

IoT Device Access

User Guide

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1 Overview

IoT Device Access (IoTDA) lets you connect and manage an enormous number of devices. It can be used together with other Huawei Cloud services to quickly construct IoT applications, simplify device management, and reduce manual operations, thereby improving management efficiency. Using the IoTDA console, you can create, develop, and debug products, register, manage, and authenticate devices, and upgrade software and firmware. You can also create rules for device linkage and data forwarding. In addition, you can monitor the device status based on reports generated from product and device data.

| Function | Description |
|------------------------------|---|
| Product | A product is a collection of devices with the same capabilities or features. On the IoTDA console, you can quickly develop product models and codecs, and use functions such as online debugging and topic customization in end-to-end (E2E) IoT development. This helps you improve integration development efficiency and shorten the construction period of IoT solutions. |
| Product model | A product model defines the properties of a device, such as the color, size, collected data, identifiable commands, and reported events. You can create a product model on the IoTDA console. |
| Device | A device is a physical entity that belongs to a product. Each device has a unique ID. It can be a device directly connected to the platform, or a gateway that connects child devices to the platform. |
| Device authentication | The platform authenticates devices that attempt to access it. Currently, the platform supports two authentication modes: secret authentication and X.509 authentication. After the verification is successful and the device is connected to the platform, the devices can communicate with the platform. |
| Group and tag | A group is a collection of devices. You can create groups for all the devices in a resource space based on different rules, such as regions and types, and you can operate the devices by group. You can define tags and bind tags to devices. |

| Function | Description |
|---------------------------------------|--|
| Software and firmware upgrades | You can upgrade software and firmware of devices that support LwM2M and MQTT in over the air (OTA) mode. |
| Device shadow | A device shadow is a JSON file that stores the device status, latest device properties reported, and device configurations to deliver. Each device has only one shadow. A device can retrieve and set its shadow to synchronize the status, either from the shadow to the device or from the device to the shadow. |
| Gateway and child device | Devices can be directly or indirectly connected to the IoT platform. Indirectly connected devices access the platform through gateways. |
| Rule | You can set rules for devices connected to the platform. If the conditions set in a rule are met, the platform triggers the corresponding action. Device linkage and data forwarding rules are available. |
| Monitoring and O&M | IoTDA provides monitoring and O&M functions such as statistics reports, online debugging, message tracing, current alarms, and run logs. You can also monitor the device running status, device communications, and user operations, and quickly trace and locate faults, ensuring device reliability and security. |
| Resource space | Resource space is a space allocated for your applications. Resources (such as products and devices) created on the platform must belong to a resource space. You can use the resource space for domain-based management. |
| IoTDA instance | To meet the requirements of enterprise customers with different IoT device scales, IoTDA provides three editions: basic (shared instance), standard (standard instance), and enterprise (dedicated instance). You can purchase the most appropriate instance type and instance specifications based on your service scenario, device scale, and data collection frequency. |
| Data reporting | After being registered with the platform and powered on, a device can collect and report data based on the service logic. Data collection and reporting can be triggered by a schedule or by specific events. |
| Data forwarding | The data forwarding function connects IoTDA with other Huawei Cloud or third-party cloud services to smoothly transfer device data to the message middleware, storage and data analysis services, and applications. |
| Command delivery | A product model defines commands that can be delivered to the devices. Applications can call platform APIs to deliver commands to the devices to effectively manage these devices. |

Browser Requirements

To ensure good display effect and ease of use, use a browser with good compatibility. The table below lists the browser requirements.

| Browser Type | Version Requirements | Recommended Resolution |
|----------------|--|------------------------|
| Microsoft Edge | The latest three stable versions are supported and tested. | 1366 x 768 |
| Firefox | The latest three stable versions are supported and tested. | |
| Google Chrome | The latest three stable versions are supported and tested. | |

2 IoTDA Instances

2.1 Overview

IoTDA uses instances to implement data and resource isolation. Currently, the platform provides standard edition (standard instance).

- **Standard Edition**

You can experience all functions of Standard Edition free of charge within the limit on the number of messages and devices per day.

If you want to increase device and message quotas, modify the configuration on the instance page and select units with desired specifications.

Restrictions on Purchasing Instances

Note the following restrictions to prevent purchasing and creation failures:

- Restrictions on purchasing standard edition instances
 - Each tenant can subscribe to only one free trial instance in the same region.

2.2 Buying an Instance

Procedure

Step 1 In the navigation pane, choose **IoTDA Instances**, click **Buy Instance**, and select **Enterprise**.

Step 2 Enter configuration information about the instance. The system automatically calculates the fee based on **Instance Specifications** and **Required Duration**.

| Parameter | Description |
|--------------|---|
| Billing Mode | Billing mode of an instance. The value is fixed at Yearly/ Monthly . |

| Parameter | Description |
|-------------------------|--|
| Region | Region where IoTDA is deployed. Currently, CN North-Beijing4 , CN East-Shanghai1 , and CN South-Guangzhou are supported. NOTE Select a nearby region to ensure the lowest latency possible. |
| Network | Select an available VPC and subnet. Create a VPC on the VPC console . |
| Security Group | Select a security group. Create a security group on the VPC console . |
| Public Network Access | Set this parameter based on your requirements. If configured, devices can access the platform via the Internet. |
| Private Network Access | <ul style="list-style-type: none">• If you select Create Provide Network Access Point, a VPC endpoint is automatically purchased and an access address is automatically allocated.• If it is not selected, private network ingestion is still required. You can purchase VPC endpoints for connection. |
| Access Ports | You can configure access ports or use the default ports. The following ports are provided: Application access: HTTPS (443) and AMQPS (5671) Device access: CoAP (5683), CoAPS (5684), MQTT (1883), MQTTS (8883), and HTTPS (443) |
| Instance Version | Select Enterprise . |
| Enterprise Project | This parameter is displayed only for enterprise users who have enabled the enterprise project function. Enterprise projects let you manage cloud resources and users by project. For details, see Enterprise Center Overview . |
| Tags | Tags are key-value pairs, which are used to identify, classify, and search for instances. Instance tags are used to filter and manage instances only. For details, see Instance Tag Management . |
| Instance Name | Set a name for easy management. The value can contain a maximum of 64 characters consisting of letters, numbers, underscores (_), and hyphens (-). |
| Cryptographic Algorithm | General cryptographic algorithms (such as RSA and SHA-256) and SM series commercial cryptographic algorithms (Chinese cryptographic algorithms such as SM2, SM3, and SM4) are available. |
| Description | Provide a description for the instance, which can be a brief description based on the instance user and usage. |

| Parameter | Description |
|-------------------|---|
| Required Duration | Select a duration as required. You can select Auto-renew so the instance will be automatically renewed when it expires. |

Step 3 Click **Buy**.

Step 4 Confirm the specifications and click **Pay**.

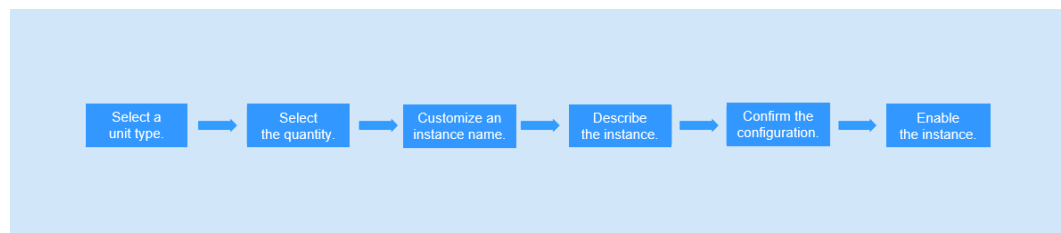
Step 5 On the payment page, select a payment method and click **Pay**.

----End

Buying a Standard Edition Instance

The standard instance provides configurable instance specifications. You can purchase more economical instances based on your service model.

Before the purchase, browse the overall process for a more efficient operation.



Procedure

Step 1 In the navigation pane, choose **IoTDA Instances**, click **Buy Instance**, and select **Standard**.

Step 2 Enter configuration information about the instance. The system automatically calculates the fee based on instance specifications and the pay-per-use mode.

| Parameter | Description |
|--------------|---|
| Billing Mode | Billing mode of an instance. Currently, only Pay-per-use is supported.. |
| Region | Region where IoTDA is available. Currently, AP-Bangkok, AP-Singapore, AF-Johannesburg, LA-Sao Paulo1, and CN-Hong Kong are supported. NOTE Select a nearby region to ensure the lowest latency possible. |

| Parameter | Description |
|--------------------|---|
| Specifications | <p>SUF unit with free specifications, SU1 unit with small specifications, SU2 unit with medium specifications, SU3 unit with large specifications, and SU4 unit with ultra-large specifications are available. You can obtain the recommended instance specifications based on the required upstream and downstream TPS.</p> <p>NOTE</p> <ul style="list-style-type: none">Instance specifications of Standard Edition = Number of units in the instance x Specifications of each unitA Standard Edition instance can contain multiple units of the same type. The maximum number of units in a single instance is 100, and the maximum TPS of upstream and downstream messages of a single instance is 100,000. For example, even if an instance contains 100 S3 units, the maximum TPS of the instance is 100,000.You can increase the number of units in the instance online, for example, upgrading a standard instance from three SU1 units to five SU2 units.An instance cannot contain different types of units, for example, <i>M</i> SU1 units and <i>N</i> SU2 units. |
| Enterprise Project | This parameter is displayed only for enterprise users who have enabled the enterprise project function. Enterprise projects let you manage cloud resources and users by project. For details, see Enterprise Center Overview . |
| Tags | Tags are key-value pairs, which are used to identify, classify, and search for instances. Instance tags are used to filter and manage instances only. For details, see Instance Tag Management . |
| Instance Name | Enter a name for easy management. The value can contain a maximum of 64 characters consisting of letters, numbers, underscores (_), and hyphens (-). |
| Description | Provide a description for the instance, which can be a brief description based on the instance user and usage. |

Step 3 Click **Buy**.

Step 4 Confirm the specifications and click **Submit**.

----End

2.3 Instance Management

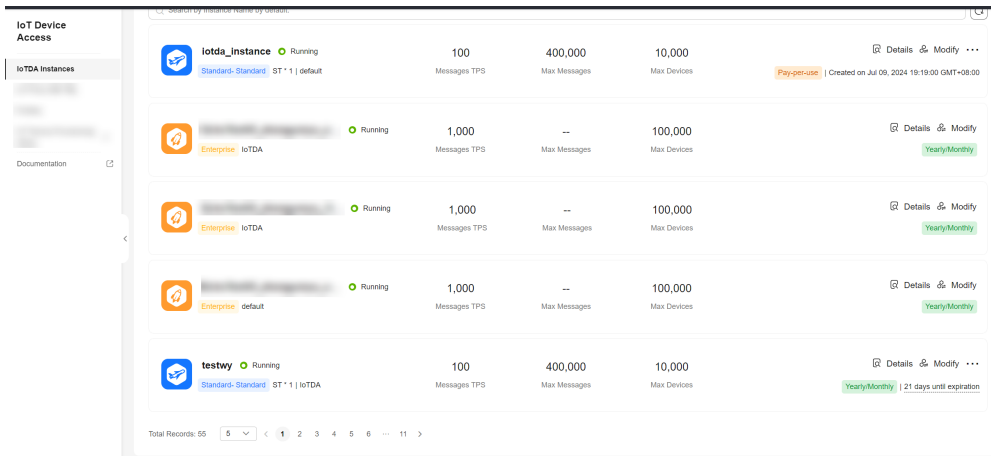
Selecting an Instance

After an instance is created, select the instance before creating products and devices and setting other functions in the instance.

Step 1 Access the [IoTDA](#) service page and click **Access Console**.

Step 2 In the navigation pane, choose **IoTDA Instances**, and click the target instance card.

Figure 2-1 Instance management - Changing instance



----End

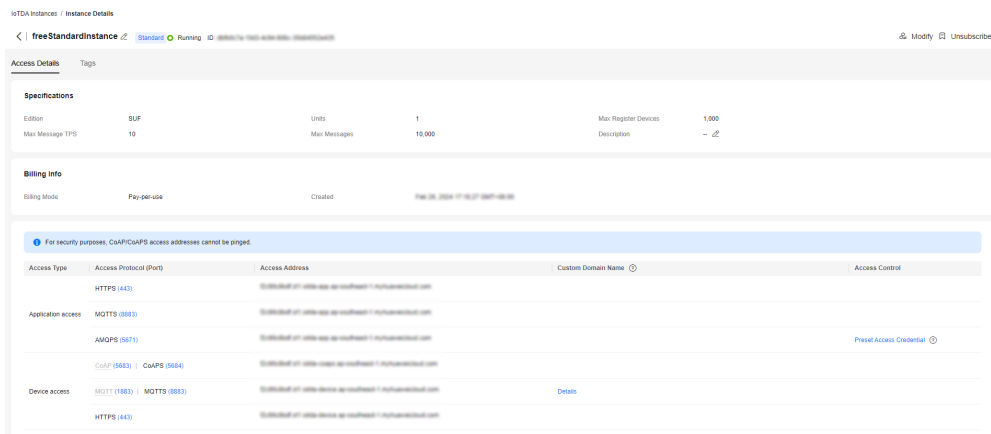
Viewing Instance Details

After purchasing an IoTDA instance, you can view the instance details in the instance details page, including the instance ID, name, and specifications.

Step 1 Access the **IoTDA** service page and click **Access Console**.

Step 2 In the navigation pane, choose **IoTDA Instances** and click **Details** corresponding to an instance.

Figure 2-2 Instance management - Instance details



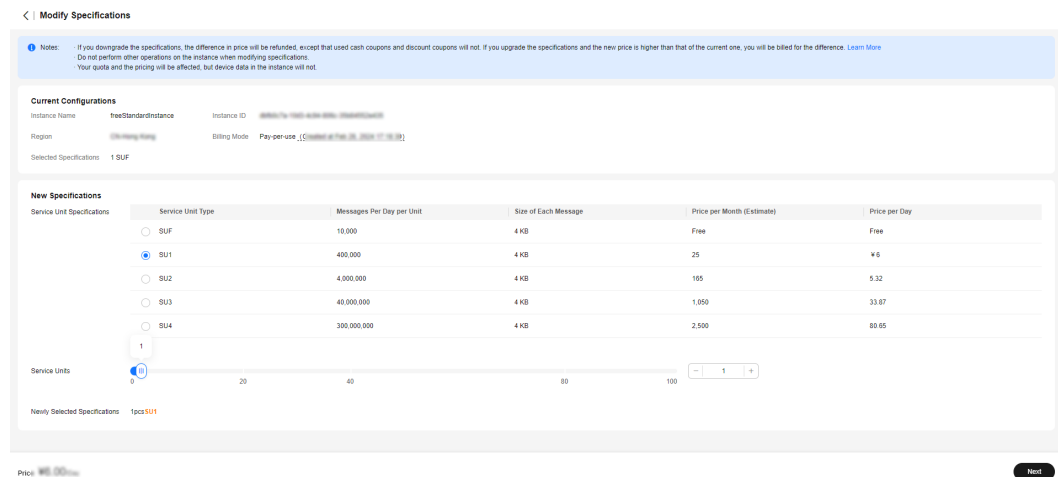
----End

Modifying Instance Specifications

You can upgrade the specifications of an IoTDA instance based on service requirements. Modifying instance specifications does not affect services.

- Step 1** Access the **IoTDA** service page and click **Access Console**.
- Step 2** In the navigation pane, choose **IoTDA Instances**. Locate the target instance, click **Modify**, and select the new instance specifications.
- Step 3** Set a delay for the change to take effect. After you set a maintenance window, the change will be performed in the scheduled time.

Figure 2-3 Instance management - Modifying specifications

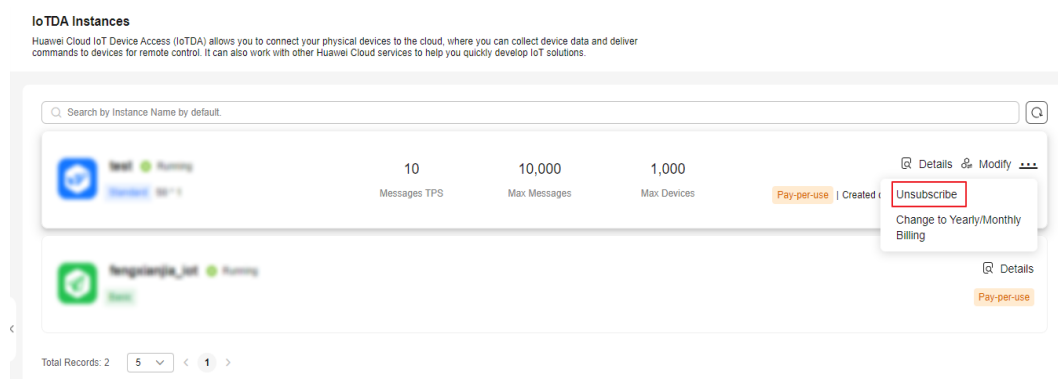


----End

Unsubscribing from an Instance

If an instance is no longer required, you can choose **More > Unsubscribe** in the **Operation** column to release your cloud service resources. For details, see [Unsubscriptions](#).

Figure 2-4 Instance management - Unsubscribing from an instance



2.4 Tag Management

2.4.1 Overview

Scenarios

You can add tags to cloud resources for quicker search. You can view, modify, and delete these tags in a unified manner, facilitating cloud resource management. You can also use the tags to collect resource cost statistics from the service dimension.

Tag Naming Rules

- Each tag consists of a key-value pair.
- A maximum of 20 tags can be added for an IoTDA instance.
- For each resource, a tag key must be unique and can have only one tag value.
- A tag consists of a tag key and a tag value. Table 1 lists the tag key and value requirements.

Table 2-1 Tag naming rules

| Parameter | Rule | Example |
|-----------|--|--------------|
| Tag key | The value cannot be empty. Must be unique for the same instance. A tag key can contain a maximum of 36 characters. Only letters, digits, hyphens (-), underscores (_), and Unicode characters (\u4E00-\u9FFF) are allowed. | Organization |
| Tag value | It can contain a maximum of 43 characters and can be left blank. Only letters, digits, periods (.), hyphens (-), underscores (_), and Unicode characters (\u4E00-\u9FFF).are allowed. | Apache |

NOTE

If your organization has configured tag policies for IoTDA, add tags to instances based on the policies. If a tag does not comply with the tag policies, instance creation may fail. Contact your administrator to learn more about tag policies.

2.4.2 Adding a Tag

You can add tags for IoTDA instances in either of the following ways:

- [Adding a Tag on the Instance Details Page](#)
- [Adding a Tag on the Tag Management Service Page](#)

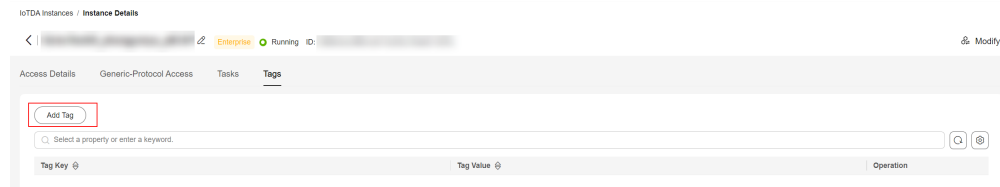
For details about how to use predefined tags, see [Using Predefined Tags](#).

Adding a Tag on the Instance Details Page

Step 1 Access the [IoTDA](#) service page and click **Access Console**.

- Step 2** In the navigation pane, choose **IoTDA Instances** and click **Details** under **Enterprise Edition**.
- Step 3** Click the **Tags** tab and then **Add Tag**. In the displayed dialog box, enter the tag key and tag value. For details, see [Tag naming rules](#).

Figure 2-5 Instance management - Adding a tag



----End

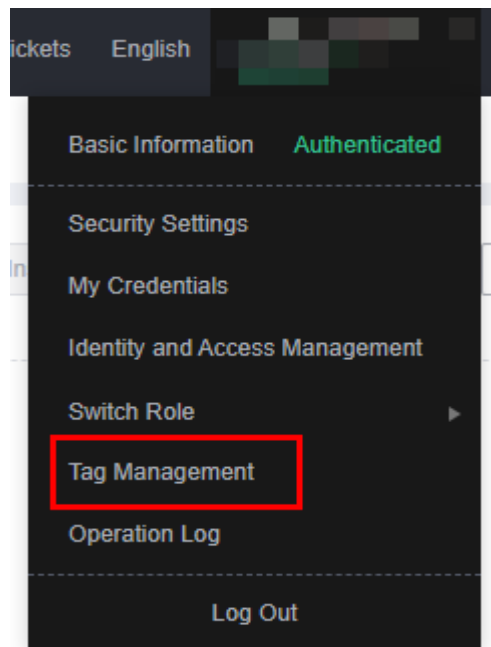
Adding a Tag on the Tag Management Service Page

NOTE

This method is suitable for adding tags with the same tag key to multiple resources.

- Step 1** Access the [IoTDA](#) service page and click **Access Console**.
- Step 2** In the upper right corner of the page, click the username and select **Tag Management** from the drop-down list.

Figure 2-6 Tag management



- Step 3** On the **Resource Tags** page, select the region where the resource is located, set **Resource Type** to **IoTDA-Instance**, and click **Search**. All IoTDA instance resources in the selected region are displayed.
- Step 4** In the **Search Result** area, click **Create Key**. In the displayed dialog box, enter a key (for example **project**) and click **OK**. After the tag is created, the tag key is


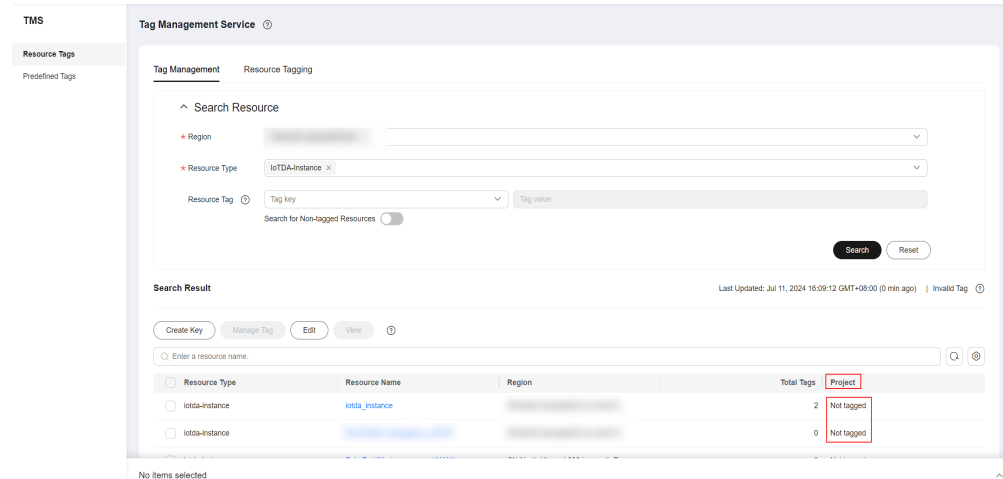
added to the resource tag list, as shown in **Figure 2-7**. If the tag is not contained in the list, click  and select the created tag from the drop-down list. By default, the value of the tag key is **Not tagged**. You need to set a value for the tag of each resource to associate the tag with the resource.

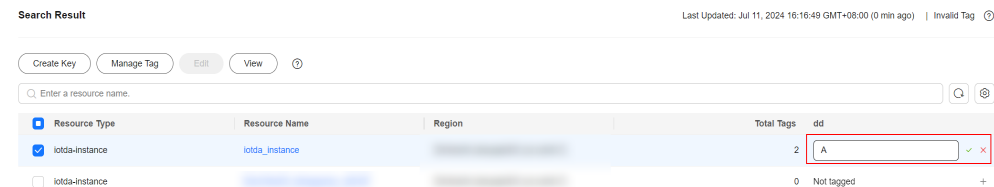
Figure 2-7 Instance tag - Tag management



Step 5 Click **Edit** to make the resource list editable.

Step 6 Select the row where the IoTDA instance resource is located, and enter the tag value (for example, A). After a value is set for a tag key, the number of tags is incremented by 1. Repeat the preceding steps to add tag values for other instances.

Figure 2-8 Instance tag - Entering a tag value



----End

Using Predefined Tags

If you want to add the same tag to multiple resources, you can create a predefined tag on the Tag Management Service (TMS) console and select the tag for the resources. This frees you from having to repeatedly enter tag keys and values. The procedure is as follows:

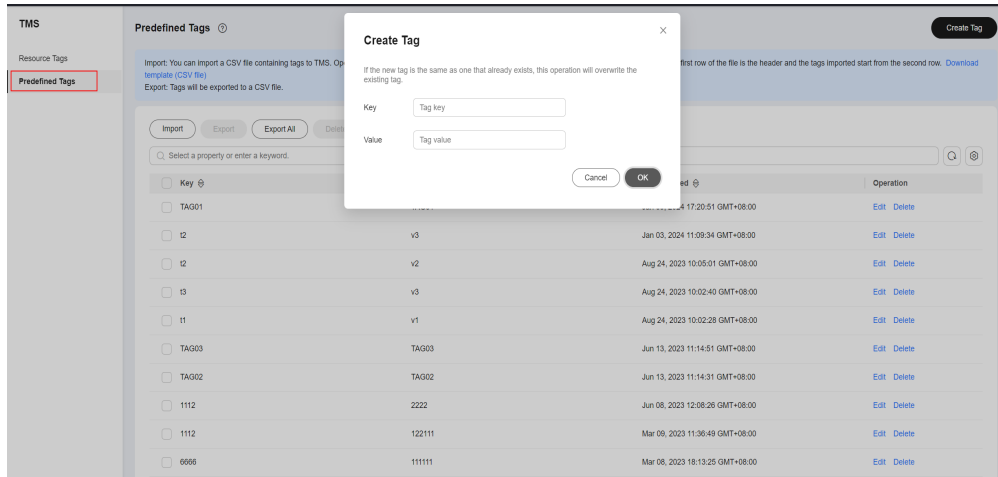
Step 1 Log in to the console.

Step 2 In the upper right corner of the page, click the username and select **Tag Management** from the drop-down list.

Step 3 In the navigation pane, choose **Predefined Tags**. In the right pane, click **Create Tag** enter a key (for example **project**) and a value (for example **A**) in the displayed dialog box.

Step 4 Choose **Service List > IoT Device Access** and select the predefined tag by following the procedure for adding a tag.

Figure 2-9 Instance tag - Predefined tags



----End

2.4.3 Deleting a Tag

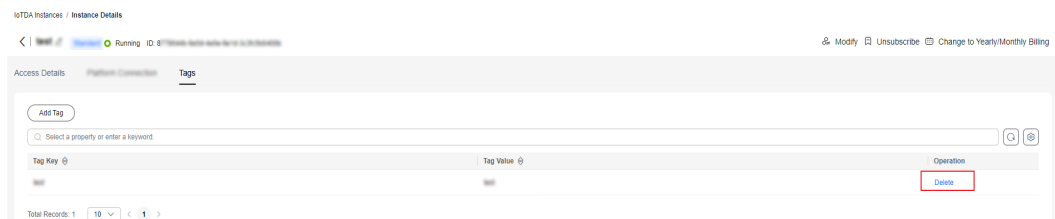
If you no longer need a tag, delete it in any of the following ways:

- [Deleting a Tag on the Instance Details Page](#)
- [Deleting a Tag on the TMS Console](#)
- [Batch Deleting Tags on the TMS Console](#)

Deleting a Tag on the Instance Details Page

- Step 1** Access the [IoTDA](#) service page and click **Access Console**.
- Step 2** In the navigation pane, choose **IoTDA Instances** and click **Details** under **Enterprise Edition**.
- Step 3** Click the **Tags** tab. Locate the row containing the tag to be deleted and click **Delete** in the **Operation** column. In the **Delete Tag** dialog box, click **OK**.

Figure 2-10 Instance management - Deleting a tag

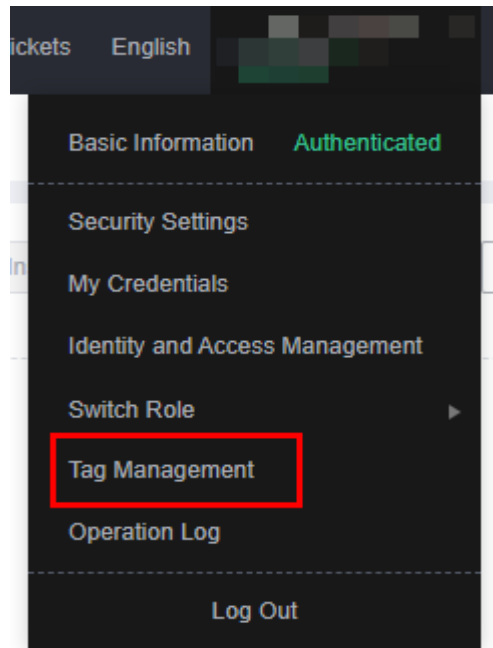


----End

Deleting a Tag on the TMS Console

- Step 1** Access the **IoTDA** service page and click **Access Console**.
- Step 2** In the upper right corner of the page, click the username and select **Tag Management** from the drop-down list.

Figure 2-11 Tag management




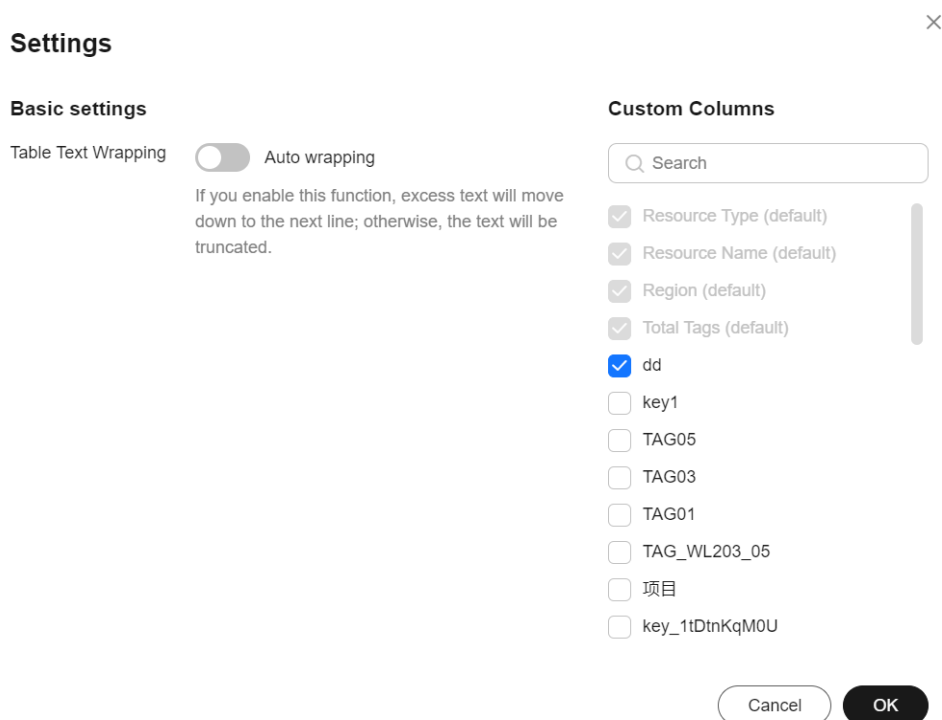
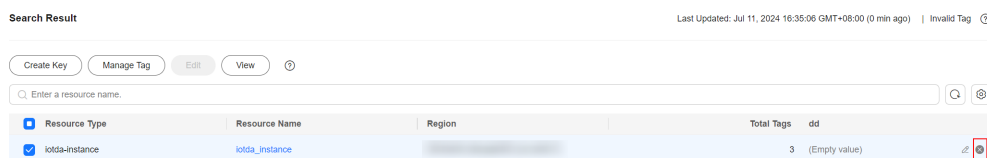
- Step 3** On the **Resource Tags** page, select the region where the resource is located, set **Resource Type** to **IoTDA-Instance**, and click **Search**. All IoTDA instance resources in the selected region are displayed.
- Step 4** In the **Search Result** area, click **Edit** to make the resource tag list editable. Click  and select the tag key to be deleted from the drop-down list. You are advised not to select more than 10 keys to display.

Figure 2-12 Instance tag - Tag list



Step 5 Locate the row containing the target IoTDA instance resource and click .

Figure 2-13 Instance tag - Deleting a tag

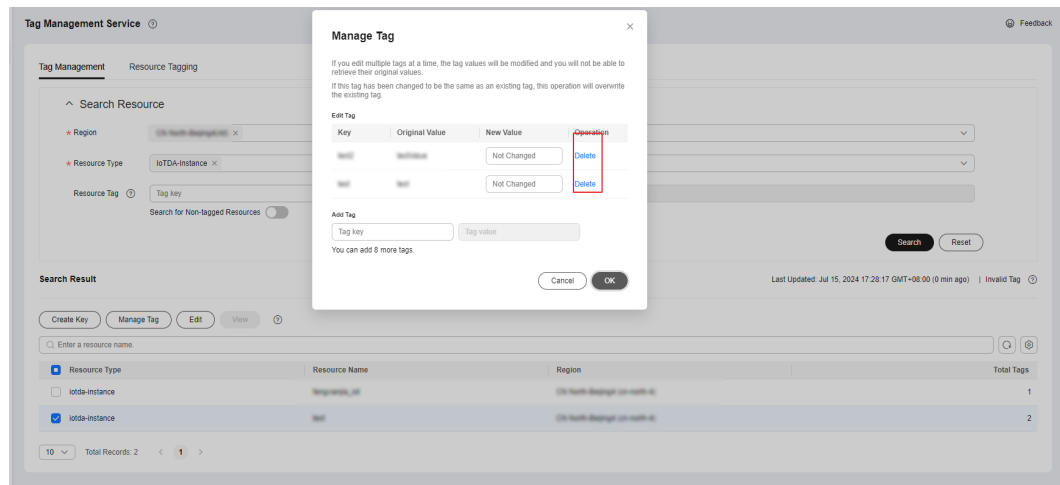


----End

Batch Deleting Tags on the TMS Console

- Step 1** Access the [IoTDA](#) service page and click **Access Console**.
- Step 2** In the upper right corner of the page, click the username and select **Tag Management** from the drop-down list.
- Step 3** On the **Resource Tags** page, select the region where the resource is located, set **Resource Type** to **IoTDA-Instance**, and click **Search**. All IoTDA instance resources in the selected region are displayed.
- Step 4** Select the IoTDA instance resource whose tag is to be deleted.
- Step 5** Click **Manage Tag** in the upper left corner of the list.
- Step 6** In the displayed **Manage Tag** dialog box, click **Delete** in the **Operation** column. Click **OK**.

Figure 2-14 Instance tag - Deleting tags in batches



----End

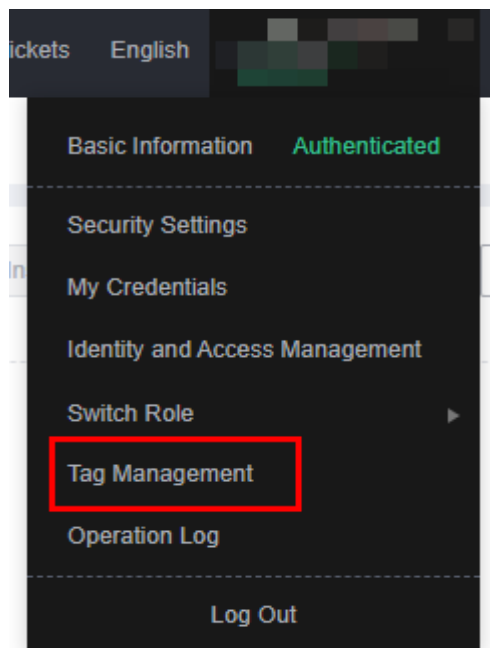
2.4.4 Searching for Resources by Tag

After adding tags to cloud resources, you can use the methods described in this section to search for resources by tag.

Filtering Resources By Tag

- Step 1** Access the [IoTDA](#) service page and click **Access Console**.
- Step 2** In the upper right corner of the page, click the username and select **Tag Management** from the drop-down list.

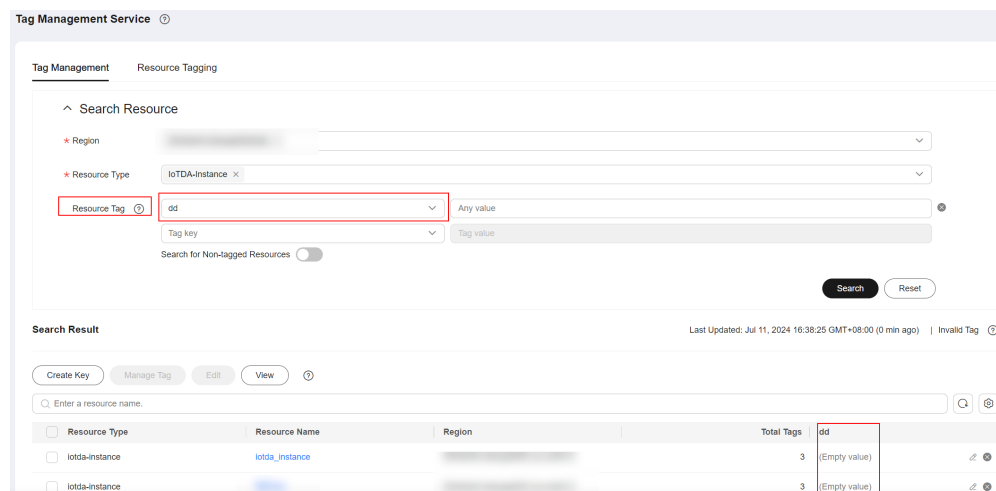
Figure 2-15 Tag management



Step 3 On the **Resource Tags** page, set the search criteria, including **Region**, **Resource Type**, and **Resource Tag**.

Step 4 Click **Search**. All the resources that meet the search criteria will be displayed.

Figure 2-16 Instance tag - Searching for resources by tag



----End

3 Resource Spaces

Resource space is a space allocated for your applications. Resources (such as products and devices) created on the platform must belong to a resource space. You can use the resource space for domain-based management.

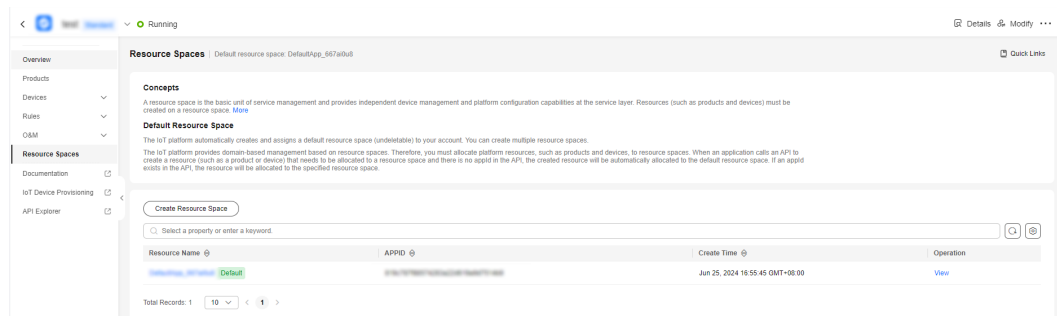
- You can create a maximum of 10 resource spaces. By default, the space automatically created by the platform when the IoTDA service is subscribed to for the first time is the default resource space.
- An **app_id**, which is a unique identifier of a resource space, is allocated by the platform when the resource space is created. **app_id** is also used in API calls.
- After a resource space is created, you can view its **app_id** in the resource space.
- The default resource space cannot be deleted. After a resource space is deleted, all resources in the space, such as devices, products, and subscription data, are deleted from the platform and cannot be restored. Exercise caution when deleting a resource space.

Creating a Resource Space

When you subscribe to IoTDA for the first time, the platform automatically creates the default resource space. Each instance has only one default resource space, which cannot be deleted.

You can create a product or register a device in the default resource space. You can also perform the following steps to create a resource space:

Figure 3-1 Resource space - Resource space list



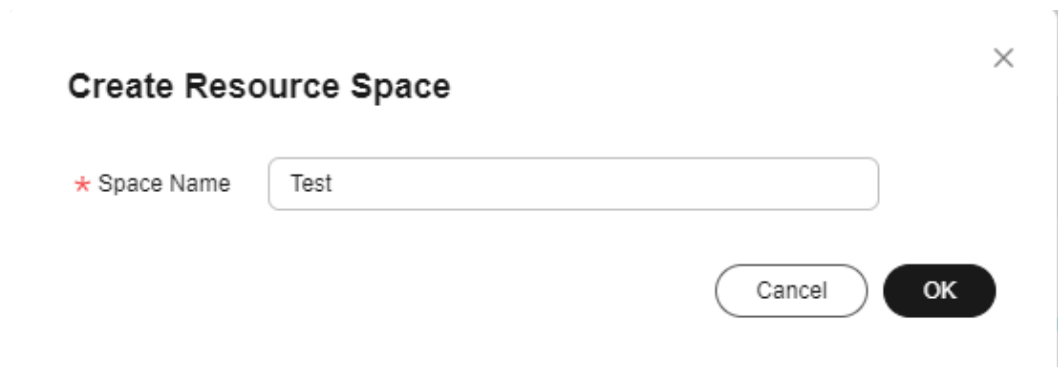
 NOTE

If you subscribed to IoTDA before 00:00 on Apr 27, 2020, see [Which Resource Space Will Be Set As Default on the IoT Platform?](#).

- Step 1** Access the **IoTDA** service page and click **Access Console**.
- Step 2** In the navigation pane, choose **IoTDA Instances**, and click the target instance card.
- Step 3** In the navigation pane, choose **Resource Spaces**. On the displayed page, click **Create Resource Space**. On the displayed dialog box, set **Space Name** and click **OK**.

The resource space name must be unique under the account.

Figure 3-2 Resource space - Creating a resource space

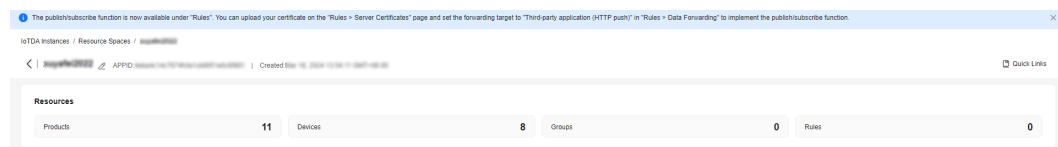


----End

Querying a Resource Space

After a resource space is created, choose **Resource Spaces** and click **View** to check the app ID (**app_id**), creation time, number of products, number of devices, number of groups, and number of created rules under the resource space. To create products, devices, groups, and rules in another resource space, switch to the target resource space.

Figure 3-3 Resource space - Viewing resource spaces

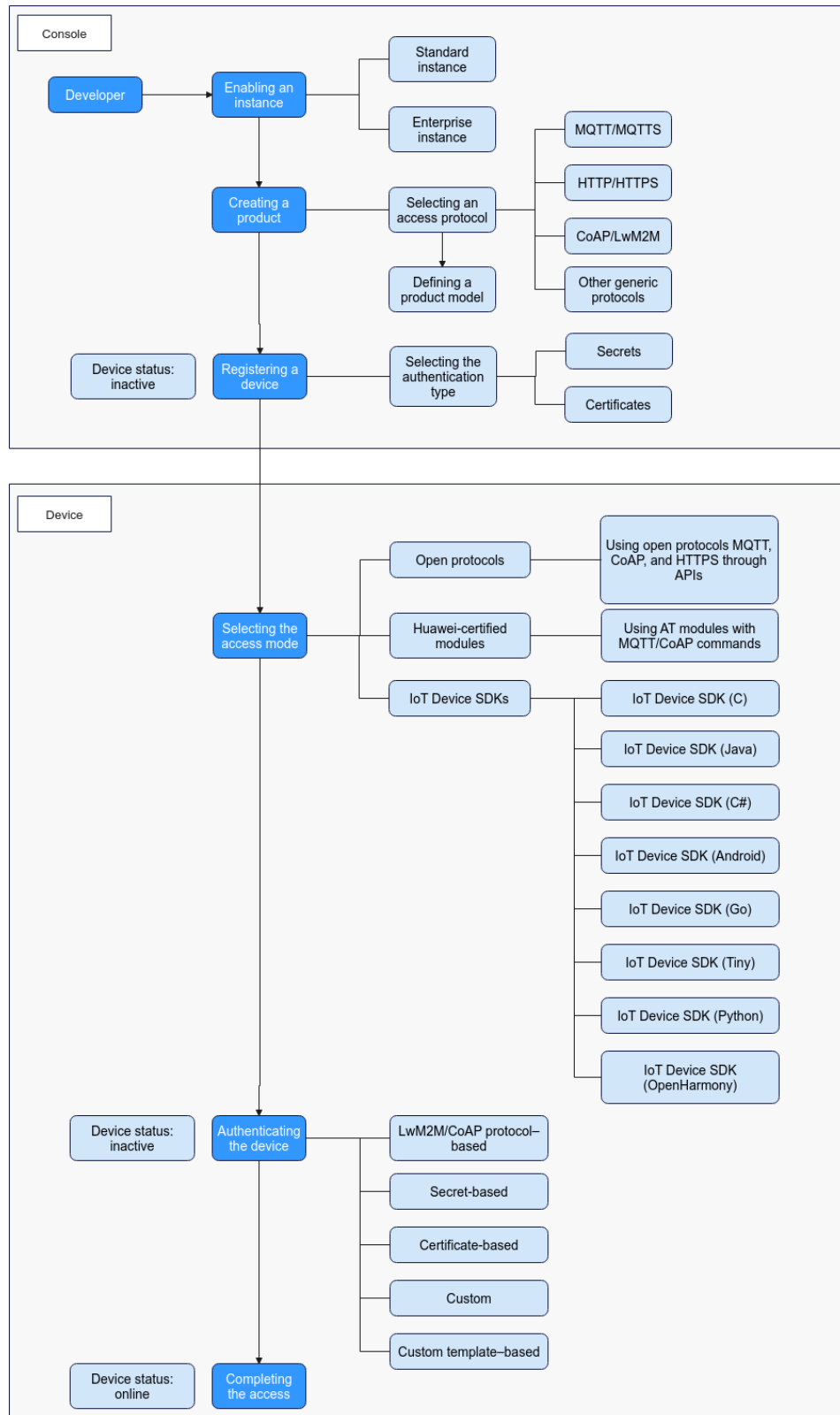


4 Device Access

4.1 Overview

Device Access Process

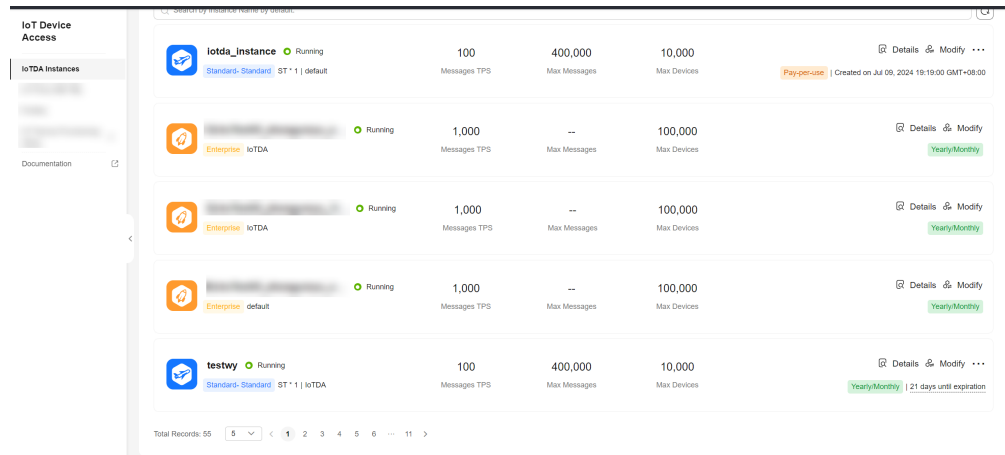
Figure 4-1 Device access process



Platform Connection Information

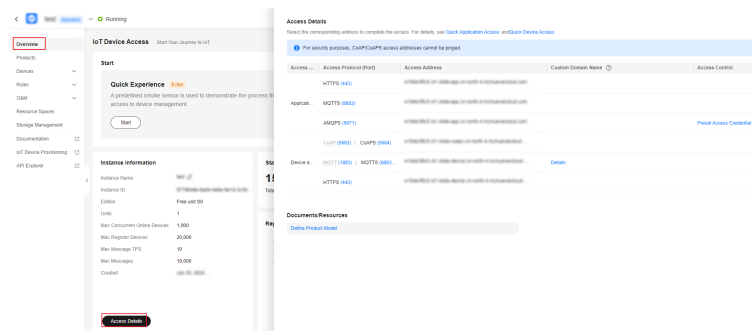
1. Log in to the **IoTDA console**. In the navigation pane, choose **IoTDA Instances**, and click the target instance card.

Figure 4-2 Instance management - Changing instance



2. In the navigation pane, choose **Overview**. In the **Instance Information** area, click **Access Details**.

Figure 4-3 Obtaining access information



Certificates

The following certificates are used when devices and applications need to verify IoTDA.

NOTE

- The certificates apply only to Huawei Cloud IoTDA and must be used together with the corresponding domain name.
- CA certificates cannot be used to verify server certificates after their expiration dates. Replace these certificates before expiration dates to ensure that devices can connect to the IoT platform properly.

Table 4-1 Certificates

| Certificate Package Name | Region and Edition | Certificate Type | Certificate Format | Description | Download Link |
|--------------------------|--|--------------------|--------------------|---|----------------------------------|
| certificate | CN-Hong Kong, AP-Singapore, AP-Bangkok, AF-Johannesburg, LA-Santiago, LA-Sao Paulo1, and ME-Riyadh | Device certificate | pem, jks, and bks | Used by a device to verify the platform identity. The certificate must be used together with the device access domain name. | Certificate file |

4.2 Device Authentication

4.2.1 Overview

IoTDA authenticates a device when the device attempts to access the platform. The authentication process depends on the access method.

| Access Type | Authentication Mode |
|------------------------------|--|
| Device using LwM2M over CoAP | You can call the API for creating a device or use the IoTDA console to register a device. Then, when connecting to the platform, a non-security device does not use DTLS/DTLS+, and carries the node ID to get authenticated. A security device uses DTLS/DTLS+, and carries both the secret and node ID to get authenticated. |

| Access Type | Authentication Mode |
|----------------------------|---|
| Device using MQTT or MQTTS | <ul style="list-style-type: none">• Using secrets: You can call the API for creating a device or use the IoTDA console to register a device. Then, you can hardcode the device ID and secret returned by the platform into the device, and preset a CA certificate on the device if it uses MQTTS protocols. When connecting to the platform, the device uses the device ID and secret to get authenticated.• Using certificates: You can upload a device CA certificate on the IoTDA console, and register the device, either by calling the API for creating a device or using the console. Then, you can hardcode the device ID returned by the platform into the device. When connecting to the platform, the device uses the X.509 certificate to get authenticated.• Using custom authentication: Before connecting a device to the platform, you can use the application to configure custom authentication information on the console, and then configure custom authentication functions by using FunctionGraph. When the device connects to IoTDA, the platform obtains parameters such as the device ID and custom authentication function name, and sends an authentication request to FunctionGraph. The user implements the authentication logic to complete access authentication.• Using custom templates: You can use a custom authentication template to orchestrate internal functions provided by the platform and flexibly customize triplet parameters ClientId, Username, and Password for MQTT device authentication. |

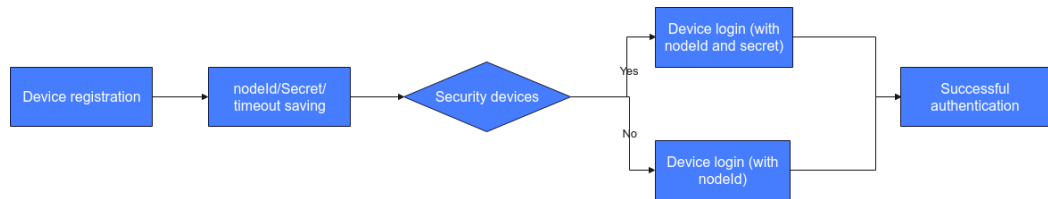
4.2.2 LwM2M/CoAP Authentication

Introduction

LwM2M/CoAP authentication supports both encrypted and non-encrypted access modes. Non-encrypted mode: Devices connect to IoTDA carrying the node ID through port 5683. Encrypted mode: Devices connect to IoTDA carrying node ID and secret through port 5684 by the DTLS/DTLS+ channel.

Authentication for Devices Using LwM2M over CoAP

Figure 4-4 LwM2M/CoAP access authentication process



1. An application calls the API for creating a device to register a device. Alternatively, a user uses the IoTDA console to register a device.
2. The platform allocates a secret to the device and returns **timeout**.

NOTE

- The secret can be defined during device registration. If no secret is defined, the platform allocates one.
 - If the device is not connected to the platform within the duration specified by **timeout**, the platform deletes the device registration information.
3. During login, the device sends a connection authentication request carrying the node ID (such as the IMEI) and secret if it is a security device, or carrying the node ID if it is a non-security device.
 4. If the authentication is successful, the platform returns a success message, and the device is connected to the platform.

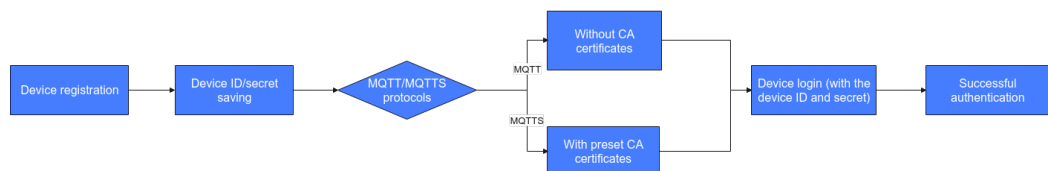
4.2.3 MQTT(S) Secret Authentication

Introduction

MQTT(S) secret authentication requires a device to have its ID and secret for access authentication. For devices connected through MQTTS, a CA certificate must be preconfigured on the devices.

Procedure

Figure 4-5 MQTT(S) secret authentication process



1. An application calls the API for creating a device to register a device. Alternatively, a user uses the IoTDA console to register a device.

NOTE

During registration, use the MAC address, serial number, or IMEI of the device as the node ID.

2. The platform allocates a globally unique device ID and secret to the device.

 **NOTE**

The secret can be defined during device registration. If no secret is defined, the platform allocates one.

3. The device needs to integrate the preset CA certificate (only for the authentication process of MQTT(S) access).
4. During login, the device sends a connection request carrying the device ID and secret.
5. If the authentication is successful, the platform returns a success message, and the device is connected to the platform.

4.2.4 MQTT(S) Certificate Authentication

Introduction

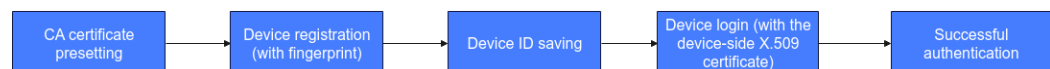
MQTT(S) certificate authentication requires you to upload a device CA certificate on the console first. Then, you can either use the API for [creating a device](#) or register the device on the console to get the device ID. When the device accesses the IoT platform, it carries the X.509 certificate for authentication, which is a digital certificate used to authenticate the communication entity.

Constraints

- Only MQTT devices can use X.509 certificates for identity authentication.
- You can upload up to 100 device CA certificates.

Procedure

Figure 4-6 MQTT(S) certificate authentication process



1. A user uploads a device CA certificate on the IoTDA console.
2. An application calls the API for creating a device to register a device. Alternatively, a user uses the IoTDA console to register a device.

 **NOTE**

During registration, use the MAC address, serial number, or IMEI of the device as the node ID.

3. The platform allocates a globally unique device ID to the device.
4. During login, the device sends a connection request carrying the [X.509 certificate](#) to the platform.
5. If the authentication is successful, the platform returns a success message, and the device is connected to the platform.

APIs

- [Create a Device](#)

- [Reset a Device Secret](#)
- [Obtain the Device CA Certificate List](#)
- [Upload a Device CA Certificate](#)
- [Delete a Device CA Certificate](#)
- [Verify a Device CA Certificate](#)

4.2.5 MQTT(S) Custom Authentication

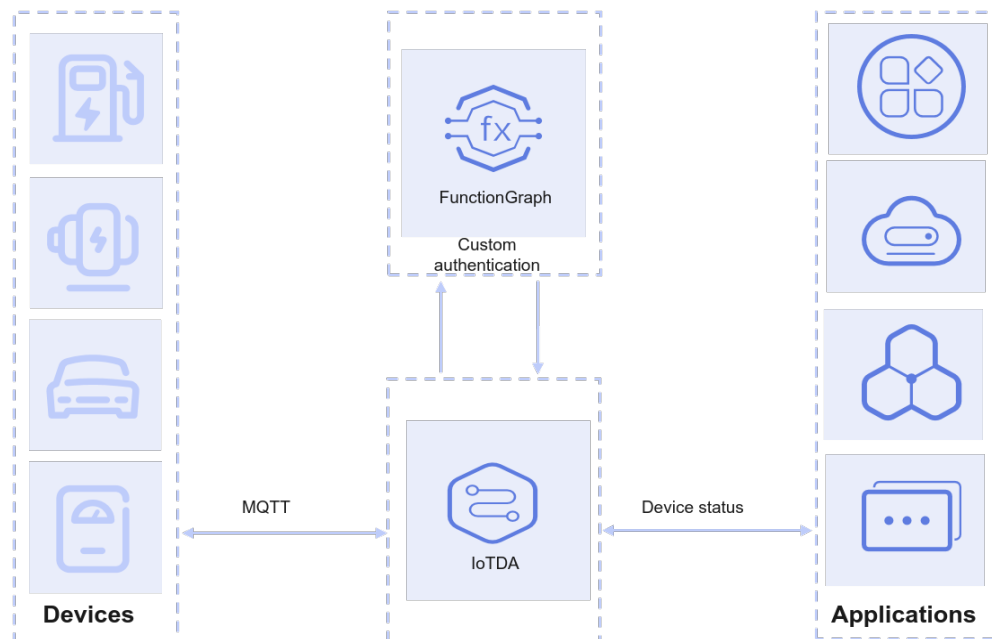
4.2.5.1 Overview

Introduction

You can use FunctionGraph to customize the identity authentication logic for devices connected to the platform.

Before connecting a device to the platform, you can use the application to configure custom authentication on the console, and then configure related functions by using [FunctionGraph](#). When the device connects to the platform, the platform obtains parameters such as the device ID and custom authentication function name, and sends an authentication request to FunctionGraph. The user implements the authentication logic to complete access authentication.

Figure 1 Custom authentication architecture



Application Scenarios

- Device migration from third-party cloud platforms to IoTDA: You can configure the custom logic to make it compatible with the original authentication mode. No modification is required on the device side.
- Native access: Custom templates provide flexible authentication.

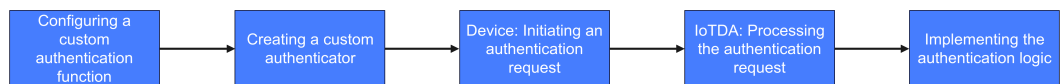
Constraints

- The device must use TLS and support **SNI (Server Name Indication)**. The SNI must carry the domain name allocated by the platform.
- By default, each user can configure up to 10 custom authenticators.
- Max. processing time: 5 seconds. If the function does not return any result within 5 seconds, the authentication fails.
- For max. TPS of authentication requests of a user, see **Specifications**. The max. TPS of custom authentication is 50% of the total authentication TPS (excluding device self-registration).
- If you have enabled the function of caching FunctionGraph authentication results, the modification takes effect only after the cache expires.
- The custom authentication mode is preferentially used for device access if conditions are met, for example, the custom authenticator name carried by the device is matched or a default custom authenticator has been configured.

4.2.5.2 Usage

Process

Figure 4-7 Custom authentication process



Procedure

Step 1 Use **FunctionGraph** to create a custom authentication function.

Figure 4-8 Function list - Creating a function

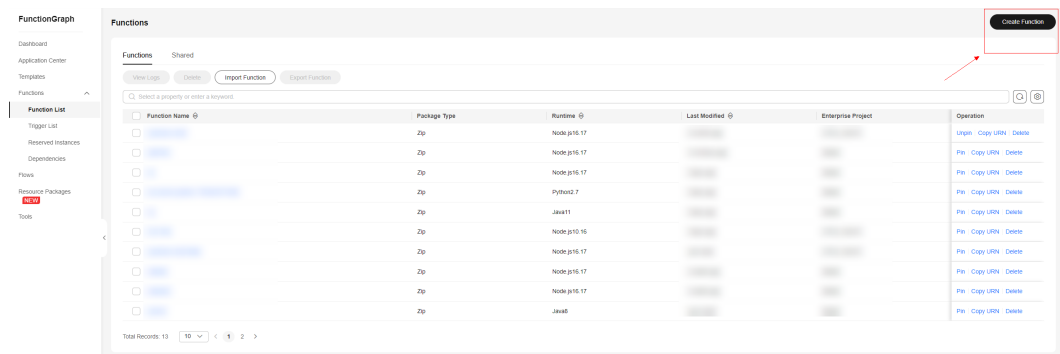
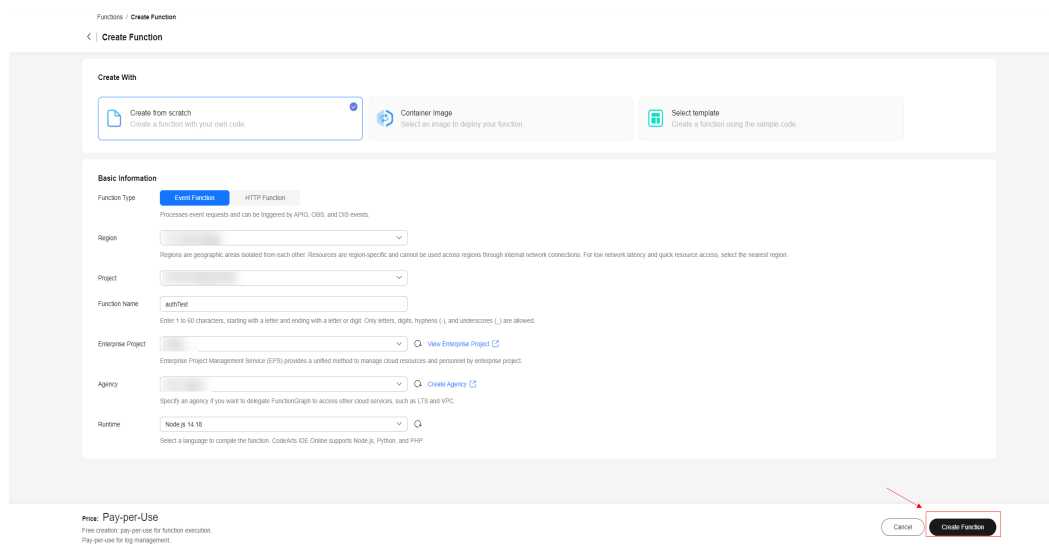


Figure 4-9 Creating a function - Parameters



Step 2 Configure custom authentication on the console for storage, management, and maintenance. You can configure up to 10 custom authenticators and choose one as the default.

Figure 4-10 Custom authentication - Creating an authenticator

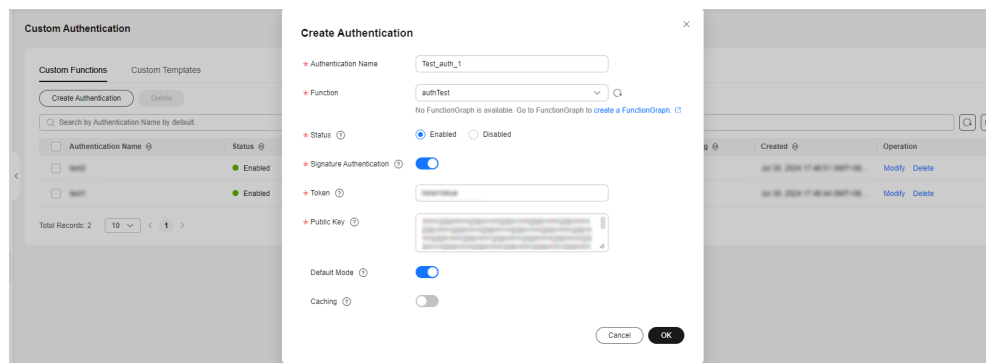


Table 4-2 Custom authentication parameters

| Parameter | Mandatory | Description |
|--------------------------|-----------|--|
| Authentication Name | Yes | Enter a custom authenticator name. |
| Function | Yes | Select the corresponding function from the list created with FunctionGraph in Step 1 . |
| Status | Yes | To use an authenticator, you must first enable it as it is disabled by default. |
| Signature Authentication | Yes | After this function is enabled (by default), authentication information that does not meet signature requirements will be rejected to reduce invalid function calls. |

| Parameter | Mandatory | Description |
|--------------|-----------|---|
| Token | No | Token for signature authentication. Used to check whether a device's signature information is valid. |
| Public Key | No | Public key for signature authentication. Used to check whether a device's signature information is valid. |
| Default Mode | Yes | After this function is enabled (disabled by default), if the username in an authentication request does not contain the authorizer_name parameter, this authenticator is used. |
| Caching | Yes | Whether to cache FunctionGraph authentication results (disabled by default). The cache duration ranges from 300 minutes to 1 day. |

Step 3 The device initiates a CONNECT request using MQTT. The request must carry the **username** parameter, which contains optional parameters related to custom authentication.

- Username format requirements: Remove braces ({}) and separate each parameter by a vertical bar (|). Do not add vertical bars (|) in the parameter content.

```
{device-identifier}|authorizer-name={authorizer-name}|authorizer-signature={token-signature}|signing-token={token-value}
```

 Example:

```
659b70a0bd3f665a471e5ec9_auth|authorizer-name=Test_auth_1|authorizer-signature=***|signing-token=tokenValue
```

Table 4-3 Description of the username parameter

| Parameter | Mandatory | Description |
|----------------------|-----------|--|
| device-identifier | Yes | Device identifier. You are advised to set it to the device ID. |
| authorizer-name | No | Custom authenticator name, which must be the same as the configured authenticator. If this parameter is not carried, the system will use either the default custom authenticator (if configured) or the original secret/certificate authentication mode. |
| authorizer-signature | No | This parameter is mandatory when the signature verification function is enabled. Obtain the value by encrypting the private key and signing-token. The value must be the same as the authentication name used in Step 2 . |
| signing-token | No | This parameter is mandatory when the signature verification function is enabled. The value is used for signature verification and must be the same as the token value used in Step 2 . |

- Run the following command to obtain authorizer-signature:
`echo -n {signing-token} | openssl dgst -sha256 -sign {private key} | openssl base64`

Table 4-4 Command parameters

| Parameter | Description |
|---|--|
| <code>echo -n {signing-token}</code> | Run the echo command to output the value of signing-token and use the -n parameter to remove the newline character at the end. The value of signing-token must be the same as that of the token in Step 2 . |
| <code>openssl dgst -sha256 -sign</code> | Hash the input data with the SHA-256 algorithm. |
| <code>{private key}</code> | Private key encrypted using the RSA algorithm. You can upload a private key file in .pem or .key format. |
| <code>openssl base64</code> | Encode the signature result using Base64 for transmission and storage. |

Step 4 When receiving an authentication request, IoTDA determines whether to use the custom authentication mode based on the username parameter and related configuration.

1. The system checks whether the username carries the custom authentication name. If yes, the authenticator processing function is matched based on the name. If no, the default custom authenticator is used to match the authentication processing function. If no matching is found, the original key/certificate authentication mode is used.
2. The system checks whether signature verification is enabled. If yes, the system checks whether the signature information carried in the username can be verified. If the verification fails, an authentication failure message is returned.
3. After the processing function is matched, the device authentication information (that is, the input parameter **event** of [Step 5](#)) is carried and an authentication request is sent to FunctionGraph through the function URN.

Step 5 Develop based on the processing function created with FunctionGraph in [Step 1](#). The function return result must meet the following requirements:

```
exports.handler = async (event, context) => {
  console.log("username=" + event.username);
  // Enter the validation logic.

  // Returned JSON format (fixed)
  const authRes = {
    "result_code": 200,
    "result_desc": "successful",
    "refresh_seconds": 300,
    "device": {
      "device_id": "myDeviceId",
      "provision_enable": true,
      "provisioning_resource": {
        "device_name": "myDeviceName",
        "node_id": "myNodeId",
```

```

        "product_id": "myProductId",
        "app_id": "customization000000000000000000",
        "policy_ids": ["657a4e0c2ea0cb2cd831d12a", "657a4e0c2ea0cb2cd831d12b"]
    }
}
}
return JSON.stringify(authRes);
}

```

Request parameters (**event**, in JSON format) of the function:

```

{
  "username": "myUserName",
  "password": "myPassword",
  "client_id": "myClientId",
  "certificate_info": {
    "common_name": "",
    "fingerprint": "123"
  }
}
}

```

Table 4-5 Request parameters

| Parameter | Type | Mandatory | Description |
|------------------|------------|-----------|---|
| username | String | Yes | The username field in the MQTT CONNECT message, the format of which is the same as that of the username field in Step 3 . |
| password | String | Yes | password parameter in the MQTT CONNECT message. |
| client_id | String | Yes | clientId parameter in the MQTT CONNECT message. |
| certificate_info | JsonObject | No | Device certificate information in the MQTT CONNECT message. |

Table 4-6 certificate_info: certificate information

| Parameter | Type | Mandatory | Description |
|-------------|--------|-----------|---|
| common_name | String | Yes | Common name parsed from the device certificate carried by the device. |
| fingerprint | String | Yes | Fingerprint information parsed from the device certificate carried by the device. |

Table 4-7 Returned parameter information

| Parameter | Type | Mandatory | Description |
|-----------------|------------|-----------|--|
| result_code | Integer | Yes | Authentication result code. If 200 is returned, the authentication is successful. |
| result_desc | String | No | Description of the authentication result. |
| refresh_seconds | Integer | No | Cache duration of the authentication result, in seconds. |
| device | JsonObject | No | Device information when the authentication is successful. When self-registration is enabled, the platform creates a device based on the device information provided if the corresponding device ID does not exist. |

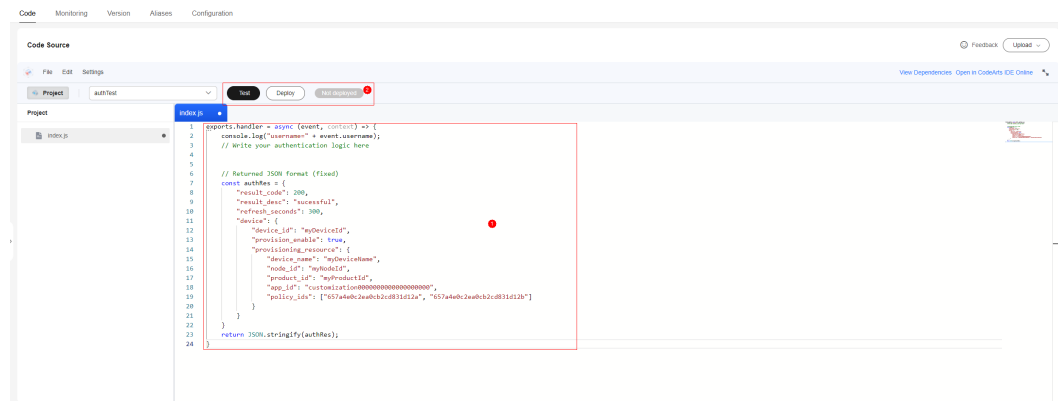
Table 4-8 Device information

| Parameter | Type | Mandatory | Description |
|-----------------------|------------|---|---|
| device_id | String | Yes | A globally unique device ID. This parameter is mandatory in both self-registration and non-self-registration scenarios. If this parameter is carried, the platform sets the device ID to the value of this parameter. Recommended format: <i>product_id</i> + _ + <i>node_id</i> . The value can contain up to 128 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed. You are advised to use at least 4 characters. |
| provision_enable | Boolean | No | Whether to enable self-registration. Default value: false . |
| provisioning_resource | JsonObject | Mandatory in the self-registration scenario | Self-registration parameters. |

Table 4-9 provisioning_resource self-registration parameters

| Parameter | Type | Mandatory | Description |
|-------------|--------------|-----------|---|
| device_name | String | No | Device name, which uniquely identifies a device in a resource space. The value can contain up to 256 characters. Only letters, digits, and special characters (_?#()., &%@!-) are allowed. You are advised to use at least 4 characters. Min. characters: 1 Max. characters: 256 |
| node_id | String | Yes | Device identifier. This parameter is set to the IMEI, MAC address, or serial number. It contains 1 to 64 characters (recommended length: 4), including letters, digits, hyphens (-), and underscores (_). (Note: Information cannot be modified once it is hardcoded to NB-IoT modules. Therefore, the node ID of an NB-IoT must be globally unique.) |
| product_id | String | Yes | Unique ID of the product associated with the device. The value is allocated by IoTDA after the product is created. The value can contain up to 256 characters. Only letters, digits, and special characters (_?#()., &%@!-) are allowed. You are advised to use at least 4 characters. Min. characters: 1 Max. characters: 256 |
| app_id | String | Yes | Resource space ID, which specifies the resource space to which the created device belongs. The value is a string of no more than 36 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed. |
| policy_ids | List<String> | No | Topic policy ID. |

Figure 4-11 Compiling a function - Deployment



Step 6 After receiving the result, FunctionGraph checks whether the self-registration is required. If yes, FunctionGraph triggers automatic device registration. By default, all self-registered devices are authenticated using secrets, which are randomly generated. After receiving the authentication result, IoTDA proceeds with the subsequent process.

----End

4.2.6 MQTT(S) Custom Template Authentication

4.2.6.1 Overview

Introduction

In addition to **the default authentication mode**, you can also use the **internal functions** provided by the platform to flexibly orchestrate authentication modes for devices connecting to the platform.

Application Scenarios

- Device migration from third-party IoT platforms to IoTDA: You can configure a custom template to be compatible with the original authentication mode. No modification is required on the device side.
- Native access: Custom templates can support more devices.

Constraints

1. The device must use TLS and support **SNI (Server Name Indication)**. The SNI must carry the domain name allocated by the platform.
2. Max. templates: five for a user. Only one template can be enabled at a time.
3. Max. functions nested: five layers.
4. Max. content length: 4,000 characters. Chinese character not allowed.
5. When the device uses secret authentication, the template password function must contain the original secret parameter (**iotda::device:secret**).
6. The format of the template authentication parameter **username** cannot be the same as that of the custom function authentication parameter **username**. Otherwise, the custom function authentication is used. For example:

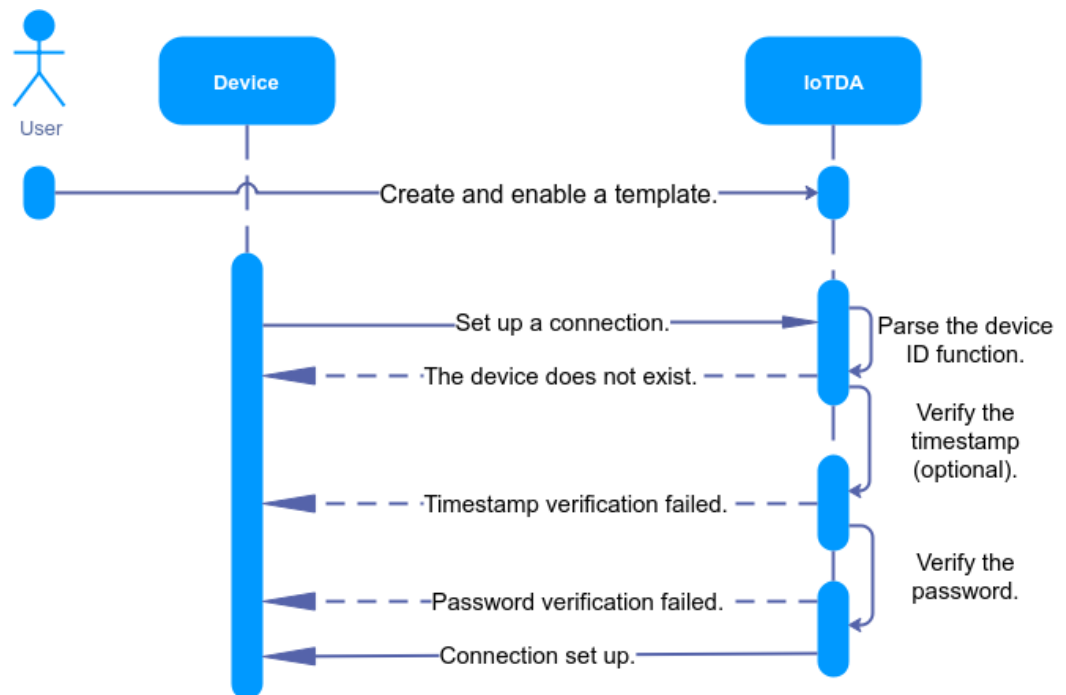
```
{deviceId}authorizer-name={authorizer-name}xxx
```

7. As custom authentication templates have higher priority, once you activate a custom authentication template, the platform uses the template instead of the default mode.

4.2.6.2 Usage

Process

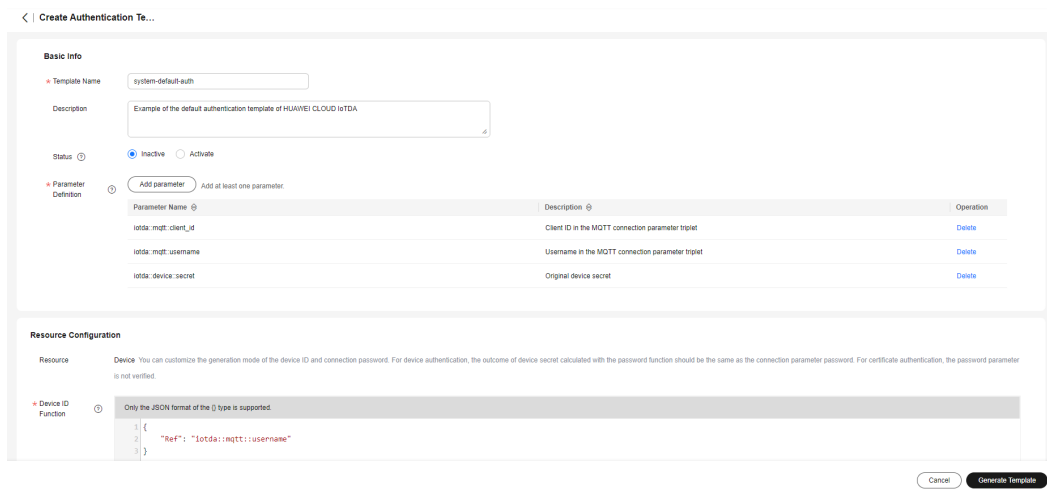
Figure 4-12 Process of authentication based on custom templates



Procedure

- Step 1** Create an authentication template. Specifically, log in to the IoTDA console, in the navigation pane, choose **Devices > Custom Authentication**, click **Custom Template**, and click **Create Template**. The authentication template used in this example is the same as that used in the [default authentication](#).

Figure 4-13 Custom authentication - Creating a template



The overall content of the template is as follows:

```
{
  "template_name": "system-default-auth",
  "description": "Example of the default authentication template of Huawei Cloud IoTDA",
  "status": "ACTIVE",
  "template_body": {
    "parameters": {
      "iotda::mqtt::client_id": {
        "type": "String"
      },
      "iotda::mqtt::username": {
        "type": "String"
      },
      "iotda::device::secret": {
        "type": "String"
      }
    },
    "resources": {
      "device_id": {
        "Ref": "iotda::mqtt::username"
      },
      "timestamp": {
        "type": "FORMAT",
        "pattern": "yyyyMMddHH",
        "value": {
          "Fn::SubStringAfter": [
            "${iotda::mqtt::client_id}",
            "_0_1_"
          ]
        }
      },
      "password": {
        "Fn::HmacSHA256": [
          "${iotda::device::secret}",
          {
            "Fn::SubStringAfter": [
              "${iotda::mqtt::client_id}",
              "_0_1_"
            ]
          }
        ]
      }
    }
  }
}
```

Table 4-10 Authentication template parameters

| Parameter | Name | Mandatory | Description |
|---------------|--------------------|-----------|--|
| template_name | Template name | Yes | Template name. The name must be unique for a single user. Max. length: 128 characters. Use only letters, digits, underscores (_), and hyphens (-). |
| description | Description | No | Template description. Max. length: 2,048 characters. Use only letters, digits, and special characters (_?#().,&%@!-). |
| status | Status | No | Template status. By default, a template is not enabled. A user can only have one enabled template at a time. |
| parameters | Parameter | Yes | <p>MQTT connection parameters predefined by the platform. When a device uses password authentication, the template must contain the original secret parameter (iotda::device:secret).</p> <p>The platform predefines the following parameters:</p> <p>iotda::mqtt::client_id: Client Id in the MQTT connection parameter triplet</p> <p>iotda::mqtt::username: User Name in the MQTT connection parameter triplet</p> <p>iotda::certificate::country: device certificate (country/region, C)</p> <p>iotda::certificate::organization: device certificate (organization, O)</p> <p>iotda::certificate::organizational_unit: device certificate (organization unit, OU)</p> <p>iotda::certificate::distinguished_name_qualifier: device certificate (distinguishable name qualifier, dnQualifier)</p> <p>iotda::certificate::state_name: device_certificate (province/city, ST)</p> <p>iotda::certificate::common_name: device certificate (common name, CN)</p> <p>iotda::certificate::serial_number: device certificate (serial number, serialNumber)</p> <p>iotda::device::secret: original secret of the device</p> |
| device_id | Device ID function | Yes | Function for obtaining the device ID, in JSON format. The platform parses this function to obtain the corresponding device information. |

| Parameter | Name | Mandatory | Description |
|-----------|------------------------|-----------|---|
| timestamp | Timestamp verification | No | Whether to verify the timestamp in the device connection information. Recommended: Enable this function if the device connection parameters (clientId and username) contain the timestamp. Verification process: The platform compares the timestamp carried by the device with the platform system time. If the timestamp plus 1 hour is less than the platform system time, the verification fails. |
| type | Timestamp type | No | UNIX : Unix timestamp. Long integer, in seconds. FORMAT : formatted timestamp, for example, 2024-03-28 11:47:39 or 2024/03/28 03:49:13 . |
| pattern | Timestamp format | No | Time format template. Mandatory when the timestamp type is FORMAT . y : year M : month d : day H : hour m : minute s : second S : millisecond Example: yyyy-MM-dd HH:mm:ss and yyyy/MM/dd HH:mm:ss |
| value | Timestamp function | No | Function for obtaining the timestamp when the device establishes a connection. Mandatory when timestamp verification is enabled. |

| Parameter | Name | Mandatory | Description |
|-----------|------------------------|-----------|---|
| password | MQTT password function | No | Password function. Mandatory when the device authentication type is secret authentication. The template parameters must contain the original device secret parameter (iotda::device:secret). For details about the device authentication type, see Registering an Individual Device . Verification process: The platform uses parameters such as the original secret of the device in the function to calculate. If the result is the same as the password carried in the connection establishment request, the authentication is successful. Otherwise, the authentication fails. |

Step 2 Select a device debugging template. Specifically, click **Debug**, select a device for debugging, enter MQTT connection parameters, and click **Debug** to view the result. Note: If **clientId** in the standard format is used, the platform verifies whether the value of **username** is the same as the prefix of **clientId**.

Figure 4-14 Custom template - Debugging

✕

Debug Authentication Template

Test Data

* Device ID [Modify](#)

* clientId

* username

* password

Test Results [Clear](#)

[Success]: [Jul 05, 2024 15:32:10 GMT+08:00]Authentication template debugged.

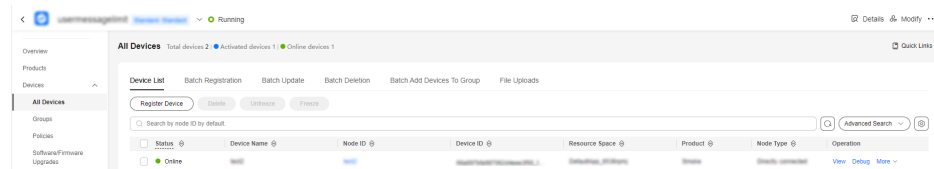
[Debug](#)

After the device debugging is successful, click **Enable** to enable the template. Once the template is enabled, it will be used for authentication of all devices, and the enabled template cannot be modified. You are advised to create a backup template for debugging, and switch to the backup template only when the debugging succeeds.

Step 3 Use the MQTT.fx tool to simulate device connection setup. Set **Broker Address** to [the platform access address](#), choose **Overview > Access Information**, and set port to **8883**.

Figure 4-15 Device connection establishment

Figure 4-16 Device list - Device online status



----End

4.2.6.3 Examples

Example 1

When a certificate is used to authenticate a device, the values of **UserName** and **ClientId** are not limited. The device ID is obtained from the common name of the device certificate.

