API Gateway

Best Practices

Issue	02
Date	2025-01-24

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1 Overview

This document summarizes practices in common application scenarios of API Gateway (APIG). Each practice case is given detailed solution description and operation guidance, helping you easily build your services based on APIG.

Table 1-1 APIG best practices

Practice	Description
Selectively Exposing CCE Workloads with a Dedicated Gateway	You can use APIG to selectively expose your workloads and microservices in Cloud Container Engine (CCE).
Selectively Exposing Service Capabilities of a Data Center Using a Dedicated Gateway	You can use APIG to set up a connection between your on-premises data center and the gateway (or the VPC bound to the gateway).
Developing a Custom Authorizer with FunctionGraph	Custom authentication is implemented using the FunctionGraph service. You can create a FunctionGraph function so that APIG can invoke it to authenticate requests for your API.
Exposing Backend Services Across VPCs Using a Dedicated Gateway	If the VPC of your backend server is different from that of your gateway, you can expose your backend service through cross-VPC interconnection.
Using WAF to Protect APIG	To protect APIG and your backend servers from malicious attacks, deploy Web Application Firewall (WAF) between APIG and the external network.

Practice	Description
Using Request Throttling 2.0 for Fine-grained Request Throttling	As users and their demands become more diversified, the traditional policies cannot meet the requirements for more refined rate limiting. To resolve this issue, APIG has launched request throttling 2.0, which is a type of plug-in policy. The 2.0 policies enable you to configure more refined throttling, for example, to throttle requests based on a certain request parameter or tenant.
Configuring Two-factor Authentication (App + Custom)	APIG allows you to configure a custom authorizer for two-factor authentication.
HTTP-to-HTTPS Auto Redirection with a Dedicated Gateway	HTTP APIs are insecure in transmission and authentication. You can upgrade them for access over HTTPS while ensuring HTTP compatibility.
Routing gRPC Service Requests Using a Dedicated Gateway	When you use a gRPC service, you can create an API in APIG to route requests for the service.
Configuring One-Way or Two-Way Authentication Between the Dedicated Gateway and Client	If the API frontend supports HTTPS, you need to add an SSL certificate for the independent domain name bound to the API group. An SSL certificate is used for data encryption and identity authentication. If an SSL certificate contains a CA certificate, client authentication (two-way authentication) is enabled by default. Or one-way authentication will be used.
Calling Different Backend Services Using a Dedicated Gateway	APIG allows you to define multiple backend policies and forward API requests to different backends based on these different policies. For example, to distinguish special calls from regular calls, you can define a policy backend that uses frontend custom authentication parameters.
Forwarding WebSocket Service Requests Using a Dedicated Gateway	You can create WebSocket APIs in the same way as you create HTTP APIs. WebSocket is a protocol for full-duplex communication over a single TCP connection.

2 API Openness

2.1 Selectively Exposing CCE Workloads with a Dedicated Gateway

2.1.1 Introduction

Scenario

You can use APIG to selectively expose your workloads and microservices in Cloud Container Engine (CCE).

Expose CCE workloads using either of the following methods. **Method 1** is recommended.

- Method 1

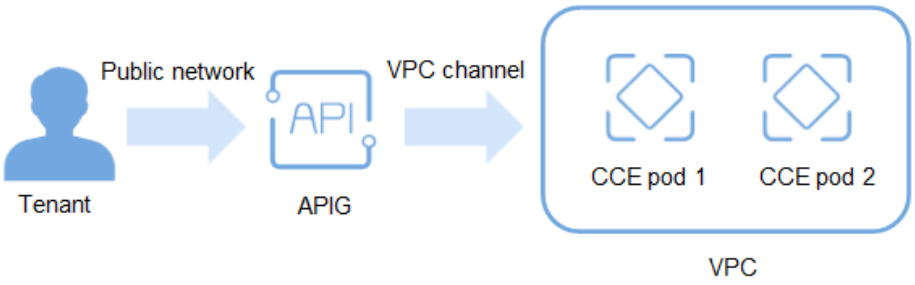
  Create a load balance channel on APIG to access pod IP addresses in CCE workloads, dynamically monitoring the changes of these addresses. When opening APIs of a containerized application, specify a load balance channel to access the backend service.

- Method 2

  Import a CCE workload to APIG. APIs and a load balance channel are generated and associated with each other to dynamically monitor pod IP address changes. Expose workloads and microservices in CCE using these APIs.

Solution Architecture

Figure 2-1 Accessing CCE workloads (composed of pods) through APIG



Advantages

- You do not need to set elastic IP addresses, reducing network bandwidth costs.

  Workload addresses in CCE can be accessed through a load balance channel that is manually created or generated by importing a workload.
- Workload pod addresses in CCE can be dynamically monitored and automatically updated by a load balance channel that is manually created or generated by importing a workload.
- CCE workloads can be released by tag for testing and version switching.
- Multiple authentication modes keep access secure.
- Request throttling policies ensure secure access to your backend service.

  Instead of direct access to containerized applications, APIG provides request throttling to ensure that your backend service runs stably.
- Pod load balancing improves resource utilization and system reliability.

Restrictions

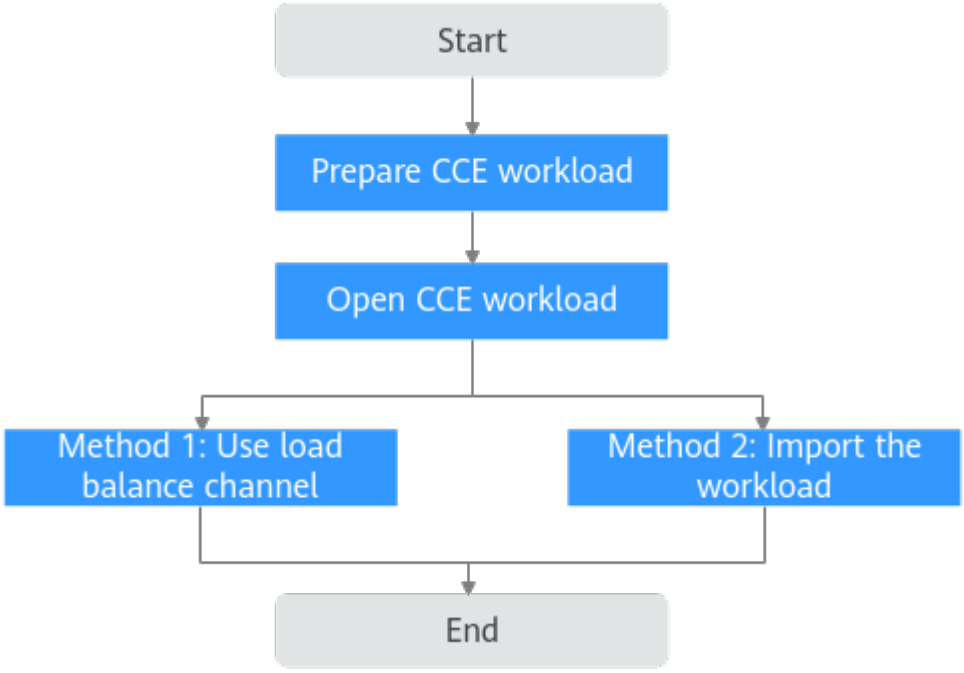
- Only CCE Turbo clusters and CCE clusters using the VPC network model are supported.
- The CCE cluster and your gateway must be in the same VPC or connected.
- If you select a CCE cluster that uses the VPC network model, add the container CIDR block of the cluster in the **Routes** area of the gateway details page.

2.1.2 Resource Planning

Table 2-1 Resource plan

Resource	Quantity
CCE	1
Dedicated gateway	1

2.1.3 General Procedure



1. **Prepare CCE workload**

   Before opening a container workload with APIG, create a CCE cluster that uses the VPC network model or a Turbo cluster on the CCE console.

2. Open CCE workload

   Method 1: Create a load balance channel on APIG to access pod addresses in the CCE workload.

   Method 2: Import a CCE workload to APIG. APIs and a load balance channel are generated and associated with each other to access pod IP addresses in the workload.

3. **(Optional) Configure workload label for grayscale release**

   Grayscale release is a service release policy that gradually switches traffic from an early version to a later version by specifying the traffic distribution weight.

2.1.4 Implementation Procedure

Preparing a CCE Workload

Step 1 Create a cluster.

1. Log in to the CCE console and buy a CCE standard or CCE Turbo cluster on the **Clusters** page. Select **CCE Standard Cluster** and set **Network Model** to **VPC network**. For details, see **Buying a CCE Cluster**.
2. After the cluster is created, record the container CIDR block.
3. Add this CIDR block in the **Routes** area of a dedicated gateway.
   a. Log in to the APIG console, and choose **Gateways** in the navigation pane.
   b. Click the gateway name to go to the details page.

c. Add the container CIDR block in the **Routes** area.

Step 2 Create a workload.

1. On the **Clusters** page of the CCE console, click the cluster name to go to the details page.
2. In the navigation pane, choose **Workloads**.
3. Click **Create Workload**. Select **Deployment**. For details, see the **Cloud Container Engine User Guide**.

   In the **Advanced Settings** > **Labels and Annotations** area, set pod labels for switching the workload and service version. In this example, set **app=deployment-demo** and **version=v1**. If you create a workload by importing a YAML file, add pod labels in this file. For details about pod labels, see **Configuring Labels and Annotations**.

   Add pod labels in a YAML file:

```
spec:
  replicas: 2
  selector:
    matchLabels:
      app: deployment-demo
      version: v1
  template:
    metadata:
      creationTimestamp: null
      labels:
        app: deployment-demo
        version: v1
```

----End

Method 1: Opening a CCE Workload by Creating a Load Balance Channel

Step 1 Create a load balance channel.

1. Go to the APIG console, and choose **Gateways** in the navigation pane.
2. Choose **API Management** > **API Policies**.
3. On the **Load Balance Channels** tab, click **Create Load Balance Channel**.

   a. Set the basic information.

Table 2-2 Basic information parameters

Parameter	Description
Name	Enter a load balance channel name. Example: **VPC_demo**.
Port	Container port of a workload for opening services. Set this parameter to **80**, which is the default HTTP port.
Routing Algorithm	Select **WRR**. This algorithm will be used to forward requests to each of the cloud servers you select in the order of server weight.
Type	Select **Microservice**.

b. Configure microservice information.

Table 2-3 Microservice configuration

Parameter	Description
Microservice Type	**Cloud Container Engine (CCE)** is always selected.
Cluster	Select the **created cluster**.
Namespace	Select a namespace in the cluster. In this example, select **default**.
Workload Type	Select **Deployment**. This parameter must be the same as the type of the created workload.
Service Label Key	Select the pod label **app** and its value **deployment-demo** of the **created workload**.
Service Label Value	

c. Configure a server group.

Table 2-4 Server group configuration

Parameter	Description
Server Group Name	Enter **server_group_v1**.
Weight	Enter **1**.
Backend Service Port	Enter **80**. This must be the same as the container port in the workload.
Description	Enter "Server group with version v1".
Tag	Select the pod label **version=v1** of the **created workload**.

d. Configure health check.

Table 2-5 Health check configuration

Parameter	Description
Protocol	Default: **TCP**.
Check Port	Backend server port in the channel.
Healthy threshold	Default: **2**. This is the number of consecutive successful checks required for a cloud server to be considered healthy.

Parameter	Description
Unhealthy Threshold	Default: **5**. This is the number of consecutive failed checks required for a cloud server to be considered unhealthy.
Timeout (s)	Default: **5**. This is the timeout used to determine whether a health check has failed.
Interval (s)	Default: **10**. This is the interval between consecutive checks.

e. Click **Finish**.

In the load balance channel list, click a channel name to view details.

Step 2 Open an API.

1. Create an API group.
   a. Choose **API Management** > **API Groups**.
   b. Click **Create API Group**, and choose **Create Directly**.
   c. Configure group information and click **OK**.
2. Create an API and bind the preceding load balance channel to it.
   a. Click the group name to go to the details page. On the **APIs** tab, choose **Create API** > **Create API**.
   b. Configure frontend information and click **Next**.

Table 2-6 Frontend configuration

Parameter	Description
API Name	Enter an API name.
Group	The group the API belongs to. Select the **preceding API group**.
URL	▪ **Method**: Request method of the API. Set this parameter to **ANY**. ▪ **Protocol**: Request protocol of the API. Set this parameter to **HTTPS**. ▪ **Subdomain Name**: The system automatically allocates a subdomain name to each API group for internal testing. The subdomain name can be accessed 1,000 times a day. ▪ **Path**: Path for requesting the API.
Gateway Response	Select a response to be displayed if the gateway fails to process an API request. Default: **default**.
Matching	Select **Prefix match**.

Parameter	Description
Authentication Mode	API authentication mode. Select **None**. (**None**: Not recommended for actual services. All users will be granted access to the API.)

c. Configure backend information and click **Next**.

Table 2-7 Parameters for defining an HTTP/HTTPS backend service

Parameter	Description
Load Balance Channel	Determine whether the backend service will be accessed using a load balance channel. For this example, select **Configure**.
URL	▪ **Method**: Request method of the API. Set this parameter to **ANY**. ▪ **Protocol**: Set this parameter to **HTTP**. ▪ **Load Balance Channel**: Select the **created channel**. ▪ **Path**: Path of the backend service.

d. Define the response and click **Finish**.

3. Debug the API.

   On the **APIs** tab, click **Debug**. Click the **Debug** button in red background. If the status code **200** is returned in the response result, the debugging is successful. Then go to the next step. Otherwise, rectify the fault by following the instructions provided in **Error Codes**.

4. Publish the API.

   On the **APIs** tab, click **Publish Latest Version**, retain the default option **RELEASE**, and click **OK**. When the exclamation mark in the upper left of the **Publish** button disappears, the publishing is successful. Then go to the next step. Otherwise, rectify the error indicated in the error message.

Step 3 Call the API.

1. Bind independent domain names to the group of this API.

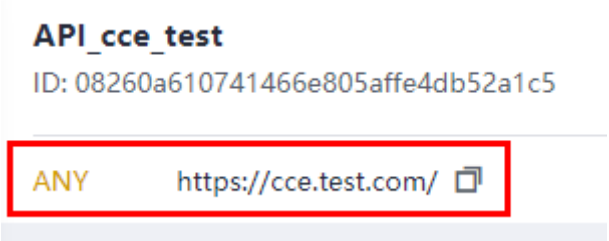
   On the group details page, click the **Group Information** tab. The debugging domain name is only used for development and testing and can be accessed 1000 times a day. Bind independent domain names to expose APIs in the group.

   Click **Bind Independent Domain Name** to bind registered public domain names. For details about how to bind a domain name, see **Binding a Domain Name**.

2. Copy the URL of the API.

   On the **APIs** tab, copy the API URL. Open a browser and enter the URL. When the defined success response is displayed, the invocation is successful.

Figure 2-2 Copying the URL



Now, the CCE workload is opened by creating a load balance channel.

