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Tracing Analysis
Product Introduction

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Document conventions

Style	Description	Example
Danger	A danger notice 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.
Warning	A warning notice 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 restart an instance.
Notice	A caution notice indicates warning information, supplementary instructions, and other content that the user must understand.	Notice: If the weight is set to 0, the server no longer receives new requests.
Note	A note indicates supplemental instructions, best practices, tips, and other content.	Note: You can use Ctrl + A to select all files.
>	Closing angle brackets are used to indicate a multi-level menu cascade.	Click **Settings**> **Network**> **Set network type**.
Bold	Bold formatting is used for buttons , menus, page names, and other UI elements.	Click **OK**.
`Courier font`	Courier font is used for commands	Run the `cd /d C:/window` command to enter the Windows system folder.
Italic	Italic formatting is used for parameters and variables.	`bae log list --instanceid` *Instance_ID*
[] or [a|b]	This format is used for an optional value, where only one item can be selected.	`ipconfig [-all|-t]`
{} or {a|b}	This format is used for a required value, where only one item can be selected.	`switch {active|stand}`

Table of Contents

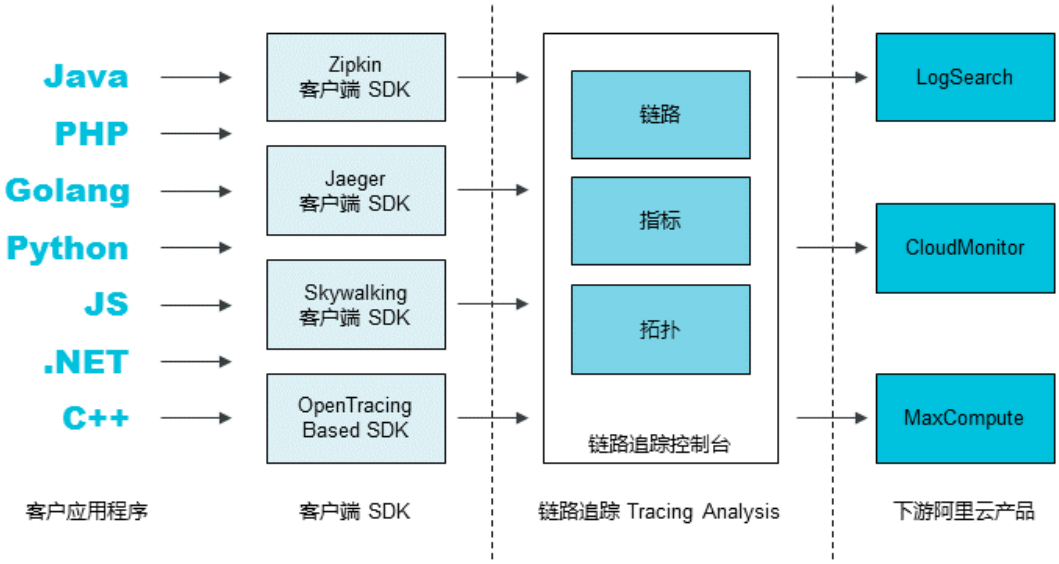
1.What is Tracing Analysis?

Tracing Analysis provides a variety of tools for distributed applications, including trace mapping, request counting, trace topology, and application dependency Analysis. With these tools, developers can quickly identify the performance bottlenecks of a distributed application architecture and improve the efficiency of microservice development and diagnosis.

Architecture

The following figure shows the product architecture of link tracing.

Product Architecture of tracing analysis



The main work process is as follows:

- The customer application reports service calls through the integrated tracing analysis SDK. Tracing analysis supports SDKs from various open source communities and the OpenTracing standard.
- After the tracing data is reported to the tracing analysis console, the tracing analysis component aggregates, computes, and persists the data in real time to form monitoring data such as the trace details, Performance Overview, and real-time topology data. You can then troubleshoot and diagnose the problem.
- You can use the trace data to connect to downstream Alibaba cloud products, such as LogSearch, CloudMonitor, and MaxCompute, for offline analysis and alert management.

Features

The main features of link tracing include:

- Query and diagnostics of distributed traces: This feature tracks microservice user requests in the distributed architecture and summarizes these requests into distributed traces.
- Real-time collection of application performance data: This feature tracks all user requests for an application and collects and analyzes in real time the performance data of the services and resources that constitute the application.
- Dynamic Discovery of distributed topology: In this way, you can obtain the distributed call information collected by tracing analysis for your distributed micro-application and PaaS products.

- Programming for multiple languages: This service is based on OpenTracing and fully compatible with open-source communities such as Jaeger and Zipkin.
- Various downstream integration scenarios: uses collected traces for log analysis and connects to downstream analysis platforms such as MaxCompute.