Table 4-11 Authentication parameters

| Parameter | Description |
|-----------|-------------|
| Client ID | Any value |
| User Name | Any value |
| Password | Empty value |

Authentication template:

```
{
  "template_name": "template1",
  "description": "template1",
  "template_body": {
    "parameters": {
      "iotda::certificate::common_name": {
        "type": "String"
      }
    }
  }
}
```

```

    },
    "resources": {
      "device_id": {
        "Ref": "iotda::certificate::common_name"
      }
    }
  }
}

```

Example 2

Device ID format: $\${ProductId}_{NodeId}$

Table 4-12 Authentication parameters

| Parameter | Description |
|-----------|---|
| Client ID | Fixed format: $\${ClientId}\securemode=2,signmethod=hmacsha256 timestamp=\${timestamp}$ <ul style="list-style-type: none"> $\\${ClientId}$ (fixed format): $\\${ProductId}\.\\${NodeId}$ <ul style="list-style-type: none"> $\\${NodeId}$: device node ID $\\${ProductId}$: product ID $\\${timestamp}$: Unix timestamp, in milliseconds |
| User Name | Fixed format: $\${NodeId}\&\${ProductId}$ |
| Password | Result value after encrypting the combination of device parameter and parameter value, with the device password as the key and HMAC-SHA256 algorithm as the tool. Encryption string format: $clientId\${clientId}deviceName\${nodeId}productKey\${productId}timestamp\${timestamp}$ <ul style="list-style-type: none"> $\\${ClientId}$ (fixed format): $\\${ProductId}\.\\${NodeId}$. $\\${NodeId}$: device node ID $\\${ProductId}$: product ID $\\${timestamp}$: timestamp |

Authentication template:

```

{
  "template_name": "template2",
  "description": "template2",
  "template_body": {
    "parameters": {
      "iotda::mqtt::client_id": {
        "type": "String"
      },
      "iotda::mqtt::username": {
        "type": "String"
      },
      "iotda::device::secret": {
        "type": "String"
      }
    }
  },
  "resources": {

```


Example 3

Device ID format: $\${productId}\${nodeId}$

Table 4-13 Parameter

| Parameter | Description |
|-----------|--|
| Client ID | Fixed format: $\${productId}\${nodeId}$ <ul style="list-style-type: none">• $\\${productId}$: product ID• $\\${nodeId}$: node ID |
| User Name | Fixed format: $\${productId}\${nodeId};12010126;\${connid};\${expiry}$ <ul style="list-style-type: none">• $\\${productId}$: product ID• $\\${nodeId}$: node ID• $\\${connid}$: random string• $\\${expiry}$: Unix timestamp, in seconds |
| Password | Fixed format: $\${token};hmacsha256$ <ul style="list-style-type: none">• $\\${token}$: result value after encrypting the User Name field, with the HMAC-SHA256 algorithm as the tool and the Base64-decoded device password as the key. |

Authentication template:

```
{
  "template_name": "template3",
  "description": "template3",
  "template_body": {
    "parameters": {
      "iotda::mqtt::client_id": {
        "type": "String"
      },
      "iotda::mqtt::username": {
        "type": "String"
      },
      "iotda::device::secret": {
        "type": "String"
      }
    },
    "resources": {
      "device_id": {
        "Ref": "iotda::mqtt::client_id"
      },
      "timestamp": {
        "type": "UNIX",
        "value": {
          "Fn::ParseLong": {
            "Fn::SplitSelect": ["${iotda::mqtt::username}", ";", 3]
          }
        }
      },
      "password": {
        "Fn::Sub": [
          "${token};hmacsha256",

```

```

{
  "token": {
    "Fn::HmacSHA256": [
      "${iotda::mqtt::username}",
      {
        "Fn::Base64Decode": "${iotda::device::secret}"
      }
    ]
  }
}

```

4.2.6.4 Internal Functions

Description

Huawei Cloud IoTDA provides multiple internal functions to use in templates. This section introduces these functions, including the input parameter type, parameter length, and return value type.

NOTE

- The entire function must be in valid JSON format.
- In a function, the variable placeholders (`${}`) or the **Ref** function can be used to reference the value defined by the input parameter.
- The parameters used by the function must be declared in the template.
- A function with a single input parameter is followed by a parameter, for example, `"Fn::Base64Decode": "${iotda::mqtt::username}"`.
- A function with multiple input parameters is followed by an array, for example, `"Fn::HmacSHA256": ["${iotda::mqtt::username}", "${iotda::device::secret}"]`.
- Functions can be nested. That is, the parameter of a function can be another function. Note that the return value of a nested function must match its parameter type in the outer function, for example, `{"Fn::HmacSHA256": [{"Fn::Base64Encode": "${iotda::device::secret}"}]}`.

Fn::ArraySelect

The internal function **Fn::ArraySelect** returns a string element whose index is **index** in a string array.

JSON

```
{"Fn::ArraySelect": [index, [StringArray]]}
```

Table 4-14 Parameters

| Parameter | Type | Description |
|---------------|----------|---|
| index | int | Index of an array element. The value is an integer and starts from 0. |
| StringArray | String[] | String array element. |
| Return values | String | Element whose index is index . |

Example:

```
{
  "Fn::ArraySelect": [1, ["123", "456", "789"]]
}
return: "456"
```

Fn::Base64Decode

The internal function **Fn::Base64Decode** decodes a string into a byte array using Base64.

JSON

```
{ "Fn::Base64Decode": "content" }
```

Table 4-15 Parameters

| Parameter | Type | Description |
|---------------|--------|----------------------------|
| content | String | String to be decoded. |
| Return Values | byte[] | Base64-decoded byte array. |

Example:

```
{
  "Fn::Base64Decode": "123456"
}
return: d76df8e7 // The value is converted into a hexadecimal string for display.
```

Fn::Base64Encode

The internal function **Fn::Base64Encode** encodes a string using Base64.

JSON

```
{ "Fn::Base64Encode": "content" }
```

Table 4-16 Parameters

| Parameter | Type | Description |
|---------------|--------|------------------------|
| content | String | String to be encoded. |
| Return Values | String | Base64-encoded string. |

Example:

```
{
  "Fn::Base64Encode": "testvalue"
}
return: "dGVzdHZhbHVl"
```

Fn::GetBytes

The internal function **Fn::GetBytes** returns a byte array encoded from a string using UTF-8.

JSON

```
{"Fn::GetBytes": "content"}
```

Table 4-17 Parameters

| Parameter | Type | Description |
|---------------|--------|---|
| content | String | String to be encoded. |
| Return Values | byte[] | Byte array converted from a string encoded using UTF-8. |

Example:

```
{  
  "Fn::GetBytes": "testvalue"  
}  
return: "7465737476616c7565" // The value is converted into a hexadecimal string for display.
```

Fn::HmacSHA256

The internal function **Fn::HmacSHA256** encrypts a string using the HMACSHA256 algorithm based on a given secret.

JSON

```
{"Fn::HmacSHA256": ["content", "secret"]}
```

Table 4-18 Parameters

| Parameter | Type | Description |
|---------------|------------------|--|
| content | String | String to be encrypted. |
| secret | String or byte[] | Secret key, which can be a string or byte array. |
| Return Values | String | Value encrypted using the HMACSHA256 algorithm. |

Example:

```
{  
  "Fn::HmacSHA256": ["testvalue", "123456"]  
}  
return: "0f9fb47bd47449b6ffac1be951a5c18a7eff694940b1a075b973ff9054a08be3"
```

Fn::Join

The internal function **Fn::Join** can concatenate up to 10 strings into one string.

JSON

```
{"Fn::Join": ["element", "element"...]}
```

Table 4-19 Parameters

| Parameter | Type | Description |
|---------------|--------|--|
| element | String | String to be concatenated. |
| Return Values | String | String obtained by concatenating substrings. |

Example:

```
{  
  "Fn::Join": ["123", "456", "789"]  
}  
return: "123456789"
```

Fn::MathAdd

The internal function **Fn::MathAdd** performs mathematical addition on two integers.

JSON

```
{"Fn::MathAdd": [X, Y]}
```

Table 4-20 Parameters

| Parameter | Type | Description |
|---------------|------|-----------------|
| X | long | Augend. |
| Y | long | Addend. |
| Return Values | long | Sum of X and Y. |

Example:

```
{  
  "Fn::MathAdd": [1, 1]  
}  
return: 2
```

Fn::MathDiv

The internal function **Fn::MathDiv** performs a mathematical division on two integers.

JSON

```
{"Fn::MathDiv": [X, Y]}
```


Table 4-21 Parameters

| Parameter | Type | Description |
|---------------|------|--------------------------|
| X | long | Dividend. |
| Y | long | Divisor. |
| Return Values | long | Value of X divided by Y. |

Example:

```
{
  "Fn::MathDiv": [10, 2]
}
return: 5

{
  "Fn::MathDiv": [10, 3]
}
return: 3
```

Fn::MathMod

The internal function **Fn::MathMod** performs the mathematical modulo on two integers.

JSON

```
{"Fn::MathMod": [X, Y]}
```

Table 4-22 Parameters

| Parameter | Type | Description |
|---------------|------|------------------------|
| X | long | Dividend. |
| Y | long | Divisor. |
| Return Values | long | Residue of X modulo Y. |

Example:

```
{
  "Fn::MathMod": [10, 3]
}
return: 1
```

Fn::MathMultiply

The internal function **Fn::MathMultiply** performs mathematical multiplication on two integers.

JSON

```
{"Fn::MathMultiply": [X, Y]}
```

Table 4-23 Parameters

| Parameter | Type | Description |
|---------------|------|-----------------------------|
| X | long | Multiplicand. |
| Y | long | Multiplier. |
| Return Values | long | Value of X multiplied by Y. |

Example:

```
{
  "Fn::MathMultiply": [3, 3]
}
return: 9
```

Fn::MathSub

The internal function **Fn::MathSub** performs mathematical subtraction on two integers.

JSON

```
{"Fn::MathSub": [X, Y]}
```

Table 4-24 Parameters

| Parameter | Type | Description |
|---------------|------|---------------------|
| X | long | Minuend. |
| Y | long | Subtrahend. |
| Return Values | long | Value of X minus Y. |

Example:

```
{
  "Fn::MathSub": [9, 3]
}
return: 6
```

Fn::ParseLong

The internal function **Fn::ParseLong** can convert a numeric string into an integer.

JSON

```
{"Fn::ParseLong": "String"}
```

Table 4-25 Parameters

| Parameter | Type | Description |
|---------------|--------|---|
| String | String | String to be converted. |
| Return Values | long | Value obtained after a string is converted into an integer. |

Example:

```
{
  "Fn::ParseLong": "123"
}
return: 123
```

Fn::Split

The internal function **Fn::Split** splits a string into a string array based on the specified separator.

JSON

```
{ "Fn::Split" : ["String", "Separator"] }
```

Table 4-26 Parameters

| Parameter | Type | Description |
|---------------|----------|--|
| String | String | String to be split. |
| Separator | String | Separator. |
| Return Values | String[] | String array obtained after String is split by Separator . |

Example:

```
{
  "Fn::Split": ["a|b|c", "|"]
}
return: ["a", "b", "c"]
```

Fn::SplitSelect

The internal function **Fn::SplitSelect** splits a string into a string array based on the specified separator, and then returns the elements of the specified index in the array.

JSON

```
{ "Fn::SplitSelect" : ["String", "Separator", index] }
```

Table 4-27 Parameters

| Parameter | Type | Description |
|---------------|--------|--|
| String | String | String to be split. |
| Separator | String | Separator. |
| index | int | Index value of the target element in the array, starting from 0. |
| Return Values | String | Substring of the specified index after a string is split by the specified separator. |

Example:

```
{
  "Fn::SplitSelect": ["abc", "|", 1]
}
return: "b"
```

Fn::Sub

The internal function **Fn::Sub** replaces variables in an input string with specified values. You can use this function in a template to construct a dynamic string.

JSON

```
{ "Fn::Sub" : [ "String", { "Var1Name": Var1Value, "Var2Name": Var2Value } ] }
```

Table 4-28 Parameters

| Parameter | Type | Description |
|---------------|--------|---|
| String | String | A string that contains variables. Variables are defined using placeholders (<code>{}</code>). |
| VarName | String | Variable name, which must be defined in the String parameter. |
| VarValue | String | Variable value. Function nesting is supported. |
| Return Values | String | Value of string after replacement in the original String parameter |

Example:

```
{
  "Fn::Sub": ["${token};hmacsha256", {
    "token": {
      "Fn::HmacSHA256": ["${iotda::mqtt::username}", {
        "Fn::Base64Decode": "${iotda::mqtt::client_id}"
      }]
    }
  }
}
```

```

    ]]
  }
  If:
  ${iotda::mqtt::username}="test_device_username"
  ${iotda::device::client_id}="OozqTPlCWTTJJEH/5s+T6w=="
  return: "0773c4fd6c92902a1b2f4a45fdcdec416b6fc2bc6585200b496e460e2ef31c3d"

```

Fn::SubStringAfter

The internal function **Fn::SubStringAfter** truncates the substring after the specified separator in a string.

JSON

```
{ "Fn::SubStringAfter" : ["content", "separator"] }
```

Table 4-29 Parameters

| Parameter | Type | Description |
|---------------|--------|--|
| content | String | String to be truncated. |
| separator | String | Separator. |
| Return Values | String | Substring after the specified separator that separates the string. |

Example:

```

{
  "Fn::SubStringAfter": ["content:123456", ":"]
}
return: "123456"

```

Fn::SubStringBefore

The internal function **Fn::SubStringBefore** truncates the substring before the specified separator in a string.

JSON

```
{ "Fn::SubStringBefore" : ["content", "separator"] }
```

Table 4-30 Parameters

| Parameter | Type | Description |
|---------------|--------|---|
| content | String | String to be truncated. |
| separator | String | Separator. |
| Return Values | String | Substring before the specified separator that separates the string. |

Example:

```
{
  "Fn::SubStringBefore": ["content:123456", ":", ""]
}
return: "content"
```

Ref

The internal function **Ref** returns the value of the specified referenced parameter. The referenced parameter must be declared in the template.

JSON

```
{ "Ref" : "paramName" }
```

Table 4-31 Parameters

| Parameter | Type | Description |
|---------------|--------|------------------------------------|
| paramName | String | Name of the referenced parameter. |
| Return Values | String | Value of the referenced parameter. |

Example:

```
{
  "Ref": "iotda::mqtt::username"
}
When iotda::mqtt::username="device_123"
return: "device_123"
```

4.3 Open Protocol Access

4.3.1 LwM2M/CoAP Access

Overview

LwM2M, proposed by the Open Mobile Alliance (OMA), is a lightweight, standard, and universal IoT device management protocol that can be used to quickly deploy IoT services in client/server mode. LwM2M establishes a set of standards for IoT device management and application. It provides lightweight, compact, and secure communication interfaces and efficient data models for M2M device management and service support. IoTDA supports encrypted and non-encrypted access. Port 5684 and CoAP over DTLS are used for encrypted service data exchange and access. Port 5683 and CoAP are used for non-encrypted access. You are advised to use the encrypted access mode for security purposes.

NOTE

For details about LwM2M syntax and APIs, see [specifications](#).

IoTDA supports the plain text, opaque, Core Link, TLV, and JSON encoding formats specified in the protocol. In the multi-field operation (for example, writing multiple resources), the TLV format is used by default.

Constraints

Table 4-32 Constraints

| Description | Limit |
|---|--|
| Supported LwM2M version | 1.1 |
| Supported DTLS version | DTLS 1.2 |
| Supported cryptographic algorithm suite | TLS_PSK_WITH_AES_128_CCM_8 and TLS_PSK_WITH_AES_128_CBC_SHA256 |
| Body length | 1 KB |
| API specifications | Specifications |

API Calling

For details about the platform endpoint, see [Platform Connection Information](#).

NOTE

Use the endpoint corresponding to CoAP (5683) or CoAPS (5684) and port 5683 (non-encrypted) or 5684 (encrypted) for device access.

4.3.2 HTTPS Access

Overview

Hypertext Transfer Protocol Secure (HTTPS) is a secure communication protocol based on HTTP and encrypted using SSL. IoTDA supports communication through HTTPS.

Constraints

| Description | Limit |
|------------------------|--|
| Supported HTTP version | HTTP 1.0 HTTP 1.1 |
| Supported HTTPS | The platform supports only the HTTPS protocol. For details about how to download a certificate, see Certificates . |
| Supported TLS version | TLS 1.2 |
| Body length | 1 MB |
| API specifications | Specifications |

| Description | Limit |
|--|-------|
| Number of child devices of which properties can be reported by a gateway at a time | 50 |

API Calling

For details about the platform endpoint, see [Platform Connection Information](#).

NOTE

Use the endpoint of IoTDA and the HTTPS port number 443.

Communication Between HTTPS Devices and the Platform

When a device connects to the platform through HTTPS, HTTPS APIs are used for their communication. These APIs can be used for device authentication as well as message and property reporting.

| Message Type | Description |
|--|---|
| Device authentication | Devices obtain access tokens. |
| Device reporting properties | Devices report property data to IoTDA in the format defined in the product model. |
| Device reporting messages | Devices report custom data to IoTDA, which then forwards reported messages to an application or other Huawei Cloud services for storage and processing. |
| Gateway reporting device properties in batches | A gateway reports property data of multiple child devices to the platform. |

Service Flow

- Step 1** Create a product on the IoTDA console or by calling the API for [creating a product](#).
- Step 2** Register a device on the [IoTDA console](#) or calling the API for [creating a device](#).
- Step 3** Call the device authentication API to obtain the access token of the device.

HTTP APIs

The following table describes the platform APIs.

| API Category | API | API | Description |
|--------------------------------|--|---|---|
| Device authentication API | Device Authentication API | /v5/device-auth | This API is used to authenticate a device. Connections can be established between devices and IoTDA after successful authentication. After the authentication is successful, IoTDA returns an access token. An access token is required when APIs for property reporting and message reporting are called. If an access token expires, you need to authenticate the device again to obtain an access token. If you obtain a new access token before the old one expires, the old access token will be valid for 30 seconds before expiration. |
| Device message reporting API | Device Message Reporting | /v5/devices/{device_id}/sys/messages/up | This API is used by a device to report custom data to IoTDA, which then forwards reported messages to an application or other Huawei Cloud services for storage and processing. |
| Device property reporting APIs | Device Property Reporting | /v5/devices/{device_id}/sys/properties/report | This API is used by a device to report property data in the format defined in the product model to IoTDA. |
| | Gateway Reporting Child Device Property | /v5/devices/{device_id}/sys/gateway/sub-devices/properties/report | This API is used to report device data in batches to IoTDA. A gateway can use this API to report the property data of a maximum of 50 child devices at the same time. |

Device Authentication API

This API is used to authenticate a device. After successful authentication, connections can be established between devices and IoTDA, and the platform

returns an access token. The access token is required when APIs for property reporting and message reporting are called. If an access token expires, you need to authenticate the device again to obtain an access token. If you obtain a new access token before the old one expires, the old access token will be valid for 30 seconds before expiration.

| | |
|---------------------------|-----------------|
| Request Method | POST |
| URI | /v5/device-auth |
| Transport Protocol | HTTPS |

| Parameter | Mandatory | Type | Location | Description |
|-----------|-----------|---------|----------|--|
| device_id | Yes | String | Body | Device ID, which uniquely identifies a device. The value of this parameter is specified during device registration or allocated by IoTDA. If the value is allocated by the platform, the value is in the format of <i>[product_id]_[node_id]</i> . The value is a string of no more than 128 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed. Value length: 1 to 128 characters |
| sign_type | Yes | Integer | Body | Password verification mode. 0 : When the timestamp is verified using the HMAC-SHA256 algorithm, IoTDA does not check whether the message timestamp is consistent with the IoTDA time but only checks whether the password is correct. 1 : When the timestamp is verified using the HMAC-SHA256 algorithm, IoTDA checks whether the message timestamp is consistent with the IoTDA time and then checks whether the password is correct. Value range: 0 to 1 |

| Parameter | Mandatory | Type | Location | Description |
|-----------|-----------|--------|----------|---|
| timestamp | Yes | String | Body | The timestamp is the UTC time when the device was connected to IoTDA, in the format of YYYYMMDDHH. For example, if the UTC time is 2018/7/24 17:56:20, the timestamp is 2018072417 . Value length: a fixed length of 10 characters |
| password | Yes | String | Body | The value of this parameter is the value of the device secret signed by using the HMAC-SHA256 algorithm with the timestamp as the key. For details, see the secret generation tool . The device secret is returned by IoTDA upon successful device registration. Value length: a fixed length of 64 characters |

| Parameter | Type | Description |
|--------------|---------|--|
| access_token | String | Device token, which is used for device authentication. Value length: 32 to 256 characters |
| expires_in | Integer | Remaining validity period of the authentication information, in seconds. |

Request example:

```
POST https://{endpoint}/v5/device-auth
Content-Type: application/json
```

```
{
  "device_id" : "*****",
  "sign_type" : 0,
  "timestamp" : "2019120219",
  "password" : "*****"
}
```

Response example:

Status Code: 200 OK

```
Content-Type: application/json
```

```
{
```

```
"access_token" : "*****",
"expires_in" : 86399
}
```

| HTTP Status Code | Description | Error Code | Error Message | Error Description |
|------------------|--------------|--------------|---|--|
| 200 | OK | - | - | - |
| 400 | Bad Request | IOTDA.00006 | Invalid input data. | Invalid request parameters. |
| 401 | Unauthorized | IOTDA.00002 | Authentication failed. | Authentication failed. |
| 403 | Forbidden | IOTDA.021101 | Request reached the maximum rate limit. | The request frequency has reached the upper limit. |
| | | IOTDA.021102 | The request rate has reached the upper limit of the tenant, limit %s. | The request frequency has reached the upper limit of the tenant. |

Device Message Reporting

This API is used by a device to report custom data to IoTDA, which then forwards reported messages to an application or other Huawei Cloud services for storage and processing.

| | |
|---------------------------|---|
| Request Method | POST |
| URI | /v5/devices/{device_id}/sys/messages/up |
| Transport Protocol | HTTPS |

| Parameter | Mandatory | Type | Location | Description |
|--------------|-----------|--------|----------|---|
| access_token | Yes | String | Header | Access token returned after the device authentication API is called. Value length: 1 to 256 characters |

| Parameter | Mandatory | Type | Location | Description |
|-----------|-----------|--------|----------|--|
| device_id | Yes | String | Path | <p>Device ID, which uniquely identifies a device. The value of this parameter is specified during device registration or allocated by IoTDA. If the value is allocated by the platform, the value is in the format of <i>[product_id]_[node_id]</i>.</p> <p>The value is a string of no more than 128 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed.</p> <p>Value length: 1 to 128 characters</p> |

 **NOTE**

This API allows a device to use a request body to report custom data to IoTDA, which then forwards the body content to applications or other Huawei Cloud services for storage and processing. IoTDA has no specific format requirements on the body content. This API can carry data whose size is smaller than 1 MB.

Request example:

```
POST https://{endpoint}/v5/devices/{device_id}/sys/messages/up
Content-Type: application/json
access_token: *****
{
  "name" : "name",
  "id" : "id",
  "content" : "messageUp"
}
```

Response example:

Status Code: 200 ok

| HTTP Status Code | Description | Error Code | Error Message | Error Description |
|------------------|--------------|-------------|------------------------|-----------------------------|
| 200 | OK | - | - | - |
| 400 | Bad Request | IOTDA.00006 | Invalid input data. | Invalid request parameters. |
| 401 | Unauthorized | IOTDA.00002 | Authentication failed. | Authentication failed. |
| 403 | Forbidden | IOTDA.00004 | Invalid access token. | Invalid token. |

| HTTP Status Code | Description | Error Code | Error Message | Error Description |
|------------------|-------------|---------------|---|--|
| | | IOTDA.0 21101 | Request reached the maximum rate limit. | The request frequency has reached the upper limit. |
| | | IOTDA.0 21102 | The request rate has reached the upper limit of the tenant, limit %s. | The request frequency has reached the upper limit of the tenant. |

Device Property Reporting

This API is used by a device to report property data in the format defined in the product model to IoTDA.

| | |
|---------------------------|---|
| Request Method | POST |
| URI | /v5/devices/{device_id}/sys/properties/report |
| Transport Protocol | HTTPS |

| Parameter | Mandatory | Type | Location | Description |
|--------------|-----------|--------|----------|--|
| access_token | Yes | String | Header | Access token returned after the device authentication API is called. Value length: 1 to 256 characters |
| device_id | Yes | String | Path | Device ID, which uniquely identifies a device. The value of this parameter is specified during device registration or allocated by IoTDA. If the value is allocated by the platform, the value is in the format of <i>[product_id]_[node_id]</i> . The value is a string of no more than 128 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed. Value length: 1 to 128 characters |

| Parameter | Mandatory | Type | Location | Description |
|-----------|-----------|------------------------------------|----------|---------------------------|
| services | Yes | List< Table 4-33 > | Body | Device service data list. |

Table 4-33 ServiceProperty

| Parameter | Mandatory | Type | Description |
|------------|-----------|--------|--|
| service_id | Yes | String | Service ID of the device. |
| properties | Yes | Object | Service properties, which are defined in the product model of the device. |
| event_time | No | String | UTC time when the device collects data. The value is in the format of yyyy-MM-dd'T'HH:mm:ss.SSS'Z'. If this parameter is not carried in the reported data or is in an incorrect format, the time when IoTDA receives the data is used. |

Example request:

```
POST https://{endpoint}/v5/devices/{device_id}/sys/properties/report
Content-Type: application/json
access_token: *****

{
  "services": [ {
    "service_id": "serviceId",
    "properties": {
      "Height": 124,
      "Speed": 23.24
    },
    "event_time": "2021-08-13T10:10:10.555Z"
  } ]
}
```

Response example:

If the status code is 200, reporting is successful.

| HTTP Status Code | Description | Error Code | Error Message | Error Description |
|------------------|-------------|-------------|---------------------|-----------------------------|
| 200 | OK | - | - | - |
| 400 | Bad Request | IOTDA.00006 | Invalid input data. | Invalid request parameters. |

| HTTP Status Code | Description | Error Code | Error Message | Error Description |
|------------------|-------------|---------------|---|---|
| | | IOTDA.0 21104 | Subdevices in the request does not exist or does not belong to the gateway. | Some child devices in the request do not exist or do not belong to the gateway. |
| 403 | Forbidden | IOTDA.0 00004 | Invalid access token. | Invalid token. |
| | | IOTDA.0 21101 | Request reached the maximum rate limit. | The request frequency has reached the upper limit. |
| | | IOTDA.0 21102 | The request rate has reached the upper limit of the tenant, limit %s. | The request frequency has reached the upper limit of the tenant. |
| | | IOTDA.0 21105 | The content reported in a single request cannot exceed 1 MB. | The content reported in a single request cannot exceed 1 MB. |

Gateway Reporting Child Device Property

This API is used to report device data in batches to IoTDA. A gateway can use this API to report the property data of a maximum of 50 child devices at the same time.

| | |
|---------------------------|---|
| Request Method | POST |
| URI | /v5/devices/{device_id}/sys/gateway/sub-devices/properties/report |
| Transport Protocol | HTTPS |

| Parameter | Mandatory | Type | Location | Description |
|--------------|-----------|--------|----------|---|
| access_token | Yes | String | Header | Access token returned after the device authentication API is called. Value length: 1 to 256 characters |

| Parameter | Mandatory | Type | Location | Description |
|-----------|-----------|------------------------------------|----------|--|
| device_id | Yes | String | Path | Device ID, which uniquely identifies a device. The value of this parameter is specified during device registration or allocated by IoTDA. If the value is allocated by the platform, the value is in the format of <i>[product_id]_[node_id]</i> . The value is a string of no more than 128 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed. Value length: 1 to 128 characters |
| devices | Yes | List< Table 4-34 > | Body | Device data list. Value length: 50 characters at most |

Table 4-34 DeviceProperty

| Parameter | Mandatory | Type | Description |
|-----------|-----------|------------------------------------|--|
| device_id | Yes | String | ID of the child device, which is unique and is allocated by IoTDA during device registration. The value is a string of no more than 128 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed. |
| services | Yes | List< Table 4-35 > | Device service data list. |

Table 4-35 ServiceProperty

| Parameter | Mandatory | Type | Description |
|------------|-----------|--------|---|
| service_id | Yes | String | Service ID of the device. |
| properties | Yes | Object | Service properties, which are defined in the product model of the device. |

| Parameter | Mandatory | Type | Description |
|------------|-----------|--------|--|
| event_time | No | String | UTC time when the device collects data. The value is in the format of yyyy-MM-dd'T'HH:mm:ss.SSS'Z'. If this parameter is not carried in the reported data or is in an incorrect format, the time when IoTDA receives the data is used. |

An example request is as follows:

```
POST https://{endpoint}/v5/devices/{device_id}/sys/gateway/sub-devices/properties/report
Content-Type: application/json
access_token: *****

{
  "devices" : [ {
    "device_id" : "deviceid_0001",
    "services" : [ {
      "service_id" : "serviceid",
      "properties" : {
        "Height" : 124,
        "Speed" : 23.24
      },
      "event_time" : "2021-08-13T10:10:10.555Z"
    } ]
  }, {
    "device_id" : "deviceid_0002",
    "services" : [ {
      "service_id" : "serviceid",
      "properties" : {
        "Height" : 124,
        "Speed" : 23.24
      },
      "event_time" : "2021-08-13T10:10:10.555Z"
    } ]
  } ]
}
```

Response example:

If the status code is 200, reporting is successful.

| HTTP Status Code | Description | Error Code | Error Message | Error Description |
|------------------|-------------|--------------|---|---|
| 200 | OK | - | - | - |
| 400 | Bad Request | IOTDA.00006 | Invalid input data. | Invalid request parameters. |
| | | IOTDA.021104 | Subdevices in the request does not exist or does not belong to the gateway. | Some child devices in the request do not exist or do not belong to the gateway. |

| HTTP Status Code | Description | Error Code | Error Message | Error Description |
|------------------|--------------|--------------|--|---|
| 401 | Unauthorized | IOTDA.00002 | Authentication failed. | Authentication failed. |
| 403 | Forbidden | IOTDA.00004 | Invalid access token. | Invalid token. |
| | | IOTDA.021101 | Request reached the maximum rate limit. | The request frequency has reached the upper limit. |
| | | IOTDA.021102 | The request rate has reached the upper limit of the tenant, limit %s. | The request frequency has reached the upper limit of the tenant. |
| | | IOTDA.021103 | The number of child devices in the request has reached the upper limit (%s). | The number of child devices in the request reaches the upper limit. |
| | | IOTDA.021105 | The content reported in a single request cannot exceed 1 MB. | The content reported in a single request cannot exceed 1 MB. |

4.3.3 MQTT(S) Access

Overview

An MQTT message consists of fixed header, variable header, and payload.

For details on how to define the fixed header and variable header, see [MQTT Version V3.1.1](#). The payload can be defined by applications in UTF-8 format, that is, by the devices and IoT platform.

NOTE

For details about MQTT syntax and APIs, see [MQTT Version V3.1.1](#).

Common MQTT message types include CONNECT, SUBSCRIBE, and PUBLISH.

- **CONNECT**: A client requests a connection to a server. For details about main parameters in the payload of a CONNECT message, see [Device Connection Authentication](#).
- **SUBSCRIBE**: A client subscribes to a topic. The main parameter **Topic name** in the payload of a SUBSCRIBE message indicates the topic whose subscriber is a device. For details, see [Topics](#).
- **PUBLISH**: The platform publishes a message.

- The main parameter **Topic name** in the variable header of a PUBLISH message indicates the topic whose publisher is a device. For details, see [Topics](#).
- The payload contains the data reported or commands delivered. It is a JSON object.

Topics

If you connect devices to the platform using MQTT, you can use topics to send and receive messages.

- Topics starting with **\$oc** are preset system topics in IoTDA. You can subscribe to and publish messages through these topics. For details about the topic list and functions, see [Topics](#).
- You can create topics that do not start with **\$oc** to send and receive custom messages.

Constraints

| Description | Limit |
|---|---|
| Number of concurrent connections to a directly connected MQTT device | 1 |
| Connection setup requests of an account per second on the device side | <ul style="list-style-type: none"> • Basic edition: 100 • Standard edition: See Specifications. |
| Number of upstream requests for an instance per second on the device side (when average message payload is 512 bytes) | <ul style="list-style-type: none"> • Basic edition: 500 • Standard edition: See Specifications. |
| Number of upstream messages for an MQTT connection | 50 per second |
| Bandwidth of an MQTT connection (upstream messages) | 1 MB (default) |
| Length of a publish message sent over an MQTT connection (Oversized messages will be rejected.) | 1 MB |
| Standard MQTT protocol | MQTT v5.0, MQTT v3.1.1, and MQTT v3.1 |
| Differences from the standard MQTT protocol | <ul style="list-style-type: none"> • Not supported: QoS 2 • Not supported: will and retain msg |
| Security levels supported by MQTT | TCP channel and TLS protocols (TLS v1, TLS v1.1, TLS v1.2, and TLS v1.3) |

| Description | Limit |
|--|--|
| Recommended heartbeat interval for MQTT connections | Range: 30s to 1200s; recommended: 120s |
| MQTT message publish and subscription | A device can only publish and subscribe to messages of its own topics. |
| Number of subscriptions for an MQTT connection | 100 |
| Length of a custom MQTT topic | 128 bytes |
| Number of custom MQTT topics added to a product | 10 |
| Number of CA certificates uploaded for an account on the device side | 100 |

Compatibility

IoTDA supports device access using [MQTT 5.0](#), [MQTT 3.1.1](#), and [MQTT 3.1](#). However, IoTDA is not a simple MQTT broker. It also integrates capabilities such as message communications, device management, rule engine, and data forwarding. The differences between the MQTT function provided by IoTDA and standard MQTT specifications are as follows:

- Devices can communicate with IoTDA using CONNECT, CONNACK, PUBLISH, PUBACK, SUBSCRIBE, SUBACK, UNSUBSCRIBE, UNSUBACK, PINGREQ, PINGRESP, and DISCONNECT packets in MQTT specifications.
- IoTDA supports MQTT QoS 0 and QoS 1, but does not support QoS 2.
- IoTDA supports clean sessions.
- IoTDA does not support the will feature. IoTDA can push device statuses. After a device goes offline, IoTDA pushes its status to your application or other cloud services based on a forwarding rule.
- IoTDA does not support retained messages. IoTDA can cache messages during message reporting and delivery.

Supported MQTT 5.0 Features

NOTE

Only enterprise edition instances support MQTT 5.0-related features.

IoTDA supports the following new MQTT 5.0 features:

- Topic aliases. Message communication topics are reduced to an integer to reduce MQTT packets and save network bandwidth resources.
- Response topics and correlation data. The two parameters can be carried during message reporting and delivery to implement cloud HTTP-like requests and responses.
- User property list. Each property consists of a key and a value and is used to transmit property data in the non-payload area.

- Content-Type. Message reporting packets can carry Content-Type to identify the packet type.
- Return codes can be carried in CONNACK and PUBACK packets, helping devices quickly locate request statuses and issues.

TLS Support for MQTT

TLS is recommended for secure transmission between devices and the platform. Currently, TLS v1.1, v1.2, v1.3, and GMTLS are supported. TLS v1.3 is recommended. TLS v1.1 will not be supported in the future. GMTLS is supported only by the enterprise edition using Chinese cryptographic algorithms.

When TLS connections are used for the basic edition, standard edition, and enterprise edition that support general cryptographic algorithms, the IoT platform supports the following cipher suites:

- TLS_AES_256_GCM_SHA384
- TLS_AES_128_GCM_SHA256
- TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256
- TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
- TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA
- TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA

When the enterprise edition that supports Chinese cryptographic algorithms uses TLS connections, the IoT platform supports the following cipher suites:

- ECC_SM4_GCM_SM3
- ECC_SM4_CBC_SM3
- ECDHE_SM4_GCM_SM3
- ECDHE_SM4_CBC_SM3
- TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384
- TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384
- TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256
- TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256

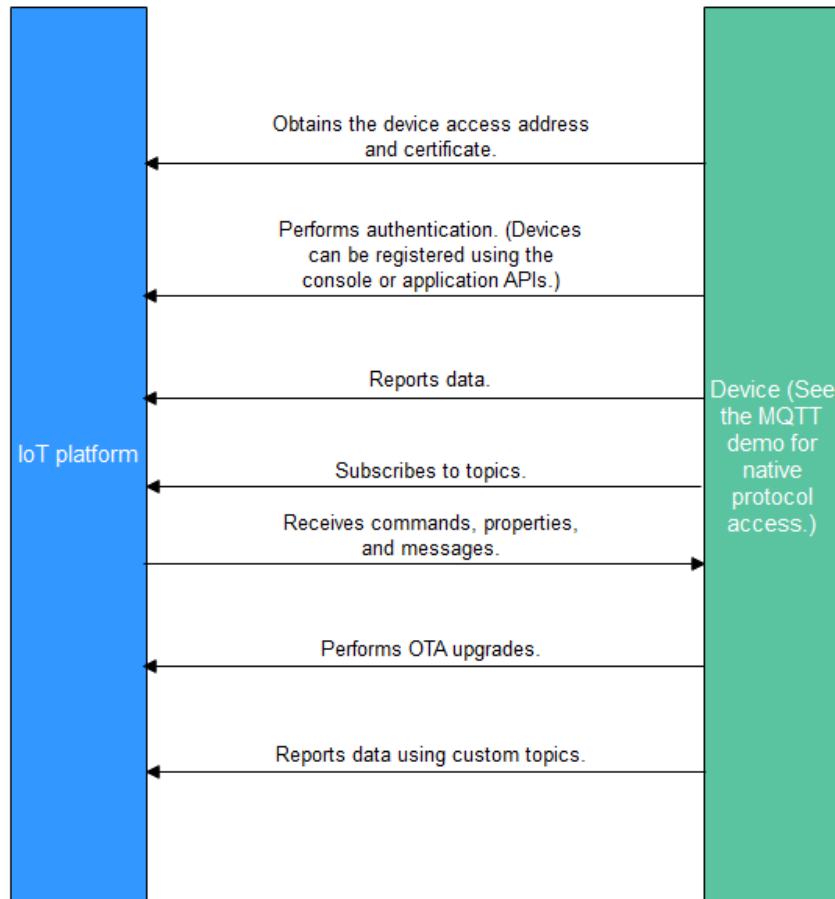
NOTE

CBC cipher suites may pose security risks.

Service Flow

MQTT devices communicate with the platform without data encryption. For security purposes, MQTTS access is recommended.

You are advised to use the [IoT Device SDK](#) to connect devices to the platform over MQTTS.



1. Create a product on the IoTDA console or by calling the API [Creating a Product](#).
2. Register a device on the [IoTDA console](#) or calling the API [Creating a Device](#).
3. The registered device can report messages and properties, receive commands, properties, and messages, perform OTA upgrades, and report data using custom topics. For details about preset topics of the platform, see [Topic Definition](#).

NOTE

You can use MQTT.fx to debug access using the native MQTT protocol. For details, see [Developing an MQTT-based Smart Street Light Online](#).

4.4 Custom Device Domain Name

Overview

A custom fully qualified domain name (FQDN) for a device to connect to IoTDA. With a custom domain name, you can manage your own server certificates, including the root certificate authority (CA), signature algorithms, and certificate lifecycles.

Scenarios

- Managing the root CAs, signature algorithms, and certificate lifecycles of server certificates.
- Disclosing the domain names to customers for branding.
- Inheriting the original domain names and server certificates during migration.

Constraints

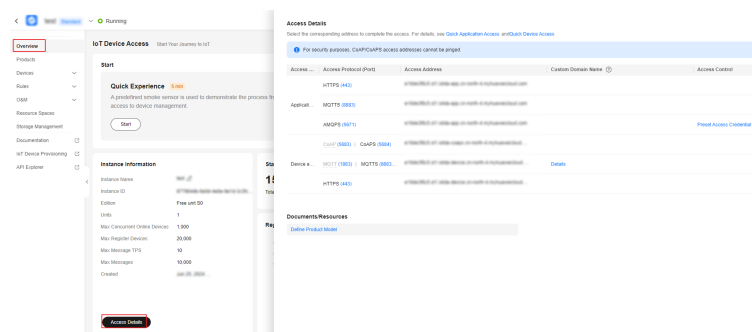
- Only the standard and enterprise editions support this function.
- Only port 8883 connected using MQTT takes effect.
- The device must use TLS and support **SNI (Server Name Indication)**. The SNI must carry the required custom domain name.
- Only one custom domain name can be configured for an IoTDA instance.

Procedure

Step 1 Configure a custom domain name.

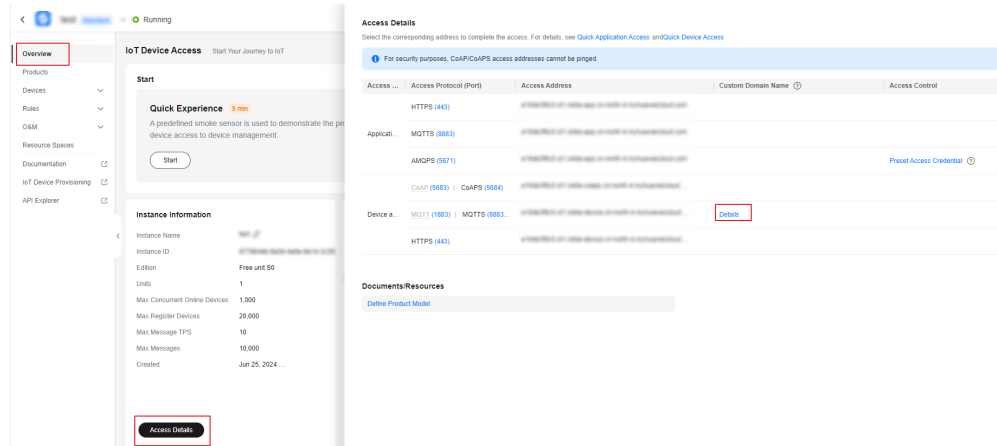
1. In the navigation pane, choose **Overview**. In the **Instance Information** area, click **Access Details**.

Figure 4-20 Obtaining access information



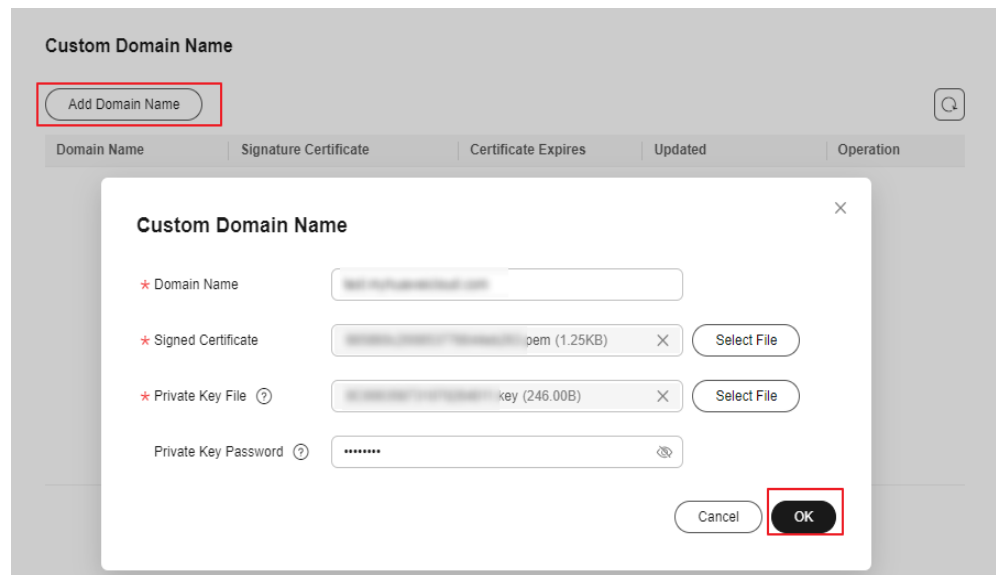
2. On the displayed page, click **Details** in the **Custom Domain Name** column.

Figure 4-21 Access information - Custom domain name details



3. On the displayed page, click **Add Domain Name**, configure parameters as prompted, and click **OK**.

Figure 4-22 Custom domain name - Configuring a custom domain name



Step 2 Create a DNS record. Contact the vendor to add domain name resolution to connect the custom domain name to the IoTDA access point. Obtain the access point by referring to [Platform Interconnection](#).

----End

5 Message Communications

5.1 Data Reporting

5.1.1 Overview

Introduction

A device connected to IoTDA can send data to IoTDA in multiple ways.

Table 5-1 Data reporting

| Type | Sub-type | Description | Application | Protocol | Product Model | Size |
|-------------------|------------------------------------|--|--|---------------|---------------|---|
| Message reporting | Device Reporting Messages | Devices directly report data to the cloud. The platform does not parse or store the reported data, and transparently transfers it from devices to applications. | Used for high-frequency data transmission or in scenarios where user-defined data formats are required. For example, a large amount of sensor data needs to be sent to applications in a short period of time. | MQTT and HTTP | Not required | <ul style="list-style-type: none"> • Max. reported message size in a request: 1 MB |
| | Custom Topic Communications | Devices report data with custom topics. The platform transparently transfers the reported data. Applications can subscribe to custom topics to differentiate services. | Used when devices need to report messages for various service types, or transfer data to specific topics in scenarios such as data migration. | MQTT | | <ul style="list-style-type: none"> • Max. available |

| Type | Sub-type | Description | Application | Protocol | Product Model | Size |
|------|----------|-------------|-------------|----------|---------------|---|
| | | | | | | bandwidth: 10 Mbit/s for standard edition users and |

| Type | Sub-type | Description | Application | Protocol | Product Model | Size |
|------|----------|-------------|-------------|----------|---------------|--|
| | | | | | | 50 Mbit/s for enterprise editions on users |

| Type | Sub-type | Description | Application | Protocol | Product Model | Size |
|-----------|--|--|--|---------------------------------|---------------|---|
| Reporting | Device Reporting Properties | The platform does not transparently transfer the reported data from devices to applications. Instead, the platform verifies and filters data based on the defined product model. If the reported data does not comply with the product model definition, the platform discards the data. | Used when the platform needs to parse and store device data with unified models that specify the data format and value range. Alternatively, used when the platform needs to store the latest image data. For example, the switch data of street lamps needs to be sent to the application side. | MQTT, HTTP, and LwM2M over CoAP | Required | <ul style="list-style-type: none"> Maximum reported property name request: 64 KB |
| | Gateway Reporting Properties in Batches | Gateways report the properties of multiple child devices at a time. The platform does not transparently transfer the reported data from devices to applications. The reported data is distributed to the corresponding child devices by the platform. | Used when a gateway is associated with multiple child devices, and you do not have strict requirements on the data reporting time. The data of these child devices can be packaged and then reported together by the gateway. | MQTT | | <ul style="list-style-type: none"> Maximum available |

| Type | Sub-type | Description | Application | Protocol | Product Model | Size |
|------|----------|-------------|-------------|----------|---------------|---|
| | | | | | | bandwidth: 10 Mbit/s for standard edition users and |

| Type | Sub-type | Description | Application | Protocol | Product Model | Size |
|------|----------|-------------|-------------|----------|---------------|--------------------------------|
| | | | | | | 50 Mbit/s for enterprise users |

 **NOTE**

- It is not suitable to report data in JSON format for devices with limited resources or with limits on bandwidth usage. In this case, devices can transparently transfer the original binary data to the platform, but a codec is required to convert binary data to JSON format. For details about how to develop codecs, see [Developing a Codec](#).
- You can forward the reported data to other Huawei Cloud services for storage and processing with [data forwarding rules](#). Then, the data is further processed through the consoles or APIs of the other services.

Figure 5-1 Conceptual diagram of message reporting

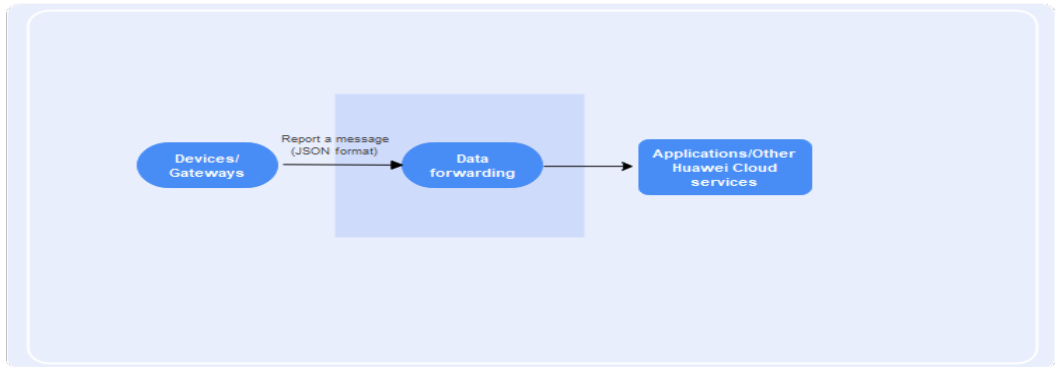


Figure 5-2 Conceptual diagram of property reporting

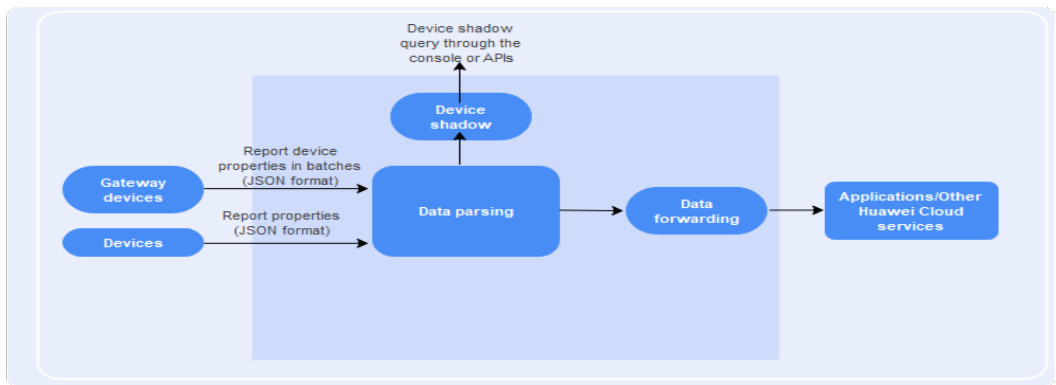
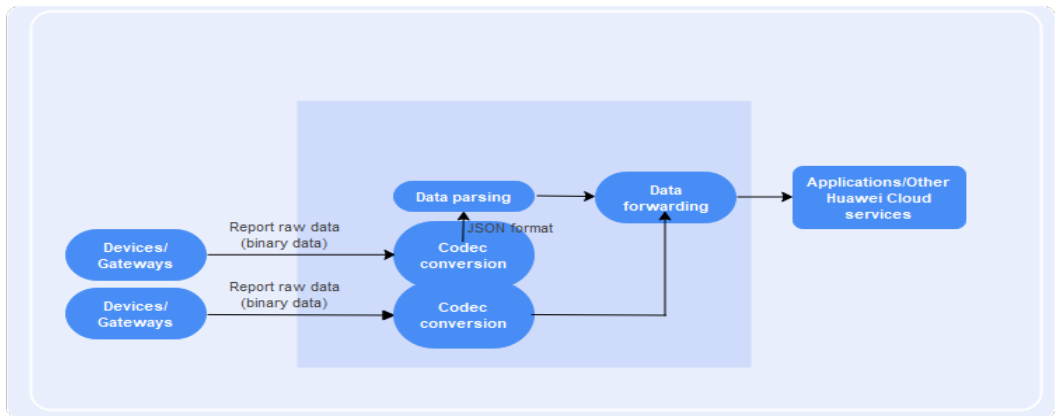


Figure 5-3 Conceptual diagram of raw binary data reporting



Application APIs

- [Modify Device Properties](#)
- [Query Device Messages](#)
- [Query a Device](#)
- [Query a Device Shadow](#)

MQTT Device APIs

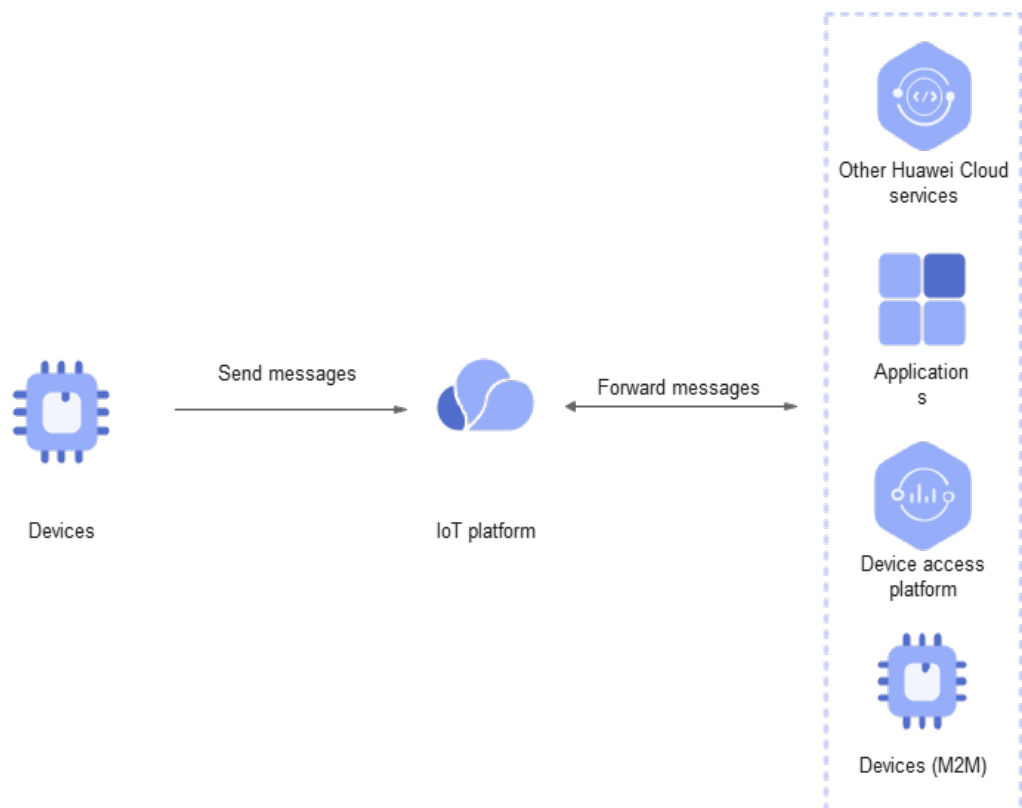
- [Device Reporting a Message](#)
- [Device Reporting Properties](#)
- [Gateway Reporting Device Properties in Batches](#)

5.1.2 Device Reporting Messages

Overview

Message reporting is a method by which a device directly sends data to the cloud and forwards the data to applications or other Huawei Cloud services through data forwarding. The platform does not parse or store the messages reported by devices. In this case, a product model is not required.

Figure 5-4 Process of device message reporting



Scenarios

IoTDA does not parse or store the data reported by devices. Instead, it forwards the data to other Huawei Cloud services for storage and processing based on [data forwarding rules](#).

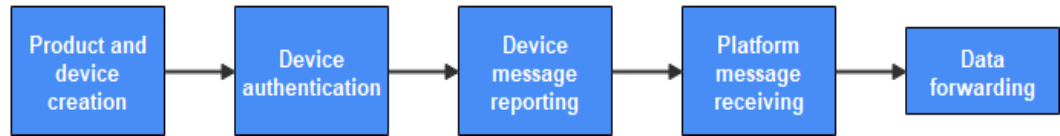
Constraints

- Max. size of a single message: 1 MB.
- Max. bandwidth of a single MQTT connection: 1 Mbit/s.

- Max. upstream messages for a single MQTT connection per second: 50 (one request is considered as one message).

Process

Figure 5-5 Process of device message reporting



Step 1 Product and device creation: For details, see [Creating a Product](#) and [Registering an Individual Device](#).

Step 2 **Device authentication**: The platform checks whether the device has the access permission.

Step 3 Device message reporting: Devices report messages through protocols such as MQTT and HTTPS.

Use different APIs for different protocols.

MQTT: Use the message reporting APIs for [MQTT devices](#).

- Example topic of MQTT message reporting:

```
$oc/devices/{device_id}/sys/messages/up
```

- Example format of MQTT message reporting:

```
{
  "content": {"hello":"123"}
}
```

HTTPS: Use the message reporting APIs for [HTTP devices](#). To obtain `access_token` for HTTP devices, see [Authenticating a Device](#). The following is an example of HTTPS device message reporting.

```
POST https://{endpoint}/v5/devices/{device_id}/sys/messages/up
Content-Type: application/json
access_token: *****
{
  "name": "name",
  "id": "id",
  "content": "messageUp"
}
```

NOTE

For details about devices using different protocols, see [MQTT Device Reporting a Message](#) and [HTTP Device Reporting a Message](#).

Step 4 Data forwarding: With the `data forwarding` function, data can be forwarded to applications or other Huawei Cloud services for further processing.

----End

Message Reporting Using Java SDK

This section describes how to use Java SDKs for the development of message reporting. JDK 1.8 or later is used.

Configure the SDK on the device side:

Step 1 Download an SDK.

Step 2 Configure the Maven dependency of the SDK on devices.

```
<dependency>
  <groupId>com.huaweicloud</groupId>
  <artifactId>iot-device-sdk-java</artifactId>
  <version>1.1.4</version>
</dependency>
```

Step 3 Configure the SDK and device connection parameters on devices.

```
// Load the CA certificate of the IoT platform. For details about how to obtain the certificate, visit https://support.huaweicloud.com/intl/en-us/devg-iot/iot\_02\_1004.html.
URL resource = BroadcastMessageSample.class.getClassLoader().getResource("ca.jks");
File file = new File(resource.getPath());

// The format is ssl://Access address:Port number.
// To obtain the access address, log in to the IoTDA console. In the navigation pane, choose Overview and click Access Details in the Instance Information area. Select the access address corresponding to port 8883.
String serverUrl = "ssl://localhost:8883";
// Device ID created on the IoT platform
String deviceId = "deviceId";
// Secret corresponding to the device ID
String deviceSecret = "secret";
// Create a device.
IoTDevice device = new IoTDevice(serverUrl, deviceId, deviceSecret, file);
if (device.init() != 0) {
    return;
}
```

Step 4 Report a device message.

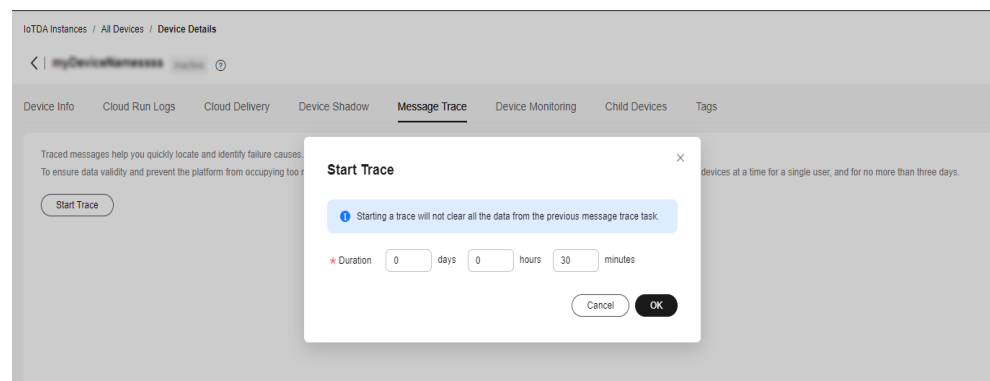
```
device.getClient().reportDeviceMessage(new DeviceMessage("hello"), new ActionListener() {
    @Override
    public void onSuccess(Object context) {
        log.info("reportDeviceMessage success: ");
    }
    @Override
    public void onFailure(Object context, Throwable var2) {
        log.error("reportDeviceMessage fail: "+var2);
    }
});
```

----End

Verify the setting:

Step 1 On the IoTDA console, choose **Devices > All Devices**, select a device to access its details page, and click **Start Trace** on the **Message Trace** tab page.

Figure 5-6 Message tracing - Starting message tracing



Step 2 Run the SDK code on the device. The following is an example of the log format when the device reports a message.

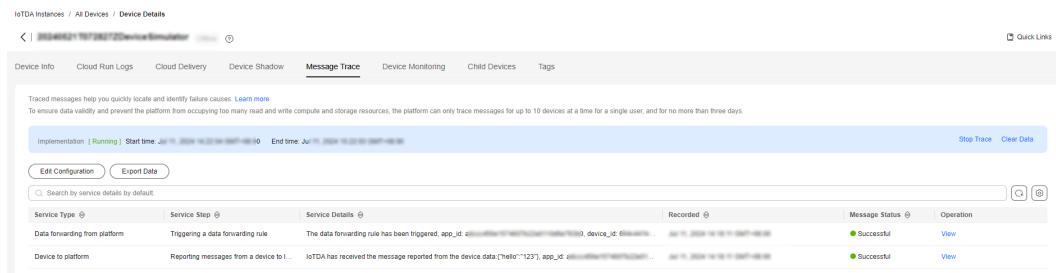
Figure 5-7 Java SDK message reporting result log

```

D:\SDK\bin\Java.exe ...
2023-05-19 15:06:12 INFO AbstractService:73 - create device, the deviceId is test111
2023-05-19 15:06:12 INFO MqttConnection:204 - try to connect to tcp://...
2023-05-19 15:06:13 INFO MqttConnection:228 - connect success, the uri is tcp://...
2023-05-19 15:06:13 INFO MqttConnection:266 - publish message topic is $oc/devices/test111/sys/events/up, msg = {"object_device_id":"test111","services":[{"paras":{"type":"DEVICE_STATUS","conten
2023-05-19 15:06:13 INFO MqttConnection:111 - Mqtt client connected, address is tcp://...
2023-05-19 15:06:13 INFO MqttConnection:268 - publish message topic is $oc/devices/test111/sys/events/up, msg = {"object_device_id":"test111","services":[{"paras":{"type":"DEVICE_STATUS","conten
2023-05-19 15:06:13 INFO MqttConnection:268 - publish message topic is $oc/devices/test111/sys/events/up, msg = {"object_device_id":"test111","services":[{"paras":{"type":"DEVICE_STATUS","conten
2023-05-19 15:06:13 INFO MqttConnection:268 - publish message topic is $oc/devices/test111/sys/messages/op, msg = {"name":"null","id":"null","content":"hello","object_device_id":"m0111"}
2023-05-19 15:06:13 INFO ReportDeviceLogSample:35 - reportDeviceMessage success:
    
```

Step 3 Check the result on the **Message Trace** tab page. The platform has received messages from the device and the data forwarding rule has been triggered.

Figure 5-8 Message tracing - Message reporting triggering a forwarding rule



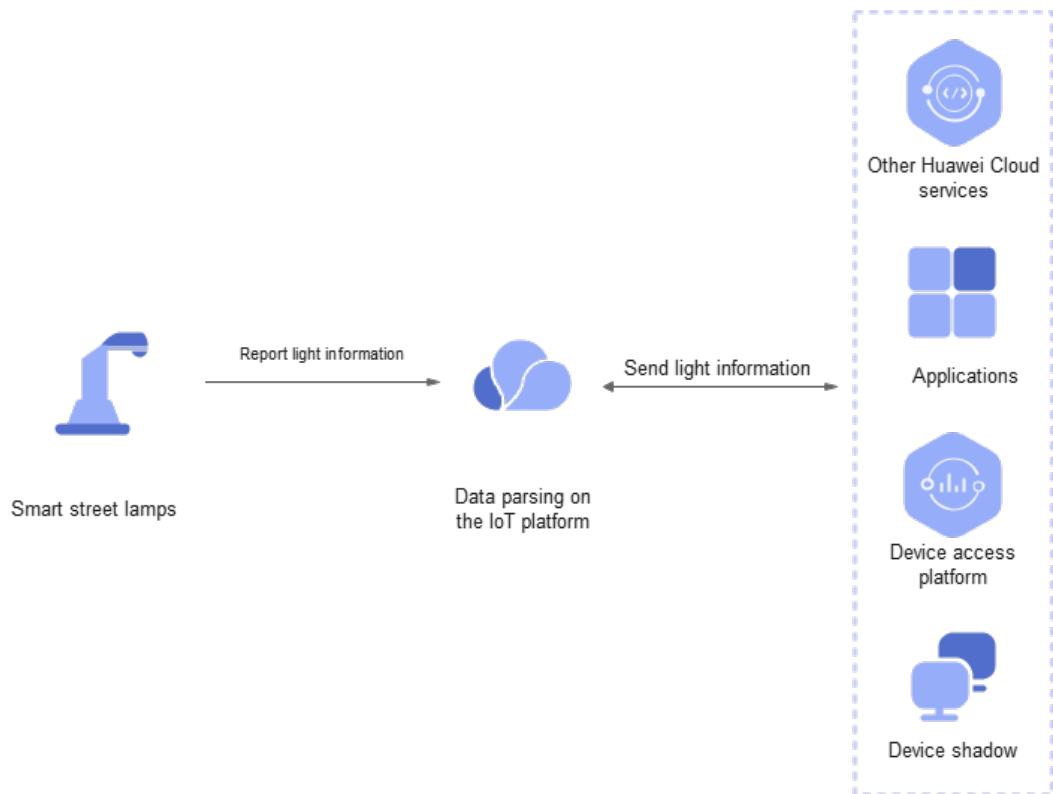
----End

5.1.3 Device Reporting Properties

Overview

Property reporting is a method by which IoTDA parses, caches, and forwards data to applications or other Huawei Cloud services through data forwarding. Product models need to be established on the platform. The platform records the latest reported property value and stores the data that complies with the product model definition. The device can obtain the latest device properties from the platform through **device shadow**.

Figure 5-9 Device Reporting Properties



Scenarios

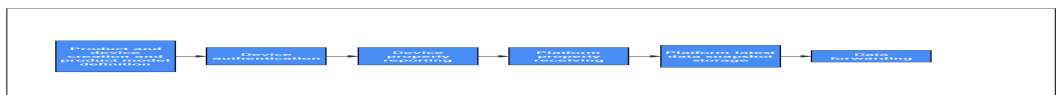
- Data of devices and applications needs to be converted, managed, and cached by the platform.
- Data needs to be forwarded to other Huawei Cloud services for storage and processing based on [data forwarding rules](#).

Constraints

- Max. size of a single message: 64 KB.
- A product model is required. The reported data must match the properties defined in the product model.
- Max. child devices of which properties can be reported by a gateway at a time: 100.

Process

Figure 5-10 Process of device property reporting



- Step 1** Product and device creation and product model definition: For details, see [Creating a Product](#), [Registering an Individual Device](#), and [Product Model Definition](#).

Step 2 Device authentication: The platform checks whether the device has the access permission.

Step 3 Device property reporting: Devices report property data using protocols such as MQTT, HTTP, and LwM2M.

Use different APIs for different protocols.

- **MQTT:** Use the property reporting APIs for **MQTT devices**. The following is an example of reporting MQTT device property.

Topic: \$oc/devices/{device_id}/sys/properties/report
Data format example:

```
{
  "services": [
    {
      "service_id": "Temperature",
      "properties": {
        "value": 57,
        "value2": 60
      }
    }
  ]
}
```

- **HTTPS:** Use the property reporting APIs for **HTTP devices**. To obtain **access_token** for HTTP devices, see **Authenticating a Device**. The following is an example of reporting HTTPS device property.

POST https://{endpoint}/v5/devices/{device_id}/sys/properties/report
Content-Type: application/json
access_token: *****

```
{
  "services": [
    {
      "service_id": "serviceId",
      "properties": {
        "Height": 124,
        "Speed": 23.24
      }
    }
  ]
}
```

- **LwM2M/CoAP:** Use the property reporting APIs for **devices using LwM2M over CoAP**. The following is an example of property reporting for devices using LwM2M over CoAP.

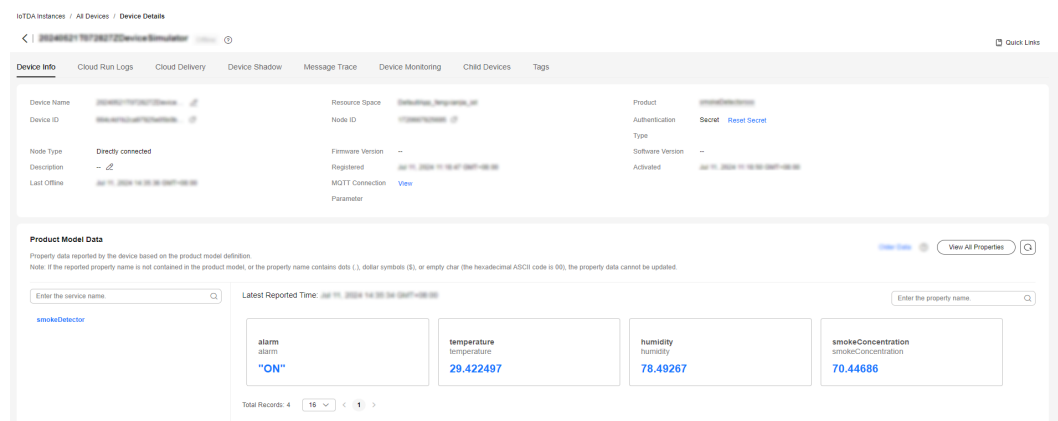
```
// Assume that the data content (value) reported by the device is c4 0d 5a 6e 96 0b c3 0e 2b 30 37.
NON-2.05 MID=48590, Token=*****, OptionSet={"Observe":22, "Content-Format":"application/octet-stream"}, c4 0d 5a 6e 96 0b c3 0e 2b 30 37
```

NOTE

- The reported device properties must match the properties defined in the product model.
- For details about devices using different protocols, see **MQTT Device Reporting Properties**, **HTTP Device Reporting Properties**, and **LwM2M/CoAP Device Reporting Properties**.

Step 4 The platform stores the latest data snapshot. If the reported data complies with the product model definition, log in to the IoTDA console, choose **Devices > All Devices**, and select a device to access its details page. The latest data snapshot is displayed on the **Device Info** tab page. The following figure is as an example.

Figure 5-11 Property reporting - Viewing data



Step 5 Data forwarding: With the **data forwarding** function, data can be forwarded to applications or other Huawei Cloud services for storage and processing.

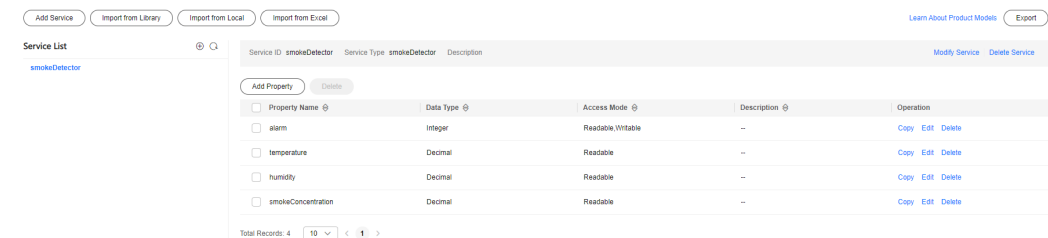
----End

Property Reporting Using Java SDK

This section describes how to use Java SDKs for the development of property reporting. JDK 1.8 or later is used.

The reported properties must match the properties defined in the **product model** corresponding to the device. The following figure provides the information of the example product model used in the SDK code.

Figure 5-12 Model definition - smokeDetector



Configure the SDK on the device side:

Step 1 **Download an SDK.**

Step 2 Configure the Maven dependency of the SDK on devices.

```
<dependency>
  <groupId>com.huaweicloud</groupId>
  <artifactId>iot-device-sdk-java</artifactId>
  <version>1.1.4</version>
</dependency>
```

Step 3 Configure the SDK and device connection parameters on devices.

```
// Load the CA certificate of the IoT platform. For details about how to obtain the certificate, visit https://support.huaweicloud.com/intl/en-us/devg-iot-hub/iot\_02\_1004.html.
URL resource = BroadcastMessageSample.class.getClassLoader().getResource("ca.jks");
File file = new File(resource.getPath());

// The format is ssl://Domain name.Port number.
```

```
// To obtain the domain name, log in to the Huawei Cloud IoTDA console. In the navigation pane, choose
Overview and click Access Details in the Instance Information area. Select the access domain name
corresponding to port 8883.
String serverUrl = "ssl://localhost:8883";
// Device ID created on the IoT platform
String deviceId = "deviceId";
// Secret corresponding to the device ID
String deviceSecret = "secret";
// Create a device.
IoTDevice device = new IoTDevice(serverUrl, deviceId, deviceSecret, file);
if (device.init() != 0) {
    return;
}
```

Step 4 Report device properties.

```
Map<String, Object> json = new HashMap<>();
Random rand = new Random();

// Set properties based on the product model.
json.put("alarm", alarm);
json.put("temperature", rand.nextFloat()*100.0f);
json.put("humidity", rand.nextFloat()*100.0f);
json.put("smokeConcentration", rand.nextFloat() * 100.0f);

ServiceProperty serviceProperty = new ServiceProperty();
serviceProperty.setProperties(json);
serviceProperty.setServiceId("smokeDetector");// The service ID must be consistent with that defined in the
product model.

device.getClient().reportProperties(Arrays.asList(serviceProperty), new ActionListener() {
    @Override
    public void onSuccess(Object context) {
        log.info("reportProperties success" );
    }

    @Override
    public void onFailure(Object context, Throwable var2) {
        log.error("reportProperties failed" + var2.toString());
    }
});
```

----End

Verify the setting:

- Step 1** Run the SDK code on the device. The following figure provides an example of the property reporting log.

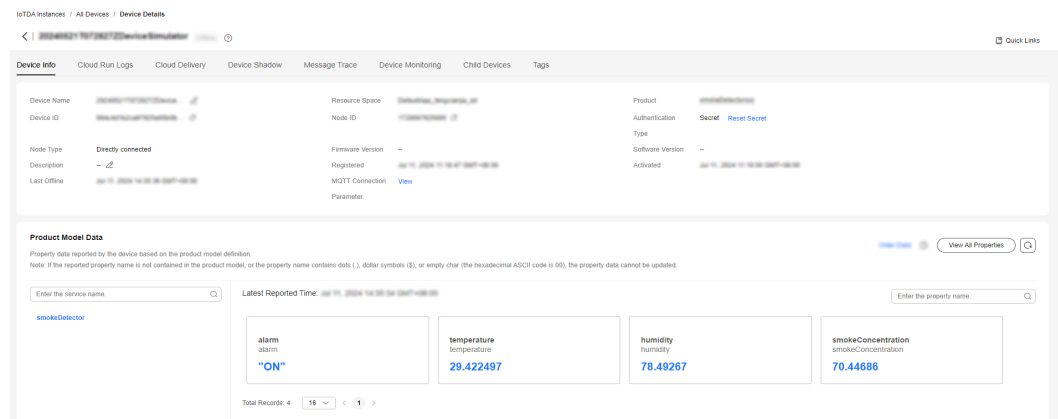
Figure 5-13 Java SDK property reporting result log



```
2023-09-19 10:55:08 INFO AbstractService:11 create device, the deviceId is test11
2023-09-19 10:55:08 INFO MqttConnection:264 try to connect to ssl://localhost:8883
2023-09-19 10:55:08 INFO MqttConnection:228 connect success, the url is ssl://localhost:8883
2023-09-19 10:55:08 INFO MqttConnection:248 publish message topic: $B2/devices/test11/properties/report, msg = {"object_device_id":"test11","services":[{"params":{"type":"DEVICE_STATUS","content":"connect success","timestamp":"168482789888"},"service_id":"$log","event_type":"log_report"}]}
2023-09-19 10:55:08 INFO MqttConnection:211 MQTT client connected, address is ssl://localhost:8883
2023-09-19 10:55:08 INFO MqttConnection:248 publish message topic: $B2/devices/test11/properties/report, msg = {"object_device_id":"test11","services":[{"params":{"type":"DEVICE_STATUS","content":"connect complete, the url is ssl://192.168.0.10:8883","timestamp":"168482789976"},"service_id":"$log","event_type":"log_report"}]}
2023-09-19 10:55:08 INFO MqttConnection:248 publish message topic: $B2/devices/test11/properties/report, msg = {"object_device_id":"test11","services":[{"params":{"device_id_version":"2023_03_29","fw_version":"null","hw_version":"null"},"service_id":"$log_info","event_type":"log_info_report"}]}
2023-09-19 10:55:08 INFO MqttConnection:248 publish message topic: $B2/devices/test11/properties/report, msg = {"services":[{"properties":{"alarm":"0K","temperature":"89.7979","humidity":"33.18825","smokeConcentration":"20.19783"},"service_id":"smokeDetector","event_time":"null"},"service_id":"$log","event_type":"log_report"}]}
2023-09-19 10:55:08 INFO MqttConnection:248 reportProperties success
```

- Step 2** Log in to the IoTDA console, choose **Devices > All Devices**, and click a device to access its details page. The latest reported data is displayed on the **Device Info** tab page.

Figure 5-14 Property reporting - Viewing data



----End

5.2 Data Delivery

5.2.1 Overview

After a device is connected to IoTDA, the platform can send data to the device in the following ways.

| Type | Description | Application | Device Shadow | Synchronous or Asynchronous | Cached by the Platform | Supported Protocol (Device) | Product Model |
|-------------------|--|---|---------------|-----------------------------|------------------------|-----------------------------|---------------|
| Message delivery | The platform directly delivers messages to devices and does not rely on product models. It is a one-way notification to devices. If a device is offline, the platform can cache messages (up to 24 hours) and send the data to the device after it goes online. | This API is used by an application to deliver a message in custom format to a device when the application cannot deliver data in the format defined in the product model. For example, sending data to devices for which no product model is defined. | Not supported | Asynchronous | Supported | MQTT | Not required |
| Property delivery | This mode is used to set or query device properties. After receiving the properties, the device needs to return the property execution result to the platform in a timely manner. If the device does not return a response, the platform considers that the property delivery times out. | It is used by the platform to proactively obtain or modify the device property value. For example, an app obtains the geographical location of a device at intervals. | Supported | Synchronous | Not supported | MQTT and LwM2M over CoAP | Required |

| Type | Description | Application | Device Shadow | Synchronous or Asynchronous | Cached by the Platform | Supported Protocol (Device) | Product Model |
|------------------|--|---|---------------|-----------------------------|------------------------|-----------------------------|---------------|
| Command delivery | <p>The platform delivers a device control command to a device and the device needs to respond. The response can carry parameters indicating operation success or failure.</p> <ul style="list-style-type: none"> When the platform delivers a synchronous command, the device needs to return the command execution result within 20 seconds. Otherwise, the command delivery is considered failed. Asynchronous command delivery can cache messages. If a device is offline, data is sent after the device goes online. The maximum cache duration is 48 hours. | <p>It is used for the command that needs to be confirmed immediately. For example, turning on the fan and controlling the street lamp switch.</p> | Not supported | Synchronous | Not supported | MQTT | Required |
| | | | | Asynchronous | Supported | LwM2M/CoAP | |

 NOTE

It is not suitable to deliver data in JSON format for devices with low configuration and limited resources or with limits on bandwidth usage. In this case, use [codecs](#) to convert the JSON format data into binary data on applications.

APIs for Applications

- [Deliver a Message to a Device](#)
- [Query Device Messages](#)

- [Query Device Properties](#)
- [Modify Device Properties](#)
- [Deliver a Command to a Device](#)
- [Deliver an Asynchronous Command](#)
- [Query a Command with a Specific ID](#)

APIs for MQTT Devices

- [Platform Delivering a Command](#)
- [Platform Delivering a Message](#)

APIs for Devices Using LwM2M over CoAP

- Platform [Delivering a Command](#)

5.2.2 Message Delivery

Overview

Message delivery does not rely on product models. The platform provides one-way notifications for devices and caches messages. It delivers messages from the cloud to devices in asynchronous mode (without waiting for responses from devices). If a device is offline, data is sent after the device is online. The maximum cache duration is 24 hours. By default, the platform stores a maximum of 20 messages for each device. If the number of messages exceeds 20, subsequent messages will replace the earliest messages. In addition, messages can be delivered in the format of [custom topics](#).

Table 5-2 Message delivery topic type

| Message Delivery Topic Type | Description |
|-----------------------------|--|
| System topic | The platform predefines topics for communications with devices. For details of the topic list and functions, see Topics . |
| Custom topic | You can customize topics for device-platform communications. Types of custom topics: <ul style="list-style-type: none">• Topics defined in the product are prefixed with \$oc/devices/{device_id}/user/. During message reporting or delivery, the platform checks whether the topic is defined in the product. Undefined topics will be rejected by the platform. For details about how to use this type of topics, see Using a Custom Topic for Communication.• Topics that do not start with \$oc, for example, /aircondition/data/up. This type of topics enables upstream and downstream message communications based on MQTT rules. The platform does not verify the topic permission. |

Scenarios

- The data format needs to be customized and does not rely on the product model.

Constraints

- Max. size of a single message: 256 KB.
- Up to 20 messages can be cached for a single device.
- Max. length of a custom MQTT topic: 128 bytes.
- Max. cache duration (configurable): 24 hours.

Quality of Service

- IoTDA supports MQTT QoS 0 and QoS 1, but does not support QoS 2.
- If the QoS of a topic is 0, the message is delivered only once without waiting for the device to return an ACK message. If the QoS of a topic is 1, the message delivery is successful only after the device returns an ACK message.
- Devices subscribe to the system topic whose QoS is 0 by default. If the downstream system topic whose QoS is 1 is required, devices need to be configured to subscribe to the topic.
- If a device needs to subscribe to a custom topic that does not start with **\$oc** and the QoS is 1, [submit a service ticket](#).
- If the QoS of the subscribed topic is 1 and the platform does not receive an ACK message from the device, the platform resends the message every 2 seconds for three times by default.

If the device still does not return an acknowledgment response and the message is still cached, the platform resends the message when the device goes online again or subscribes to a topic. By default, the platform resends the message every 10 seconds for five times.

In addition, the mechanism of resending every 2 seconds is triggered. Therefore, the device may receive duplicate messages. It is recommended that devices have deduplication mechanisms.

APIs

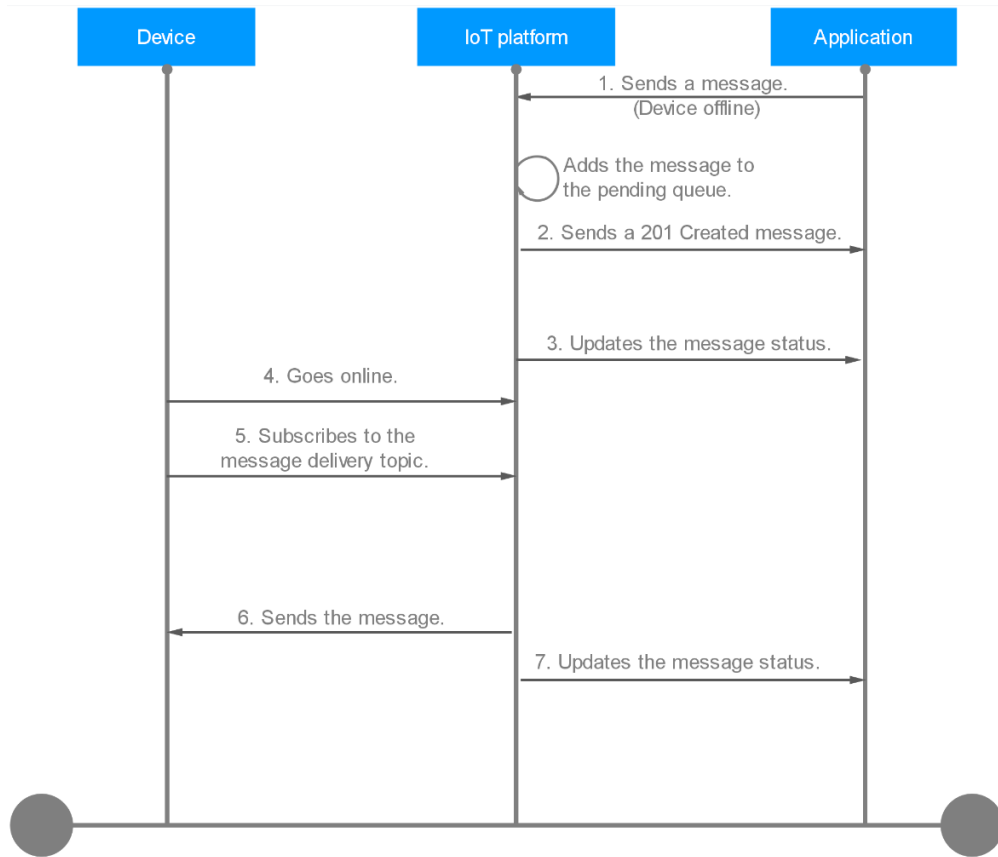
- [Deliver a Message to a Device](#)
- [Platform Delivering a Message](#).

Delayed Message Delivery

Message delivery is a mode in which the platform directly delivers messages to devices. When a device is offline, the platform caches messages to be delivered until the device goes online.

The following describes how to use a system topic to cache and deliver messages to devices.

Figure 5-15 Process of delayed message delivery



1. An application or the third-party platform calls the API for **delivering a message to a device** to send a message to IoTDA. Example message:

```

POST https://{Endpoint}/v5/iot/{project_id}/devices/{device_id}/messages
Content-Type: application/json
X-Auth-Token: *****
    
```

```

{
  "message_id": "99b32da9-cd17-4cdf-a286-f6e849cbc364",
  "name": "messageName",
  "message": "HelloWorld"
}
    
```

2. The platform sends a 201 Created message carrying the message status **PENDING** to the application.
3. The platform pushes the message result to the application through the API for **pushing a device message status change notification**. If the device is offline, the message status is **PENDING**.

```

Topic: $oc/devices/{device_id}/sys/messages/down
Data format:
    
```

```

{
  "resource": "device.message.status",
  "event": "update",
  "notify_data": {
    "message_id": "string",
    "name": "string",
    "device_id": "string",
    "status": "PENDING",
    "timestamp": "string"
  }
}
    
```


4. The device goes online.
5. The device subscribes to the non-system topic to receive messages. (Implicit subscription mode: Devices do not need to subscribe to downstream system topics.)

6. The platform sends the message to the device according to the protocol specifications. Example message:

Topic: \$oc/devices/{**device_id**}/sys/messages/down

Data format:

```
{
  "object_device_id": "{object_device_id}",
  "name": "name",
  "id": "id",
  "content": "hello"
}
```

7. The platform pushes the final result of the message to the application. The message status is **DELIVERED**. For details about the used APIs, see [Push a Device Message Status Change Notification](#).

Topic: \$oc/devices/{**device_id**}/sys/messages/down

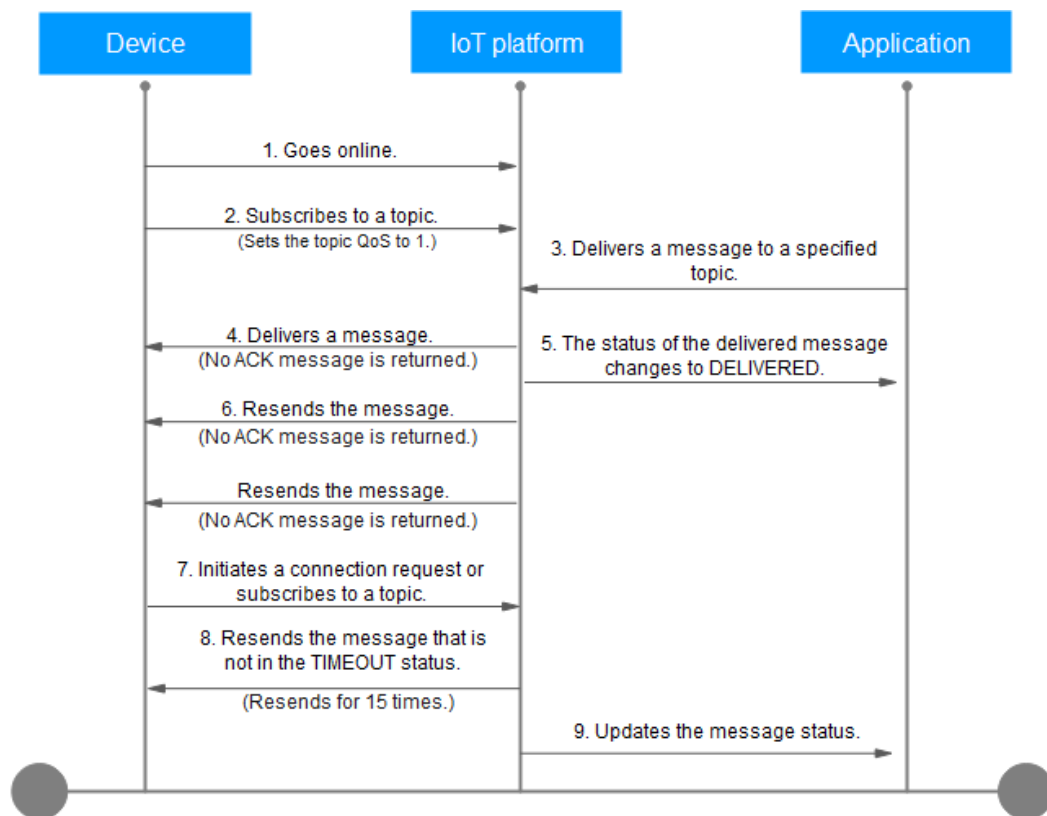
Data format:

```
{
  "resource": "device.message.status",
  "event": "update",
  "notify_data": {
    "message_id": "string",
    "name": "string",
    "device_id": "string",
    "status": "DELIVERED",
    "timestamp": "string"
  }
}
```

Introduction for QoS 1

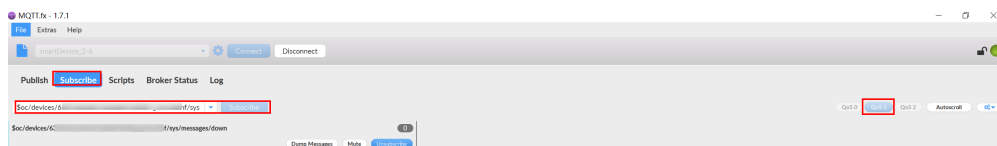
The following uses an MQTT device as an example to describe how to use a system topic whose QoS is 1 to deliver messages to devices.