----End

Method 2: Opening a CCE Workload by Importing It

Step 1 Import a CCE workload.

1. Go to the APIG console, and choose **Gateways** in the navigation pane.
2. Choose **API Management** > **API Groups**.
3. Choose **Create API Group** > **Import CCE Workload**.
   a. Enter information about the CCE workload to import.

Table 2-8 Workload information

Parameter	Description
Group	Group to which the CCE workload belongs. Default: **New group**.
Cluster	Select the **created cluster**.
Namespace	Select a namespace in the cluster. In this example, select **default**.
Workload Type	Select **Deployment**. This parameter must be the same as the type of the created workload.
Service Label Key	Select the pod label **app** and its value **deployment-demo** of the **created workload**.
Service Label Value	
Tag	Another pod label **version=v1** of the workload is automatically selected.

   b. Configure API information.

Table 2-9 API information

Parameter	Description
Protocol	API request protocol. **HTTPS** is selected by default.

Parameter	Description
Request Path	API request path for prefix match. Default: **/**. In this example, retain the default value.
Port	Enter **80**. This must be the same as the container port in the workload.
Authentication Mode	Default: **None**. (**None**: Not recommended for actual services. All users will be granted access to the API.)
CORS	Disabled by default.
Timeout (ms)	Backend timeout. Default: **5000**.

4. Click **OK**. The CCE workload is imported, with an API group, API, and load balance channel generated.

Step 2 View the generated API and load balance channel.

1. View the generated API.
   a. Click the **API group name**, and then view the API name, request method, and publishing status on the **APIs** tab.
   b. Click the **Backend Configuration** tab and view the bound load balance channel.
2. View the generated load balance channel.
   a. Choose **API Management** > **API Policies**.
   b. On the **Load Balance Channels** tab, click the channel name to view details.
3. Check that this load balance channel is the one bound to the API, and then go to the next step. If it is not, repeat **Step 1**.

Step 3 Open the API.

Since importing a CCE workload already creates an API group and API, you only need to publish the API in an environment.

1. Debug the API.

   On the **APIs** tab, click **Debug**. Click the **Debug** button in red background. If the status code **200** is returned in the response result, the debugging is successful. Then go to the next step. Otherwise, rectify the fault by following the instructions provided in **Error Codes**.
2. Publish the API.

   On the **APIs** tab, click **Publish Latest Version**, retain the default option **RELEASE**, and click **OK**. When the exclamation mark in the upper left of the **Publish** button disappears, the publishing is successful. Then go to the next step.

Step 4 Call the API.

1. Bind independent domain names to the group of this API.

   On the group details page, click the **Group Information** tab. The debugging domain name is only used for development and testing and can be accessed

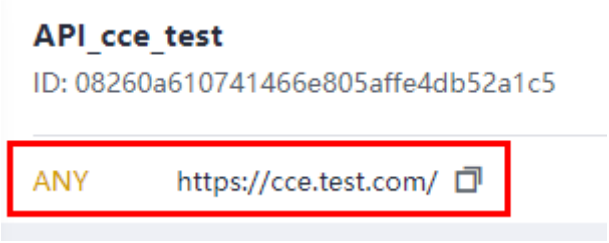
1000 times a day. Bind independent domain names to expose APIs in the group.

Click **Bind Independent Domain Name** to bind registered public domain names. For details about how to bind a domain name, see **Binding a Domain Name**.

2. Copy the URL of the API.

   On the **APIs** tab, copy the API URL. Open a browser and enter the URL. When the defined success response is displayed, the invocation is successful.

   Figure 2-3 Copying the URL

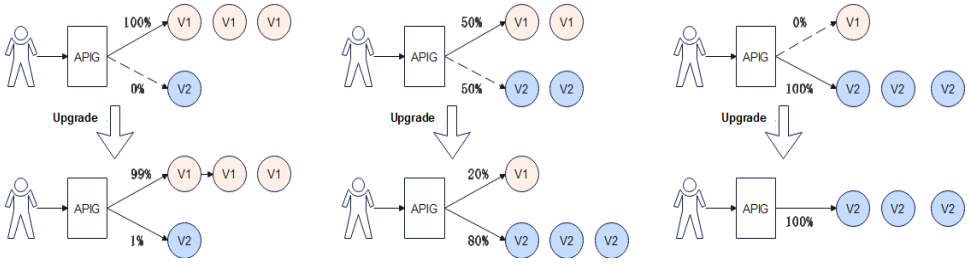
   Now, the CCE workload has been opened by importing it.

----End

(Optional) Configuring Workload Labels for Grayscale Release

Grayscale release is a service release policy that gradually switches traffic from an early version to a later version by specifying the traffic distribution weight. Services are verified during release and upgrade. If a later version meets the expectation, you can increase the traffic percentage of this version and decrease that of the early version. Repeat this process until a later version accounts for 100% and an early version is down to 0. Then the traffic is successfully switched to the later version.

Figure 2-4 Grayscale release principle



CCE workloads are configured using the pod label selector for grayscale release. You can quickly roll out and verify new features, and switch servers for traffic processing. For details, see **Using Services to Implement Simple Grayscale Release and Blue-Green Deployment**.

The following describes how to smoothly switch traffic from V1 to V2 through grayscale release.

Step 1 Create a workload, set a pod label with the same value as the **app** label of the preceding workload. For details, see the **preceding workload**.

On the workload creation page, go to the **Advanced Settings** > **Labels and Annotations** area, and set **app=deployment-demo** and **version=v2**. If you create a workload by importing a YAML file, add pod labels in this file.

Step 2 For the server group with pod label **version=v1**, adjust the traffic weight.

1. On the APIG console, choose **Gateways** in the navigation pane.
2. Choose **API Management** > **API Policies**.
3. On the **Load Balance Channels** tab, click the name of the **created channel**.
4. In the **Backend Server Address** area, click **Modify**.
5. Change the weight to **100**, and click **OK**.

   Weight is the percentage of traffic to be forwarded. All traffic will be forwarded to the pod IP addresses in server group **server_group_v1**.

Step 3 Create a server group with pod label **version=v2**, then set the traffic weight.

1. In the **Backend Server Address** area, click **Create Server Group**.

   Table 2-10 Server group configuration

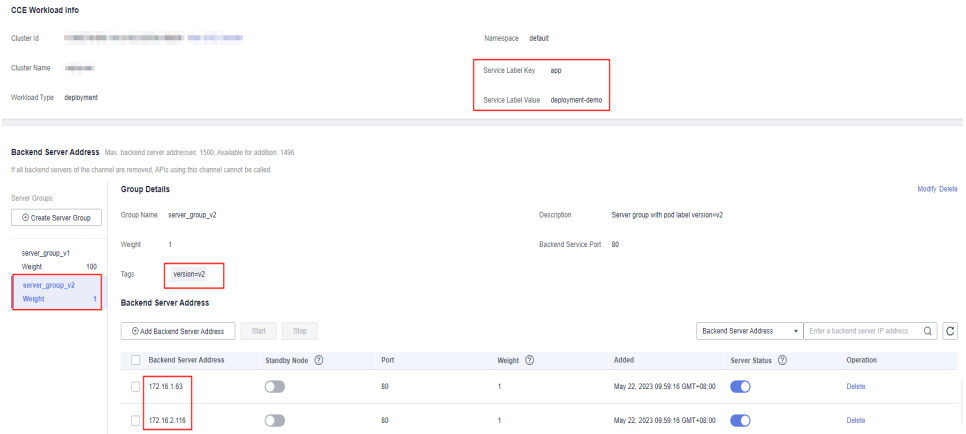
Parameter	Description
Server Group Name	Enter **server_group_v2**.
Weight	Enter **1**.
Backend Service Port	Enter **80**.
Tag	Select pod label **version=v2**.

2. Click **OK**.

Step 4 Refresh the backend server addresses.

Refresh the page for the backend server addresses. The load balance channel automatically monitors the pod IP addresses of the workload and dynamically adds the addresses as backend server addresses. As shown in the following figure, tags **app=deployment-demo** and **version=v2** automatically match the pod IP addresses (backend server addresses) of the **workload**.

Figure 2-5 Pod IP addresses automatically matched



100 of 101 (server group weight of total weight) traffic is distributed to **server_group_v1**, and the remaining to the later version of **server_group_v2**.

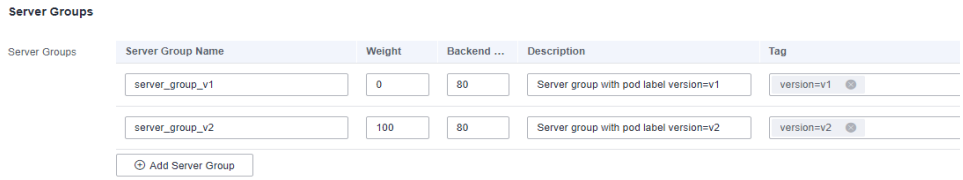
Figure 2-6 Click **Modify** in the upper right of the page.

Step 5 Check that the new features released to V2 through grayscale release are running stably.

If the new version meets the expectation, go to **Step 6**. Otherwise, the new feature release fails.

Step 6 Adjust the weights of server groups for different versions.

Gradually decrease the weight of **server_group_v1** and increase that of **server_group_v2**. Repeat **Step 5** to **Step 6** until the weight of **server_group_v1** becomes **0** and that of **server_group_v2** reaches **100**.



As shown in the preceding figure, all requests are forwarded to **server_group_v2**. New features are switched from workload **deployment-demo** of **version=v1** to **deployment-demo2** of **version=v2** through grayscale release. (You can adjust the traffic weight to meet service requirements.)

Step 7 Delete the backend server group **server_group_v1** of **version=v1**.

Now all traffic has been switched to the backend server group of **version=v2**. You can delete the server group of **version=v1**.

1. Go to the load balance channel details page on the APIG console, delete all IP addresses of the server group of **version=v1** in the **Backend Server Address** area.
2. Click **Delete** on the right of this area to delete the server group of **version=v1**.

   The backend server group **server_group_v2** of **version=v2** is kept.

----End

2.2 Selectively Exposing Service Capabilities of a Data Center Using a Dedicated Gateway

Scenario

The backend services of APIG can be deployed in the following modes:

- Deployed in a VPC and accessible only using private IP addresses.

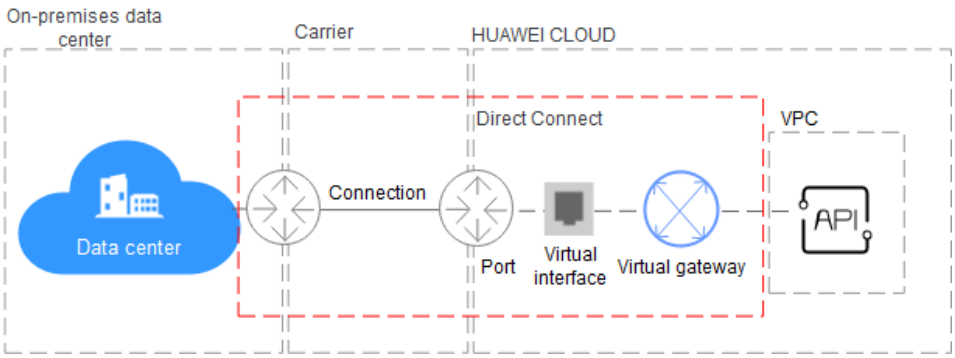
  You can create a VPC channel on APIG to enable network routing between APIG and the VPC.
- Deployed on the public network and accessible using a public IP address.
- Deployed in an on-premises data center and not accessible using a public IP address.

  If you use a dedicated API gateway, you can set up a connection between your on-premises data center and the gateway (or the VPC bound to the gateway).

This section describes the procedures for using APIG to selectively expose APIs of backend services deployed in a local data center.

Solution Architecture

Figure 2-7 Connecting a data center to a dedicated API gateway with Direct Connect



Connecting a Data Center to APIG

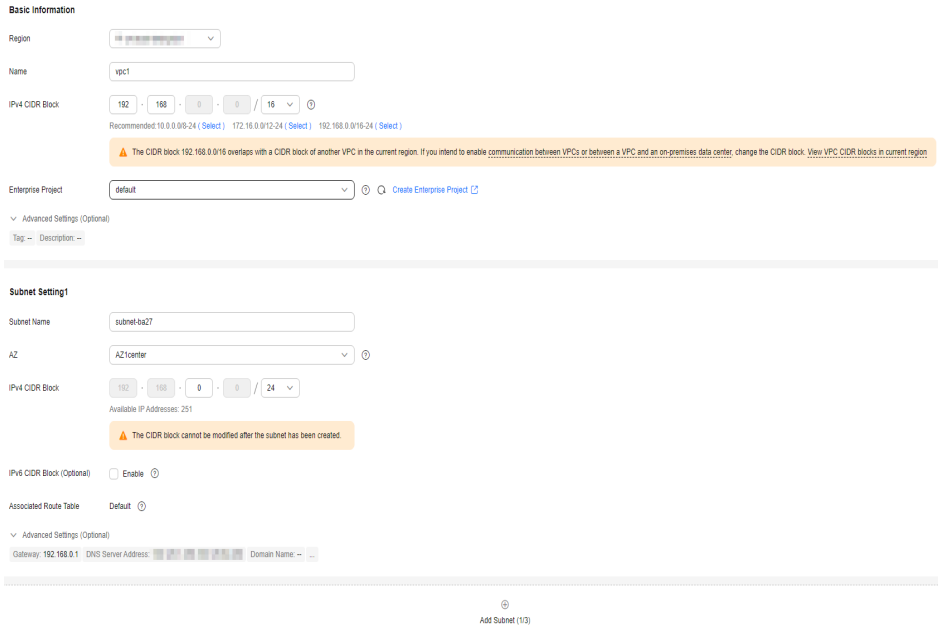
Step 1 Create a VPC. If you already have one, skip this step.

For details, see the **Virtual Private Cloud User Guide**.

To allow APIG to access services in your on-premises data center, bind a VPC to your dedicated gateway, and establish a connection between the data center and VPC using Direct Connect.

- Specify a subnet for your dedicated gateway.
- A connection links a local data center to only one VPC. You are advised to bind all your cloud resources to the same VPC to reduce costs.

Figure 2-8 Creating a VPC



Step 2 Create a dedicated API gateway.

For details, see **Buying a Dedicated Gateway**.

Step 3 Buy a connection.

To buy a connection for connecting the data center to APIG (bound VPC), do as follows:

1. **Create a Connection**

   Buy a connection to establish connectivity between your on-premises data center and Huawei Cloud. You are advised to choose **Full Service Installation**, which means that Huawei Cloud will complete the construction.

   If you already have a connection between your data center and Huawei Cloud, use the connection instead.

2. **Create a Virtual Gateway**

   The virtual gateway connects to the VPC of your dedicated gateway.

   Select the subnet that the dedicated gateway uses, to connect to the VPC. For details about the subnet, go to the gateway details page.

