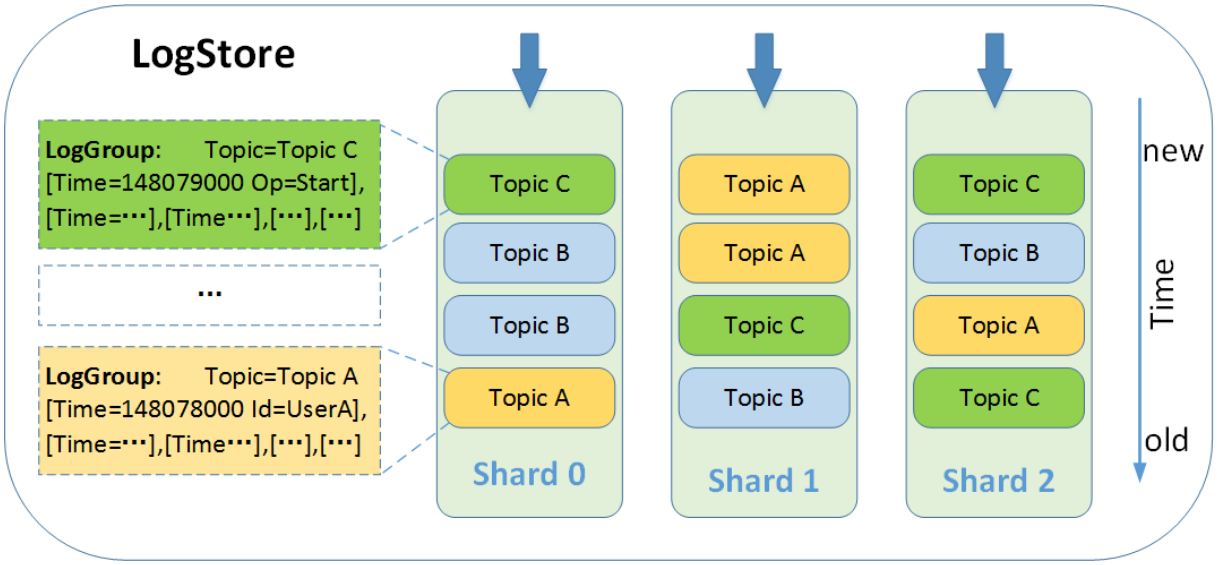
5.6 Log topic

Logs in a Logstore can be classified by log topics. You can specify the topic when writing and querying logs. For example, as a platform user, you can use your user ID as the log topic when writing logs. In this way, you can select to only view your own logs based on the log topic when querying logs. If you do not need to classify the logs in a Logstore, use the same topic for all of the logs.

 **Note:**

A null string is a valid log topic and is the default log topic when writing and querying logs. So if you do not need to use the log topic, the easiest way is to use the default log topic, the null string, when writing and querying logs.

The relationship among Logstores, log topics, and logs is as follows.



6 Limits

6.1 Basic resources

Resources	Limit	Note
Project	Up to 50 projects can be created for each account.	If you have an extra demand, please open a ticket to apply for support.
Logstore	Up to 200 Logstores can be created in each project.	If you have an extra demand, please open a ticket to apply for support.
Shard	• Up to 200 shards can be created in each project. • Up to 10 shards can be created in each Logstore . You can increase the number of shards by splitting shards.	If you have an extra demand, please open a ticket to apply for support.
LogtailConfig	Up to 100 LogtailConfigs can be created for each project.	If you have an extra demand, please open a ticket to apply for support.
Log storage time	Permanent storage is supported. You can also customize the log storage time in the range of 1 to 3000.	-
Machine group	Up to 100 machine groups can be created for each project.	If you have an extra demand, please open a ticket to apply for support.
Consumer group	Up to 10 consumer groups can be created for eachLogstore.	You can delete unused consumer groups.
Quick query	Up to 100 quick queries can be created for each project.	-
Dashboard	• Up to 50 dashboards can be created for each project. • Each dashboard can contain up to 50 analysis charts.	-

Resources	Limit	Note
LogItem	The maximum length of a LogItem is 1 MB.	1 MB is for the API parameter . If Logtail is used to collect logs, the maximum length for a single LogItem is 512 KB.
LogItem (Key)	The maximum length is 128 bytes.	-
LogItem (Value)	The maximum length is 1 MB.	-
Log group	Each log group contains up to 4096 logs and the maximum length of a log is 10 MB.	-

6.2 Data read and write

Resource	Limit	Description	Note
Project	Write traffic protection	The write traffic is up to 30 GB/min.	If the limit is exceeded , the status code of 403 is returned , prompting Inflow Quota Exceed. If you have an extra demand , please open a ticket to apply for support.
	Number of writes protection	The maximum number of writes is 600000 per minute.	If the limit is exceeded , the status code of 403 is returned, prompting Write QPS Exceed. If you have an extra demand, please open a ticket to apply for support.
	Number of reads protection	The maximum number of reads is 600000 per minute.	If the limit is exceeded , the status code of 403 is returned, prompting Read QPS Exceed. If you have an extra demand, please open a ticket to apply for support.

Resource	Limit	Description	Note
Shard	Write traffic	The maximum write traffic is 5 MB/s.	Not required. When the limit is exceeded, the system serves as much as possible, but does not guarantee the service quality.
	Number of writes.	The maximum number of writes is 500 per second.	Not required. When the limit is exceeded, the system serves as much as possible, but does not guarantee the service quality.
	Read traffic	The maximum read traffic is 10 MB/s.	Not required. When the limit is exceeded, the system serves as much as possible, but does not guarantee the service quality.
	Number of reads	The maximum number of reads is 100 per second.	Not required. When the limit is exceeded, the system serves as much as possible, but does not guarantee the service quality.

6.3 Search, analysis, and visualization

Function	Item	Limit	Note
Query	Number of keywords	The number of conditions specified for querying words besides Boolean logical operators. You can query up to 30 keywords each time.	For example, "a and b or c and d...".
	The length of a single value.	The maximum length of a single value is 10 KB. The excess part of the value is not queried.	If the length of a single value is greater than 10 KB, the log might not be found through

Function	Item	Limit	Note
			keywords, but the data is still complete.
	Single project concurrency	The number of single project concurrency is up to 100.	-
	Number of entries of returned query results	By default, a maximum of 100 entries of query results are returned each time.	You can read the full query results by turning pages.
	Single Log content display	For logs exceeding 10,000 characters , Log service only processes the first 10,000 characters using the DOM word segmentation due to Web browser performance.	-
SQL analysis	Maximum length of a single value	The maximum length of a single value is 2 KB. The excess part of the value is not queried.	Query results might not be accurate when the limit is exceeded , but the data is still complete.
	Single project concurrency	The number of single project concurrency is up to 30.	-
	Number of entries of results in each analysis	Results returned by each analysis are up to 100 MB or 100000 entries.	-