Figure 5-16 Process of using QoS 1 for message delivery



1. The device goes online.
2. Subscribe to a topic for the device and set QoS to 1.

Figure 5-17 Setting QoS to 1 for the subscribed topic



3. An application or the third-party platform calls the API for **delivering a message to a device** to send a message to IoTDA. Example message:
 POST https://{Endpoint}/v5/iot/{project_id}/devices/{device_id}/messages
 Content-Type: application/json
 X-Auth-Token: *****

```
{
  "message_id": "99b32da9-cd17-4cdf-a286-f6e849cbc364",
  "name": "messageName",
  "message": "HelloWorld"
}
```
4. The platform sends the message to the device according to the protocol specifications. An MQTT device needs to subscribe to the non-system topic to receive messages. (Implicit subscription mode: Devices do not need to subscribe to downstream system topics.) Example message:
 Topic: \$oc/devices/{device_id}/sys/messages/down
 Data format:

```
{
  "object_device_id": "{object_device_id}",
```

```

"name": "name",
"id": "id",
"content": "hello"
}

```

5. After delivering a message to the device, the platform returns a 201 Created message to the application. The message status is **DELIVERED**. Message delivery is an asynchronous operation. The platform can return the response without waiting for an ACK message from the device.
6. If the IoT platform does not receive an ACK response from the device, it resends the message every 2 seconds for three times by default.
7. The device goes online again or subscribes to a topic.
8. If the device does not return an ACK response for the previous message and the message does not time out, the platform resends the message every 10 seconds for five times by default. This mechanism of resending every 2 seconds is triggered.
9. The platform pushes the final result of the message to the application. The message status is **DELIVERED** or **TIMEOUT**. For details about the used APIs, see [Push a Device Message Status Change Notification](#).

Topic: \$oc/devices/{device_id}/sys/messages/down

Data format:

```

{
  "resource": "device.message.status",
  "event": "update",
  "notify_data": {
    "message_id": "string",
    "name": "string",
    "device_id": "string",
    "status": "DELIVERED",
    "timestamp": "string"
  }
}

```

Message Delivery Status

The following figure shows the MQTT device message execution status and status change mechanism.

Figure 5-18 Device message status

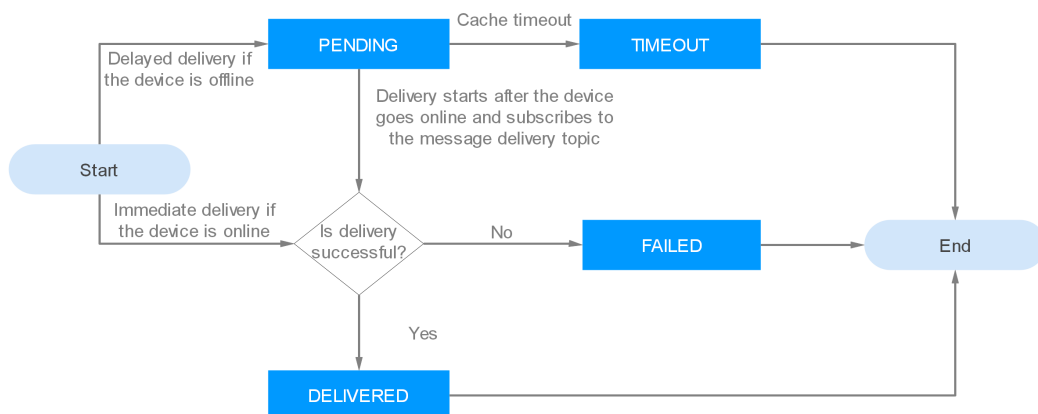


Table 5-3 Status

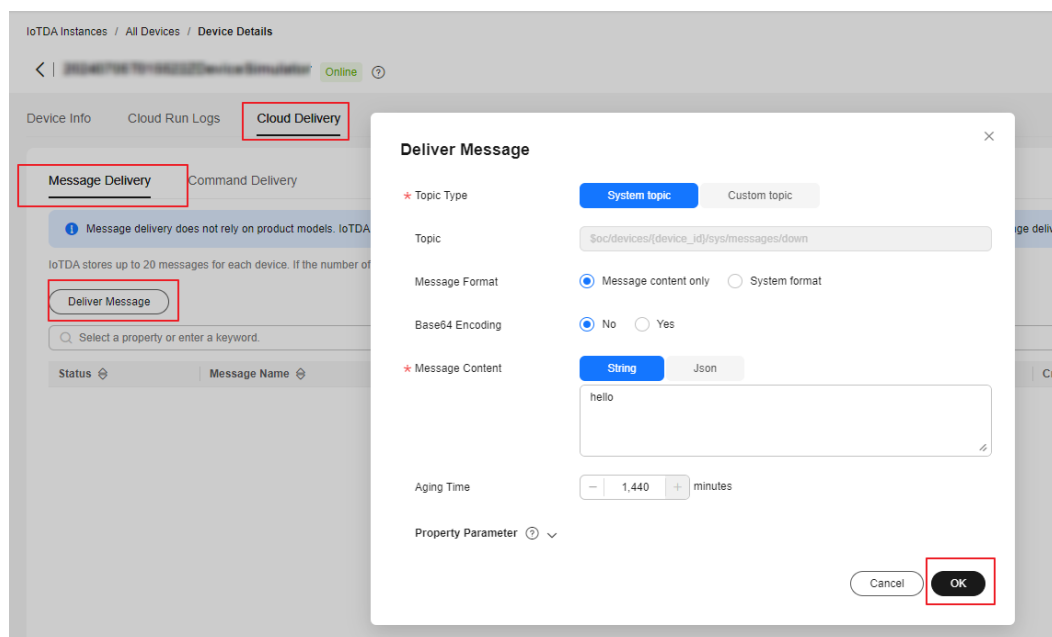
| Status | Description |
|-----------|---|
| PENDING | If an MQTT device is offline, the platform caches the message. In this case, the task status is PENDING . |
| TIMEOUT | If the platform does not deliver the message in the pending status after one day, the task status changes to TIMEOUT . |
| DELIVERED | After the platform sends the message to the device, the task status changes to DELIVERED . |
| FAILED | If the platform fails to send a message to the device, the task status changes to FAILED . |

Example of Platform Message Delivery

To deliver messages from the cloud, create a delivery task on the console. The following uses an MQTT device as an example to describe how to cache and deliver messages on the IoTDA console.

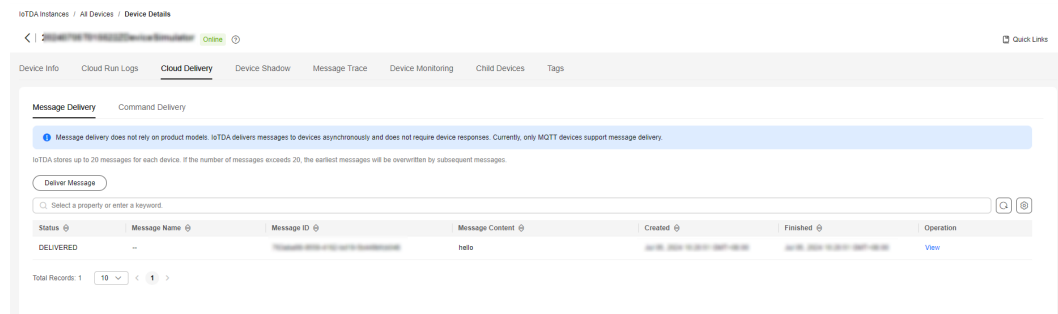
- Step 1** Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Devices > All Devices**. On the device list, click a device to access its details page.
- Step 3** Click the **Cloud Delivery** tab. On the **Message Delivery** tab page, click **Deliver Message**. In the displayed dialog box, configure the content and the parameters for the command to deliver.

Figure 5-19 Message delivery - MQTT



Step 4 The delivery status is **DELIVERED** on the platform.

Figure 5-20 Querying results



----End

Configure the Java SDK on the application side:

Step 1 Configure the Maven dependency. In this example, the development environment is JDK 1.8 or later. [Download an SDK](#).

```
<dependency>
  <groupId>com.huaweicloud.sdk</groupId>
  <artifactId>huaweicloud-sdk-core</artifactId>
  <version>[3.0.40-rc, 3.2.0]</version>
</dependency>
<dependency>
  <groupId>com.huaweicloud.sdk</groupId>
  <artifactId>huaweicloud-sdk-iotda</artifactId>
  <version>[3.0.40-rc, 3.2.0]</version>
</dependency>
```

Step 2 The following is an example of a message sent by the application to a single device:

```
public class MessageDistributionSolution {
  // REGION_ID: If CN East-Shanghai1 is used, enter cn-east-3. If CN North-Beijing4 is used, enter cn-north-4. If CN South-Guangzhou is used, enter cn-south-4.
  private static final String REGION_ID = "<YOUR REGION ID>";
  // ENDPOINT: On the console, choose Overview and click Access Addresses to view the HTTPS application access address.
  private static final String ENDPOINT = "<YOUR ENDPOINT>";
  // For the standard or enterprise edition, create a region object.
  public static final Region REGION_CN_NORTH_4 = new Region(REGION_ID, ENDPOINT);
  public static void main(String[] args) {
    String ak = "<YOUR AK>";
    String sk = "<YOUR SK>";
    String projectId = "<YOUR PROJECTID>";
    // Create a credential.
    ICredential auth = new
    BasicCredentials().withDerivedPredicate(AbstractCredentials.DEFAULT_DERIVED_PREDICATE)
      .withAk(ak)
      .withSk(sk)
      .withProjectId(projectId);
    // Create and initialize an IoTDA client instance.
    IoTDAClient client = IoTDAClient.newBuilder().withCredential(auth)
      // For the basic edition, select the region object in IoTDARegion.
      // .withRegion(IoTDARegion.CN_NORTH_4)
      // For the standard or enterprise edition, create a region object.
      .withRegion(REGION_CN_NORTH_4).build();
    // Instantiate a request object.
    CreateMessageRequest request = new CreateMessageRequest();
    request.withDeviceId("<YOUR DEVICE ID>");
    DeviceMessageRequest body = new DeviceMessageRequest();
    body.withMessage("<YOUR DEVICE MESSAGE>");
    request.withBody(body);
```

```

try {
    CreateMessageResponse response = client.createMessage(request);
    System.out.println(response.toString());
} catch (ConnectionException e) {
    e.printStackTrace();
} catch (RequestTimeoutException e) {
    e.printStackTrace();
} catch (ServiceResponseException e) {
    e.printStackTrace();
    System.out.println(e.getHttpStatusCode());
    System.out.println(e.getRequestId());
    System.out.println(e.getErrorCode());
    System.out.println(e.getErrorMsg());
}
}
}

```

Table 5-4 Parameters

| Parameter | Description |
|-------------------------|---|
| ak | Access key ID (AK) of your Huawei Cloud account. You can create and check your AK/SK on the My Credentials > Access Keys page of the Huawei Cloud console. For details, see Access Keys . |
| sk | Secret access key (SK) of your Huawei Cloud account. |
| projectId | Project ID. For details on how to obtain a project ID, see Obtaining a Project ID . |
| IoTDARRegion.CN_NORTH_4 | Region where the platform to be accessed is located. The available regions of the platform have been defined in the SDK code IoTDARRegion.java . On the console, you can view the region name of the current service and the mapping between regions and endpoints. For details, see Platform Connection Information . |
| REGION_ID | If CN East-Shanghai1 is used, enter cn-east-3 . If CN North-Beijing4 is used, enter cn-north-4 . If CN South-Guangzhou is used, enter cn-south-4 . |
| ENDPOINT | On the console, choose Overview and click Access Addresses to view the HTTPS application access address. |
| DEVICE_ID | Unique ID of the device that a message is delivered to. The value of this parameter is allocated by the platform during device registration. The value is a string of no more than 128 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed. |

----End

In the example, JDK 1.8 or a later version is used. [Download an SDK](#). Configure the Java SDK on the device:

Step 1 Configure the Maven dependency of the SDK on devices.

```

<dependency>
  <groupId>com.huaweicloud</groupId>

```

```
<artifactId>iot-device-sdk-java</artifactId>
<version>1.1.4</version>
</dependency>
```

Step 2 Configure the SDK and device connection parameters on devices.

```
// Load the CA certificate of the IoT platform. For details about how to obtain the certificate, visit https://support.huaweicloud.com/intl/en-us/devg-iotHub/iot\_02\_1004.html.
URL resource = BroadcastMessageSample.class.getClassLoader().getResource("ca.jks");
File file = new File(resource.getPath());

// The format is ssl://Domain name:Port number.
// To obtain the domain name, log in to the Huawei Cloud IoTDA console. In the navigation pane, choose
Overview and click Access Details in the Instance Information area. Select the access domain name
corresponding to port 8883.
String serverUrl = "ssl://localhost:8883";
// Device ID created on the platform
String deviceId = "deviceId";
// Secret corresponding to the device ID
String deviceSecret = "secret";
// Create a device.
IoTDevice device = new IoTDevice(serverUrl, deviceId, deviceSecret, file);
if (device.init() != 0) {
    return;
}
```

Step 3 Define the message delivery callback function.

```
client.setDeviceMessageListener(deviceMessage -> {
    log.info("the onDeviceMessage is {}", deviceMessage.toString());
});
```

----End

Verify the setting:

Step 1 On the IoTDA console, click the target instance card. In the navigation pane, choose **Devices > All Devices**. On the displayed page, locate the target device, and click **View** in the **Operation** column to access its details page. Click the **Message Trace** tab, and click **Start Trace**.

Figure 5-21 Message tracing - Starting message tracing

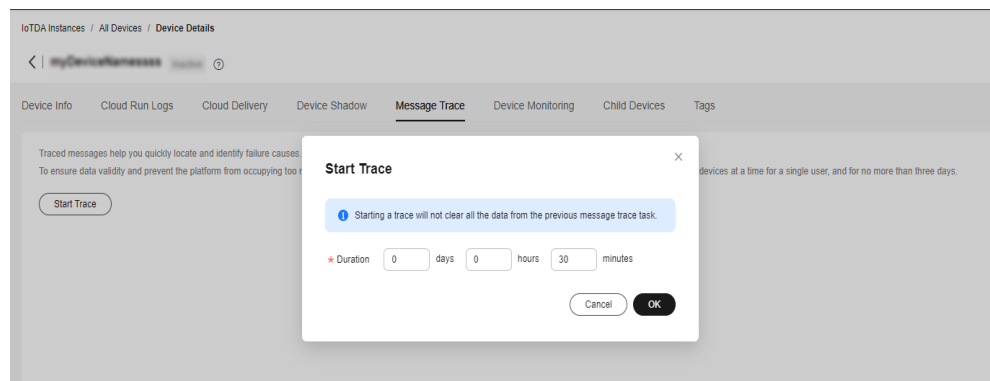
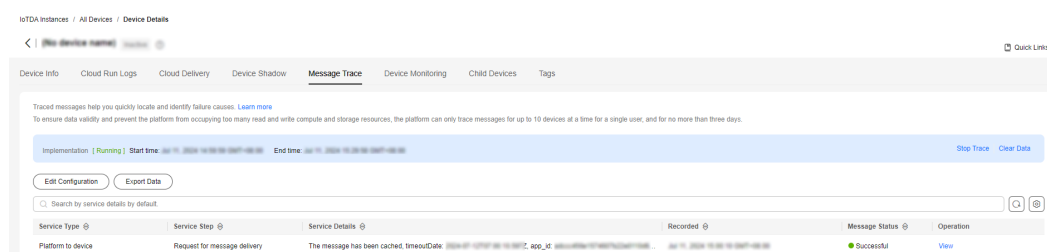
**Step 2** Run the SDK code on the application and deliver a message. The following is an example of the response from the platform.

Figure 5-22 Response indicating the delivery success of the application message

```
class CreateMessageResponse {
  messageId: 8a33c102-3ece-471c-ad87-96313daa0e53
  result: class MessageResult {
    status: PENDING
    createTime: 20230606T083644Z
    finishedTime: null
  }
}
```

Step 3 The record can be checked on the **Message Trace** tab page.

Figure 5-23 Message tracing - Caching delivered messages

Step 4 Run the SDK code on the device. The following is an example of the log format when the device receives a message.

Figure 5-24 Device receiving messages

```
D:\JDK\bin\java.exe ...
2023-05-22 16:56:52 INFO AbstractService:73 - create device, the deviceId is test333
2023-05-22 16:56:52 INFO MqttConnection:204 - try to connect to tcp://...
2023-05-22 16:56:53 INFO MqttConnection:220 - connect success, the url is tcp://...
2023-05-22 16:56:53 INFO MqttConnection:208 - publish message topic is $oc/devices/test333/sys/events/up, msg = {"object_device_id":"test333","services":[{"paras":{"type":"DEVICE_STATUS","content":...
2023-05-22 16:56:53 INFO MqttConnection:111 - Mqtt client connected, address is tcp://...
2023-05-22 16:56:53 INFO MqttConnection:208 - publish message topic is $oc/devices/test333/sys/events/up, msg = {"object_device_id":"test333","services":[{"paras":{"device_sdk_version":"JAVA_v1.2.0"
2023-05-22 16:56:53 INFO MqttConnection:208 - publish message topic is $oc/devices/test333/sys/events/up, msg = {"object_device_id":"test333","services":[{"paras":{"type":"DEVICE_STATUS","content":...
2023-05-22 16:56:53 INFO MqttConnection:91 - messageArrived topic = $oc/devices/test333/sys/properties/set/request_id=5c7f4e5a-0e8b-4d16-a763-559215871056, msg = {"services":[{"properties":{"51af452
2023-05-22 16:56:53 INFO MqttConnection:208 - publish message topic is $oc/devices/test333/sys/properties/set/request_id=5c7f4e5a-0e8b-4d16-a763-559215871056, msg = {"result_code":0,"result
2023-05-22 16:56:55 INFO MqttConnection:91 - messageArrived topic = $oc/devices/test333/sys/messages/down, msg = {"name":null,"id":"e2c1d4-8370-4330-86c2-920899b70bac","content":"HelloWorld"}
2023-05-22 16:56:55 INFO ReportDeviceLogSample:37 - the onDeviceMessage is {"name":null,"id":"e2c1d4-8370-4330-86c2-920899b70bac","content":"HelloWorld","object_device_id":null}
```

----End

5.2.3 Property Delivery

Overview

Property delivery is used for property query or modification. An application or the platform can obtain device property information or modify the properties, and synchronize the modification result to the device. After receiving a message, the device needs to return the property execution result to the platform in a timely manner. If the device does not respond, the platform considers that the property delivery times out.

Scenarios

- The platform proactively obtains or modifies device properties.

- The platform standardizes, parses, and filters the data.

Constraints

- Max. size of a single message: 64 KB.
- **Product models** are required.

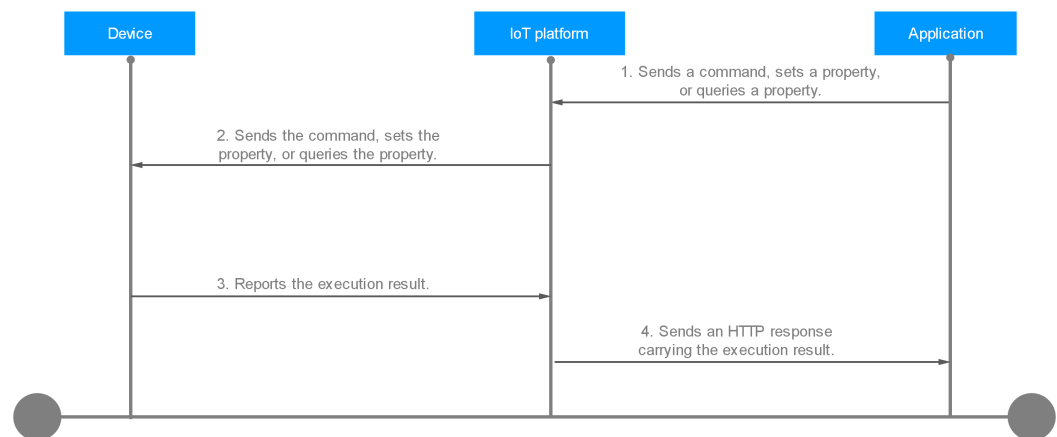
APIs

- **Platform Setting Device Properties**
- **Platform Querying Device Properties**

Property Delivery Usage

Property delivery is used for property modification or query. The following uses property modification as an example.

Figure 5-25 Process of property delivery



1. An application calls the API for **modifying device properties** to deliver a request to the platform. Example message:

```

PUT https://{endpoint}/v5/iot/{project_id}/devices/{device_id}/properties
{
  "services" : [ {
    "service_id" : "Temperature",
    "properties" : {
      "value" : 57
    }
  }, {
    "service_id" : "Battery",
    "properties" : {
      "level" : 80
    }
  }
]
}
    
```

2. The platform sends the property to the device according to the protocol specifications. The following is an example of **setting properties** through the APIs for MQTT devices.

```

Topic: $oc/devices/{device_id}/sys/properties/set/request_id={request_id}
Data format:
{
  "object_device_id": "{object_device_id} ",
  "services": [
    
```

```
{
  "service_id": "Temperature",
  "properties": {
    "value": 57,
    "value2": 60
  }
},
{
  "service_id": "Battery",
  "properties": {
    "level": 80,
    "level2": 90
  }
}
]
```

3. The device executes the command and returns the execution result. Example message:

```
Topic: $oc/devices/{device_id}/sys/properties/set/response/request_id={request_id}
Data format:
{
  "result_code": 0,
  "result_desc": "success"
}
```

4. The platform synchronously sends a response to the HTTP command. Example message:

```
Status Code: 200 OK
Content-Type: application/json
{
  "response" : {
    "result_code" : 0,
    "result_desc" : "success"
  }
}
```

Using the Java SDK for Property Delivery

This section describes how to use the Java SDK for the development of property configuration. [Download an SDK](#). JDK 1.8 or later is used.

Configure the SDK on the application side:

- Step 1** Configure the Maven dependency.

```
<dependency>
  <groupId>com.huaweicloud.sdk</groupId>
  <artifactId>huaweicloud-sdk-core</artifactId>
  <version>[3.0.40-rc, 3.2.0)</version>
</dependency>
<dependency>
  <groupId>com.huaweicloud.sdk</groupId>
  <artifactId>huaweicloud-sdk-iotda</artifactId>
  <version>[3.0.40-rc, 3.2.0)</version>
</dependency>
```

- Step 2** Set the device properties on the application by referring to the following example.

```
public class AttributeDistributionSolution {
  // REGION_ID: If CN East-Shanghai1 is used, enter cn-east-3. If CN North-Beijing4 is used, enter cn-north-4. If CN South-Guangzhou is used, enter cn-south-4.
  private static final String REGION_ID = "<YOUR REGION ID>";
  // ENDPOINT: On the console, choose Overview and click Access Addresses to view the HTTPS application access address.
  private static final String ENDPOINT = "<YOUR ENDPOINT>";
  // For the standard or enterprise edition, create a region object.
  public static final Region REGION_CN_NORTH_4 = new Region(REGION_ID, ENDPOINT);
  public static void main(String[] args) {
```

```

String ak = "<YOUR AK>";
String sk = "<YOUR SK>";
String projectId = "<YOUR PROJECTID>";
// Create a credential.
ICredential auth = new
BasicCredentials().withDerivedPredicate(AbstractCredentials.DEFAULT_DERIVED_PREDICATE)
    .withAk(ak)
    .withSk(sk)
    .withProjectId(projectId);
// Create and initialize an IoTDAClient instance.
IoTDAClient client = IoTDAClient.newBuilder().withCredential(auth)
    // For the basic edition, select the region object in IoTDARegion.
    //withRegion(IoTDARegion.CN_NORTH_4)
    // For the standard or enterprise edition, create a region object.
    .withRegion(REGION_CN_NORTH_4).build();
// Instantiate a request object.
UpdatePropertiesRequest request = new UpdatePropertiesRequest();
request.withDeviceId("<YOUR DEVICE_ID>");
DevicePropertiesRequest body = new DevicePropertiesRequest();
body.withServices("[{"service_id": "smokeDetector", "properties": {"alarm": "hello", "
    "temperature": 10.323, "humidity": 654.32, "smokeConcentration": 342.4}}]");
request.withBody(body);
try {
    UpdatePropertiesResponse response = client.updateProperties(request);
    System.out.println(response.toString());
} catch (ConnectionException e) {
    e.printStackTrace();
} catch (RequestTimeoutException e) {
    e.printStackTrace();
} catch (ServiceResponseException e) {
    e.printStackTrace();
    System.out.println(e.getStatusCode());
    System.out.println(e.getRequestId());
    System.out.println(e.getErrorCode());
    System.out.println(e.getErrorMsg());
}
}
}

```

Table 5-5 Parameters

| Parameter | Description |
|------------------------|--|
| ak | Access key ID (AK) of your Huawei Cloud account. You can create and check your AK/SK on the My Credentials > Access Keys page of the Huawei Cloud console. For details, see Access Keys . |
| sk | Secret access key (SK) of your Huawei Cloud account. |
| projectId | Project ID. For details on how to obtain a project ID, see Obtaining a Project ID . |
| IoTDARegion.CN_NORTH_4 | Region where the platform to be accessed is located. The available regions of the platform have been defined in the SDK code IoTDARegion.java . On the console, you can view the region name of the current service and the mapping between regions and endpoints. For details, see Platform Connection Information . |
| REGION_ID | If CN East-Shanghai1 is used, enter cn-east-3 . If CN North-Beijing4 is used, enter cn-north-4 . If CN South-Guangzhou is used, enter cn-south-4 . |

| Parameter | Description |
|-----------|--|
| ENDPOINT | On the console, choose Overview and click Access Addresses to view the HTTPS application access address. |
| DEVICE_ID | Unique ID of the device that a message is delivered to. The value of this parameter is allocated by the platform during device registration. The value is a string of no more than 128 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed. |

----End

Configure the SDK on the device side:

Step 1 Configure the Maven dependency of the SDK on devices.

```
<dependency>
  <groupId>com.huaweicloud</groupId>
  <artifactId>iot-device-sdk-java</artifactId>
  <version>1.1.4</version>
</dependency>
```

Step 2 Configure the SDK and device connection parameters on devices.

```
// Load the CA certificate of the IoT platform. For details about how to obtain the certificate, visit https://support.huaweicloud.com/intl/en-us/devg-iotHub/iot\_02\_1004.html.
URL resource = AttributeSample.class.getClassLoader().getResource("ca.jks");
File file = new File(resource.getPath());

// Format: ssl://Domain name:Port number
// To obtain the domain name, log in to the Huawei Cloud IoTDA console. In the navigation pane, choose Overview and click Access Details in the Instance Information area. Select the access domain name corresponding to port 8883.
String serverUrl = "ssl://localhost:8883";
// Device ID created on the platform
String deviceId = "deviceId";
// Secret corresponding to the device ID
String deviceSecret = "secret";
// Create a device.
IoTDevice device = new IoTDevice(serverUrl, deviceId, deviceSecret, file);
if (device.init() != 0) {
    return;
}
```

Step 3 Define the property delivery callback function.

```
device.getClient().setPropertyListener(new PropertyListener() {

    // Process property writing.
    @Override
    public void onPropertiesSet(String requestId, List<ServiceProperty> services) {

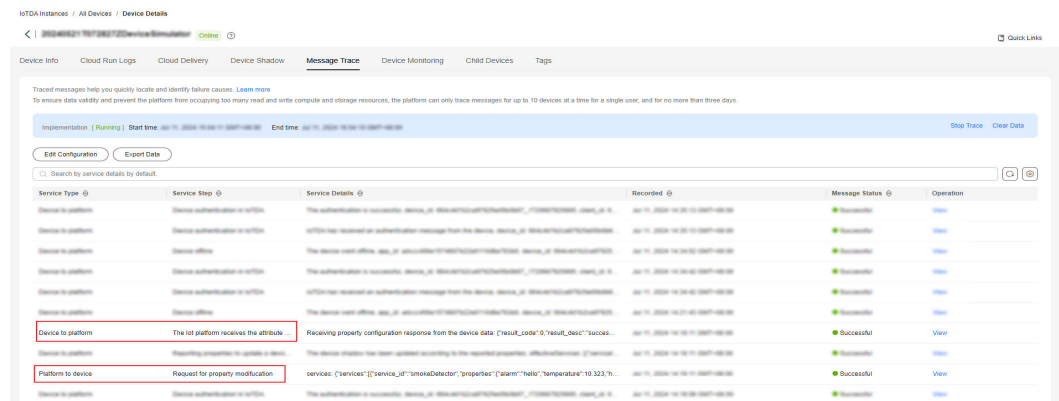
        // Traverse services.
        for (ServiceProperty serviceProperty: services){

            log.info("OnPropertiesSet, servid = " + serviceProperty.getServiceId());

            // Traverse properties.
            for (String name :serviceProperty.getProperties().keySet()){
                log.info("property name = "+ name);
                log.info("set property value = "+ serviceProperty.getProperties().get(name));
                if (name.equals("alarm")){
                    // Change the local value.
                    alarm = (Integer) serviceProperty.getProperties().get(name);
                }
            }
        }
    }
});
```


Step 4 Check the result on the **Message Trace** tab page.

Figure 5-28 Message tracing - Delivering properties



----End

5.2.4 Command Delivery

Overview

A product model defines commands that can be delivered to the devices. Applications can call platform APIs to deliver commands to the devices to effectively manage these devices.

IoTDA supports synchronous and asynchronous command delivery.

Table 5-6 Command delivery

| Mechanism | Description | Scenario | Devices Using LwM2M over CoAP | Devices Using MQTT |
|------------------------------|--|--|-------------------------------|--------------------|
| Synchronous command delivery | An application calls the synchronous command delivery API to deliver a command to a specified device for device control. The platform sends the command to the device and returns the command execution result in an HTTP request to the application. If the device does not respond, the platform returns a timeout message to the application. | Applicable to commands that must be executed in real time, for example, turning on a street lamp or closing a gas meter switch. Applications should determine the appropriate time to deliver a command. | Not applicable | Applicable |

| Mechanism | Description | Scenario | Devices Using LwM2M over CoAP | Devices Using MQTT |
|-------------------------------|--|---|-------------------------------|--------------------|
| Asynchronous command delivery | <p>An application calls the asynchronous command delivery API to deliver a command to a specified device for device control. The platform sends the command to the device and asynchronously pushes the command execution result to the application.</p> <p>Asynchronous command delivery is classified into immediate delivery and delayed delivery.</p> <ul style="list-style-type: none"> In immediate delivery, the platform delivers commands to a device regardless of whether the device is online. If the device is offline or the device does not receive the command, the delivery fails. In delayed delivery, the platform caches a command and delivers it to a device when the device goes online or reports data. If a device has multiple pending commands, the platform delivers the commands in sequence. | <ul style="list-style-type: none"> Immediate delivery applies to scenarios with high real-time requirements. Delayed delivery applies to commands that do not need to be executed immediately, for example, configuring water meter parameters. | Applicable | Not applicable |

 NOTE

For details, see [Synchronous Command Delivery](#) and [Asynchronous Command Delivery](#).

Scenarios

- Synchronous delivery applies to scenarios that require real-time command delivery. Asynchronous delivery is used for device control.
- Data needs to be forwarded to other Huawei Cloud services for storage and processing based on [data forwarding rules](#).

Constraints

- Max. size of a single message: 256 KB.
- [Product models](#) are required.
- Devices need to respond to the synchronous command within 20 seconds.
- Up to 20 asynchronous commands can be cached at a time.
- Max. cache duration (configurable): 48 hours.

APIs

- APIs for the platform and applications
 - [Deliver a Command to a Device](#)
 - [Deliver an Asynchronous Command](#)
 - [Query a Command with a Specific ID](#)
- APIs for MQTT devices
 - [Platform Delivering a Command](#)
 - [Platform Delivering a Message](#).
- APIs for devices using LwM2M over CoAP
 - [Platform Delivering a Command](#)

Synchronous Command Delivery

You can deliver synchronous commands to MQTT devices one by one or in batches.

Table 5-7 Synchronous command delivery

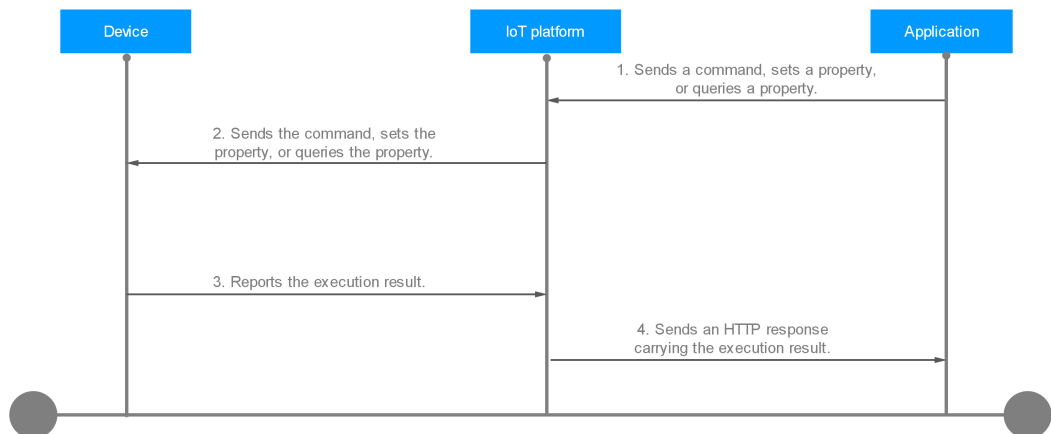
| Type | Description | Scenario | Example |
|--|--|---|---|
| Synchronous command delivery to a single MQTT device | IoTDA delivers a control command to a single device. | The function is used to deliver a control command to a single device. | Synchronous Command Delivery to an Individual MQTT Device |

| Type | Description | Scenario | Example |
|---|---|---|--|
| Synchronous command delivery to a batch of MQTT devices | IoTDA delivers control commands to devices in batches. You can create a batch task to perform operations on multiple devices at a time. | The function is used to deliver control commands to devices in batches. | Synchronous Command Delivery to a Batch of MQTT Devices |

Synchronous Command Delivery to an Individual MQTT Device

For details on how to set and query properties, see instructions of the APIs for [querying device properties](#) and [modifying device properties](#).

Figure 5-29 Command delivery process



1. An application calls the API for [delivering a command to a device](#) to send a command to the platform. Example message:

```

POST https://{Endpoint}/v5/iot/{project_id}/devices/{device_id}/commands
Content-Type: application/json
X-Auth-Token: *****
    
```

```

{
  "service_id": "WaterMeter",
  "command_name": "ON_OFF",
  "paras": {
    "value": "ON"
  }
}
    
```

2. The platform sends the command to the device according to the protocol specifications. Example message:

```

Topic: $oc/devices/{device_id}/sys/commands/request_id={request_id}
Data format:
{
  "object_device_id": "{object_device_id}",
  "command_name": "ON_OFF",
  "service_id": "WaterMeter",
  "paras": {
    "value": "ON"
  }
}
    
```

- After executing the command, the device returns the command execution result through the API for [delivering a command](#). Example message:

Topic: \$oc/devices/{**device_id**}/sys/commands/response/request_id={**request_id**}

Data format:

```
{
  "result_code": 0,
  "response_name": "COMMAND_RESPONSE",
  "paras": {
    "result": "success"
  }
}
```

- The platform synchronously sends a response to the HTTP command. Example message:

Status Code: 200 OK

Content-Type: application/json

```
{
  "command_id" : "b1224afb-e9f0-4916-8220-b6bab568e888",
  "response" : {
    "result_code" : 0,
    "response_name" : "COMMAND_RESPONSE",
    "paras" : {
      "result" : "success"
    }
  }
}
```

Synchronous Command Delivery to a Batch of MQTT Devices

The API for [creating a batch task](#) can be used to deliver a command to multiple MQTT devices. The following describes how to call the API for [creating a batch task](#) to deliver commands in batches.

- An application calls the API for [creating a batch task](#) to send a command to the platform. Example message:

POST https://{**Endpoint**}/v5/iot/{**project_id**}/batchtasks

Content-Type: application/json

X-Auth-Token: *****

```
{
  "app_id": "*****",
  "task_name": "task123",
  "task_type": "createCommands",
  "targets": [
    "*****",
    "*****"
  ],
  "document": {
    "service_id": "water",
    "command_name": "ON_OFF",
    "paras": {
      "value": "ON"
    }
  }
}
```

Table 5-8 Parameters for creating a batch task of command delivery

| Parameter | Mandator y | Description |
|-----------|------------|--------------------|
| app_id | No | Resource space ID. |

| Parameter | Mandatory | Description |
|-----------|-----------|--|
| task_name | Yes | Custom task name. |
| task_type | Yes | Type of the batch task. For details, see Create a Batch Task . Options: <ul style="list-style-type: none"> createCommand: task for creating synchronous commands in batches createAsyncCommand: task for creating asynchronous commands in batches |
| targets | No | Device ID array, which is the target for executing the batch task. |
| document | No | Task execution data file, in JSON format (key-value pairs). For details, see Deliver a Command to a Device . |

- The platform returns a **201 Created** message to the application.
- The device receives the command and sends the command result to the platform through the upstream topic. For details, see [Platform Delivering a Command](#).
- Call the API for [querying the batch task list](#) to query the execution status of a batch command delivery task.

Asynchronous Command Delivery

Asynchronous command delivery is used for IoTDA or applications to deliver commands to devices using LwM2M over CoAP to access IoTDA. Two modes are available.

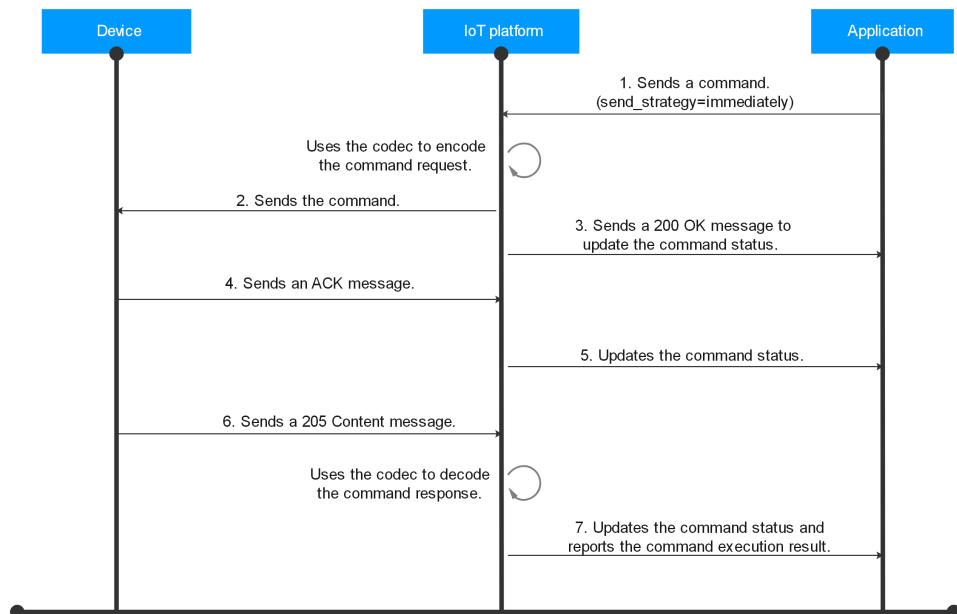
Table 5-9 Asynchronous command delivery

| Type | Description | Scenario | Process |
|---|---|---|---|
| Immediate delivery of asynchronous commands | IoTDA delivers commands to a device upon receiving a command regardless of whether the device is online. If the device is offline or the device does not receive the command, the delivery fails. | It is used in scenarios that have high requirements for timeliness. | Immediate Delivery of Asynchronous Commands |

| Type | Description | Scenario | Process |
|---|--|--|--|
| Delayed delivery of asynchronous commands | The platform caches a command and delivers it to a device when the device goes online or reports properties. If a device has multiple cached commands, the platform delivers the commands in sequence. | Delayed delivery applies to commands that do not need to be executed immediately, for example, configuring water meter parameters. | Delayed Delivery of Asynchronous Commands |

Immediate Delivery of Asynchronous Commands

Figure 5-30 Command delivery for devices using LwM2M over CoAP



An example of the corresponding steps is as follows:

1. An application calls the API for **delivering an asynchronous command** to send a command to the platform. The **send_strategy** parameter in the command request is set to **immediately**. Example message:

```

POST https://{endpoint}/v5/iot/{project_id}/devices/{device_id}/async-commands
Content-Type: application/json
X-Auth-Token: *****

{
  "service_id" : "WaterMeter",
  "command_name" : "ON_OFF",
  "paras" : {
    "value" : "ON"
  },
}
    
```

```
"expire_time": 0,  
"send_strategy": "immediately"  
}
```

- The platform uses the **codec** to encode the command request, and sends the command through the **Execute** operation of the device management and service implementation interface defined in the LwM2M protocol. The message body is in binary format.
- The platform sends a 200 OK message carrying the command status **SENT** to the application. (If the device is offline or the device does not receive the command, the delivery fails and the command status is **FAILED**.)
- The device returns an ACK message after receiving the command.
- If the application has subscribed to command status change notifications, the platform pushes a message to the application by calling the API for pushing a command status change notification. The command status carried in the message is **DELIVERED**. Example message:

```
Method: POST  
request:  
Body:  
{  
  "resource": "device.command.status",  
  "event": "update",  
  "event_time": "20200811T080745Z",  
  "notify_data": {  
    "header": {  
      "app_id": "*****",  
      "device_id": "*****",  
      "node_id": "test0001",  
      "product_id": "*****",  
      "gateway_id": "*****",  
      "tags": []  
    },  
    "body": {  
      "command_id": "*****",  
      "created_time": "20200811T080738Z",  
      "sent_time": "20200811T080738Z",  
      "delivered_time": "20200811T080745Z",  
      "response_time": "",  
      "status": "DELIVERED",  
      "result": null  
    }  
  }  
}
```

- After the command is executed, the device returns the command execution result in a 205 Content message.
- If the application has subscribed to command status change notifications, the platform uses the codec to decode the command response and sends a push message to the application by calling the API for pushing a command status change notification. The command status carried in the message is **SUCCESSFUL**. Example message:

```
Method: POST  
request:  
Body:  
{  
  "resource": "device.command.status",  
  "event": "update",  
  "event_time": "20200811T080745Z",  
  "notify_data": {  
    "header": {  
      "app_id": "*****",  
      "device_id": "*****",  
      "node_id": "test0001",  
      "product_id": "*****",  
      "tags": []  
    },  
    "body": {  
      "command_id": "*****",  
      "created_time": "20200811T080738Z",  
      "sent_time": "20200811T080738Z",  
      "delivered_time": "20200811T080745Z",  
      "response_time": "",  
      "status": "SUCCESSFUL",  
      "result": null  
    }  
  }  
}
```

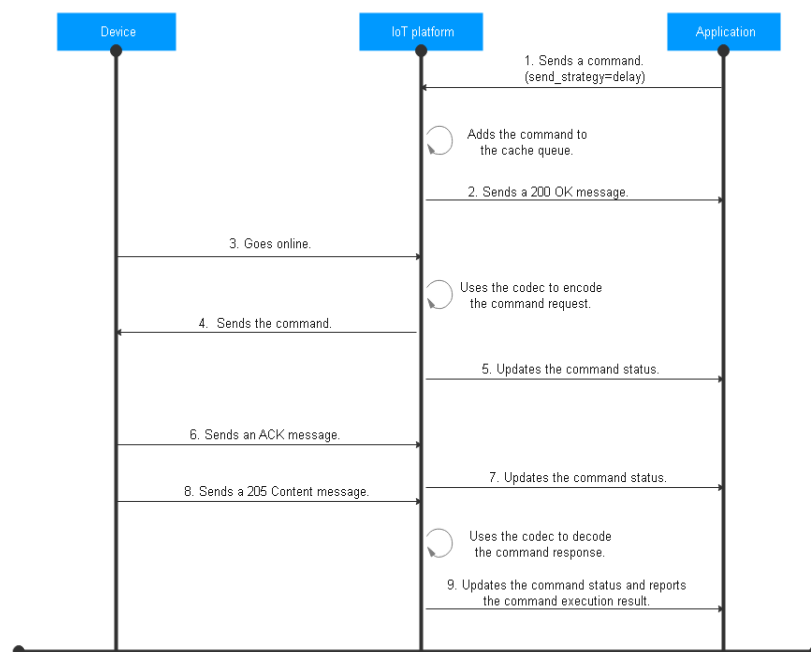
```

"gateway_id": "*****",
"tags": []
},
"body": {
  "command_id": "*****",
  "created_time": "20200811T080738Z",
  "sent_time": "20200811T080738Z",
  "delivered_time": "20200811T080745Z",
  "response_time": "20200811T081745Z",
  "status": "SUCCESSFUL",
  "result": {
    "resultCode": "SUCCESSFUL",
    "resultDetail": {
      "value": "ON"
    }
  }
}
}
}
}
}

```

Delayed Delivery of Asynchronous Commands

Figure 5-31 Delayed command delivery for devices using LwM2M over CoAP



1. An application calls the API for **delivering an asynchronous command** to send a command to the platform. The **send_strategy** parameter in the command request is set to **delay**.
2. The platform adds the command to the cache queue and reports a 200 OK message. The command status is **PENDING**.
3. The device goes online or reports data to the platform.
4. The platform uses the **codec** to encode the command request and sends the command to the device according to the protocol specifications.

5. If the application has subscribed to command status change notifications, the platform pushes a message to the application by calling the API for pushing a command status change notification. The command status carried in the message is **SENT**.
6. The subsequent flow is the same as 4 to 7 described in the immediate delivery scenario.

LwM2M/CoAP Device Command Execution Status

The figure below illustrates the command execution status and the table below describes the status change mechanism.

Figure 5-32 LwM2M/CoAP command delivery status

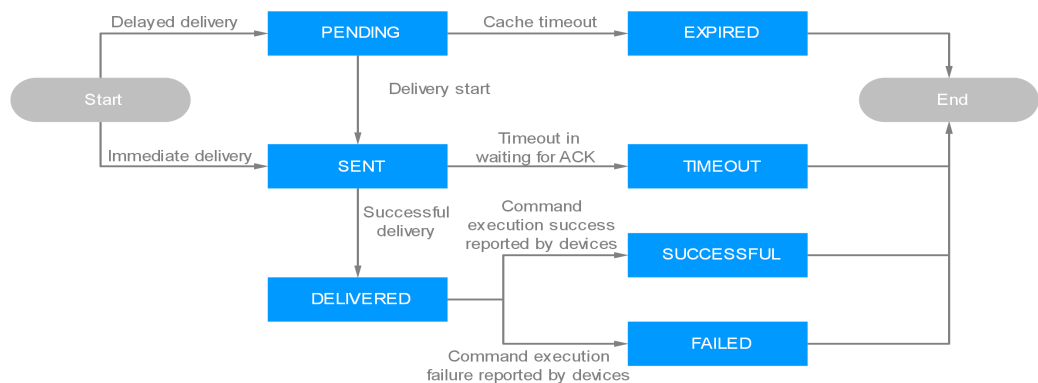


Table 5-10 LwM2M/CoAP command execution status

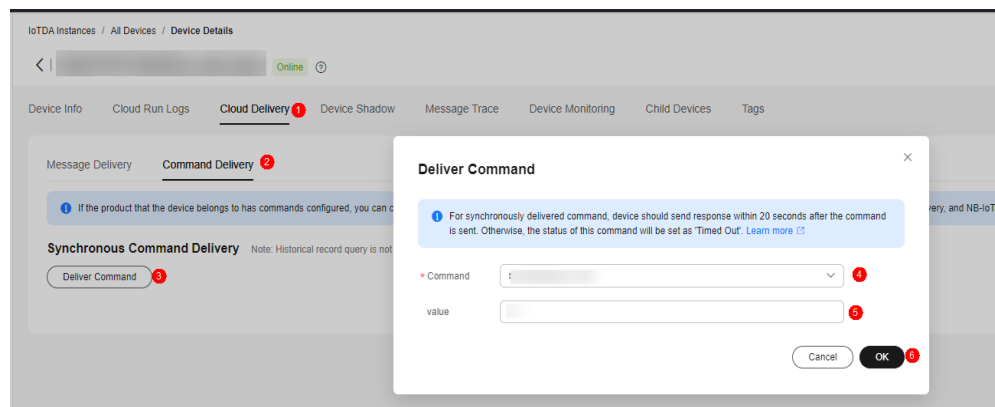
| Status | Description |
|---------|--|
| PENDING | <ul style="list-style-type: none"> • For a device using LwM2M over CoAP in delayed delivery mode, the platform caches a command if the device has not reported data. The command status is PENDING. • This status does not exist for devices using LwM2M over CoAP in immediate delivery mode. |
| EXPIRED | <ul style="list-style-type: none"> • For a device using LwM2M over CoAP in delayed delivery mode, if the platform does not deliver a command to the device within a specified time, the command status is EXPIRED. The expiration time is subject to the value of expireTime carried in the command request. If expireTime is not carried, the default value (24 hours) is used. • This status does not exist for devices using LwM2M over CoAP in immediate delivery mode. |

| Status | Description |
|------------|--|
| SENT | <ul style="list-style-type: none"> For a device using LwM2M over CoAP in delayed delivery mode, the platform sends a cached command when receiving data reported by the device. In this case, the command status changes from PENDING to SENT. For a device using LwM2M over CoAP in immediate delivery mode, if the device is online when the platform delivers a command, the command status is SENT. |
| TIMEOUT | If the platform does not receive a response within 180 seconds after delivering a command to a device using LwM2M over CoAP, the command status is TIMEOUT . |
| DELIVERED | If the platform receives a response from a device, the command status is DELIVERED . |
| SUCCESSFUL | If the platform receives a result indicating that the command is executed, the command status is SUCCESSFUL . |
| FAILED | <ul style="list-style-type: none"> If the platform receives a result indicating that the command execution failed, the command status is FAILED. For a device using LwM2M over CoAP in immediate delivery mode, if the device is offline when the platform delivers a command, the command status is FAILED. |

Platform Command Delivery Example

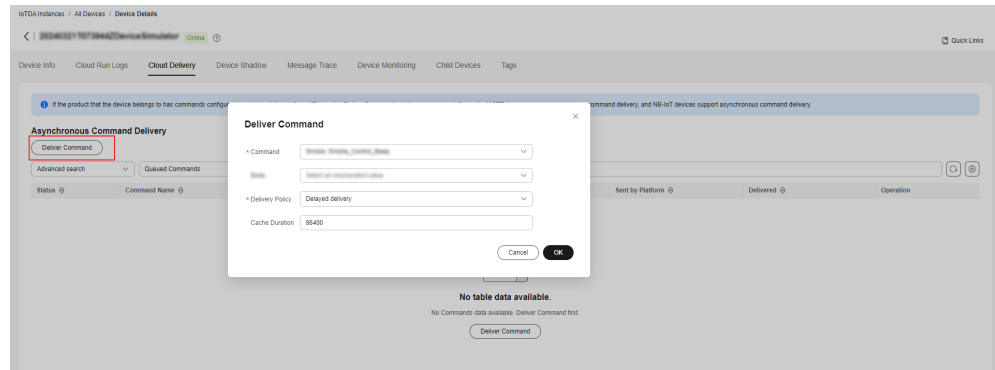
- Step 1** Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Devices > All Devices**. On the device list, click a device to access its details page.
- Step 3** The **Cloud Delivery** tab page varies according to the device protocol.
 - Devices using MQTT support only synchronous command delivery. Click **Command Delivery** on the right. In the displayed dialog box, select the command to be delivered and set command parameters.

Figure 5-33 Command delivery - Synchronous command delivery



- Devices using LwM2M over CoAP support only asynchronous command delivery. Click **Deliver Command** on the right. In the displayed dialog box, select the command to be delivered and set command parameters. You can choose to send the command immediately or after a delay.

Figure 5-34 Command delivery - Asynchronous command delivery



----End

NOTE

- On the **Message Trace** tab page, you can view the creation time, sending time, delivered time, and the delivery status of a command delivery task. This information helps you learn the **command execution status**.
- In addition, you can call the API for **querying a command with a specific ID** to query the status and content of delivered commands on the platform.

The application uses the Java SDK for the development of synchronous command delivery. The development environment used in the example is JDK 1.8 or later.
[Download an SDK.](#)

Step 1 Configure the Maven dependency.

```
<dependency>
  <groupId>com.huaweicloud.sdk</groupId>
  <artifactId>huaweicloud-sdk-core</artifactId>
  <version>[3.0.40-rc, 3.2.0]</version>
</dependency>
<dependency>
  <groupId>com.huaweicloud.sdk</groupId>
  <artifactId>huaweicloud-sdk-iotda</artifactId>
  <version>[3.0.40-rc, 3.2.0]</version>
</dependency>
```

Step 2 The following is an example of delivering a synchronous command:

```
public class CommandSolution {
  // REGION_ID: If CN East-Shanghai1 is used, enter cn-east-3. If CN North-Beijing4 is used, enter cn-north-4. If CN South-Guangzhou is used, enter cn-south-4.
  private static final String REGION_ID = "<YOUR REGION ID>";
  // ENDPOINT: On the console, choose Overview and click Access Addresses to view the HTTPS application access address.
  private static final String ENDPOINT = "<YOUR ENDPOINT>";
  // For the standard or enterprise edition, create a region object.
  public static final Region REGION_CN_NORTH_4 = new Region(REGION_ID, ENDPOINT);
  public static void main(String[] args) {
    String ak = "<YOUR AK>";
    String sk = "<YOUR SK>";
    String projectId = "<YOUR PROJECTID>";
    // Create a credential.
    ICredential auth = new
```

```

BasicCredentials().withDerivedPredicate(AbstractCredentials.DEFAULT_DERIVED_PREDICATE)
    .withAk(ak)
    .withSk(sk)
    .withProjectId(projectId);
// Create and initialize an IoTDAClient instance.
IoTDAClient client = IoTDAClient.newBuilder().withCredential(auth)
    // For the basic edition, select the region object in IoTDARegion.
    //withRegion(IoTDARegion.CN_NORTH_4)
    // For the standard or enterprise edition, create a region object.
    .withRegion(REGION_CN_NORTH_4).build();
// Instantiate a request object.
CreateCommandRequest request = new CreateCommandRequest();
request.withDeviceId("<YOUR_DEVICE_ID>");
DeviceCommandRequest body = new DeviceCommandRequest();
body.withParas("{\"value\":\"1\"}");
request.withBody(body);
try {
    CreateCommandResponse response = client.createCommand(request);
    System.out.println(response.toString());
} catch (ConnectionException e) {
    e.printStackTrace();
} catch (RequestTimeoutException e) {
    e.printStackTrace();
} catch (ServiceResponseException e) {
    e.printStackTrace();
    System.out.println(e.getHttpStatusCode());
    System.out.println(e.getRequestId());
    System.out.println(e.getErrorCode());
    System.out.println(e.getErrorMsg());
}
}
}

```

Table 5-11 Parameters

| Parameter | Description |
|------------------------|--|
| ak | Access key ID (AK) of your Huawei Cloud account. You can create and check your AK/SK on the My Credentials > Access Keys page of the Huawei Cloud console. For details, see Access Keys . |
| sk | Secret access key (SK) of your Huawei Cloud account. |
| projectId | Project ID. For details on how to obtain a project ID, see Obtaining a Project ID . |
| IoTDARegion.CN_NORTH_4 | Region where the platform to be accessed is located. The available regions of the platform have been defined in the SDK code IoTDARegion.java . On the console, you can view the region name of the current service and the mapping between regions and endpoints. For details, see Platform Connection Information . |
| REGION_ID | If CN East-Shanghai1 is used, enter cn-east-3 . If CN North-Beijing4 is used, enter cn-north-4 . If CN South-Guangzhou is used, enter cn-south-4 . |
| ENDPOINT | On the console, choose Overview and click Access Addresses to view the HTTPS application access address. |

| Parameter | Description |
|-----------|--|
| DEVICE_ID | Unique ID of the device that a message is delivered to. The value of this parameter is allocated by the platform during device registration. The value is a string of no more than 128 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed. |

----End

To configure the device to use the Java SDK to deliver synchronous commands, perform the following steps. In this example, JDK 1.8 or a later version is used.

Step 1 Configure the Maven dependency of the SDK on devices.

```
<dependency>
  <groupId>com.huaweicloud</groupId>
  <artifactId>iot-device-sdk-java</artifactId>
  <version>1.1.4</version>
</dependency>
```

Step 2 Configure the SDK and device connection parameters on devices.

```
// Load the CA certificate of the IoT platform. For details about how to obtain the certificate, visit https://support.huaweicloud.com/intl/en-us/devg-iotHub/iot\_02\_1004.html.
URL resource = BroadcastMessageSample.class.getClassLoader().getResource("ca.jks");
File file = new File(resource.getPath());

// The format is ssl://Domain name:Port number.
// To obtain the domain name, log in to the Huawei Cloud IoTDA console. In the navigation pane, choose Overview and click Access Details in the Instance Information area. Select the access domain name corresponding to port 8883.
String serverUrl = "ssl://localhost:8883";
// Device ID created on the platform
String deviceId = "deviceId";
// Secret corresponding to the device ID
String deviceSecret = "secret";
// Create a device.
IoTDevice device = new IoTDevice(serverUrl, deviceId, deviceSecret, file);
if (device.init() != 0) {
    return;
}
```

Step 3 Set the command delivery callback function and send a response.

```
client.setCommandListener(new CommandListener() {
    @Override
    public void onCommand(String requestId, String deviceId, String commandName, Map<String, Object> paras) {
        log.info("onCommand, deviceId = " + deviceId);
        log.info("onCommand, name = " + commandName);
        log.info("onCommand, paras = " + paras.toString());

        // Define the processing command.

        // Send a command response.
        device.getClient().respondCommand(requestId, new CommandResp(0));
    }
});
```

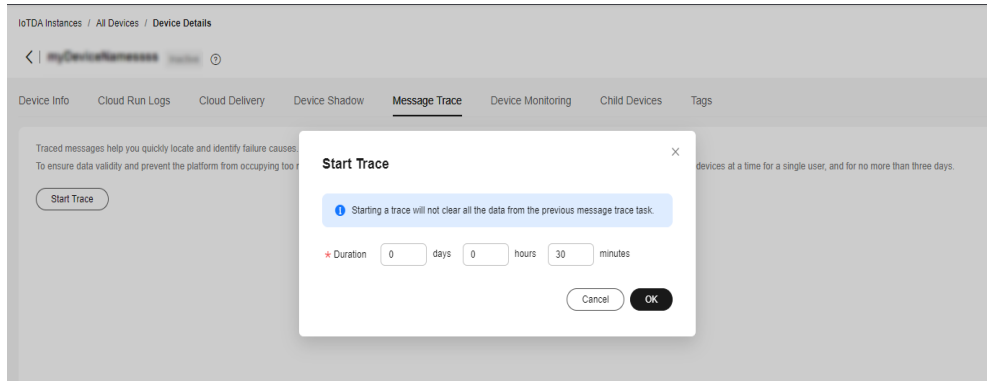
----End

Verify the setting:

Step 1 On the IoTDA console, click the target instance card. In the navigation pane, choose **Devices > All Devices**. On the displayed page, locate the target device,

and click **View** in the **Operation** column to access its details page. Click the **Message Trace** tab, and click **Start Trace**.

Figure 5-35 Message tracing - Starting message tracing



Step 2 Run the SDK code on the device to bring the device online.

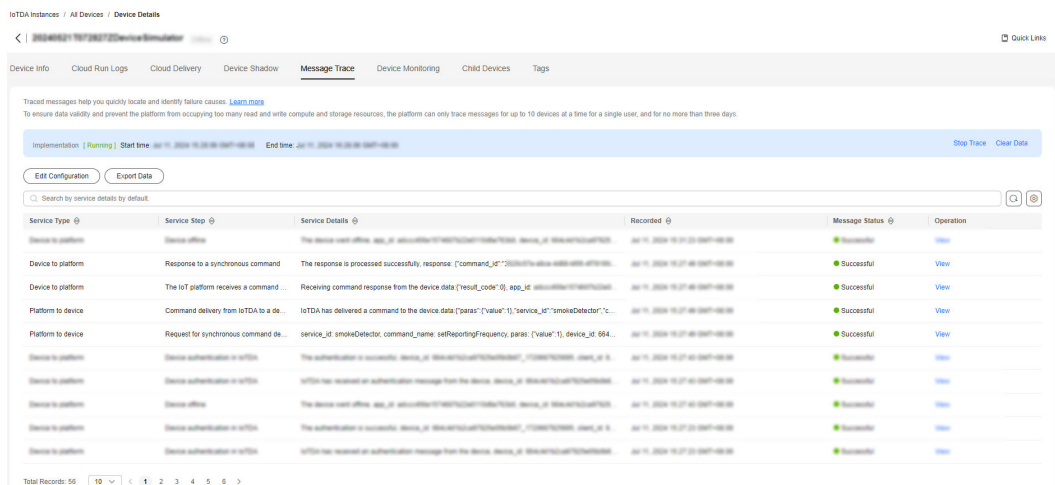
Step 3 Run the application code. After receiving a command, the device processes and responds to the command. The following is an example of a command received by the device.

Figure 5-36 Successful command delivery result on the device

```
2023-05-22 17:48:38 INFO NetConnection:95 - messageReceived topic = $ev/devices/test333/sys/commands/request/request_id=8373c582-5dca-4973-8ba8-90d1b84f1a2, msg = {"paras":{"LED":"1"},"service_id":"null","command_name":"null"}
2023-05-22 17:48:38 INFO ReportDeviceLogSample:46 - onCommand, serviceId = null
2023-05-22 17:48:38 INFO ReportDeviceLogSample:46 - onCommand, name = null
2023-05-22 17:48:38 INFO ReportDeviceLogSample:47 - onCommand, paras = {"LED":"1"}
2023-05-22 17:48:38 INFO NetConnection:96 - publish message topic is $ev/devices/test333/sys/commands/response/request_id=8373c582-5dca-4973-8ba8-90d1b84f1a2, msg = {"paras":{"result_code":"0","response_name":"null"}}
```

Step 4 Check the result on the **Message Trace** tab page.

Figure 5-37 Message tracing - Delivering commands



----End

5.3 Custom Topic Communications

5.3.1 Overview

Introduction

IoTDA uses topics to communicate with devices connected using MQTT. There are custom topics and system topics. System topics are basic communications topics preconfigured on the platform. You can also customize topics on the platform based on service requirements. Note that message through both custom topics and system topics are transparently transmitted on the platform, which means that the platform does not proactively parse data content.

Table 5-12 Topic categories

| Category | Description | Scenario |
|--------------|--|---|
| System topic | The platform predefines topics for communications with devices. For details of the topic list and functions, see Topics . | Message reporting, property reporting, command delivery, and events |
| Custom topic | You can customize topics for device-platform communications. Types of custom topics: <ul style="list-style-type: none">• Custom Topics Starting with \$oc: Topics defined in the product are prefixed with \$oc/devices/{device_id}/user/. During message reporting or delivery, the platform checks whether the topic is defined in the product. Undefined topics will be rejected by the platform.• Custom Topics Not Starting with \$oc: Topics that do not start with \$oc, for example, /aircondition/data/up. They are used for upstream and downstream message communications based on MQTT rules. The platform checks the topic permission using topic policies. | Scenarios where services require specific topics, such as M2M communications , broadcast communications , and device migration. |

Scenarios

- Devices publish messages to custom topics. Applications smoothly [forward data](#) to message middleware, storage, data analysis, and service applications.
- An application calls the API for [delivering a message to a device](#) to publish messages to a specified custom topic. The device subscribes to this topic to receive messages from the server.
- [M2M communications](#), [broadcast communications](#), and device migration.

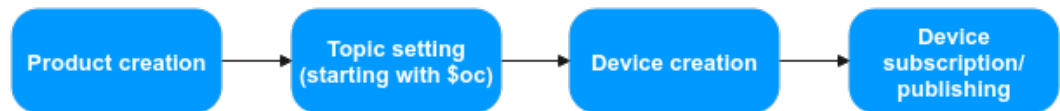
Constraints

- You can define a maximum of 50 custom topics for a product model.
- Custom topics are only available for message communications.
- Max. length of a custom MQTT topic: 128 bytes.

5.3.2 Custom Topics Starting with \$oc

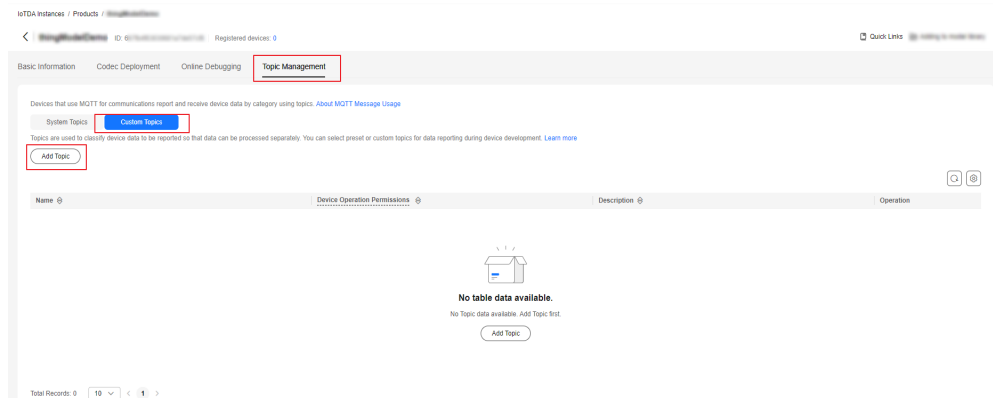
Process

Figure 5-38 Communications with custom topics starting with \$oc



- Step 1** Product creation: Access the **IoTDA** service page and click **Access Console**. Click the target instance card. For details, see **Creating a Product**.
- Step 2** Topic setting: On the product details page, create a custom topic prefixed with **\$oc/devices/{device_id}/user/**.
1. Select an MQTT product. On the product details page, click the **Topic Management** tab, select **Custom Topic**, and click **Add Topic**.

Figure 5-39 Topic management - Custom topics



2. In the displayed dialog box, select device operation permissions and enter the topic name.

Figure 5-40 Topic management - Adding a custom topic

Add Topic

✕

i Prefixes of topics defined in products are fixed at `$oc/devices/{device_id}/user/`. Replace `{device_id}` with the actual device ID during publish and subscription. A custom topic can contain up to 128 bytes and must be in a slash-separated format.

Custom topics with non-fixed prefixes (for example, `/aircondition/data/up`) cannot be added here. [Learn more>>](#)

* Name `$oc/devices/{device_id}/user/`

* Device Operation Permissions ▼

Description 0/256 ↵

Cancel
OK

Table 5-13 Parameters

| Parameter | Description |
|------------------------------|---|
| Name | <p>The topic prefix is fixed at <code>\$oc/devices/{device_id}/user/</code>. Replace <code>{device_id}</code> with the actual device ID during publishing and subscription. A custom topic must be in a slash-separated format.</p> <p>Enter 1 to 64 characters. Use only digits, letters, underscores (<code>_</code>), and slashes (<code>/</code>). The slashes cannot be consecutive.</p> <p>NOTE Custom topics do not support custom variables. For example, <code>{type}</code> in <code>\$oc/devices/{device_id}/user/setting/{type}</code> is a variable and is not supported.</p> |
| Device Operation Permissions | <ul style="list-style-type: none"> – Publish: Devices can report messages using this topic. A topic is carried in a device message during data transfer for better classification. – Subscribe: Applications can specify a topic to deliver messages to devices. – Publish and subscription: Devices can report and receive messages using this topic. |

| Parameter | Description |
|-------------|-------------------------------------|
| Description | Provide a description of the topic. |

3. Click **OK**. After the topic is added, you can modify or delete it in the custom topic list.

Step 3 Device creation: Create a device under the product. The created device inherits the custom topics set for the product. For details, see [Registering an Individual Device](#).

Step 4 Device subscription/publishing: For details about how to publish and subscribe to messages through custom topics, see [Using a Custom Topic for Communication](#).

----End

Java SDK Usage on the Device Side

Devices can integrate the [device SDKs](#) provided by Huawei Cloud IoT to quickly connect to Huawei Cloud IoTDA and report messages. The following example uses the Java SDK to connect a device to IoTDA for publishing and subscribing to messages through the custom topic `$oc/devices/ + device.getDeviceld() + /user/wpy`.

1. Configure the Maven dependency of the SDK on the device.

```
<dependency>
  <groupId>com.huaweicloud</groupId>
  <artifactId>iot-device-sdk-java</artifactId>
  <version>1.1.4</version>
</dependency>
```

2. Configure the SDK and device connection parameters on the device.

```
// Load the CA certificate of the IoT platform. For details about how to obtain the certificate, visit
https://support.huaweicloud.com/intl/en-us/devg-iothub/iot\_02\_1004.html.
URL resource = MessageSample.class.getClassLoader().getResource("ca.jks");
File file = new File(resource.getPath());

// The format is ssl://Domain name:Port number.
// To obtain the domain name, log in to the Huawei Cloud IoTDA console. In the navigation pane,
choose Overview and click Access Details in the Instance Information area. Select the access
domain name corresponding to port 8883.
String serverUrl = "ssl://localhost:8883";
// Device ID created on the IoT platform
String deviceld = "deviceld";
// Secret corresponding to the device ID
String deviceSecret = "secret";
// Initialize the device connection.
IoTDevice device = new IoTDevice(serverUrl, deviceld, deviceSecret, file);
if (device.init() != 0) {
  return;
}
```

3. Report a device message.

```
device.getClient().publishRawMessage(new RawMessage( "$oc/devices/" + device.getDeviceld() + "/"
user/wpy", "hello", 1), new ActionListener() {
  @Override
  public void onSuccess(Object context) {
    System.out.println("reportDeviceMessage success: ");
  }
  @Override
  public void onFailure(Object context, Throwable var2) {
    System.out.println("reportDeviceMessage fail: " + var2);
  }
});
```

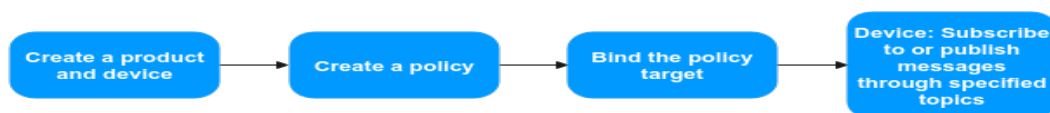
4. Subscribe to the topic.

```
device.getClient().subscribeTopic(new RawMessage("$oc/devices/" + device.getDeviceId() + "/user/  
wpy", new ActionListener() {  
    @Override  
    public void onSuccess(Object context) {  
        System.out.println("subscribeTopic success: ");  
    }  
    @Override  
    public void onFailure(Object context, Throwable var2) {  
        System.out.println("subscribeTopic fail: " + var2);  
    }  
}, 0);
```

5.3.3 Custom Topics Not Starting with \$oc

Process

Figure 5-41 Communications with custom topics not starting with \$oc



NOTE

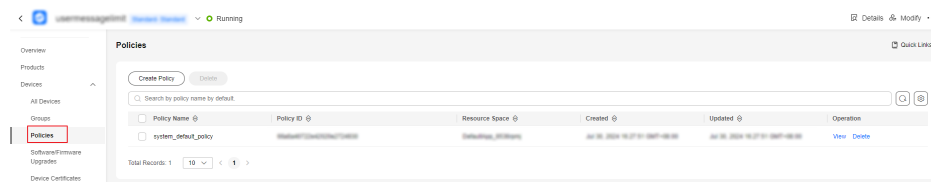
- By default, communications can be performed based on all custom topics not starting with **\$oc**. The **system_default_policy** policy is added to newly created resource spaces by default, allowing all associated devices to publish or subscribe to messages through all topics. You can delete the policy if necessary.
- Policies are only used for communications with custom topics that do not start with **\$oc**. For custom topics starting with **\$oc**, their permissions are determined by product settings.
- Policies are not available in the following regions: CN South-Guangzhou, CN North-Beijing4, and CN East-Shanghai1.

Step 1 Create a product and create a device on the platform.

Step 2 Create a policy to control the topics subscription/publishing permissions. (optional)

1. Go to the policy page. Access the **IoTDA** service page and click **Access Console**. Click the target instance card. In the navigation pane, choose **Devices > Policies**.

Figure 5-42 Device policy - Access page



2. Create a policy. Click **Create Policy**, set policy parameters, and click **Generate**. The following figure shows how to publish and subscribe to messages through topic **/v1/test/hello**.

Table 5-14 Parameters

| Parameter Description | |
|-----------------------|--|
| Resource Space | Select a resource space from the drop-down list box or create one . |
| Policy Name | Customize a value, for example, PolicyTest . Max: 128 characters. Use only letters, digits, underscores (_), and hyphens (-). |
| Resource | For MQTT topic publishing and subscription, topic: must be used as the parameter prefix. For example, to forbid the subscription to /test/v1 , set this parameter to topic:/test/v1 . |
| Operation | Options: Publish and Subscribe , meaning the topic publishing and subscription requests of MQTT devices. |
| Permission | Options: Allowed and Denied , meaning whether the permission to publish or subscribe to messages through a topic is assigned. |

Step 3 Bind the policy target. A policy can be bound to resource spaces, products, or devices. The bound devices are allowed or disallowed to publish or subscribe to messages through a specific topic accordingly. (optional)

Figure 5-43 Device policy - Binding a device

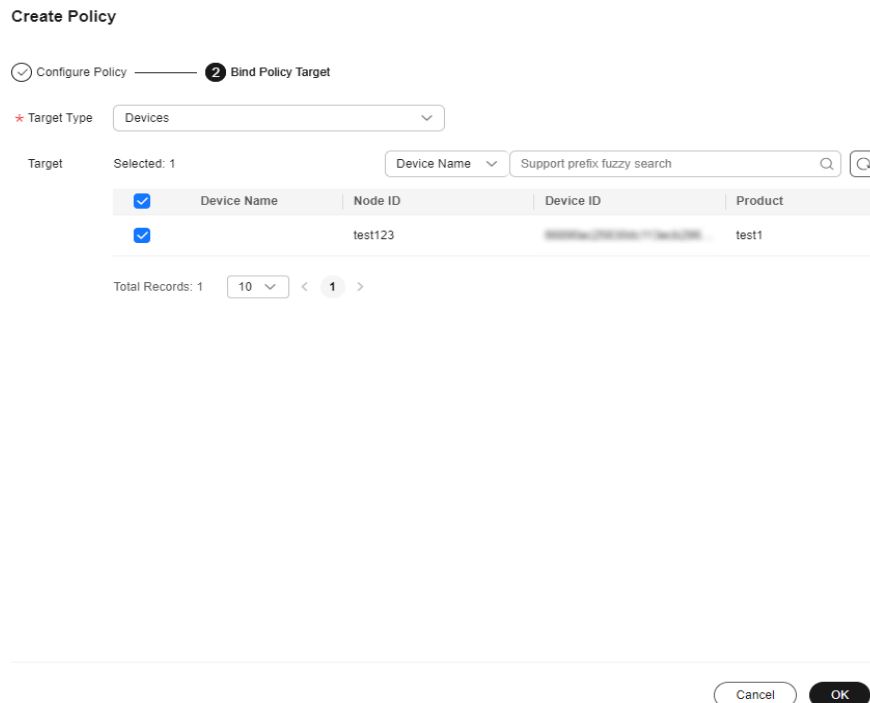


Table 5-15 Parameters

| Parameter Description | |
|-----------------------|--|
| Target Type | <p>You can set resource spaces, products, or devices as the target type. The three types can coexist. For example, product A and device C (under product B) can be bound to the same policy.</p> <ul style="list-style-type: none">• Resource space: used for domain-based management of multiple service applications. After a resource space is bound to a policy, all devices in this resource space adopt the policy. You can also select multiple resource spaces for binding.• Product: Generally, a product has multiple devices. After a product is bound to a policy, all devices of this product adopt the policy. Compared with the resource space, the binding scope is smaller. You can select products in different resource spaces for binding.• Device: minimum unit for the target bound to a policy. You can select devices from different resource spaces and products for binding. |
| Target | <p>After you select a policy target type, available targets are displayed in the Target area. Select targets as required.</p> |

- Step 4** Use the device to subscribe to or publish messages through the specified topic. Only custom topics successfully bound in the policy can be used.

----End

Java SDK Usage on the Device Side

Devices can integrate the [device SDKs](#) provided by Huawei Cloud IoT to quickly connect to Huawei Cloud IoTDA and report messages. The following example uses the Java SDK to connect a device to IoTDA for publishing and subscribing to messages through the custom topic `/test/deviceToCloud`.

1. Configure the Maven dependency of the SDK on the device.

```
<dependency>
  <groupId>com.huaweicloud</groupId>
  <artifactId>iot-device-sdk-java</artifactId>
  <version>1.1.4</version>
</dependency>
```

2. Configure the SDK and device connection parameters on the device.

```
// Load the CA certificate of the IoT platform. For details about how to obtain the certificate, visit
https://support.huaweicloud.com/intl/en-us/devg-iotHub/iot\_02\_1004.html.
URL resource = MessageSample.class.getClassLoader().getResource("ca.jks");
File file = new File(resource.getPath());

// The format is ssl://Domain name:Port number.
// To obtain the domain name, log in to the Huawei Cloud IoTDA console. In the navigation pane,
choose Overview and click Access Details in the Instance Information area. Select the access
domain name corresponding to port 8883.
String serverUrl = "ssl://localhost:8883";
// Device ID created on the IoT platform
String deviceId = "deviceId";
// Secret corresponding to the device ID
String deviceSecret = "secret";
// Initialize the device connection.
```

```
IoTDevice device = new IoTDevice(serverUrl, deviceId, deviceSecret, file);  
if (device.init() != 0) {  
    return;  
}
```

3. Report a device message.

```
device.getClient().publishRawMessage(new RawMessage("/test/deviceToCloud", "hello", 1), new  
ActionListener() {  
    @Override  
    public void onSuccess(Object context) {  
        System.out.println("reportDeviceMessage success: ");  
    }  
    @Override  
    public void onFailure(Object context, Throwable var2) {  
        System.out.println("reportDeviceMessage fail: " + var2);  
    }  
});
```

4. Subscribe to the topic.

```
device.getClient().subscribeTopic(new RawMessage("/test/deviceToCloud", new ActionListener() {  
    @Override  
    public void onSuccess(Object context) {  
        System.out.println("subscribeTopic success: ");  
    }  
    @Override  
    public void onFailure(Object context, Throwable var2) {  
        System.out.println("subscribeTopic fail: " + var2);  
    }  
    }  
}, 0);
```

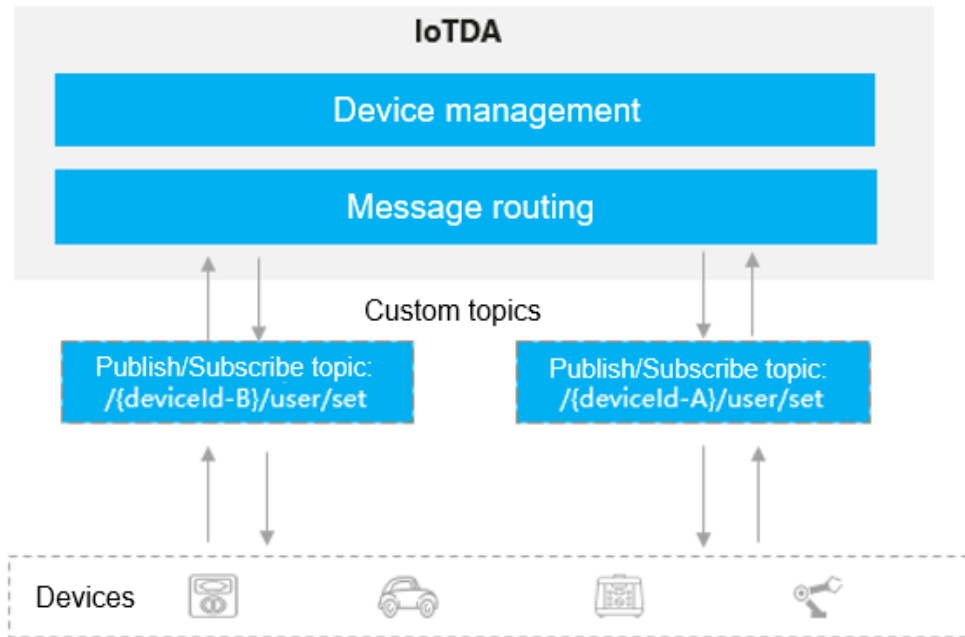
5.4 M2M Communications

5.4.1 Overview

Introduction

IoTDA supports MQTT-based machine-to-machine (M2M) communications. The platform processes the connection and communication requests from devices, so you can focus on service implementation. With M2M communications, devices can communicate with each other flexibly.

Figure 5-44 Service flow



NOTE

- During M2M communications, messages sent through the PUB interface and messages received through the SUB interface are counted as charging messages. No additional fee is generated.

Scenarios

- Instant messaging scenario where a sender and recipient communicate with each other.
- Smart home scenario where messages are exchanged between mobile apps and smart devices.
- Device linkage scenario where devices exchange data and communicate with each other.

Constraints

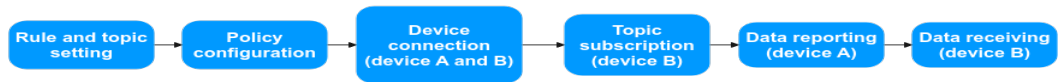
- Not available for the basic edition users.
- Only available for devices connected using MQTT.
- Max. topic length: 128 bytes.
- Max. MQTT message size: 1 MB.
- Max. subscribers of a topic: 1,000 devices.
- An MQTT device can subscribe to up to 100 topics (50 custom topics at most).
- Max. upstream messages for an MQTT device: 50 messages per second.

5.4.2 Usage

Process

This section takes one-to-one communications between devices as an example.

Figure 5-45 M2M communication process



- Step 1** Rule and topic setting: Create an M2M data forwarding rule and set a forwarding topic on the console.
- Step 2** Policy configuration: On the console, configure policies to allow devices that send and receive data to publish and subscribe to data.
- Step 3** Device authentication: Devices A and B initiate connection authentication requests. For details about authentication parameters, see [Device Connection Authentication](#).
- Step 4** Topic subscription: Device B subscribes to a cloud-based topic that is set during the data forwarding rule creation. If the subscription is successful, the platform returns an **ACK** message.
- Step 5** Data reporting: Device A publishes data through the cloud-based topic. If the publishment is successful, the platform returns an **ACK** message.
- Step 6** Data receiving: If the data forwarding is successful, device B receives the data from device A.

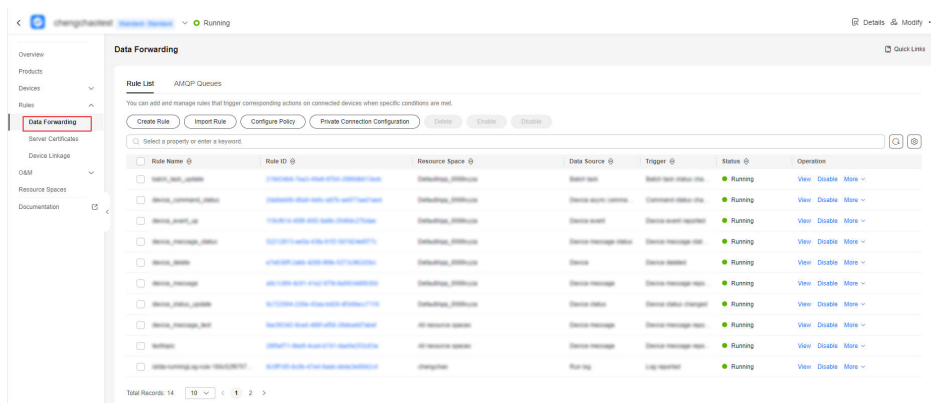
----End

Procedure

The following example describes how to create a data forwarding rule on the platform. You can modify the rule for different scenarios.

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card. In the navigation pane, choose **Rules > Data Forwarding**.

Figure 5-46 Data forwarding - List



- Step 2** Click **Create Rule**, configure the parameters based on the service requirements, and click **Create Rule**. The following figure shows an example.

Figure 5-47 Creating a forwarding rule - M2M

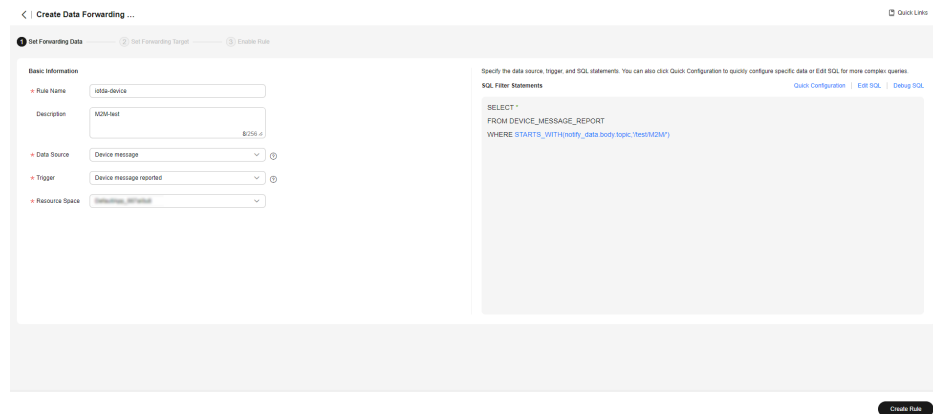


Table 5-16 Parameters for creating a data forwarding rule

| Parameter Description | |
|-----------------------|--|
| Rule Name | Customize a value, for example, test . The value can contain up to 256 characters. Only letters, digits, and special characters (<code>[_?#().,&%@!-]</code>) are allowed. |
| Description | Description of the rule, which is user-defined. |
| Data Source | Data source of the forwarding rule. You can select multiple data sources from the drop-down list. In the M2M scenario, select Device message . |
| Trigger | Available trigger events vary with the data sources. In the M2M scenario, select Device message reported . |
| Resource Space | Select an existing resource space from the drop-down list or create a Resource Space first. |
| SQL Filter Statements | You can use SQL statements to filter data. For details, see SQL Statements . In the example figure, notify_data.body.topic IN ('/test/M2M') in the WHERE statement indicates that only the data whose topic is /test/M2M will be forwarded. |

Step 3 Go to the second stage. You can set the data forwarding target, topic, and cache time. In M2M scenario, select **Device** for **Forwarding Target**, set the parameters based on service requirements, and click **OK**.