3. **Create a Virtual Interface**

   The virtual interface links the connection with the virtual gateway, enabling connectivity between the connection and the VPC of the dedicated gateway.

   Configure the remote gateway and remote subnet as the gateway and subnet for accessing the open API of your on-premises data center. For example, if the API calling address of your data center is **http://192.168.0.25:80/***{URI}*, configure the remote gateway and remote subnet as those of **192.168.0.25**.

4. **Configure Routes**

   Configure routes at your premises if the subnet of your data center is within the following three segments: 10.0.0.0/8-24, 172.16.0.0/12-24, and 192.168.0.0/16-24.

Step 4 Verify the network connectivity.

Create another pay-per-use ECS and select the same VPC, subnet, and security group as the dedicated gateway. If the data center can connect to the ECS, the data center can also connect to the dedicated gateway.

Step 5 **Exposing APIs with the Dedicated Gateway**.

----End

Exposing APIs with the Dedicated Gateway

After you connect the data center to the dedicated gateway, you can expose APIs using the gateway. For details, see **API Gateway User Guide**.

When creating an API, specify the backend address as the API calling address of your data center.

2.3 Exposing Backend Services Across VPCs Using a Dedicated Gateway

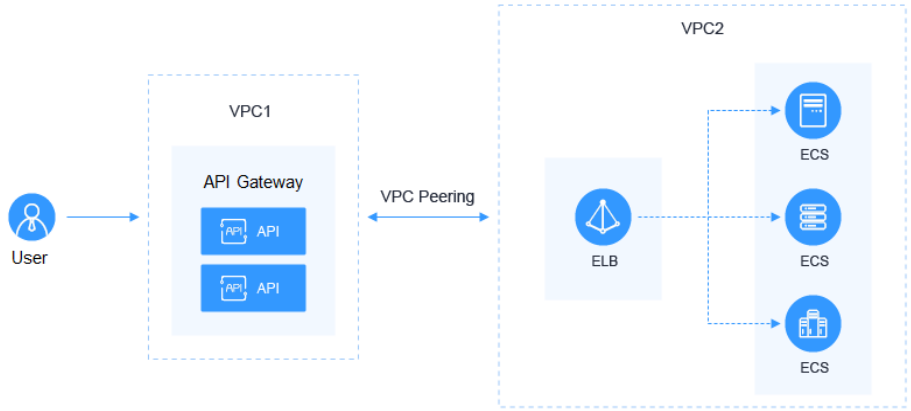
2.3.1 Introduction

Scenario

If the VPC of your backend server is different from that of your gateway, how do you configure cross-VPC interconnection? This section uses Elastic Load Balance (ELB) as an example to describe how to expose services in a private network load balancer using APIG.

Solution Architecture

Figure 2-9 Exposing backend services across VPCs



Advantages

Without modifying the existing network architecture, you can have all requests directly forwarded to your backend server through flexible configuration.

Restrictions

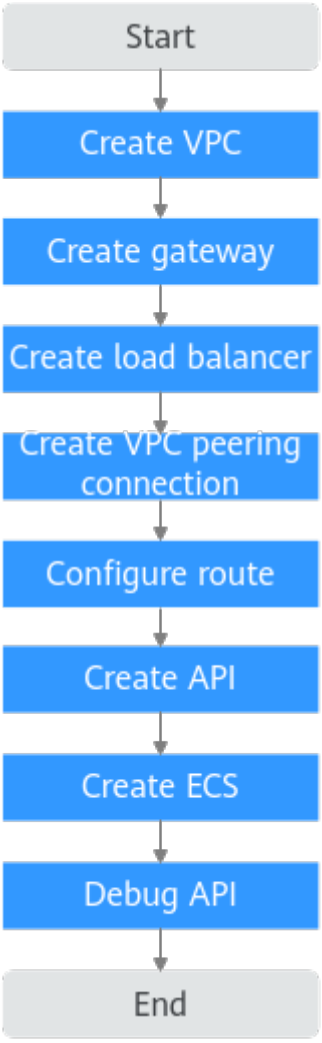
VPC 1, VPC 2, and the VPC CIDR block of your gateway cannot overlap. For details about the VPC CIDR block planning of the gateway, see **Table 2-13**.

2.3.2 Resource Planning

Table 2-11 Resource plan

Resource	Quantity
VPC	2
Dedicated gateway	1
Load balancer	1
ECS	1

2.3.3 General Procedure



1. **Create a VPC.**

   Create two VPCs, one for your gateway and the other for your backend service.
2. **Create a gateway.**

   Create a dedicated gateway in VPC 1.
3. **Create a load balancer.**

   Create a load balancer in VPC 2.
4. **Create a VPC peering connection.**

   Create a VPC peering connection to connect VPC 1 and VPC 2.
5. **Configure a route.**

   Configure a route for the dedicated gateway by setting the IP address to the IPv4 CIDR block of VPC 2 where the purchased load balancer is located.
6. **Create an API.**

   Create an API and set the backend service address to the IP address of the load balancer.
7. **Create an ECS.**

   Create an ECS in VPC 2, and deploy the backend service on the ECS.
8. **Debug the API.**

   Verify that the connection to the private network load balancer is successful.

2.3.4 Implementation Procedure

Creating a VPC

Step 1 Log in to the network console.

Step 2 In the navigation pane, choose **Virtual Private Cloud** > **My VPCs**.

Step 3 On the **Virtual Private Cloud** page, click **Create VPC**, and configure the parameters by referring to **Table 2-12** and **Table 2-13**. For details, see sections "Creating a VPC" and "Creating a Subnet for the VPC" in the *Virtual Private Cloud User Guide*.

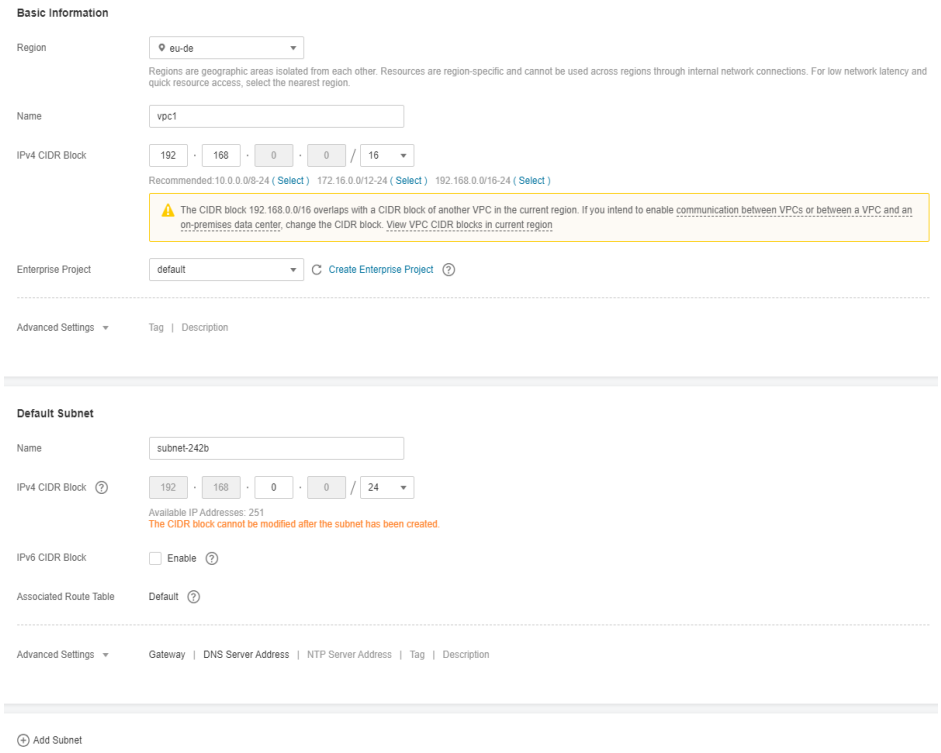


Table 2-12 Configuration information

Parameter	Description
Region	Select a region.
Name	Enter **VPC1**. This VPC will be used to run a gateway.
Enterprise Project	Select **default**.
Name	A subnet is automatically created when you create a VPC.

Table 2-13 VPC CIDR block planning

VPC 1	VPC of APIG	VPC 2
10.X	172.31.0.0/16	Must be different from VPC 1 and the VPC of the gateway.
172.X	192.168.0.0/16	
192.X	172.31.0.0/16	

Step 4 Click **Create Now**.

Step 5 Repeat **Step 3** to **Step 4** to create **VPC2** for running your backend service.

----End

Creating a Gateway

Step 1 Go to the APIG console.

Step 2 In the navigation pane, choose **Gateways**.

Step 3 Click **Buy Gateway**.

Table 2-14 Gateway information

Parameter	Description
Billing Mode	Billing mode of the gateway. Select **Pay-per-use**.
Region	Select the region where the gateway is located. It must be the same as the region of VPC 1.
AZ	The AZ where the gateway is located. Select **AZ1**.
Gateway Name	Name of the gateway.
Edition	Select **Professional**. The edition cannot be changed after the gateway is created.
Scheduled Maintenance	Select a time period when the gateway can be maintained by technical support engineers. A period with low service traffic is recommended. For this example, retain the default value **22:00:00---02:00:00**.
Enterprise Project	Select the enterprise project to which the gateway belongs. For this example, retain the default value **default**.
Network	Select **VPC 1** and a subnet.
Security Group	Click **Manage Security Groups** and create a security group. Ensure that you have selected **default** for **Enterprise Project**.
Description	Description of the gateway.

Step 4 Click **Next**.

Step 5 If the gateway configurations are correct, read and confirm your acceptance of the customer agreement and privacy statement, and create the instance.

----End

Creating a Load Balancer

Step 1 Return to the network console.

Step 2 In the navigation pane, choose **Elastic Load Balance** > **Load Balancers**.

Step 3 Click **Buy Elastic Load Balancer**.

Step 4 Configure the load balancer information. For details, see section **Load Balancer** in the *Elastic Load Balance User Guide*.

Table 2-15 Load balancer parameters

Parameter	Description
Type	Type of the load balancer.
Billing Mode	By default, **Pay-per-use** is selected.
Region	Select the region where the load balancer is located. It must be the same as the region of VPC 2.
AZ	The AZ where the load balancer is located. Select **AZ1**.
Name	Name of the load balancer.
Enterprise Project	Select **default**.
Specification	Select **Fixed** – **Application load balancing (HTTP/HTTPS)** and **Network load balancing (TCP/UDP)** by default.
Network Type	Select **Private IPv4 network** by default.
VPC	Select **VPC 2**.
Frontend Subnet	Select a subnet.

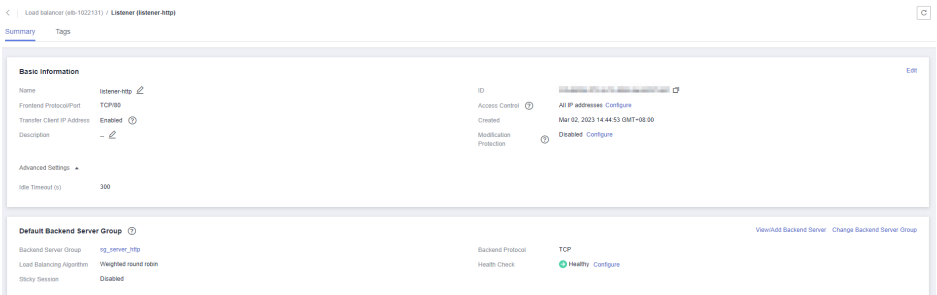
Step 5 Click **Next**.

Step 6 Confirm the configuration and click **Submit**.

Step 7 Add a listener.

1. Click the name of the load balancer. On the **Listeners** tab page, click **Add Listener**.
2. Configure the listener name, frontend protocol, and port, and click **Next**.
3. Configure the backend server group name, backend protocol, and load balancing algorithm. Then click **Next**.
4. Add backend servers and click **Next**.
5. Click **Submit**. The following figure shows the configuration.

Figure 2-10 Viewing the basic information and backend server group of the listener



----End

Creating a VPC Peering Connection

Step 1 In the navigation pane, choose **Virtual Private Cloud** > **VPC Peering Connections**.

Step 2 Click **Create VPC Peering Connection** and configure the parameters.

Table 2-16 Configuring a VPC peering connection

Parameter	Description
Region	Select a region that is the same as the region of **VPC 1**.
VPC Peering Connection Name	Name of the VPC peering connection.
Local VPC	Select **VPC 1**.
Account	By default, **My account** is selected.
Peer Project	Select a project
Peer VPC	Select **VPC 2**.

Step 3 Click **OK**.

Step 4 In the displayed dialog box, click **Add Now** to go to the VPC peering connection details page.

Step 5 On the **Associated Routes** area, click **Add Route**.

1. In the displayed dialog box, enter the route information.

   Table 2-17 Local and peer routing information

Parameter	Description
Local routes	
VPC	Select **VPC 1**.
Route Table	VPC 1 route table
Destination	Enter the service address displayed on the details page of the **load balancer**.
Peer routes	
VPC	Select **VPC 2**.
Route Table	VPC 2 route table
Destination	Enter the private outbound address displayed on the details page of the **dedicated gateway**.

2. Click **OK**.

----End

Configuring a Route

Step 1 Return to the APIG console.

Step 2 In the navigation pane, choose **Gateways**.

Step 3 Click the name of the created **dedicated gateway** or click **Access Console**.

Step 4 Click **Change** in the **Routes** area, enter the IPv4 CIDR block of VPC 2 where the load balancer you created is located.

Step 5 Click **Save**.

----End

Creating an API

Step 1 On the APIG console, choose **API Management** > **APIs**, and click **Create API** > **Create API**.

Step 2 Configure the frontend information and click **Next**.

Table 2-18 Frontend configuration

Parameter	Description
API Name	Enter an API name.
Group	The default option is **DEFAULT**.
URL	• **Method**: Request method of the API. Set this parameter to **GET**. • **Protocol**: Request protocol of the API. Set this parameter to **HTTPS**. • **Subdomain Name**: The system automatically allocates a subdomain name to each API group for internal testing. The subdomain name can be accessed 1,000 times a day. • **Path**: Path for requesting the API.
Gateway Response	Select a response to be displayed if the gateway fails to process an API request. The default gateway response is **default**.
Authentication Mode	API authentication mode. Select **None**. (**None**: Not recommended for actual services. All users will be granted access to the API.)

Step 3 Configure the backend information and click **Next**.

Table 2-19 Parameters for defining an HTTP/HTTPS backend service

Parameter	Description
Load Balance Channel	Determine whether the backend service will be accessed using a load balance channel. For this example, select **Skip**.
URL	• **Method**: Request method of the API. Set this parameter to **GET**. • **Protocol**: Set this parameter to **HTTP**. • **Backend Address**: Enter the service address of the load balancer you created. • **Path**: Path of the backend service.

Step 4 Define the response and click **Finish**.