2.Terms

This topic describes basic concepts before using tracing analysis, including the role of the distributed tracing system, what a call chain is, the OpenTracing data model that tracing links depend on, and how data is reported to the tracing system.

Why is a distributed tracing system needed?

In order to cope with various complex business, development engineers began to adopt Agile development, continuous integration and other development methods. The system architecture has evolved from a stand-alone software system to a microservices model. Microservices are built on different sets of software, which may be developed by different teams, implemented in different programming languages, or released on multiple servers. Therefore, if a service error occurs, it may cause service exceptions in dozens of applications.

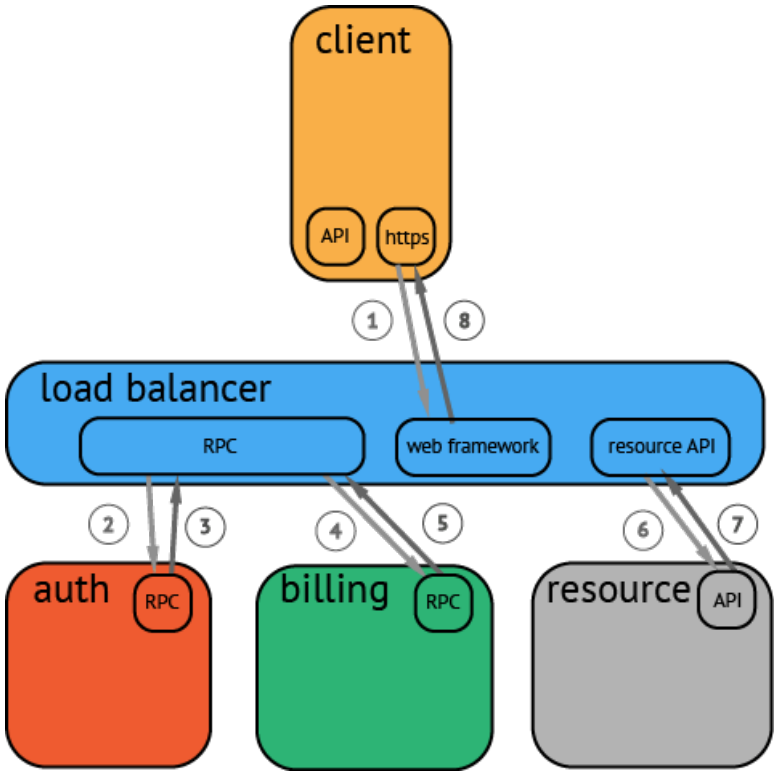
The distributed tracing system can record request information, such as the execution process and time consumption of a remote method call. It is an important tool for troubleshooting system problems and system performance.

What is a Trace?

Broadly speaking, a trace of call represents the execution process of a transaction or process in a (distributed) system. In the OpenTracing standard, a call chain is a Directed Acyclic Graph (Directed Acyclic Graph) composed of multiple spans. Each Span represents a named and timed continuous execution segment in the call chain.

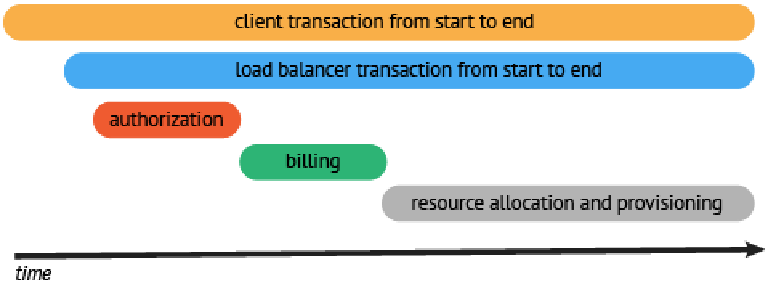
The following example shows a distributed call. When a client initiates a request, the request first goes to the Server Load Balancer, passes through the authentication service, billing service, and finally the resource, and finally returns the result.

Example of a distributed call



After the system collects and stores the data, the distributed tracing system can be used to generate a timing diagram that contains a timeline.