Figure 5-48 Creating a forwarding target - to a device

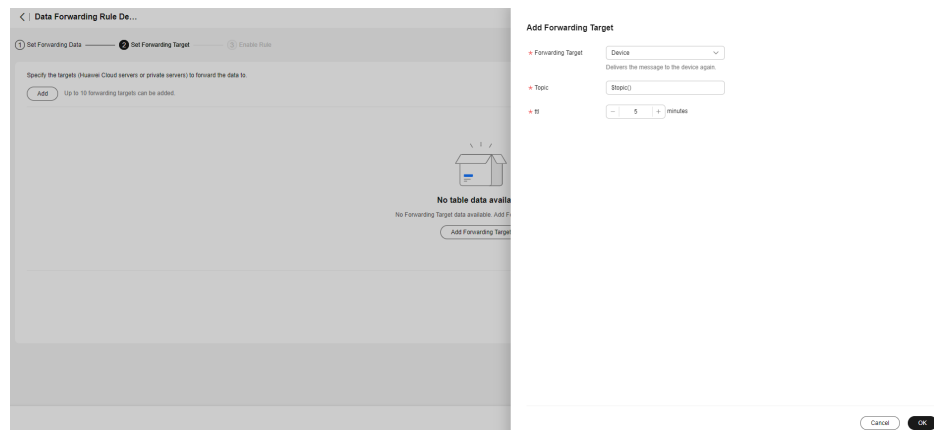
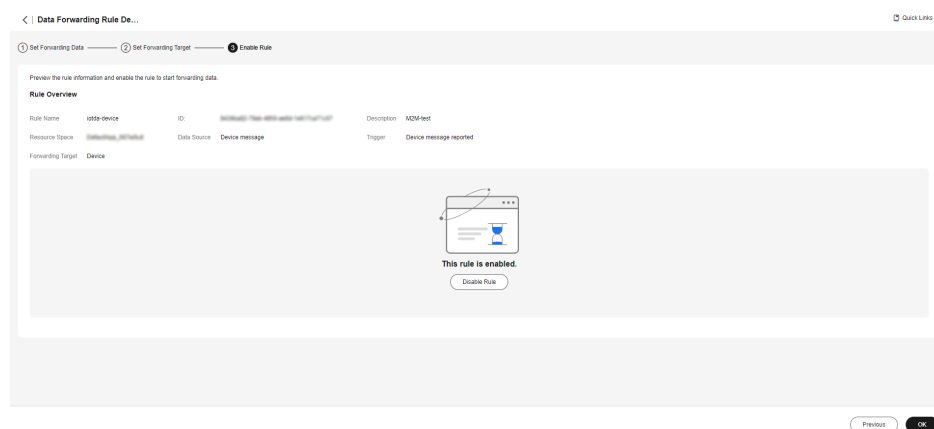


Table 5-17 Parameters for setting a forwarding target

| Parameter | Description |
|-------------------|---|
| Forwarding Target | Select a forwarding target from the drop-down list. In the M2M scenario, select Device . |
| Topic | Max: 128 characters. It can start with dollar signs (\$) and slashes (/) but cannot end with them. Use only digits, letters, and the following characters: () ',-.:=@;_!*'%?+\. |
| ttl | The platform caches messages when a device is offline, and delivers them when the device comes back online. ttl is the data cache time whose value ranges from 0 to 1,440 (one day) minutes and must be a multiple of 5. When the value is set to 0 , data is not cached. |

Step 4 Go to the third stage and enable the rule.

Figure 5-49 Enabling a rule - Forwarding data to a device



----End

5.4.3 Example

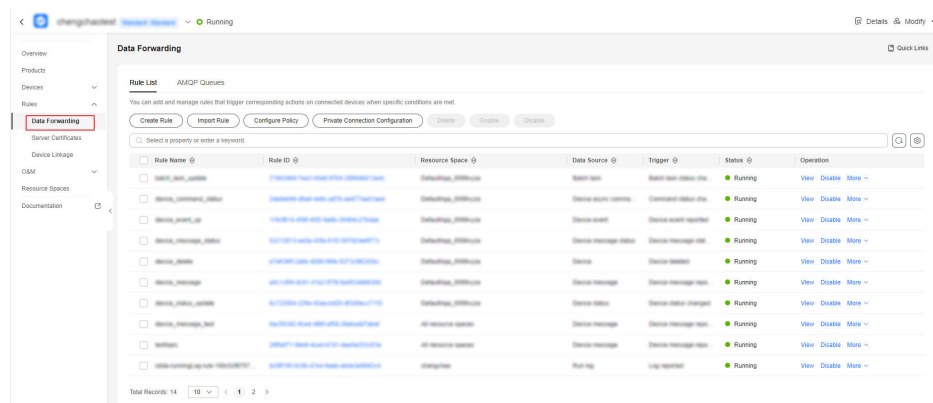
Preparations

1. Creating a product and device
 - Create a product. Access the **IoTDA** service page and click **Access Console**. Click the target instance card. Choose **Products** in the navigation pane and click **Create Product**. Set the parameters as prompted and click **OK**. For details, see **Creating a Product**.
 - Create a device. On the IoTDA console, choose **Devices > All Devices** in the navigation pane, and click **Register Device**. Set the parameters as prompted and click **OK**. For details, see **Registering an Individual Device**.

Configuring a Data Forwarding Rule

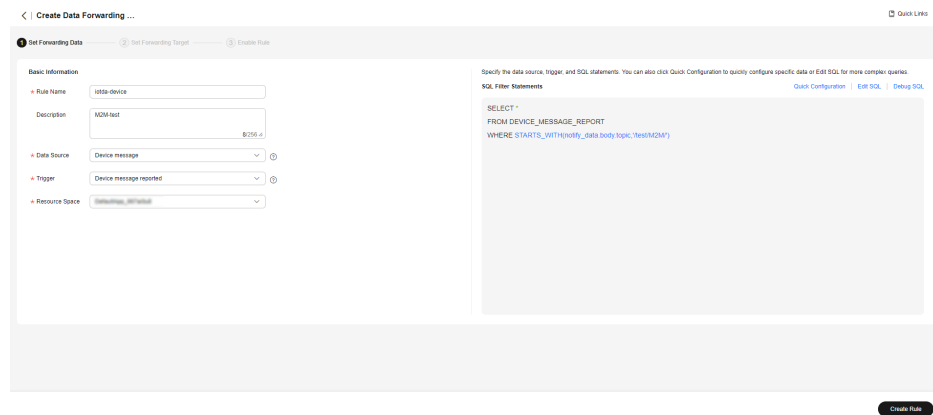
- Step 1** Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Rules > Data Forwarding**.

Figure 5-50 Data forwarding - List



- Step 3** On the **Rule List** tab page, click **Create Rule**. Set the rule parameters and forwarded data, and configure the data filtering statement as follows: **STARTS_WITH(notify_data.body.topic, '/test/M2M/')**.

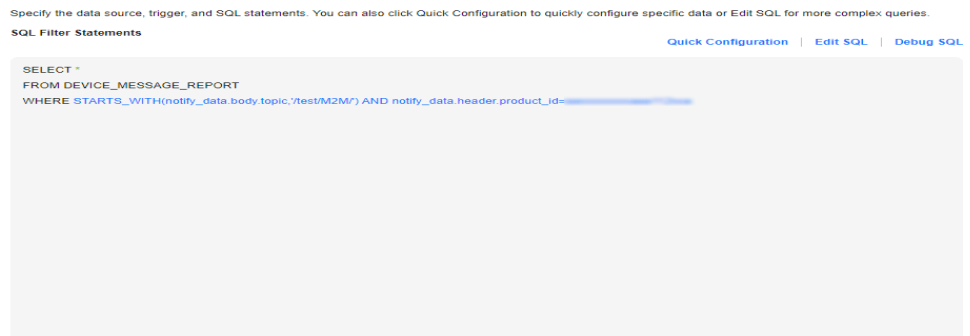
Figure 5-51 Creating a forwarding rule - M2M



 NOTE

- Configuration of **Figure 2**: For all devices in the resource space *XXX*, when they report messages with topics containing **/test/M2M/**, the forwarding rule will be triggered and the messages will be forwarded to the specified forwarding target.
- To forward the data reported by a specified device, add **AND notify_data.header.device_id='\${Device ID}'** to the SQL statements.
- To forward the data reported by a specified **product**, add **AND notify_data.header.product_id='\${Product ID}'** to the SQL statements.

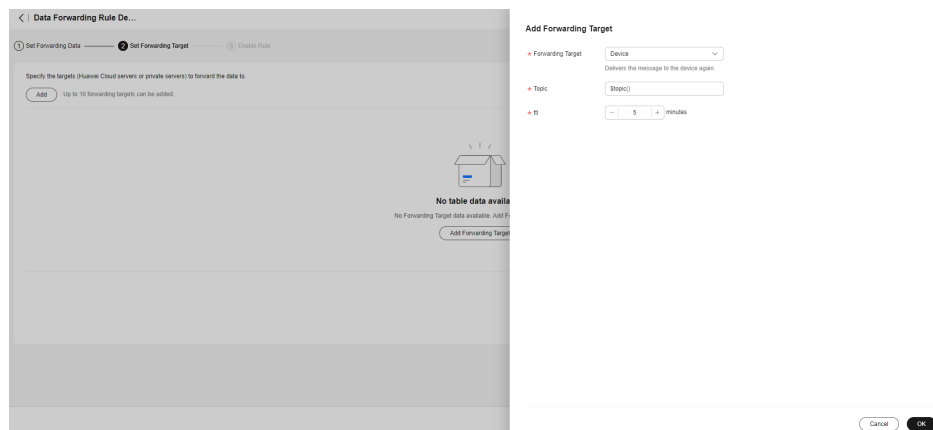
Figure 5-52 Data forwarding - M2M_SQL statement example



- For details about SQL settings, see [SQL Statements](#).

Step 4 Set the forwarding target. Click **Add**. Select **Device** for **Forwarding Target**, set **Topic** to **\$topic()** (the topic remains unchanged after forwarding), and set **tll** to 5 minutes (data is cached for 5 minutes). Click **OK**.

Figure 5-53 Creating a forwarding target - to a device



Step 5 Click **Enable Rule** in the middle of the page.

2. Register device A (**test111**) and device B (**test222**) under the product created in step 1. For details, see [Registering an Individual Device](#).

Figure 5-56 Device - Registering an M2M device

Register Device ✕

* Resource Space ?

* Product
Mqtt devices have subscribed to the platform preset topic by default. [Subscribed topics](#)

* Node ID ?

Device ID ?

Device Name

Description
0/2,048

Authentication Type ? Secret X.509 certificate

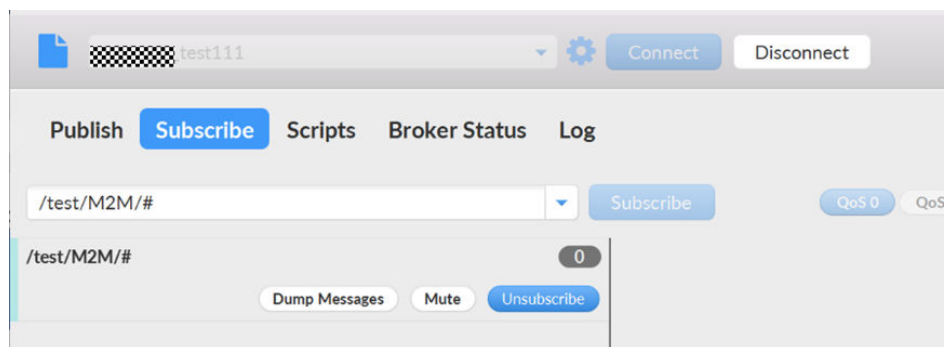
Secret

Confirm Secret

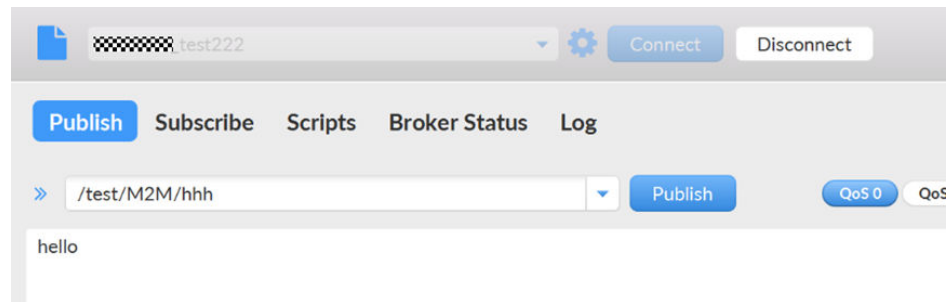
Cancel OK

3. This section uses MQTT.fx as an example to describe how to implement M2M communications. You can also test based on your service requirements.
 - a. Open two MQTT.fx to simulate devices A (**test111**) and B (**test222**).
 - b. On the **Subscribe** page of device B, enter the topic **/test/M2M/#** and click **Subscribe**.

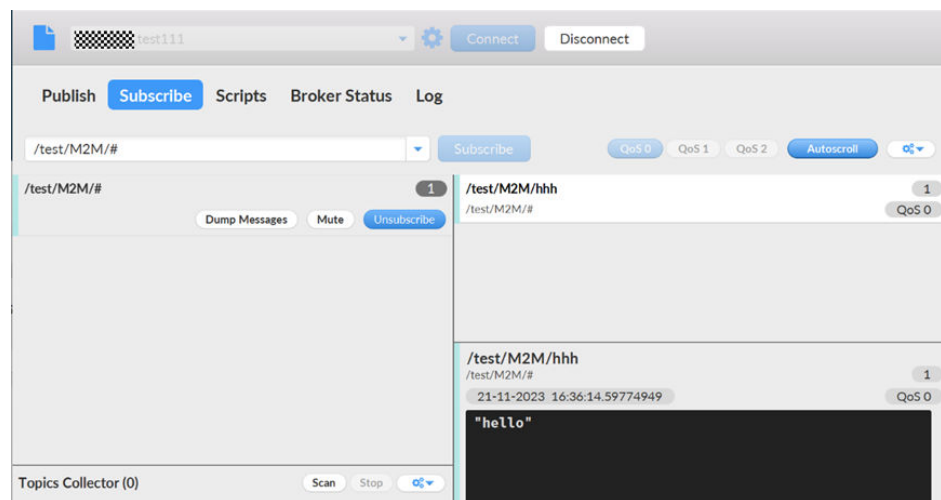
Figure 5-57 Entering a topic on the **Subscribe** page of device B



- c. Let device A send a message to device B. On the **Publish** page of device A, enter the topic **/test/M2M/\${Any word}**. Enter the message to be sent (for example, **hello**) in the text box, and click **Publish**.

Figure 5-58 Entering a message on the **Publish** page of device A

On the **Subscribe** page of device B, you can see the received message, as shown in the following figure.

Figure 5-59 Subscribe page of device B

5.5 Device Topic Policies

5.5.1 Overview

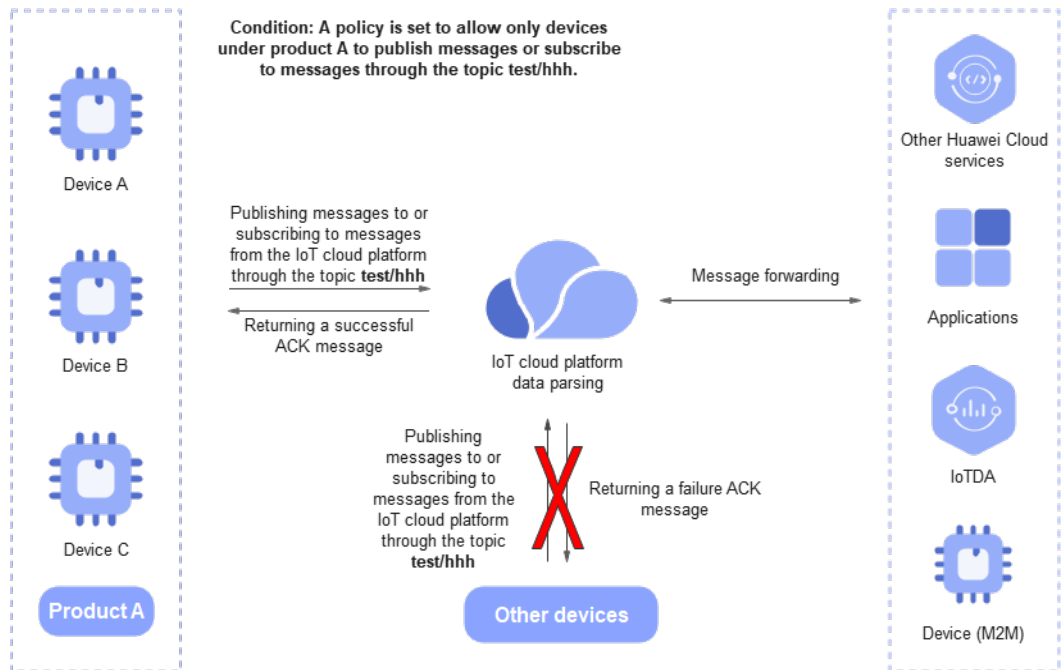
Overview

IoTDA provides device topic policies, with which you can implement flexible role-based access control, and authorize clients to publish or subscribe to messages through topics not starting with **\$oc**. You can manage the topic-based data publishing and subscription permissions of devices, products, or groups, improving communications security. Device policies are mainly used for protocols used in data publishing and subscription mechanisms, for example, MQTT and MQTTS on the device side. Currently, this feature is available for users in invitation-only regions of south China and international regions.

NOTICE

The **system_default_policy** policy is added to the newly created resource space by default, which allows devices in this resource space to publish or subscribe to messages through topics (not starting with **\$oc**) of all devices under all resource spaces. You can delete the policy if necessary.

Figure 5-60 Conceptual diagram of topic policies



Scenarios

- Group-based communications: For example, devices A, B, and C belong to a group, and only devices A, B, and C are allowed to subscribe to the topic of the group.
- Region-based communications: Regions are divided based on the data publishing and subscription permissions. Only devices of the same region can communicate with each other.

Restrictions

- Max. policies for a tenant: 50.
- Applicable topics: custom topics that do not start with **\$oc**.
- Max. policy file size: 10 KB. Max. files configured for a policy: 10.
- Max. policies configured for a device or product: 5.
- Max. topics subscribed by a device (client): 50.
- Max. topic length: 128 bytes.
- Supported QoS: QoS 0 and QoS 1.

5.5.2 Content

IoTDA provides device topic policies, with which you can authorize clients to publish or subscribe to messages through custom topics not starting with **\$oc**, enhancing communications security. Device policies are mainly used for protocols used in data publishing and subscription mechanisms, for example, MQTT and MQTTS on the device side. Currently, this feature is available for users in invitation-only regions of south China.

Policy Wildcards

You can use wildcards for policies. An asterisk (*) indicates any combination of characters, and a question mark (?) indicates a character of any kinds. Plus signs (+) and number signs (#) do not have special meanings.

Table 5-18 Policy wildcards

| Wild card | MQTT Wildcard | Applicable to Policy | Example MQTT Topic | Example MQTT Topic for Policy |
|-----------|---------------|----------------------|---|---|
| # | Yes | No | test/# | Not applicable. The number sign (#) is regarded as a character without special meaning. |
| + | Yes | No | test/+some | Not applicable. The plus sign (+) is regarded as a character without special meaning. |
| * | No | Yes | Not applicable. The asterisk (*) is regarded as a character without special meaning. | test/* test/*/some |
| ? | No | Yes | Not applicable. The question mark (?) is regarded as a character without special meaning. | test/????/some test/set????/some |

Table 5-19 Example usage of wildcards in policies

| Target Topic | Topic Definition in Policy | Description |
|--|----------------------------|---|
| Example topics: test/topic1/ some test/topic2/ some test/topic3/ some | topic:test/topic?/some | Common points: test/topic + <i>a character</i> + /some . In the policy definition, a question mark (?) indicates a character. Therefore, the policy topic can be defined as topic:test/topic?/some . |
| Example topics: test/ topic1/pub/ some test/topic2/sub/ some test/topic3/ some | topic:test/topic*/some | Common points: test/topic + <i>one or more characters</i> + /some . In policy definition, the asterisk (*) indicates multiple or one character. Therefore, the policy topic can be defined as topic:test/topic*/some . |

Policy Variables

You can use a policy variable as a placeholder for resource or condition key to filter topics when defining policy resource. During MQTT topic verification, the system replaces the variable with the corresponding ID for matching.

Variables are prefixed with a dollar sign (\$), followed by a pair of braces ({}), which contain the variable name in the request. The following table lists the supported variables. Assume that the client ID of an MQTT device is **test_clientId**, the product ID is **test_productId**, and the device ID is **test_deviceId**.

Table 5-20 Policy variables

| Policy Variable | Description | Example MQTT Topic | Example MQTT Topic for Policy |
|----------------------------------|-------------|-------------------------------|--------------------------------------|
| \$ {devices.deviceId} | Device ID | test/test_deviceId/topic | test/\${devices.deviceId}/topic |
| \$ {devices.clientId} | Client ID | test/test_clientId/topic | test/\${devices.clientId}/topic |
| \$ {devices.productId} | Product ID | test/test_productId/ topic | test/\${devices.productId}/ topic |

Table 5-21 Example usage of variables in policies

| Scenario | Example Policy Topic Definition | Description |
|--|---------------------------------|--|
| Distinguishing topics by device | test/\${devices.deviceId}/topic | Devices can subscribe to or publish messages through topic test/\${Device ID}/topic with their data isolated. |
| Distinguishing topics by device and time segment | test/\${devices.clientId}/topic | Devices can subscribe to or publish messages through topic test/\${Device client ID}/topic . Different from deviceId , clientId carries a timestamp to distinguish time segments. |

Policy Priority

If multiple policies with different effect are bound to the same device, the policy with higher priority (**Denied** over **Allowed**) takes effect.

For example, a device has two policies: policy 1 and policy 2. Policy 1 denies subscription to topic A, and policy 2 allows subscription to topic A. When the device subscribes to topic A, the platform rejects the subscription request from the device.

Table 5-22 Policy priority

| Topic | Policy 1 | Policy 2 | Effective Policy |
|------------|--|---|------------------|
| test/topic | "effect": "ALLOW", "resources": ["topic:test/topic"] | "effect": "DENY", "resources": ["topic:test/topic"] | Denied |

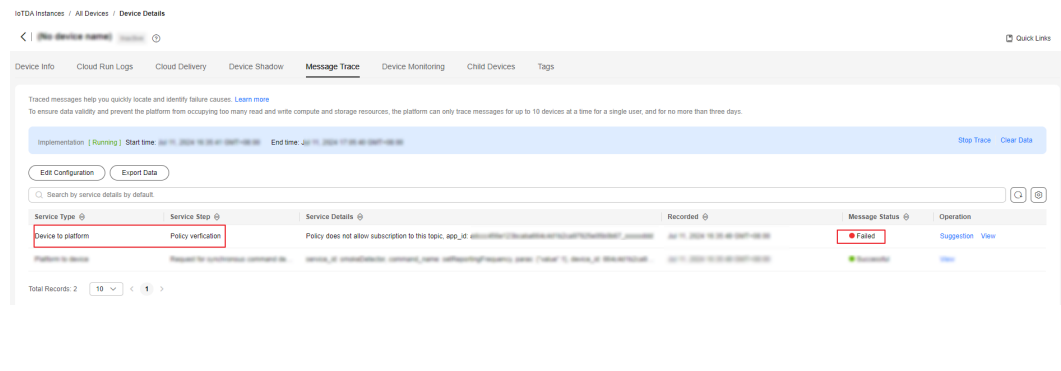
Policy Topic Constraints

1. Max. length: 128 bytes.
2. Unallowed wildcards for topic publishing: number signs (#) and plus signs (+).
3. Consecutive slashes (/) are not allowed, for example, **///test/**.
4. Max. slashes (/) in a topic: 7.

CAUTION

If the topic to be published or subscribed to does not meet the preceding requirements, the subscription or publishing request will be rejected. On the device details page, choose the **Message Trace** tab. The error information is displayed.

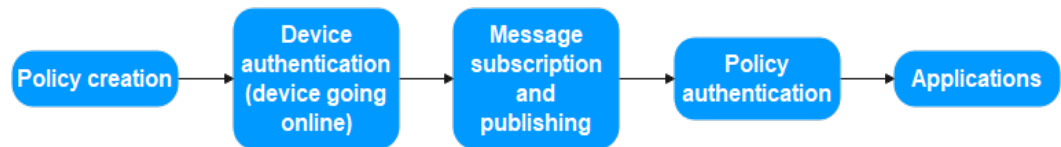
Figure 5-61 Message tracing - Verifying a policy



5.5.3 Usage

Process

Figure 5-62 Device policy usage process



- Step 1** Policy creation: A user creates a device policy on the console. For details, see [Examples](#).
- Step 2** Device authentication: An MQTT device initiates a connection authentication request. For details about authentication parameters, see [Device Connection Authentication](#).
- Step 3** Message subscription or publishing: The device applies to publishing or subscribing to messages through a specific topic on the cloud server.
- Step 4** Policy authentication: The cloud server filters topics subscribed to or published by the device based on the policy. If the device is not allowed to subscribe to the topic, the cloud server returns a failure ACK message and the subscription fails. Otherwise, a successful ACK message is returned, indicating that the subscription is successful.
- Step 5** Data push: Messages successfully published by the device can be pushed to the application through data transfer.

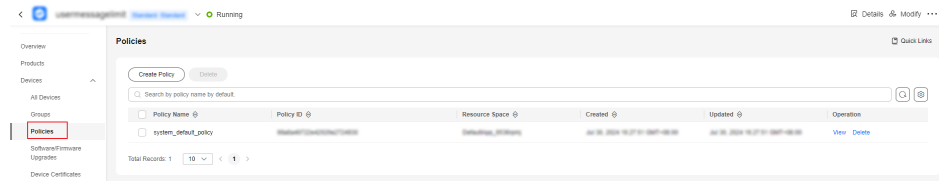
----End

Procedure

The following example describes how to set topic policies and bind policy targets on the IoTDA console for MQTT device.

1. Go to the policy page. Access the **IoTDA** service page and click **Access Console**. Click the target instance card. In the navigation pane, choose **Devices > Policies**.

Figure 5-63 Device policy - Access page



2. Create a policy. Click **Create Policy**, set policy parameters based on service requirements, and click **Generate**. The following figure shows the example parameter values.

Figure 5-64 Device policy - Creating a policy

Create Policy

1 Configure Policy — 2 Bind Policy Target

* Resource Space:

* Policy Name:

* Policy Configuration: A maximum of 10 policy documents can be created.

| Operation | Permission | Op... |
|--|--------------------------------------|---------------------------------------|
| <input type="button" value="Publish"/> <input type="button" value="Subscription"/> | <input type="text" value="Allowed"/> | <input type="button" value="Delete"/> |

* Resources Add up to 10 resources for a policy.

| Code | Resource Name | Op... |
|------|---|---------------------------------------|
| 1 | <input type="text" value="topic:/v1/test/hello"/> | <input type="button" value="Delete"/> |

Table 5-23 Parameter description

| Parameter Description | |
|-----------------------|--|
| Resource Space | Select a resource space from the drop-down list box or create one . |

| | |
|-------------|--|
| Policy Name | Customize a value, for example, PolicyTest . The value is a string of no more than 128 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed. |
| Resource | For MQTT topic publishing and subscription, topic: must be used as the parameter prefix. For example, to forbid the subscription to /test/v1 , set this parameter to topic:/test/v1 . |
| Operation | Options: Publish and Subscribe , meaning the topic publishing and subscription requests of MQTT devices. |
| Permission | Options: Allowed and Denied , meaning whether the permission to publish or subscribe to messages of a topic is assigned. |

3. Bind the policy target. A policy can be bound to resource spaces, products, or devices. The bound devices are allowed or disallowed to publish or subscribe to messages through a specific topic accordingly.

Figure 5-65 Device policy - Binding a device

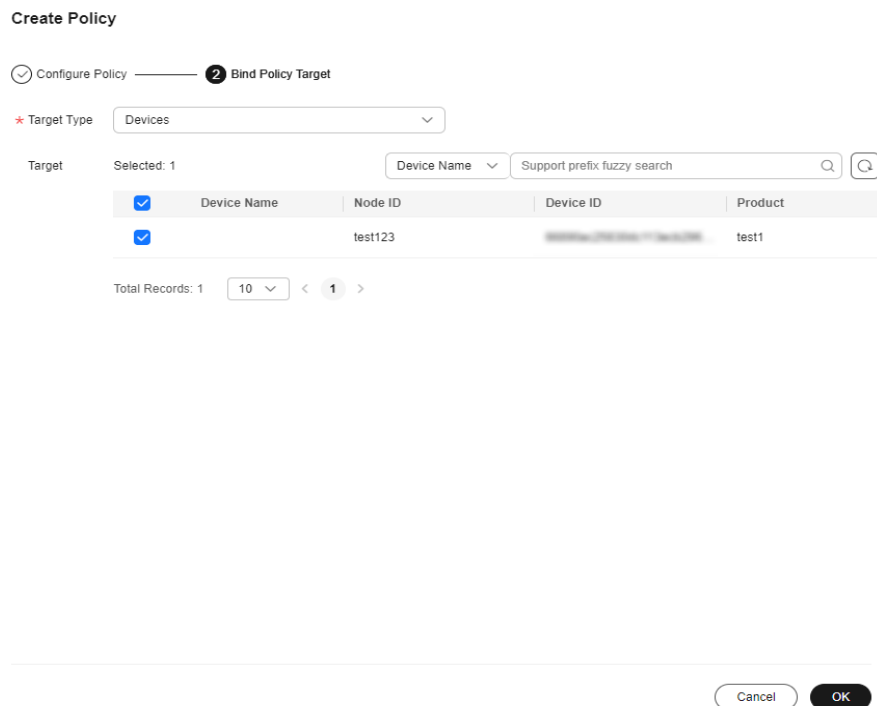


Table 5-24 Parameter description

| Parameter Description |
|-----------------------|
|-----------------------|

| | |
|-------------|--|
| Target Type | <p>You can set resource spaces, products, or devices as the target type. The three types can coexist. For example, product A and device C (under product B) can be bound to the same policy.</p> <ul style="list-style-type: none">• Resource space: used for domain-based management of multiple service applications. After a resource space is bound to a policy, all devices in this resource space adopt the policy. You can also select multiple resource spaces for binding.• Product: Generally, a product has multiple devices. After a product is bound to a policy, all devices of this product adopt the policy. Compared with the resource space, the binding scope is smaller. You can select products in different resource spaces for binding.• Device: minimum unit for the target bound to a policy. You can select devices from different resource spaces and products for binding. |
| Target | <p>After you select a policy target type, available targets are displayed in the Target area. Select targets as required.</p> |

5.5.4 Examples

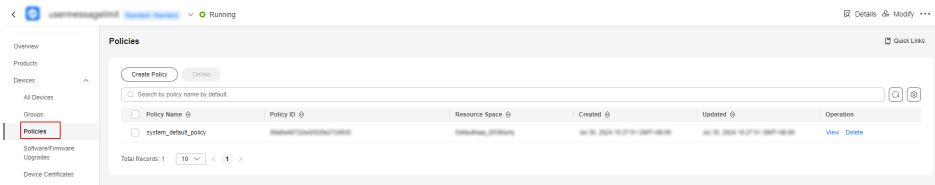
Scenarios

- [Scenario 1: Allowing or Denying the Message Publishing Through a Specific Topic](#)
- [Scenario 2: Using Policy in E2E \(M2M\) Communications](#)

Scenario 1: Allowing or Denying the Message Publishing Through a Specific Topic

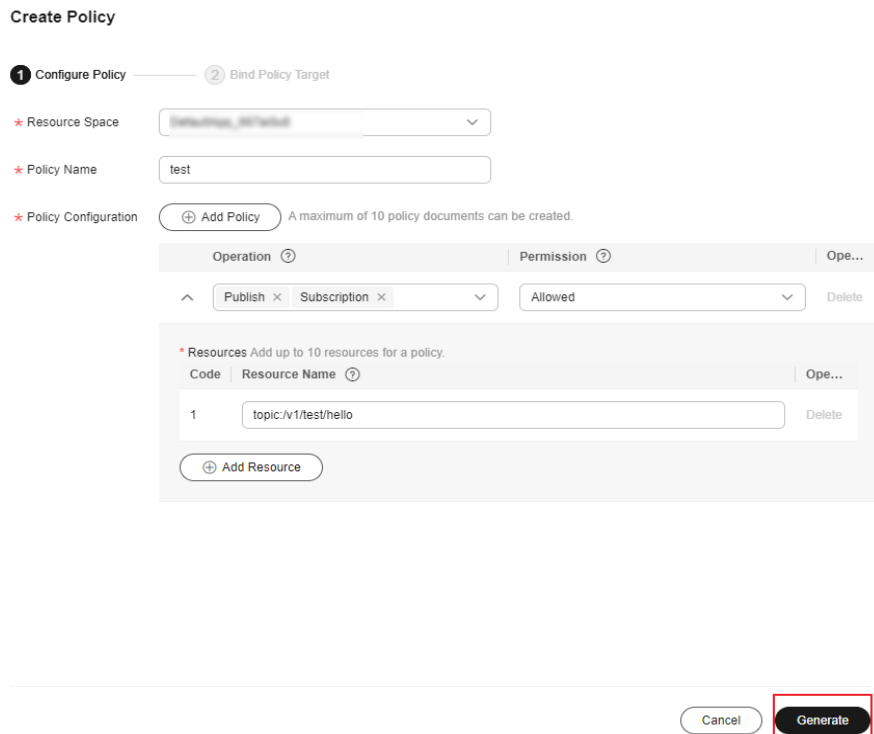
1. Create a product and device.
 - Create a product. Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card. Choose **Products** in the navigation pane and click **Create Product**. Set the parameters as prompted and click **OK**. For details, see [Creating a Product](#).
 - Create a device. On the IoTDA console, choose **Devices > All Devices** in the navigation pane, and click **Register Device**. Set the parameters as prompted and click **OK**. For details, see [Registering an Individual Device](#).
2. Create a policy.
 - Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
 - Choose **Devices > Policies** in the navigation pane.

Figure 5-66 Device policy - Access page



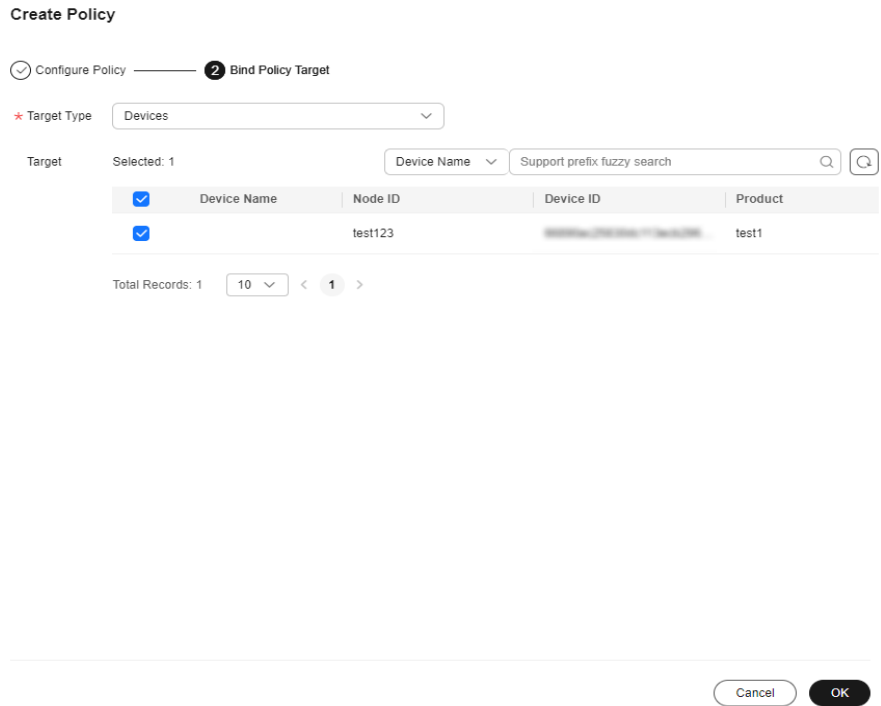
- Click **Create Policy**, set policy parameters, and click **Generate**. The application scope of the policy is the resource space (appld). Resources starting with **topic:** indicate topics in MQTT communications and are used for publishing and subscription. In this example, the topic that can be published and subscribed to is **/v1/test/hello**.

Figure 5-67 Device policy - Creating a policy



- Bind the policy. In this example, set **Target Type** to **Devices** and select the devices to which the policy is to be bound.

Figure 5-68 Device policy - Binding a device



- Verify the policy.
 - i. Obtain connection parameters. In the navigation pane, choose **Devices > All Devices**, find the devices bound to the policy in the preceding step, go to the device details page, and view the connection parameters.

Figure 5-69 Device - Device details

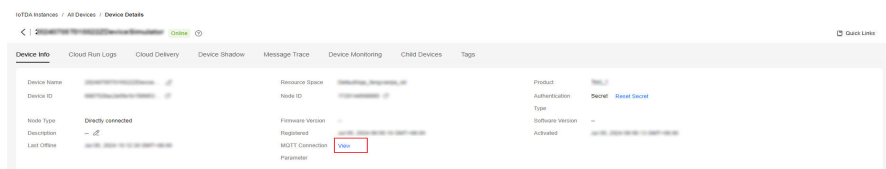
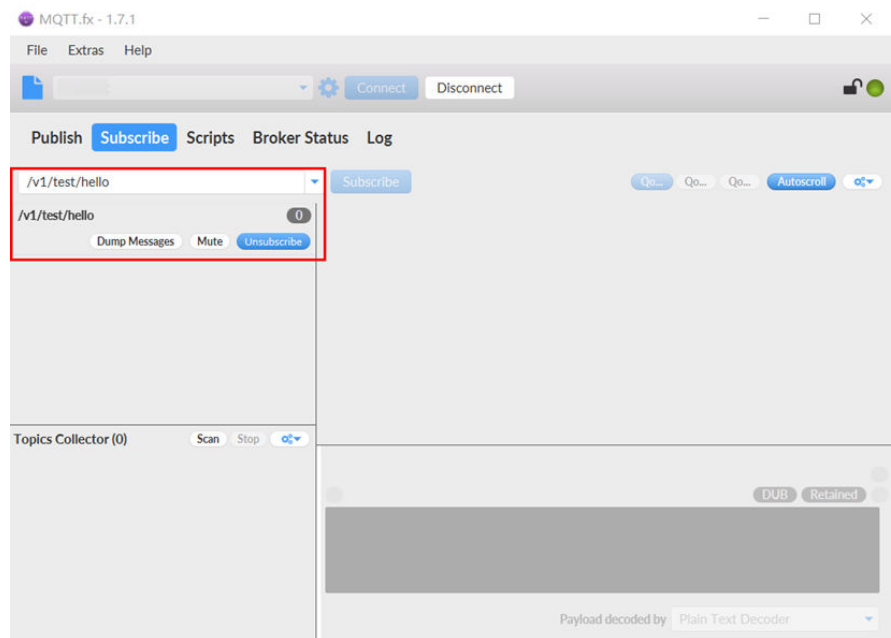


Figure 5-70 Device - Device details - MQTT connection parameters



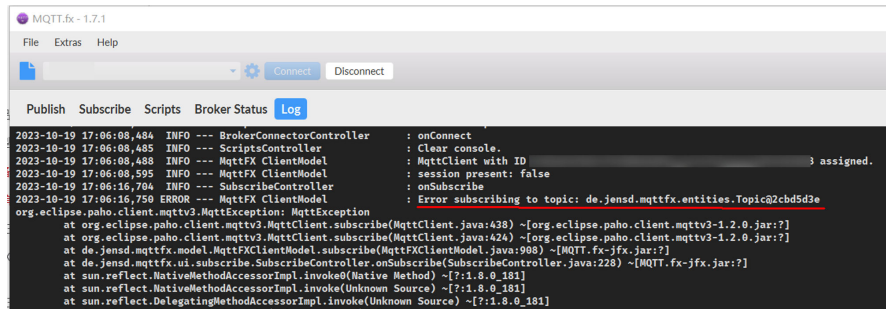
- ii. Use the MQTT.fx tool to connect to the cloud platform. Open the MQTT.fx tool, set authentication parameters for the devices bound to the policy in the preceding step, click **Apply**, and click **Connect** for connection authentication.
- iii. Use the device to subscribe to the allowed topic **/v1/test/hello**. The subscription is successful.

Figure 5-71 Successful subscription



- iv. Use the device to subscribe to another topic **/v2/test/hello**. The subscription failed.

Figure 5-72 Failed subscription

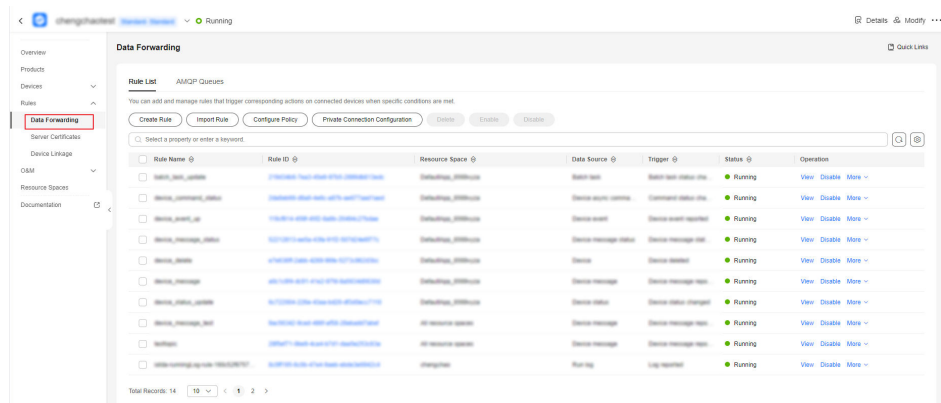


Scenario 2: Using Policy in E2E (M2M) Communications

In this example, you can enable device A under product A and all devices under product B to communicate with each other, and only allow them to subscribe to or publish messages through topics starting with `/test/M2M/`.

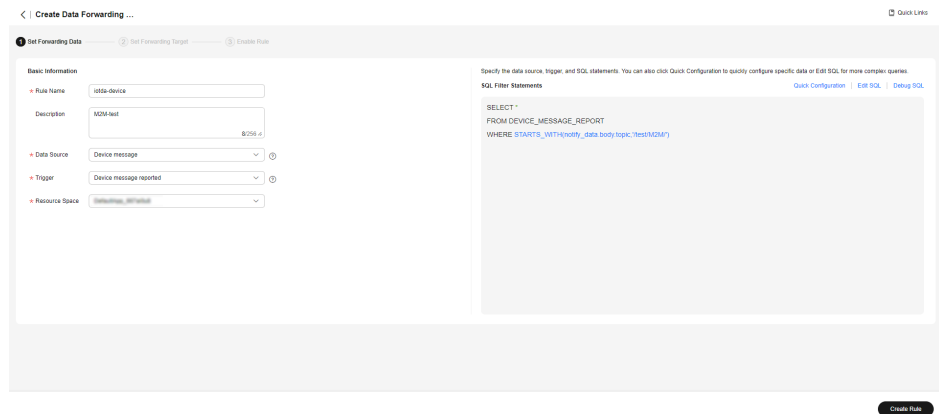
1. Create a product and device.
 - Create a product. Access the **IoTDA** service page and click **Access Console**. Click the target instance card. Choose **Products** in the navigation pane and click **Create Product**. Set the parameters as prompted and click **OK**. For details, see **Creating a Product**.
 - Create a device. On the IoTDA console, choose **Devices > All Devices** in the navigation pane, and click **Register Device**. Set the parameters as prompted and click **OK**. For details, see **Registering an Individual Device**.
2. Configure a data forwarding rule.
 - Access the **IoTDA** service page and click **Access Console**. Click the target instance card. In the navigation pane, choose **Rules > Data Forwarding**.

Figure 5-73 Data forwarding - List



- Click **Create Rule**, set the parameters as required, and click **Create Rule**. Set the SQL filter statement to `STARTS_WITH(notify_data.body.topic, '/test/M2M/')`.

Figure 5-74 Creating a forwarding rule - M2M



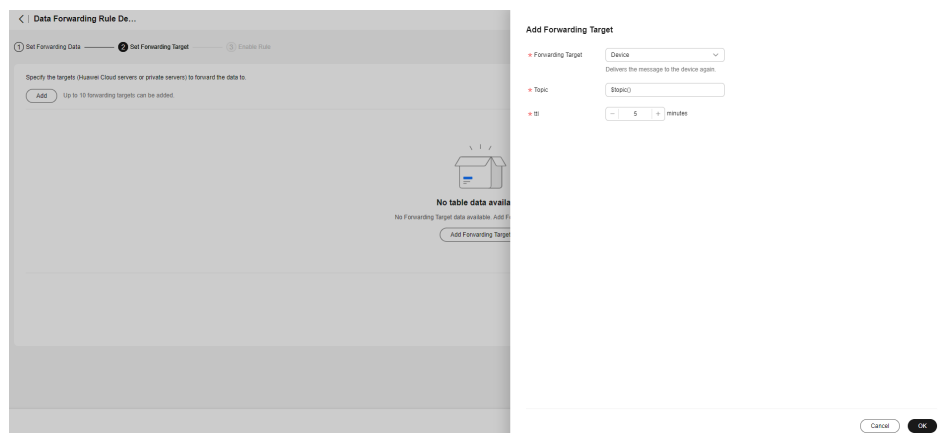
NOTE

For details about how to use SQL filter statements, see [SQL Statements](#).

STARTS_WITH(notify_data.body.topic,'test/M2M/') indicates that data with topics starting with **/test/M2M/** is filtered.

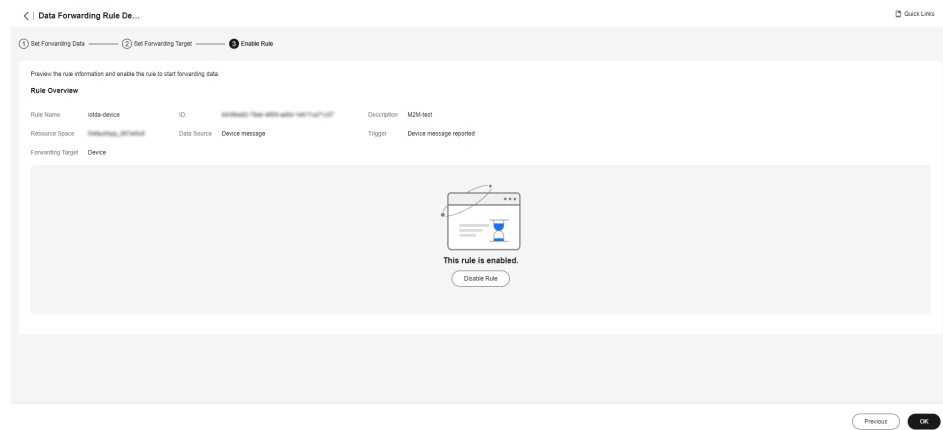
- Set the forwarding target. Set **Forwarding Target** to **Device**, set **Topic** to **\$topic()** (indicating that the forwarded topic remains unchanged and the original topic is delivered), and click **OK**.

Figure 5-75 Creating a forwarding target - to a device



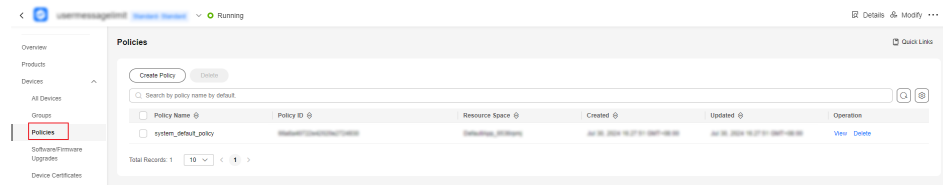
- Click **Enable Rule** in the middle of the page.

Figure 5-76 Enabling a rule - Forwarding data to a device



3. Set a policy.
 - Choose **Devices > Policies** in the navigation pane.

Figure 5-77 Device policy - Access page



- Click **Create Policy**, set policy parameters, and click **Generate**, as shown in the following figure.

Figure 5-78 Device policy - Creating a policy (M2M)

Create Policy

1 Configure Policy — 2 Bind Policy Target

* Resource Space

* Policy Name

* Policy Configuration A maximum of 10 policy documents can be created.

| Operation ? | Permission ? | Ope... |
|--|--------------------------------------|---------------------------------------|
| <input type="button" value="Publish x"/> <input type="button" value="Subscription x"/> <input type="text" value=""/> | <input type="text" value="Allowed"/> | <input type="button" value="Delete"/> |

* Resources Add up to 10 resources for a policy.

| Code | Resource Name ? | Ope... |
|------|---|---------------------------------------|
| 1 | <input type="text" value="topic/test/M2M/*"/> | <input type="button" value="Delete"/> |

- Bind the policy to the target products and devices. Set **Target Type** to **Products** and select the products to which the policy is to be bound. You can later modify the policy on the policy details page to add the devices to be bound.

Figure 5-79 Device policy - Binding a product

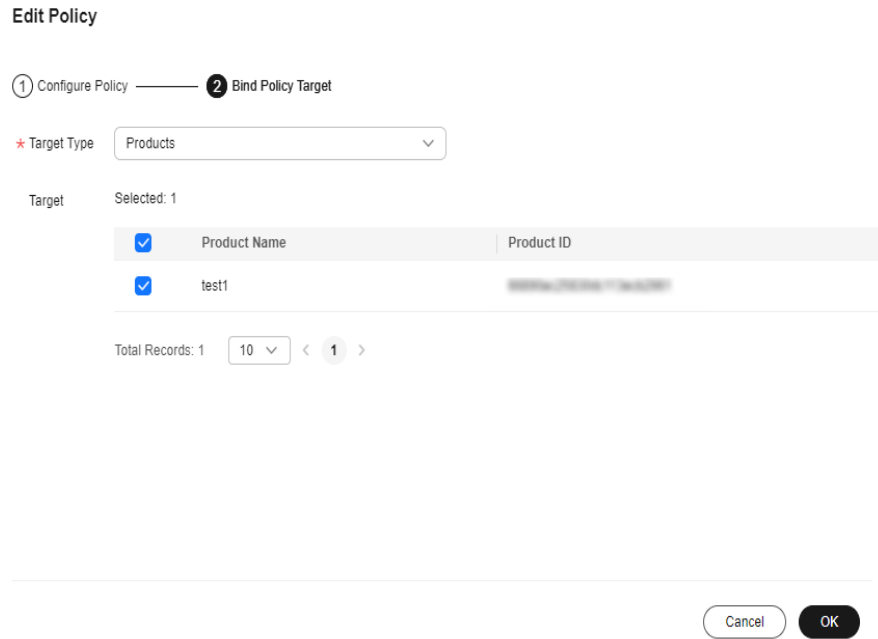
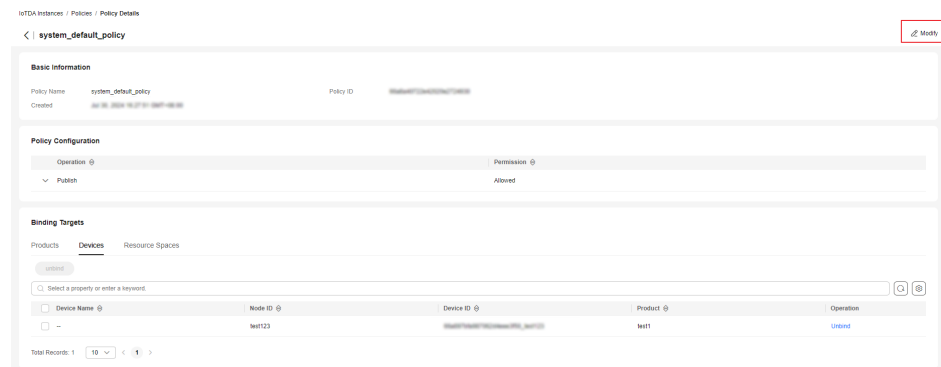
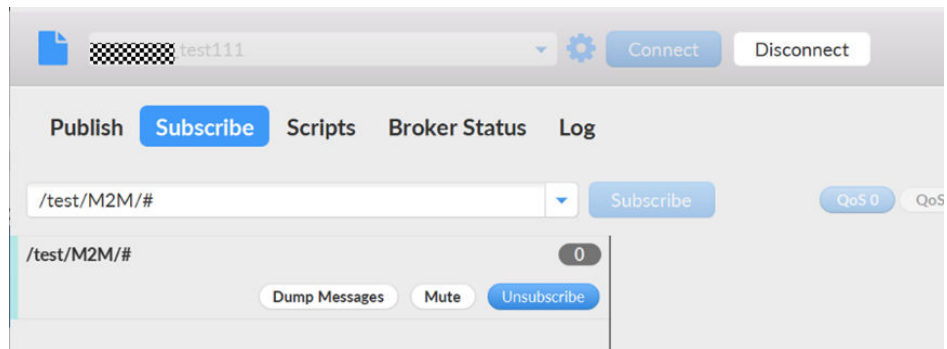


Figure 5-80 Device policy - Encoding a policy



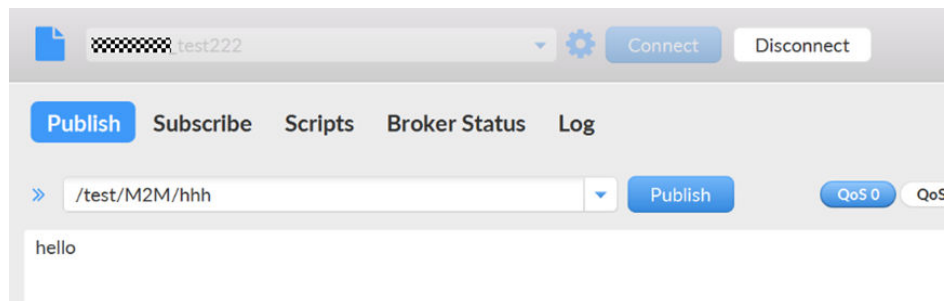
4. Verify the policy.
 - a. Open two MQTT.fx tools to simulate device A (**test111**) under product A and device B (**test222**) under product B.
 - b. On the **Subscribe** page of device B, enter the topic **/test/M2M/#** and click **Subscribe**.

Figure 5-81 Entering a topic on the Subscribe page of device B



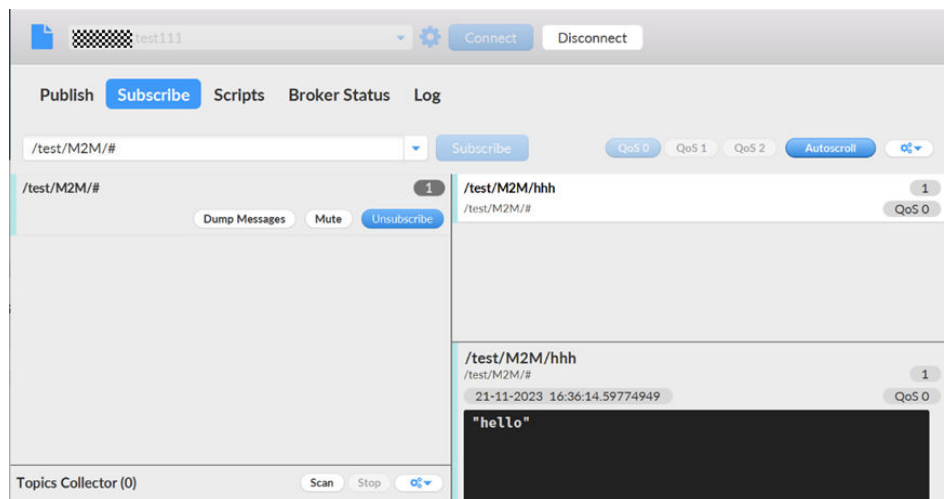
- c. Let device A send a message to device B. On the **Publish** page of device A, enter the topic **/test/M2M/{Any word}**. Enter the message to be sent (for example, **hello**) in the text box, and click **Publish**.

Figure 5-82 Entering a message on the Publish page of device A



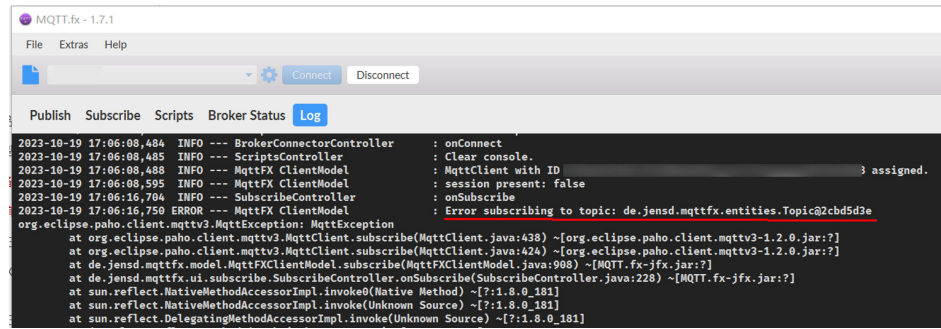
On the **Subscribe** page of device B, you can see the received message, as shown in the following figure.

Figure 5-83 Subscribe page of device B



- d. For devices not belonging to product B, they cannot subscribe to or publish messages through the topic **/test/M2M/#**.

Figure 5-84 Failed subscription



5.6 Broadcast Communication

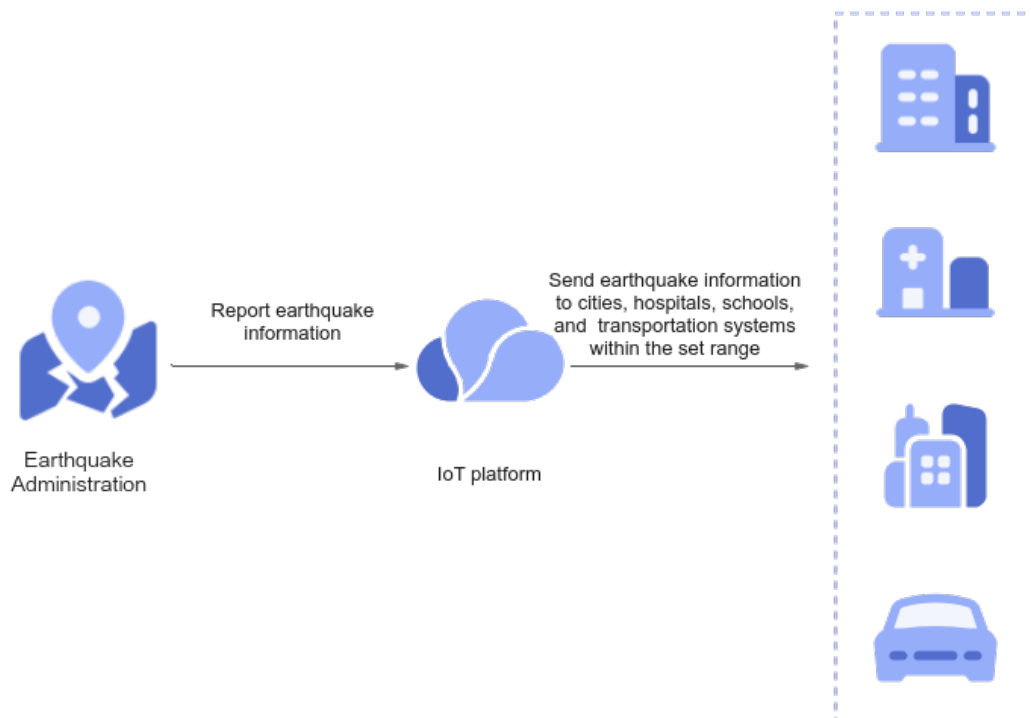
5.6.1 Broadcast Communication Overview

Introduction

Broadcast communication is often used for one-to-many message communication. If multiple devices subscribe to the same broadcast topic, applications can call the broadcast message delivery API to publish messages to these devices when they are online. You can use broadcast to send notifications to devices of specific types.

For example, the Earthquake Administration sends earthquake warning information to all citizens in a specified area.

Figure 5-85 Example broadcast communication scenario



Scenarios

- Broadcast messages are sent to devices in a specified group.
- Broadcast messages are sent to all online devices in a specified area for earthquake warning.

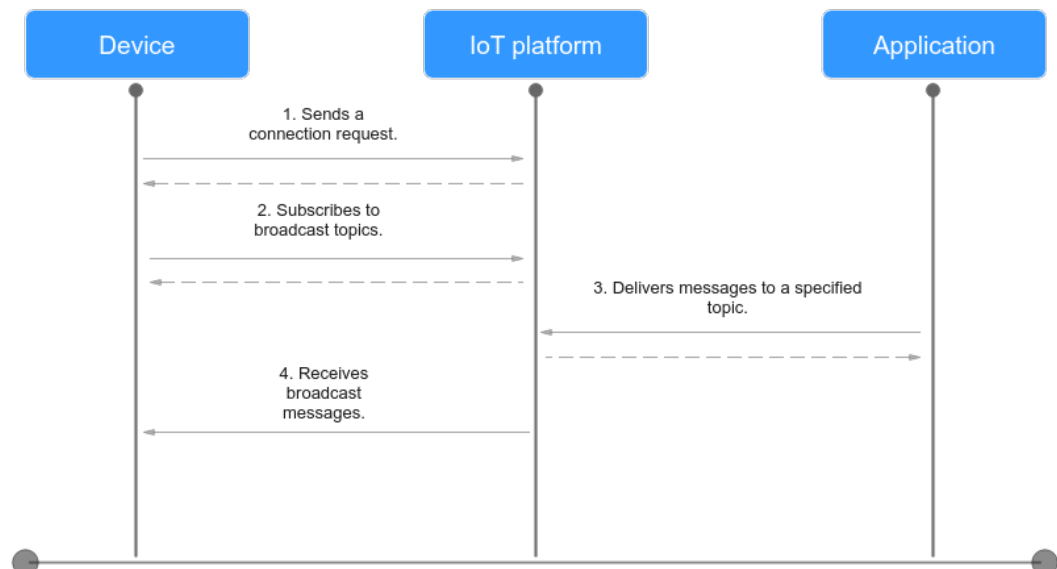
Constraints

- The prefix of a broadcast topic subscribed by devices must be **\$oc/broadcast/**.
- The length of a broadcast topic subscribed by devices cannot exceed 128 bytes.
- A maximum of seven slashes (/) can be used in a broadcast topic subscribed by devices.
- A single device can subscribe to a maximum of 50 broadcast topics.
- A topic can be subscribed to by a maximum of 1000 devices.
- The broadcast communication API on the application side can be called only once per minute.
- Currently, this function is available for standard instances in the CN North-Beijing4 region.

5.6.2 Broadcast Communication Usage

Broadcast Communication Usage

Figure 5-86 Broadcast communication sequence diagram



Procedure

Step 1 Initiate the connection authentication for the device. For details, see [Device Connection Authentication](#).

Step 2 After the device is authenticated, initiate broadcast topic subscription. The broadcast topic must be prefixed with **\$oc/broadcast/**. An example is as follows:

```
$oc/broadcast/test
```

- Step 3** The application **broadcasts a message** with the topic name and message content specified.

```
POST https://{Endpoint}/v5/iot/{project_id}/broadcast-messages
Content-Type: application/json
X-Auth-Token: *****

{
  "topic_full_name" : "$oc/broadcast/test",
  "message" : "eyJhbjoxfQ=="
}
```

CAUTION

The topic must be prefixed with **\$oc/broadcast/**, and the message content must be encoded using Base64.

- Step 4** The device receives the broadcast message. Example message:

```
Topic: $oc/broadcast/test
Data content
{"a":1}
```

----End

5.6.3 Broadcast Communication Example

Java SDK Usage

This section describes how to use the Java SDK for the development of broadcast communication.

Development Environment Requirements

JDK 1.8 or later has been installed.

Configuring the SDK for the Application

1. Configure the Maven dependency.

```
<dependency>
  <groupId>com.huaweicloud.sdk</groupId>
  <artifactId>huaweicloud-sdk-core</artifactId>
  <version>[3.0.40-rc, 3.2.0)</version>
</dependency>
<dependency>
  <groupId>com.huaweicloud.sdk</groupId>
  <artifactId>huaweicloud-sdk-iotda</artifactId>
  <version>[3.0.40-rc, 3.2.0)</version>
</dependency>
```

2. The following is a complete example of a broadcast message. The topic must be prefixed with **\$oc/broadcast/**, and the message content must be encoded using Base64.

```
public class BroadcastMessageSolution {
  // REGION_ID: If CN East-Shanghai1 is used, enter cn-east-3. If CN North-Beijing4 is used, enter
cn-north-4. If CN South-Guangzhou is used, enter cn-south-4.
  private static final String REGION_ID = "<YOUR REGION ID>";
  // ENDPOINT: On the console, choose Overview and click Access Addresses to view the HTTPS
```

```
application access address.
private static final String ENDPOINT = "<YOUR ENDPOINT>";
// For the standard or enterprise edition, create a region object.
public static final Region REGION_CN_NORTH_4 = new Region(REGION_ID, ENDPOINT);
public static void main(String[] args) {
    String ak = "<YOUR AK>";
    String sk = "<YOUR SK>";
    String projectId = "<YOUR PROJECTID>";
    // Create a credential.
    ICredential auth = new
BasicCredentials().withDerivedPredicate(AbstractCredentials.DEFAULT_DERIVED_PREDICATE)
        .withAk(ak)
        .withSk(sk)
        .withProjectId(projectId);
    // Create and initialize an IoTDAClient instance.
    IoTDAClient client = IoTDAClient.newBuilder().withCredential(auth)
        // For the basic edition, select the region object in IoTDARegion.
        //withRegion(IoTDARegion.CN_NORTH_4)
        // For the standard or enterprise edition, create a region object.
        .withRegion(REGION_CN_NORTH_4).build();
    // Instantiate a request object.
    BroadcastMessageRequest request = new BroadcastMessageRequest();
    DeviceBroadcastRequest body = new DeviceBroadcastRequest();
    body.withMessage(Base64.getEncoder().encodeToString("hello".getBytes()));
    body.withTopicFullName("$oc/broadcast/test");
    request.withBody(body);
    try {
        BroadcastMessageResponse response = client.broadcastMessage(request);
        System.out.println(response.toString());
    } catch (ConnectionException e) {
        e.printStackTrace();
    } catch (RequestTimeoutException e) {
        e.printStackTrace();
    } catch (ServiceResponseException e) {
        e.printStackTrace();
        System.out.println(e.getHttpStatusCode());
        System.out.println(e.getRequestId());
        System.out.println(e.getErrorCode());
        System.out.println(e.getErrorMsg());
    }
}
```

Table 5-25 Parameters

| Parameter | Description |
|-----------|--|
| ak | Access key ID (AK) of your Huawei Cloud account. You can create and view your AK/SK on the My Credentials > Access Keys page of the Huawei Cloud console. For details, see Access Keys . |
| sk | Secret access key (SK) of your Huawei Cloud account. |
| projectId | Project ID. For details on how to obtain a project ID, see Obtaining a Project ID . |

| Parameter | Description |
|------------------------|--|
| IoTDARegion.CN_NORTH_4 | Region where the IoT platform to be accessed is located. The available regions of the IoT platform have been defined in the SDK code IoTDARegion.java . On the console, you can view the region name of the current service and the mapping between regions and endpoints. For details, see Platform Connection Information . |
| REGION_ID | If CN East-Shanghai1 is used, enter cn-east-3 . If CN North-Beijing4 is used, enter cn-north-4 . If CN South-Guangzhou is used, enter cn-south-4 . |
| ENDPOINT | On the console, choose Overview and click Access Addresses to view the HTTPS application access address. |

Configuring the SDK on Devices

1. Configure the Maven dependency of the SDK on devices.

```
<dependency>
  <groupId>com.huaweicloud</groupId>
  <artifactId>iot-device-sdk-java</artifactId>
  <version>1.1.4</version>
</dependency>
```

2. Configure the SDK and device connection parameters on devices.

```
// Load the CA certificate of the IoT platform. For details about how to obtain the certificate, visit
https://support.huaweicloud.com/intl/en-us/devg-iotHub/iot\_02\_1004.html.
URL resource = BroadcastMessageSample.class.getClassLoader().getResource("ca.jks");
File file = new File(resource.getPath());
```

```
// The format is ssl://Domain name:Port number.
// To obtain the domain name, log in to the Huawei Cloud IoTDA console. In the navigation pane,
choose Overview and click Access Details in the Instance Information area. Select the access
domain name corresponding to port 8883.
String serverUrl = "ssl://localhost:8883";
// Device ID created on the IoT platform
String deviceId = "deviceId";
// Secret corresponding to the device ID
String deviceSecret = "secret";
// Create a device.
IoTDevice device = new IoTDevice(serverUrl, deviceId, deviceSecret, file);
if (device.init() != 0) {
  return;
}
```

3. Subscribe to a broadcast topic for the device. The broadcast topic must be prefixed with **\$oc/broadcast/**.

```
device.getClient().subscribeTopic("$oc/broadcast/test", null, rawMessage -> {
  log.info(" on receive message topic : {}, payload : {}", rawMessage.getTopic(),
    new String(rawMessage.getPayload()));
  rawMessage.getPayload();
}, 0);
```

Testing and Verification

Run the SDK code on the device to bring the device online and subscribe to the broadcast topic for the device. Run the SDK code on the application and call the **broadcastMessage** API to send a broadcast message to the device. Example message:

Figure 5-87 Broadcast message example

```

Run: BroadcastMessageSolution x BroadcastMessageSample x
2023-04-22 22:10:34 INFO MqttConnection:113 - Mqtt client connected. address is ssl://...stl.iotda-device.cn-north-4.myhuaweicloud.com:8883
2023-04-22 22:10:34 INFO MqttConnection:270 - publish message topic is Soc/devices/63db7fa81eaf704179a9bca5_broadcastTest/sys/events/up, msg =
{"object_device_id":"63db7fa81eaf704179a9bca5_broadcastTest","services":[{"paras":{"type":"DEVICE_STATUS","content":"connect complete, the url is ssl://...stl.iotda-device.cn-north-4
.myhuaweicloud.com:8883","timestamp":"1682172634786"},"service_id":"$log","event_type":"log_report","event_time":"20230422T141034Z","event_id":null}]}
2023-04-22 22:10:34 INFO MqttConnection:270 - publish message topic is Soc/devices/63db7fa81eaf704179a9bca5_broadcastTest/sys/events/up, msg =
{"object_device_id":"63db7fa81eaf704179a9bca5_broadcastTest","services":[{"paras":{"type":"DEVICE_STATUS","content":"connect complete, the url is ssl://...stl.iotda-device.cn-north-4
.myhuaweicloud.com:8883","timestamp":"1682172634786"},"service_id":"$log","event_type":"log_report","event_time":"20230422T141034Z","event_id":null}]}
2023-04-22 22:10:48 INFO MqttConnection:93 - messageArrived topic = Soc/broadcast/test, msg = hello
2023-04-22 22:10:48 INFO BroadcastMessageSample:33 - on receive message topic : Soc/broadcast/test , payload : hello
    
```

5.7 Codecs

Definition

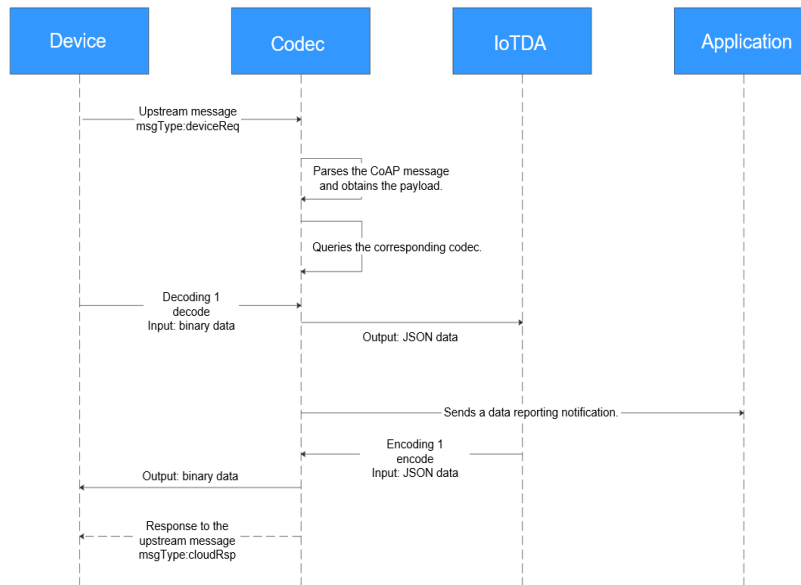
IoTDA uses codecs to convert data between the binary and JSON formats as well as between JSON formats. For MQTT devices, use JavaScript and FunctionGraph to develop codecs. For LwM2M devices, use online (graphical) and offline codec development.

For example, in the NB-IoT scenario where devices use CoAP over UDP to communicate with the platform, the payload of CoAP messages carries data at the application layer, at which the data type is defined by the devices. As NB-IoT devices require low power consumption, data at the application layer is generally in binary format instead of JSON. However, the platform sends data in JSON format to applications. Therefore, codec development is required for the platform to convert data between binary and JSON formats.



Data Reporting

Figure 5-88 Data reporting flowchart

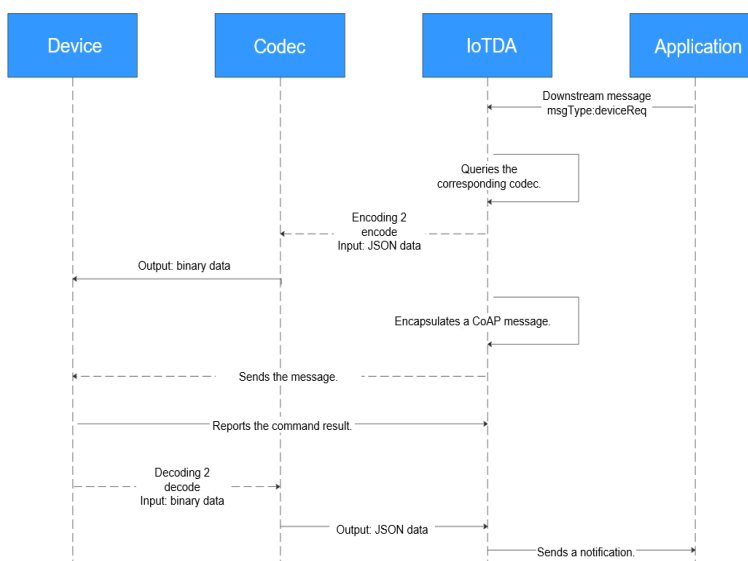


In the data reporting process, the codec is used in the following scenarios:

- Decoding binary data reported by a device into JSON data and sending the decoded data to an application
- Encoding JSON data returned by an application into binary data and sending the encoded data to a device

Command Delivery

Figure 5-89 Command delivery flowchart



In the command delivery process, the codec is used in the following scenarios:

- Encoding JSON data delivered by an application into binary data and sending the encoded data to a device
- Decoding binary data returned by a device into JSON data and reporting the decoded data to an application

Development Methods

The platform provides multiple methods for developing codecs. You can select a method as required. Offline codec development is complex and time-consuming. Graphical codec development and script-based codec development are recommended.

- Graphical development: The codec of a product can be quickly developed in a visualized manner on the IoTDA console. For details, see [Online Development](#).
- Script-based development: JavaScript scripts are used to implement encoding and decoding. For details, see [JavaScript Script-based Development](#).
- FunctionGraph development: FunctionGraph is used to implement encoding and decoding. For details, see [FunctionGraph Documentation](#).

6 Device Management

6.1 Product Creation

The first step of using the IoT platform is to create a product on the IoTDA console. A product is a collection of devices with the same capabilities or features.

Procedure

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** Choose **Products** in the navigation pane and click **Create Product** on the left. Set the parameters as prompted and click **OK**.

| Set Basic Info | |
|----------------|--|
| Resource Space | Select a resource space from the drop-down list box. If a resource space does not exist, create it first. |
| Product Name | Define a product name. The product name must be unique in the same resource space. The value can contain up to 64 characters. Only letters, digits, and special characters (<code>_? '#()., & % @ ! -</code>) are allowed. |

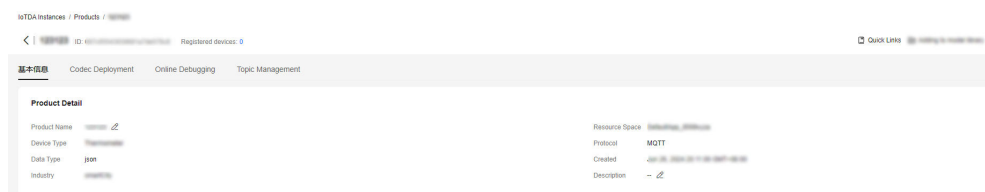
| | |
|--------------------------|--|
| Protocol | <ul style="list-style-type: none"> • MQTT: MQTT is used by devices to access the platform. The data format can be binary or JSON. If the binary format is used, the codec must be deployed. • LwM2M over CoAP: LwM2M/CoAP is used only by NB-IoT devices with limited resources (including storage and power consumption). The data format is binary. The codec must be deployed to interact with the platform. • HTTPS is a secure communication protocol based on HTTP and encrypted using SSL. IoTDA supports communication through HTTPS. • Modbus: Modbus is used by devices to access the platform. Devices that use the Modbus protocol to connect to IoT edge nodes are called indirectly connected devices. For details about the differences between directly connected devices and indirectly connected devices, see Gateways and Child Devices. • HTTP (TLS encryption), ONVIF, OPC UA, OPC DA, other, TCP, and UDP: IoT Edge is used for connection. |
| Data Type | <ul style="list-style-type: none"> • JSON: JSON is used for the communication protocol between the platform and devices. • Binary: You need to develop a codec on the IoTDA console to convert binary code data reported by devices into JSON data. The devices can communicate with the platform only after the JSON data delivered by the platform is parsed into binary code. |
| Industry | Set this parameter based on service requirements. |
| Device Type | Set this parameter based on service requirements. |
| Advanced Settings | |
| Product ID | Set a unique identifier for the product. If this parameter is specified, the platform uses the specified product ID. If this parameter is not specified, the platform allocates a product ID. |
| Description | Provide a description for the product. Set this parameter based on service requirements. |

You can click **More > Delete** to delete a product that is no longer used. After the product is deleted, its resources such as the product models and codecs will be cleared. Exercise caution when deleting a product.

----End

Follow-Up Procedure

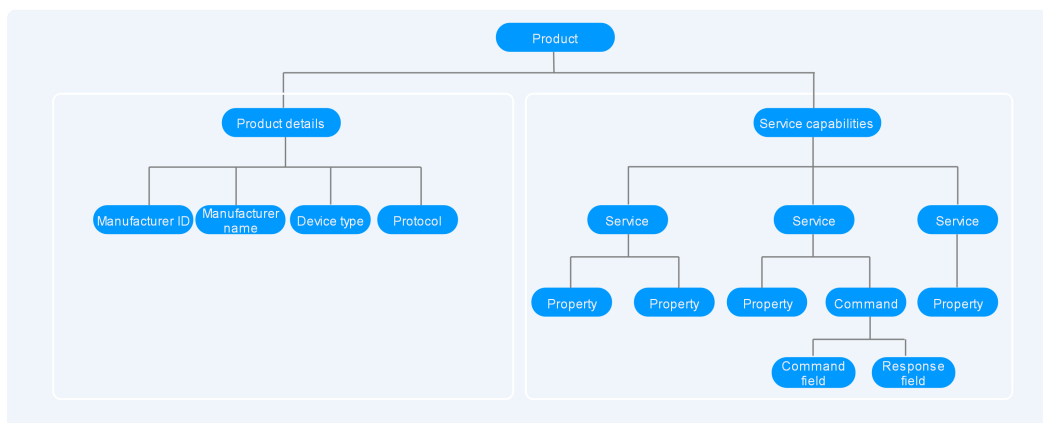
1. In the product list, click the name of a product to access its details. On the product details page displayed, you can view basic product information, such as the product ID, product name, device type, data format, resource space, and protocol type.

Figure 6-1 Product details

2. On the product details page, you can **develop a product model**, **develop a codec**, **perform online debugging**, and **customize topics**.

Product Models

A product model describes the capabilities and features of a device. You can build an abstract model of a device by defining a product model on the platform so that the platform can know what services, properties, and commands are supported by the device, such as its color or any on/off switches. After defining a product model, you can use it during **device creation**.



A product model consists of product details and service capabilities.

- **Product details**

Product details describe basic information about a device, including the device and protocol type.

Example device type: **WaterMeter**. Example protocol type: **CoAP**.

- **Service capabilities**

The capabilities of a device are divided into several services. Properties, commands, and command parameters are defined for each service.

For example, a water meter has multiple capabilities. It reports the water flow, alarms, battery life, and connection data, and it receives commands too. The table below describes its capabilities from five services, each of which has its own properties or commands.

| Service Type | Description |
|------------------|--|
| WaterMeterBasic | Defines parameters reported by the water meter, such as the water flow, temperature, and pressure. If these parameters need to be controlled or modified using commands, these parameters must be defined in the commands. |
| WaterMeterAlarm | Defines data reported by the water meter in various alarm scenarios. Commands need to be defined if necessary. |
| Battery | Defines the voltage and current intensity of the water meter. |
| DeliverySchedule | Defines transmission rules for the water meter. Commands need to be defined if necessary. |
| Connectivity | Defines connectivity parameters of the water meter. |

 NOTE

You can define the number of services as required. For example, the **WaterMeterAlarm** service can be further divided into **WaterPressureAlarm** and **WaterFlowAlarm** services or be integrated into the **WaterMeterBasic** service.

Model Development

The platform provides multiple methods for developing product models. You can select a method as required.

- **Custom model (online development):** Build a product model from scratch. For details, see [Developing a Product Model Online](#).
- **Upload local profile (offline development):** Upload a local product model to the platform. For details, see [Developing a Product Model Offline](#).
- **Import from Excel:** Develop a product model by importing an Excel file. For details, see [Import from Excel](#).
- **Import from Library:** You can use a preset product model to quickly develop a product. The platform provides standard and manufacturer-specific product models. Standard product models comply with industry standards and are suitable for devices of most manufacturers in the industry. Manufacturer-specific product models are suitable for devices provided by a small number of manufacturers. You can select a product model as required.

6.2 Registering Devices

6.2.1 Registering an Individual Device

A device is a physical entity that belongs to a product. Each device has a unique ID. It can be a device directly connected to the platform, or a gateway that

connects child devices to the platform. You can register a physical device with the platform, and use the device ID and secret allocated by the platform to connect your SDK-integrated device to the platform.

The platform allows an application to call the API [Creating a Device](#) to register an individual device. Alternatively, you can register an individual device on the IoTDA console. This topic describes the procedure on the IoTDA console.

Procedure

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Devices > All Devices**. On the displayed page, click **Register Device**, set parameters based on the table below, and click **OK**.

Figure 6-2 Device - Registering a secret device

The screenshot shows a 'Register Device' dialog box with the following fields and options:

- Resource Space**: A dropdown menu with a red asterisk and a help icon.
- Product**: A dropdown menu with a red asterisk.
- Node ID**: A text input field with a red asterisk and a help icon.
- Device ID**: A text input field with a help icon.
- Device Name**: A text input field.
- Description**: A text area with a character count '0/2,048' and a refresh icon.
- Authentication Type**: A selector with two options: 'Secret' (highlighted in blue) and 'X.509 certificate'.
- Secret**: A text input field with a red asterisk and a toggle icon.
- Confirm Secret**: A text input field with a red asterisk and a toggle icon.

At the bottom right, there are two buttons: 'Cancel' and 'OK'.

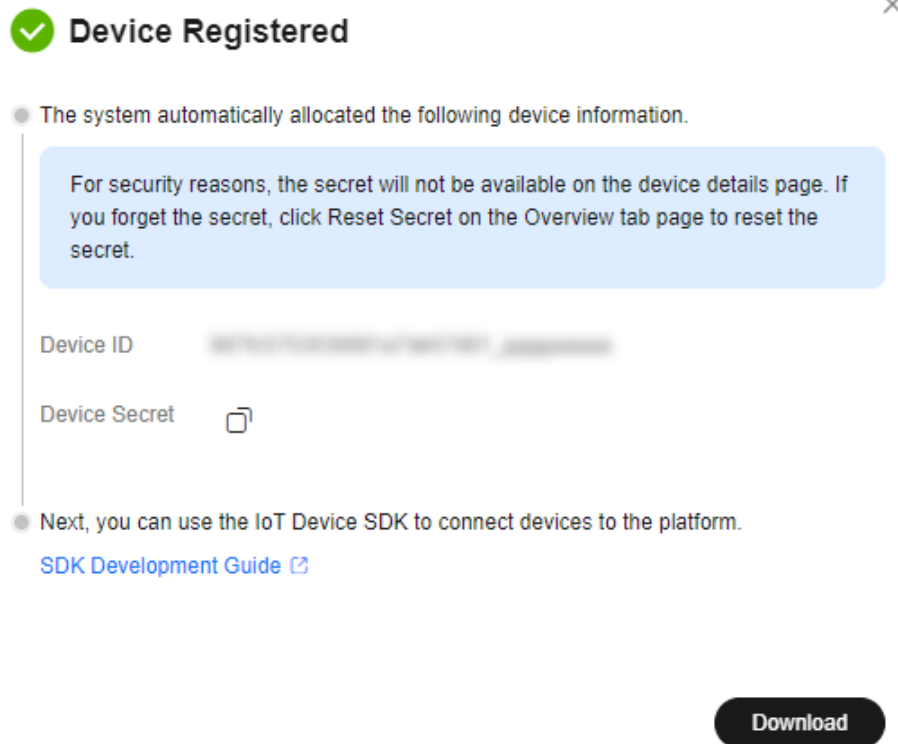
Table 6-1 Registering a device with secret

| Parameter | Description |
|----------------|--|
| Resource Space | Select the resource space to which a device belongs. |

| Parameter | Description |
|---------------------|---|
| Product | Select the product to which the device belongs. You can select a product only after it is defined. If no product is available, create a product by following the instructions provided in Product Creation . |
| Node ID | Set this parameter to the IMEI, MAC address, or serial number of the device. If the device is not a physical one, set this parameter to a custom string that contains letters, digits, hyphens (-), and underscores (_). |
| Device ID | Enter a unique device ID. If this parameter is carried, the platform will use the parameter value as the device ID. Otherwise, the platform will allocate a device ID, which is in the format of <i>product_id_node_id</i> . |
| Device Name | Customize the name of the device. |
| Description | Customize device description. |
| Authentication Type | <ul style="list-style-type: none"> • Secret: The device uses the secret for identity verification. • X.509 certificate: The device uses an X.509 certificate for identity verification. |
| Secret | Customize the secret used for device access. If the secret is left blank, the platform automatically generates one. |
| Fingerprint | <p>This parameter is displayed when Authentication Type is set to X.509 certificate. Import the fingerprint corresponding to the preset device certificate on the device side. You can run openssl x509 -fingerprint -sha256 -in deviceCert.pem in the OpenSSL view to query the fingerprint.</p> <pre>[root@88-iot-w12-2-jump-cert122312 ~]# openssl x509 -fingerprint -sha256 -in deviceCert.pem SHA256 Fingerprint: 4F:19:100:45:08:08:07:1E:6A:7E:77:01:4A:90:75:7F:32:07:DA:27:25:07:7C:49:3E:FF:50:7A:0F:4E:00:4D:F0:54:1E</pre> <p>Delete the colons (:) from the obtained fingerprint when filling it.</p> |

Save the device ID and secret. They are used for authentication when the device attempts to access the platform.