----End

Creating an ECS

Step 1 Log in to the cloud server console.

Step 2 Click **Buy ECS**.

Step 3 Configure the basic settings and click **Next: Configure Network**.

Table 2-20 Basic settings

Parameter	Description
Billing Mode	Select **Pay-per-use**.
Region	Select the region where the ECS is located. It must be the same as the region of VPC 2.
AZ	Select the AZ where the ECS is located.
CPU Architecture	The default option is **x86**.
Specifications	Select specifications that match your service planning.
Image	Select an image that matches your service planning.
VPC	Select **VPC 2**.
Primary NIC	Select the subnet of the **created VPC**.
Security Group	Select the security group created for the **dedicated gateway**.
EIP	Select **Not required**.
ECS Name	Enter an ECS name.

Parameter	Description
Login Mode	Credential for logging in to the ECS. The default option is **Password**.
Username	The default user is **root**.
Password	Set a password for logging in to the ECS.
Confirm Password	Enter the password again.
Enterprise Project	Select "default".

Step 4 Read and confirm your acceptance of the agreement. Then click **Create**.

----End

Debugging the API

Step 1 In the **load balancer** listener details, click **View/Add Backend Server**.

Step 2 On the **Backend Servers** page, add the **created ECS**.

Step 3 Go to the **API Management** > **APIs** page of **the dedicated gateway**, and choose **More** > **Debug** in the row that contains **the API you created**.

Step 4 Enter the request parameters and click **Debug**.

If the status code is **200**, the debugging is successful. Otherwise, rectify the fault by following the instructions provided in **Error Codes**.

----End

2.4 Routing gRPC Service Requests Using a Dedicated Gateway

2.4.1 Introduction

Scenario

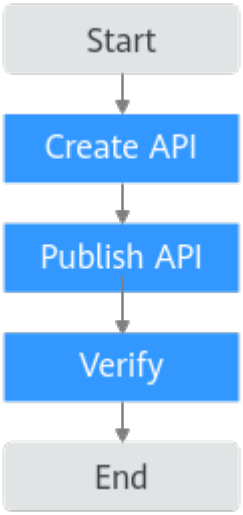
gRPC is a modern, open-source, high-performance Remote Procedure Call (RPC) framework that can run in any environment. You only need to define the request and response of each API, and let the gRPC framework take care of the rest. gRPC uses protocol buffers (protobuf) both as its Interface Definition Language (IDL) and for bottom-layer message exchange.

When you use a gRPC service, you can create an API in APIG to route requests for the service.

Restrictions

Due to the constraints of the gRPCs protocol, gRPC APIs cannot be imported, exported, or debugged,

2.4.2 General Procedure



1. **Create an API**.
   Create a gRPC API with gRPCs as both the frontend and backend protocols.
2. **Publish the API**.
   Publish the gRPC API in an environment.
3. **Verify the API**.
   Use a gRPC client to test the gRPC service. If the server returns a response normally, the gRPC service is available.

2.4.3 Implementation Procedure

Prerequisites

- Both the client and server are of the gRPC type.
- The server has a proto file that defines API request and response parameters. The proto file is used in gRPC to define data structures and service APIs. It describes data structures and interactions using Protobuf and serves as a contract for communication between the client and server.

Creating an API

Step 1 Log in to the APIG console.

Step 2 Select a gateway at the top of the navigation pane.

Step 3 In the navigation pane, choose **API Management** > **APIs**.

Step 4 Click **Create API** > **Create gRPC API**. For details, see **Creating a gRPC API**.

Step 5 Configure the frontend information according to the following table. Click **Next**.

Table 2-21 Frontend configuration

Parameter	Description
API Name	Enter an API name.
Group	Group to which the API belongs. The default value is **DEFAULT**.
URL	• **Method**: Request method of the API. Default: **POST**. • **Protocol**: Request protocol of the API. Default: **GRPCS**. • **Subdomain Name**: The system automatically allocates a subdomain name to each API group for internal testing. The subdomain name can be accessed 1,000 times a day. • **Path**: Path for requesting the API. In this example, enter **/helloworld.Greeter**. For details about the request path, see the **proto file**. **helloworld** indicates the package name, and **Greeter** indicates the service name.
Gateway Response	Select a response to be displayed if the gateway fails to process an API request. The default gateway response is **default**.
Matching	Select **Prefix match**.
Authentication Mode	API authentication mode. Select **None**. (**None**: Not recommended for actual services. All users will be granted access to the API.)

Step 6 Configure the backend information according to the following table. Click **Finish**.

Table 2-22 Backend configuration

Parameter	Description
Load Balance Channel	Determine whether the backend service will be accessed using a load balance channel. For this example, select **Skip**.
URL	• **Method**: Request method of the API. Default: **POST**. • **Protocol**: Request protocol of the backend service. Default: **GRPCS**. • **Backend Address**: Address and port of the backend service. • **Path**: Path of the backend service. In this example, enter **/**.

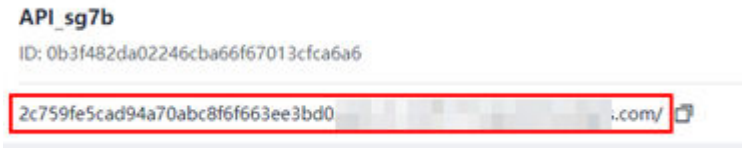
----End

Publishing the API

Step 1 On the **APIs** tab, select the created API and click **Publish Latest Version**.

NOTE

On the **APIs** page, the API URL only shows the domain name and path. It does not show the request method or protocol. When sending a gRPC request, enter the domain name.



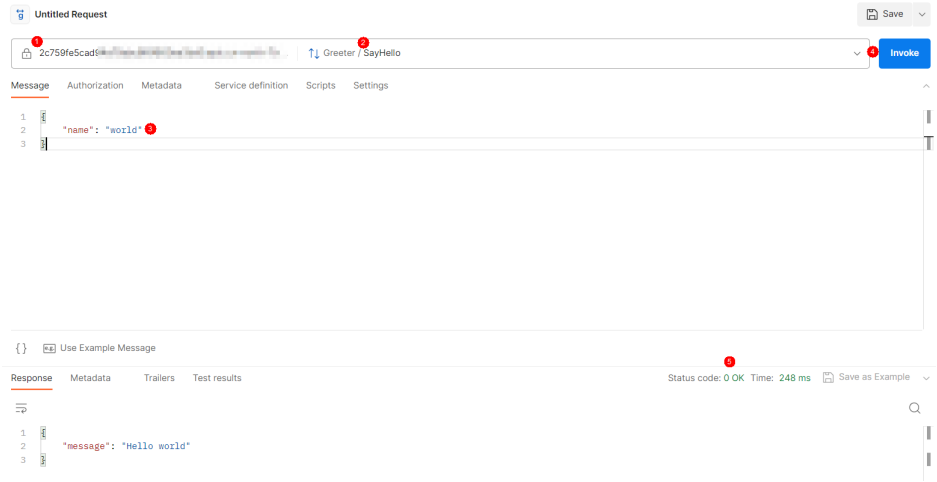
Step 2 Select the environment where the API will be published, and enter a description.

Step 3 Click **OK**. After the API is published, the red exclamation mark (!) in the upper left corner of the **Publish** button disappears.

----End

Verifying the API

Use the **API test** tool to invoke the created API, or invoke this API on a client.



Step 1 Enter the debugging domain name of the API's group.

Step 2 Import the proto file of the server.

The proto file contains the following content:

```
syntax = "proto3";
package helloworld;
// The greeting service definition.
service Greeter {
// Sends a greeting
rpc SayHello (HelloRequest) returns (HelloReply) {}
}
// The request message containing the user's name.
message HelloRequest {
string name = 1;
}
// The response message containing the greetings
message HelloReply {
string message = 1;
}
```


- **helloworld**: package name
- **Greeter**: service name
- **SayHello**: method name
- **HelloRequest**: request body
- **HelloReply**: response body

Step 3 Enter an API request in the **message** area according to the proto file.

```
{
   "name": "world"
}
```

Step 4 Click **Invoke** to send the request.

Step 5 View the response in the **Response** area. If status code **0 OK** is displayed, the invocation is successful.

----End

2.5 Forwarding WebSocket Service Requests Using a Dedicated Gateway

Scenario

You can create WebSocket APIs using APIG same as creating an HTTP API. WebSocket is a protocol for full-duplex communication over a single TCP connection. It outweighs HTTP in real-time, two-way communication between the client and server, proving invaluable for applications such as instant messaging, online gaming, and real-time data update in the financial sector.

Restrictions

- WebSocket APIs cannot be debugged on the APIG console.
- The WebSocket API has a timeout, and if the idle time of a WebSocket connection without ping/pong exceeds the configured timeout, the connection expires.

Prerequisites

Prepare a WebSocket service backend for which ping/pong keepalive has been performed.

Procedure

Step 1 Log in to the APIG console.

Step 2 Select a gateway at the top of the navigation pane.

Step 3 In the navigation pane, choose **API Management** > **APIs**.

Step 4 Click **Create API** > **Create API** and configure the frontend.

Table 2-23 Frontend configuration

Parameter	Description
API Name	Enter the API name, for example, **API01**.
Group	Group to which the API belongs. The default value is **DEFAULT**.
URL	• **Method**: Request method of the API. Set this parameter to **GET**. • **Protocol**: Request protocol of the API. Default: **HTTPS**, which corresponds to the WebSocket Secure (WSS). • **Subdomain Name**: The system automatically allocates a subdomain name to each API group for internal testing. The subdomain name can be accessed 1,000 times a day. • **Path**: Path for requesting the API. In this example, enter **/hello**.
Gateway Response	Select a response to be displayed if the gateway fails to process an API request. **default** is selected by default.
Authentication Mode	API authentication mode. Select **None**. (**None**: Not recommended for actual services. All users will be granted access to the API.)

Step 5 Click **Next** and configure the backend information.

Table 2-24 Backend configuration

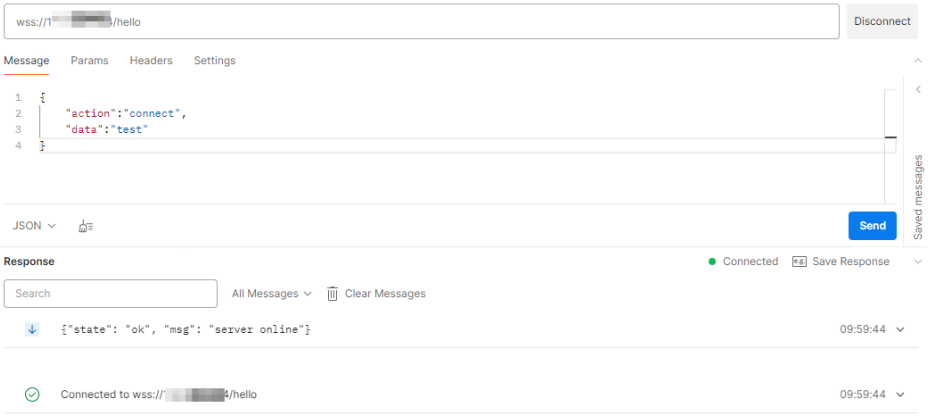
Parameter	Description
Backend Type	Select **HTTP&HTTPS**.
Load Balance Channel	Determine whether the backend service will be accessed using a load balance channel. For this example, select **Skip**.
URL	• **Method**: Request method of the API. Set this parameter to **GET**. • **Protocol**: Set this parameter to **HTTP**. • **Backend Address**: Address and port of the WebSocket backend service. • **Path**: Path of the backend service. In this example, enter **/**.
Timeout (ms)	Adjust the backend timeout to be longer than the ping/pong heartbeat interval. For example, if the ping/pong heartbeat interval is 20s, the timeout can be set to (20000 ms, 60000 ms].

Step 6 Click **Finish**.

Step 7 After the API is created, click **Publish Latest Version** on the **APIs** page to publish the API.

Step 8 Use the API test tool to call the API.

In this practice, enter **wss://***IP address***/hello** to call an API in the DEFAULT group. The IP address is the EIP in the **Gateway Information** on the APIG console.



----End

2.6 HTTP-to-HTTPS Auto Redirection with a Dedicated Gateway

2.6.1 Introduction

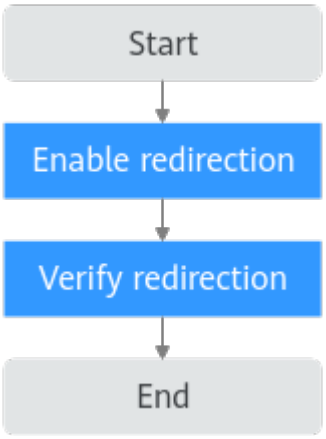
Scenario

APIG supports HTTP-to-HTTPS redirection. HTTP APIs are insecure in transmission and authentication. You can upgrade them for access over HTTPS while ensuring HTTP compatibility.

Restrictions

Redirection is only suitable for GET and HEAD requests. Redirecting other requests may cause data loss due to browser restrictions.

2.6.2 General Procedure



1. **Enable redirection**.

   Ensure that the API for which you enable redirection uses HTTPS or HTTP&HTTPS for frontend requests.

2. **Verify redirection**.

   Verify that the redirection function is working.

2.6.3 Implementation Procedure

Prerequisites

- You have created an API whose frontend request protocol is set to **HTTPS** or **HTTP&HTTPS**.
- The API has been published.
- An independent domain name and SSL certificate have been bound to the API group to which the API belongs.

For details about these operations, see the **APIG User Guide**

Enabling Redirection

Step 1 Log in to the APIG console.

Step 2 In the navigation pane, choose **API Management** > **API Groups**.

Step 3 Click a group name to go to the details page.

Step 4 On the **Group Information** tab, locate the bound independent domain name, and enable **HTTP-to-HTTPS Auto Redirection**.

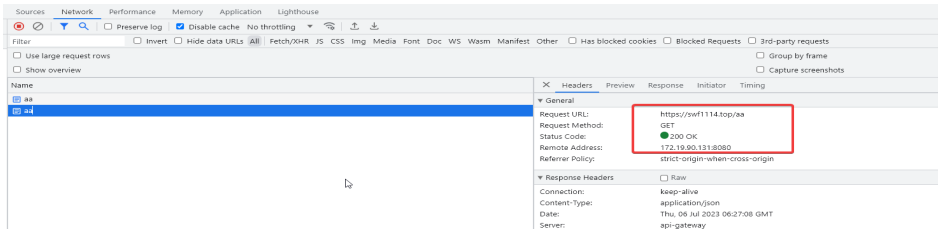
----End

Verifying Redirection

Step 1 Use a browser to call the API through HTTPS.