Link diagram containing the timeline



Data Model

Overall concept

In OpenTracing, a Trace is implicitly defined by the Span in this Trace. A trace can be considered as a directed acyclic graph (DAG) that consists of multiple spans. The relationship between spans is named References. The call chain in the following example consists of eight spans.

```
Causal relationship between spans in A single Trace [Span A] ← ←(The root Span) | + ------ + ------ + | | [span B] [Span C] ← ←(Span C is A child node of Span A, ChildOf) | [Span D] + --- + ------- + | | [Span E] [Span F] |result > [Span G] |result> [Span H] // Trigger function (Span G is called after Span F, FollowsFrom)
```

In some cases, a timing diagram based on a timeline can be used to better display the call chain.

```
time relationship between spans in A single Trace -- | ------- | ------- | ------- | ------- | ------- | ------- | ------- |-> time [Span A&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip; ..&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip; ..] [Span C&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip;&hellip; ..] [Span E&hellip;&hellip;&hellip;&hellip;] [Span F.] [span G ・] [Span H ・]
```

Link

You can call this operation to create tracers (startSpan), Extract (Extract), and Inject (passthrough). It has the following capabilities:

- Create a new Span or set the Span property

```
/**Create and start a span. On the page that appears, specify the name of the operation and options. * *For example,** create a Span: **sp := tracer. Without parentSpan. StartSpan(" GetFeed ") ** create a Span with parentSpan * sp := tracer.StartSpan("GetFeed",opentracing.ChildOf(parentSpan.Context())) example */ StartSpan(operationName string, opts ...StartSpanOption) Span
```

Each Span contains the following objects:

- Operation name: Operation name (also known as Span name).
- Start timestamp: The Start time of the day period.
- Finish timestamp: indicates the end time.
- Span tag: a set of Span tags. It is composed of a set of key-value pairs. In a key-value pair, the key must be a String and the value can be a String, Boolean, or numeric value.
- Span log: A Collection of Span logs. Each Log operation contains one key-value pair and one timestamp. In a key-value pair, the key must be a String and the value can be of any type.
- SpanContext: The pan context object. Each SpanContext contains the following states:
  - To implement any OpenTracing service, it must rely on a unique Span to transmit the status of the current call chain across process boundaries (for example, the Trace and Span ids).
  - Baggage Items are the data accompanying a Trace and a collection of key-value pairs. They are stored in a Trace and must be transmitted across process boundaries.
- References (relationship between spans): Zero or multiple related spans. Spans establish the relationship based on the SpanContext.

- Pass-through data

  Passthrough data is divided into two steps:

  i. Parses the SpanContext object from the request.

  ```
  // Inject() takes the `sm` SpanContext instance and injects it for // propagation within `carrier`. The actual type of `carrier` depends on // the value of `format`. /**Parse the SpanContext (including traceId, spanId, and bagged) from the Carrier based on the format parameter. **Example:** carrier := opentracing.HTTPHeadersCarrier(httpReq.Header) // * clientContext, err := tracer.Extract(opentracing.HTTPHeaders, carrier) // */ Extract(format interface parameter parameter, carrier interface{}) (spanccontext, error)
  ```

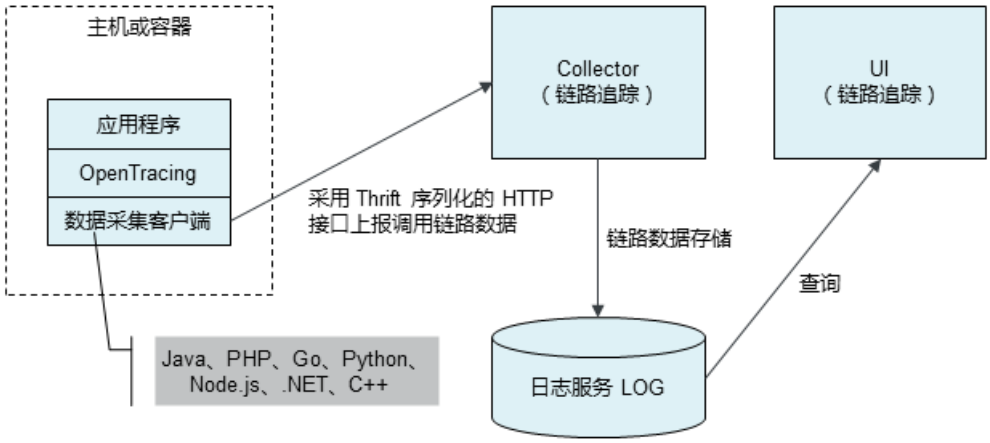
  ii. Inject SpanContext to the request.

  ```
  /**Inject *** inject traceId,spanId, and Baggage in SpanContext to the request (Carrier) according to the format parameter. **e.g** carrier := opentracing.HTTPHeadersCarrier(httpReq.Header) then * err := tracer.Inject(span.Context(), opentracing.HTTPHeaders, carrier) producer */ Inject(sm SpanContext, format interface response parameter, carrier interface{}) error
  ```

How is the data reported?

The following figure shows how data is reported without an Agent.

Data Reporting



The following figure shows how the data is reported by an Agent.

Report data through Agent