Figure 6-3 Device registered



NOTE

If the secret is lost, you can [update the secret](#). The secret generated during device registration cannot be retrieved.

You can delete a device that is no longer used from the [device list](#). Deleted devices cannot be retrieved. Exercise caution when performing this operation.

----End

APIs

- [Querying the Device List](#)
- [Creating a Device](#)
- [Querying a Device](#)
- [Modifying a Device](#)
- [Deleting a Device](#)
- [Resetting a Device Secret](#)

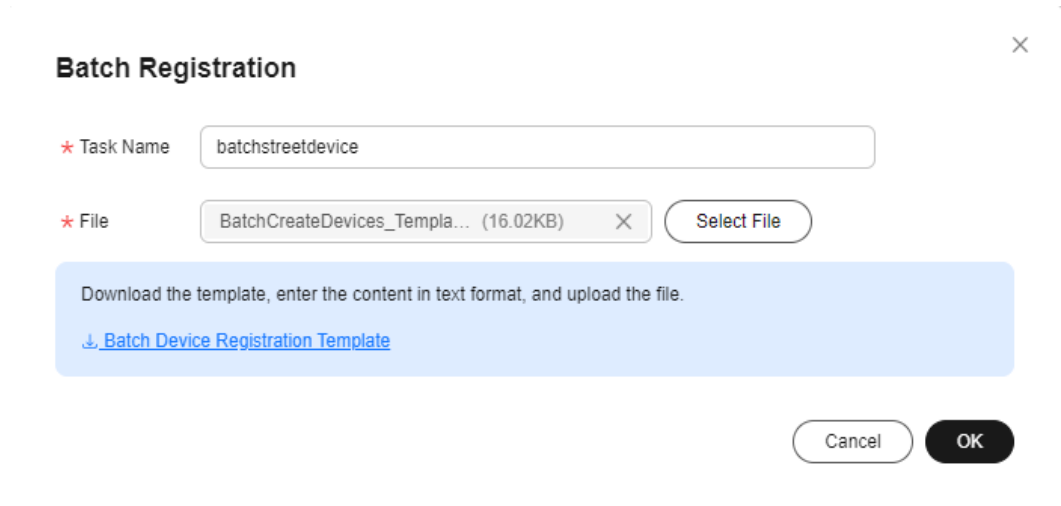
6.2.2 Registering a Batch of Devices

IoTDA allows an application to call the API [Creating a Batch Task](#) to register a batch of devices. Alternatively, you can perform batch registration on the IoTDA console. This topic describes how to use the IoTDA console to register a batch of devices.

Procedure

- Step 1** Access the **IoTDA** service page and click **Access Console**.
- Step 2** In the navigation pane, choose **Devices > All Devices**, click the **Batch Registration** tab, and then click **Batch Register**.
- Step 3** In the displayed **Batch Registration** dialog box, enter the task name, download and fill in the **Batch Device Registration Template**, upload the file, and click **OK**.

Figure 6-4 Device - Registering devices in batches



- Step 4** If the devices use the native MQTT protocol, click the batch task registration record to open the task execution details, and save the device IDs and secrets generated, which will be used for device access.

Figure 6-5 Batch device registering - Execution details

The screenshot shows a web interface for 'Task Details'. The 'Execution Details' tab is active. Below the tab is a search bar with the text 'Search by status by default.' and two icons. A table follows with the following columns: Status, Parameters, Output, and Error Cause. The table contains 10 rows, all with a green status icon and the text 'Success...'. The Parameters column shows '"product_id=f... n...'. The Output column shows 'deviceId=6...'. The Error Cause column shows '--'. At the bottom of the table, there is a pagination control showing 'Total Records: 26' and a dropdown menu set to '10'. A button labeled 'Export Result' is located at the bottom right of the table area.

| Status | Parameters | Output | Error Cause |
|------------|-----------------------|---------------|-------------|
| Success... | "product_id=f... n... | deviceId=6... | -- |
| Success... | "product_id=f... n... | deviceId=6... | -- |
| Success... | "product_id=f... n... | deviceId=6... | -- |
| Success... | "product_id=f... n... | deviceId=6... | -- |
| Success... | "product_id=f... n... | deviceId=6... | -- |
| Success... | "product_id=f... n... | deviceId=6... | -- |
| Success... | "product_id=f... n... | deviceId=6... | -- |
| Success... | "product_id=f... n... | deviceId=6... | -- |
| Success... | "product_id=f... n... | deviceId=6... | -- |
| Success... | "product_id=f... n... | deviceId=6... | -- |

----End

APIs

- [Creating a Device](#)
- [Querying the Batch Task List](#)
- [Creating a Batch Task](#)
- [Querying a Batch Task](#)

6.2.3 Registering a Device Authenticated by an X.509 Certificate

An X.509 certificate is a digital certificate used for communication entity authentication. IoTDA allows devices to use their X.509 certificates for authentication. The use of X.509 certificate authentication protects devices from being spoofed.

Before registering a device authenticated by an X.509 certificate, upload the device CA certificate to the platform and bind the device certificate to the device during device registration. This topic describes how to upload a device CA certificate to

the platform and register a device that uses the X.509 certificate for authentication.

Constraints

- Only MQTT devices can use X.509 certificates for identity authentication.
- You can upload a maximum of 100 device CA certificates.

Uploading a Device CA Certificate

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Devices > Device Certificates**. On the **Device CA Certificates** tab page, click **Upload Certificate**.
- Step 3** In the displayed dialog box, click **Select File** to add a file, and then click **OK**.

Figure 6-6 Device CA certificate - Uploading a certificate



NOTE

Device CA certificates are provided by device vendors. You can [prepare a commissioning certificate](#) during commissioning. For security reasons, you are advised to replace the commissioning certificate with a commercial certificate during commercial use. Purchased CA certificates (in formats such as PEM and JKS) can be directly uploaded to the platform.

----End

Making a Device CA Commissioning Certificate

This section uses the Windows operating system as an example to describe how to use OpenSSL to make a commissioning certificate. The generated certificate is in PEM format.

1. Download and install [OpenSSL](#).
2. Open the CLI as user **admin**.
3. Run **cd c:\openssl\bin** (replace **c:\openssl\bin** with the actual OpenSSL installation directory) to access the OpenSSL view.
4. Generate a public/private key pair.

```
openssl genrsa -out rootCA.key 2048
```
5. Use the private key in the key pair to generate a CA certificate.

```
openssl req -x509 -new -nodes -key rootCA.key -sha256 -days 1024 -out rootCA.pem
```

The system prompts you to enter the following information. All the parameters can be customized.

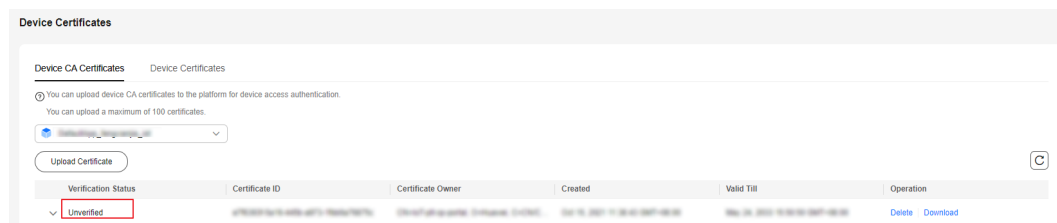
- Country Name (2 letter code) [AU]: country, for example, CN
- State or Province Name (full name) []: state or province, for example, GD
- Locality Name (for example, city) []: city, for example, SZ
- Organization Name (for example, company) []: organization, for example, Huawei
- Organizational Unit Name (for example, section) []: organization unit, for example, IoT
- Common Name (e.g. server FQDN or YOUR name) []: common name, for example, zhangsan
- Email Address []: email address, for example, 1234567@163.com

Obtain the generated CA certificate **rootCA.pem** from the **bin** folder in the OpenSSL installation directory.

Uploading a Verification Certificate

If the uploaded certificate is a commissioning certificate, the certificate status is **Unverified**. In this case, upload a verification certificate to verify that you have the CA certificate.

Figure 6-7 Device CA certificate - Unverified certificate



The verification certificate is created based on the private key of the device CA certificate. Perform the following operations to create a verification certificate:

Step 1 Generate a key pair for the verification certificate.

```
openssl genrsa -out verificationCert.key 2048
```

Step 2 Create a certificate signing request (CSR) for the verification certificate.

```
openssl req -new -key verificationCert.key -out verificationCert.csr
```

The system prompts you to enter the following information. Set **Common Name** to the verification code and set other parameters as required.

- Country Name (2 letter code) [AU]: country, for example, CN
- State or Province Name (full name) []: state or province, for example, GD
- Locality Name (for example, city) []: city, for example, SZ
- Organization Name (for example, company) []: organization, for example, Huawei
- Organizational Unit Name (for example, section) []: organization unit, for example, IoT
- Common Name (e.g. server FQDN or YOUR name) []: verification code for verifying the certificate. For details on how to obtain the verification code, see [Step 5](#).

- Email Address []: email address, for example, 1234567@163.com
- Password[]: password, for example, 1234321
- Optional Company Name[]: company name, for example, Huawei

Step 3 Use the CSR to create a verification certificate.

```
openssl x509 -req -in verificationCert.csr -CA rootCA.pem -CAkey rootCA.key -CAcreateserial -out verificationCert.pem -days 500 -sha256
```

Obtain the generated verification certificate **verificationCert.pem** from the **bin** folder of the OpenSSL installation directory.


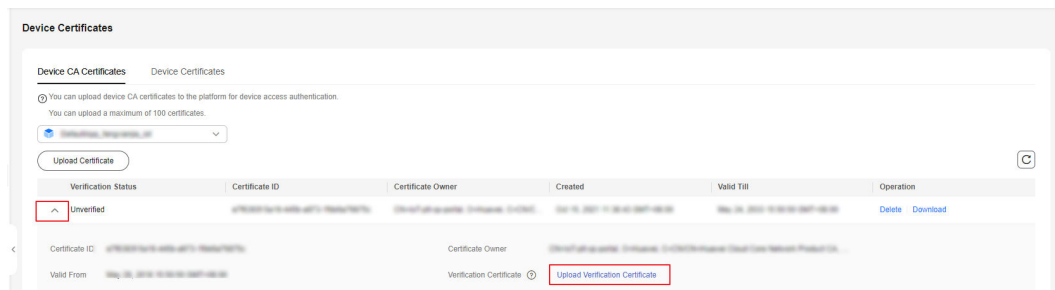
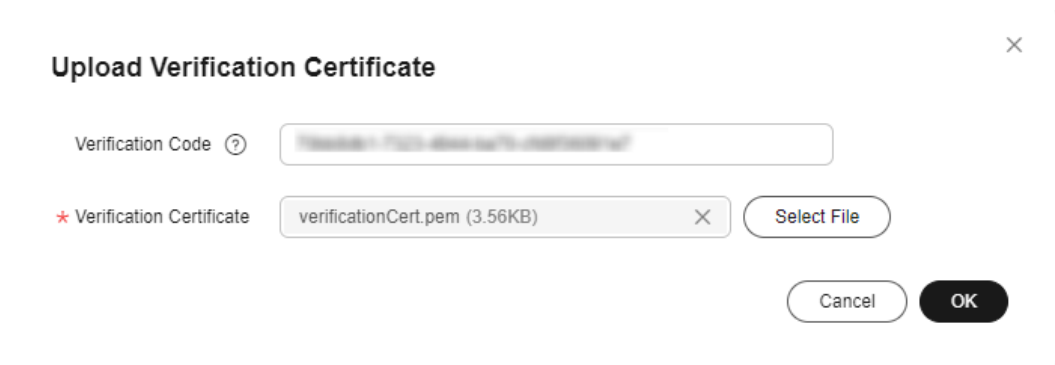
Step 4 Select the corresponding certificate, click , and click **Upload Verification Certificate**.

Figure 6-8 Device CA certificate - Verifying a certificate



Step 5 In the displayed dialog box, click **Select File** to add a file, and then click **OK**.

Figure 6-9 Device CA certificate - Uploading a verified certificate



After the verification certificate is uploaded, the certificate status changes to **Verified**, indicating that you have the CA certificate.

----End

Presetting an X.509 Certificate

Before registering an X.509 device, preset the X.509 certificate issued by the CA on the device.

 NOTE

The X.509 certificate is issued by the CA. If no commercial certificate issued by the CA is available, you can [create an X.509 commissioning certificate](#). Purchased certificates or certificates (in formats such as PEM and JKS) issued by authoritative organizations can be directly uploaded to the platform.

Creating an X.509 Commissioning Certificate

1. Run **cmd** as user **admin** to open the CLI and run **cd c:\openssl\bin** (replace **c:\openssl\bin** with the actual OpenSSL installation directory) to access the OpenSSL view.

2. Generate a public/private key pair.

```
openssl genrsa -out deviceCert.key 2048
```

3. Create a CSR for the device certificate.

```
openssl req -new -key deviceCert.key -out deviceCert.csr
```

The system prompts you to enter the following information. All the parameters can be customized.

- Country Name (2 letter code) [AU]: country, for example, CN
- State or Province Name (full name) []: state or province, for example, GD
- Locality Name (for example, city) []: city, for example, SZ
- Organization Name (for example, company) []: organization, for example, Huawei
- Organizational Unit Name (for example, section) []: organization unit, for example, IoT
- Common Name (e.g. server FQDN or YOUR name) []: common name, for example, zhangsan
- Email Address []: email address, for example, 1234567@163.com
- Password[]: password, for example, 1234321
- Optional Company Name[]: company name, for example, Huawei

4. Create a device certificate using CSR.

```
openssl x509 -req -in deviceCert.csr -CA rootCA.pem -CAkey rootCA.key -CAcreateserial -out deviceCert.pem -days 500 -sha256
```

Obtain the generated device certificate **deviceCert.pem** from the **bin** folder in the OpenSSL installation directory.

Registering a Device Authenticated by an X.509 Certificate

Step 1 Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.

Step 2 In the navigation pane, choose **Devices > All Devices**, click **Register Device**, set parameters based on the table below, and click **OK**.

Figure 6-10 Device - Registering an X.509 device

Table 6-2 Registering a device using X.509 certificate

| Parameter | Description |
|----------------|---|
| Resource Space | Select the resource space to which a device belongs. |
| Product | Select the product to which the device belongs. You can select a product only after it is defined. If no product is available, create a product by following the instructions provided in Product Creation . |
| Node ID | Set this parameter to the IMEI, MAC address, or serial number of the device. If the device is not a physical one, set this parameter to a custom string that contains letters, digits, hyphens (-), and underscores (_). |
| Device ID | Enter a unique device ID. If this parameter is carried, the platform will use the parameter value as the device ID. Otherwise, the platform will allocate a device ID, which is in the format of <i>product_id_node_id</i> . |
| Device Name | Customize the device name. |
| Description | Customize device description. |

| Parameter | Description |
|---------------------|---|
| Authentication Type | X.509 certificate : The device uses an X.509 certificate for identity verification. |
| Fingerprint | This parameter is displayed when Authentication Type is set to X.509 certificate . Import the fingerprint corresponding to the preset device certificate on the device side . You can run openssl x509 -fingerprint -sha256 -in deviceCert.pem in the OpenSSL view to query the fingerprint. Note: Delete the colon (:) from the obtained fingerprint when filling it. <pre>[root@8s -iot-wl2-2-jump-cert1223]# openssl x509 -fingerprint -sha256 -in deviceCert.pem SHA256 Fingerprint: 11:47:91:50:45:BB:03:57:E6:A7:57:70:4A:90:75:F3:07:0A:27:58:7C:49:3E:FF:59:7A:6F:4F:08:40:F8:54:E8</pre> |

----End

APIs

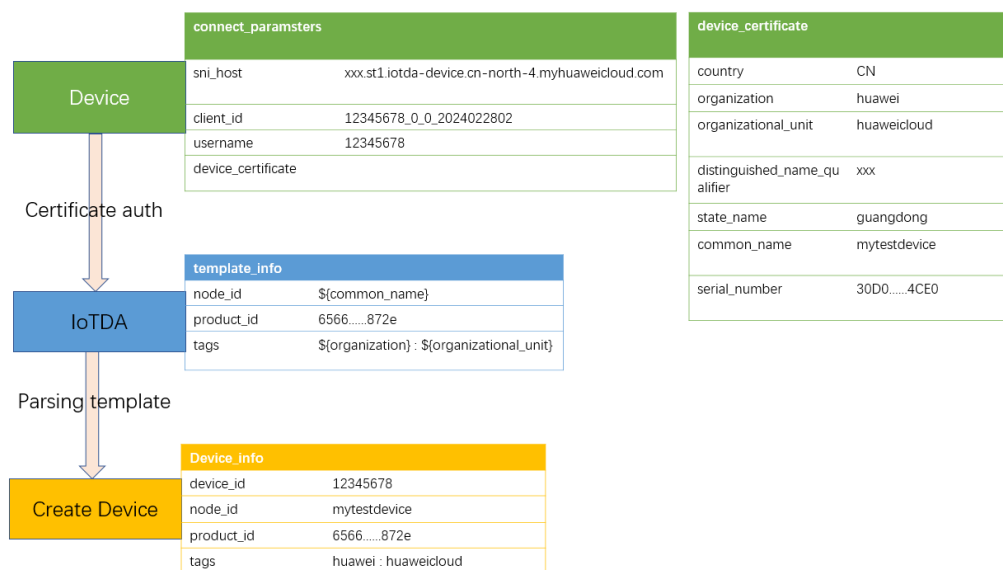
- [Obtaining the Device CA Certificate List](#)
- [Uploading a Device CA Certificate](#)
- [Deleting a Device CA Certificate](#)
- [Verifying a Device CA Certificate](#)

6.2.4 Device Self-Registration

Overview

For security, devices can connect to IoTDA only after their basic information (such as the device ID and authentication information) is registered on the platform. You can register a device on the platform manually or use self-registration templates, with which the device information is automatically registered when the device connects to the platform for the first time. This section describes how to use certificates and server name indication (SNI) to implement device self-registration.

Figure 6-11 Service flow



Scenarios

- Common scenarios: With self-registration, devices are registered automatically with device certificates, free of device provisioning.
- IoV: With self-registration, head units can go online immediately upon starting, simplifying application development.
- Large enterprise customers: With self-registration, the customers who have purchased multiple IoTDA instances do not need to register and provision devices under different instances separately in advance.

Constraints

- A maximum of 10 self-registration templates can be created for an account.
- To use the device self-registration function, the device must use TLS and enable the **SNI** extension. The SNI must carry the domain name allocated by the platform. You can obtain the domain name by choosing **Overview** and clicking **Access Details**.
- Currently, this function supports only bidirectional MQTTS certificate authentication.

Procedure

- Step 1** Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
- Step 2** Create a self-registration template. In the navigation pane, choose **Devices** > **Self-Registration Template**, and click **Create Template**. You can bind policies to devices in the template in advance. For details about how to use device policies, see **Device Topic Policies**. Set the node ID and product ID (mandatory). Set the device ID to the value of **Username** in the MQTT connection parameters. The product must be created on the platform in advance.

Figure 6-12 Self-registration template - Creating a template

The screenshot displays the 'Configure Resource' and 'Configure Policy' sections of the IoTDA console. The 'Configure Resource' section includes a 'Device' dropdown menu, a 'Node ID' dropdown menu, a 'Product ID' dropdown menu, and a 'Tag' section with a 'Max. tags: 5' limit and two tag input fields. The 'Configure Policy' section shows a table of policies.

| Policy Name | Policy ID | Operation |
|-----------------------|------------------------|-----------|
| system_default_policy | 66890a68a3ee9079c58b50 | Delete |

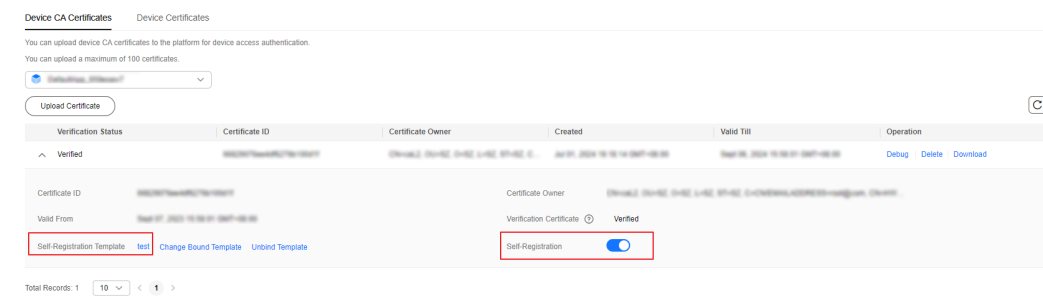
NOTE

The platform predefines the parameters that can be declared and referenced in the template, as shown below. The certificate must contain the parameters referenced in the template.

- **iotda::certificate::country:** country
- **iotda::certificate::organization:** organization
- **iotda::certificate::organizational_unit:** department
- **iotda::certificate::distinguished_name_qualifier:** distinguished name
- **iotda::certificate::state_name:** province/state
- **iotda::certificate::common_name:** common name
- **iotda::certificate::serial_number:** serial number

Step 3 Create a device certificate by referring to [Registering a Device Authenticated by an X.509 Certificate](#). Upload the CA certificate to the platform, verify the certificate, bind the self-registration template created in [Step 2](#), and enable the self-registration function.

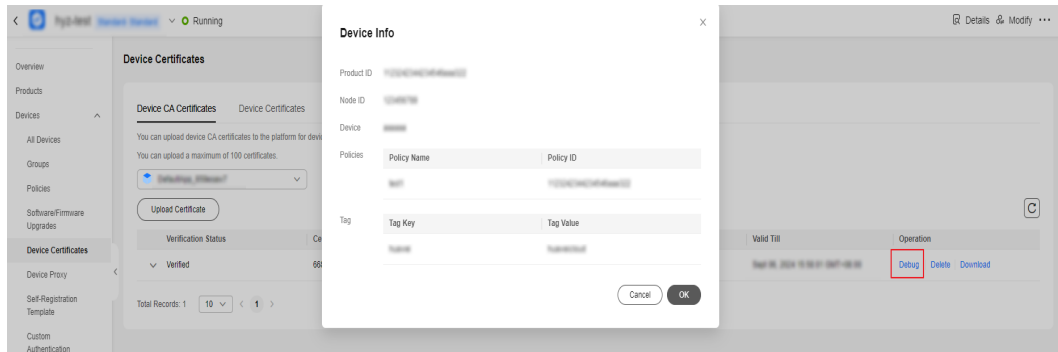
Figure 6-13 Device CA certificate - Binding a template

**NOTICE**

The device to register and its CA certificate must be in the same resource space. Ensure that the CA certificate and the product corresponding to the product ID in the template are in the same resource space.

Step 4 In the navigation pane, choose **Devices > Device Certificates**. On the **Device CA Certificates** tab page, click **Debug** to upload the device certificate created in [Step 3](#), and check whether the pre-parsed device information meets the expectation.

Figure 6-14 Device CA certificate - Debugging a certificate



----End

Verification

1. Use the MQTT.fx tool to simulate the connection of a device to the platform for the first time and the automatic registration. Set the client ID by referring to [Connection Parameters](#). Set **User Name** to the ID of the device registered in the platform. **Password** is not required. Obtain the CA certificate of the platform by referring to [Certificates](#). After the connection is successful, check the registered device information on the platform.

Figure 6-15 Connection parameters

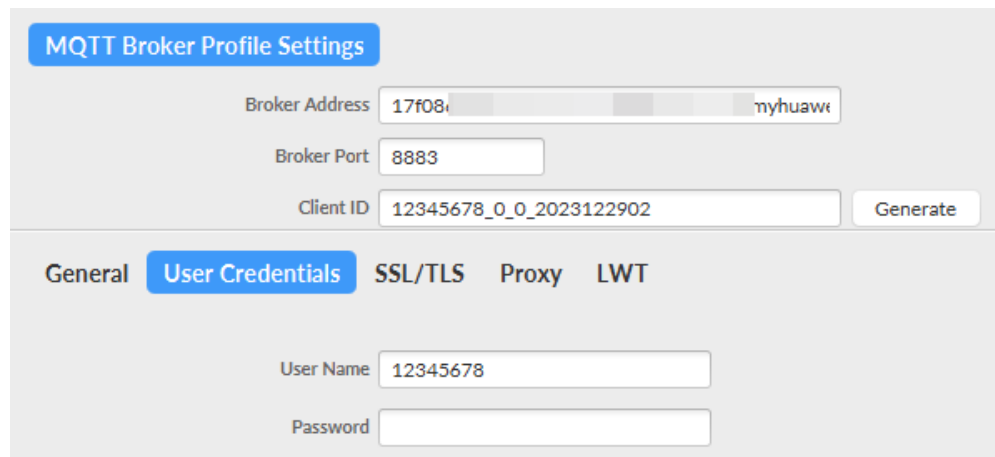
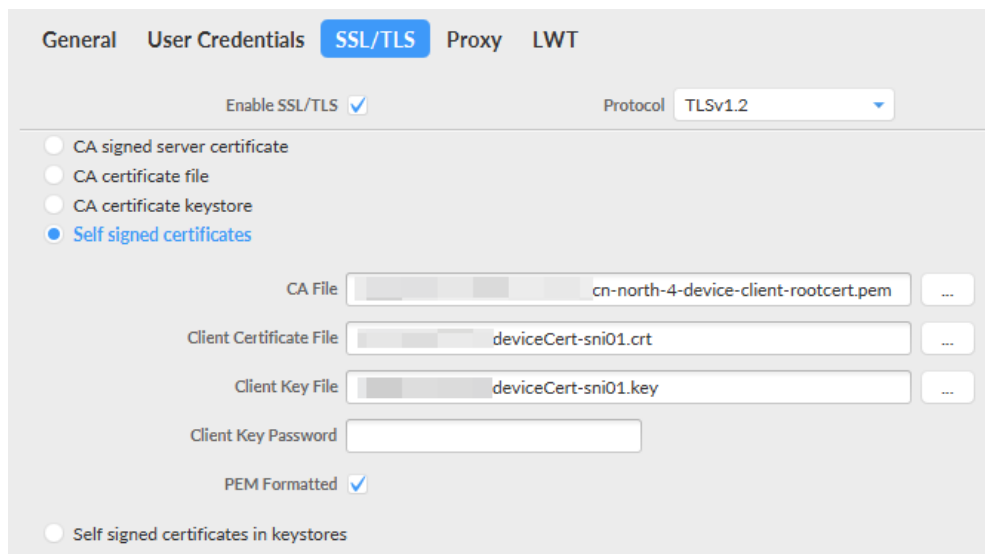
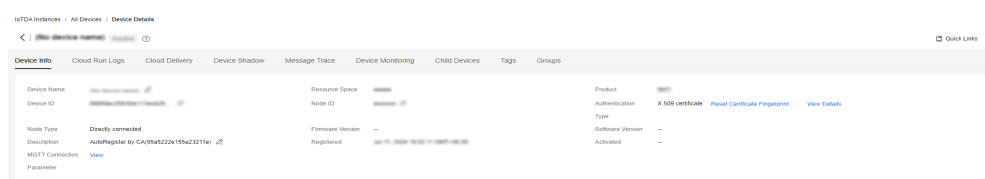


Figure 6-16 Certificate information



2. After the connection is successful, you can find the self-registered device in the device list on the console.

Figure 6-17 Device - Self-registered device details



6.3 Device Management

After a device is registered, you can manage the device, view device information, and freeze the device on the IoTDA console.

- Step 1** Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Devices > All Devices**. By default, all devices in the current instance are displayed in the device list.

Figure 6-18 Device - Device list

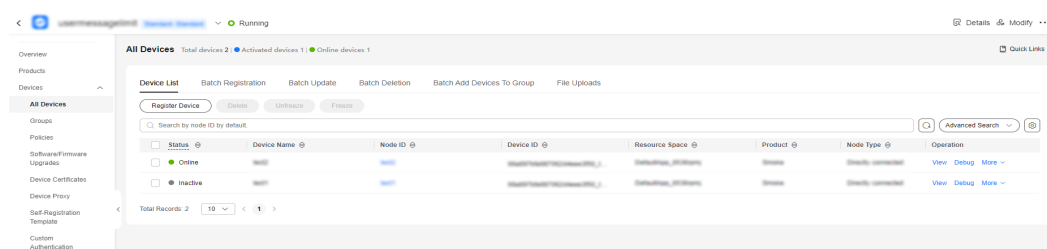


Table 6-3 Device list functions

| Function | Description |
|-------------------------|---|
| Search for a device | Search for a specific device based on the status, device name, node ID, device ID, resource space, product, and node type. |
| View device information | View the device status , device name, and node ID in the device list. Click View in the row of a device to access the device details. |
| Delete a device | Click Delete in the row of a device to delete the device. NOTE After a device is deleted, the related device data is deleted. Exercise caution when performing this operation. To delete a large number of devices, you can call the API for creating a batch task or delete devices in batches on the IoTDA console. For details, see Deleting a Batch of Devices . |
| Freeze a device | Click Freeze in the row of a device to freeze the device. NOTE A frozen device cannot go online. Only devices that are directly connected to the platform can be frozen. To freeze a large number of devices, you can call the API for creating a batch task . |
| Unfreeze a device | Click Unfreeze in the row of a device to unfreeze the device. To unfreeze a large number of devices, you can call the API for creating a batch task . |
| Debug a device | Click Debug in the row of a device to debug the device. |

----End

Device Status

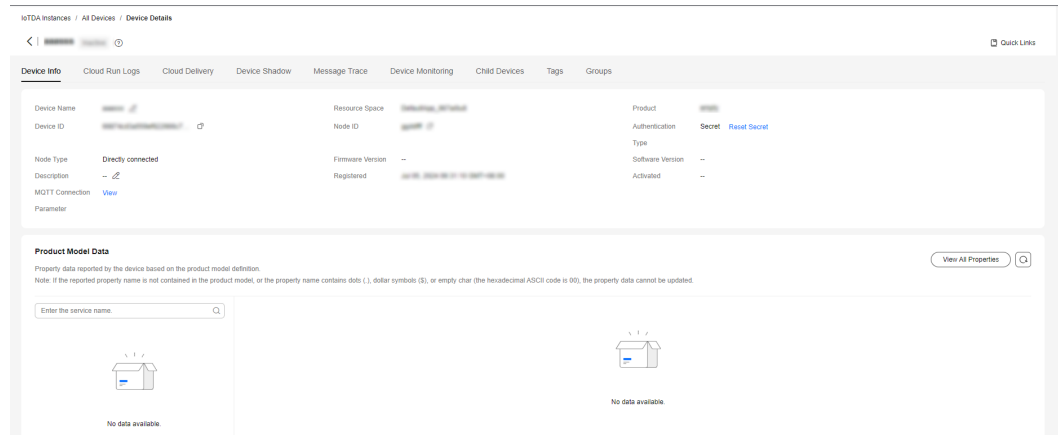
You can view the device status (online, offline, inactive, abnormal, or frozen) on the IoTDA console. You can also learn the device status by means of **subscription**. The table below describes the device statuses.

| Type | Status | Short-Connection Device (Such as NB-IoT Devices) | Persistent Connection Device (MQTT Device) |
|-------------------|----------|---|--|
| Connection status | Online | If a device has reported data within 25 hours, the device status is Online . If no data has been reported within the past 25 hours, the device status is Abnormal . | The device is connected to the platform. |
| | Offline | If a device reports no data for 49 hours after connecting to the platform, the platform sets the device status to Offline . | After the device is disconnected from the platform for 1 minute (the data is automatically updated every minute), the device status is set to Offline . If you manually refresh the status on the page, the device status is displayed as Offline . |
| | Abnormal | If a device reports no data for 25 hours after connecting to the platform, the platform sets the device status to Abnormal . | This status does not apply to persistent connection devices. |
| | Inactive | The device is registered with but does not connect to the platform. The device activation procedure is described in Initializing a Device . | The device is registered with but does not connect to the platform. The device activation procedure is described in Initializing a Device . |
| Management status | Frozen | After a device is frozen, it cannot be connected to the IoT platform. Currently, only devices directly connected to the IoT platform can be frozen. | |

Viewing Device Details

In the device list, click **View** in the row of a device to access its details.

Figure 6-19 Device - Device details



| Tab | Description |
|----------------|---|
| Device Info | <ul style="list-style-type: none"> Viewing device information: You can view basic device information, including the node ID, device ID, node type, software version, and firmware version. You can also call the API for modifying a device. <ul style="list-style-type: none"> Node ID is a unique physical identifier for the device, such as its IMEI or MAC address. This parameter is used by the platform to authenticate the device during device access. Device ID uniquely identifies a device. It is allocated by the platform during device registration and used for device access authentication and message transmission. Resetting a secret: The secret is used for authentication when MQTT devices, NB-IoT devices, or SDK-integrated devices access the platform. After the secret is reset, the new secret must be updated on the device, and the device must carry the new secret for authentication during platform connection. Viewing the latest reported data: View the latest data reported by the device to the platform. |
| Cloud Run Logs | IoTDA records connections with devices and applications. You can view the information on the console. For details, see Run Logs (New Version) . |
| Cloud Delivery | You can create a command or message (MQTT device only) delivery task for an individual device on the IoTDA console. For details, see Data Delivery . |
| Device Shadow | The platform provides the device shadow to cache the device status. When the device is online, delivered commands can be directly obtained. When the device is offline, it can proactively obtain the delivered commands after going online. For details, see Device Shadow . |
| Message Trace | The platform supports quick fault locating and cause analysis through message trace. For details, see Message Trace . |

| Tab | Description |
|-------------------|---|
| Device Monitoring | <ul style="list-style-type: none">• Device run logs: If you enable device log collection, local logs can be uploaded to Log Tank Service (LTS). (Note that this function is available only for MQTT devices.)• Anomaly detection: IoTDA provides device anomaly detection functions. For details, see Anomaly Detection. |
| Child Devices | Devices can be directly or indirectly connected to the IoT platform. Indirectly connected devices access the platform through gateways. For details, see Gateways and Child Devices . |
| Tags | You can define tags and bind tags to devices. For details, see Tags . |
| Groups | You can add devices to different groups for batch operations. For details, see Groups and Tags . |

Deleting a Batch of Devices

To delete devices in batches on the IoTDA console, perform the following steps:

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Devices > All Devices**, click the **Batch Deletion** tab, and click **Batch Deletion**.
- Step 3** In the displayed dialog box, download **Batch Device Deletion Template**, enter the IDs of the devices to be deleted in the template, specify **Task Name**, upload the file, and click **OK**. Alternatively, you can specify a product to delete devices in batches.

Figure 6-20 Device - Deleting devices in batches (by file)

Batch Delete ×

* Task Name

* Select Type File Product

* File

Download the template, enter the content in text format, and upload the file.

[Batch Device Deletion Template](#)

Figure 6-21 Device - Deleting devices in batches (by product)

The screenshot shows a 'Batch Delete' dialog box with the following elements:

- Task Name:** A text input field.
- Select Type:** Two buttons, 'File' (grey) and 'Product' (blue).
- Resource Space:** A dropdown menu.
- Product:** A dropdown menu.
- Warning:** An orange banner with a warning icon and the text: "Using the 'Product' type will delete all devices under the selected product, please operate with caution."
- Buttons:** 'Cancel' and 'OK' buttons at the bottom right.

The task execution status and result are displayed. If the success rate is not 100%, click the task name to open the task details page and view the failure cause.

----End

6.4 Groups and Tags

Group Introduction

A device group is a collection of devices. You can create groups for all the devices in a resource space based on rules (such as regions and types), and operate these devices by group. For example, you can perform a firmware upgrade on a group of water meters in the resource space. Devices in a group can be added, deleted, modified, and queried. A device can be bound to and unbound from multiple groups.

Table 6-4 Classification

| Group Type | Description |
|---------------|---|
| Static group | <p>You need to manually add devices to or remove devices from a group. Group nesting is supported.</p> <p>Restrictions:</p> <ul style="list-style-type: none">• A maximum of 1,000 groups (including nested child groups) can be created for a single instance of an account.• A maximum of 20,000 devices can be added to a group.• A device can be bound to a maximum of 10 groups.• A maximum of five group layers are supported.• A child group can belong to only one parent group.• If a group has child groups, the group cannot be deleted directly. You need to delete the child groups before deleting the parent group. |
| Dynamic group | <p>Devices are automatically added to or removed from the group based on the dynamic query rules of SQL-like statements. You cannot manually manage devices in a dynamic group.</p> <p>Restrictions:</p> <ul style="list-style-type: none">• A maximum of 10 dynamic groups can be created for a single instance of an account.• When a dynamic group is created for the first time, a maximum of 100,000 devices can be matched. (There is no limit on the number of devices that can be added to the dynamic group later.)• Dynamic groups are parent groups by default. Dynamic groups cannot be nested.• After a dynamic group is created, its rules cannot be modified.• Devices in a dynamic group cannot be manually managed.• This API is supported only by standard and enterprise editions.• The maximum TPS for an account to create a dynamic group is 1 (one request per second). |

Managing Groups

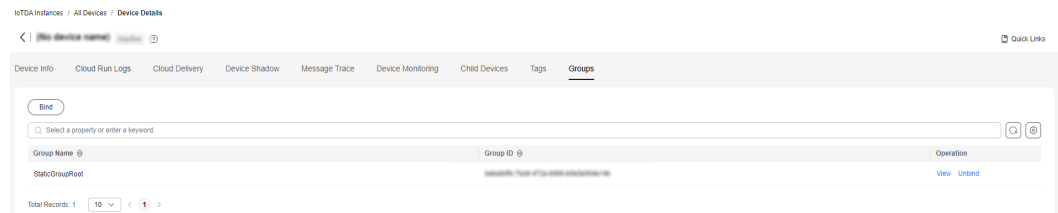
- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Devices > Groups**.
- Step 3** You can add, modify, or delete a group.

Table 6-5 Description

| Operation | Description |
|-----------------|--|
| Binding | Click Bind to bind a device to a group. |
| Batch unbinding | Select multiple devices (up to 100 devices at a time) and click Batch Unbind to unbind the selected devices from the current group. |
| Unbinding | Locate the target device and click Unbind to unbind the device from the group. |

Step 5 In the navigation pane, choose **Devices > All Devices**. On the displayed page, locate the target device, click **View** in the **Operation** column. Click the **Groups** tab page to check and manage the associated groups. For details, see [Table 6-5](#).

Figure 6-25 Device - Group management

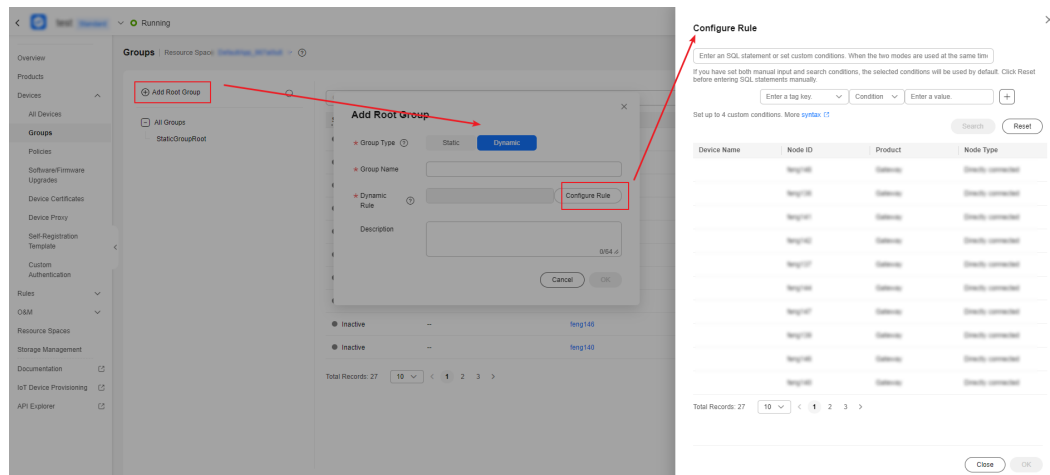


----End

Dynamic group

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Devices > Groups**.
- Step 3** Click **Add Root Group** to add a group. Set **Group Type** to **Dynamic**.
- Step 4** Set parameters as prompted, enter SQL-like statements, and click **Configure Rule** to check the matched devices. Click **OK** to complete the dynamic group creation.

Figure 6-26 Group - Creating a dynamic group



NOTE

- For details about the dynamic rule syntax, see [Advanced Search](#).
- The difference between dynamic group rules and advanced search is that dynamic group rules do not support `app_id` and `group_id` filtering.
- You can click **Try** to enter a dynamic rule. After you enter a dynamic rule, click **OK**. The rule is automatically written back.

----End

Dynamic Group Example

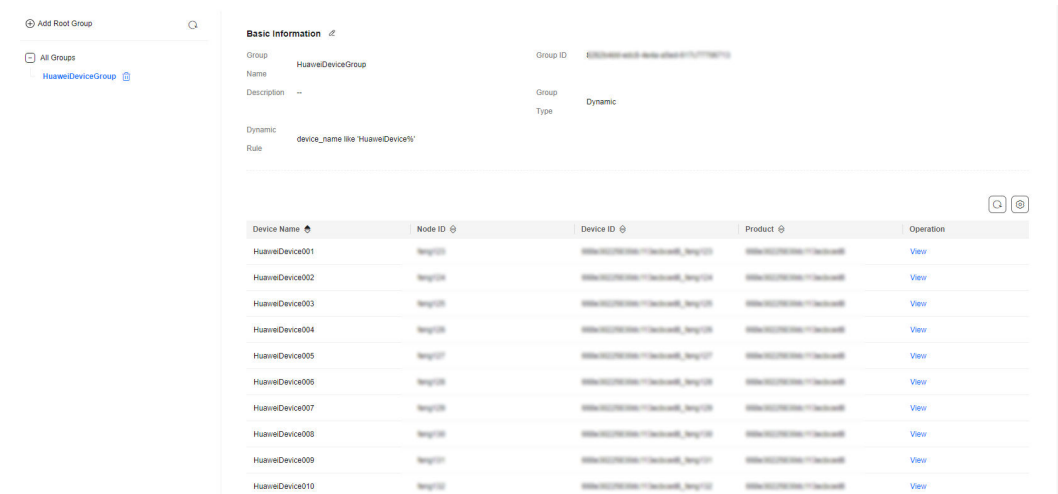
Create a dynamic group based on the device name fuzzy match rule (other conditions can be selected based on the site requirements) and select the dynamic group to execute the OTA upgrade task.

Devices in a dynamic group are dynamically adjusted based on device names, and the status of the OTA upgrade task associated with the dynamic group also changes dynamically.

For details, see [Upgrading the Firmware for a Batch of Devices](#) and [Dynamic group](#).

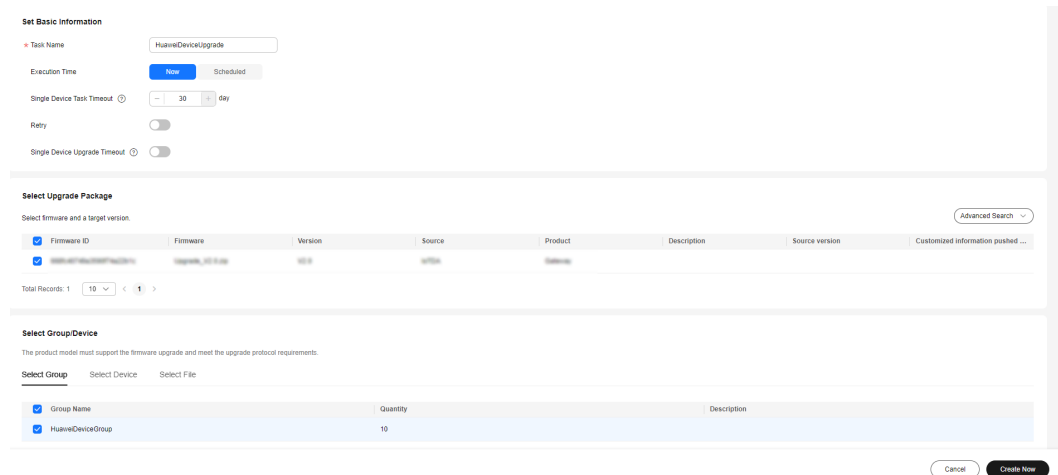
- Step 1** Create a dynamic group named **HuaweiDeviceGroup** and set the group rule to `device_name like 'HuaweiDevice %'`.

Figure 6-27 Dynamic group - Details



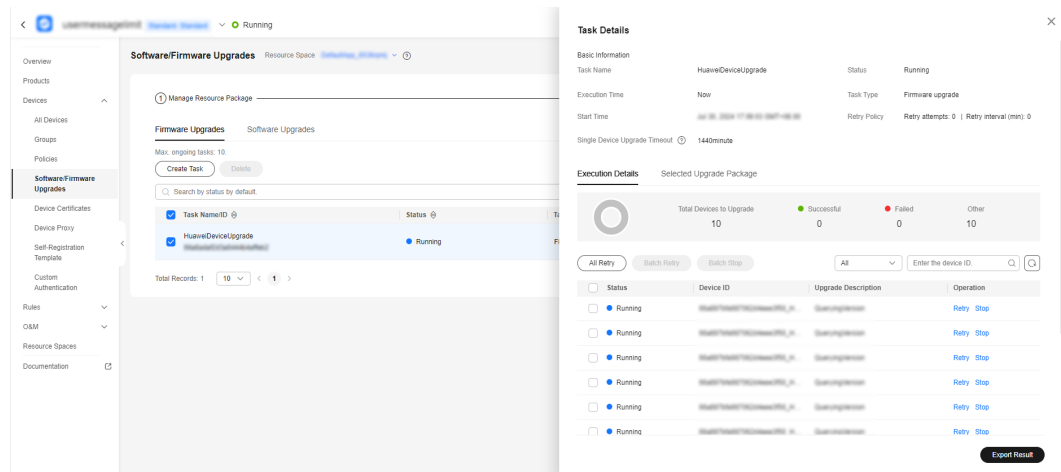
Step 2 Create a device firmware upgrade task and select the dynamic group **HuaweiDeviceGroup**.

Figure 6-28 Creating a firmware upgrade task - Dynamic group



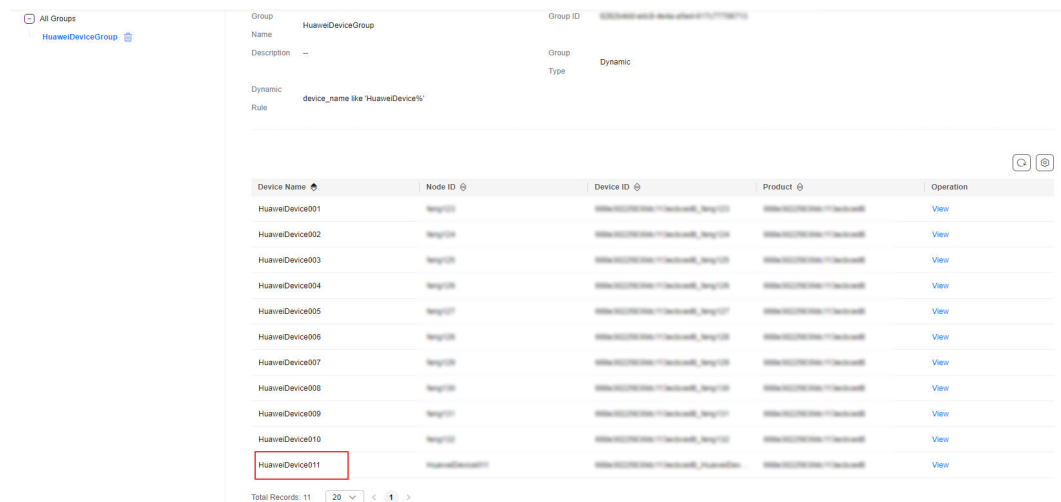
Step 3 After the dynamic group is created, you can view that the devices in the dynamic group are added to the upgrade task.

Figure 6-29 Firmware upgrade task - Details (dynamic group)



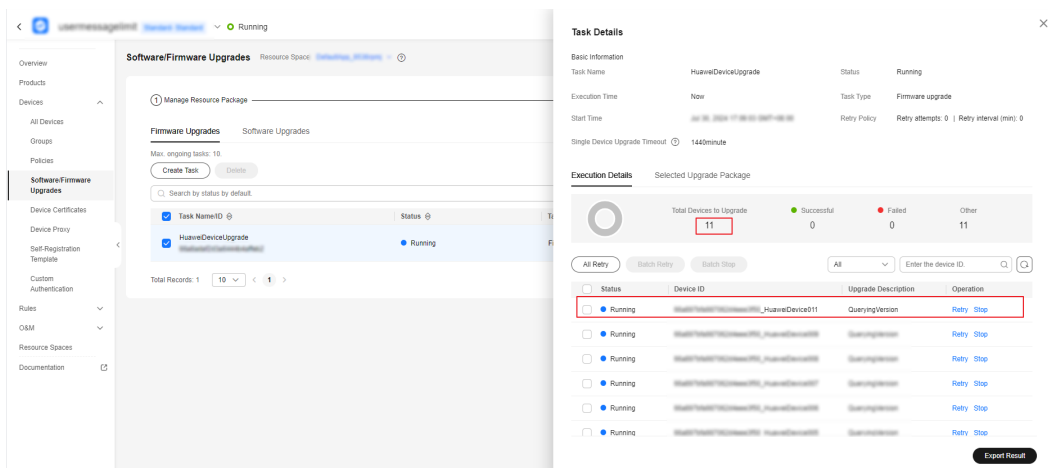
Step 4 Register a device by referring to [Registering a Single Device](#). The device name is **HuaweiDevice011**. After the registration is successful, you can view that the device has been automatically added to the dynamic group **HuaweiDeviceGroup**.

Figure 6-30 Dynamic group - Adding a device



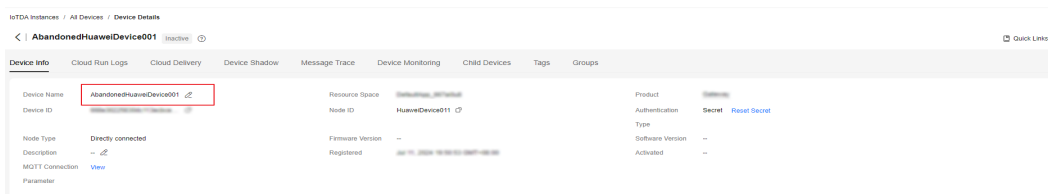
Step 5 View the sub-task details of the software and firmware upgrade task. You can see that the device has been automatically added to the upgrade task.

Figure 6-31 Firmware upgrade task - Adding a device to a dynamic group



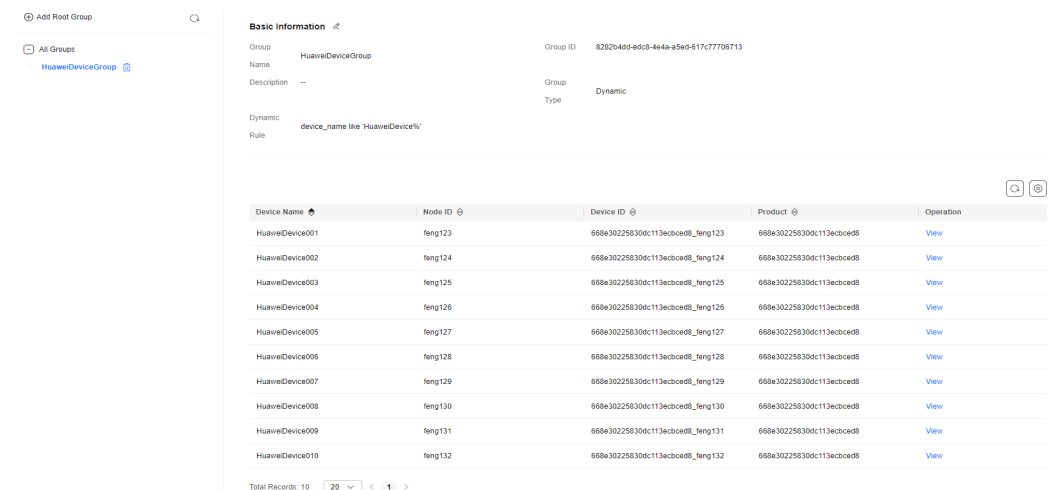
Step 6 On the **HuaweiDevice001** details page, change the device name to **AbandonedHuaweiDevice001**.

Figure 6-32 Device - Changing device name



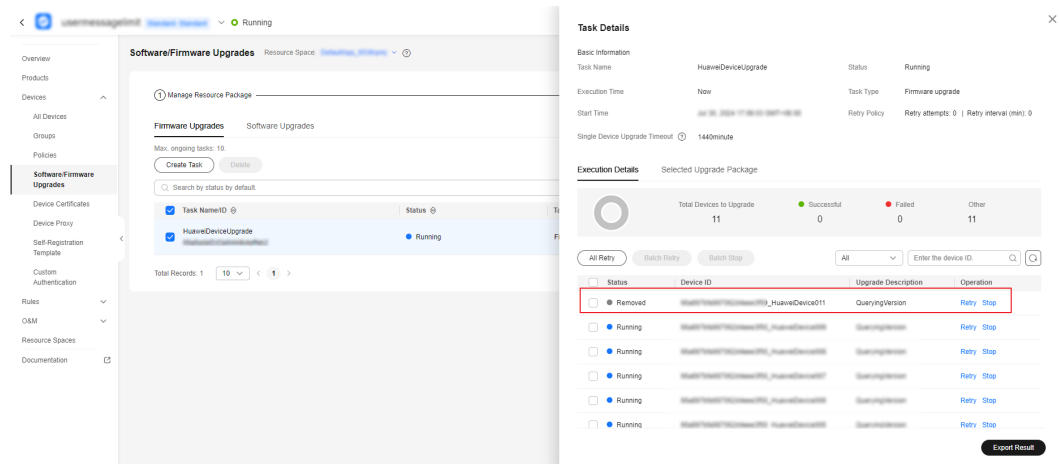
Step 7 After the device name is changed successfully, the device is automatically removed from the **HuaweiDeviceGroup** dynamic group.

Figure 6-33 Dynamic group - Removing a device



Step 8 Check the sub-task details of the software and firmware upgrade task. The upgrade status of the device is **Removed**.

Figure 6-34 Firmware upgrade task - Removing a device from a dynamic group



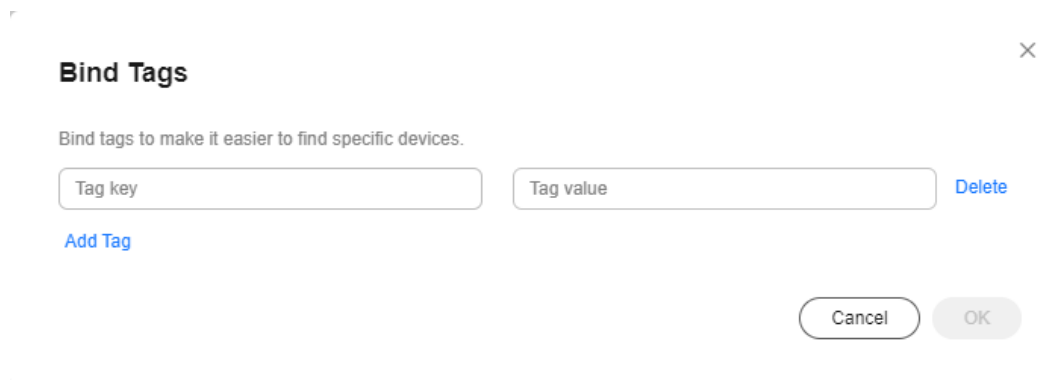
----End

Tags

Tags are used to classify devices. You can bind tags to devices on the device details page to manage devices.

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Devices > All Devices**. On the displayed page, locate the target device, and click **View** in the **Operation** column to access its details page.
- Step 3** On the **Tags** tab page, click **Bind Tags** to bind one or more tags to the device.

Figure 6-35 Device - Binding a tag



----End

Group-related APIs

- [Query the Device Group List](#)
- [Create a Device Group](#)
- [Query a Device Group](#)

- [Modify a Device Group](#)
- [Delete a Device Group](#)
- [Manage Devices in a Device Group](#)
- [Query Devices in a Group](#)

Tag-related APIs

- [Binding Tags](#)
- [Unbinding Tags](#)

6.5 Advanced Search

Overview

To quickly find the desired device, you can use advanced search to set flexible search criteria using SQL-like statements to search. For example, you can search for devices by prefix fuzzy match or by tag. This section guides you on using advanced search and SQL-like syntax.

Constraints

- This API is supported only by Standard and Enterprise editions.
- The maximum TPS for an account to call this API is 1 (one request per second).

Scenarios

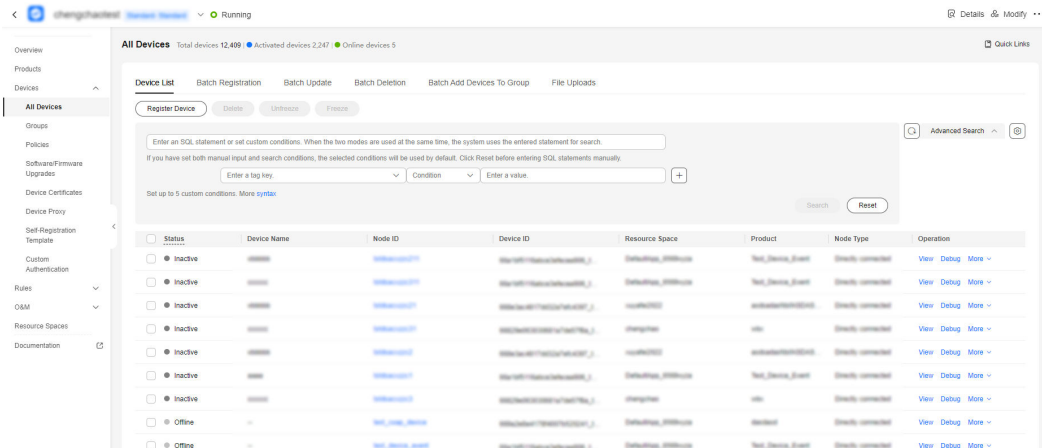
Device search: On the **All Devices > Device List** page, use SQL-like statements to search for specified devices for subsequent management operations.

Dynamic device grouping: Based on the rules of SQL-like statement, devices that meet the filter criteria are automatically added to the group for management.

Procedure

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Devices > All Devices**. By default, all devices under your account are displayed in the device list.
- Step 3** Click **Advanced Search**, enter an SQL-like statement, and click **Search** to display the target devices.

Figure 6-36 Device - Advanced search



----End

SQL-like Syntax Description

When using SQL-like statements on the console, omit the select, from, order by, and limit clauses. **You only need to enter a where clause to edit user-defined conditions.** The maximum length of a statement is 400 characters. The content in the clause is case sensitive, but keywords in SQL statements are case insensitive. On the console, data is sorted based on the marker field desc by default.

A where clause:

```
[condition1] AND [condition2]
```

Example:

```
product_id = 'testProductId'
```

Up to five conditions are supported. Conditions cannot be nested. For details about the parameters that support query, see [Table 6-6](#) and [Table 6-7](#).

AND and **OR** are supported. For details about the priority, see the standard SQL syntax. By default, the priority of **AND** is higher than that of **OR**.

Table 6-6 Description of query condition parameters

| Parameter | Data Type | Description | Value Range |
|------------|-----------|--------------------|---|
| app_id | string | Resource space ID. | The value can contain up to 36 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed. |
| device_id | string | Device ID. | The value can contain up to 128 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed. |
| gateway_id | string | Gateway ID. | The value can contain up to 128 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed. |

| Parameter | Data Type | Description | Value Range |
|-------------|-----------|---|--|
| product_id | string | ID of the product associated with the device. | The value can contain up to 36 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed. |
| device_name | string | Device name. | The value can contain up to 256 characters. Only letters, digits, and special characters (_?'#().,&%@!-) are allowed. |
| node_id | string | Node ID. | The value can contain up to 64 characters. Only letters, digits, underscores (_), and hyphens (-) are allowed. |
| status | string | Device status. | The value can be ONLINE , OFFLINE , ABNORMAL , INACTIVE , or FROZEN . |
| node_type | string | Device node type. | The value can be GATEWAY (a directly connected device or gateway) and ENDPOINT (an indirectly connected device). |
| tag_key | string | Tag key. | The value can contain up to 64 characters. Only letters, digits, underscores (_), periods (.), and hyphens (-) are allowed. |
| tag_value | string | Tag value. | The value can contain up to 128 characters. Only letters, digits, underscores (_), periods (.), and hyphens (-) are allowed. |
| sw_version | string | Software version. | The value can contain up to 64 characters. Only letters, digits, underscores (_), hyphens (-), and periods (.) are allowed. |
| fw_version | string | Firmware version. | The value can contain up to 64 characters. Only letters, digits, underscores (_), hyphens (-), and periods (.) are allowed. |
| group_id | string | Group ID. | The value can contain up to 36 characters, including hexadecimal strings and hyphens (-). |
| create_time | string | Device registration time. | Format: yyyy-MM-dd'T'HH:mm:ss.SSS'Z', for example, 2015-06-06T12:10:10.000Z |
| marker | string | Result record ID. | The value is a string of 24 hexadecimal characters, for example, ffffffffffffffffffffffff . |

Table 6-7 Supported operators

| Operator | Supported By |
|----------|---|
| = | All parameters |
| != | All parameters |
| > | create_time and marker |
| < | create_time and marker |
| like | device_name , node_id , tag_key , and tag_value |
| in | Parameters except tag_key and tag_value. |
| not in | Parameters except tag_key and tag_value. |

SQL Restrictions

- **like**: Only prefix match is supported. Suffix match or wildcard match is not supported. At least four characters must be contained for prefix match. Special characters cannot be contained. Only letters, digits, underscores (_), and hyphens (-) are allowed. The prefix must end with %.
- Other SQL statements, such as nested SQL statements, union, join, and alias, are not supported.
- The SQL statement can contain up to 400 characters. Up to five request conditions are supported.
- The condition value cannot be null or an empty string.

APIs

[Query Device List Flexibly](#)

6.6 Device Shadow

Overview

IoTDA supports the creation of device shadows. A device shadow is a JSON file that stores the device status, latest device properties reported, and device configurations to deliver. Each device has only one shadow. A device can retrieve and set its shadow to synchronize properties, either from the shadow to the device or from the device to the shadow.

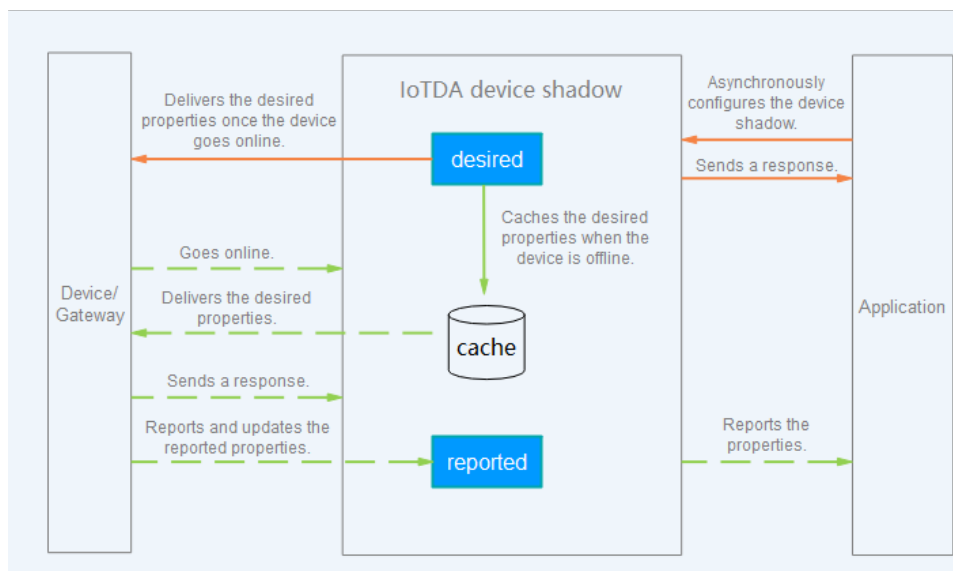
The device shadow contains two sections: desired and reported.

- The desired section stores the desired configurations of device properties. You can modify the desired properties in the device shadow when needed. If the device is online, the desired properties are synchronized to the device immediately. If the device is offline, the desired properties are synchronized to the device when the device goes online or reports data.

- The reported section stores the properties most recently reported by the device. When the device reports data, the platform changes the properties in the reported section to those reported by the device.

NOTE

- You can configure the device shadow by calling the application API or using the IoTDA console. (Specifically, access a device details page, click the **Device Shadow** tab, and click **Configure Property**.) The device shadow is mainly used to configure device properties. Its configuration depends on the **product model**.
- The device shadow configuration is an asynchronous command. The platform directly returns a configuration response. Then, the platform determines whether to deliver the configuration immediately or cache the configuration based on the device status.
- When the device goes online, the device shadow delivers the desired properties to the device. After the device reports its properties, the device shadow checks whether the reported properties match the delivered ones. If they match, the shadow data is configured on the device and the cache is cleared. If they do not match, the shadow data fails to be configured on the device. When the device goes online or reports properties next time, the platform delivers the desired properties to the device again until the configuration delivery is successful.
- Restriction: Keys in the device shadow JSON file cannot contain periods (.), dollar signs (\$), and the null character (hexadecimal ASCII code 00). Otherwise, the device shadow file cannot be refreshed.
- When desired properties are delivered to a device, the device needs to return a response to indicate that the request has been received. If the device does not respond, the platform considers that the device does not support device shadow configuration and **sets device properties**. The IoT platform has a 5-minute protection period to prevent excessive traffic from affecting the device. During this period, the platform does not deliver the difference between reported and desired properties even if they are different. If the device responds to property configuration in the delivery process properly, the platform delivers the difference to the device each time the properties are reported.



Application Scenarios

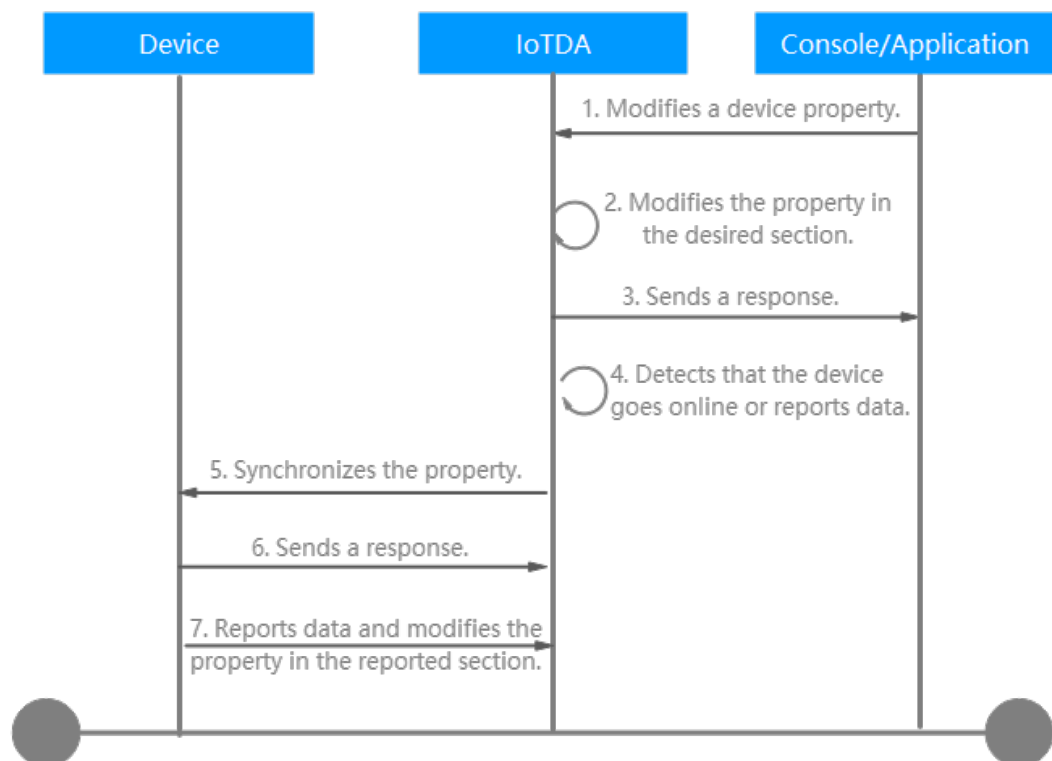
The device shadow is applicable to devices with limited resources and low power consumption or devices in the dormant state for a long time.

- Querying the latest data reported by the device and the latest online status of the device:
 - You may not be able to query the console for the mostly recent data because the device is offline or the network is unstable. With the device shadow, the platform can obtain the data from the shadow.
 - There may be too many applications simultaneously querying the device. IoT devices typically have limited processing capabilities, so too many queries can adversely affect their performance. With the device shadow, the device can synchronize its status to the shadow just once. The applications can obtain the device status from the device shadow, without reaching the real device.
- Modifying device properties: You can modify device properties on the device details page. Because the device may be offline for a long time, the modified device properties cannot be delivered to the device in time. The platform stores these properties in the device shadow. When the device goes online, the platform synchronizes the properties from the shadow to the device.

Service Flow

Modifying a Device Property

After a property in the desired section is modified, it is synchronized to the device immediately if the device is online, or cached and delivered until the device goes online or reports data.



1. A user modifies a device property on the console or application. Example message:

```

PUT https://{Endpoint}/v5/iot/{project_id}/devices/{device_id}/shadow
Content-Type: application/json
X-Auth-Token: *****
    
```

```
Instance-Id: *****
{
  "shadow" : [ {
    "desired" : {
      "temperature" : "60"
    },
    "service_id" : "WaterMeter",
    "version" : 1
  } ]
}
```

2. The platform modifies the property in the desired section.
3. The platform sends a response.
4. The platform detects that the device goes online or reports data.
5. The platform synchronizes the property to the device. Example message:

Topic: \$oc/devices/{device_id}/sys/properties/set/request_id={request_id}
Data format:

```
{
  "object_device_id": "{object_device_id} ",
  "services": [
    {
      "service_id": "Temperature",
      "properties": {
        "value": 57,
        "value2": 60
      }
    },
    {
      "service_id": "Battery",
      "properties": {
        "level": 80,
        "level2": 90
      }
    }
  ]
}
```

6. The device sends a response. When desired properties are delivered to a device, the device needs to return a response to indicate that the request has been received. Example message:

Topic: \$oc/devices/{device_id}/sys/properties/set/response/request_id={request_id}

Data format:

```
{
  "result_code": 0,
  "result_desc": "success"
}
```

7. When a device reports properties, the platform stores the latest property values reported by the device.

- When the device reports properties, the platform changes the properties in the reported section to those reported by the device. Example message:

Topic: \$oc/devices/{device_id}/sys/properties/report

Data format:

```
{
  "services": [
    {
      "service_id": "Temperature",
      "properties": {
        "value": 57,
        "value2": 60
      },
      "event_time": "20151212T121212Z"
    },
  ]
}
```

```
"service_id": "Battery",
"properties": {
  "level": 80,
  "level2": 90
},
"event_time": "20151212T121212Z"
}
]
}
```

- The device proactively deletes the reported section of the device shadow.
 - The device proactively deletes a single property from **services** in the reported section.

When a device reports a **null** property, the platform deletes the property from the reported section of the device shadow. An example message is as follows:

```
Topic: $oc/devices/{device_id}/sys/properties/report
{
  "services": [
    {
      "service_id": "Temperature",
      "properties": {
        "value": null,
        "value2": 60
      },
      "event_time": "20151212T121212Z"
    }
  ]
}
```

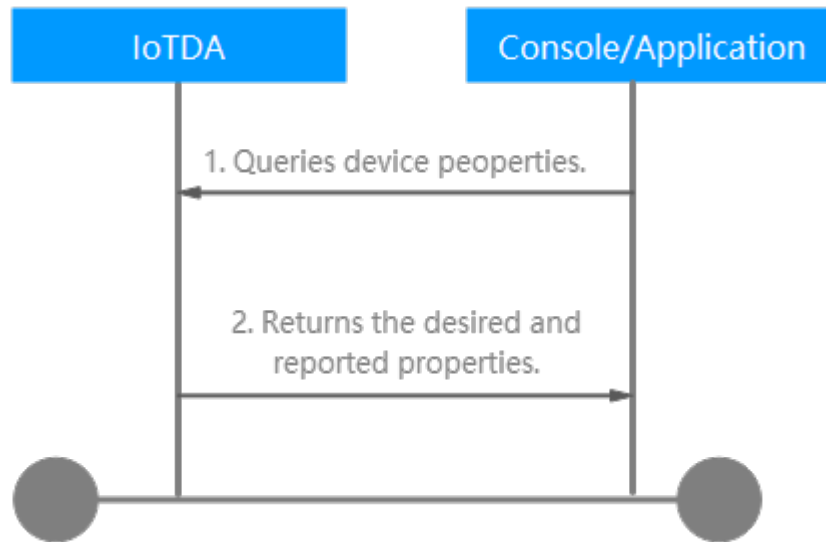
- The device proactively deletes all properties from **services** in the reported section.

When a device reports properties that are set to **{}**, the platform deletes all property from **services** in reported section of the device shadow. An example message is as follows:

```
Topic: $oc/devices/{device_id}/sys/properties/report
{
  "services": [
    {
      "service_id": "Temperature",
      "properties": {},
      "event_time": "20151212T121212Z"
    }
  ]
}
```

Querying Device Properties

The device shadow saves the most recent device properties. Once the device properties change, the device synchronizes the changes to the device shadow. Using the device shadow, a user can obtain the device status quickly regardless of whether the device is online.



1. A user queries device properties on the console or application. Example message:

```
GET https://{Endpoint}/v5/iot/{project_id}/devices/{device_id}/shadow
Content-Type: application/json
X-Auth-Token: *****
Instance-Id: *****
```

2. The platform returns the desired and reported properties. Example message:

Status Code: 200 OK

Content-Type: application/json

```
{
  "device_id" : "*****",
  "shadow" : [ {
    "desired" : {
      "properties" : {
        "temperature" : "60"
      },
      "event_time" : "20151212T121212Z"
    },
    "service_id" : "WaterMeter",
    "reported" : {
      "properties" : {
        "temperature" : "60"
      },
      "event_time" : "20151212T121212Z"
    },
    "version" : 1
  } ]
}
```

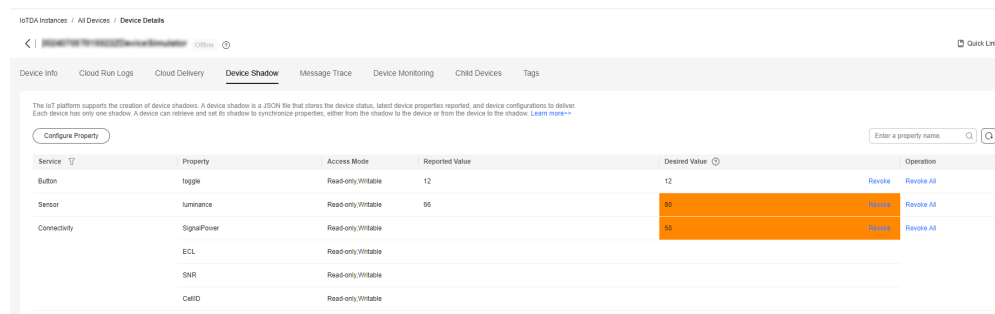
Query, Modification, and Deletion

Querying a device shadow

Method 1: Use an application to call the API for [querying a device shadow](#).

Method 2: Log in to the [console](#) and click the target instance card. In the navigation pane, choose **Devices > All Devices**. On the displayed page, locate the target device, and click **View** in the **Operation** column to access its details page. Click the **Device Shadow** tab, and check the device properties, including the reported and desired values.

- If the reported value is inconsistent with the desired value, the desired value is highlighted. This may occur when the device is offline and the value is still in the device shadow waiting to be synchronized to the device.
- If the reported value matches the desired value, the desired value is not highlighted. The latest property reported by the device matches the desired property.

Figure 6-37 Device shadow - Viewing

The IoT platform supports the creation of device shadows. A device shadow is a JSON file that stores the device status, latest device properties reported, and device configurations to deliver. Each device has only one shadow. A device can retrieve and set its shadow to synchronize properties, either from the shadow to the device or from the device to the shadow. [Learn more](#)

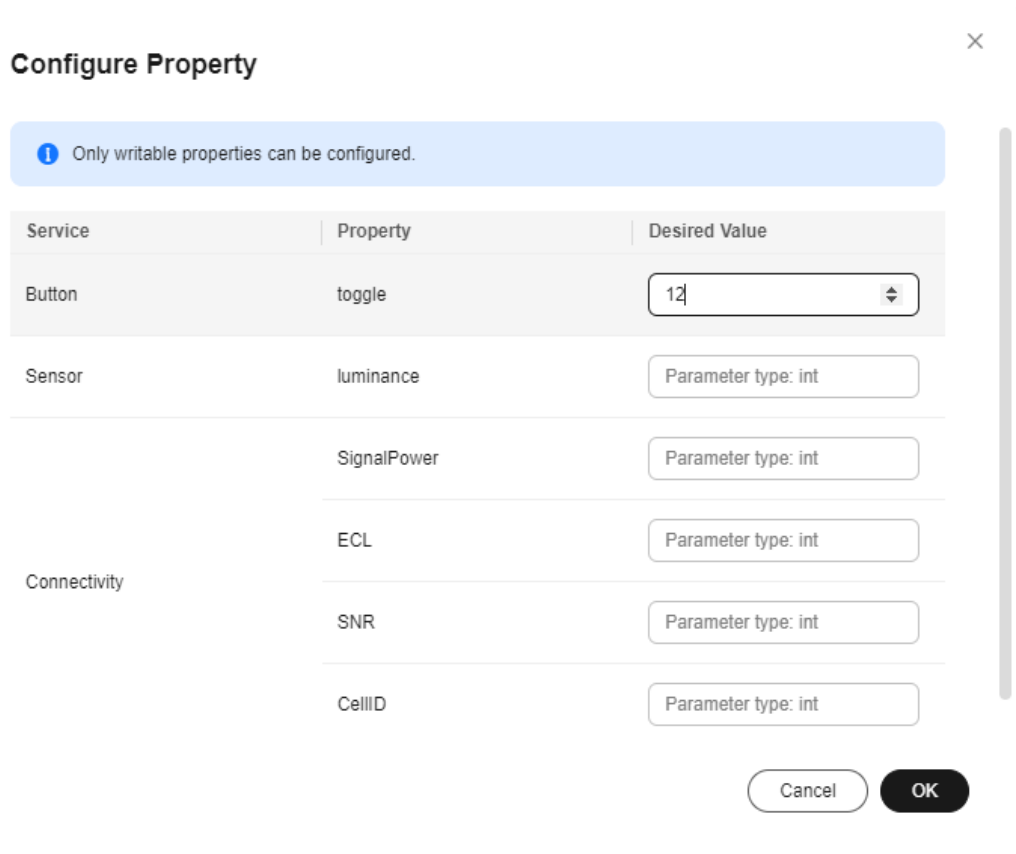
| Service | Property | Access Mode | Reported Value | Desired Value | Operation |
|--------------|-------------|--------------------|----------------|---------------|---------------------|
| Button | toggle | Read-only/Writable | 12 | 12 | Refresh Refresh All |
| Sensor | lumiance | Read-only/Writable | 66 | 85 | Refresh Refresh All |
| Connectivity | SignalPower | Read-only/Writable | | 53 | Refresh Refresh All |
| | ECL | Read-only/Writable | | | |
| | SNR | Read-only/Writable | | | |
| | CellID | Read-only/Writable | | | |

Modifying a device shadow

Method 1: Use an application to call the API for **configuring desired properties in a device shadow**.

Method 2: Log in to the **console** and click the target instance card. In the navigation pane, choose **Devices > All Devices**. On the displayed page, locate the target device, and click **View** in the **Operation** column to access its details page. Click the **Device Shadow** tab, and click **Configure Property**. In the displayed dialog box, enter the desired value and click **OK**.

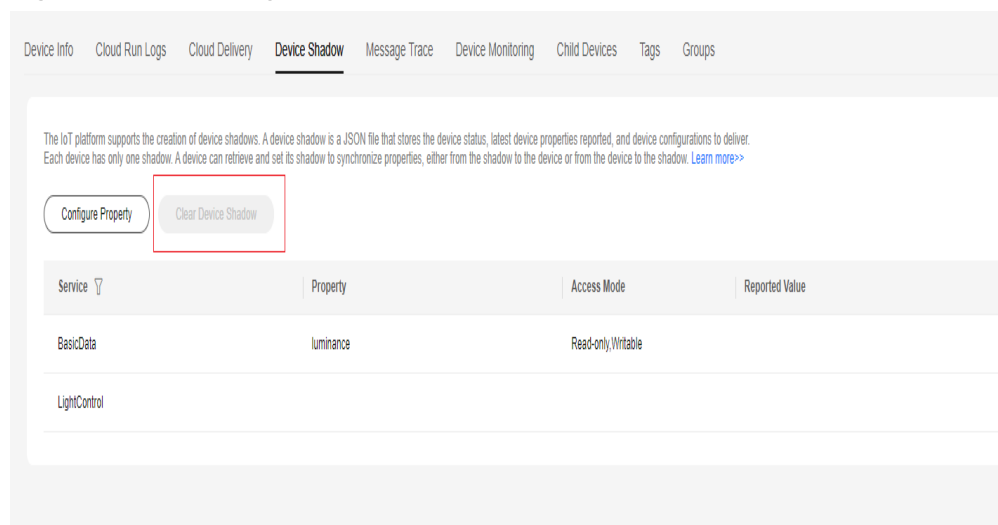
Figure 6-38 Device shadow - Configuring property



Deleting a device shadow

After a device shadow is deleted, the platform clears all data (including the reported and desired values) in the device shadow.

Figure 6-39 Deleting a device shadow



APIs

Querying a Device Shadow

Configuring Desired Properties in a Device Shadow

6.7 OTA Upgrade

6.7.1 Software/Firmware Package Upload

Overview

Software includes system software and application software. The system software provides the basic device functions, such as the compilation tool and system file management. The application software provides functions such as data collection, analysis, and processing, depending on the features the device provides. Software upgrade, also called software over the air (SOTA), allows you to upgrade the software of LwM2M or MQTT devices in OTA mode.

- For an LwM2M product model, the software upgrade complies with **PCP**. You must comply with PCP during **device adaptation development** of software upgrades.
- For an MQTT product model, the software upgrade protocol is not verified.

Firmware is like a device driver for the hardware. It is responsible for the underlying work of a system, for example, the basic input/output system (BIOS) on a computer mainboard. Firmware upgrade, also called firmware over the air (FOTA), allows you to upgrade the firmware of LwM2M or MQTT devices in OTA mode.

Procedure

You need to add an upgrade package on the IoTDA console to upgrade device software and firmware. You can either use an OBS file as an upgrade package or upload a local upgrade package.

NOTE

- The size of the OBS file cannot exceed 1 GB. You will be billed for storing and downloading the OBS file.
OBS billing items include the storage space, request, data transfer, data restoration, and data processing. Billing modes include pay-per-use and yearly/monthly. For details, see **Billing**.
For example, if a user in CN North-Beijing4 needs to upgrade 10,000 devices per month and the size of the upgrade package is 100 MB, you will be charged CNY512.15 in total (including CNY0.139 for storage, CNY512 for data transfer, and 0.01 for requests) on a pay-per-use basis.
If the yearly/monthly billing mode is used, you will be charged CNY506.01 in total (including CNY1.00 for storage, CNY505.00 for 1 TB Internet outbound traffic package for a month, and CNY0.01 for requests).
- You are not billed for uploading local upgrade packages. The maximum package size is 20 MB.
- The upgrade package format can only be .bin, .dav, .tar, .gz, .zip, .gzip, .apk, .tar.gz, .tar.xz, .pack, .exe, .bat, or .img.

Step 1 Access the **IoTDA** service page and click **Access Console**. Click the target instance card.

Step 2 In the navigation pane, choose **Devices > Software/Firmware Upgrades**.

Step 3 To upload a firmware upgrade package, click the **Firmware List** tab and click **Upload**. To upload a software upgrade package, click the **Software List** tab and click **Upload**.

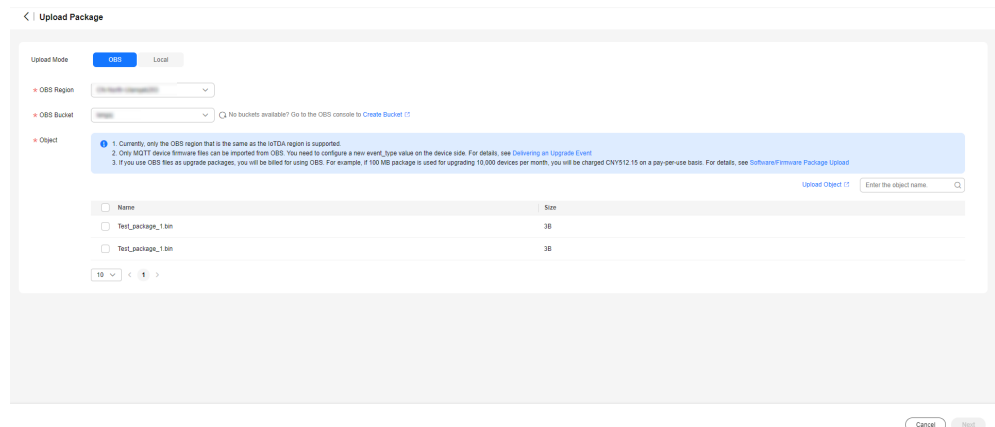
Step 4 On the package upload page, select **OBS** or **Local** for **Upload Mode**.