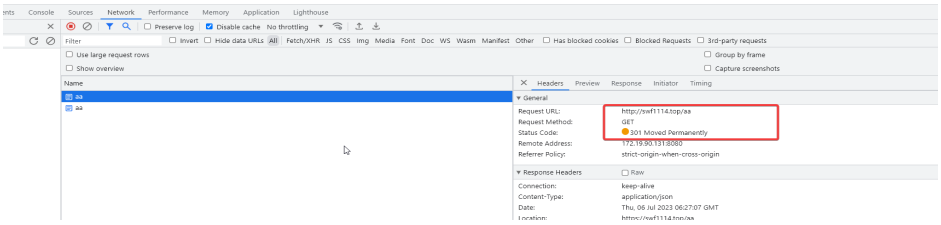
1. In the address bar of the browser, enter **https://***API request path*, and press **Enter**.

2. Press **F12**.
3. Check the status code displayed on the **Network** tab. **200** means the calling is successful.



Step 2 Use a browser to call the API through HTTP.

1. In the address bar of the browser, enter **http://***API request path*, and press **Enter**.
2. Press **F12**.
3. Check the status code displayed on the **Network** tab. **301** means the redirection is successful.



----End

2.7 Calling Different Backend Services Using a Dedicated Gateway

2.7.1 Introduction

Scenario

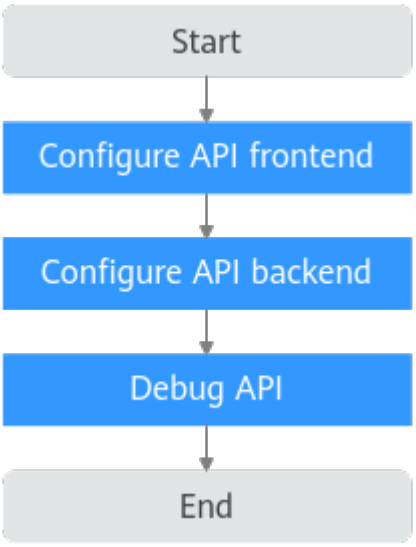
APIG allows you to define multiple backend policies and forward API requests to different backends based on these different policies. For example, to distinguish special calls from regular calls, you can define a policy backend that uses frontend custom authentication parameters. This section uses frontend authentication parameters (system parameter) as an example to describe how to forward API requests to a specified backend.

Restrictions

- Before adding a backend policy, set the security authentication mode of the frontend to **Custom** or enable **Two-Factor Authentication** (App or IAM authentication).
- API requests that do not meet the conditions of any backend will be forwarded to the default backend.

- The **Condition Value** of the **System parameter - Frontend authentication parameter** can only be character string, integer, or Boolean.
- A maximum of five policy backends can be defined for an API.

2.7.2 General Procedure



1. **Configuring the API Frontend**

   Set the security authentication mode of the API frontend to **Custom** or enable **Two-Factor Authentication** (app or IAM authentication), and select a custom authorizer. If no custom authorizer is available, click **Create Custom Authorizer**.

2. **Configuring the API Backend**

   Add a policy for the backend. Set the **Source** of the **Policy Conditions** to **System parameter - Frontend authentication parameter**, and configure the **Parameter Name**, **Condition Type**, and **Condition Value**. The **Parameter Name** and **Condition Value** must be the same as the key-value pair in the **context** field in the return value of the frontend custom authentication function.

3. **Debugging the API**

   Debug the API and check whether the added policy backend is called.

2.7.3 Implementation Procedure

Prerequisites

1. A custom authentication function has been created. For details, see **Creating a Function**. The function's return value must have a **context** field with key-value pairs, where the values are limited to string, boolean, or integer. The key-value pair corresponds to the **Parameter Name** and **Condition Value** of the **System parameter - Frontend authentication parameter** configured in **Policy Conditions**.

Figure 2-11 Custom authentication function

2. A custom frontend authorizer has been created. If no custom authorizer is available, create one by following the instructions in **Custom Authorizer**.

Configuring the API Frontend

Step 1 Log in to the APIG console.

Step 2 Select a gateway at the top of the navigation pane.

Step 3 In the navigation pane, choose **API Management** > **APIs**.

Step 4 Click **Create API** > **Create API** and configure the frontend.

Table 2-25 Frontend configuration

Parameter	Description
API Name	Enter an API name.
Group	Group to which the API belongs. The default value is **DEFAULT**.
URL	• **Method**: Request method of the API. Default: **GET**. • **Protocol**: Request protocol of the API. Default: **HTTPS**. • **Subdomain Name**: The system automatically allocates a subdomain name to each API group for internal testing. The subdomain name can be accessed 1,000 times a day. • **Path**: Path for requesting the API. In this example, enter **/1234**.

Parameter	Description
Gateway Response	Select a response to be displayed if the gateway fails to process an API request. The default gateway response is **default**.
Authentication Mode	API authentication mode. Select **Custom**.
Custom Authorizer	Select the custom authorizer created in **Prerequisites**.

----End

Configuring the API Backend

Step 1 After configuring the frontend, click **Next**.

Set **Backend Type** to **Mock** and enter **Default backend** in the **Response**.

Step 2 Click ⊕ to add a backend policy based on the following table.

Table 2-26 Policy backend configuration

Parameter	Description
Name	Enter a policy name.
Backend Type	Select **Mock**.
Response	Enter **Policy backend**.
Policy Conditions	• **Source**: Select **System parameter - Frontend authentication parameter**. • **Parameter Name**: Enter **authstatus1** under the **context** field in the response body of the custom authentication function created in **Prerequisites**. • **Condition Type**: Select **Equal**. • **Condition Value**: Enter **False** under the **context** field in the response body of the custom authentication function created in **Prerequisites**.

Step 3 Click **Finish**.

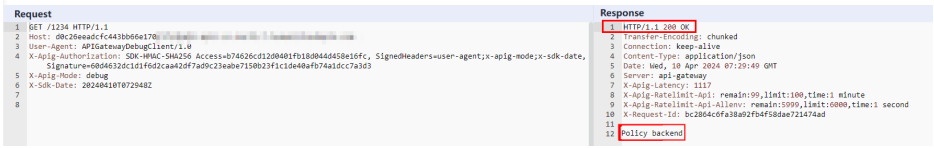
----End

Debugging the API

The **Mock** backend type helps you view the result with a response. For other backend types, you can check whether the backend address is successfully accessed.

Step 1 On the **APIs** page, click **Debug** to debug the created API.

If **200 OK** is displayed in **Response**, the API is successfully invoked. If the **Policy backend** is also returned, the configured policy backend condition matches the key-value pair in the **context** field in the response body of the custom authentication function, and the API invokes the policy backend. Otherwise, rectify the fault by following the instructions provided in **Error Codes**.



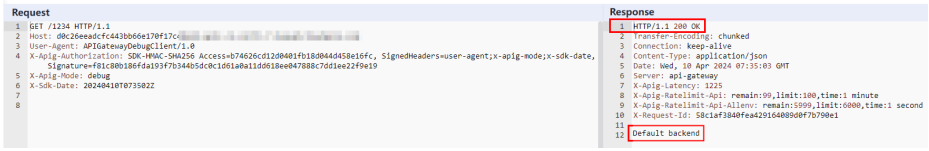
Step 2 On the **APIs** page, click **Modify**. The API configuration page is displayed.

Step 3 Click **Next**. On the backend configuration page, change **Condition Value** of the added policy to **True**.

Step 4 Click **Finish**.

Step 5 Debug the API again.

The policy backend parameter and condition value do not match any key-value pair of the frontend custom authentication function. Therefore, the API policy backend cannot be matched based on the frontend authentication parameters. In this case, **200 OK** is displayed with the return result of **Default backend**, indicating that the default backend of the API is invoked. Otherwise, rectify the fault by following the instructions provided in **Error Codes**.



----End

3 API Authentication

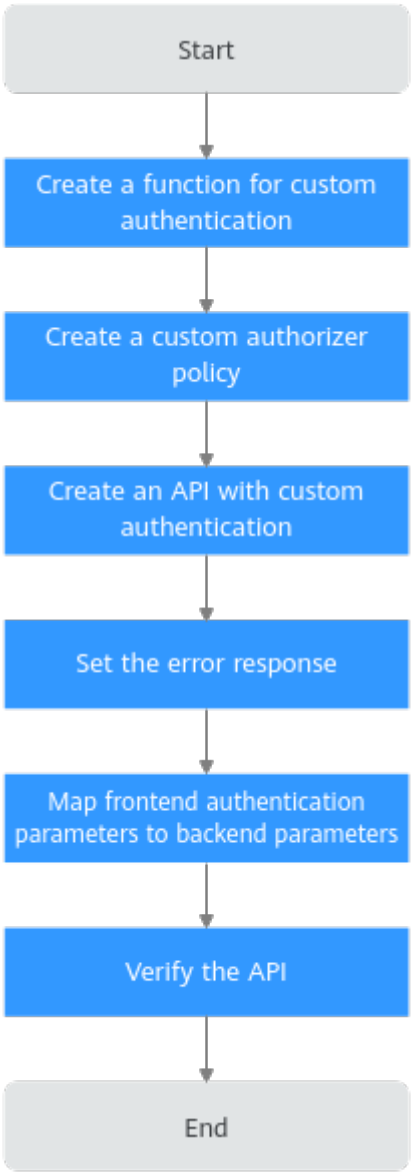
3.1 Developing a Custom Authorizer with FunctionGraph

Scenario

In addition to IAM and app authentication, APIG also supports custom authentication with your own authentication system, which can better adapt to your business capabilities.

Custom authentication is implemented using the FunctionGraph service. You can create a FunctionGraph function so that APIG can invoke it to authenticate requests for your API. This section uses basic authentication as an example to describe how to implement custom authentication with FunctionGraph.

General Procedure



1. **Developing a Custom Authentication Function**

   Create a function for custom authentication.

2. **Creating a Custom Authorizer**

   Create a custom authorizer in APIG to connect the function.

3. **Creating a Custom Authentication API**

   Create an API with **Custom** authentication mode.

4. **Setting the Error Response**

   To include the **context** field of the function response in the API response result, modify the gateway response.

5. **Mapping Frontend Authentication Parameters to Backend Parameters**

   Add a system parameter to transfer the **context** information returned by the function to the backend.

6. **Verifying the API**

   Call the API and check whether the **context** information of the function is successfully returned.

Developing a Custom Authentication Function

Create a function on the FunctionGraph console by referring to **Creating a Function for Frontend Custom Authentication**.

Create a function on the FunctionGraph page according to the following table.

Table 3-1 Function configuration

Parameter	Description
Create With	Select **Create from scratch**.
Function Type	Default: **Event Function**
Region	Select the same region as that of APIG.
Project	Projects group and isolate resources (including compute, storage, and network resources) across physical regions. A default project is provided for each Huawei Cloud region, and subprojects can be created under each default project. Users can be granted permissions to access all resources in a specific project. The selected region is used by default.
Function Name	Set this name as planned.
Enterprise Project	Enterprise projects group and manage resources across regions. Resources in enterprise projects are logically isolated. Select **default**.
Agency	An agency that delegates FunctionGraph to access other cloud services. For this example, select **Use no agency**.
Runtime	Select **Python 3.6**.

After the function is created, go to the function details page. On the **Code** tab page, copy the following code to **index.py** (if you are using a dedicated gateway, for which the **authorizer_context_support_num_bool** parameter has been enabled, the type of **value** in **context** can be boolean or number).

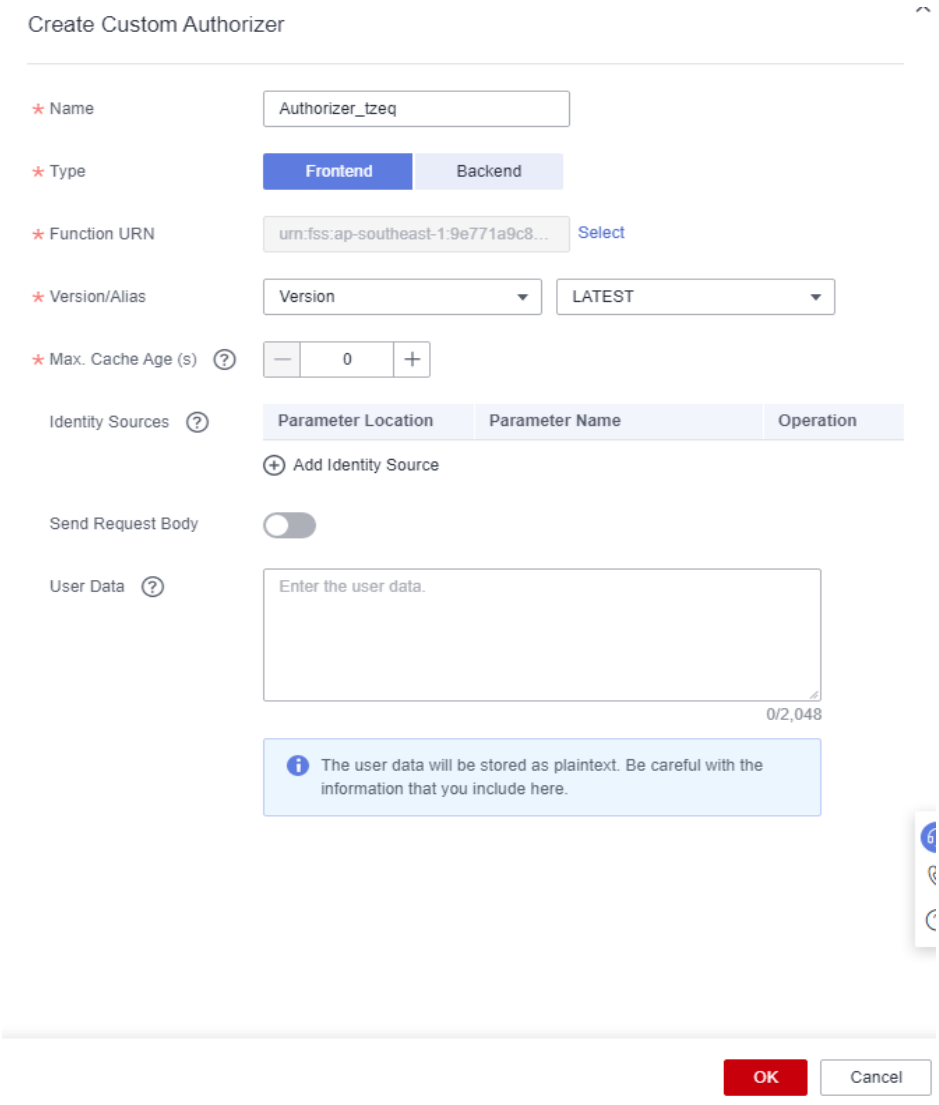
```
# -*- coding:utf-8 -*-
import json
def handler(event, context):
# If the authentication information is correct, the username is returned.
    if event["headers"]["authorization"]=='Basic dXN****cmQ=':
        return {
            'statusCode': 200,
            'body': json.dumps({
                "status":"allow",
                "context":{
                    "user_name":"user1"
```



```
            }
        })
    }
else:
    return {
        'statusCode': 200,
        'body': json.dumps({
            "status":"deny",
            "context":{
                "code": "1001",
                "message":"incorrect username or password",
                "authorizer_success": "false"
            }
        })
    }
```

Creating a Custom Authorizer

On the APIG console, choose **API Policies** > **Custom Authorizers**, click **Create Custom Authorizer** page, set **Type** to **Frontend**, and select the created function for **Function URN**.



Creating a Custom Authentication API

On the **APIs** page of the APIG console, create an API by referring to **Creating an API**. Set the authentication mode to **Custom**, and select the custom authorizer created in the preceding section. After modifying the API, publish it.

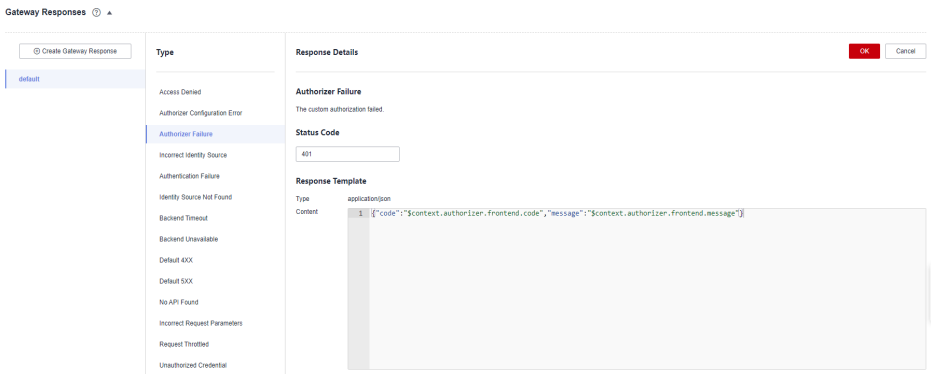
Setting the Error Response

If incorrect authentication information is carried in a request for the API, the response is displayed as follows:

```
{"error_msg":"Incorrect authentication information: frontend authorizer","error_code":"APIG.0305","request_id":"36e42b3019077c2b720b6fc847733ce9"}
```

To return the field in the function's **context** as the API response (if you are using a dedicated gateway, for which the **authorizer_context_support_num_bool** parameter has been enabled, the type of **value** in **context** can be boolean or number), modify the gateway response template. On the details page of the group to which the API belongs, navigate to the **Gateway Responses** area on the **Gateway Information** tab, and click **Edit**. Change the status code to **401**, modify the response template with the following code, and click **OK** (no need to add double quotes for variables of the boolean or number type):

```
{"code":"$context.authorizer.frontend.code","message":"$context.authorizer.frontend.message",
"authorizer_success": "$context.authorizer.frontend.authorizer_success"}
```



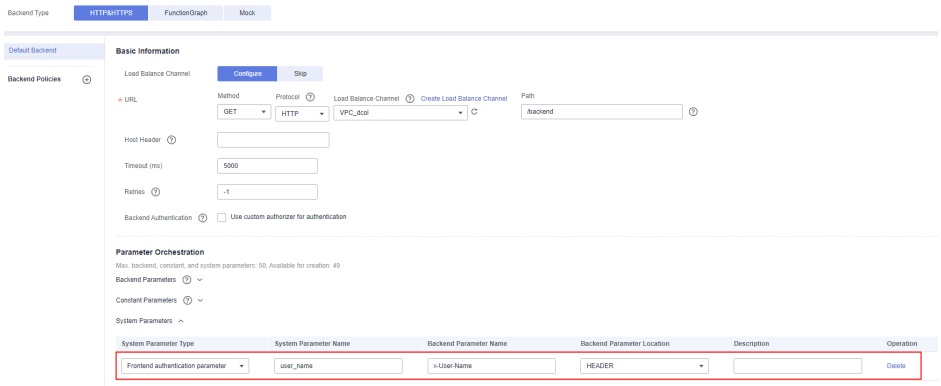
After the modification, if incorrect authentication is transferred when calling the API, the status code **401** is returned and the response result is as follows:

```
{"code":"1001","message":"incorrect username or password","authorizer_success": "false"}
```

Mapping Frontend Authentication Parameters to Backend Parameters

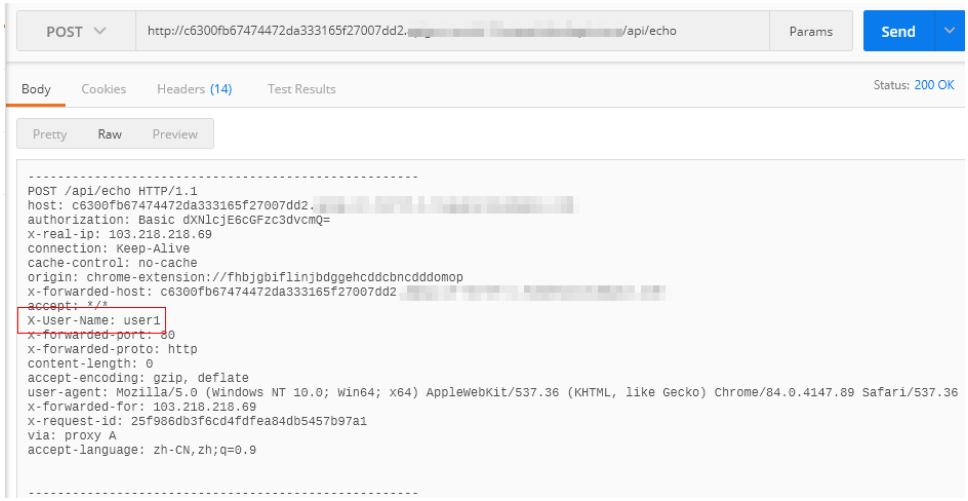
If the authentication is successful, the context information returned by the function can be transferred to the backend of the API. To do this, perform the following configurations:

On the **APIs** page, choose **More** > **Edit** in the row that contains the API, and go to the **Define Backend Request** page. Add a system parameter, specify the parameter type as **Frontend authentication parameter**, set the parameter name to the content of the **context** field in the function response, and set the name and location of the backend parameter to which you want to the map the frontend authentication parameter.



Verifying the API

After modifying the API, publish it again. If the authentication information carried in a request for the API is correct, the response result contains the **X-User-Name** header field whose value is the same as that of **user_name** in the **context** field of the authentication function.



3.2 Configuring Two-factor Authentication (App + Custom)

Scenario

Two-factor authentication allows you to customize an API authentication policy together with the app or IAM authentication. This section describes how to create an API that uses two-factor authentication (app + custom).

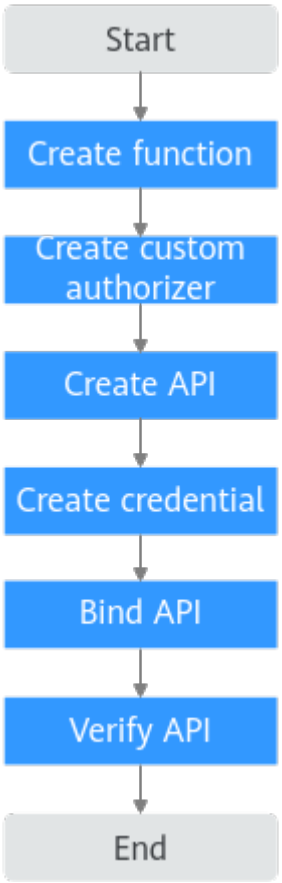
Advantages

You can use a custom authorizer to ensure API security.

Restrictions

The custom authorizer depends on FunctionGraph. Before creating a custom authorizer, you need to create a function.

General Procedure



1. **Create a function**.

   The function will be used for custom authentication.

2. **Create a custom authorizer**.

   Set the authorizer type to **Frontend**, and select the function created in the previous step.

3. **Create an API**.

   Set authentication mode to **App**, enable **Two-Factor Authentication**, and select the custom authorizer created in the previous step.

4. **Create a credential.**

   APIs that use app authentication require a credential to call. Create a credential to generate an ID and key/secret pair.

5. **Bind the credential to the created API.**

   APIs that use app authentication can be called only with bound credentials.

6. **Verify the API.**

   Call the API to check whether two-factor authentication is configured successfully.

Implementation Procedure

Step 1 Log in to the FunctionGraph console. On the **Dashboard** page, click **Create Function**.

1. Set the parameters according to the following table, and click **Create Function**.

Table 3-2 Function configuration

Parameter	Description
Create With	Select **Create from scratch**.
Function Type	Default: **Event Function**
Region	Select the same region as that of APIG.
Project	Projects group and isolate resources (including compute, storage, and network resources) across physical regions. A default project is provided for each Huawei Cloud region, and subprojects can be created under each default project. Users can be granted permissions to access all resources in a specific project. The selected region is used by default.
Function Name	Set this name as planned.
Enterprise Project	Enterprise projects group and manage resources across regions. Resources in enterprise projects are logically isolated. Select **default**.
Agency	An agency that delegates FunctionGraph to access other cloud services. For this example, select **Use no agency**.
Runtime	Select **Python 3.9**.

2. After the function is created, go to the function details page. On the **Configuration** tab, choose **Environment Variables** in the left pane, and click **Edit Environment Variable** > **Add**.

Table 3-3 Configuring environment variables

Parameter	Description
Key	Name of the environment variable. Add the **token** and **test** environment variables. **token** is a header for identity authentication, and **test** is for parameter query.
Value	Environment variable value. Set the value of **token** to **Basic dXNlcjE6cGFzc3dvcmQ=** and **test** to **user@123**.

Parameter	Description
Encrypted	If enabled, the environment variable value is encrypted and displayed as an asterisk (*). During parameter transmission, the key value is also encrypted. Encrypt the sensitive **token** key in this example.

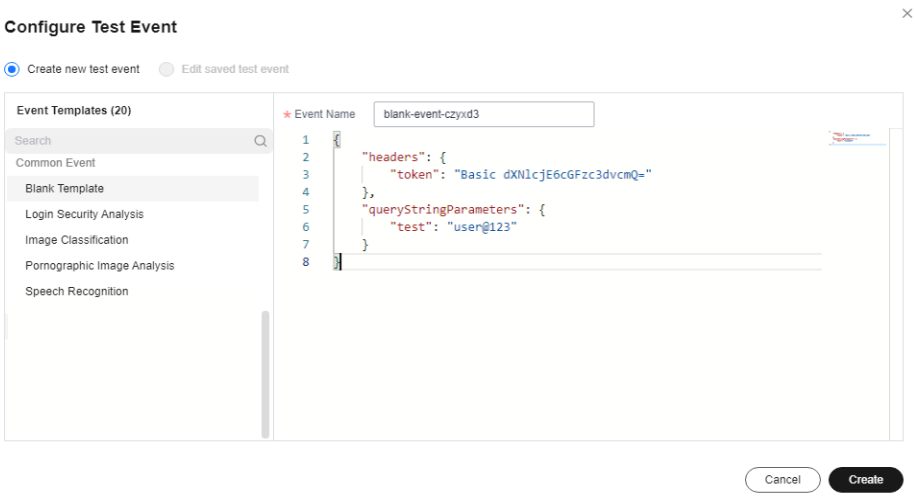
3. On the **Code** tab, copy the following code to **index.py**, and click **Deploy**. For details about coding, see **Creating a Function for Frontend Custom Authentication**.

```
# -*- coding:utf-8 -*-
import json
def handler(event, context):
    testParameter = context.getUserData('test');
    userToken = context.getUserData('token');
    if event["headers"].get("token") == userToken and event["queryStringParameters"].get("test") ==
testParameter:
        resp = {
            'statusCode': 200,
            'body': json.dumps({
                "status":"allow",
                "context":{
                    "user":"auth success"
                }
            })
        }
    else:
        resp = {
            'statusCode': 401,
            'body': json.dumps({
                "status":"deny",
            })
        }
    return json.dumps(resp)
```

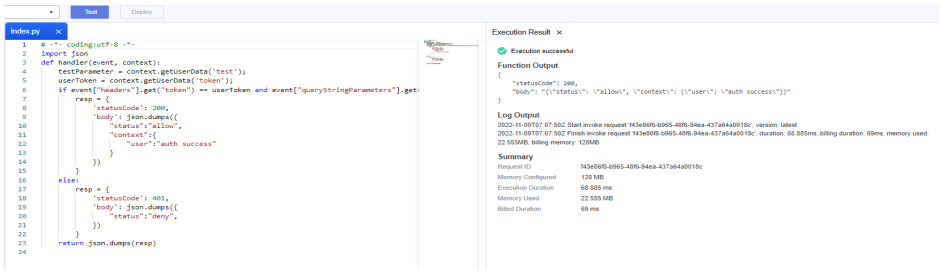
4. Configure a test event to debug the code.

   a. Select **Configure Test Event** from the drop-down list and configure a test event. Set the following code as the test event. **The parameter values in the test event must be the same as those of the environment variables.**

```
{
    "headers": {
        "token": "Basic dXNlcjE6cGFzc3dvcmQ="
    },
    "queryStringParameters": {
        "test": "user@123"
    }
}
```

b. Click **Test**. If the following information is displayed, the code debugging is successful.



c. Click **Deploy**.

Step 2 Go to the APIG console, and choose **API Management** > **API Policies**.

On the **Custom Authorizers** tab, create a custom authorizer.

Table 3-4 Custom authorizer configuration

Parameter	Description
Name	Set this name as planned.
Type	Select **Frontend**.
Function URN	Click **Select** and select the **created function**.
Version/Alias	**Version** is selected by default.
Max. Cache Age (s)	30
Identity Sources	Set two identity sources: header **token** and query string **test**.

Step 3 Choose **API Management** > **APIs**, and click **Create API** > **Create API**.

1. Configure the frontend information according to the following table.

Table 3-5 Frontend configuration

Parameter	Description
API Name	Enter an API name.
Group	Group to which the API belongs. The default value is **DEFAULT**.
URL	**Method**: Request method of the API. Set this parameter to **GET**. **Protocol**: Request protocol of the API. Set this parameter to **HTTPS**. **Subdomain Name**: The system automatically allocates a subdomain name to each API group for internal testing. The subdomain name can be accessed 1,000 times a day. **Path**: Path for requesting the API. Enter **/api/two_factor_authorization**.
Gateway Response	Select a response to be displayed if the gateway fails to process an API request. The default gateway response is **default**.
Authentication Mode	API authentication mode. Set this parameter to **App**.
Two-Factor Authentication	Enable this option and select a **custom authorizer**.

2. Click **Next** and set the backend type to **Mock**.

   Select a status code, set the response, and click **Finish**.

3. Publish the API.

Step 4 In the navigation pane, choose **API Management** > **Credentials**.

Click **Create Credential**, enter a credential name, and click **OK**.