- **OBS:** Before using this mode, click **Agree** in the displayed authorization dialog box. After authorization, select the bucket where the upgrade file is located. If no bucket is available, click **Create Bucket** to go to the OBS page and create a bucket. If the upgrade file is not uploaded to the corresponding bucket, click **Upload Object** to go to the OBS bucket page and upload the upgrade file. Select the target OBS object and click **Next**.

NOTICE

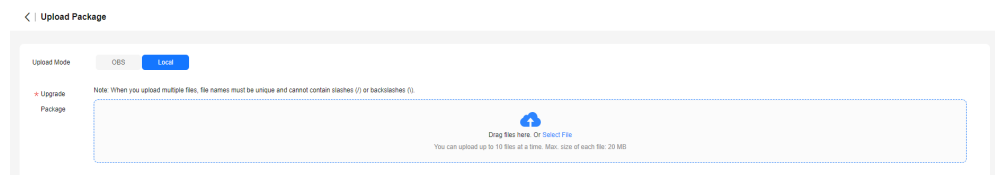
If you have not authorized IoTDA to access Key Management Service (KMS), click **Authorize Access** in **Encryption Service Authorization**. Otherwise, upgrade file downloading will be affected if you set or modify **Default Encryption** for the bucket on the OBS console.

Figure 6-40 Uploading the upgrade package - OBS file



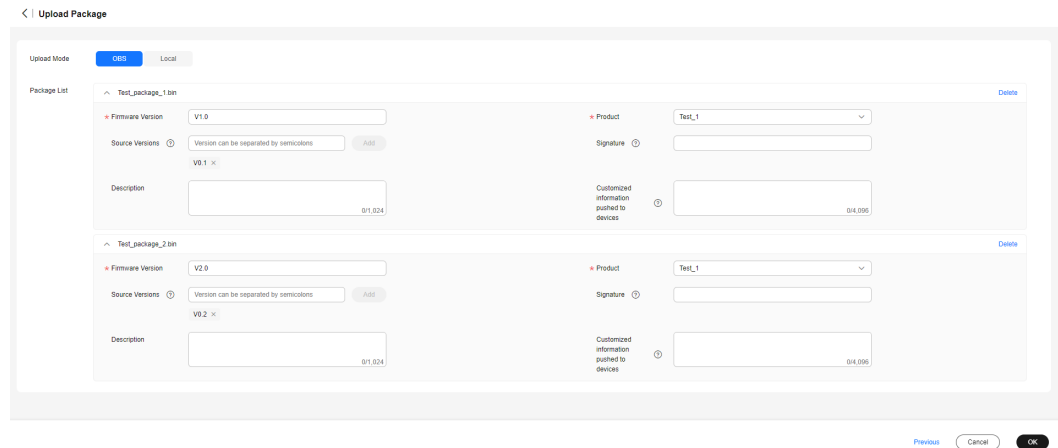
- **Local:** Drag and drop a file or click **Select File** to upload a software/firmware upgrade package.

Figure 6-41 Uploading the upgrade package - local file



Step 5 Configure parameters in the upgrade package list based on the following information, and click **OK**.

Figure 6-42 Uploading the upgrade package - OBS file parameters



Fill in the parameters as follows:

| Parameter | Description |
|---------------------------|---|
| Firmware/Software Version | Version of the firmware/software package. (A device reports the version number after the upgrade. The platform checks whether the version number reported by the device is the same as the value of this parameter. If they are the same, the upgrade is successful.) |
| Product | Select the product model of the corresponding device. |
| Source Versions | Source version of the device that can be upgraded. Enter the version manually. To add multiple versions, press Enter after inputting one version, and then input the next. NOTE Currently, the platform does not support automatic differential upgrade packages. You can prepare differential packages on your local PC and upload them to the platform. Then, specify different source versions for these differential packages. You can select multiple differential packages when creating an upgrade task. During a software/firmware upgrade, the platform delivers differential packages based on source versions reported by devices. |

| Parameter | Description |
|--|--|
| Software Package Segment Size | Size of each segment of the software package downloaded by the device, in bytes. The value ranges from 32 to 500. The default value is 500 . This function is supported only by NB-IoT device software upgrade tasks. |
| Description | Description of the firmware/software package. |
| Customized information pushed to devices | The platform delivers the custom information when delivering an upgrade notification to devices. |

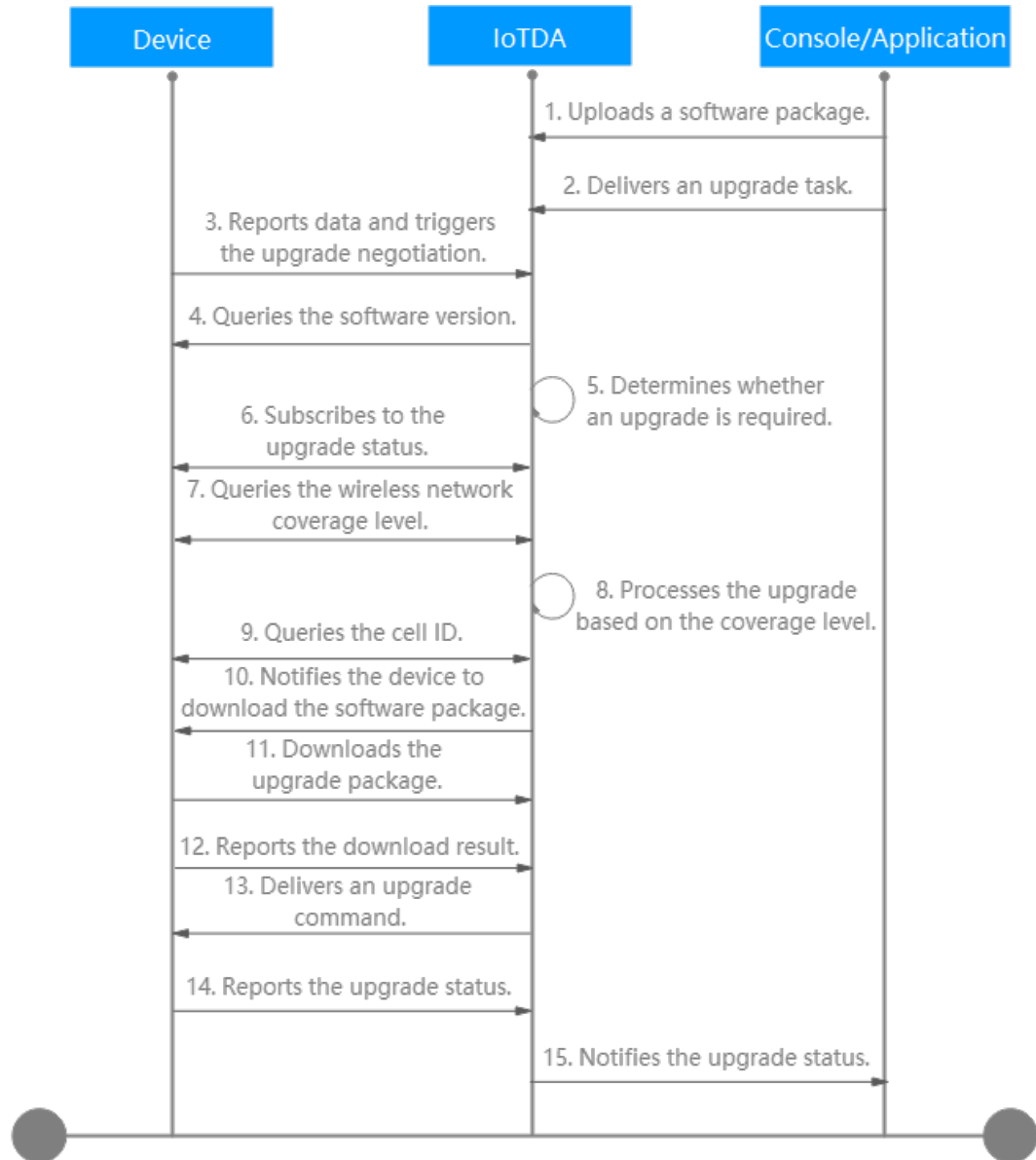
 **NOTE**

- The function of uploading signed software/firmware packages has been brought offline. Uploaded signed software/firmware packages can still be used for upgrade. To ensure proper use of software/firmware upgrades, directly upload the upgrade files to be delivered to devices.
- Only MQTT devices can use OBS files as software/firmware upgrade files. You need to configure a new **event_type** value on the device side.
- If no device source version is specified for an upgrade package, all selected devices will be upgraded.

----End

6.7.2 OTA Upgrade for NB-IoT Devices

Software Upgrade for Devices Using LwM2M over CoAP



The software upgrade process for a device using LwM2M over CoAP is as follows:

1–2: A user uploads a software package on the IoTDA console and creates a software upgrade task on the console or an application.

3: A device reports data to the platform. The platform detects that the device is online and triggers the upgrade negotiation process. (The timeout interval is 24 hours.)

4–5: The platform delivers a command to the device to query its software version and determines whether an upgrade is required based on the target version. (In step 4, the timeout interval for the device to report the software version is 3 minutes.)

- If the returned software version is the same as the target version, no upgrade is required.
- If the returned software version is different from the target version, the platform continues the upgrade.

6. The platform subscribes to the software upgrade status from the device.

7–8: The platform queries the radio coverage of the cell where the device resides, and obtains the cell ID, reference signal received power (RSRP), and signal to interference plus noise ratio (SINR). (The timeout interval for the reporting of the radio coverage level and cell ID is about 3 minutes.)

- If the query is successful, the platform calculates the number of concurrent upgrade tasks based on the RSRP and SINR ranges described in the figure below, and continues with [step 10](#).
 - RSRP and SINR in range 0: 50 devices in the cell can be upgraded simultaneously.
 - RSRP in range 0 and SINR in range 1: 10 devices in the cell can be upgraded simultaneously.
 - RSRP in range 1 and SINR in range 2: Only one device in the cell can be upgraded at a time.
 - RSRP and SINR can be queried but are not within any of the three ranges: Only one device in the cell can be upgraded at a time.

| Radio Coverage Range | RSRP Range (dBm) | SINR Range (dB) |
|----------------------|--------------------------------|----------------------------|
| 0 | $-105 \leq \text{RSRP}$ | $7 \leq \text{SINR}$ |
| 1 | $-115 \leq \text{RSRP} < -105$ | $-3 \leq \text{SINR} < 7$ |
| 2 | $-125 \leq \text{RSRP} < -115$ | $-8 \leq \text{SINR} < -3$ |

NOTE

If only a small number of devices can be upgraded simultaneously, you can contact the local carrier to see if coverage can be improved.

- If the query fails, the process continues with [step 9](#).

9. The platform delivers a command to query the cell ID of the device.

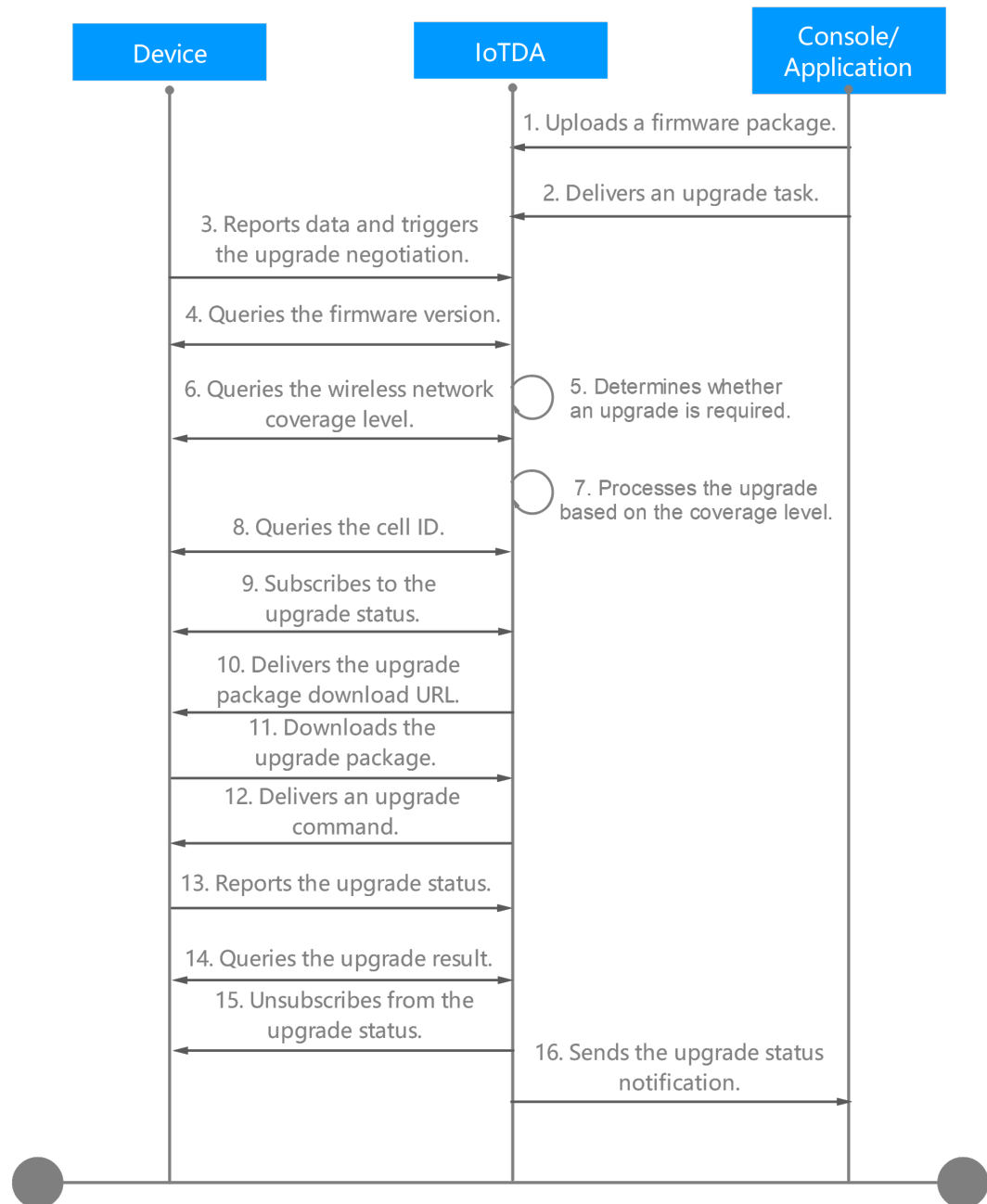
- If the query is successful, 10 devices in the cell can be upgraded simultaneously.
- If the query fails, the upgrade fails.

10–12: The platform notifies the device of a new software package version. The device starts to download the software package. Software packages can be downloaded in segments, and resumable download is supported. The **versionCheckCode** field carried in a software package segment determines the software package to which the segment belongs. After the download is complete, the device notifies the platform. (The timeout interval for step 11 is 60 minutes.)

13–14: The platform delivers an upgrade command to the device, and the device performs the upgrade. After the upgrade is complete, the device notifies the platform. (The timeout interval for the device to report the upgrade result and status is 30 minutes.)

15. The platform notifies the IoTDA console or application of the upgrade result.

Firmware Upgrade for Devices Using LwM2M



The firmware upgrade process for a device using LwM2M is as follows:

1–2: A user uploads a firmware package on the IoTDA console and creates a firmware upgrade task on the console or an application.

3. A device reports data to the platform. The platform detects that the device is online and triggers the upgrade negotiation process. (The timeout interval is 24 hours.)

4–5: The platform delivers a command to query the device firmware version and determines whether an upgrade is required based on the target version. (In step 4, the timeout interval for the device to report the firmware version is 3 minutes.)

- If the returned firmware version is the same as the target version, no upgrade is required.
- If the returned firmware version is different from the target version, the platform continues the upgrade.

6–7: The platform queries the radio coverage of the cell where the device resides, and obtains the cell ID, RSRP, and SINR. (The timeout interval for the reporting of the radio coverage level and cell ID is about 3 minutes.)

- If the query is successful, the platform calculates the number of concurrent upgrade tasks based on the RSRP and SINR ranges described in the figure below, and continues with [step 9](#).
 - RSRP and SINR in range 0: 50 devices in the cell can be upgraded simultaneously.
 - RSRP in range 0 and SINR in range 1: 10 devices in the cell can be upgraded simultaneously.
 - RSRP in range 1 and SINR in range 2: Only one device in the cell can be upgraded at a time.
 - RSRP and SINR can be queried but are not within any of the three ranges: Only one device in the cell can be upgraded at a time.

| Radio Coverage Range | RSRP Range (dBm) | SINR Range (dB) |
|----------------------|--------------------------------|----------------------------|
| 0 | $-105 \leq \text{RSRP}$ | $7 \leq \text{SINR}$ |
| 1 | $-115 \leq \text{RSRP} < -105$ | $-3 \leq \text{SINR} < 7$ |
| 2 | $-125 \leq \text{RSRP} < -115$ | $-8 \leq \text{SINR} < -3$ |

NOTE

If only a small number of devices can be upgraded simultaneously, you can contact the local carrier to see if coverage can be improved.

- If the query fails, the process continues with [step 8](#).

8. The platform delivers a command to query the cell ID of the device.

- If the query is successful, 10 devices in the cell can be upgraded simultaneously.
- If the query fails, the upgrade fails.

9. The platform subscribes to the firmware upgrade status from the device.

10–11: The platform delivers the package download URL. The device downloads the firmware package from the URL. After the download is complete, the device notifies the platform. (Firmware packages can be downloaded in segments, and resumable download is supported.) (The timeout interval for step 11 is 60 minutes.)

12–13: The platform delivers an upgrade command to the device, and the device performs the upgrade. After the upgrade is complete, the device notifies the

platform. (The timeout interval for the device to report the upgrade result and status is 30 minutes.)

14–16: The platform delivers a command to query the firmware upgrade result. After obtaining the result, the platform unsubscribes from the upgrade status and notifies the IoTDA console or application of the upgrade result.

 **NOTE**

The platform supports resumable download.

Firmware Upgrade Failure Causes

The following table lists the failure causes reported by the platform.

| Error Message | Description | Solution |
|---|--|--|
| Device Abnormal is not online | The device is offline or abnormal. | Check the device. |
| Task Conflict | A task conflict occurs. | Check whether a software upgrade, firmware upgrade, log collection, or device restart task is in progress. |
| Waiting for the device online timeout | The device does not go online within the specified time. | Check the device. |
| Wait for the device to report upgrade result timeout | The device does not report the upgrade result within the specified time. | Check the device. |
| Waiting for report device firmware version timeout | The device does not report the firmware version within the specified time. | Check the device. |
| Waiting for report cellId timeout | The device does not report the cell ID within the specified time. | Check the device. |
| Updating timeout and query device version for check timeout | The device does not report the upgrade result or device version within the specified time. | Check the device. |
| Waiting for device downloaded package timeout | The device does not finish downloading the firmware package within the specified time. | Check the device. |

| Error Message | Description | Solution |
|---|---|-------------------|
| Waiting for device start to update timeout | The device does not start the update within the specified time. | Check the device. |
| Waiting for device start download package timeout | The device does not start to download the firmware package within the specified time. | Check the device. |

The following table lists the failure causes reported by devices.

| Error Message | Description | Solution |
|--|---|--|
| Not enough storage for the new firmware package | The storage space is insufficient for the firmware package. | Check the storage space of the device. |
| Out of memory during downloading process | The memory was insufficient during the download. | Check the device memory. |
| Connection lost during downloading process | The connection was interrupted during the download. | Check the device connection status. |
| Integrity check failure for new downloaded package | The integrity check on the firmware package fails. | Check whether the firmware package downloaded is complete. |
| Unsupported package type | The firmware package type is not supported. | Check whether the device status and firmware package provided by the manufacturer are correct. |
| Invalid URI | The URI is invalid. | Check whether the download address of the firmware package is correct. |
| Firmware update failed | The firmware fails to update. | Check the device. |

FAQs

The following lists the frequently asked questions about software and firmware upgrades. For more questions, see [OTA Upgrades](#).

- [Can the Target Version Be Earlier Than the Source Version?](#)

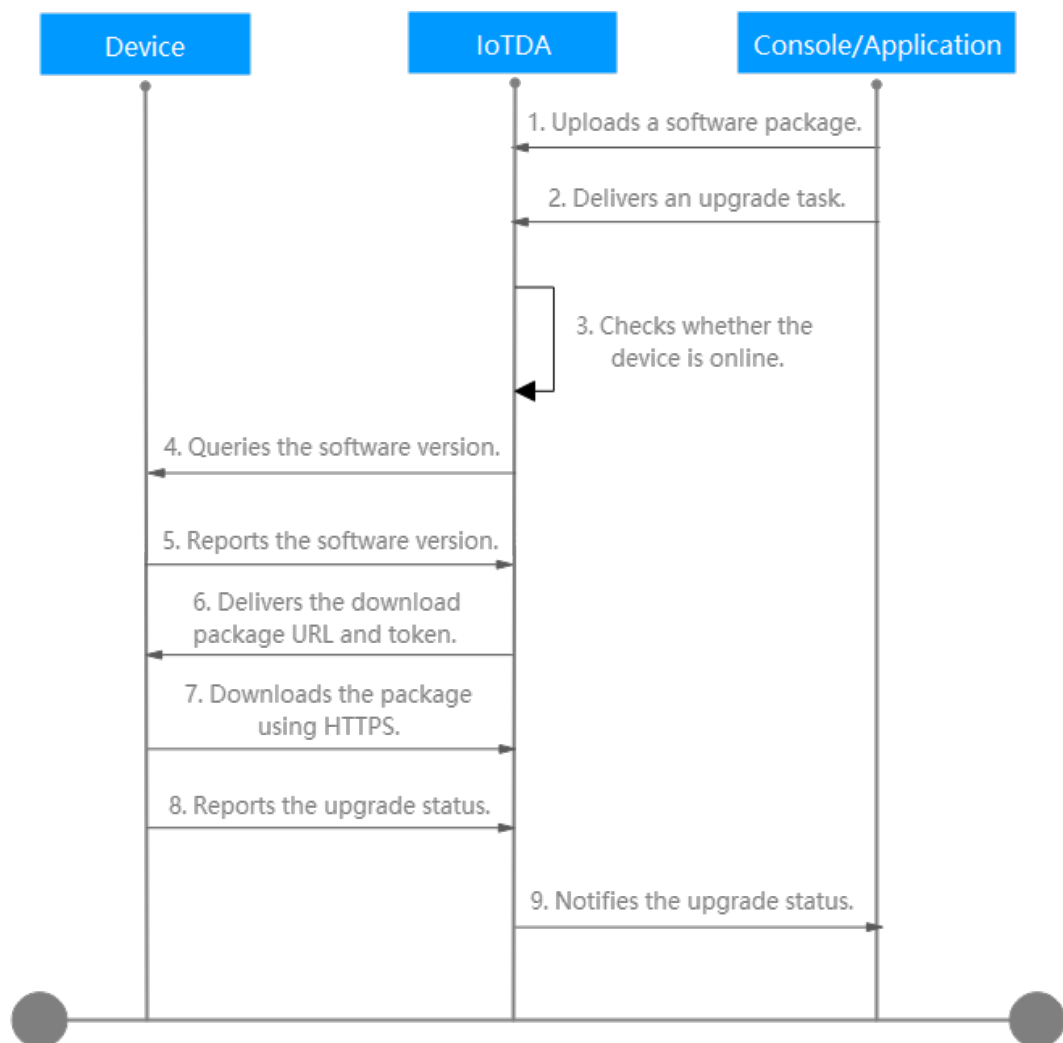
- [How Do I Obtain Software or Firmware Packages and Their Version Numbers?](#)
- [Are Services Interrupted During a Software or Firmware Upgrade?](#)
- [What Are Common Software or Firmware Upgrade Errors?](#)

APIs

- [Create a Batch Task](#)
- [Query the Batch Task List](#)
- [Query a Batch Task](#)

6.7.3 OTA Upgrade for MQTT Devices

Software Upgrade for Devices Using MQTT



The software upgrade process for a device using MQTT is as follows:

1–2: A user uploads a software package on the IoTDA console and creates a software upgrade task on the console or an application.

3. The platform checks whether the device is online and triggers the upgrade negotiation process immediately when the device is online. If the device is offline,

the platform waits for the device to go online and **subscribes to the upgrade topic**. After detecting that the device goes online, the platform triggers the upgrade negotiation process. (The timeout interval for the device to go online is within 25 hours.)

4–5: The platform delivers a command to the device to query its software version and determines whether an upgrade is required based on the target version. (The timeout interval for step 5 is 3 minutes.)

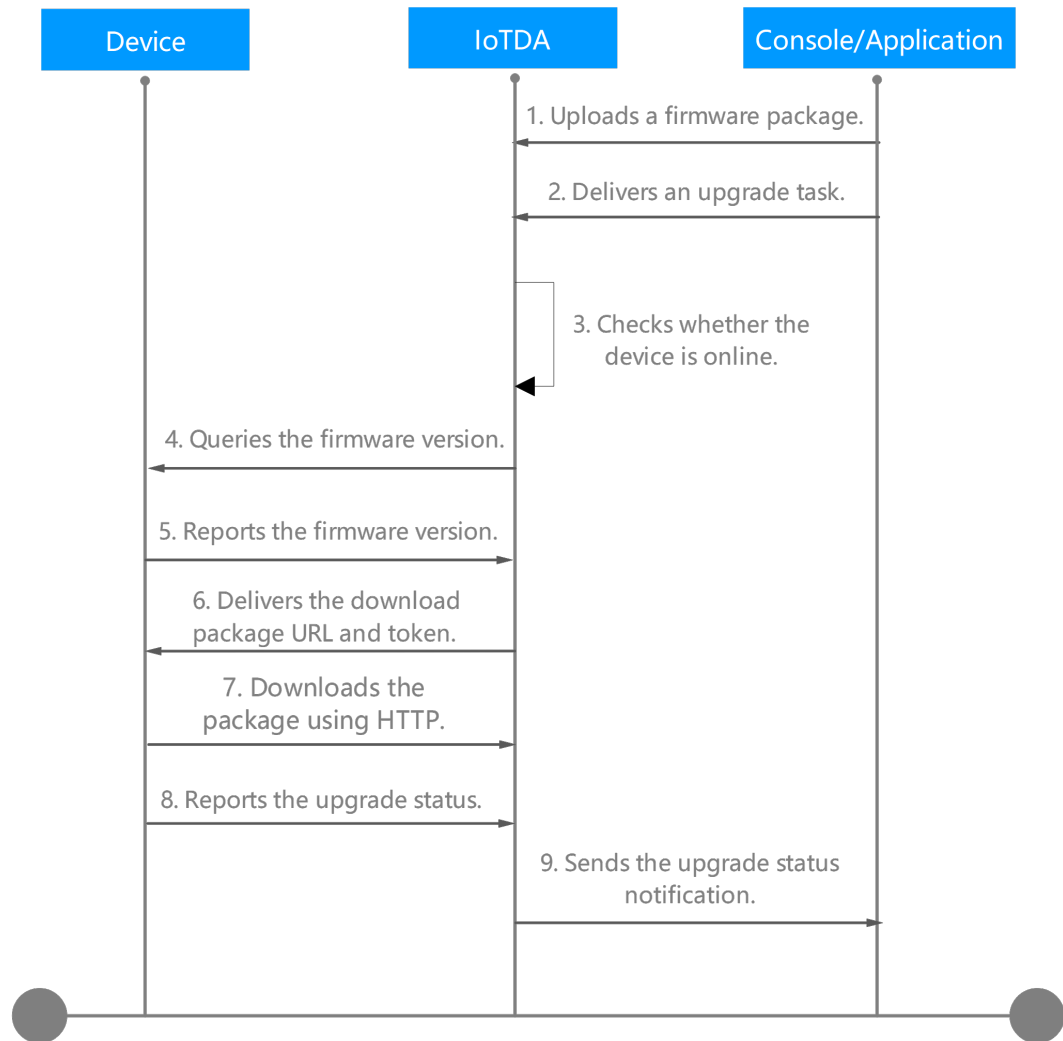
- If the returned software version is the same as the target version, no upgrade is required. The upgrade task is marked successful.
- If the returned software version is different from the target version and this version supports upgrades, the platform continues the upgrade.

6–7: The platform delivers the **package download URL**, token, and package information. The user downloads the software package using HTTPS based on the package download URL and token. The token is valid for 24 hours. (The timeout interval for package download and upgrade status reporting is 24 hours.)

8. The device upgrades the firmware. After the upgrade is complete, the device returns the upgrade result to the platform. (If the version number returned after the device upgrade is the same as the configured version number, the upgrade is successful.)

9. The platform notifies the IoTDA console or application of the upgrade result.

Firmware Upgrade for Devices Using MQTT



The firmware upgrade process for a device using MQTT is as follows:

1–2: A user uploads a firmware package on the IoTDA console and creates a firmware upgrade task on the console or an application.

3. The platform checks whether the device is online and triggers the upgrade negotiation process immediately when the device is online. If the device is offline, the platform waits for the device to go online and **subscribes to the upgrade topic**. After detecting that the device goes online, the platform triggers the upgrade negotiation process. (The timeout interval for the device to go online is within 25 hours.)

4–5: The platform delivers a command to query the device firmware version and determines whether an upgrade is required based on the target version. (The timeout interval for step 5 is 3 minutes.)

- If the returned firmware version is the same as the target version, no upgrade is required. The upgrade task is marked successful.
- If the returned firmware version is different from the target version and this version supports upgrades, the platform continues the upgrade.

6–7: The platform delivers the **package download URL**, token, and package information. The user downloads the software package using HTTPS based on the package download URL and token. The token is valid for 24 hours. (The timeout interval for package download and upgrade status reporting is 24 hours.)

8. The device upgrades the firmware. After the upgrade is complete, the device returns the upgrade result to the platform. (If the version number returned after the device upgrade is the same as the configured version number, the upgrade is successful.)

9. The platform notifies the IoTDA console or application of the upgrade result.

 **NOTE**

The platform supports resumable download.

Firmware Upgrade Failure Causes

The following table lists the failure causes reported by the platform.

| Error Message | Description | Solution |
|---|--|--|
| Device Abnormal is not online | The device is offline or abnormal. | Check the device. |
| Task Conflict | A task conflict occurs. | Check whether a software upgrade, firmware upgrade, log collection, or device restart task is in progress. |
| Waiting for the device online timeout | The device does not go online within the specified time. | Check the device. |
| Wait for the device to report upgrade result timeout | The device does not report the upgrade result within the specified time. | Check the device. |
| Waiting for report device firmware version timeout | The device does not report the firmware version within the specified time. | Check the device. |
| Waiting for report cellid timeout | The device does not report the cell ID within the specified time. | Check the device. |
| Updating timeout and query device version for check timeout | The device does not report the upgrade result or device version within the specified time. | Check the device. |

| Error Message | Description | Solution |
|---|--|-------------------|
| Waiting for device downloaded package timeout | The device does not finish downloading the firmware package within the specified time. | Check the device. |
| Waiting for device start to update timeout | The device does not start the update within the specified time. | Check the device. |
| Waiting for device start download package timeout | The device does not start to download the firmware package within the specified time. | Check the device. |

The following table lists the failure causes reported by devices.

| Error Message | Description | Solution |
|--|---|--|
| Not enough storage for the new firmware package | The storage space is insufficient for the firmware package. | Check the storage space of the device. |
| Out of memory during downloading process | The memory was insufficient during the download. | Check the device memory. |
| Connection lost during downloading process | The connection was interrupted during the download. | Check the device connection status. |
| Integrity check failure for new downloaded package | The integrity check on the firmware package fails. | Check whether the firmware package downloaded is complete. |
| Unsupported package type | The firmware package type is not supported. | Check whether the device status and firmware package provided by the manufacturer are correct. |
| Invalid URI | The URI is invalid. | Check whether the download address of the firmware package is correct. |
| Firmware update failed | The firmware fails to update. | Check the device. |

FAQs

The following lists the frequently asked questions about software and firmware upgrades. For more questions, see [OTA Upgrades](#).

- [Can the Target Version Be Earlier Than the Source Version?](#)
- [How Do I Obtain Software or Firmware Packages and Their Version Numbers?](#)
- [Are Services Interrupted During a Software or Firmware Upgrade?](#)
- [What Are Common Software or Firmware Upgrade Errors?](#)

APIs

- [Create a Batch Task](#)
- [Query the Batch Task List](#)
- [Query a Batch Task](#)

6.7.4 OTA Upgrade for a Batch of Devices

Uploading a Software/Firmware Package

You need to upload a software/firmware upgrade package before creating a batch software/firmware upgrade task. The platform supports the following upload modes:

1. Use the application to call the API for [creating an OTA upgrade package](#).
2. On the console, choose **Software/Firmware Upgrades**, and upload a software/firmware upgrade package. For details, see [Software/Firmware Package Upload](#).

NOTE

- The OTA upgrade package uploaded using the API can be used only for upgrading MQTT devices.
- If the upgrade package is an OBS object, the delivered upgrade package link is the OBS link no matter whether the CDN domain name acceleration is configured for the OBS bucket.

Upgrading the Software for a Batch of Devices

There are two ways to upgrade the software for a batch of devices:

1. Use the application to call the API for [creating a batch task](#) to create an upgrade task for a batch of devices.
2. Create a software upgrade task on the IoTDA console.

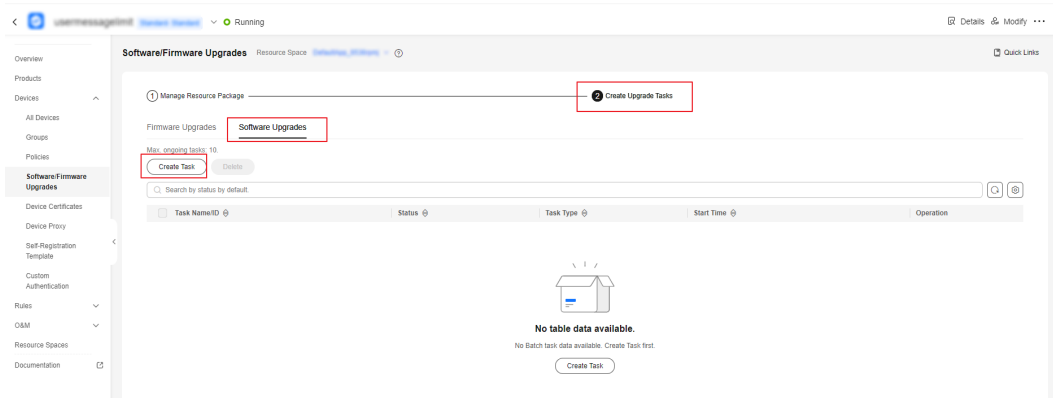
The following describes how to create a software upgrade task for a batch of devices on the console.

Step 1 Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.

Step 2 In the navigation pane, choose **Devices > Software/Firmware Upgrades**, and click **Create Upgrade Task**.

Step 3 On the **Software Upgrades** tab page, click **Create Task**.

Figure 6-43 Software/Firmware upgrade - Creating a software upgrade task



Step 4 In the **Set Basic Information** pane, set the task name, execution time, and retry policy.

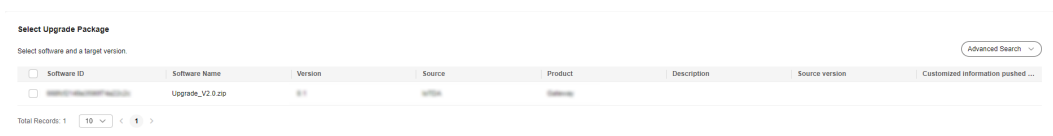
If **Retry** is enabled, you can set the number of retry attempts and retry interval. You are advised to set **Retry Attempts** to **2** and **Retry Interval (min)** to **5**. If an upgrade fails, the upgrade will be retried 5 minutes later.

Figure 6-44 Creating a software upgrade task - Basic information



Step 5 Select a software package.

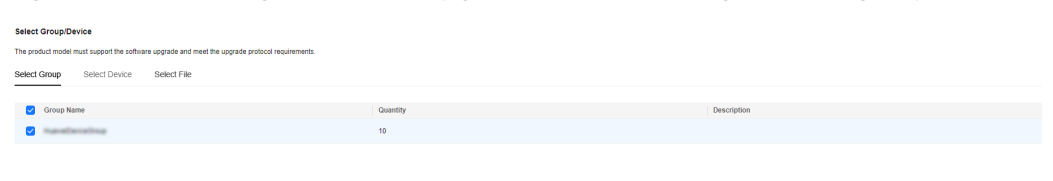
Figure 6-45 Creating a software upgrade task - Selecting an upgrade package



Step 6 Select the device or device group to upgrade and click **Create Now**.

For details on how to create a group and add devices to the group, see [Groups and Tags](#).

Figure 6-46 Creating a software upgrade task - Selecting a device group



Step 7 View the result on the task list. Click **View** to check the result for each device on the execution details page.

 **NOTE**

An upgrade task that is being executed cannot be deleted. To delete an upgrade task, manually stop the task first.

----End

Upgrading the Firmware for a Batch of Devices

There are two ways to upgrade the firmware for a batch of devices:

1. Use the application to call the API for **creating a batch task** to create an upgrade task for a batch of devices.
2. Create a firmware upgrade task on the IoTDA console.

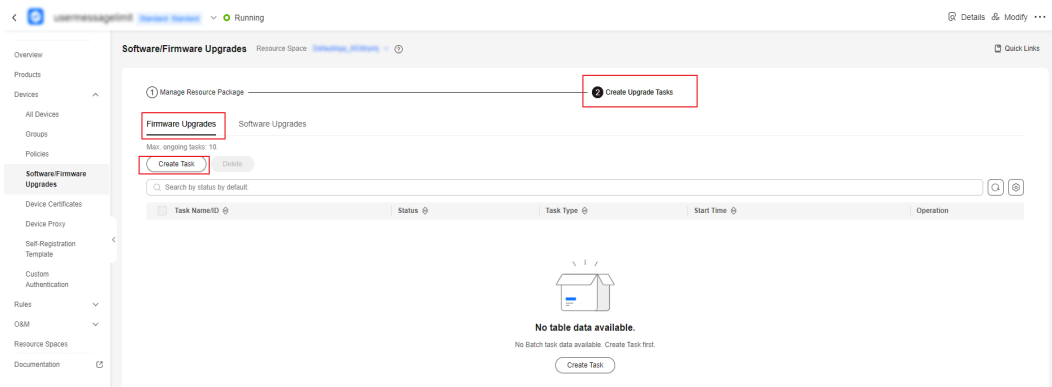
The following describes how to create a firmware upgrade task for a batch of devices on the console.

Step 1 Access the **IoTDA** service page and click **Access Console**. Click the target instance card.

Step 2 In the navigation pane, choose **Devices > Software/Firmware Upgrades**, and click **Create Upgrade Task**.

Step 3 On the **Firmware Upgrades** tab page, click **Create Task**.

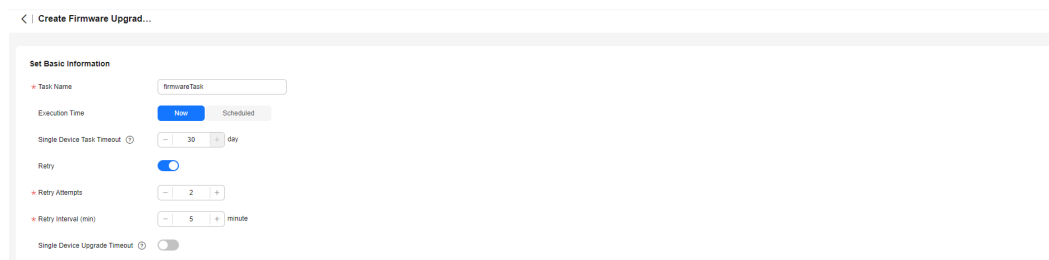
Figure 6-47 Software/Firmware upgrade - Creating a firmware upgrade task



Step 4 In the **Set Basic Information** pane, set the task name, execution time, and retry policy.

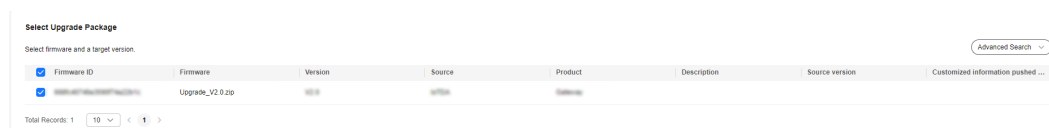
If **Retry** is enabled, you can set the number of retry attempts and retry interval. You are advised to set **Retry Attempts** to **2** and **Retry Interval (min)** to **5**. That is, if the upgrade fails, the upgrade will be retried in 5 minutes. (The maximum number of retry attempts is 5 and the maximum retry interval is 1,440 minutes.)

Figure 6-48 Creating a firmware upgrade task - Basic information



Step 5 Select a firmware package.

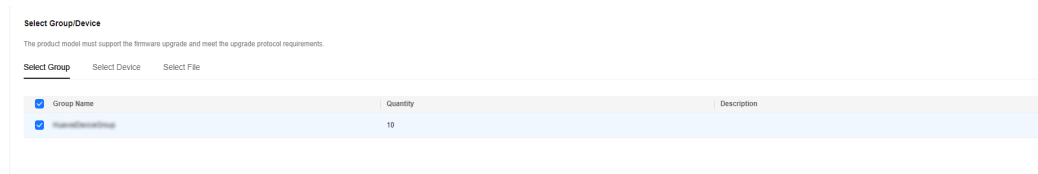
Figure 6-49 Creating a firmware upgrade task - Selecting an upgrade package



Step 6 Select the device group to upgrade and click **Create Now**.

For details on how to create a group and add devices to the group, see [Groups and Tags](#).

Figure 6-50 Creating a firmware upgrade task - Selecting a device group



Step 7 View the result on the task list. Click **View** to check the result for each device on the **Execution Details** page.

NOTE

An upgrade task that is being executed cannot be deleted. To delete an upgrade task, manually stop the task first.

----End

Troubleshooting Software/Firmware Upgrade Failure

The following table lists the failure causes reported by the platform.

| Error Message | Description | Solution |
|-------------------------------|------------------------------------|--|
| Device Abnormal is not online | The device is offline or abnormal. | Check the device. |
| Task Conflict | A task conflict occurs. | Check whether a software upgrade, firmware upgrade, log collection, or device restart task is in progress. |

| Error Message | Description | Solution |
|---|--|-------------------|
| Waiting for the device online timeout | The device does not go online within the specified time. | Check the device. |
| Wait for the device to report upgrade result timeout | The device does not report the upgrade result within the specified time. | Check the device. |
| Waiting for report device firmware version timeout | The device does not report the firmware version within the specified time. | Check the device. |
| Waiting for report cellId timeout | The device does not report the cell ID within the specified time. | Check the device. |
| Updating timeout and query device version for check timeout | The device does not report the upgrade result or device version within the specified time. | Check the device. |
| Waiting for device downloaded package timeout | The device does not finish downloading the firmware package within the specified time. | Check the device. |
| Waiting for device start to update timeout | The device does not start the update within the specified time. | Check the device. |
| Waiting for device start download package timeout | The device does not start to download the firmware package within the specified time. | Check the device. |

The following table lists the failure causes reported by devices.

| Error Message | Description | Solution |
|---|---|--|
| Not enough storage for the new firmware package | The storage space is insufficient for the firmware package. | Check the storage space of the device. |

| Error Message | Description | Solution |
|--|---|--|
| Out of memory during downloading process | The memory was insufficient during the download. | Check the device memory. |
| Connection lost during downloading process | The connection was interrupted during the download. | Check the device connection status. |
| Integrity check failure for new downloaded package | The integrity check on the firmware package fails. | Check whether the firmware package downloaded is complete. |
| Unsupported package type | The firmware package type is not supported. | Check whether the device status and firmware package provided by the manufacturer are correct. |
| Invalid URI | The URI is invalid. | Check whether the download address of the firmware package is correct. |
| Firmware update failed | The firmware fails to update. | Check the device. |

FAQs

The following lists the frequently asked questions about software and firmware upgrades. For more questions, see [OTA Upgrades](#).

- [Can the Target Version Be Earlier Than the Source Version?](#)
- [How Do I Obtain Software or Firmware Packages and Their Version Numbers?](#)
- [Are Services Interrupted During a Software or Firmware Upgrade?](#)
- [What Are Common Software or Firmware Upgrade Errors?](#)

APIs

- [Create a Batch Task](#)
- [Query the Batch Task List](#)
- [Query a Batch Task](#)

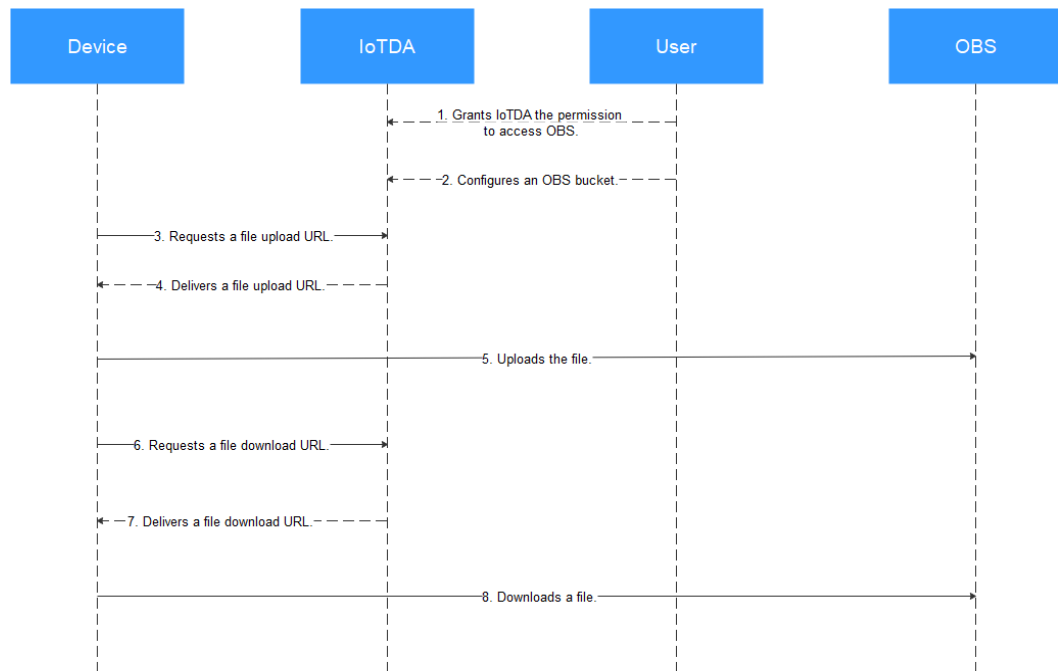
6.8 File Upload

Overview

Devices can upload run logs, configuration files, and other files to the platform for log analysis, fault locating, and device data backup. When a device uploads files to Object Storage Service (OBS) using HTTPS, you can manage the uploaded files on OBS.

Service Flow

Figure 6-51 File upload process



1. A user grants IoTDA the permission to access OBS.

2. The user configures an OBS bucket.

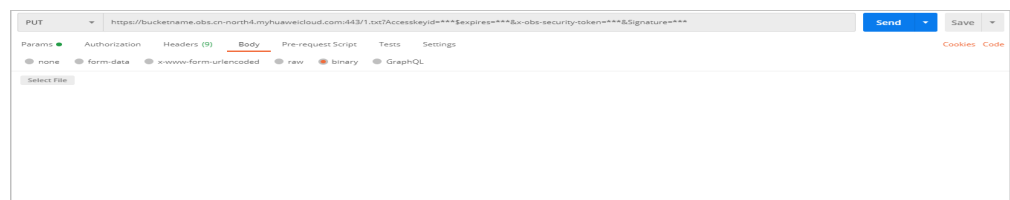
3-4. A device requests a file upload URL, and the platform delivers a URL. For details on the URL format, see [Device Requesting a URL for File Upload](#).

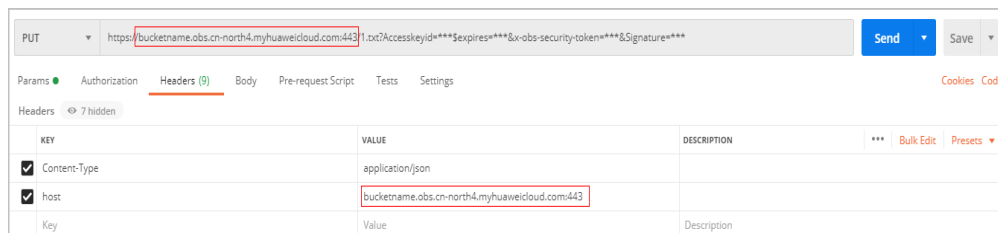
5. The device calls the OBS API and uses the URL delivered by the platform to upload a device file. The validity period of the URL is subject to the value of **expire** (in seconds) delivered by the platform. The default validity period is 1 hour.

- Method 1: Directly use the URL. Postman is used as an example.

Use the PUT method to call the URL, set the body to binary, and select the file to upload. The file name must be the same as the reported file name.

The header of the API does not need to contain **Content-Type** or **Host**. If carried, **Content-Type** must be set to **text/plain** and **Host** must be set to the domain name of the URL. Otherwise, the 403 status code **SignatureDoesNotMatch** is returned.





- Method 2: Integrate the OBS SDK to call the API.
Follow the instructions provided in [Accessing OBS Using a Temporary URL](#) to use a PUT request to upload an object's SDK to upload the file.

6–7. When the device requests to download a file stored in OBS, the platform delivers a file download URL. For details on the URL format, see [Platform Delivering a Temporary URL for File Upload](#).

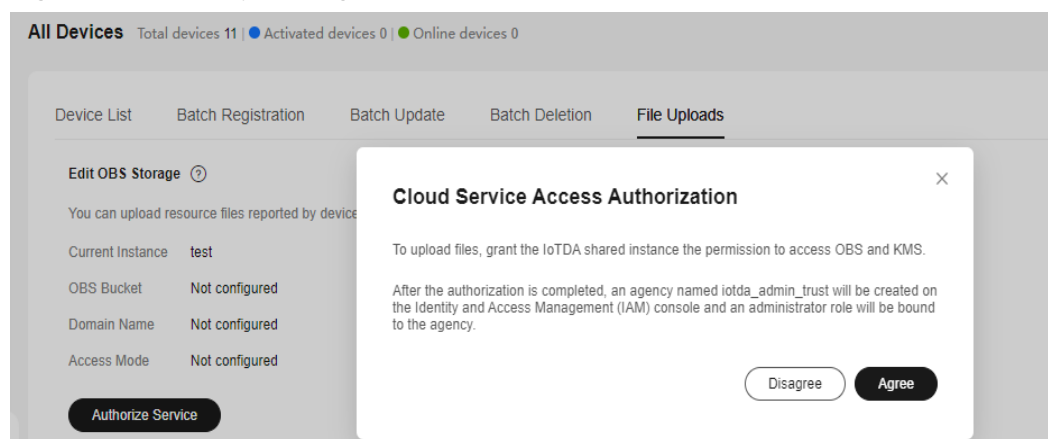
8. The device calls the OBS API and uses the URL delivered by the platform to download the file.

- Method 1: Use the GET method to call the URL. The header of the API does not need to contain **Content-Type** or **Host**. If carried, **Content-Type** must be set to **text/plain** and **Host** must be set to the domain name of the URL. Otherwise, the 403 status code **SignatureDoesNotMatch** is returned.
- Method 2: Integrate the OBS SDK to call the API and use the GET request to download the object's SDK to download the file.

Configuring File Upload

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Devices > All Devices**. On the displayed page, click **File Uploads**.
- Step 3** Click **Authorize Service**. In the dialog box displayed, click **Agree**.

Figure 6-52 File uploading - Authorization



Note: If you have only granted IoTDA the permissions to access OBS, choose **Devices > All Devices** in the navigation pane, click the **File Uploads** tab, and click **Authorize KMS** to grant IoTDA the permissions to access Key Management Service (KMS).

Step 4 (Optional) Create a bucket on the OBS console if no bucket is available.

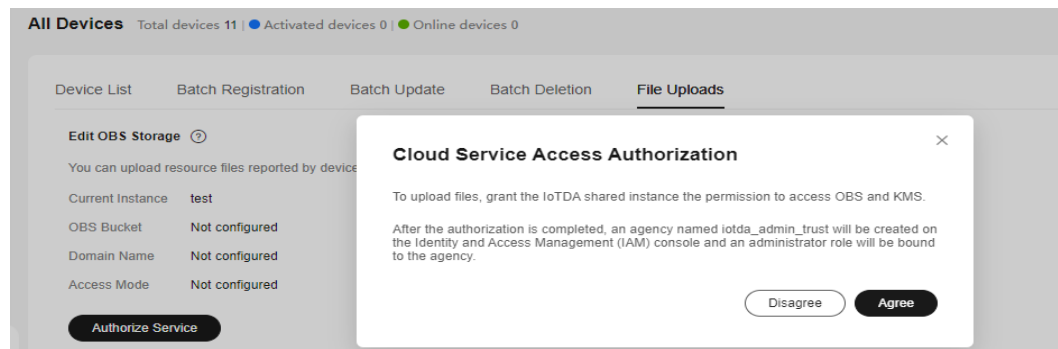
1. Log in to the OBS console.
2. Click **Create Bucket** in the upper right corner to [create a bucket](#).

NOTE

If you use OBS to manage files, you will be charged by OBS. IoTDA does not charge you for file storage. For details about OBS billing, see [Billing](#).

Step 5 Click **Edit OBS Storage** and select a bucket. All device files in the instance will be uploaded to this bucket. You can click **Edit** to select another bucket.

Figure 6-53 File uploading - Storage configuration

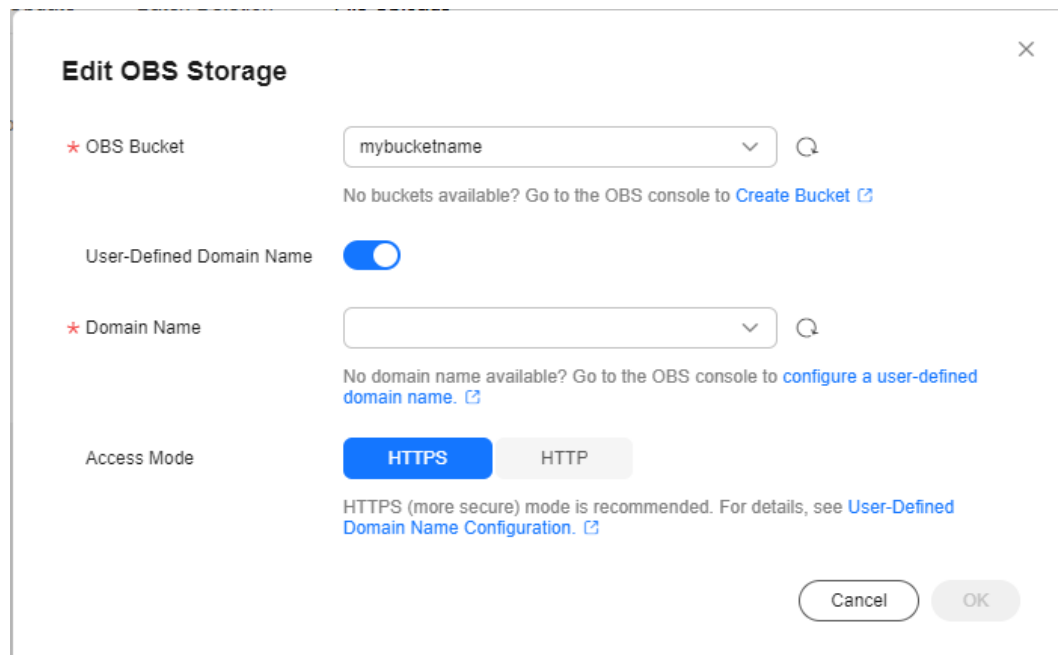


NOTE

When you call the OBS API used for uploading device files, only one file can be uploaded at a time, and the file size cannot exceed 5 GB.

Step 6 If you want to use a custom domain name, enable **User-Defined Domain Name**, select the required domain name configured for the OBS bucket, select **HTTPS** or **HTTP** for **Access Mode**, and click **OK**.

Figure 6-54 File uploading - Configuring a custom domain name



NOTE

The custom domain name is the temporary URL domain name delivered by the platform to the device for OBS file uploading or downloading.

----End

6.9 Gateways and Child Devices

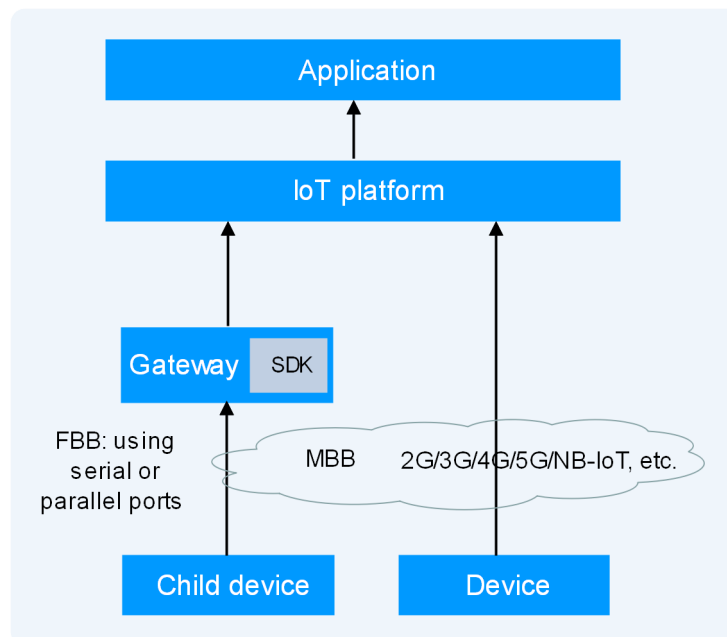
Overview

IoT devices can connect to IoTDA in two modes.

- Directly connected devices: Devices directly connect to the platform using specified protocols.
- Indirectly connected devices: Devices that do not support the TCP/IP protocol stack cannot directly communicate with the platform and need to use gateways as media for data forwarding. Devices directly connected to the platform through MQTT can be used as gateways.

The following figure shows the relationship between directly connected devices and indirectly connected devices.

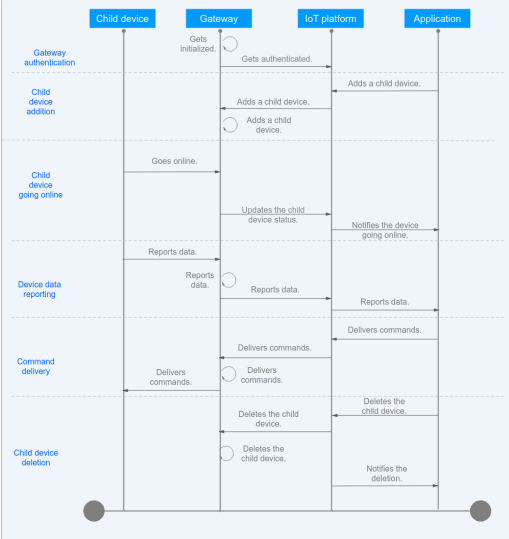
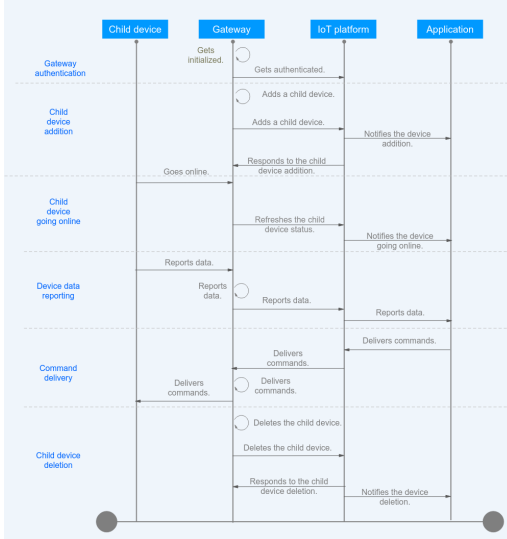
Figure 6-55 Gateways and child devices



Service Flow

You can use the APIs provided by IoT device SDKs to connect gateways and child devices to the platform. API names of SDKs vary depending on the language. For details, see [IoT Device SDK \(Java\)](#), [IoT Device SDK \(C\)](#), [IoT Device SDK \(C#\)](#), [IoT Device SDK \(Android\)](#), and [IoT Device SDK Tiny \(C\)](#).

Table 6-8 Service Flow

| Child Device Management Process at the Application Side | Child Device Management Process at the Gateway Side |
|--|--|
| <p>Figure 6-56 Child device management process at the application side</p>  | <p>Figure 6-57 Child device management process at the gateway side</p>  |
| <p>1. A user uploads the product model of a gateway to the platform and registers the gateway.</p> | |
| <p>2. The gateway calls the authentication API to go online.</p> | |
| <p>3. The user uploads the product model of a child device to the platform.</p> | |
| <p>4. After the gateway authentication is successful, an application calls the API for creating a device. (The device information entered in the API request must be consistent with that defined in the product model). After the child device is added, the user can view it on the console. For details, see Viewing a Child Device. The user can also add child devices on the console. For details, see Adding a Child Device on the Platform.</p> | <p>4. After the gateway authentication is successful, the gateway calls the API described in Platform Notifying a Gateway of New Child Device Connection. (The device information entered in the API request must be consistent with that defined in the product model). After the processing is complete, the platform sends the processing result to the gateway through the API described in Platform Responding to a Request for Adding Child Devices.</p> |

| Child Device Management Process at the Application Side | Child Device Management Process at the Gateway Side |
|---|---|
| <p>5. The status of the newly added child device is still displayed as Inactive on the console. This is because the gateway has not reported the latest status of the child device to the platform. Call the API described in Gateway Updating Child Device Status after the child device is added or before the child device reports data.</p> <p>NOTE The status of a child device indicates whether the child device is connected to the gateway, and the gateway reports the status to the platform for status updates. If the gateway cannot report the status of a child device, the child device status is not updated on the platform. For example, after a child device connects to the platform through a gateway, the child device status is displayed as online. If the gateway is disconnected from the platform, the gateway can no longer report the child device status and the platform will consider the child device online.</p> | |
| <p>6. The gateway calls the API described in Gateway Reporting Device Properties in Batches to report the data of the child device. The parameters in the API request are the information about the gateway and the child device.</p> | |
| <p>7. The gateway subscribes to a topic for command delivery, and receives and processes commands delivered by the application or platform.</p> | |
| <p>8. The application calls the API for deleting a device to command the gateway to delete the child device. The gateway deletes the device upon receiving the command.</p> | <p>8. The gateway calls the API described in Gateway Requesting for Deleting Child Devices. After receiving the request, the platform processes the data and sends the result to the device through the API described in Platform Responding to a Request for Deleting Child Devices.</p> |

Connecting a Gateway to the Platform

Connect a gateway to the platform by integrating the gateway with the SDK. For details, see [Indirectly Connecting to the Platform](#).

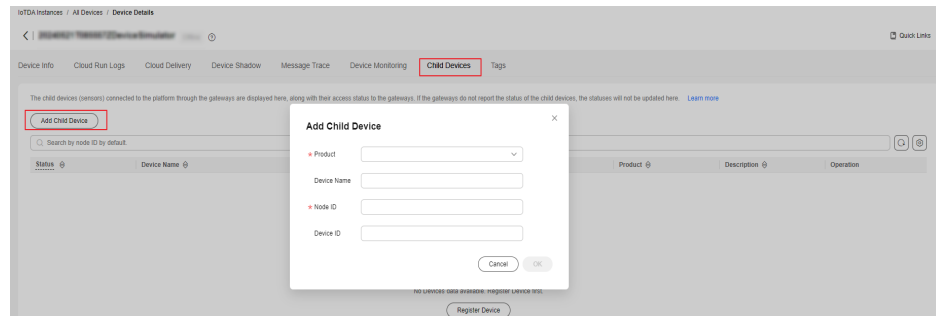
Adding a Child Device on the Platform

- Method 1**

After the gateway is connected to the platform, call the API [Creating a Device](#) to connect the child device to the platform.
- Method 2**

Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card. In the navigation pane, choose **Devices > All Devices**. On the device list, click a gateway to access its details page. On the **Child Devices** tab page, click **Add Child Device**.

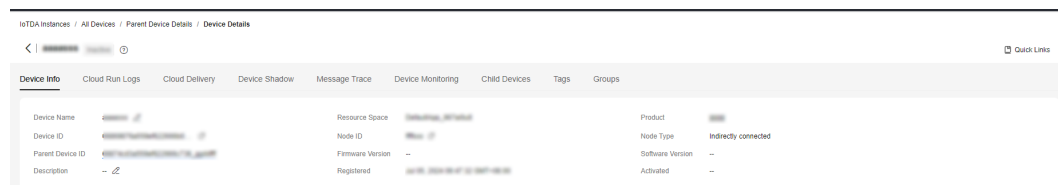
Figure 6-58 Device - Adding a child device



Viewing a Child Device

- Step 1** Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Devices > All Devices**. In the device list, click **View** in the row of a gateway to access its details.
- Step 3** On the **Child Devices** tab page, view the status, device ID, and node ID of the child devices connected to the platform through the gateway.
- Step 4** Click **View** in the row of a child device to view its **details**.

Figure 6-59 Device - Child device details



----End

6.10 Authentication Credentials

Introduction

When connecting to IoTDA, a device must carry a credential for authentication. Currently, two types of authentication credentials are available.

- **Secret:** the device secret you preset on IoTDA during device registration for future authentication. After successful authentication, the device is activated and communicates with the platform. There are two types of secrets:
 - **Master secret:** primary secret used for device access authentication.
 - **Sub secret:** secondary secret used when the master secret fails to pass the authentication. Unavailable for devices accessed using CoAP.
- **X.509 certificate:** a digital certificate used for communication entity authentication. IoTDA allows devices to use their own X.509 certificates. For details, see [Connecting a Device That Uses the X.509 Certificate Based on MQTT.fx](#). In this mode, the platform verifies the device certificate fingerprints

that you preset on the platform for authentication during connection establishment. There are two types of fingerprints:

- Master fingerprint: primary fingerprint used for device access certificate authentication.
- Sub fingerprint: secondary fingerprint used when the master fingerprint fails to pass the authentication. Unavailable for devices accessed using CoAP.

Updating

You need to update a device access credential in some scenarios, for example, when an X.509 certificate is about to expire. You can reset device credentials by calling the APIs for [resetting a device fingerprint](#) or [resetting a device secret](#). IoTDA provides master/sub fingerprints and secrets to prevent device authentication failure and service interruption during credential update and resetting. For example, when you add a new certificate fingerprint, the platform sets the fingerprint as a backup (sub fingerprint). In this way, the corresponding device can use both the old certificate (if not updated on the device side timely) and the new certificate to connect to the platform smoothly.

Scenarios

1. In high availability (HA) scenarios, a device has two secrets to connect to the platform.
2. During the credential update and resetting, a device does not disconnect from the platform and causes no service losses.

Procedure

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Devices > All Devices**. By default, all devices in the current instance are displayed in the device list.
- Step 3** Click **View** in the **Operation** column of the target device. On the displayed page, click **Reset Secret** or **Reset Fingerprint**. In the displayed dialog box, select **Sub secret** or **Sub fingerprint**.

Figure 6-60 Device details - Resetting sub secret

Reset Secret ×

After the secret is reset, the original secret becomes invalid. The new secret must be updated on the device, and the device must carry the new secret for authentication during platform connection. You can specify a new secret in the text box below. If you do not specify a new secret, the platform automatically generates one.

Reset Object Master secret **Sub secret**

New Secret [?]

Confirm New Secret

Forcibly Disconnect [?]

Cancel OK

Figure 6-61 Device details - Resetting sub fingerprint

Reset Certificate Fingerprint ×

After the certificate fingerprint is reset, the old one gets invalid. You need to update the new certificate fingerprint information to the device. When the device initiates a registration request, it will use the new certificate fingerprint for identity authentication.

Reset Object Master fingerprint **Sub fingerprint**

★ Fingerprint

Forcibly Disconnect [?]

Cancel OK

----End

APIs

- [Reset a Device Fingerprint](#)
- [Reset a Device Secret](#)

6.11 Device Certificates

Overview

For a device using MQTTS X.509 certificates, when it connects to the platform for the first time, IoTDA utilizes the uploaded and verified device CA certificate to authenticate the device certificate. After the authentication is successful, the platform automatically saves the device certificate and generates expiration warnings. You can check and disable device certificates.

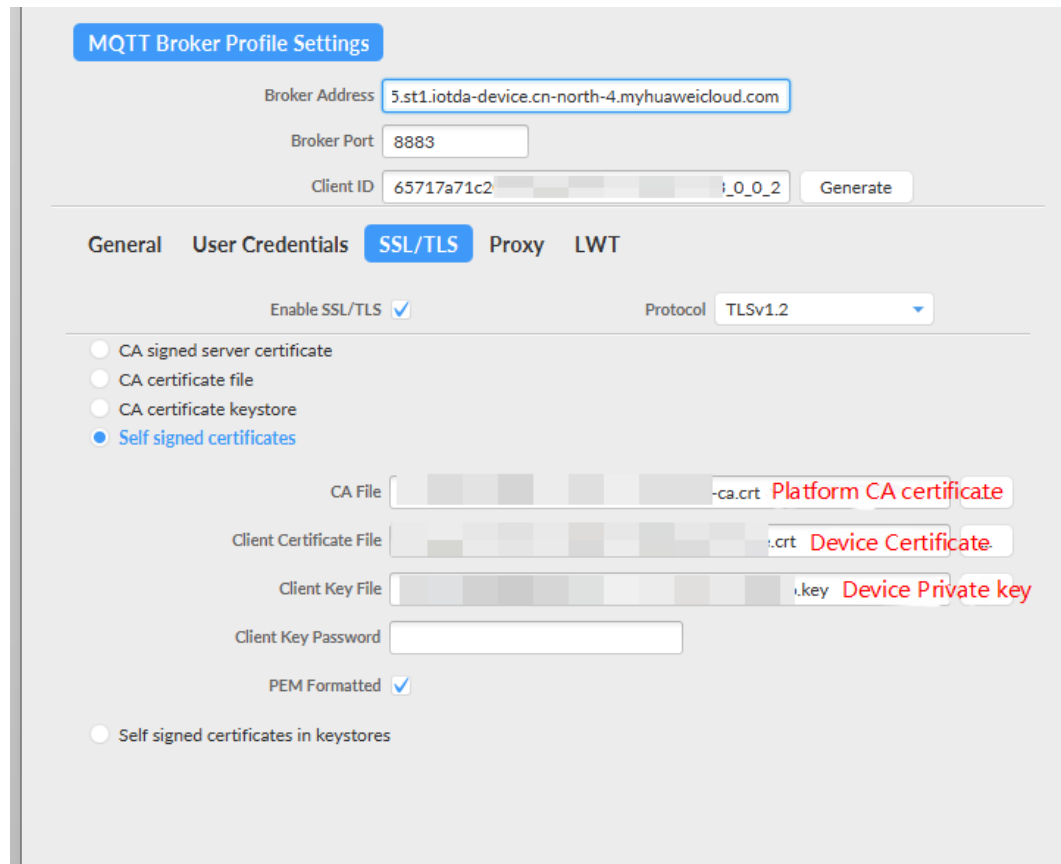
Constraints

1. IoTDA generates alarms for device certificates that are about to expire within 30 days. Update the certificates in a timely manner to prevent access failures.
2. The device certificate quota provided by IoTDA is 1.5 times of the device quantity quota. To ensure smooth storage of new certificates, delete expired certificates in a timely manner. Failure to do so may result in the inability to check certificates on the console. However, this does not affect device access to the platform.
3. A device is associated with a device certificate through the certificate fingerprint. After a device certificate is disabled, all devices associated with it cannot access the platform.

Procedure

- Step 1** Upload and verify the device CA certificate. For details about how to create and verify a device CA certificate, see [Registering a Device Authenticated by an X.509 Certificate](#).
- Step 2** Register a device that uses the X.509 certificate for authentication. Log in to the IoTDA console. In the navigation pane, choose **Devices > All Devices**. On the displayed page, click **Register Device**. Set **Authentication Type** to **X.509 certificate** and **Fingerprint** to the SHA-256 fingerprint of the device certificate. If you do not specify the fingerprint, the device certificate fingerprint carried when the device successfully accesses the platform for the first time is recorded by default.
- Step 3** Use the device certificate to access the device to the platform.

Figure 6-62 Device connection parameters



Step 4 Log in to the IoTDA console. In the navigation pane, choose **Devices > Device Certificates**. Click the **Device Certificates** tab to check the device certificate list and details.

Figure 6-63 Device certificate - Certificate list

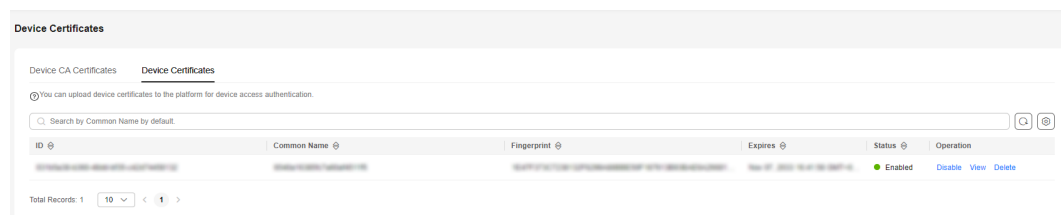
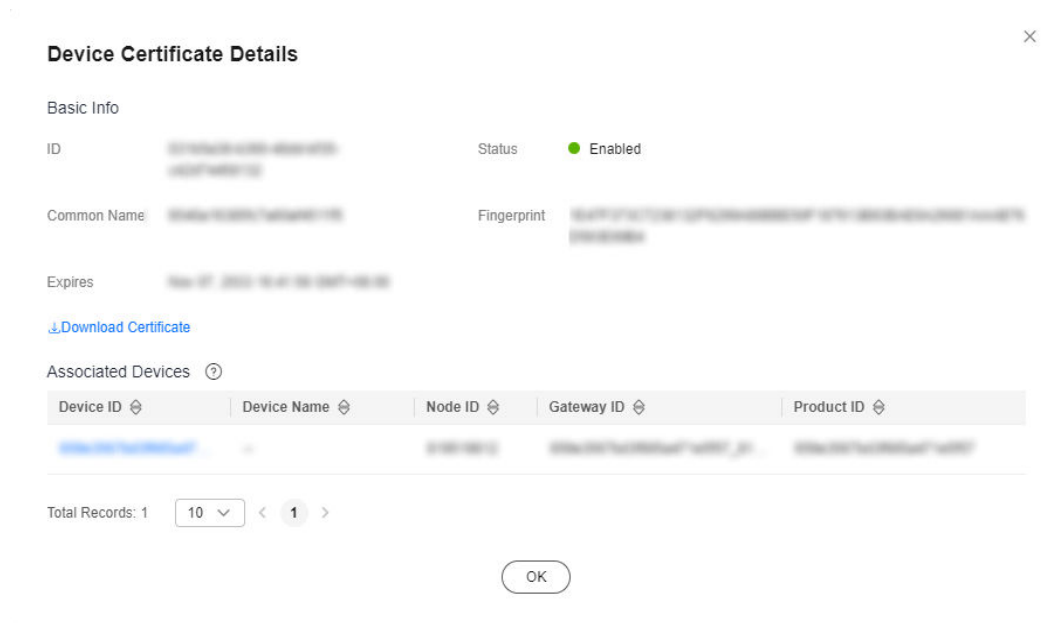
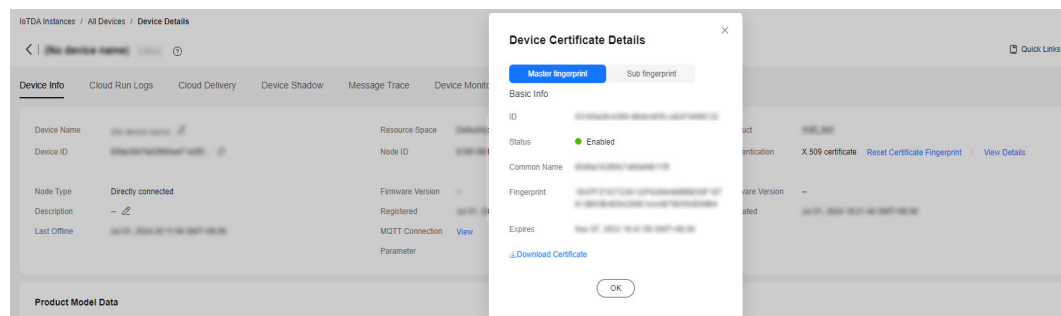


Figure 6-64 Device certificate - Certificate details



Step 5 In the navigation pane, choose **Devices > All Devices**. Locate the target device, click **View** in the **Operation** column. On the displayed page, click the button for checking the certificate details.

Figure 6-65 Device - Device details - Certificate details

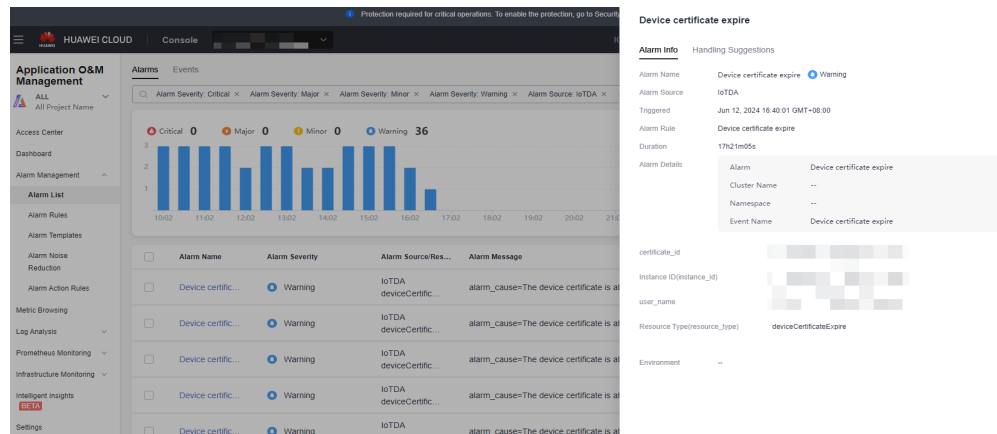


----End

Device Certificate Alarms

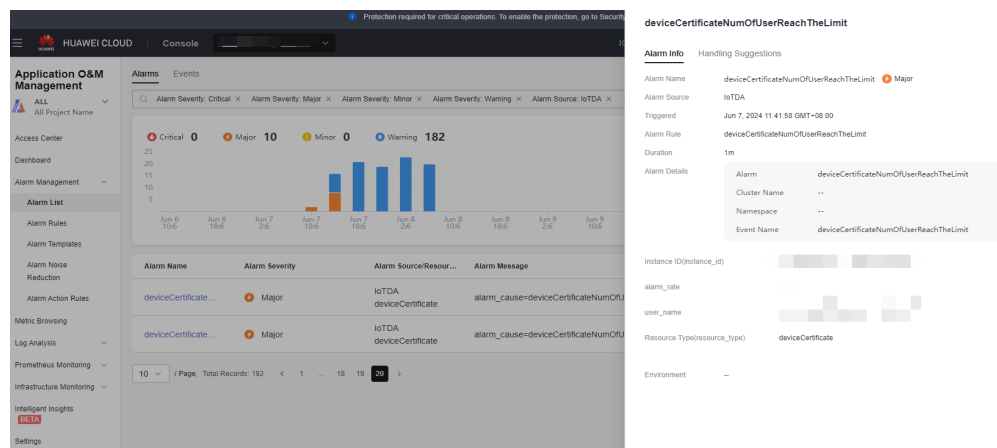
- IoTDA generates an expiration warning for device certificates. You can check the certificates that are about to expire in the recent month in the Application Operations Management (AOM) alarm list.

Figure 6-66 Device certificate expiration alarm -AOM



- IoTDA generates a warning when the number of device certificates exceeds the threshold. Delete expired certificates in a timely manner.

Figure 6-67 Insufficient device certificate quota -AOM



AOM allows you to create an alarm action rule to send alarm notifications through SMSs, emails, and WeCom messages. For details, see [Creating an Alarm Action Rule](#).

7 Rules

7.1 Overview

You can set rules for devices connected to the platform. If the conditions set in a rule are met, the platform triggers the corresponding action. Device linkage and data forwarding rules are available.

- **Device linkage**

When specific conditions are met, the platform triggers collaborative response of multiple devices to implement device linkage and intelligent control. Currently, IoTDA supports cloud rules and device rules. If you want to create a cloud rule and select **Send notifications** for **Action** in a rule, the platform will work with Huawei Cloud [Simple Message Notification \(SMN\)](#) to set and deliver topic notifications. If you want to create a device rule, the platform will deliver the rule to devices for unified management and execution.
- **Data forwarding**

IoT Device Access (IoTDA) can seamlessly forward data to other Huawei Cloud services and third-party applications, providing full-stack services for device data storage, computing, and analysis.

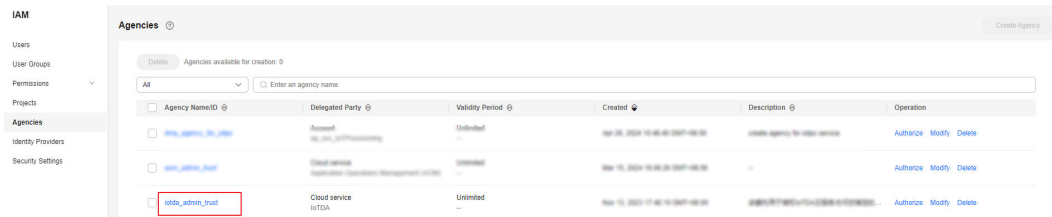
Cloud Service Access Authorization

The platform can connect to Huawei Cloud services. When creating a rule for connecting to Data Ingestion Service (DIS), Distributed Message Service (DMS) for Kafka, Object Storage Service (OBS), ROMA Connect, or SMN for the first time, you must authorize the platform to access the cloud service.

After the authorization, data on the platform can be forwarded to other Huawei Cloud services using data forwarding rules, or the platform can send commands to control devices using device linkage rules.

An agency named `iotda_admin_trust` is created on the [Identity and Access Management \(IAM\)](#) console and an administrator role is bound by default.

Figure 7-1 Agency - iotda_admin_trust



7.2 Data Forwarding Process

Overview

The data forwarding function connects IoTDA with other Huawei Cloud or third-party cloud services to smoothly transfer device data to the message middleware, storage and data analysis services, and applications. Currently, IoTDA supports multiple forwarding types.

Table 7-1 Data forwarding types

| Type | Forwarding Target | Description | Operation |
|----------------------|-------------------------------------|--|-----------------------------------|
| Third-party services | Third-party application (HTTP push) | Data is transferred to customers' HTTP servers with URL specified in the data forwarding rule. | HTTP/HTTPS Data Forwarding |
| | AMQP message queue | Data is transferred to the AMQP channels specified in the data forwarding rule for client-platform connection and data exchange. | AMQP Data Forwarding |
| | MQTT message queue | Data is transferred to the MQTT topics specified in the data forwarding rule for client-platform connection and data exchange. | MQTT Data Forwarding |
| | M2M communication | IoTDA supports MQTT-based message communication between devices based on topics specified in the data forwarding rule. The platform pushes messages reported by devices to the specified topics. Other devices can receive messages from different devices by subscribing to the specified topics. | M2M Communications |

| Type | Forwarding Target | Description | Operation |
|--------------|---------------------------------|---|--|
| Data storage | GeminiDB Influx | <p>Data is transferred to GeminiDB Influx, a cloud-native time series database compatible with InfluxDB. GeminiDB Influx reads and writes time series data with high performance and compression ratio in high concurrency scenarios, provides cold and hot tiered storage, elastic scale-out, and monitoring and alarm reporting. It stores the data with compression algorithms, allows you to query data using SQL-like statements, and supports multi-dimensional aggregation computing and visual analysis.</p> <p>Scenarios: It is widely used to monitor resources, services, IoT devices, and industrial production processes, evaluate production quality, and trace faults. With high throughput and concurrency, it can handle a large number of connections in a very short period of time, making it an excellent choice for IoT applications.</p> <p>Learn more about InfluxDB instance specifications.</p> | Forwarding Data to GeminiDB Influx |
| | RDS for MySQL | <p>Data is transferred to RDS for MySQL. Compared with self-managed databases, this service is cheaper, out-of-the-box, and easy to operate and maintain. It supports auto scaling and provides functions such as instance management and monitoring, backup and restoration, log management, and parameter management. Standalone and primary/standby deployment modes are available.</p> <p>Scenarios: website, gaming, e-commerce, and financial services, and mobile and enterprise applications</p> <p>Learn more about RDS for MySQL instance specifications.</p> | Forwarding Data to MySQL for Storage |

| Type | Forwarding Target | Description | Operation |
|------|--|--|---|
| | Object Storage Service (OBS) | <p>Data is transferred to OBS. OBS provides customers with massive, secure, reliable, and cost-effective data storage capabilities and multiple storage types. OBS can work with Cloud Stream Service (CS) to analyze stream data in real time. The analysis results can be used for data visualization in other cloud services or third-party applications.</p> <p>Scenarios: massive big data storage and analysis</p> <p>Learn more about OBS storage specifications.</p> | Forwarding Device Data to OBS for Long-Term Storage |

NOTICE

Maximum data forwarding rate through the public network: 1 Mbit/s. The excess messages will be discarded.

Procedure

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Rules > Data Forwarding**, and click **Create Rule** in the upper left corner.
- Step 3** Configure related parameters and click **Create Rule**.

Table 7-2 Parameters for creating a rule

| Parameter | Description |
|-------------|---------------------------------|
| Rule Name | Name of the rule to be created. |
| Description | Description of the rule. |

| Parameter | Description |
|----------------|--|
| Data Source | <ul style="list-style-type: none"> ● Device: Device information, such as device addition, deletion, and update, will be forwarded. When Data Source is set to Device, quick configuration is not supported. ● Device property: A property value reported by a device in a resource space will be forwarded. Click Quick Configuration on the right and select the product, property, and service data to forward. ● Device message: A message reported by a device in a resource space will be forwarded. Click Quick Configuration on the right and select data of a specified topic to forward. Select the product to which the topic belongs and enter the topic name. You can use a custom topic on the product details page or a preset topic. ● Device message status: The status of device messages exchanged between the device and platform will be forwarded. For details on the device message status, see Message Delivery Status. When Data Source is set to Device message status, quick configuration is not supported. ● Device status: The status change of a directly or an indirectly connected device in a resource space will be forwarded. Click Quick Configuration on the right to forward information about devices whose status is Online, Offline, or Abnormal to other services. For details on the status of devices directly connected to the platform, see Device Management. ● Batch task: The batch task status will be forwarded. When Data Source is set to Batch Task, quick configuration is not supported. ● Product: Product information, such as product addition, deletion, and update, will be forwarded. When Data Source is set to Product, quick configuration is not supported. ● Asynchronous command status of the device: Status changes of asynchronous commands to devices using LwM2M over CoAP will be forwarded. For details on the asynchronous command status of devices, see Asynchronous Command Delivery. When Data Source is set to Asynchronous command status of the device, quick configuration is not supported. ● Run log: Service run logs of MQTT devices will be forwarded. When Data Source is set to Run log, quick configuration is not supported. |
| Trigger | After you select a data source, the platform automatically matches trigger events. |
| Resource Space | You can select a single resource space or all resource spaces. If All resource spaces is selected, quick configuration is not supported. |

Step 4 Click the **Set Forwarding Target** tab, and then click **Add** to set a forwarding target.

Data can be forwarded to [Data Ingestion Service \(DIS\)](#), [Distributed Message Service \(DMS\) for Kafka](#), [Object Storage Service \(OBS\)](#), [FunctionGraph](#), [Log Tank Service \(LTS\)](#), [GeminiDB Influx](#), [RDS for MySQL](#), [third-party applications \(HTTP push\)](#), [AMQP message queues](#), [MQTT message queues](#), and devices.

Table 7-3 Parameters for setting the forwarding target

| Forwarding Target | Description |
|---|---|
| Data Ingestion Service (DIS) | <ul style="list-style-type: none"> ● Region: Select the region of the service to which data will be forwarded. If you are not authorized to access the service in this region, perform authorization as required. ● Stream Homing: You can select either of the following: <ul style="list-style-type: none"> – In-house stream: Select a stream. If no DIS stream is available, create one on the DIS console. – Delegated by others: You can use DIS streams authorized by other users. Obtain the stream ID from the DIS console. |
| Distributed Message Service (DMS) for Kafka NOTE Data can be forwarded only to Kafka premium instances. You need to enable automatic topic creation. | <ul style="list-style-type: none"> ● Region: Select the region of the service to which data will be forwarded. If you are not authorized to access the service in this region, perform authorization as required. ● Connection Address: Obtain the connection address by following the instructions provided in Accessing a Kafka Instance with SASL. Basic and standard instances support only access to Kafka premium instances over the Internet. Enterprise instances support access to Kafka premium instances over a private network. ● Topic: Customize a topic. ● SASL-based authentication: If SASL authentication is enabled, enter the SASL username and password entered in Buying a Kafka Instance. ● Kafka Security Protocol: If SASL authentication is enabled, select the security protocol supported by the Kafka instance you purchased. ● SASL Mechanism: If SASL authentication is enabled, select the SASL authentication mechanism supported by the Kafka instance you purchased. |

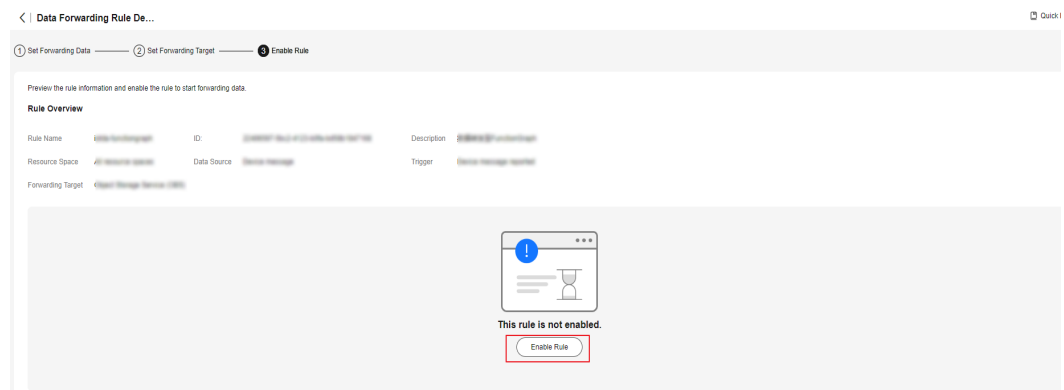
| Forwarding Target | Description |
|--|--|
| Object Storage Service (OBS) | <ul style="list-style-type: none"> • Region: Select the region of the service to which data will be forwarded. If you are not authorized to access the service in this region, perform authorization as required. • OBS Bucket: Select a bucket as required. If no OBS bucket is available, create one on the OBS console. • Custom Directory: Separate different directory levels by slashes (/). The directory cannot start or end with a slash (/) or contain two or more consecutive slashes (/). |
| Third-party application (HTTP push) | You can use HTTP or HTTPS to push messages. For details on how to set parameters, see HTTP/HTTPS Subscription/Push . |
| AMQP message queue | Message Queue: Select the queue to which messages are to be pushed. If no queue is available, create one. For details on the restrictions on message queue names, see AMQP Server Configuration . |
| FunctionGraph NOTE Currently, only data of instances of Enterprise and Standard editions can be forwarded to FunctionGraph. | <ul style="list-style-type: none"> • Function Name: Select the name (latest version) of the function to be called. Currently, cross-region function calling is not supported. If no function is available, create one. |

| Forwarding Target | Description |
|--|--|
| <p>GeminiDB Influx</p> <p>NOTE Currently, only data of instances of Enterprise and Standard editions can be forwarded to GeminiDB Influx.</p> | <ul style="list-style-type: none"> ● Database Instance Address: Enter the address for connecting to the GeminiDB Influx instance. IoTDA enterprise edition instances can connect to GeminiDB Influx using private network IP addresses, while standard edition instances support only public network connection. For details, see Connection Methods. ● Database Name: Enter a database name. If no database exists, go to the GeminiDB Influx console to create a database. ● Access Account and Access Password: Access the GeminiDB Influx console to obtain the account and password. For details, see Resetting the Administrator Password. ● Table: Enter the name of the target table (measurement). If the table does not exist, it will be automatically created. ● Field Mappings: <ul style="list-style-type: none"> - Forwarding Field: Enter the attribute name of the data to be forwarded. Data to be forwarded is in JSON format. Separate multi-level attribute names with periods (.). For details about the format of data to be forwarded, see Data Transfer APIs. - Target Field: Enter the column name of the database. |

| Forwarding Target | Description |
|--|---|
| <p>RDS for MySQL</p> <p>NOTE Currently, only data of instances of Enterprise and Standard editions can be forwarded to RDS for MySQL.</p> | <ul style="list-style-type: none"> ● Database Instance Address: Enter the address for connecting to the RDS instance. IoTDA enterprise edition instances can connect to RDS using private network IP addresses, while standard edition instances support only public network connection. For details, see Connection Management. ● Database Name: Enter a database name. If no database exists, go to the RDS for MySQL console to create a database. ● Access Account and Access Password: Access the RDS console to obtain the account and password. For details, see Resetting a Password for a Database Account. ● SSL: Select whether to connect to the database in SSL mode. You are advised to use the SSL mode. If not, security risks may exist during data transmission. To use the SSL mode, configure an SSL connection in the database instance first. ● Table: Select the name of the table to which data is forwarded. ● Field Mappings: <ul style="list-style-type: none"> - Forwarding Field: Enter the attribute name of the data to be forwarded. Data to be forwarded is in JSON format. Separate multi-level attribute names with periods (.). For details about the format of data to be forwarded, see Data Transfer APIs. - Target Field: Enter the column name of the database. |
| <p>MQTT message queue</p> | <p>Push Topic: Select the topic to which the message is to be pushed.</p> |
| <p>Device</p> | <p>MQTT is used to implement message communications between devices. For details about the parameters, see Usage.</p> |

Step 5 Start a rule.

After the rule is configured, click the button for enabling the rule to start data forwarding.

Figure 7-2 Data forwarding - Enabling a rule

Step 6 IoTDA provides connectivity testing of the rule action forwarding target. For details, see [Connectivity Tests](#).

----End

7.3 SQL Statements

When creating a data forwarding rule, you must compile SQL statements to parse and process JSON data reported by devices. For details about the JSON data format, see [Data Transfer APIs](#). This section describes how to compile SQL statements used in data forwarding rules.

SQL Statements

An SQL statement consists of the SELECT and WHERE clauses. Each clause can contain a maximum of 500 characters. Chinese and other character sets are not supported. Contents in the SELECT and WHERE clauses are case-sensitive. However, keywords such as SELECT, WHERE, and AS are case-insensitive.

The following example uses messages reported by a device as the source data.

```
{
  "resource": "device.message",
  "event": "report",
  "event_time": "20151212T121212Z",
  "notify_data": {
    "header": {
      "device_id": "*****",
      "product_id": "ABC123456789",
      "app_id": "*****",
      "gateway_id": "*****",
      "node_id": "ABC123456789",
      "tags": [ {
        "tag_value": "testTagValue",
        "tag_key": "testTagName"
      } ]
    },
    "body": {
      "topic": "topic",
      "content": {
        "temperature": 40,
        "humidity": 24
      }
    }
  }
}
```

In the source data, **content** in the **body** is the data reported by the device. You can set **temperature** greater than 38 as the trigger condition, and filter out other fields to obtain only **device_id** and **content**. The example SQL statement is as follows:

```
SELECT notify_data.header.device_id AS device_id, notify_data.body.content WHERE  
notify_data.body.content.temperature > 38
```

When the temperature reported by the device is higher than 38°C, data forwarding is triggered. The data format after forwarding is as follows:

```
{  
  "device_id": "*****",  
  "notify_data.body.content": {  
    "temperature": 40,  
    "humidity": 24  
  }  
}
```

SELECT Clause

The SELECT clause consists of **SELECT** followed by multiple SELECT subexpressions, which can be *, JSON variables, string constants, or integer constants. A JSON variable is followed by an AS keyword and an AS variable, 32 characters in total. If a constant or function is used, you must use AS to specify the name.

- JSON variable

A JSON variable can contain letters, digits, underscores (_), and hyphens (-). To distinguish a hyphen (-) from the minus sign, use double quotation marks (") to enclose the JSON variable with a hyphen, for example, "**msg-type**".

The JSON variable extracts data of the nested structure.

```
{  
  "a": "b",  
  "c": {  
    "d": "e"  
  }  
}
```

c.d can be used to extract character string **e**, which can be nested at multiple layers.

- AS variable

An AS variable consists of letters and is case sensitive. The variable [a-zA-Z_-]* is supported. If a hyphen (-) is used, enclose it with double quotation marks (").

- Constant integer

SELECT supports constant integers, which must be followed by an AS clause. For example:

NOTE

Value range of the constant integer: -2147483648 to 2147483647

```
SELECT 5 AS number
```

- Constant character string

SELECT supports constant character strings, which must meet the [a-zA-Z_-]* expression. The character strings must be enclosed in single quotation marks (') and followed by an AS clause.

 **NOTE**

A string can contain up to 50 characters.
SELECT 'constant_info' AS str

WHERE Clause

In the WHERE clause, you can perform Boolean operations using JSON variables, make some non-null judgments, and combine the results using AND or OR.

- **IS NULL and IS NOT NULL**

Null judgment can be used in the WHERE clause. If the JSON variable cannot extract data or the extracted array is empty, **IS NULL** is true. Otherwise, **IS NOT NULL** is true.

WHERE data IS NULL

- **IN and NOT IN**

The IN operator can be used in the WHERE clause. If the target value is in the specified value set, IN is true. Otherwise, NOT IN is true. The IN operator supports strings and numbers, the IN set only supports constants. The types of all elements in the IN set must be the consistent and be the same as the type of the target value.

WHERE notify_data.header.product_id IN ('productId1','productId2')

- **Operators > <**

The greater than (>) and less than (<) operators can be used in the WHERE clause. The operators can be used between two JSON variables, between a JSON variable and a constant, or between a constant and a constant only when the value of a JSON variable is a constant integer. The operators can be used together with AND or OR.

For example:

WHERE data.number > 5 Obtains the information of the target whose **data.number** is greater than 5.
WHERE data.tag < 4 Obtains the information of the target whose **data.tag** is less than 4.
WHERE data.number > 5 AND data.tag < 4 Obtains the information of the target whose **data.number** is greater than 5 and **data.tag** less than 4.

- **Equals sign (=)**

The equals sign (=) can be used in the WHERE clause for comparison between JSON variables, between JSON variable integers and integer constants, and between JSON variable strings and string constants. If **IS NULL** for the two JSON variables is true, the comparison result of the equals sign (=) is false. The operators can be used together with AND or OR.

WHERE data.number = 5 Obtains the information of the target whose **data.number** is 5.
WHERE data.tag = 4 Obtains the information of the target whose **data.tag** is 4.
WHERE data.number = 5 OR data.tag = 4 Obtains the information of the target whose **data.number** is 5 or **data.tag** is 4.

Constraints

Table 7-4 Restrictions on using SQL statements

| Object | Restriction |
|---------------|----------------|
| SELECT clause | 500 characters |

| Object | Restriction |
|-----------------|----------------|
| WHERE clause | 500 characters |
| AS clause | 10 AS clauses |
| JSON data depth | 400 levels |

Debugging SQL Statements

The IoT platform provides the online SQL debugging function. To debug SQL statements, perform the following operations:

1. After compiling the SQL statements, click **Debug**.
2. On the **Debug Parameters** tab page, enter the data to debug, and click **Start Debugging**.

Function List

Multiple functions are used in rules. You can use these functions when compiling SQL statements to implement diversified data processing.

Table 7-5 Function list

| Function Name | Parameter | Function | Return Value Type | Restriction |
|---------------|------------------|--|-------------------|-------------|
| GET_TAG | String tagKey | Obtains tag_value corresponding to a specified tag_key . GET_TAG('testTagName') | String | - |
| CONTAINS_TAG | String tagKey | Checks whether the specified tag_key is contained. CONTAINS_TAG('testTagName') | Boolean | - |

| Function Name | Parameter | Function | Return Value Type | Restriction |
|-------------------|------------------------------------|---|-------------------|----------------------------------|
| GET_SERVICE | String serviceId and boolean fuzzy | Obtains the service. If fuzzy is set to false or left blank, the service with the specified service ID is obtained. If fuzzy is set to true , the service is queried through fuzzy match. If multiple services with the same service ID exist in a message body, the result is not guaranteed. GET_SERVICE('Battery',true) | JSON structure | Used only for property reporting |
| GET_SERVICES | String serviceId and boolean fuzzy | Obtains services. If fuzzy is set to false or left blank, services with the specified service ID are obtained. If fuzzy is set to true , services are queried through fuzzy match. The query results are combined into an array. GET_SERVICES('Battery',true) | JSON array | Used only for property reporting |
| CONTAINS_SERVICES | String serviceId and boolean fuzzy | If fuzzy is set to false or left empty, the system checks whether the specified service ID exists. If fuzzy is set to true , fuzzy match is used to determine whether service ID in the property contains the specified parameter. CONTAINS_SERVICES('Battery',true) | Boolean | Used only for property reporting |

| Function Name | Parameter | Function | Return Value Type | Restriction |
|------------------------|---|--|-------------------|----------------------------------|
| GET_SERVICE_PROPERTIES | String serviceld | Obtains the properties field of the service with a specific service ID. GET_SERVICE_PROPERTIES('Battery') | JSON structure | Used only for property reporting |
| GET_SERVICE_PROPERTY | String serviceld, String propertyKey | Obtain the value of propertyKey in properties of a service with a specific service ID. Example: GET_SERVICE_PROPERTY('Battery','batteryLevel') | String | Used only for property reporting |
| STARTS_WITH | String input, String prefix | Checks whether the value of input starts with prefix . STARTS_WITH('abcd','abc') STARTS_WITH(notify_data.header.device_id,'abc') STARTS_WITH(notify_data.header.device_id,notify_data.header.product_id) | Boolean | - |
| ENDS_WITH | String input, String suffix | Checks whether the value of input ends with suffix . ENDS_WITH('abcd','bcd') ENDS_WITH(notify_data.header.device_id,'abc') ENDS_WITH(notify_data.header.device_id,notify_data.header.node_id) | Boolean | - |
| CONCAT | String input1, String input2 | Concatenates character strings and returns the results. CONCAT('ab','cd') CONCAT(notify_data.header.device_id,'abc') CONCAT(notify_data.header.product_id,notify_data.header.node_id) | String | - |
| REPLACE | String input, String target, String replacement | Replaces a part of a character string. That is, replace target in the input with replacement . REPLACE(notify_data.header.node_id,'nodeld','IMEI') | - | - |

| Function Name | Parameter | Function | Return Value Type | Restriction |
|---------------|--|---|-------------------|-------------|
| SUBSTRING | String input, int beginIndex, int endIndex(required=false) | Obtains the substring of the returned string. That is, the beginIndex (included) to endIndex (excluded) characters of the input value. Note: endIndex is optional. SUBSTRING(notify_data.header.device_id,3) SUBSTRING(notify_data.header.device_id,3,12) | - | - |
| LOWER | String input | Converts all values in input to lowercase letters. LOWER(notify_data.header.app_id) | - | - |
| UPPER | String input | Converts all values in input to uppercase letters. UPPER(notify_data.header.app_id) | - | - |

7.4 Connectivity Tests

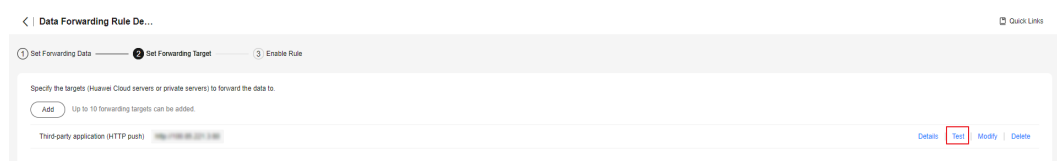
Overview

IoTDA provides connectivity tests on the forwarding targets. In the service debugging phase, you can simulate service data to test the availability of rule actions and the consistency of forwarded data. If a fault occurs in data forwarding during service running, you can perform connectivity tests to reproduce and locate the fault.

Procedure

1. After creating a forwarding rule, click **Test** in row of the forwarding target to be debugged.

Figure 7-3 Forwarding target - Test



7.5 Data Forwarding to Huawei Cloud Services

7.5.1 Forwarding Data to DIS

Scenarios

Forwarding data to Data Ingestion Service (DIS) allows you to collect, process, and distribute real-time streaming data efficiently. DIS interconnects with multiple third-party data collection tools and provides cloud service connectors, agents, and SDKs. You can also dump data to other cloud services for subsequent data processing like data storage and analysis.

Purchasing a DIS Stream (Example: Forwarding Data to DIS and Dumping Data to OBS)

- Step 1** Log in to Huawei Cloud and access the [Object Storage Service \(OBS\)](#) console.
- Step 2** Click **Create Bucket**, configure the parameters as required, and click **Create Now**.
- Step 3** In the bucket list, click the created bucket. The **Objects** page is displayed. Click **Create Folder** and enter a folder name as prompted.
- Step 4** Log in to Huawei Cloud and access [Data Ingestion Service \(DIS\)](#).
- Step 5** Click **Access Console** to go to the DIS console.
- Step 6** Click **Buy Stream** in the upper right corner, configure parameters as required, and click **Next**.

Figure 7-5 Buying a DIS stream

The screenshot shows the 'Buy Stream' configuration page in the Huawei Cloud console. The page is titled 'Buy Stream' and has a dark header with navigation links: Console, Beijing4, Billing & Costs, Resources, Enterprise, Developer Tools, ICP License, Support, Service Tickets, and English. The main content area is white and contains several configuration sections:

- Billing Mode:** Set to 'Pay-per-use'.
- Region:** Set to 'CN North-Beijing4'. A note below states: 'Regions are geographic areas isolated from each other. Resources are region-specific and cannot be used across regions through internal network connections. For low network latency and quick resource access, select the nearest region.'
- Stream Name:** Set to 'dis-2sjp'. A note below states: 'The system automatically populates an editable stream name that contains the prefix "dis" followed by four alphanumeric characters.'
- Stream Type:** Set to 'Common'. There is an 'Advanced' option with a help icon.
- Partitions:** Set to '1'. There is a 'Partition Calculator' link and a note: 'You can use a maximum of 45 partitions. Learn how to increase quota.' Below this, it says 'Selected: Common DIS stream | 1 partition | maximum stream capacity: 1 MB/s (write); 2 MB/s (read)'. There are minus and plus buttons to adjust the number of partitions.
- Data Retention (hours):** Set to '24'. There are minus and plus buttons to adjust the retention time.
- Source Data Type:** Set to 'BLOB'. There are 'JSON' and 'CSV' options with a help icon.
- Auto Scaling:** A toggle switch is currently turned off.
- Enterprise Project:** Set to 'default'.

At the bottom of the page, the 'Partition Price' is shown as '¥0.10/hour'. A red 'Next' button is located in the bottom right corner.

Step 7 In the navigation pane, choose **Stream Management** and click a purchased stream. Click the **Dump Tasks** tab. Click **Create Dump Task**. Set **Dump Destination** to **OBS**, **Dump Bucket** to the bucket created in step 2, and **File Directory** to the folder created in step 3. Click **Create Now**.

Figure 7-6 Selecting a stream

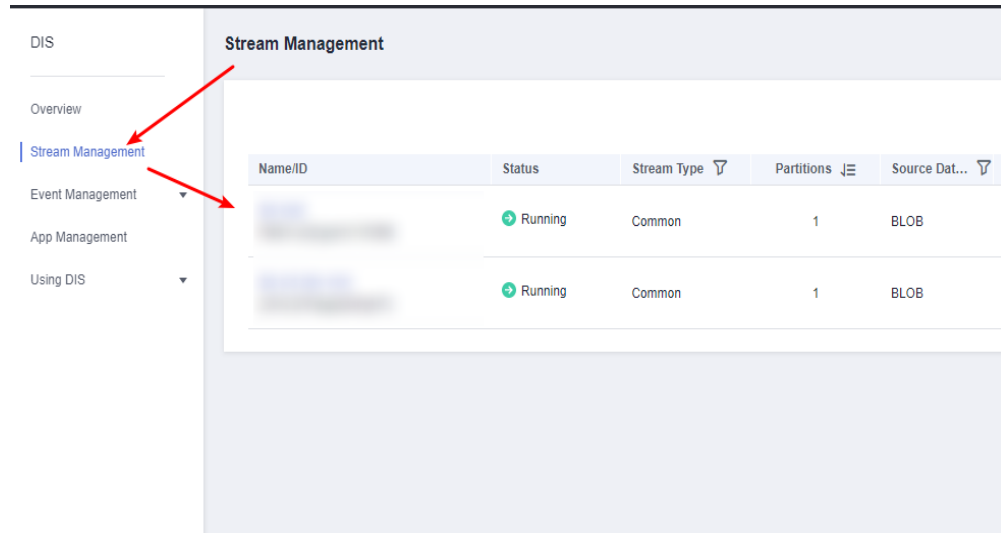


Figure 7-7 Accessing the dump task tab

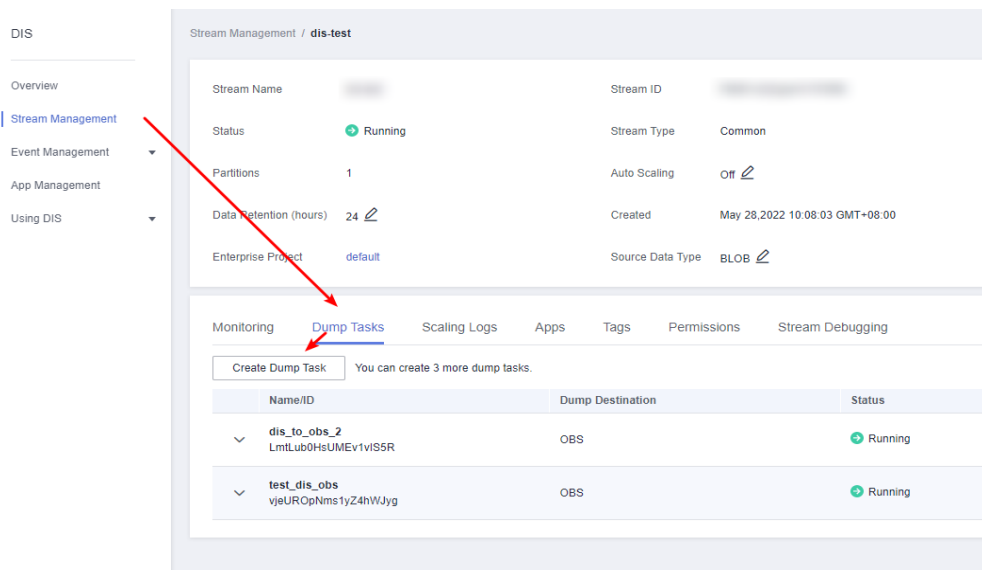


Figure 7-8 Configuring a dump task

The screenshot shows the 'Create Dump Task' configuration interface. At the top, there is a title 'Create Dump Task' and a link '< Back to Dump Task List'. Below this, the configuration is organized into several sections:

- Source Data Type:** Set to 'BLOB'.
- Dump Destination:** A set of tabs with 'OBS' selected, and other options 'MRS', 'DLI', 'DWS', and 'CloudTable'.
- Task Name:** A text input field containing 'task_obs'.
- Dump File Format:** A dropdown menu with 'Text' selected.
- Dump Bucket:** A text input field followed by a 'Select' button.
- File Directory:** A text input field.
- Time Directory Format:** A dropdown menu with 'N/A' selected.
- Record Delimiter:** A dropdown menu with 'Line break (\n)' selected.
- Offset:** A dropdown menu with 'Latest' selected.
- Dump Interval (s):** A numeric input field with a value of '300' and minus/plus buttons.

----End

Configuring IoTDA

You can configure data forwarding rules in IoTDA to forward data reported by devices to DIS.

- Step 1** Go to the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Rules > Data Forwarding**, and click **Create Rule** in the upper left corner.
- Step 3** Configure the parameters based on the following table. The following parameter values are only examples. You can configure the parameters by referring to [Data Forwarding Overview](#) and click **Create Rule**.

Table 7-6 Rule parameters

| Parameter | Description |
|----------------|--|
| Rule Name | Customize a name, for example, iotda-dis . |
| Description | Enter a rule description, for example, forwarding data to DIS . |
| Data Source | Select Device property . |
| Trigger | Device property reported is automatically configured. |
| Resource Space | Select All resource spaces . |

Step 4 Click the **Set Forwarding Target** tab, click **Add** to set a forwarding target, and click **OK**.

Table 7-7 Forwarding target parameters

| Parameter | Description |
|-------------------|--|
| Forwarding Target | Choose Data Ingestion Service (DIS) . |
| Region | Currently, you can only forward data to DIS in the same region. If IoTDA is not authorized to access the service in this region, configure cloud service access authorization as prompted. |
| Stream Homing | Select either of the in-house stream or the stream Delegated by others . |
| Stream | Select a stream. |

Figure 7-9 Creating a forwarding target - to DIS

Add Forwarding Target

★ Forwarding Target

DIS provides efficient collection, transmission, and distribution of real-time data. It also provides an abundant selection of APIs to help you quickly create real-time data applications.

Region

Stream Homing In-house stream Delegated by others

Stream

No streams available? Go to the DIS console to [Create Stream](#)

Step 5 Click **Enable Rule** to activate the configured data forwarding rule.

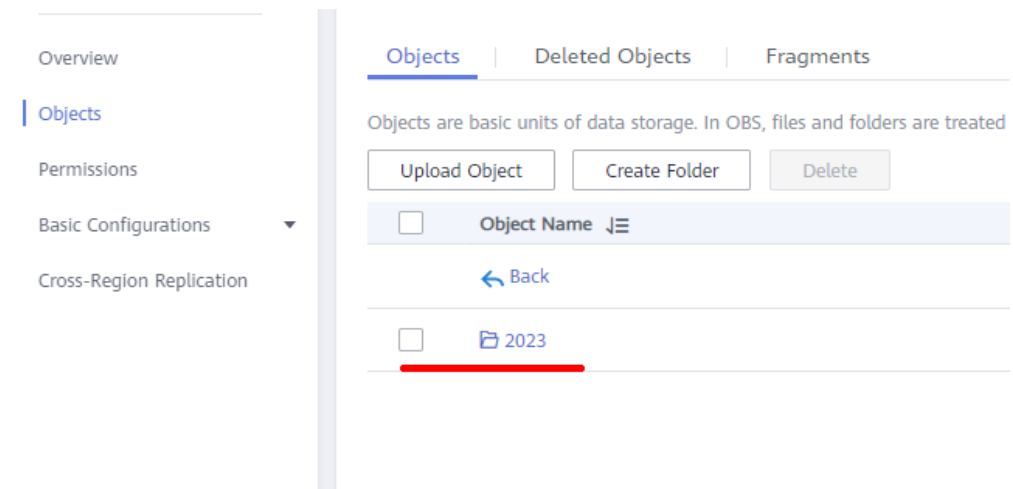
----End

Verifying Configurations

- You can use a registered physical device to access the platform and enable the device to report data.
- You can also use a simulator to simulate a device to report data. For details, see [Developing an MQTT-based Smart Street Light Online](#).

Expected result:

Log in to the OBS console, click the bucket created in **2**, and click the folder created in **3** to view the latest data forwarded from DIS to OBS.

Figure 7-10 Viewing OBS data

7.5.2 Forwarding Data to GeminiDB Influx

Scenarios

Forward data to GeminiDB Influx and cloud-native time series database with full compatibility with the service. GeminiDB Influx reads and writes time series data with high performance and compression ratio in high concurrency scenarios, provides cold and hot tiered storage, elastic scale-out, and monitoring and alarm reporting. It stores the data with compression algorithms, allows you to query data using SQL-like statements, and supports multi-dimensional aggregation computing and visual analysis. It is widely used to monitor resources, services, IoT devices, and industrial production processes, evaluate production quality, and trace faults. GeminiDB Influx can achieve very high throughput and concurrency, so it can handle a large number of connections in a very short period of time, making it an excellent choice for IoT applications.

Buying GeminiDB Influx Instances

- Step 1** Log in to [GeminiDB Influx](#) and click **Buy Now**.
- Step 2** Select either of the **Pay-per-use** or **Yearly/Monthly** as the **Billing Mode**, configure specifications and storage space as required, and set **Compatible API to InfluxDB**. For details, see [Buying a Cluster Instance](#).

Figure 7-11 Buying an InfluxDB Instance

Buy DB Instance

Billing Mode: Yearly/Monthly Pay-per-use

Region:

Regions are geographic areas isolated from each other. Resources are region-specific and cannot be used across regions through internal network connections. For low network latency and q

DB Instance Name:

Compatible API: Cassandra MongoDB InfluxDB Redis

DB Instance Type: Cluster

DB Engine Version: 1.7

AZ: cn-north-4a,cn-north-4b,cn-north-4c cn-north-4a

Three-AZ deployment is recommended to provide cross-AZ DR and ensure RPO is 0.

| Flavor Name | vCPU Memory |
|--|------------------|
| <input checked="" type="radio"/> geminidb.influxdb.large.4 | 2 vCPUs 8 GB |
| <input type="radio"/> geminidb.influxdb.xlarge.4 | 4 vCPUs 16 GB |
| <input type="radio"/> geminidb.influxdb.2xlarge.4 | 8 vCPUs 32 GB |
| <input type="radio"/> geminidb.influxdb.4xlarge.4 | 16 vCPUs 64 GB |

Step 3 Download the InfluxDB client and connect to an instance through the client by referring to [Connecting to an Instance over a Public Network](#).

Step 4 After connecting to the instance through the client, run the following command to create a database. `#{databaseName}` can be customized.

```
create database #{databaseName}
```

Figure 7-12 Creating a database

```
>
>
> create database test_influxdb
>
> show databases
name: databases
name
----
_internal
test_influxdb
>
>
>
```

----End

Configuring IoTDA

You can configure data forwarding rules in IoTDA to forward data reported by devices to InfluxDB.

Step 1 Go to the [IoTDA](#) service page and click **Access Console**.

Step 2 In the navigation pane, choose **Rules > Data Forwarding**, and click **Create Rule** in the upper left corner.

- Step 3** Set the parameters based on the table below. The following parameter values are only examples. You can create a rule by referring to [Data Forwarding Overview](#) and click **Create Rule**.

Table 7-8 Rule parameters

| Parameter | Description |
|----------------|---|
| Rule Name | Customize a name, for example, iotda-InfluxDB . |
| Description | Enter a rule description, for example, forwarding data to InfluxDB . |
| Data Source | Select Device . |
| Trigger | Device added is automatically configured. |
| Resource Space | Select All resource spaces . |

- Step 4** Click the **Set Forwarding Target** tab, click **Add** to set a forwarding target, and click **Next**.

Table 7-9 Forwarding target parameters

| Parameter | Description |
|---------------------------|---|
| Forwarding Target | Select GeminiDB Influx . |
| Database Instance Address | Enter the connection address of the Influx instance you purchased. IoTDA enterprise edition instances support private network access of Influx instances in the same VPC and subnet. |
| Database Name | Enter the name of the database created in InfluxDB. |
| Access Account | Enter the InfluxDB account name. |
| Access Password | Password of the InfluxDB. |
| Certificate ID | Truststore certificate, which is used by the client to verify the server certificate. If this parameter is left blank, the default certificate provided by GeminiDB Influx is used. For GeminiDB Influx instances using private certificates , upload a custom CA on the Rules > Server Certificates page and complete binding. |

- Step 5** Set the target fields and click **OK** to complete configuration.

Table 7-10 Field mapping parameters

| Parameter | Description |
|-----------|--|
| Save To | Enter the table name, which is user-defined. |

| Parameter | Description |
|----------------|---|
| Field Mappings | Configure the field mappings. You can customize the target field and configure the forwarding field by referring to Push a Device Addition Notification . |

Figure 7-13 Creating a forwarding target - to InfluxDB

Add Forwarding Target ✕

★ Forwarding Target

GeminiDB Influx API is a cloud-native NoSQL time-series database with decoupled compute and storage and full compatibility with InfluxDB. It is suitable for processing and analyzing time series data such as resource monitoring data.

★ Database Instance Address Enter the connected service address. (format: IP:port or domain name:port)

★ Database Name

★ Access Account

★ Access Password

Figure 7-14 Setting InfluxDB field mapping

Add Forwarding Target ✕

Forwarding Target

Database Name

Save To

Field Mappings Add data field mappings.

| Forwarding Field | Operation | Target Field | Operation |
|--|------------------------|--|------------------------|
| <input type="text" value="request_id"/> Quick Select | Delete | <input type="text" value="requestid"/> | Delete |
| <input type="text" value="notify_data_header.app_i"/> Quick Select | Delete | <input type="text" value="appid"/> | Delete |
| <input type="text" value="notify_data"/> Quick Select | Delete | <input type="text" value="content"/> | Delete |
| <input type="text" value="event_time"/> Quick Select | Delete | <input type="text" value="eventTime"/> | Delete |

Step 6 Click **Enable Rule** to activate the configured data forwarding rule.

----End

Verifying Configurations

Log in to the IoTDA console and create a device.

Expected result:

Log in to InfluxDB through the client. Access the database and query data.

```
show databases //Query the database.
use test_influxdb //Switch the database.
select * from demo //Query data.
```

Figure 7-15 Test message

```
>
> use test_influxdb
Using database test_influxdb
>
>
> select * from test_influxdb
name: test_influxdb
time                content
-----
eventTime          requestId
.....
2023-06-08T02:50:27.916Z [{"body":{"app_id":"","app_name":"","device_id":"","node_id":"","gateway_id":"","mode_type":"GATEWAY","auth_info":{"auth_type":"SECRET","secure_access":false,"timeout":0},"product_id":"","product_name":"test_test","status":"INACTIVE","create_time":"20230608T025027Z"},"20230608T025027Z.68872c94-4054-4e09-a97f-3481562afbe2"}]
```

7.5.3 Forwarding Data to DMS for Kafka for Storage

Scenarios

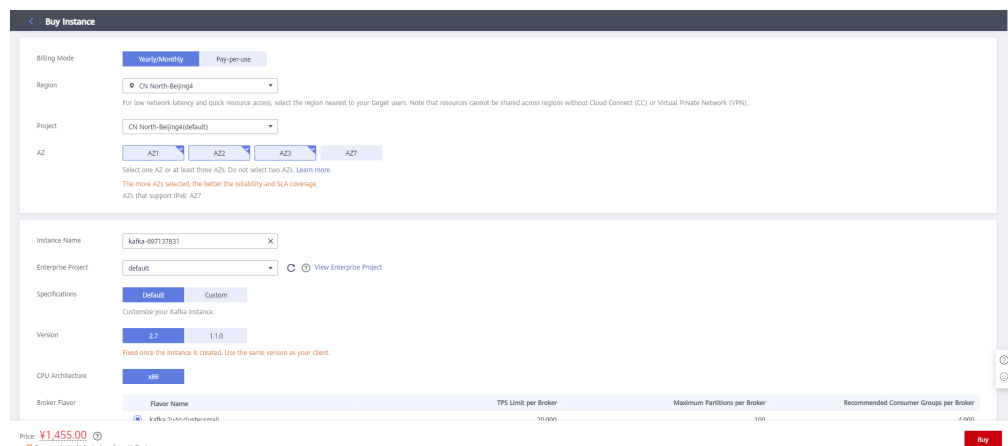
If you want to store data reported by devices, you can either forward the data to application servers or to Distributed Message Service (DMS) for Kafka for storage.

In this example, data reported by all devices is forwarded to DMS for Kafka.

Buying a Kafka Instance

1. Log in to Huawei Cloud and visit [DMS for Kafka](#).
2. Click **Access Console** to go to the DMS for Kafka console.
3. Click **Buy Instance** in the upper right corner, select instance specifications and **configure a security group** as required, and click **Buy**.

Figure 7-16 Buying a Kafka Instance



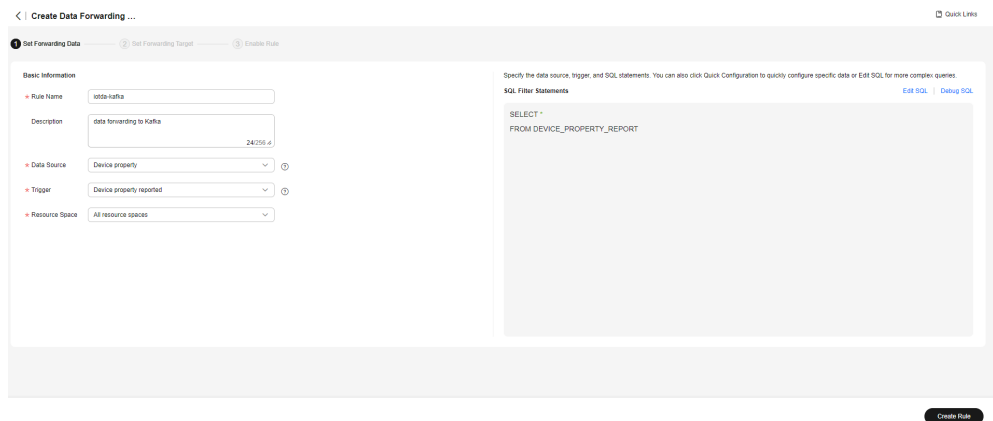
Configuring IoTDA

Using IoTDA, you can create a product model, register a device, and set a data forwarding rule to forward data reported by the device to DMS for Kafka.

1. Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
2. In the navigation pane, choose **Rules > Data Forwarding**, and click **Create Rule** in the upper left corner.
3. Set the parameters based on the table below. The following parameter values are only examples. You can create a rule by referring to **Data Forwarding Overview** and click **Create Rule**.

| Parameter | Description |
|----------------|--|
| Rule Name | Customize a name, for example, iotda-kafka . |
| Description | Customize a rule description, for example, forwarding data to DMS for Kafka for storage . |
| Data Source | Select Device property . |
| Trigger | Device property reported is automatically populated. |
| Resource Space | Select All resource spaces . |

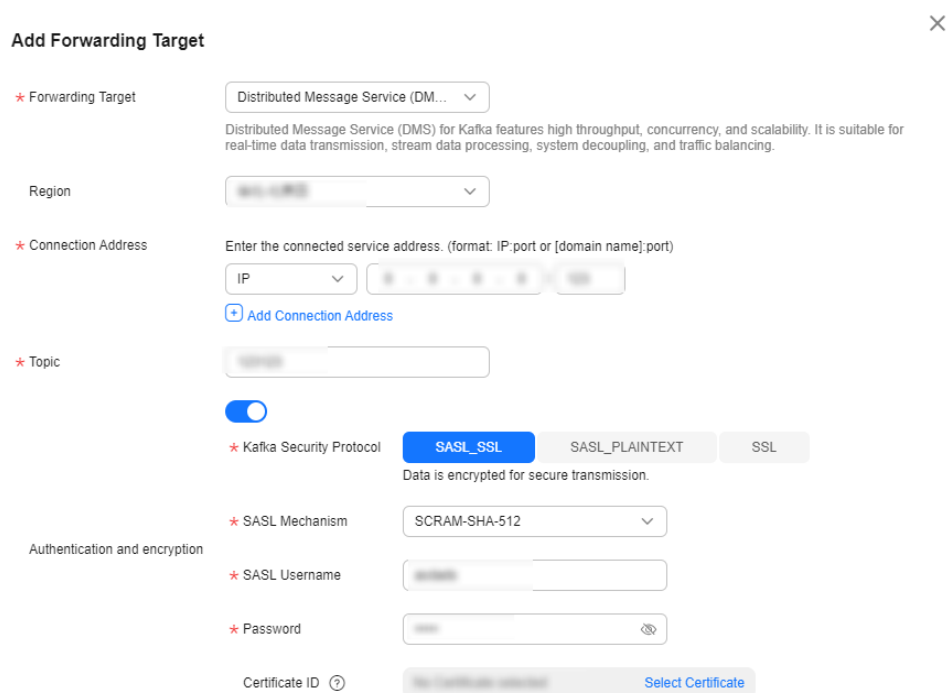
Figure 7-17 Rules triggered by property reporting - Forwarding data to Kafka



4. Click the **Set Forwarding Target** tab, and then click **Add** to set a forwarding target.

| Parameter | Description |
|-------------------|--|
| Forwarding Target | Select Distributed Message Service (DMS) for Kafka . |
| Region | Select the region where DMS for Kafka is located. If IoTDA is not authorized to access the service in this region, configure cloud service access authorization as prompted. |

| Parameter | Description |
|-------------------------|--|
| Connection Address | Obtain the connection address by following the instructions provided in Accessing a Kafka Instance with SASL . Basic and standard instances support only access to Kafka premium instances over the Internet. Enterprise instances support access to Kafka premium instances over a private network. |
| Topic | Customize a topic. For details, see Creating a Topic . |
| SASL | If SASL authentication is enabled, enter the security protocol, SASL authentication mechanism, and SASL username and password you used when you buy a Kafka instance . |
| Kafka Security Protocol | Select the Kafka security protocol you used when you buy a Kafka instance . |
| SASL Mechanism | Select the SASL authentication mechanism you enabled when you buy a Kafka instance . |
| SASL Username | Enter the SASL username you entered when buying a Kafka instance . |
| Password | Enter the password you entered when buying a Kafka instance . |

Figure 7-18 Creating a forwarding target - to Kafka with a custom certificate

Add Forwarding Target ✕

* Forwarding Target: Distributed Message Service (DM...)

Distributed Message Service (DMS) for Kafka features high throughput, concurrency, and scalability. It is suitable for real-time data transmission, stream data processing, system decoupling, and traffic balancing.

Region: [Region]

* Connection Address: Enter the connected service address. (format: IP:port or [domain name]:port)

IP: [IP] [Port]

+ Add Connection Address

* Topic: [Topic]

Authentication and encryption

* Kafka Security Protocol: **SASL_SSL** SASL_PLAINTEXT SSL
Data is encrypted for secure transmission.

* SASL Mechanism: SCRAM-SHA-512

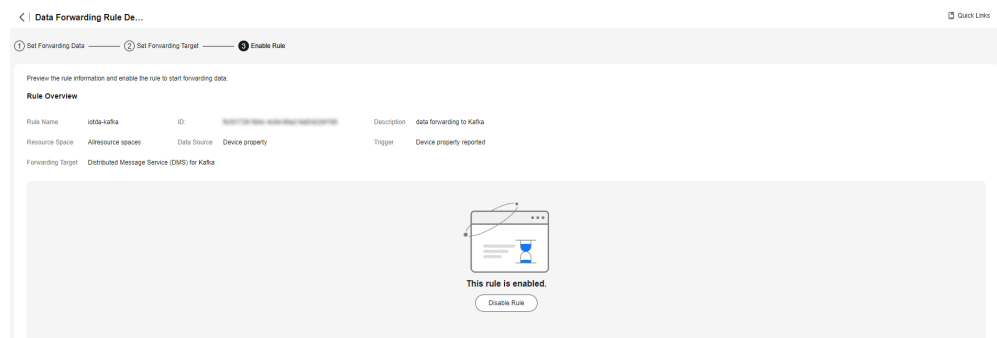
* SASL Username: [Username]

* Password: [Password]

Certificate ID: [Certificate ID] [Select Certificate](#)

5. Click **Enable Rule** to activate the configured data forwarding rule.

Figure 7-19 Enabling a rule - Forwarding data to Kafka



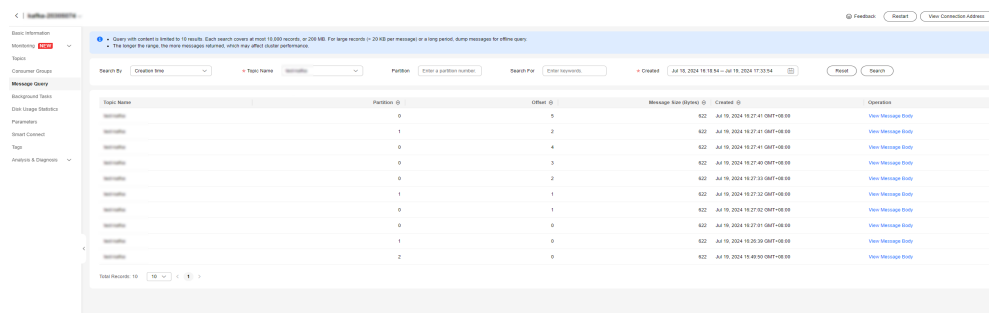
Verifying the Configurations

- You can use a registered physical device to access the platform and enable the device to report data.
- You can also use a simulator to simulate a device to report data. For details, see [Developing an MQTT-based Smart Street Light Online](#).

Expected result:

Log in to the DMS for Kafka [management console](#) and click the Kafka instance name to go to the instance management page. On the **Message Query** page, you can view the data reported by the device.

Figure 7-20 Viewing Kafka messages - Kafka



You can also use the DMS for Kafka API [Querying Messages](#) to read files.

7.5.4 Forwarding Data to FunctionGraph

Scenarios

FunctionGraph processes the real-time stream data reported by devices to IoTDA. With FunctionGraph, you only need to upload your code and set running conditions to track device properties, message reporting, and status changes as well as analyze, sort out, and measure data flows.

In this example, all properties reported by devices are forwarded to FunctionGraph. The properties are pushed to different paths on your HTTP server based on the resource space ID. You need to deploy an HTTP server. In this example, the data forwarding capability of IoTDA triggers the event function. No additional trigger is required.

Building a Function Project

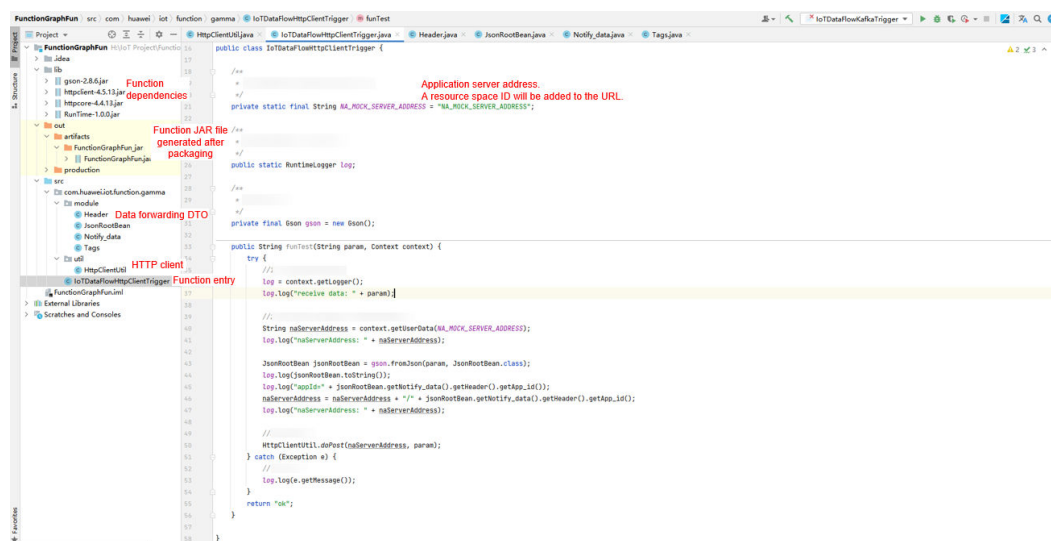
You can download and use the source code (including function dependencies) for converting the format of reported device properties and forwarding the data to a third-party application.

Creating a project

This example uses the Java language to implement device connection, data stream conversion, and data push. For details about function development, see [Developing Functions in Java](#).

[Download the sample source code](#), decompress it, and import it to IDEA. For details about the code, see [Sample code](#). Transfer your server address through the function environment variable `NA_MOCK_SERVER_ADDRESS`.

Figure 7-21 Sample code



Packaging the project

Package the project into a JAR file using **Build Artifacts** of IDEA. The following figure shows the IDEA configuration and packaging.

Figure 7-22 Artifacts Output configuration

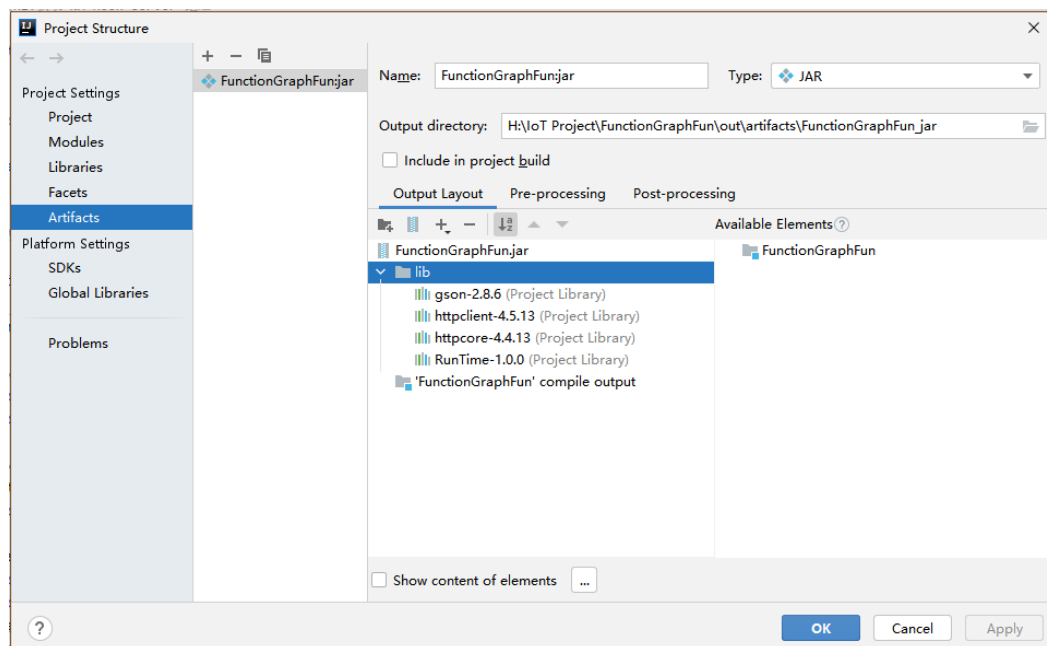
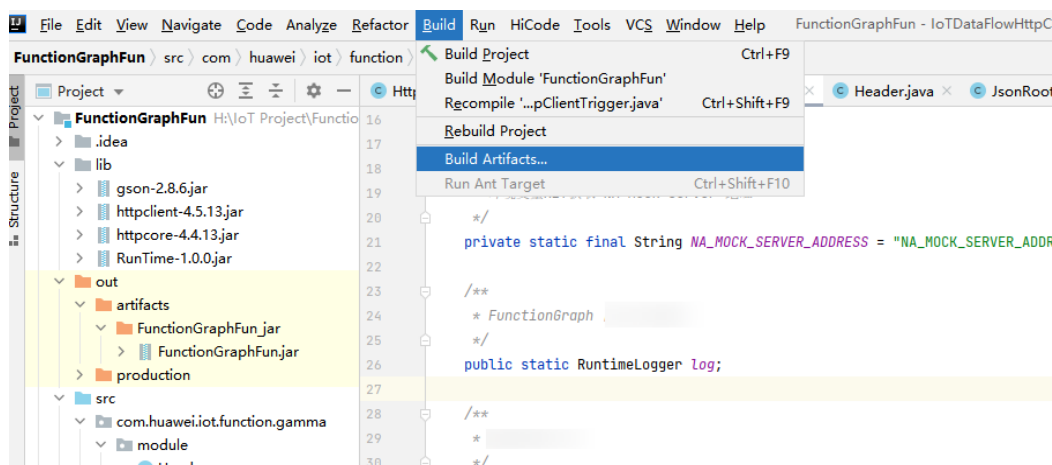


Figure 7-23 Build Artifacts



Uploading the Function to FunctionGraph

Create a function on the FunctionGraph console.

Step 1 Log in to the [FunctionGraph console](#), and choose **Functions > Function List** in the navigation pane.

Step 2 Click **Create Function**.

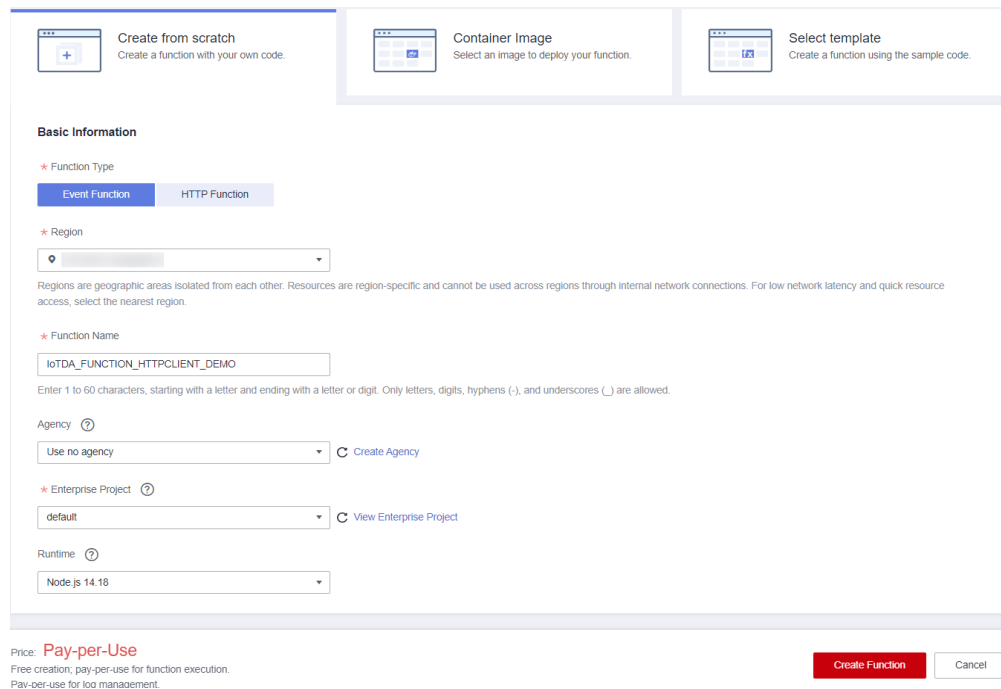
Step 3 Configure the function information, as shown in the following figure.

Click **Create from scratch**.

Enter **IoTDA_FUNCTION_HTTPCLIENT_DEMO** in **Function Name**.

Select **Java 8** for **Runtime**.

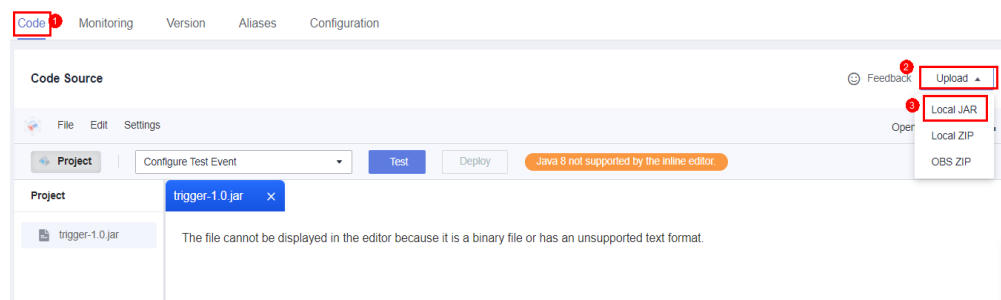
Figure 7-24 Creating a function



Step 4 Click **Create Function**. After the function is created, the function details page is displayed.

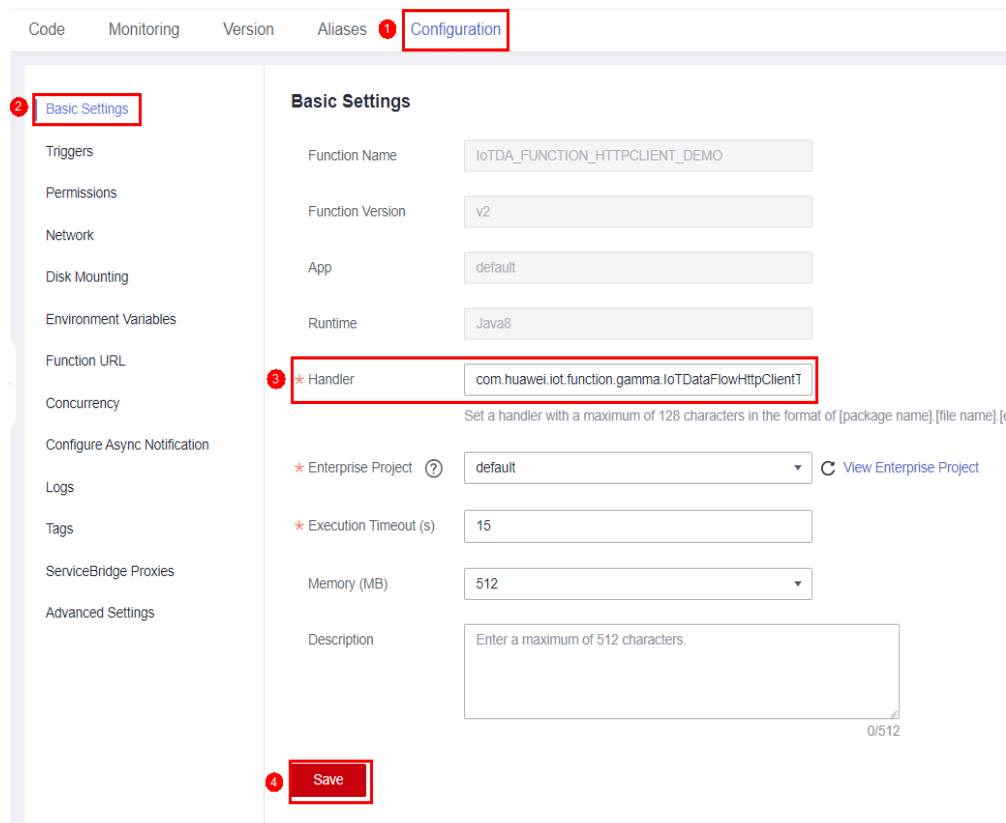
Step 5 Click the **Code** tab and click **Upload** > **Local JAR** to upload the code package **FunctionGraphFun.jar**.

Figure 7-25 Uploading the code



Step 6 Modify the function runtime parameters. Click the **Configuration** tab, choose **Basic Settings**, and set **Handler** to **com.huawei.iot.function.gamma.IoTDataFlowHttpClientTrigger.funTest**. Click **Save** to save the configuration.

Figure 7-26 Setting the handler

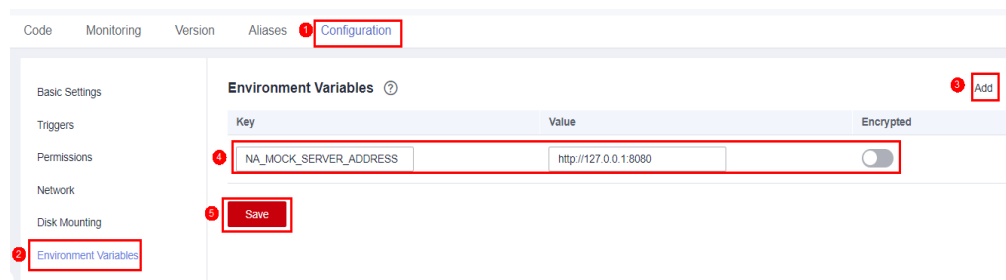


NOTICE

The default function memory size is 512 MB, and the default timeout interval is 15s. This example is only for demonstration. For commercial use, optimize the function parameters based on the site requirements.

Step 7 Modify the environment variables transferred during function calling. Set the environment variable **NA MOCK SERVER ADDRESS** to the target HTTP server address. Note that the server address in the example is not a real one. Replace it with your actual HTTP server address. Click **Save** to save the configuration.

Figure 7-27 Configuring environment variables for function calling



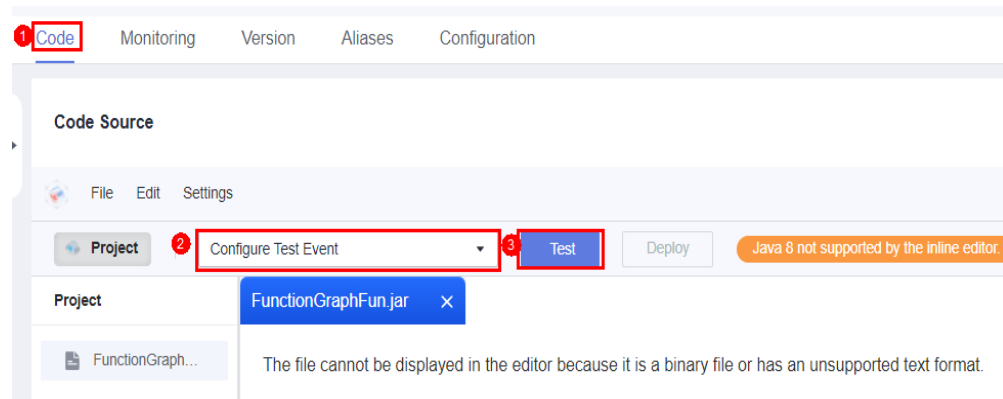
----End

Adding an Event Source

After creating the function, you can add an event source. In this example, an HTTP push test event is configured to simulate device data forwarded by IoTDA. The procedure is as follows:

- Step 1** On the `IoTDA_FUNCTION_HTTPCLIENT_DEMO` function page, click the **Code** tab and select **Configure Test Event**.

Figure 7-28 Configuring a test event



- Step 2** In the **Configure Test Event** dialog box, enter the test event information.

Select **Create new test event**.

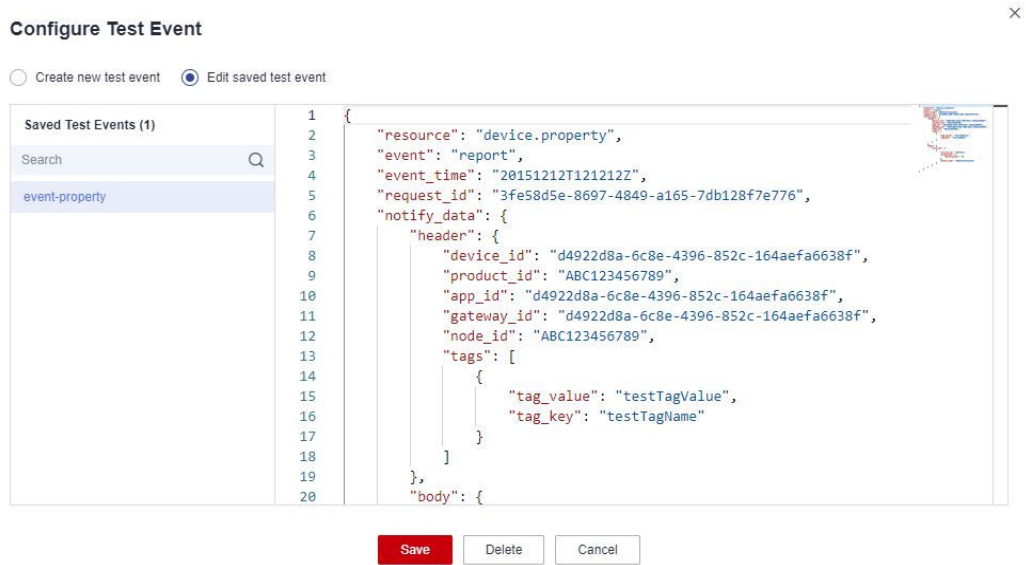
Event Templates: Select **blank-template**.

Event Name: Enter **event-property**.

The following is an example of the test parameters for reporting device properties:

```
{
  "resource":"device.property",
  "event":"report",
  "event_time":"string",
  "notify_data":{
    "header":{
      "app_id":"*****",
      "device_id":"*****",
      "node_id":"ABC123456789",
      "product_id":"ABC123456789",
      "gateway_id":"*****",
      "tags":[{
        "tag_key":"testTagName",
        "tag_value":"testTagValue"
      }]
    },
    "body":{
      "services":[{
        "service_id":"string",
        "properties":{
        },
        "event_time":"string"
      }]
    }
  }
}
```

Figure 7-29 Configuring a test event



Step 3 Click **Save**.

----End

Testing Data

Perform the following steps to process the simulated data:

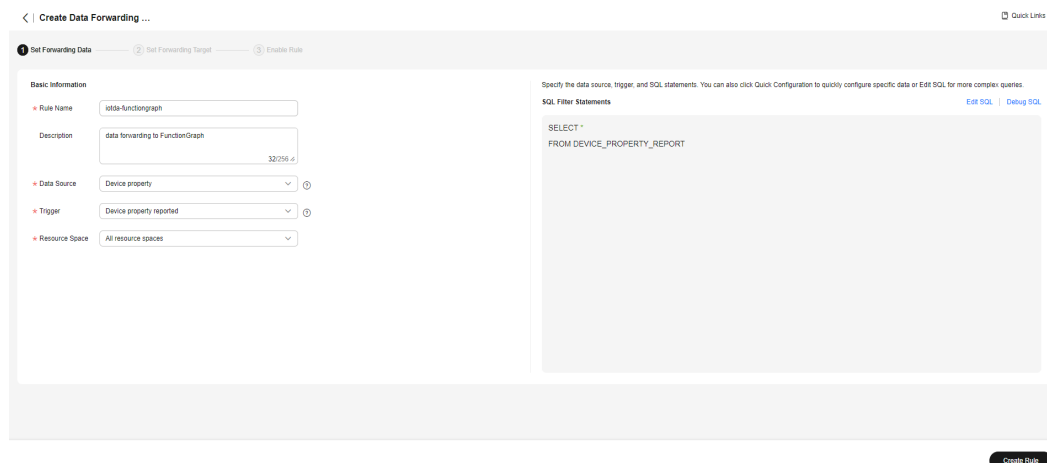
Step 1 On the function details page, select test event **event-property**, and click **Test** to test the function.

Figure 7-30 Configuring a test event



Step 2 After the function is executed, view the function execution status in the log on the right of the function details page.

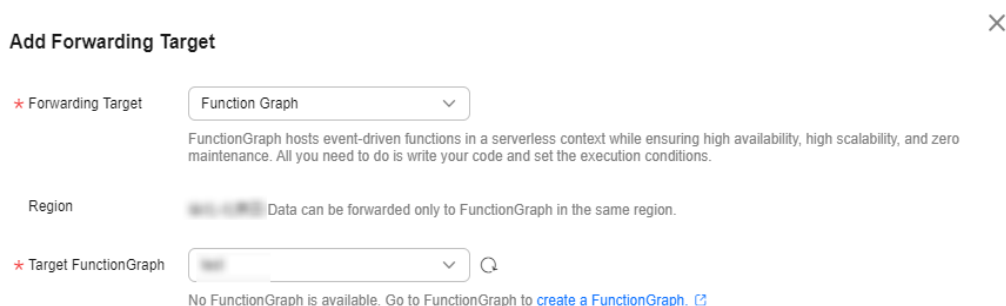
Figure 7-32 Rules triggered by property reporting - Forwarding data to FunctionGraph



Step 4 Click the **Set Forwarding Target** tab, click **Add** to set a forwarding target, and click **OK**.

| Parameter | Description |
|-------------------|--|
| Forwarding Target | Select FunctionGraph . |
| Region | Currently, you can only forward data to FunctionGraph in the same region. If IoTDA is not authorized to access the service in this region, configure cloud service access authorization as prompted. |
| Target Function | Select the function created in FunctionGraph. |

Figure 7-33 Creating a forwarding target - to FunctionGraph



Step 5 Click **Enable Rule** to activate the configured data forwarding rule.

----End

Verifying the Configurations

- You can connect a physical device registered with IoTDA to the platform and report properties defined in the product model.
- You can also use a simulator to simulate device properties reporting. For details, see [Developing an MQTT-based Smart Street Light Online](#).

Figure 7-35 Example of creating a database table

```
CREATE TABLE `notify_all` (
  `id` int(11) unsigned NOT NULL AUTO_INCREMENT,
  `resource` varchar(32) DEFAULT NULL,
  `event` varchar(32) DEFAULT NULL,
  `content` json DEFAULT NULL,
  `event_time` char(16) DEFAULT NULL,
  `receive_time` timestamp NULL DEFAULT CURRENT_TIMESTAMP,
  PRIMARY KEY (`id`)
) ENGINE=InnoDB AUTO_INCREMENT=7 DEFAULT CHARSET=utf8mb4;
```

----End

Configuring IoTDA

Using IoTDA, you can create a product model, register a device, and set a data forwarding rule to forward data reported by the device to MySQL.

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Products**. Click **Create Product** and select the resource space to which the new product will belong.

 **NOTE**

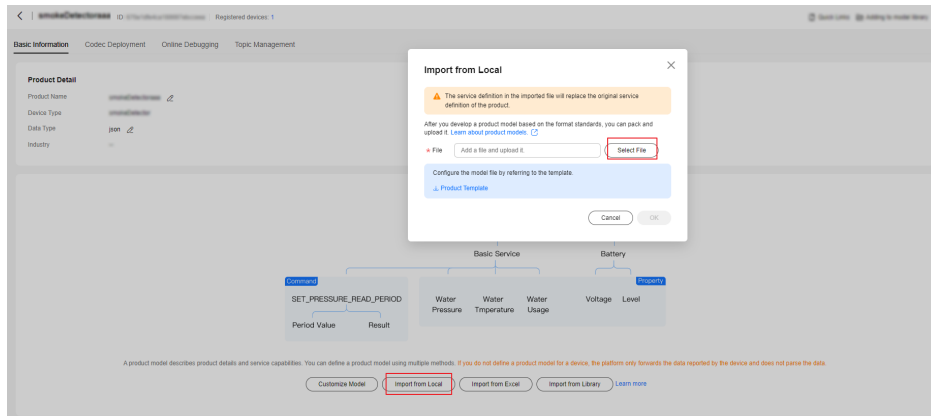
The product model and device used in this topic are only examples. You can use your own product model and device.

- Step 3** Click **Create Product** to create a product using MQTT. Set the parameters and click **OK**.

| Basic Information | |
|-------------------|--|
| Product Name | Enter a value, for example, MQTT_Device . |
| Protocol Type | Select MQTT . |
| Data Type | Select JSON . |
| Industry | Set the parameters as required. |
| Device Type | |

- Step 4** Click [here](#) to download a sample product model.
- Step 5** On the **Basic Information** tab page, click **Import from Local**. In the displayed dialog box, load the local product model and click **OK**.

Figure 7-36 Product - Uploading a product model



Step 6 In the navigation pane, choose **Devices > All Devices**. Click **Register Device**, set device registration parameters, and click **OK**. Save the device ID and secret returned after the registration.

Figure 7-37 Device - Registering a secret device

The 'Register Device' form contains the following fields and options:

- Resource Space**: Dropdown menu.
- Product**: Dropdown menu.
- Node ID**: Text input field.
- Device ID**: Text input field.
- Device Name**: Text input field.
- Description**: Text area with a character count of 0/2,048.
- Authentication Type**: Radio buttons for 'Secret' (selected) and 'X.509 certificate'.
- Secret**: Text input field with a visibility toggle.
- Confirm Secret**: Text input field with a visibility toggle.

Buttons: 'Cancel' and 'OK'.

| Parameter | Description |
|----------------|--|
| Resource Space | Select the resource space (created in step 3) to which the product will belong. |

| Parameter | Description |
|---------------------|---|
| Product | Select the product created in step 3 . |
| Node ID | Set this parameter to the IMEI, MAC address, or serial number of the device. If the device is not a physical one, set this parameter to a custom character string that contains letters and digits. |
| Device Name | Customize the product name. |
| Device ID | Customize the value. You can leave it empty, then the platform will automatically generate a device ID. |
| Authentication Type | Select Secret . |
| Secret | Customize the secret used for device access. If the secret is left blank, the platform automatically generates one. |

Step 7 In the navigation pane, choose **Rules > Data Forwarding**, and click **Create Rule** in the upper left corner.

 **NOTE**

You can also add a MySQL database as the forwarding target on the details page of a created rule.

Step 8 Set the parameters based on the table below. The following parameter values are only examples. You can configure parameters of data forwarding rules by referring to [Data Forwarding](#). After configuring the parameters, click **Create Rule**.

| Parameter | Description |
|-----------------|--|
| Rule Name | Customize a name, for example, iotda-mysql . |
| Description | Enter a rule description, for example, forwarding data to MySQL for storage . |
| Data Source | Select Device property . |
| Trigger | Device property reported is automatically populated. |
| Resource Spaces | Select a resource space to which the data source to be forwarded belongs or all resource spaces. |

Step 9 Click the **Set Forwarding Target** tab, and then click **Add** to set a forwarding target.

| Parameter | Description |
|---------------------------|---|
| Forwarding Target | Select MySQL (RDS) . |
| Database Instance Address | Enter the IP address (or port number) for connecting the database instance. |

| Parameter | Description |
|-----------------|--|
| Database Name | Enter the name of the destination database in the database instance. |
| Access Account | Enter the account of the database instance. |
| Access Password | Enter the password of the database instance. |
| SSL | Select whether to connect to the database in SSL mode. You are advised to use SSL for connection. If not, security risks may exist during data transmission. To use the SSL mode, configure an SSL connection in the database instance first. |
| Certificate ID | Truststore certificate, which is used by the client to verify the server certificate. If this parameter is left blank, the default certificate provided by RDS for MySQL is used. For RDS for MySQL instances using custom certificates , upload the custom CA on the Rules > Server Certificates page and complete the binding. |

Step 10 Click **Next**. IoTDA will connect to the database during the process.

Step 11 Select the target table and configure the mapping between the data to forward and the database table.

- **Forwarding Field:** JSON key of the data to forwarded.
- **Target Field:** field in the database table. After a target field is selected, the field type is automatically matched.

Figure 7-38 Setting MySQL field mapping

✕

Add Forwarding Target

★ Forwarding Target MySQL is an open-source relational database management system and uses the popular database management language, SQL, to manage databases.

Forwarding Target MySQL (RDS)

Database Name

★ Save To

Field Mappings Add data field mappings.

| Forwarding Field | | Target Field | Field Type | Operation |
|--|------------------------------|---|------------|------------------------|
| <input type="text" value="resource"/> | Quick Select | <input type="text" value="resource"/> | VARCHAR | Delete |
| <input type="text" value="event"/> | Quick Select | <input type="text" value="event"/> | VARCHAR | Delete |
| <input type="text" value="notify_data"/> | Quick Select | <input type="text" value="content"/> | JSON | Delete |
| <input type="text" value="event_time"/> | Quick Select | <input type="text" value="event_time"/> | CHAR | Delete |

+ Add Field

Figure 7-40 Purchasing OBS

Replicate Existing Settings

Only the following bucket configurations can be replicated: region, data redundancy, storage class, bucket policy, default encryption, direct reading, enterprise project, and tags.

Region

Regions are geographic areas isolated from each other. Resources are region-specific and cannot be used across regions through internal network connections. For low network latency and quick resource access, select the nearest region. Once a bucket is created, the region cannot be changed.

Bucket Name

Cannot be the same as that of the current user's existing buckets. Cannot be the same as that of any other user's existing buckets. Cannot be edited after creation.

Data Redundancy Policy Multi-AZ storage Single-AZ storage

This setting can't be changed after the bucket is created. Multi-AZ storage is more expensive, but offers a higher availability. Pricing details

Data is stored in multiple AZs in the same region, improving availability.

Default Storage Class

Standard

High performance, reliability, and availability

Multi-AZ Single-AZ Image

Infrequent Access

High reliability, low cost, and few access

Multi-AZ Single-AZ Image

Archive

For data accessed once a year

Single-AZ

[Pricing](#)

If you do not specify a storage class during object upload, any objects you upload inherit this default storage class.

Bucket Policy Private Public Read Public Read and Write Replicate Bucket Policy

Only the bucket owner have full control over the bucket.

Default Encryption Enable Recommended **Encryption is recommended to keep data secure.**

Create Use

Bucket price: **Free** Billing: **Pay-per-use/Resource packages** [Pricing details](#)

----End

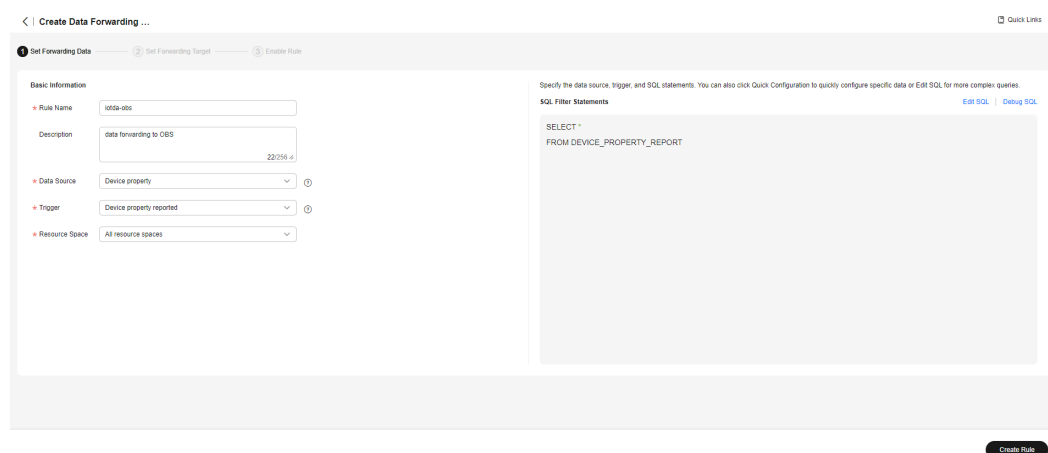
Configuring IoTDA

Using IoTDA, you can create a product model, register a device, and set a data forwarding rule to forward data reported by the device to OBS.

Creating a rule

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Rules > Data Forwarding**, and click **Create Rule** in the upper left corner.
- Step 3** Set the parameters based on the table below. The following parameter values are only examples. You can create a rule by referring to [Data Forwarding](#) and click **Create Rule**.

| Parameter | Description |
|-----------------|--|
| Rule Name | Customize a name, for example, iotda-obs . |
| Description | Enter a rule description, for example, forwarding data to OBS for storage . |
| Data Source | Select Device property . |
| Trigger | Device property reported is automatically populated. |
| Resource Spaces | Select All resource spaces . |

Figure 7-41 Rules triggered by property reporting - Forwarding data to OBS

Step 4 Click the **Set Forwarding Target** tab, and then click **Add** to set a forwarding target.

| Parameter | Description |
|-------------------|--|
| Forwarding Target | Select Object Storage Service (OBS) . |
| Region | Select the region where OBS is located. If IoTDA is not authorized to access the service in this region, configure cloud service access authorization as prompted. |
| OBS Bucket | Select the bucket where data is to be stored. If no OBS bucket is available, create one on the OBS console. |

Figure 7-42 Creating a forwarding target - to OBS in JSON

Edit Forwarding Target ✕

★ Forwarding Target Object Storage Service (OBS)

OBS is a stable, secure, cloud storage service that is scalable, efficient and easy-to-use. It allows you to store any amount of unstructured data in any format, and provides REST APIs so you can access your data from anywhere.

Region China North-1 (Beijing)

OBS Bucket iotda-obs-1234567890 🔍

No buckets available? Go to the OBS console to [Create Bucket](#)

Custom Directory ? device_property_{YYYY}/{MM}

File Name device_property_{YYYY}{MM}

File Type JSON CSV

Cancel OK

Step 5 Click **Enable Rule** to activate the configured data forwarding rule.

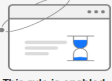
Figure 7-43 Enabling a rule - Forwarding data to OBS

1 Set Forwarding Data > 2 Set Forwarding Target > 3 **Enable Rule**

Preview the rule information and enable the rule to start forwarding data.

Rule Overview

| Rule Name | ID | Description | Resource Space | Data Source | Trigger | Forwarding Target |
|-----------|------------|------------------------|---------------------|-----------------|--------------------------|------------------------------|
| iotda-obs | [redacted] | data forwarding to Obs | All resource spaces | Device property | Device property reported | Object Storage Service (OBS) |


This rule is enabled.
Disable Rule

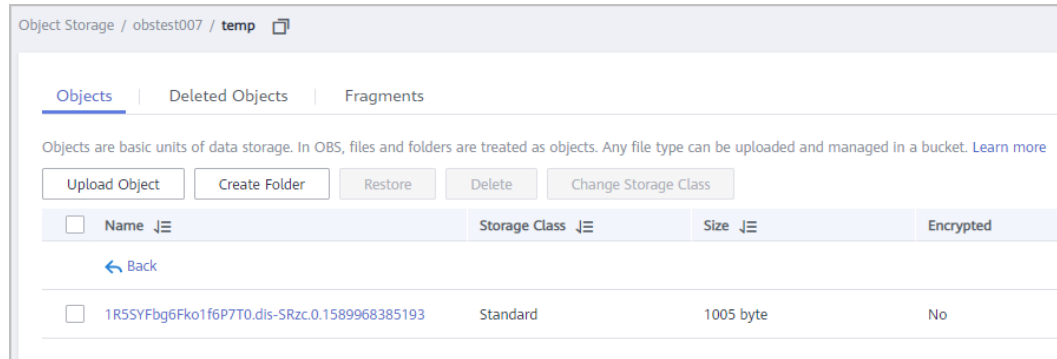
----End

Verifying the Configurations

- You can use a registered physical device to access the platform and enable the device to report data.
- You can also use a simulator to report data by simulating a device. For details, see [Developing an MQTT-based Smart Street Light Online](#).

Log in to the OBS [console](#), and click the bucket name. On the **Objects** page, you can view the data reported by the device.

Figure 7-44 Querying reported data in OBS



You can also use the OBS API [Downloading Objects](#) to read files.

7.6 Data Forwarding to Third-Party Applications

7.6.1 Forwarding Modes

A device can connect to and communicate with the platform. The device reports data to the platform using custom topics or product models. After the subscription/push configuration on the console is complete, the platform forwards messages about device lifecycle changes, reported device properties, reported device messages, device message status changes, device status changes, and batch task status changes to the application.

The platform supports four data forwarding modes: HTTP/HTTPS, AMQP, MQTT, and M2M communications.

- HTTP/HTTPS mode
 - Subscription: You can use an application to call the platform APIs to configure and activate rules, or create a subscription task on the console for obtaining changed device service and management details. Service details involve device lifecycle, device data reporting, device message status, and device status. Management details involve software/firmware upgrade status and result. Related APIs: [Create a Rule Triggering Condition](#), [Create a Rule Action](#), and [Modify a Rule Trigger Condition](#). The URL of the application, also called the callback URL, must be specified during subscription. For details, see [How Do I Obtain the Callback URL When Calling the Subscription API?](#) .
 - Push: After a subscription is successful, the platform pushes the corresponding change to a specified callback URL based on the type of data subscribed. (For details on the pushed content, see [Data Transfer APIs](#).) If an application does not subscribe to a specific type of data notification, the platform does not push the data to the application even if the data has changed. The platform pushes data, in JSON format, using

HTTP or HTTPS. HTTPS requires authentication and is more secure. Therefore, HTTPS is recommended.

For details, see [HTTP/HTTPS Data Forwarding](#).

- AMQP mode
 - Subscription: AMQP is short for Advanced Message Queuing Protocol. You can create a subscription task on the IoTDA console, or call platform APIs to configure and activate rules for obtaining changed device service and management details. Service details involve device lifecycle, device data reporting, device message status, and device status. Management details involve software/firmware upgrade status and result. Related APIs: [Create a Rule Triggering Condition](#), [Create a Rule Action](#), and [Modify a Rule Triggering Condition](#). The AMQP message channel must be specified during subscription creation.
 - Push: After a subscription is created, the platform pushes the corresponding change to the specified AMQP message queue based on the type of data subscribed. If an application does not subscribe to a specific type of data notification, the platform does not push the data to the application even if the data has changed. You can use the AMQP client to establish a connection with the platform to receive data.

For details, see [AMQP Data Forwarding](#).

- MQTT mode
 - Subscription: You can call platform APIs to configure and activate rules for obtaining the changed device service and management details. Service details involve device lifecycle, device data reporting, device message reporting, and device status. Management details involve software/firmware upgrade status and result. Related APIs: [Create a Rule Triggering Condition](#), [Create a rule action](#), and [Modify a Rule Triggering Condition](#). The topic for receiving push messages must be specified during subscription creation.
 - Push: After a subscription is created, the platform pushes the corresponding change to the specified topic based on the type of data subscribed. If an application does not subscribe to a specific type of data notification, the platform does not push the data to the application even if the data has changed. You can use the MQTT client to establish a connection with the platform to receive data.

For details, see [MQTT Data Forwarding](#).

- M2M communications
 - Subscription: You can create rules on the console or call the platform APIs to configure and activate rules for obtaining messages reported by devices from the platform. Related APIs: [Create a Rule Triggering Condition](#), [Create a Rule Action](#), and [Modify the Rule Triggering Condition](#). Device subscription supports only message reporting.
 - Push: After the subscription is successful, the platform pushes messages reported by devices to the specified MQTT topic. After devices are connected to the platform, you can subscribe to the topic to receive data for inter-device message communications.