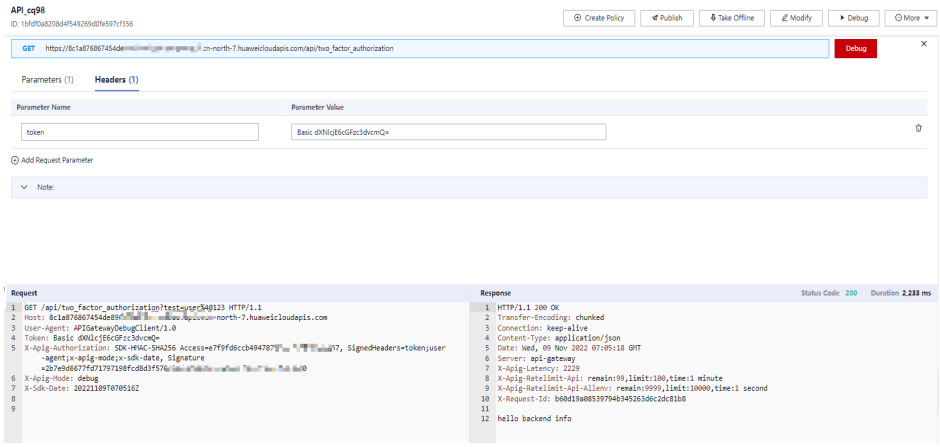
Step 5 Bind the credential to the API.

Click the credential name to go to the details page. In the **APIs** area, click **Bind to APIs**, select an API, and click **OK**.

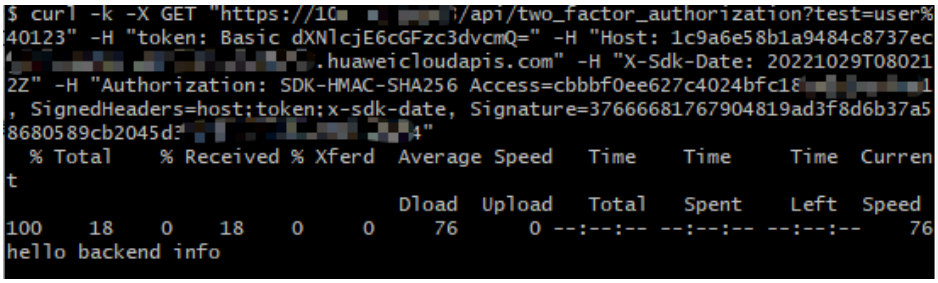
Step 6 Verify the API.

- Call the API on the debugging page of APIG to verify if two-factor authentication is configured successfully.

  Add **test** on the **Parameters** tab and add **token** on the **Headers** tab. Use the same parameter values set for the custom authentication function. If the parameter values are different, the server will return a 401 message indicating that the authentication fails.



- Alternatively, call the API with a **curl** command. Download the JavaScript SDK first. To call the API, input a key and secret as well as the header and query string to generate a **curl** command, and then copy this command to your CLI for execution. For details, see **curl** in the *API Gateway Developer Guide*.



----End

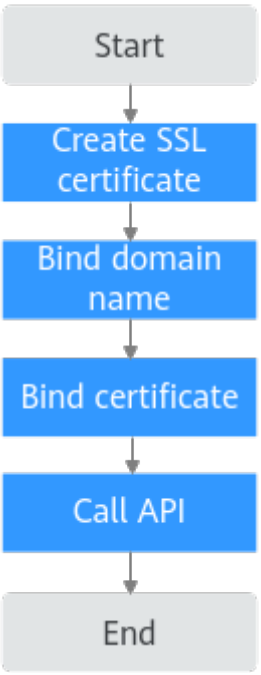
3.3 Configuring One-Way or Two-Way Authentication Between the Dedicated Gateway and Client

Scenario

If the API frontend supports HTTPS, you need to add an SSL certificate for the independent domain name bound to the API group. An SSL certificate is used for data encryption and identity authentication. If an SSL certificate contains a **CA certificate**, client authentication (two-way authentication) is enabled by default. Or one-way authentication will be used.

- One-way authentication: When a client connects to a server, the client verifies the validity of the SSl certificate of the server.
- Two-way authentication: When a client connects to a server, both the client and server verify the validity of the SSl certificate.

General Procedure



Dedicated gateways support both one-way and two-way authentication. These two modes have the same procedure. The following will take one-way authentication as an example. For details about two-way authentication, see **Two-Way Authentication**.

1. **Create an SSL certificate**.

   An SSL certificate is used for data encryption and identity authentication.

2. **Bind a domain name**.

   Bind the group to which the API belongs with a licensed and resolved independent domain name.

3. **Bind a certificate**.

   Bind the independent domain name to the created SSL certificate.

4. **Call the API**.

   Check whether the API call is successful.

One-Way Authentication

Step 1 Log in to the APIG console.

Step 2 Select a gateway at the top of the navigation pane.

Step 3 Create an SSL certificate.

1. In the navigation pane, choose **API Management** > **API Policies**.
2. On the **SSL Certificates** tab, click **Create SSL Certificate**.

Table 3-6 Certificate configuration for one-way authentication

Parameter	Description
Name	Enter a certificate name.
Instances Covered	Select **Current**.
Content	-----Start certificate----- MIICXgIBAAKBgQC6ndRHy5Dv5TcZiVzT6qF iaMGy61ZIbUrmBhUn61vMdvOHmtblST+fSl ZheNAcv2hQR4aqJLi4wrcerTaRyG9op3OSh... -----End certificate-----
Key	-----Start RSA private key----- MIICXgIBAAKBgQC6ndRHy5Dv5TcZiVzT6qF iaMGy61ZIbUrmBhUn61vMdvOHmtblST+fSl ZheNAcv2hQR4aqJLi4wrcerTaRyG9op3OSh... -----End RSA private key-----
CA	No CA certificate is required for one-way authentication.

3. Click **OK**.

Step 4 Bind a domain name.

1. In the navigation pane, choose **API Management** > **API Groups**.
2. Click the name of the group to which the API belongs. The group details page is displayed.
3. On the **Group Information** tab page, click **Bind Independent Domain Name**.

Table 3-7 Independent domain name configuration

Parameter	Description
Domain Name	Enter a licensed domain name.
Minimum TLS Version	Select **TLS1.2**.
HTTP-to-HTTPS Auto Redirection	Disabled by default.

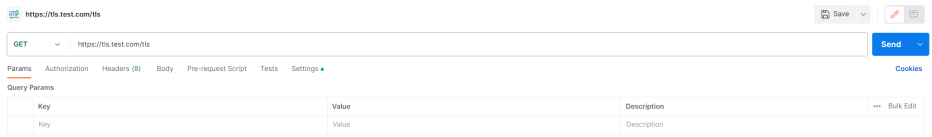
4. Click **OK**.

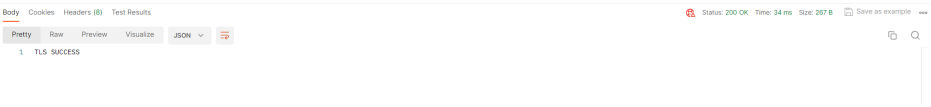
Step 5 Bind a certificate.

1. In the row that contains the domain name, click **Select SSL Certificate**.
2. Select the created certificate and click **OK**. Client authentication should be disabled for one-way authentication.

Step 6 Call the API.

Use the API test tool to call the API. If the status code is **200**, the API is successfully called. Otherwise, rectify the fault by following the instructions provided in **Error Codes**.





----End

Two-Way Authentication

Step 1 On the **SSL Certificates** tab, click **Create SSL Certificate**.

Table 3-8 Certificate configuration for two-way authentication

Parameter	Description
Name	Enter a certificate name.
Instances Covered	Select **Current**.
Content	Enter the certificate content. -----Start certificate----- MIICXgIBAAKBgQC6ndRHy5Dv5TcZiVzT6qF iaMGy61ZIbUrmBhUn61vMdvOHmtblST+fSl ZheNAcv2hQR4aqJLi4wrcerTaRyG9op3OSh... -----End certificate-----
Key	Enter the key. -----Start RSA private key----- MIICXgIBAAKBgQC6ndRHy5Dv5TcZiVzT6qF iaMGy61ZIbUrmBhUn61vMdvOHmtblST+fSl ZheNAcv2hQR4aqJLi4wrcerTaRyG9op3OSh... -----End RSA private key-----

Parameter	Description
CA	Enter the CA certificate content. **After the CA certificate is configured, bind the SSL certificate to the independent domain name and enable Client Authentication.** -----Start certificate----- MIICXgIBAAKBgQC6ndRHy5Dv5TcZiVzT6qF iaMGy61ZIbUrmBhUn61vMdvOHmtblST+fSl ZheNAcv2hQR4aqJLi4wrcerTaRyG9op3OSh... -----End certificate-----

Step 2 Click **OK**.

Step 3 Bind a domain name.

1. In the navigation pane, choose **API Management** > **API Groups**.
2. Click the name of the group to which the API belongs. The group details page is displayed.
3. On the **Group Information** tab page, click **Bind Independent Domain Name**.

   Table 3-9 Independent domain name configuration

Parameter	Description
Domain Name	Enter a licensed domain name.
Minimum TLS Version	Select **TLS1.2**.
HTTP-to-HTTPS Auto Redirection	Disabled by default.

4. Click **OK**.

Step 4 Bind a certificate.

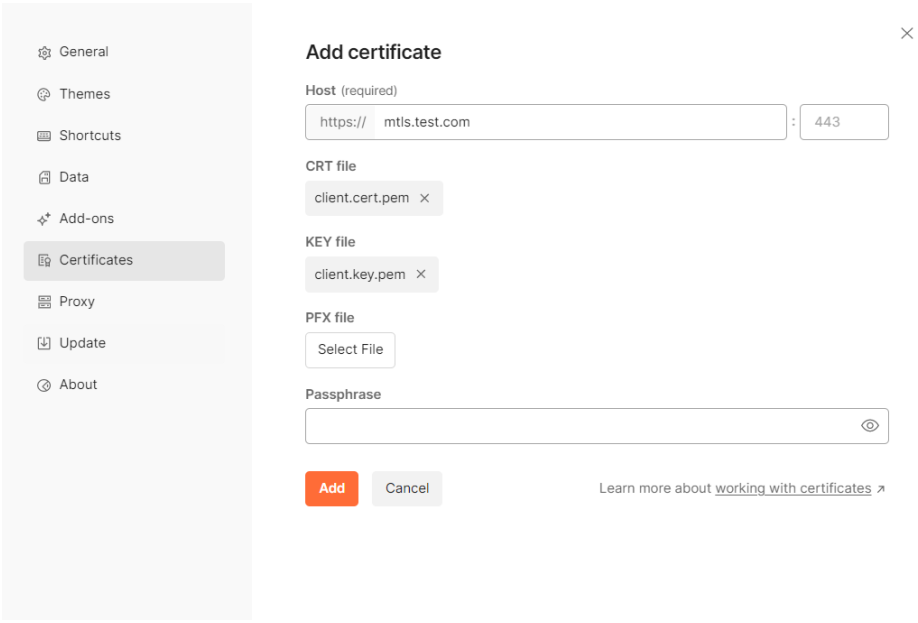
1. In the row that contains the domain name, click **Select SSL Certificate**.
2. Select the created certificate, select **Enable Client Authentication**, and click **OK**.

Step 5 Call the API.

Use the API test tool to call the API. If the status code is **200**, the API is successfully called. Otherwise, rectify the fault by following the instructions provided in **Error Codes**.

You need to configure the client certificate when accessing APIs.

If Postman is used to call APIs, you need to add client certificates to **Certificates** in **Setting** and upload the client certificates and key.



----End

4 API Policies

4.1 Using Request Throttling 2.0 for Fine-grained Request Throttling

4.1.1 Introduction

Scenario

If the number of requests initiated from public networks for open APIs on APIG is not limited, the continuous increase in users will deteriorate the backend performance. And what's worse, the website or program will break down due to a large number of requests sent by malicious users. The traditional request throttling policies of APIG throttle requests by API, user, credential, and source IP address.

However, as users and their demands become more diversified, these traditional policies cannot meet the requirements for more refined rate limiting. To resolve this issue, APIG has launched request throttling 2.0, which is a type of plug-in policy. The 2.0 policies enable you to configure more refined throttling, for example, to throttle requests based on a certain request parameter or tenant.

This section describes how to create a request throttling 2.0 policy for rate limiting in different scenarios.

Advantages

- A request throttling 2.0 policy limits the number of times that an API can be called within a specific time period. Basic, parameter-based, and excluded throttling is supported.
  - Basic throttling: Throttle requests by API, user, credential, or source IP address. This function is similar to a traditional request throttling policy but is incompatible with it.
  - Parameter-based throttling: Throttle requests based on headers, path parameter, method, query strings, or system parameters.

  - Excluded throttling: Throttle requests for specific tenants or credentials.
- API requests allowed in a time period can be limited by user or credential.
- Request throttling can be precise to the day, hour, minute, or second.

Restrictions

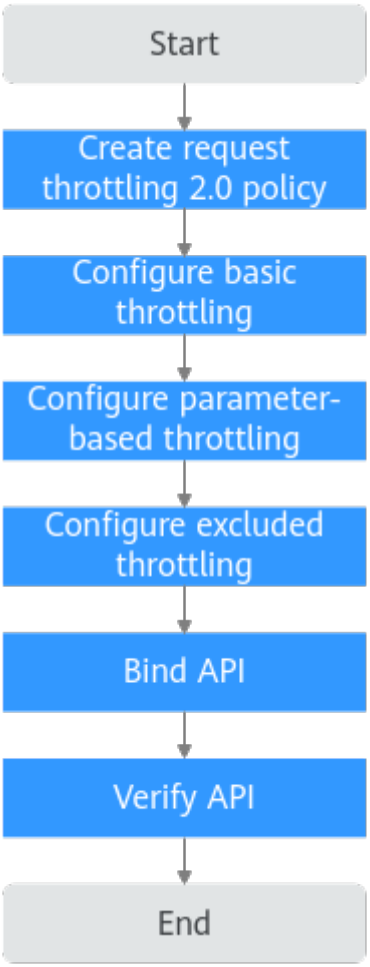
- Adding a request throttling 2.0 policy to an API means binding them together. An API can be bound with only one such policy in an environment, but each policy can be bound to multiple APIs. The APIs bound with request throttling 2.0 policies must have been published.
- For APIs not bound with a request throttling 2.0 policy, the throttling limit is the value of **ratelimit_api_limits** set on the **Parameters** page of the gateway.
- A traditional request throttling policy becomes invalid if a request throttling 2.0 policy is bound to the same API as the traditional one.
- You can define a maximum of 100 parameter-based throttling rules.
- The policy content cannot exceed 65,535 characters.
- If your gateway does not support request throttling 2.0, contact technical support.

4.1.2 General Procedure

Assume that you have the following request throttling requirements for an API:

1. The API can be called up to 10 times per 60s but can be called by a user only 5 times per 60s.
2. Only 10 requests containing header field **Host=www.abc.com** are allowed in 60s.
3. Only 10 requests with method **GET** and path **reqPath = /list** are allowed in 60s.
4. Only 10 requests with path **reqPath = /fc** are allowed in 60s.
5. Each excluded tenant can only call the API 5 times per 60s.

Following this procedure to create a request throttling 2.0 policy and bind it to an API.



1. **Create a policy.**
   Enter the basic information of the request throttling 2.0 policy.
2. **Configure basic throttling.**
   Configure the basic throttling settings.
3. **Configure parameter-based throttling.**
   Enable parameter-based throttling, and define parameters and rules.
4. **Configure excluded throttling.**
   Enable excluded throttling, and configure excluded tenants and credentials.
5. **Bind the policy to an API.**
   Bind the request throttling 2.0 policy to the API.
6. **Verify the API.**
   Call the API and verify whether the request throttling 2.0 policy has taken effect.

4.1.3 Implementation Procedure

Step 1 Create a policy.

1. Log in to the APIG console and create a request throttling 2.0 policy.
2. In the navigation pane, choose **API Management** > **API Policies**. Click **Create Policy**, and select **Request Throttling 2.0**.

3. Configure basic policy information to meet your demands.

Table 4-1 Policy basic Information

Parameter	Description
Name	Set this name as planned.
Throttling	Select **High-performance**.
Policy Type	Select **API-specific**, which means measuring and throttling requests of a single API.
Period	Throttling period. Set this parameter to 60s.

Step 2 Configure basic throttling.

As required in **1**, set **Max. API Requests** to 10 times per 60s and **Max. User Requests** to 5 times per 60s.

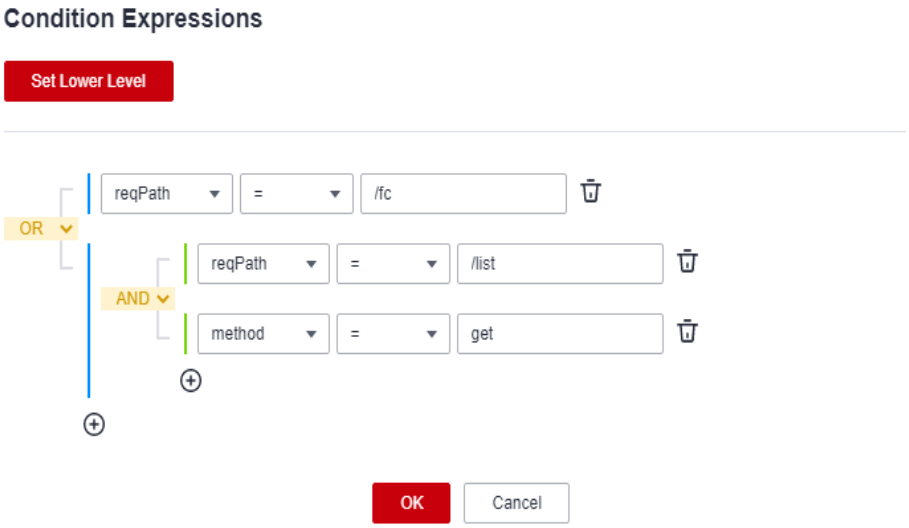
Table 4-2 Basic throttling

Parameter	Description
Max. API Requests	10
Max. User Requests	5

Step 3 Configure parameter-based throttling.

1. As required in **2**, enable parameter-based throttling, and define the header and rule.
   a. Click **Add Parameter**, select **header** for **Parameter Location**, and enter **Host** for **Parameter**.
   b. In the **Rules** area, click **Add Rule**, and set **Max. API Requests** to **10** and **Period** to **60 seconds**. Then click , and set the matching condition **Host = www.abc.com**.
   c. Click **OK**. The header matching rule **Host = www.abc.com** is generated, indicating that an API bound with this policy can only be called 10 times per 60s by requests whose **Host** header is **www.abc.com**.
2. As required in **3** and **4**, define multiple rules with parameter **Path**.
   a. In the **Rules** area, click **Add Rule**, and set **Max. API Requests** to **10** and **Period** to **60 seconds**. Then click to open the **Condition Expressions** dialog box.
   b. Add these three condition expressions: **reqPath = /fc**, **reqPath = /list**, and **method = get**.
   c. Click **Set Lower Level**.
   d. Put the two **reqPath** expressions in an **OR** relationship. This means the condition is met when either of the two paths is matched.

e. Select **reqPath = /list** and **method = get**, click **Set Lower Level**, and select **AND**.



f. Click **OK**. It indicates that APIs with path **/list** and method **GET** or APIs with path **/fc** bound with this policy can only be called 10 times per 60s.

Step 4 Configure excluded throttling.

As required in 5, enable excluded throttling. Add an excluded tenant with a threshold of 5 requests per 60s.

Table 4-3 Excluded throttling

Parameter	Description
Account ID	Tenant ID
Threshold	5

Step 5 Click **OK**. The request throttling 2.0 policy is configured.

Step 6 Bind this policy to an API.

1. Click the policy name to go to the policy details page.
2. In the **APIs** area, select environment **RELEASE** and click **Bind to APIs**. Select an API and click **OK**.

Step 7 Verify the API.

Call the API and verify whether the request throttling 2.0 policy has taken effect.

----End

5 API Security

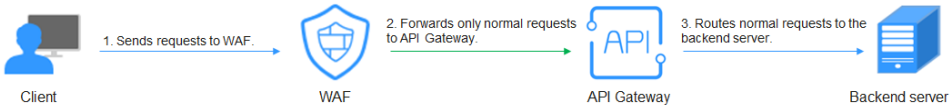
5.1 Using WAF to Protect APIG

Scenario

To protect API Gateway and your backend servers from malicious attacks, deploy Web Application Firewall (WAF) between API Gateway and the external network.

Solution Architecture

Figure 5-1 Access to a backend server



Advantages

Solution 1: Providing services using API group domain names is highly scalable.

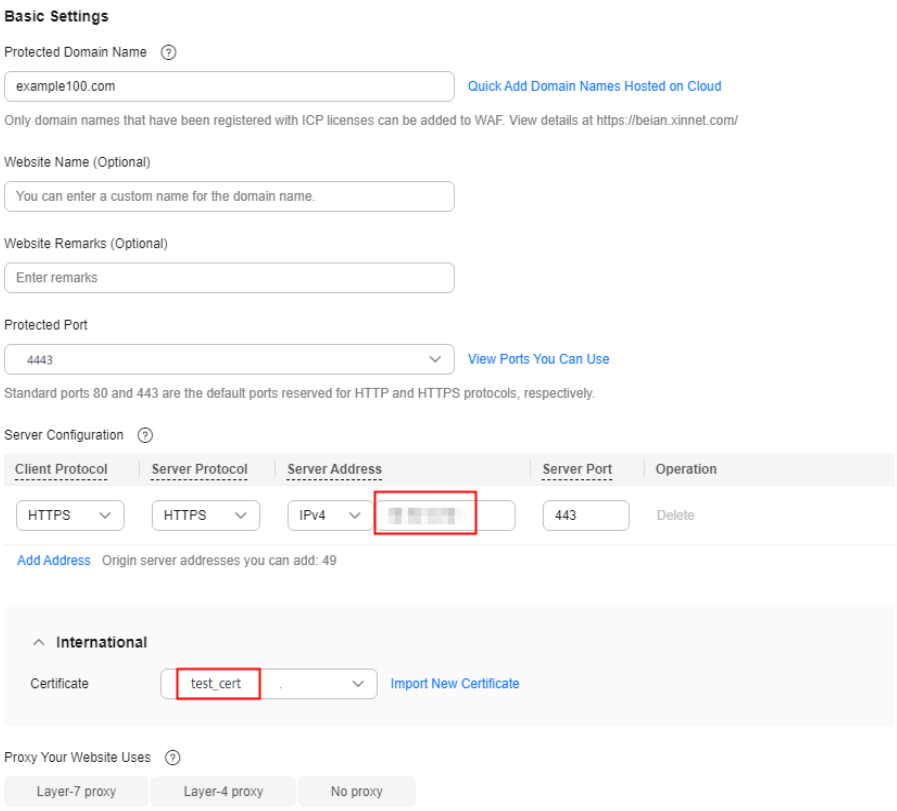
(Recommended) Solution 1: Register API Group Debugging Domain Name on WAF and Use the Domain Name to Access the Backend Service

Step 1 Create an API group in a gateway, record the domain name, and create an API in the group.

1. Log in to the APIG console, and choose **API Management** > **API Groups**.
2. Click **Create API Group** > **Create Directly** and enter the group name.
3. Click the name of the created group. The group details page is displayed.
4. On the **Group Information** tab, view and record the debugging domain name. It is unique and cannot be changed. It can be accessed up to 1,000 times a day.
5. On the APIs tab, click **Create API** > **Create API** to add an API.

Step 2 Add a domain name to WAF. Log in to the WAF console and choose **Website Settings** > **Add Website**. **When configuring the Server Address, you need to enter the domain name of the API group and add a certificate. After adding a domain name, you need to whitelist the back-to-origin IP addresses, test WAF locally, and modify the DNS resolution settings of the domain name.** For details, see **Connection Process (Cloud Mode)**.

Users can use a public network client to access WAF with its domain name. WAF then uses the same domain name to forward the request to APIG. There is no limit on the number of requests that APIG can receive for the domain name.

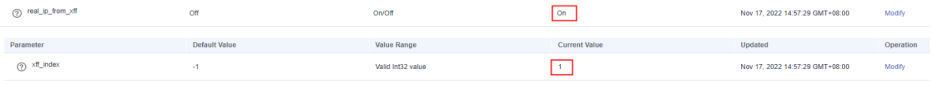


Step 3 On the gateway details page, bind the domain name to the API group.

1. Go to the APIG console, and choose **API Management** > **API Groups**.
2. Click the name of a created group.
3. On the **Group Information** tab, click **Bind Independent Domain Name**.
4. In the dialog box that is displayed, add the domain name.

Step 4 Enable **real_ip_from_xff** and set the parameter value to **1**.

1. In the navigation pane of the APIG console, choose **Gateways**.
2. On the **Parameters** tab, configure **real_ip_from_xff**.



When a user accesses WAF using a public network client, WAF records the actual IP address of the user in the HTTP header **X-Forwarded-For**. APIG resolves the actual IP address of the user based on the header.

----End

Solution 2: Forward Requests Through the DEFAULT Group and Use Gateway Inbound Access Address to Access the Backend Service from WAF

Step 1 View the inbound access addresses of your gateway. There is no limit on the number of times the API gateway can be accessed using an IP address.

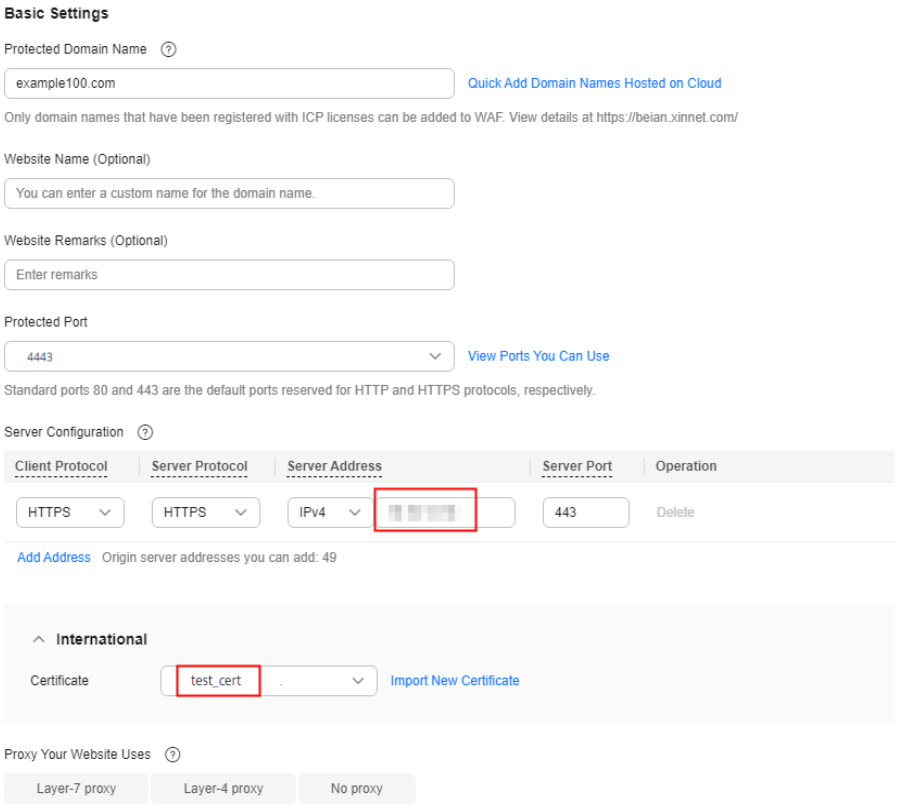
1. Log in to the APIG console, and choose **Gateways** in the navigation pane.
2. Click the gateway name or **Access Console**.
3. On the **Basic Information** tab, view the inbound access.
   - **VPC Access Address**: VPC private access address
   - **EIP**: public network access address

Step 2 Create an API in the **DEFAULT** group.

1. Go to the APIG console, and choose **API Management** > **API Groups**.
2. Click the name of the **DEFAULT** group.
3. Click **Create API** > **Create API** to add an API.

Step 3 Add a domain name to WAF. Log in to the WAF console and choose **Website Settings** > **Add Website**. **Set the Server Address to the inbound access of the gateway and add a certificate. After adding a domain name, you need to whitelist the back-to-origin IP addresses, test WAF locally, and modify the DNS resolution settings of the domain name.** For details, see **Connection Process (Cloud Mode)**.

- If WAF and your gateway are in the same VPC, set **Server Address** to the VPC access address.
- If your gateway is bound with an EIP, set **Server Address** to the EIP.

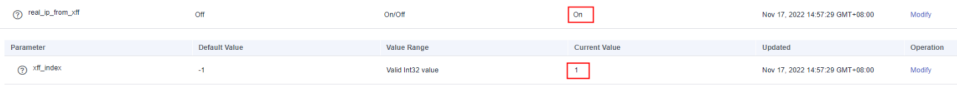


Step 4 On the gateway details page, bind the domain name to the **DEFAULT** group.

1. Go to the APIG console, and choose **API Management** > **API Groups**.
2. Click the name of the **DEFAULT** group.
3. On the **Group Information** tab, click **Bind Independent Domain Name**.
4. In the dialog box that is displayed, add the domain name.

Step 5 Enable **real_ip_from_xff** and set the parameter value to **1**.

1. In the navigation pane of the APIG console, choose **Gateways**.
2. On the **Parameters** tab, configure **real_ip_from_xff**.



When a user accesses WAF using a public network client, WAF records the actual IP address of the user in the HTTP header **X-Forwarded-For**. APIG resolves the actual IP address of the user based on the header.

----End