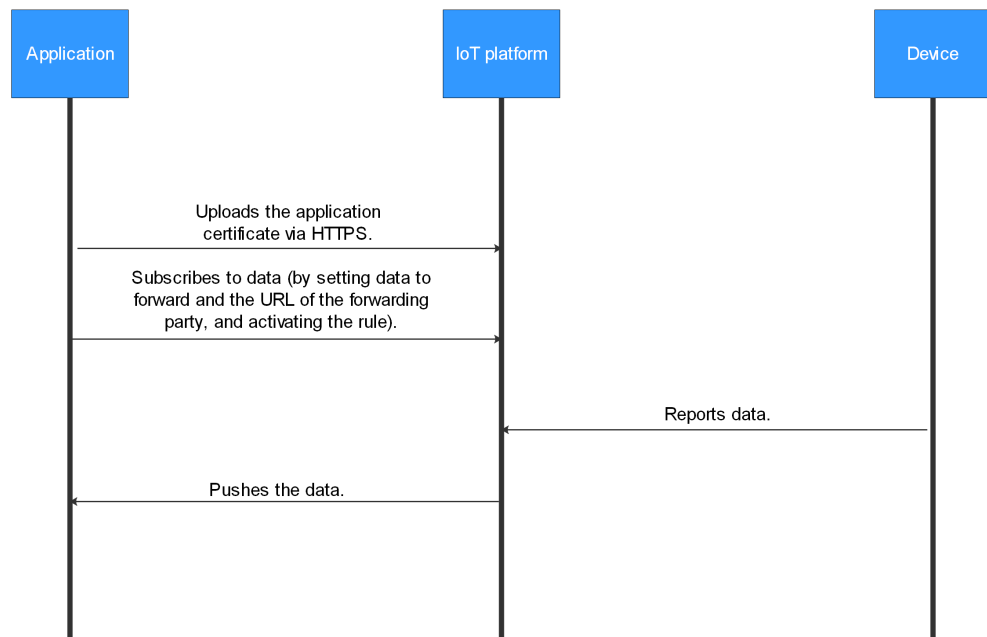
For details, see [M2M Communications](#).

| Data Forwarding Mode | Application Scenario | Advantage | Restrictions |
|------------------------------|---|---|--|
| HTTP/HTTPS subscription/push | An application functions as the server and passively receives messages from the platform. | - | The traffic control limit is 800 TPS per second. HTTP/HTTPS is not recommended for large-traffic push. |
| AMQP subscription/push | An application functions as the client and proactively pulls messages from the platform or passively receives messages from the platform by means of listening. | Data can be obtained proactively. | For details, see Connection Specifications . |
| MQTT subscription/push | An application functions as a client and can receive messages from IoT cloud services through subscription. | - | For details, see Constraints . |
| M2M communications | <ul style="list-style-type: none"> Smart home scenario where messages are exchanged between mobile apps and smart devices. Device linkage scenario where devices exchange data and communicate with each other. | Communications among devices are supported. | For details, see Overview . |

7.6.2 HTTP/HTTPS Data Forwarding

Overview

The figure below shows the subscription and push process.



Before pushing HTTPS messages to an application, the platform must verify the application authenticity. Therefore, the application CA certificate must be loaded to the platform. (You can [create a commissioning certificate](#) during commissioning and replace it with a commercial certificate during commercial use to avoid security risks.)

Push mechanism: After receiving a push message from the platform, the application returns a 200 OK message. If the application does not respond within 15 seconds or returns a non-200 response code (500, 501, 502, 503, or 504), the message push fails and the message will be discarded. If the platform fails to push the message for 10 times in a row, IoTDA adds the host address of the subscription URL to the blacklist and messages to push will be stacked on the platform for one day or until the stack size of data become 1 GB. To retain only the latest data, see [Data Forwarding Stack Policies](#). Then, the platform attempts to push messages to the host address in the blacklist every 3 minutes. If the push fails, the platform keeps the blacklist. If the push succeeds, the platform removes the host address from the blacklist. After the host address is removed from the blacklist, the latest messages are pushed only after all stacked messages are pushed based on the maximum flow control value. The default flow control value is 800 TPS per second. For details about the customized configuration, see [Data Forwarding Flow Control Policies](#).

Subscribing to Data

After connecting to IoTDA, an application calls an API to subscribe to data.

- For details on how to configure HTTP or HTTPS subscriptions on the console, see [Configuring HTTP/HTTPS Subscription](#) and [Loading the CA Certificate](#).
- For details on how to subscribe to data through APIs, see [Calling APIs](#), [Creating a Rule Trigger Condition](#), [Creating a Rule Action](#), and [Modifying a Rule Trigger Condition](#).

Format of Pushed Data

For details on the format of data pushed by the platform to applications after data subscription is created, see [Data Transfer APIs](#).

NOTE

In the HTTP message header, the value of **Content-Type** is **application/json**, and the character set is **UTF-8**.

Loading the CA Certificate

If HTTPS is used, you must load the push certificate by following the instructions provided in this section. Then create a subscription task on the console by following the instructions provided in [Configuring HTTP/HTTPS Subscription](#).

- If the application cancels the subscription and then re-subscribes the data again (with the URL unchanged), the CA certificate must be loaded to the platform again.
- If a subscription type (URL) is added, you must load the CA certificate corresponding to the URL to the platform. Even if the CA certificate used by the new URL is the same as that used by the original URL, the CA certificate must be loaded again.

Step 1 Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.

Step 2 In the navigation pane, choose **Rules > Server Certificates**. Click **Upload Certificate**, configure parameters based on the following table, and click **OK**.

| Parameter | Description |
|------------------|---|
| Certificate Name | Used to distinguish different certificates and can be customized. |
| CA Certificate | A CA certificate from the application can be applied for and purchased in advance. NOTE You can create a commissioning certificate during commissioning. For security reasons, you are advised to replace the commissioning certificate with a commercial certificate during commercial use. |


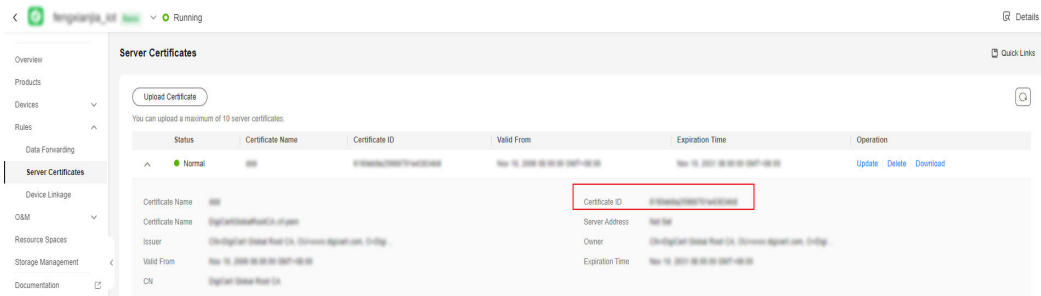
Step 3 In the navigation pane, choose **Rules > Server Certificate**, locate the target certificate, click  to obtain the certificate ID, which is used as a parameter in the API [Creating a Rule Action](#).

Figure 7-45 Server certificate - Obtaining the certificate ID

----End

Creating a Commissioning Certificate

A commissioning certificate, or a self-signed certificate, is used for authentication when the client accesses the server through HTTPS. When the platform uses HTTPS to push data to an application, the platform authenticates the application. This section uses the Windows operating system as an example to describe how to use OpenSSL to make a commissioning certificate. The generated certificate is in PEM format and the suffix is **.cer**.

The table below lists common certificate storage formats.

| Storage Format | Description |
|----------------|---|
| DER | Binary code. The suffix is .der , .cer , or .crt . |
| PEM | Base64 code. The suffix is .pem , .cer , or .crt . |
| JKS | Java certificate storage format. The suffix is .jks . |

NOTE

The commissioning certificate is used only for commissioning. During commercial use, you must apply for certificates from a trusted CA. Otherwise, security risks may occur.

- Step 1** Download and install [OpenSSL](#).
- Step 2** Open the CLI as user **admin**.
- Step 3** Run `cd c:\openssl\bin` (replace `c:\openssl\bin` with the actual OpenSSL installation directory) to access the OpenSSL view.
- Step 4** Generate the private key file **ca_private.key** of the CA root certificate.

```
openssl genrsa -passout pass:123456 -aes256 -out ca_private.key 2048
```

 - **aes256**: cryptographic algorithm
 - **passout pass**: private key password
 - **2048**: key length
- Step 5** Use the private key file of the CA root certificate to generate the **ca.csr** file to be used in [6](#).


```
openssl req -passin pass:123456 -new -key ca_private.key -out ca.csr -subj "/C=CN/ST=GD/L=SZ/O=Huawei/OU=IoT/CN=CA"
```

Modify the following information based on actual conditions:

- **C**: country, for example, CN
- **ST**: region, for example, GD
- **L**: city, for example, SZ
- **O**: organization, for example, Huawei
- **OU**: organization unit, for example, IoT
- **CN**: common name (the organization name of the CA), for example, CA

Step 6 Create the CA root certificate **ca.cer**.

```
openssl x509 -req -passin pass:123456 -in ca.csr -out ca.cer -signkey ca_private.key -CAcreateserial -days 3650
```

Modify the following information based on actual conditions:

- **passin pass**: The value must be the same as the private key password set in [4](#).
- **days**: validity period of the certificate.

Step 7 Generate the private key file for the application.

```
openssl genrsa -passout pass:123456 -aes256 -out server_private.key 2048
```

Step 8 Generate the **.csr** file for the application.

```
openssl req -passin pass:123456 -new -key server_private.key -out server.csr -subj "/C=CN/ST=GD/L=SZ/O=Huawei/OU=IoT/CN=appserver.iot.com"
```

Modify the following information based on actual conditions:

- **C**: country, for example, CN
- **ST**: region, for example, GD
- **L**: city, for example, SZ
- **O**: organization, for example, Huawei
- **OU**: organization unit, for example, IoT
- **CN**: common name. Enter the domain name or IP address of the application.

Step 9 Use the CA private key file **ca_private.key** to sign the file **server.csr** and generate the server certificate file **server.cer**.

```
openssl x509 -req -passin pass:123456 -in server.csr -out server.cer -sha256 -CA ca.cer -CAkey ca_private.key -CAserial ca.srl -CAcreateserial -days 3650
```

Step 10 (Optional) If you need a **.crt** or **.pem** certificate, proceed this step. The following uses the conversion from **server.cer** to **server.crt** as an example. To convert the **ca.cer** certificate, replace **server** in the command with **ca**.

```
openssl x509 -inform PEM -in server.cer -out server.crt
```

Step 11 In the **bin** folder of the OpenSSL installation directory, obtain the CA certificate (**ca.cer/ca.crt/ca.pem**), application server certificate (**server.cer/server.crt/server.pem**), and private key file (**server_private.key**). The CA certificate is loaded to the platform, and the application server certificate and private key file are loaded to the application.

----End

Configuring HTTP/HTTPS Subscription

This section describes how to configure HTTP or HTTPS subscription on the console.

- Step 1** Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Rules > Data Forwarding**, and click **Create Rule** in the upper left corner.
- Step 3** Set the parameters based on the table below and click **Create Rule**.

Table 7-11 Parameters for creating a rule

| Parameter | Description |
|-------------|---------------------------------|
| Rule Name | Name of the rule to be created. |
| Description | Description of the rule. |

| Parameter | Description |
|----------------|--|
| Data Source | <ul style="list-style-type: none"> ● Device: Device information, such as device addition, deletion, and update, will be forwarded. When Data Source is set to Device, quick configuration is not supported. ● Device property: A property value reported by a device in a resource space will be forwarded. Click Quick Configuration on the right and select the product, property, and service data to forward. ● Device message: A message reported by a device in a resource space will be forwarded. Click Quick Configuration on the right and select data of a specified topic to forward. Select the product to which the topic belongs and enter the topic name. You can use a custom topic on the product details page or a preset topic. ● Device message status: The status of device messages exchanged between the device and platform will be forwarded. For details on the device message status, see Message Delivery Status. When Data Source is set to Device message status, quick configuration is not supported. ● Device status: The status change of a directly or an indirectly connected device in a resource space will be forwarded. Click Quick Configuration on the right to forward information about devices whose status is Online, Offline, or Abnormal to other services. For details on the status of devices directly connected to the platform, see Device Management. ● Batch task: The batch task status will be forwarded. When Data Source is set to Batch Task, quick configuration is not supported. ● Product: Product information, such as product addition, deletion, and update, will be forwarded. When Data Source is set to Product, quick configuration is not supported. ● Asynchronous command status of the device: Status changes of asynchronous commands to devices using LwM2M over CoAP will be forwarded. For details on the asynchronous command status of devices, see Asynchronous Command Delivery. When Data Source is set to Asynchronous command status of the device, quick configuration is not supported. ● Run log: Service run logs of MQTT devices will be forwarded. When Data Source is set to Run log, quick configuration is not supported. |
| Trigger | After you select a data source, the platform automatically matches trigger events. |
| Resource Space | You can select a single resource space or all resource spaces. If All resource spaces is selected, quick configuration is not supported. |

Step 4 Under **Set Forwarding Target**, click **Add**. On the displayed page, set the parameters based on the table below and click **OK**.

| Parameter | Description |
|-------------------------|--|
| Forwarding Target | Select Third-party application (HTTP push) . |
| Push URL | Enter the URL for IoTDA to push messages to the application. For example, if the URL is https://www.example.com:8443/example/ , set Domain/IP and Port to www.example.com:8443 in Loading the CA Certificate . <ul style="list-style-type: none">• If the push URL uses HTTP, the CA certificate is not required.• If the push URL uses HTTPS, upload the CA certificate. For details about how to upload a certificate, see Loading the CA Certificate. |
| Token | Used for signature authentication. The value can contain 3 to 32 characters, including letters and digits. When pushing data to the user server, the platform signs the token and assembles the signature information into the header. |
| Certificate ID | This configuration is valid only for the HTTPS server. It is used as the truststore certificate for the client to verify the compliance of the commercial certificate of the server. This configuration is unavailable for non-compliant certificates such as self-signed certificates and certificates with incomplete certificate chains. |
| Certificate Domain Name | To enable SNI, configure corresponding certificate and domain name on the server in advance. |

Step 5 After the rule is defined, click **Enable Rule** to start forwarding data to the HTTP or HTTPS message queue.

----End

Token-based Platform Authentication for HTTP/HTTPS Push

If you select **Authentication** and enter the token when adding the **Third-party application (HTTP push)** forwarding target, the platform will add the following parameters to the header of the HTTP or HTTPS request:

| Parameter | Description |
|-----------|--|
| timestamp | Timestamp when the platform pushes data. |
| nonce | Random number generated by the platform. |
| signature | Signature consisting of token , timestamp , and nonce . |

Signature rules:

1. Sort **token**, **timestamp**, and **nonce** in alphabetical order.
2. Encrypt the sorted string using SHA-256.
3. After receiving the pushed message, you can encrypt **timestamp** and **nonce** in the header and **token** based on rules and compare the obtained value with the signature in the header to determine whether the message is from the platform.

Java example for signature verification:

1. Add the dependency. Use a specific version based on the actual service requirements.

```
<dependency>
  <groupId>commons-codec</groupId>
  <artifactId>commons-codec</artifactId>
  <version>${commons.version}</version>
</dependency>
```

2. Obtain the signature information from the request header and use the **commons-codec** dependency package for signature.

```
public boolean checkSignature(String nonce, String timestamp, String signature, String token) {
    List<String> list = new ArrayList<>();
    list.add(token);
    if (StringUtil.isNotEmpty(nonce)) {
        list.add(nonce);
    }
    if (StringUtil.isNotEmpty(timestamp)) {
        list.add(timestamp);
    }
    Collections.sort(list);
    StringBuilder signatureBuilder = new StringBuilder();
    for (String s : list) {
        signatureBuilder.append(s);
    }
    String serverSignature = DigestUtils.sha256Hex(signatureBuilder.toString());
    if (StringUtil.isNotEmpty(serverSignature) && serverSignature.equals(signature)) {
        return true;
    }
    return false;
}
```

3. For example, the token is set to **aaaaaa** in a request, and the header contains the following parameters:

```
nonce: 8b9b796d388d49bba43adaa53aaf5bc4
timestamp: 1675654743514
signature: 2ff821fb8a976ede7d06434395ec8c25e4100bff8b3d12d8099ef7e30b58bd4c
```

The string after sorting is

16756547435148b9b796d388d49bba43adaa53aaf5bc4aaaaaa. The string encrypted using SHA-256 is

2ff821fb8a976ede7d06434395ec8c25e4100bff8b3d12d8099ef7e30b58bd4c

**CAUTION**

After a token is created, you need to configure a new token each time you modify the forwarding target. Otherwise, the token does not take effect.

Platform Certification

As a server, if an application needs to authenticate the platform, the platform CA certificate must be loaded on the application. For details, see [Obtaining Resources](#).

FAQ

The following lists the frequently asked questions about the subscription and push service. For more questions, see [Subscription and Push](#).

- [How Do I Obtain the Access Addresses and Certificates of the Old and New Domain Names?](#)
- [How Do I Obtain the Callback URL When Calling the Subscription API?](#)
- [Can a Domain Name Be Used in a Callback URL?](#)
- [What Do I Do If Message Push Fails After Subscription?](#)
- [Why Does the Application Receive Multiple Push Messages After a Device Reports a Piece of Data?](#)
- [Why Was the Callback URL Invalid During the Subscription API Call?](#)
- [How Can I Obtain the subscriptionId Needed in Calling the API for Deleting a Subscription?](#)
- [Can an Application Subscribe to the Platform Data When the Application Only Has an Internal IP Address?](#)

APIs

[Creating a Rule Action](#)

[Creating a Rule Trigger Condition](#)

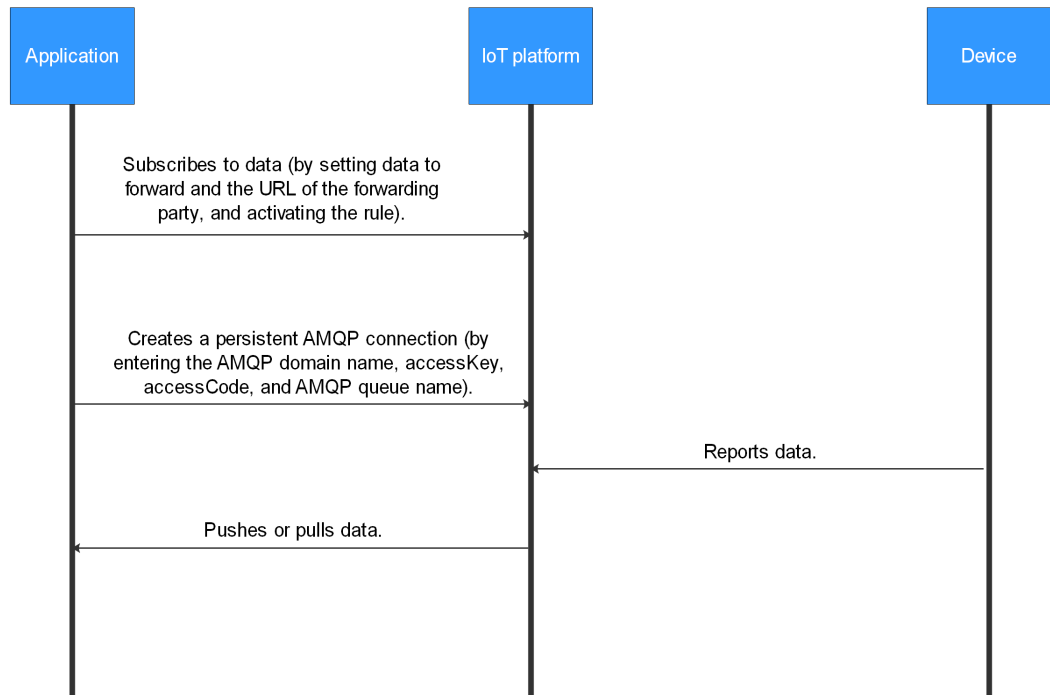
[Modifying a Rule Trigger Condition](#)

[Data Transfer APIs](#)

7.6.3 AMQP Data Forwarding

7.6.3.1 Overview

The figure below shows the subscription and push process.



Push mechanism: After receiving a message from the platform, the application returns a response. (The automatic response mode is recommended.) If the application does not pull data after the connection is established, data will be stacked on the server. The server stores only the data that is received in the last 24 hours and occupies less than 1 GB disk space. If the application does not pull data in a timely manner, the platform clears expired and excess data on a rolling basis. If the application does not respond in time after receiving the message and the persistent connection is interrupted, the corresponding data will be pushed again in the next connection established.

Subscribing to Data

After connecting to IoTDA, an application calls an API to subscribe to data.

- For details on how to configure subscriptions on the console, see [AMQP Server Configuration](#).
- For details on how to subscribe to data through APIs, see [Calling APIs](#), [Creating a Rule Trigger Condition](#), [Creating a Rule Action](#), and [Modifying a Rule Trigger Condition](#).

Format of Pushed Data

For details on the format of data pushed by the platform to applications after data subscription is created, see [Data Transfer APIs](#).

NOTE

In the HTTP message header, the value of **Content-Type** is **application/json**, and the character set is **UTF-8**.

APIs

[Creating a Rule Action](#)

[Creating a Rule Trigger Condition](#)

[Modifying a Rule Trigger Condition](#)

[Data Transfer APIs](#)

[Creating an AMQP Queue](#)

[Querying the AMQP List](#)

[Querying an AMQP Queue](#)

[Generating an Access Credential](#)

7.6.3.2 AMQP Server Configuration

This topic describes how to set and manage AMQP server subscription on the IoT platform.

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Rules > Data Forwarding**, and click **Create Rule** in the upper left corner.
- Step 3** Set the parameters based on the table below and click **Create Rule**.

Table 7-12 Parameters for creating a rule

| Parameter | Description |
|-------------|---------------------------------|
| Rule Name | Name of the rule to be created. |
| Description | Description of the rule. |

| Parameter | Description |
|----------------|--|
| Data Source | <ul style="list-style-type: none"> ● Device: Device information, such as device addition, deletion, and update, will be forwarded. When Data Source is set to Device, quick configuration is not supported. ● Device property: A property value reported by a device in a resource space will be forwarded. Click Quick Configuration on the right and select the product, property, and service data to forward. ● Device message: A message reported by a device in a resource space will be forwarded. Click Quick Configuration on the right and select data of a specified topic to forward. Select the product to which the topic belongs and enter the topic name. You can use a custom topic on the product details page or a preset topic. ● Device message status: The status of device messages exchanged between the device and platform will be forwarded. For details on the device message status, see Message Delivery Status. When Data Source is set to Device message status, quick configuration is not supported. ● Device status: The status change of a directly or an indirectly connected device in a resource space will be forwarded. Click Quick Configuration on the right to forward information about devices whose status is Online, Offline, or Abnormal to other services. For details on the status of devices directly connected to the platform, see Device Management. ● Batch task: The batch task status will be forwarded. When Data Source is set to Batch Task, quick configuration is not supported. ● Product: Product information, such as product addition, deletion, and update, will be forwarded. When Data Source is set to Product, quick configuration is not supported. ● Asynchronous command status of the device: Status changes of asynchronous commands to devices using LwM2M over CoAP will be forwarded. For details on the asynchronous command status of devices, see Asynchronous Command Delivery. When Data Source is set to Asynchronous command status of the device, quick configuration is not supported. ● Run log: Service run logs of MQTT devices will be forwarded. When Data Source is set to Run log, quick configuration is not supported. |
| Trigger | After you select a data source, the platform automatically matches trigger events. |
| Resource Space | You can select a single resource space or all resource spaces. If All resource spaces is selected, quick configuration is not supported. |

Step 4 Under **Set Forwarding Target**, click **Add**. On the displayed page, set the parameters based on the table below and click **OK**.

| Parameter | Description |
|-------------------|---|
| Forwarding Target | Select AMQP message queue . |
| Message Queue | Click Select to select a message queue. <ul style="list-style-type: none">If no message queue is available, create one. The queue name must be unique under a tenant and can contain 8–128 characters, including letters, numbers, underscores (_), hyphens (-), periods (.), and colons (:).To delete a message queue, click Delete on the right of the message queue. NOTE A subscribed queue cannot be deleted. |

Step 5 After the rule is defined, click **Enable Rule** to start forwarding data to the AMQP message queue.

----End

7.6.3.3 AMQP Queue Alarm Configuration

When you consume messages from a subscribed AMQP queue, the consumer side may go offline and message consumption may slow down due to network communication problems or untimely acknowledgements to received messages. In this case, messages are stacked and cannot be processed in real time.

IoTDA supports AMQP queue alarm configuration. You can set alarm rules to monitor AMQP queue message stacking and consumption speed. After a rule is triggered, alarm information is sent to you immediately so that you can locate and rectify faults in a timely manner. This section describes how to configure alarm rules for AMQP queues.

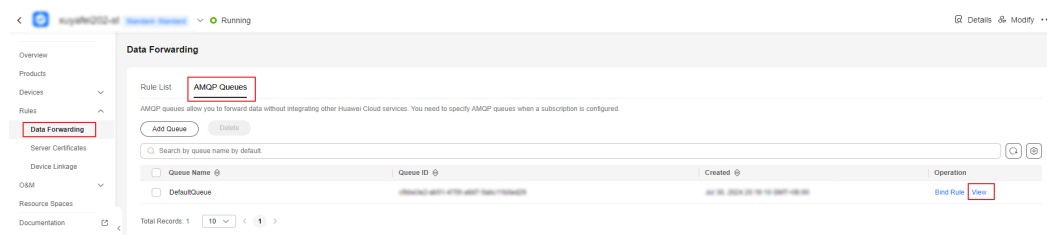
Procedure

Step 1 Access the **IoTDA** service page and click **Access Console**. Click the target instance card.

Step 2 In the navigation pane, choose **Rules > Data Forwarding**.

Step 3 Click the **AMQP Queues** tab, locate the queue to configure alarms, and click **View**.

Figure 7-46 Data forwarding - AMQP message queue details



Step 4 Click **Configure Alarm**.

Figure 7-47 AMQP message queue - Alarm configuration

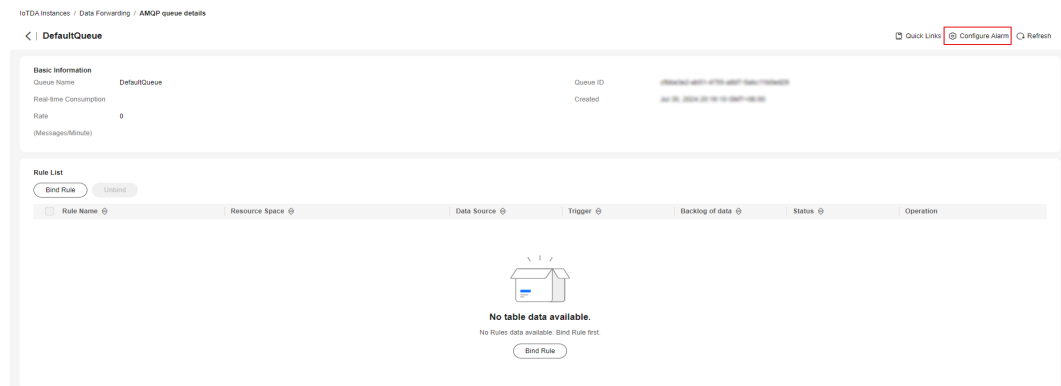
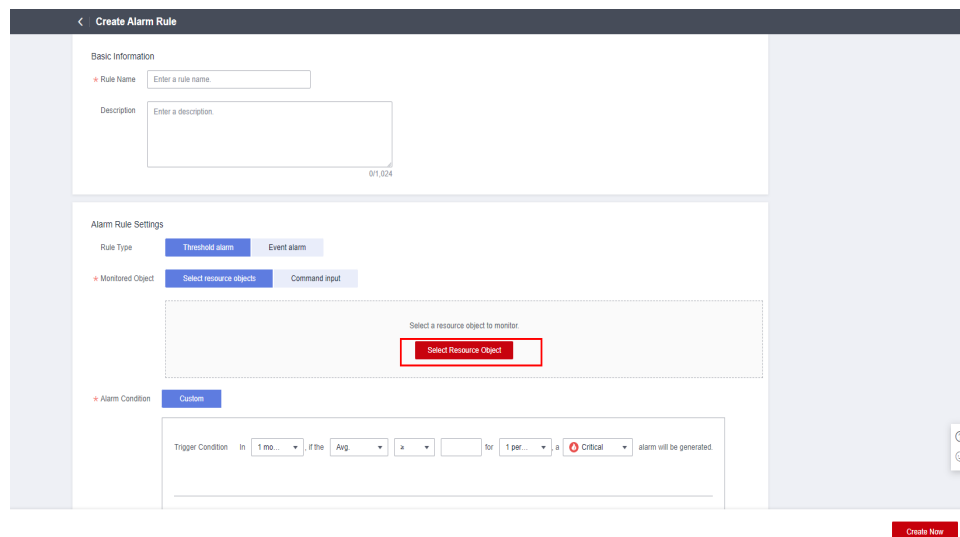


Figure 7-48 Creating an alarm rule



Step 5 Click **Select Resource Object**. Set **Add By** to **Dimension**, and select a proper metric and dimension based on the following tables.



Search for the **iotda_amqp_forwarding_backlog_message_count** and **iotda_amqp_forwarding_consume_rate** under all metrics.

Figure 7-49 Selecting the object to be monitored

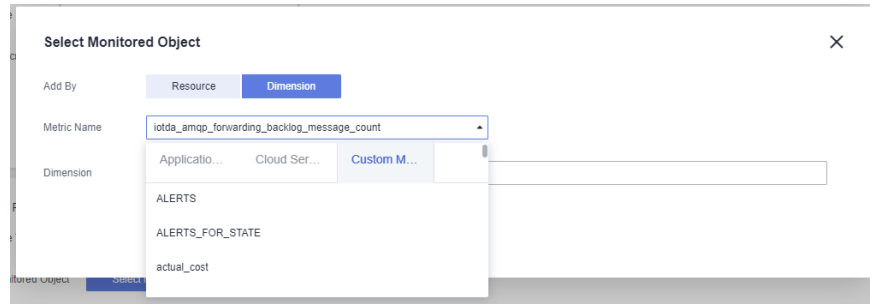


Table 7-13 Metric description

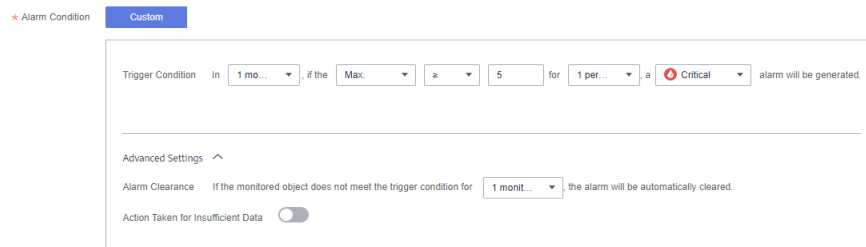
| Metric Name | Description |
|---|--|
| iotda_amqp_forwarding_backlog_message_count | Number of stacked messages in the queue. |
| iotda_amqp_forwarding_consume_rate | Queue message consumption speed. |

Table 7-14 Metric dimension description

| Dimension | Description |
|-----------|---|
| clusterId | Cluster ID. |
| namespace | Namespace. The value is fixed to AOM.IoTDA . |
| queueName | AMQP queue name. |
| userName | Username. |

Step 6 Set an alarm condition based on the site requirements.

Figure 7-50 Alarm condition



Step 7 Select an alarm tag. If you want to view the alarm on the **Device Alarms** page in IoTDA, configure the following custom tag.

Table 7-15 Custom tag

| Tag Name | Tag Value |
|-------------------|-----------|
| resource_provider | IoTDA |

Figure 7-51 Current alarms - AMQP alarms

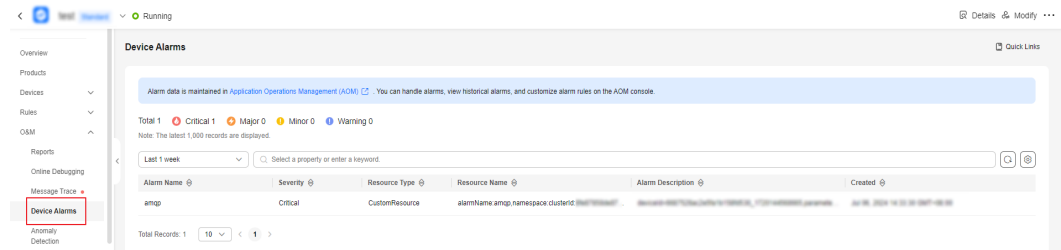
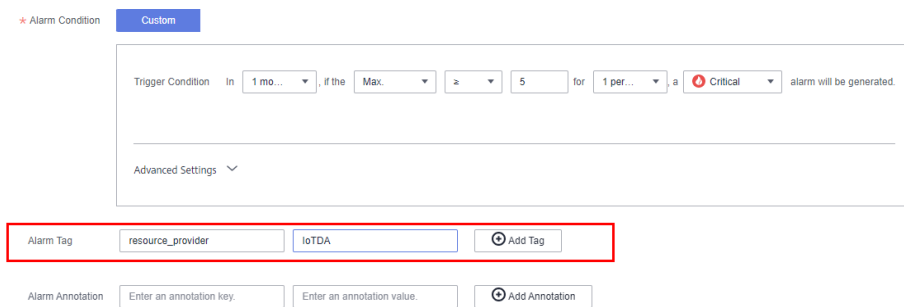
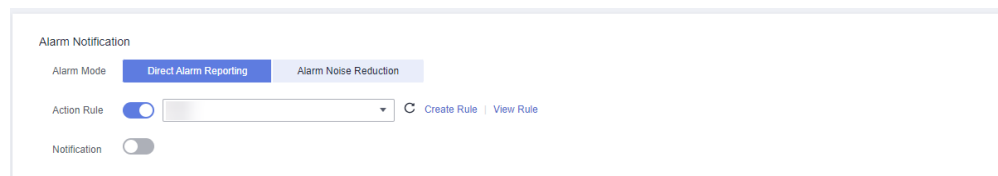


Figure 7-52 Adding a custom tag



Step 8 Specify an action rule for alarm notifications. When an alarm is triggered, the action rule notifies topic subscribers of the alarm through different channels (for example, emails or SMSs) based on the topic. For details, see [Creating an Alarm Action Rule](#).

Figure 7-53 Alarm notification



Step 9 Click **Create Now**.

----End

7.6.3.4 AMQP Client Access

After configuring and activating rules by calling the platform APIs [Creating a Rule Triggering Condition](#), [Creating a Rule Action](#), and [Modifying a Rule Triggering Condition](#), connect the AMQP client to IoTDA. Then run the AMQP client on your server to receive subscribed-to messages.

Protocol Version

For details on AMQP, see [AMQP](#).

The IoT platform supports only AMQP 1.0.

Connection Establishment and Authentication

1. The AMQP client establishes a TCP connection with the platform and performs TLS handshake verification.

NOTE

To ensure security, the AMQP client must use TLS 1.2 for encryption. Non-encrypted TCP transmission is not supported. The difference between the client time and standard time cannot be greater than 5 minutes. Otherwise, the connection will fail.

2. The client requests to set up a connection.
3. The client sends a request to the platform to establish a receiver link (a unidirectional channel for the platform to push data to the client). The receiver link must be set up within 15 seconds after the connection is set up on the client. Otherwise, the platform will close the connection. After the receiver link is set up, the client is connected to the platform.

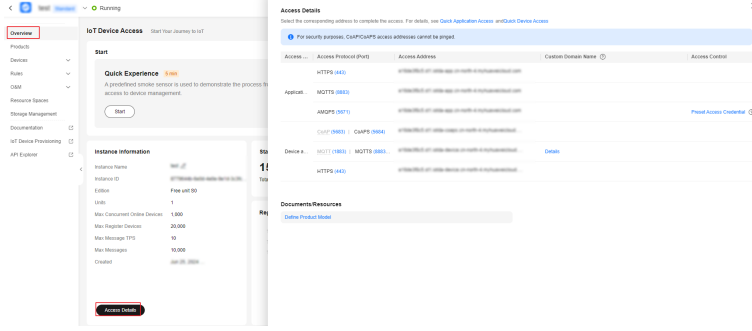
NOTE

A maximum of 10 receiver links can be created for a connection, and sender links cannot be created. Therefore, the platform can push messages to the client, but the client cannot send messages to the platform.

Connection Configuration Parameters

The table below describes the connection address and connection authentication parameters for the AMQP client to connect to the platform.

- AMQP access address: `amqps://${server.address}:5671`
- Connection string: `amqps://${server.address}:5671?amqp.vhost=default&amqp.idleTimeout=8000&amqp.saslMechanisms=PLAIN`

| Parameter | Description |
|---------------------|---|
| server.address | <p>AMQP server access address. Obtaining method: Log in to the console, choose IoTDA Instances, and click the target instance card. In the navigation pane, choose Overview. Click Access Details in the Instance Information area, and check the AMQPS access address.</p> <p>Figure 7-54 Obtaining access information</p>  |
| amqp.vhost | Currently, AMQP uses the default host. Only the default host is supported. |
| amqp.saslMechanisms | Connection authentication mode. Currently, PLAIN-SASL is supported. |
| amqp.idleTimeout | Heartbeat interval, in milliseconds. If the heartbeat interval expires and no frame is transmitted on the connection, the platform closes the connection. |

- Port: 5671
 - Client identity authentication parameters
- ```
username = "accessKey=${accessKey}|timestamp=${timestamp}|instanceId=${instanceId}"
password = "${accessCode}"
```

| Parameter | Mandatory or Optional | Description                                                                                                                                                                                                                                            |
|-----------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| accessKey | Mandatory             | An accessKey can be used to establish a maximum of 32 concurrent connections. When establishing a connection for the first time, preset the parameter by following the instructions provided in <a href="#">Obtaining the AMQP Access Credential</a> . |

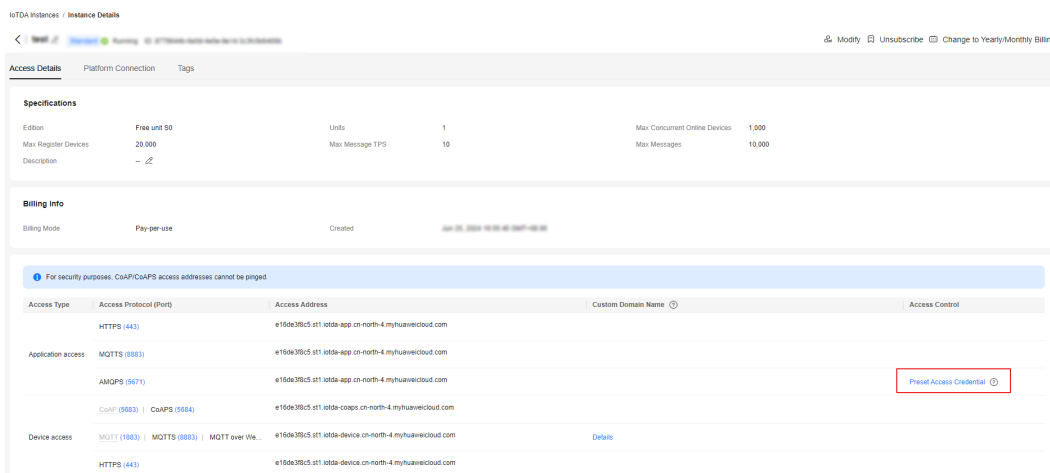
| Parameter  | Mandatory or Optional | Description                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| timestamp  | Mandatory             | Indicates the current time. The value is a 13-digit timestamp, accurate to milliseconds.<br>The server verifies the client timestamp. There is a 5-minute difference between the client timestamp and server timestamp.                                                                                                                                                                                                                          |
| instanceId | Optional              | Instance ID. This parameter is mandatory when multiple instances of the standard edition are purchased in the same region. For details, see <a href="#">Viewing Instance Details</a> .                                                                                                                                                                                                                                                           |
| accessCode | Mandatory             | The value can contain a maximum of 256 characters. When establishing a connection for the first time, preset the parameter by following the instructions provided in <a href="#">Obtaining the AMQP Access Credential</a> . If the accessCode is lost, you can call the API <a href="#">Generating an Access Credential</a> or follow the instructions provided in <a href="#">Obtaining the AMQP Access Credential</a> to reset the accessCode. |

## Obtaining the AMQP Access Credential

If an application uses AMQP to access the platform for data transfer, preset an access credential. You can call the API [Generating an Access Credential](#) or use the console to preset an access credential. The procedure for using the console to generate an access credential is as follows:

- Step 1** Choose **IoTDA Instances**, select the edition of your instance, and click **Details** to go to the instance details page.
- Step 2** Click **Preset Access Credential** to preset the accessCode and accessKey.

**Figure 7-55** Instance management - Preset access credential





**NOTE**

If you already have an access credential, the accessKey cannot be used after you preset the access credential again.

----End

## Connection Specifications

| Key                                                              | Documentation |
|------------------------------------------------------------------|---------------|
| Maximum number of queues that can be subscribed for a connection | 10            |
| Maximum number of queues for a user                              | 100           |
| Maximum number of connections for a tenant                       | 32            |
| Cache duration of a message (days)                               | 1             |

## Receiving Push Messages

After the receiver link between the client and platform is established, the client can proactively pull data or register a listener to enable the platform to push data. The proactive mode is recommended, because the client can pull data based on its own capability.

### 7.6.3.5 Java SDK Access Example

This topic describes how to connect an AMQP-compliant JMS client to the IoT platform and receive subscribed messages from the platform.

## Development Environment Requirements

JDK 1.8 or later has been installed.

## Obtaining the Java SDK

The AMQP SDK is an open-source SDK. If you use Java, you are advised to use the Apache Qpid JMS client. Visit [Qpid JMS](#) to download the client and view the instructions for use.

## Adding a Maven Dependency

```
<!-- amqp 1.0 qpid client -->
<dependency>
 <groupId>org.apache.qpid</groupId>
 <artifactId>qpid-jms-client</artifactId>
 <version>0.61.0</version>
</dependency>
```

## Sample Code

You can click [here](#) to obtain the Java SDK access example. For details on the parameters involved in the demo, see [AMQP Client Access](#).

### CAUTION

All sample code contains the logic of server reconnection upon disconnection.

You can obtain [AmqpClient.java](#), [AmqpClientOptions.java](#), and [AmqpConstants.java](#) used in the sample code from [here](#).

#### 1. Create **AmqpClient**.

```
// Change the values of the following parameters as required.
AmqpClientOptions options = AmqpClientOptions.builder()
 .host(AmqpConstants.HOST)
 .port(AmqpConstants.PORT)
 .accessKey(AmqpConstants.ACCESS_KEY)
 .accessCode(AmqpConstants.ACCESS_CODE)
 .queuePrefetch(1000) // The SDK allocates the queue with the memory size set in this parameter
to receive messages. If the client memory size is small, set this parameter to a smaller value.
 .build();
AmqpClient amqpClient = new AmqpClient(options);
amqpClient.initialize();
```

#### 2. Configure a listener to consume AMQP messages.

```
try {
 MessageConsumer consumer = amqpClient.newConsumer(AmqpConstants.DEFAULT_QUEUE);
 consumer.setMessageListener(message -> {
 try {
 // Process messages. If the processing is time-consuming, you are advised to start a new thread.
 Otherwise, the connection may be cut off due to heartbeat timeout.
 processMessage(message.getBody(String.class));
 // If options.isAutoAcknowledge==false is configured, call message.acknowledge();
 } catch (Exception e) {
 log.warn("message.getBody error,exception is ", e);
 }
 });
} catch (Exception e) {
 log.warn("Consumer initialize error,", e);
}
```

#### 3. Pull AMQP messages.

```
// Create a thread pool to pull messages.
ExecutorService executorService = new ThreadPoolExecutor(1, 1, 60, TimeUnit.SECONDS, new
LinkedBlockingQueue<>(1));

try {
 MessageConsumer consumer = amqpClient.newConsumer(AmqpConstants.DEFAULT_QUEUE);
 executorService.execute(() -> {
 while (!isClose.get()) {
 try {
 Message message = consumer.receive();
 // Process messages. If the processing is time-consuming, you are advised to start a new
thread. Otherwise, the connection may be cut off due to heartbeat timeout.
 processMessage(message.getBody(String.class));
 // If options.isAutoAcknowledge==false is configured, call message.acknowledge();
 } catch (JMSException e) {
 log.warn("receive message error,", e);
 }
 }
 });
}
```

```
} catch (Exception e) {
 log.warn("Consumer initialize error,", e);
}
```

4. For more demos about AMQP message consumption, see the access demo project that uses the java SDK.

## Resources

### AmqpClient.java

```
package com.iot.amqp;

import lombok.extern.slf4j.Slf4j;
import org.apache.commons.lang3.StringUtils;
import org.apache.qpid.jms.JmsConnection;
import org.apache.qpid.jms.JmsConnectionExtensions;
import org.apache.qpid.jms.JmsConnectionFactory;
import org.apache.qpid.jms.JmsQueue;
import org.apache.qpid.jms.transports.TransportOptions;
import org.apache.qpid.jms.transports.TransportSupport;

import javax.jms.Connection;
import javax.jms.JMSException;
import javax.jms.MessageConsumer;
import javax.jms.Session;
import java.util.Collections;
import java.util.HashSet;
import java.util.Set;

@Slf4j
public class AmqpClient {
 private final AmqpClientOptions options;
 private Connection connection;
 private Session session;
 private final Set<MessageConsumer> consumerSet = Collections.synchronizedSet(new HashSet<>());

 public AmqpClient(AmqpClientOptions options) {
 this.options = options;
 }

 public String getId() {
 return options.getClientId();
 }

 public void initialize() throws Exception {
 String connectionUrl = options.generateConnectUrl();
 log.info("connectionUrl={}", connectionUrl);
 JmsConnectionFactory cf = new JmsConnectionFactory(connectionUrl);
 // Trust the server.
 TransportOptions to = new TransportOptions();
 to.setTrustAll(true);
 cf.setSslContext(TransportSupport.createJdkSslContext(to));
 String userName = "accessKey=" + options.getAccessKey();
 cf.setExtension(JmsConnectionExtensions.USERNAME_OVERRIDE.toString(), (connection, uri) -> {
 String newUserName = userName;
 if (connection instanceof JmsConnection) {
 newUserName = ((JmsConnection) connection).getUsername();
 }
 if (StringUtils.isEmpty(options.getInstancedId())) {
 // userName of IoTDA is in the following format: accessKey=${accessKey}|timestamp=${timestamp}.
 return newUserName + "|timestamp=" + System.currentTimeMillis();
 } else {
 //If multiple Standard Editions are purchased in the same region, the format of userName is
 accessKey=${accessKey}|timestamp=${timestamp}|instanced=${instanced}.
 return newUserName + "|timestamp=" + System.currentTimeMillis() + "|instanced=" +
 options.getInstancedId();
 }
 });
 }
}
```

```
});
// Create a connection.
connection = cf.createConnection(userName, options.getAccessCode());
// Create sessions Session.CLIENT_ACKNOWLEDGE and Session.AUTO_ACKNOWLEDGE. For
Session.CLIENT_ACKNOWLEDGE, manually call message.acknowledge() after receiving a message. For
Session.AUTO_ACKNOWLEDGE, the SDK automatically responds with an ACK message (recommended).
session = connection.createSession(false, options.isAutoAcknowledge() ?
Session.AUTO_ACKNOWLEDGE : Session.CLIENT_ACKNOWLEDGE);
connection.start();
}

public MessageConsumer newConsumer(String queueName) throws Exception {
 if (connection == null || !(connection instanceof JmsConnection) || ((JmsConnection)
connection).isClosed()) {
 throw new Exception("create consumer failed,the connection is disconnected.");
 }
 MessageConsumer consumer;

 consumer = session.createConsumer(new JmsQueue(queueName));
 if (consumer != null) {
 consumerSet.add(consumer);
 }
 return consumer;
}

public void close() {
 consumerSet.forEach(consumer -> {
 try {
 consumer.close();
 } catch (JMSEException e) {
 log.warn("consumer close error,exception is ", e);
 }
 });

 if (session != null) {
 try {
 session.close();
 } catch (JMSEException e) {
 log.warn("session close error,exception is ", e);
 }
 }

 if (connection != null) {
 try {
 connection.close();
 } catch (JMSEException e) {
 log.warn("connection close error,exception is", e);
 }
 }
}
}
```

### AmqpClientOptions.java

```
package com.iot.amqp;

import lombok.Builder;
import lombok.Data;
import org.apache.commons.lang3.StringUtils;

import java.text.MessageFormat;
import java.util.HashMap;
import java.util.Map;
import java.util.UUID;
import java.util.stream.Collectors;

@Data
@Builder
public class AmqpClientOptions {
```

```
private String host;
@Builder.Default
private int port = 5671;
private String accessKey;
private String accessCode;
private String clientId;

/**
 * Specifies the instance ID. This parameter is required when multiple instances of the Standard Edition
are purchased in the same region.
 */
private String instanceId;

/**
 * Only true is supported.
 */
@Builder.Default
private boolean useSsl = true;

/**
 * IoTDA supports default only.
 */
@Builder.Default
private String vhost = "default";

/**
 * IoTDA supports PLAIN only.
 */
@Builder.Default
private String saslMechanisms = "PLAIN";

/**
 * true: The SDK automatically responds with an ACK message (default).
 * false: After receiving a message, manually call message.acknowledge().
 */
@Builder.Default
private boolean isAutoAcknowledge = true;

/**
 * Reconnection delay (ms)
 */
@Builder.Default
private long reconnectDelay = 3000L;

/**
 * Maximum reconnection delay (ms). The reconnection delay increases with the number of reconnection
times.
 */
@Builder.Default
private long maxReconnectDelay = 30 * 1000L;

/**
 * Maximum number of reconnection times. The default value is -1, indicating that the number of
reconnection times is not limited.
 */
@Builder.Default
private long maxReconnectAttempts = -1;

/**
 * Idle timeout interval. If the peer end does not send an AMQP frame within the interval, the connection
will be cut off. The default value is 30000, in milliseconds.
 */
@Builder.Default
private long idleTimeout = 30 * 1000L;

/**
 * The values below control how many messages the remote peer can send to the client and be held in a
pre-fetch buffer for each consumer instance.
 */
```

```
@Builder.Default
private int queuePrefetch = 1000;

/**
 * Extended parameters
 */
private Map<String, String> extendedOptions;

public String generateConnectUrl() {
 String uri = MessageFormat.format("{0}://{1}:{2}", (useSsl ? "amqps" : "amqp"), host,
String.valueOf(port));
 Map<String, String> uriOptions = new HashMap<>();
 uriOptions.put("amqp.vhost", vhost);
 uriOptions.put("amqp.idleTimeout", String.valueOf(idleTimeout));
 uriOptions.put("amqp.saslMechanisms", saslMechanisms);

 Map<String, String> jmsOptions = new HashMap<>();
 jmsOptions.put("jms.prefetchPolicy.queuePrefetch", String.valueOf(queuePrefetch));
 if (StringUtil.isEmpty(clientId)) {
 jmsOptions.put("jms.clientID", clientId);
 } else {
 jmsOptions.put("jms.clientID", UUID.randomUUID().toString());
 }
 jmsOptions.put("failover.reconnectDelay", String.valueOf(reconnectDelay));
 jmsOptions.put("failover.maxReconnectDelay", String.valueOf(maxReconnectDelay));
 if (maxReconnectAttempts > 0) {
 jmsOptions.put("failover.maxReconnectAttempts", String.valueOf(maxReconnectAttempts));
 }
 if (extendedOptions != null) {
 for (Map.Entry<String, String> option : extendedOptions.entrySet()) {
 if (option.getKey().startsWith("amqp.") || option.getKey().startsWith("transport.")) {
 uriOptions.put(option.getKey(), option.getValue());
 } else {
 jmsOptions.put(option.getKey(), option.getValue());
 }
 }
 }
 StringBuilder stringBuilder = new StringBuilder();
 stringBuilder.append(uriOptions.entrySet().stream()
 .map(option -> MessageFormat.format("{0}={1}", option.getKey(), option.getValue()))
 .collect(Collectors.joining("&", "failover:(" + uri + "?", ")"));
 stringBuilder.append(jmsOptions.entrySet().stream()
 .map(option -> MessageFormat.format("{0}={1}", option.getKey(), option.getValue()))
 .collect(Collectors.joining("&", "?", "")));
 return stringBuilder.toString();
}
}
```

### AmqpConstants.java

```
package com.iot.amqp;

public interface AmqpConstants {
 /**
 * AMQP access domain name
 * eg: "****.iot-amqps.cn-north-4.myhuaweicloud.com";
 */
 String HOST = "127.0.0.1";

 /**
 * AMQP access port
 */
 int PORT = 5671;

 /**
 * Access key
 * A timestamp does not need to be combined.
 */
}
```

```
String ACCESS_KEY = "accessKey";

/**
 * Access code
 */
String ACCESS_CODE = "accessCode";

/**
 * Default queue
 */
String DEFAULT_QUEUE = "DefaultQueue";
}
```

### 7.6.3.6 Node.js SDK Access Example

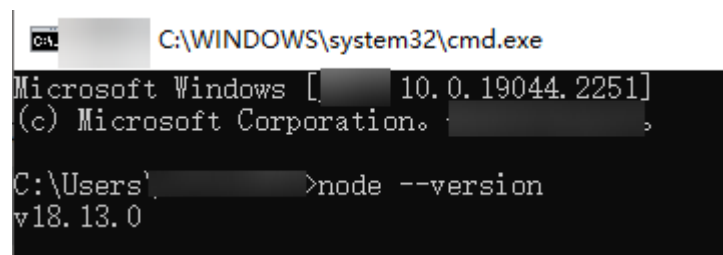
This topic describes how to use a Node.js AMQP SDK to connect to the Huawei Cloud IoT platform and receive subscribed messages from the platform.

## Development Environment

Node.js 8.0.0 or later is used. [Download](#) it from the Node.js official website. After installation, run the following command to check the version:

```
node --version
```

If the version is displayed and is later than 8.0.0, the installation is successful.



```
C:\WINDOWS\system32\cmd.exe
Microsoft Windows [10.0.19044.2251]
(c) Microsoft Corporation.
C:\Users\>node --version
v18.13.0
```

## Sample Code

1. Create a JavaScript file (for example, **HwlotAmqpClient.js**) on the local computer and save the following sample code to the file. Modify related connection parameters by referring to [AMQP Client Access](#).

```
const container = require('rhea');
// Obtain the timestamp.
var timestamp = Math.round(new Date());

// Set up a connection.
var connection = container.connect({
 // Access domain name. For details, see AMQP Client Access.
 'host': '${UUCID}.iot-amqps.cn-north-4.myhuaweicloud.com',
 'port': 5671,
 'transport': 'tls',
 'reconnect': true,
 'idle_time_out': 8000,
 // Method to assemble username. For details, see AMQP Client Access.
 'username': 'accessKey=${yourAccessKey}|timestamp=' + timestamp + '|instanceId=${instanceId}',
 // accessCode. For details, see AMQP Client Access.
 'password': '${yourAccessCode}',
 'saslmMechannisms': 'PLAIN',
 'rejectUnauthorized': false,
 'hostname': 'default',
});

// Create a Receiver connection. You can use DefaultQueue.
```

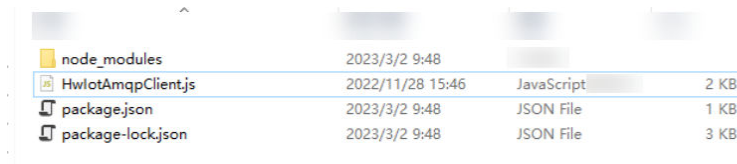
```
var receiver = connection.open_receiver('${yourQueue}');

// Callback function for receiving messages pushed from the cloud
container.on('message', function (context) {
 var msg = context.message;
 var content = msg.body;
 console.log(content);
 // Send an ACK message. Note that the callback function should not contain time-consuming logic.
 context.delivery.accept();
});
```

- Go to the directory where the **HwlotAmqpClient.js** file is located and run the following command to install the rhea library:

```
npm install rhea
```

After installation, the project files shown in the following figure are displayed.



- Run the following command to start the AMQP client:

```
node HwlotAmqpClient.js
```

- Running result examples

- Successful subscription:

If the following log information is displayed, the AMQP client successfully subscribes to the IoT platform and obtains data from the platform.

```
D:\tmp\amp>node HwlotAmqpClient.js
(node:18904) Warning: Setting the NODE_TLS_REJECT_UNAUTHORIZED environment variable to '0' makes TLS connections and HTTPS requests insecure by disabling certificate verification
(node:18904) (Use 'node --trace-warnings ...' to show where the warning was created)
{"resource":{"device":{"product_id":"ABC123456789","gateway_id":"ABC123456789","tag_value":"testTagValue"},"services":[{"service_id":"string","properties":{"event_time":"string"}}]}}
```

- Failed subscription:

The following log indicates that the AMQP client authentication fails on the IoT platform. Check whether the access code is correct and whether the difference between the timestamp and the standard time is greater than 5 minutes.

```
D:\tmp\amp>node HwlotAmqpClient.js
(node:18904) Warning: Setting the NODE_TLS_REJECT_UNAUTHORIZED environment variable to '0' makes TLS connections and HTTPS requests insecure by disabling certificate verification
(node:18904) (Use 'node --trace-warnings ...' to show where the warning was created)
node:events:491
 throw er; // Unhandled 'error' event
 ^
Error: ConnectionError: Failed to authenticate: 1
 at Connection.handle_error (D:\tmp\amp\node_modules\rhea\lib\connection.js:470:36)
 at Connection.sasl_failed (D:\tmp\amp\node_modules\rhea\lib\connection.js:454:10)
 at SaslClient.on_sasl_outcome (D:\tmp\amp\node_modules\rhea\lib\sasl.js:318:25)
 at c.dispatch (D:\tmp\amp\node_modules\throu\lib\troups.js:242:35)
 at Transport.read (D:\tmp\amp\node_modules\rhea\lib\transport.js:117:36)
 at SaslClient.read (D:\tmp\amp\node_modules\rhea\lib\sasl.js:336:6)
 at Connection.input (D:\tmp\amp\node_modules\rhea\lib\connection.js:567:37)
 at TLSSocket.emit (node:events:515:23)
 at addChunk (node:internal/stream/readable.js:224:12)
 at readableAddChunk (node:internal/stream/readable.js:207:9)
 at Container.dispatch (D:\tmp\amp\node_modules\rhea\lib\container.js:41:33)
 at Connection.dispatch (D:\tmp\amp\node_modules\rhea\lib\connection.js:261:40)
 at Connection.input (D:\tmp\amp\node_modules\rhea\lib\connection.js:553:18)
 at TLSSocket.emit (node:events:515:23)
 at addChunk (node:internal/stream/readable.js:224:12)
 at readableAddChunk (node:internal/stream/readable.js:207:9)
 at Readable.push (node:internal/stream/readable.js:234:10)
 at TLSSocket.onStreamRead (node:internal/stream_base_commons:190:23) {
 condition: 'msg:unauthorized-access',
 description: 'Failed to authenticate: 1'
}
```

### 7.6.3.7 C# SDK Access Example

This topic describes how to connect an AMQP.Net Lite client to the IoT platform and receive subscribed messages from the platform.

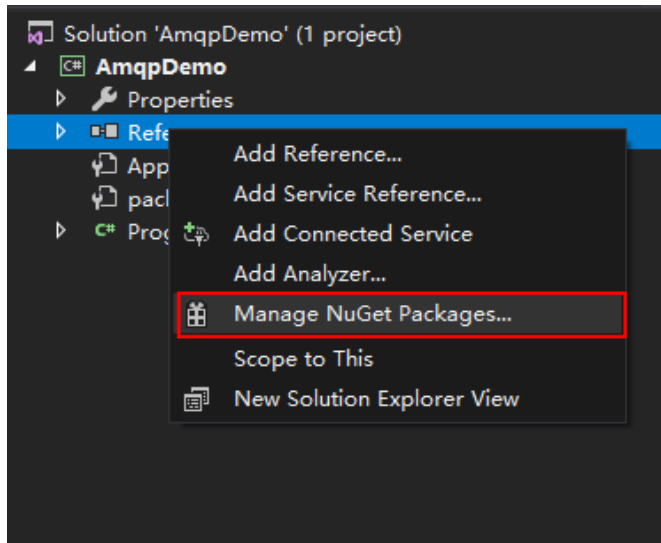
## Requirements for the Development Environment

.NET Framework 4.6 or later has been installed.

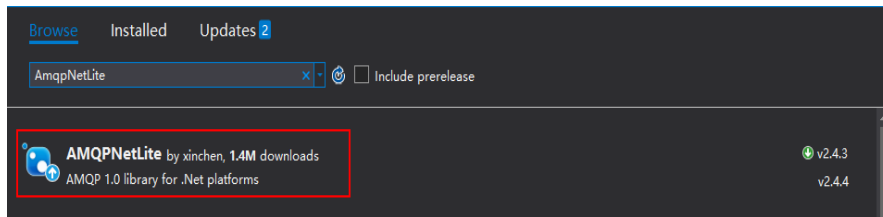


## Obtaining the Java SDK

1. Right-click the project directory and choose **Manage NuGet Packages**.



2. In the NuGet manager, search for **AmqpNetLite** and install the required version.



## Sample Code

For details about the parameters in the demo, see [AMQP Client Access](#).

```
using Amqp;
using Amqp.Framing;
using Amqp.Sasl;
using System;
using System.Threading;

namespace AmqpDemo
{
 class Program
 {
 /// <summary>
 /// Access domain name. For details, see "AMQP Client Access".
 /// See Connection Configuration Parameters.
 /// </summary>
 static string Host = "${Host}";

 /// <summary>
 /// Port
 /// </summary>
 static int Port = 5671;

 /// <summary>
 /// Access key
 /// </summary>
 static string AccessKey = "${YourAccessKey}";

 /// <summary>
```

```
/// Access code
/// </summary>
static string AccessCode = "${yourAccessCode}";

/// <summary>
/// Instance ID. This parameter is required when multiple instances of the Standard Edition are
purchased in the same region.
/// </summary>
static string InstanceId = "${instanceId}";

/// <summary>
/// Queue name
/// </summary>
static string QueueName = "${yourQueue}";

static Connection connection;

static Session session;

static ReceiverLink receiverLink;

static DateTime lastConnectTime = DateTime.Now;

static void Main(string[] args)
{
 try
 {
 connection = CreateConnection();
 // Add a connection exception callback.
 connection.AddClosedCallback(ConnectionClosed);

 // Create a session.
 var session = new Session(connection);

 // Create a receiver link.
 receiverLink = new ReceiverLink(session, "receiverName", QueueName);

 // Receive a message.
 ReceiveMessage(receiverLink);
 }
 catch (Exception e)
 {
 Console.WriteLine(e);
 }

 // Press Enter to exit the program.
 Console.ReadLine();

 ShutDown();
}

/// <summary>
/// Create a connection.
/// </summary>
/// <returns>Connection</returns>
static Connection CreateConnection()
{
 lastConnectTime = DateTime.Now;
 long timestamp = new DateTimeOffset(DateTime.UtcNow).ToUnixTimeMilliseconds();
 string userName = "accessKey=" + AccessKey + "|timestamp=" + timestamp + "|instanceId=" +
InstanceId;
 Address address = new Address(Host, Port, userName, AccessCode);
 ConnectionFactory factory = new ConnectionFactory();
 factory.SASL.Profile = SaslProfile.External;
 // Trust the server and skip certificate verification.
 factory.SSL.RemoteCertificateValidationCallback = (sender, certificate, chain, sslPolicyError) =>
{ return true; };
 factory.AMQP.IdleTimeout = 8000;
 factory.AMQP.MaxFrameSize = 8 * 1024;
```

```
factory.AMQP.HostName = "default";
var connection = factory.CreateAsync(address).Result;
return connection;
}

static void ReceiveMessage(ReceiverLink receiver)
{
 receiver.Start(20, (link, message) =>
 {
 // Process the message in the thread pool to prevent the thread that pulls the message from
 // being blocked.
 ThreadPool.QueueUserWorkItem((obj) => ProcessMessage(obj), message);
 // Return an ACK message.
 link.Accept(message);
 });
}

static void ProcessMessage(Object obj)
{
 if (obj is Message message)
 {
 string body = message.Body.ToString();
 Console.WriteLine("receive message, body=" + body);
 }
}

static void ConnectionClosed(IAmqpObject amqpObject, Error e)
{
 // Reconnection upon disconnection
 ThreadPool.QueueUserWorkItem((obj) =>
 {
 ShutDown();
 int times = 0;
 while (times++ < 5)
 {
 try
 {
 Thread.Sleep(1000);
 connection = CreateConnection();
 // Add a connection exception callback.
 connection.AddClosedCallback(ConnectionClosed);

 // Create a session.
 session = new Session(connection);

 // Create a receiver link.
 receiverLink = new ReceiverLink(session, "receiverName", QueueName);

 // Receive a message.
 ReceiveMessage(receiverLink);
 break;
 }
 catch (Exception exception)
 {
 Console.WriteLine("reconnect error, exception =" + exception);
 }
 }
 });
}

static void ShutDown()
{
 if (receiverLink != null)
 {
 try
 {
 receiverLink.Close();
 }
 }
}
```

```
 }
 catch (Exception e)
 {
 Console.WriteLine("close receiverLink error, exception =" + e);
 }
}

if (session != null)
{
 try
 {
 session.Close();
 }
 catch (Exception e)
 {
 Console.WriteLine("close session error, exception =" + e);
 }
}

if (connection != null)
{
 try
 {
 connection.Close();
 }
 catch (Exception e)
 {
 Console.WriteLine("close connection error, exception =" + e);
 }
}
}
}
```

### 7.6.3.8 Android SDK Access Example

This topic describes how to use AMQP to connect the Android system to the IoT platform and receive subscribed messages from the platform.

## Preparations

- Install Android Studio. Go to the [Android Studio website](#) to download and install a desired version. The following uses Android Studio 4.1.1 running on 64-bit Windows as an example.

**Figure 7-56** Downloading Android Studio

Android Studio downloads

| Platform            | Android Studio package                                                            | Size   | SHA-256 checksum                                                 |
|---------------------|-----------------------------------------------------------------------------------|--------|------------------------------------------------------------------|
| Windows<br>(64-bit) | <a href="#">android-studio-ide-192.6392135-windows.exe</a><br>Recommended         | 756 MB | 07b6df807fda59e69f05b85ff6f6bd0c70d09e57fb151197155ef5f115f96e59 |
|                     | <a href="#">android-studio-ide-192.6392135-windows.zip</a><br>No .exe installer   | 770 MB | 24f8f9ce467b935c25d89b90cad402d21dd45d4ba9af1ad35baeeb414609e483 |
| Windows<br>(32-bit) | <a href="#">android-studio-ide-192.6392135-windows32.zip</a><br>No .exe installer | 770 MB | 7b24742726bbc8b40a55dab1f7cdf923ba384b233c21d35d6e96fa36320d067  |
| Mac<br>(64-bit)     | <a href="#">android-studio-ide-192.6392135-mac.dmg</a>                            | 768 MB | c50d347469be0d995e6b4d74ea72b3a5f2572e72b4eac37a0834b0a0984d9583 |
| Linux<br>(64-bit)   | <a href="#">android-studio-ide-192.6392135-linux.tar.gz</a>                       | 772 MB | 33ec9f61b20b71ca175cd39083b1379ebba896de78b826ea5df5d440c6adfd2a |
| Chrome OS           | <a href="#">android-studio-ide-192.6392135-cros.deb</a>                           | 653 MB | 59023aaabc7d5822fd7b1c5a71589b18e487ca8d7fd4320c3547ee0ad390e4ca |

- Install the JDK. You can also use the built-in JDK of the IDE.

- a. Go to the [Oracle website](#) to download a desired version. The following uses JDK 8 for Windows x64 as an example.
- b. After the download is complete, run the installation file and install Node.js as prompted.

## Development Environment

The development environments used in this example are as follows:

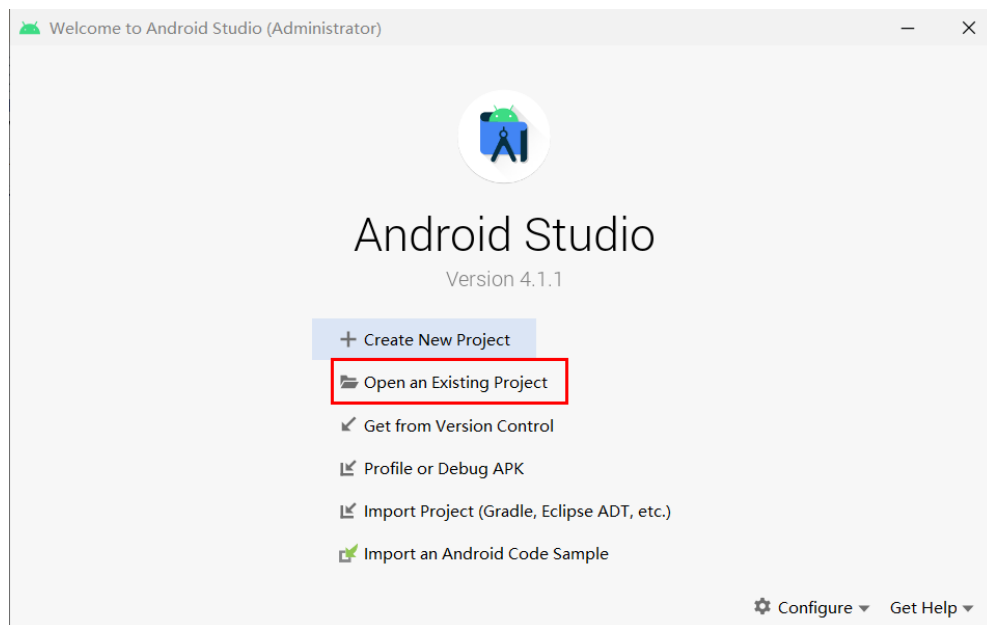
- JDK 1.8 or later
- Android SDK Platform of API level 28 or later
- [Apache Qpid Proton-J](#) client

## Sample Code

**Step 1** Download the [AMQP demo](#).

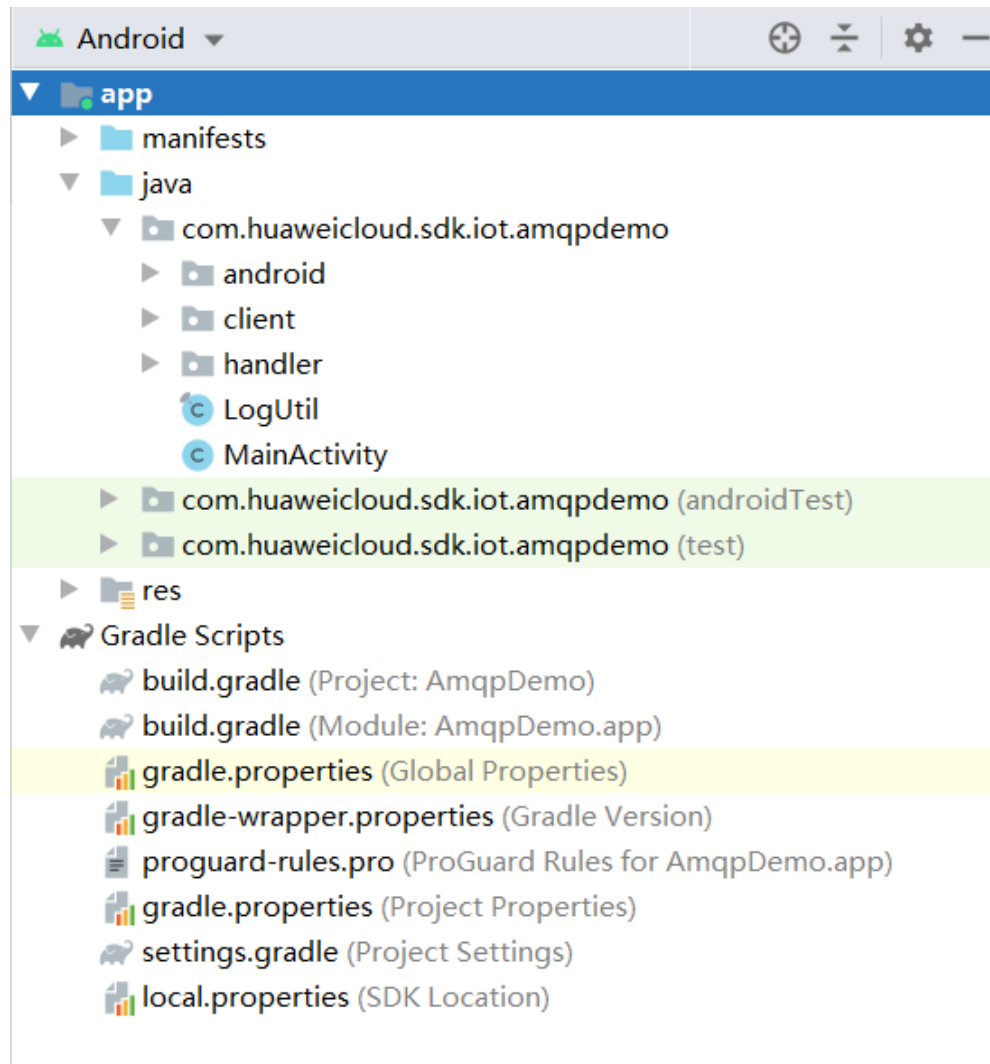
**Step 2** Run Android Studio, click **Open**, and select the sample code downloaded in **1**.

**Figure 7-57** Incorporate into existing projects



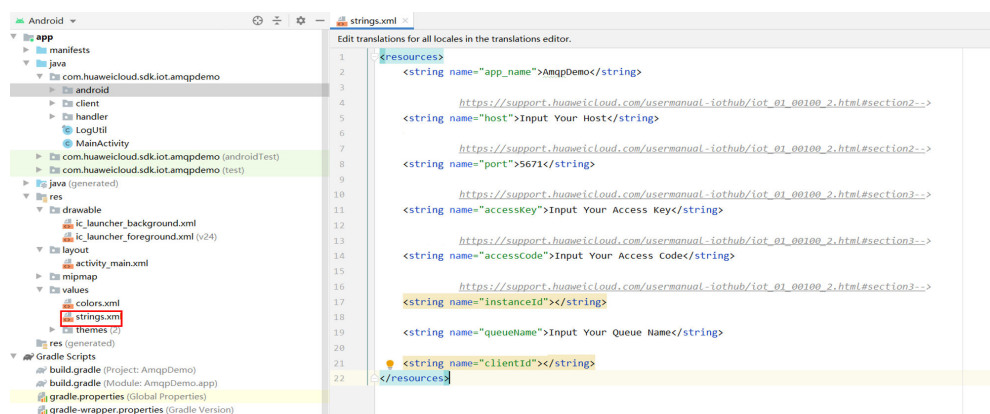
**Step 3** Import the sample code.

Figure 7-58 Importing the project structure



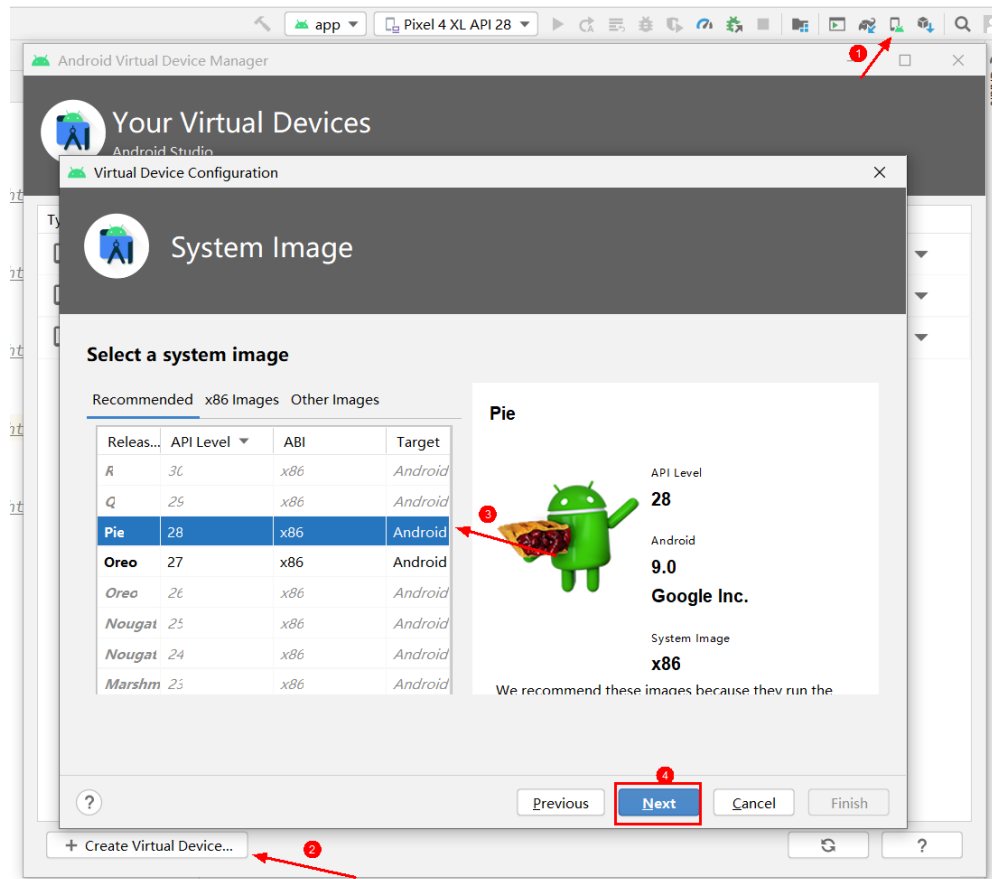
**Step 4** (Optional) Set AMQP connection parameters in the `res\values\strings.xml` file in advance. For details, see [AMQP Client Access](#).

Figure 7-59 Modifying connection parameters



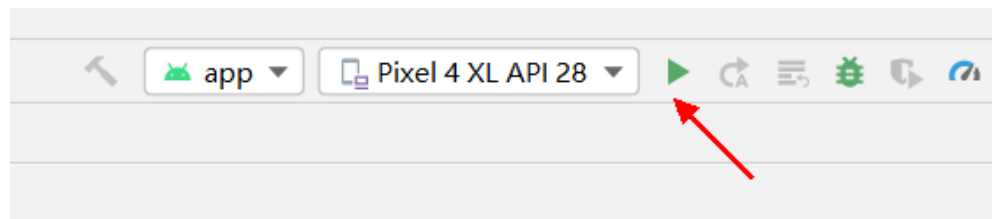
**Step 5** In the AVD Manager configuration, select a device model and a virtual device of API level 28 for debugging.

**Figure 7-60** Configuring the AVD Manager



**Step 6** Start the demo for debugging.

**Figure 7-61** Starting the demo

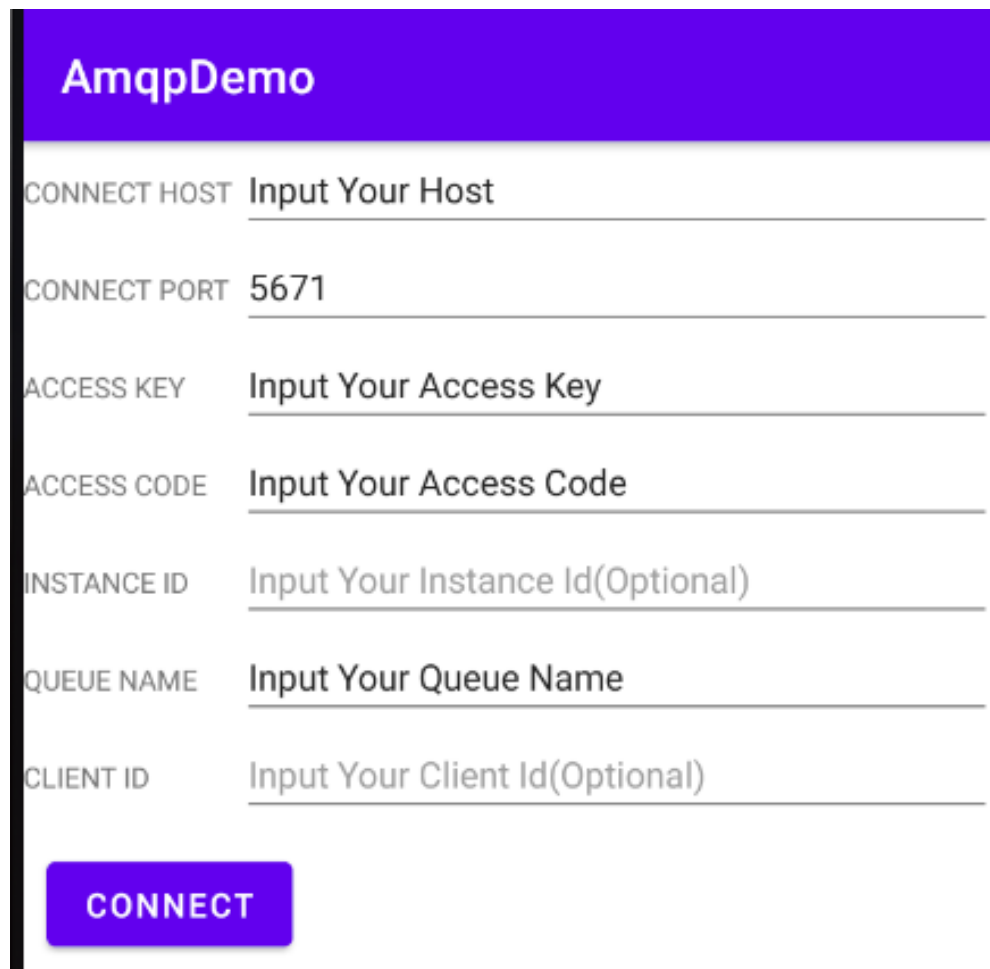


----End

## Related Information

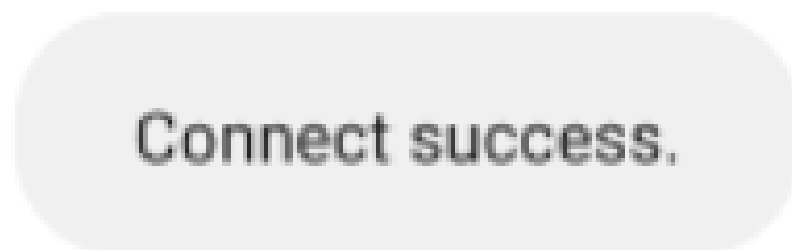
AMQP connection configuration page is displayed in the following figure. **INSTANCE ID** is mandatory when multiple standard IoTDA instances are purchased in the same region. For details about the parameters, see [AMQP Client Access](#).

Figure 7-62 AMQP connection configuration



- The following figure shows the page indicating that the connection is successful after the parameter modification.

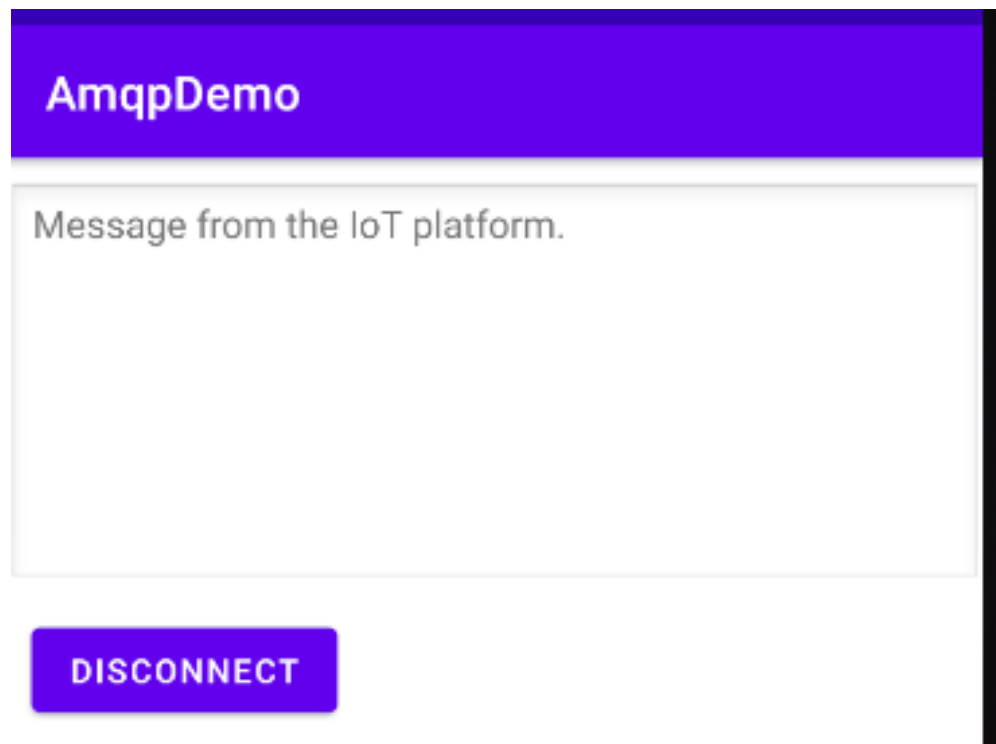
Figure 7-63 Connection succeeded



- The following figure shows the page indicating that the transfer data is successfully obtained.

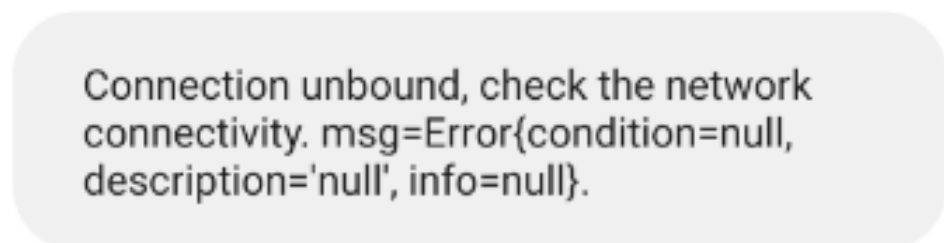


**Figure 7-64** Receiving platform messages



- The following figure shows the page indicating that the network connection failed.

**Figure 7-65** Network connection failed



- The following figure shows the page indicating that access information (**accessKey**, **accessCode**, and **instanceId**) is incorrect.

**Figure 7-66** Incorrect access information

```
Sasl failed. Check whether the
accessKey、 accessCode and
instanceId are correct. sasl=SaslImpl
[_outcome=PN_SASL_AUTH,
state=PN_SASL_FAIL, done=true,
role=CLIENT]
```

- The following figure shows the page indicating that the queue does not exist.

**Figure 7-67** Queue not existing

```
Link remote close. Check whether
the queue is exist in IoT platform.
msg=Error{condition=amqp:not-allowed,
description=', info=null}
```

### 7.6.3.9 Python SDK Access Example

This topic describes how to use a Python 3 SDK to connect to the Huawei Cloud IoT platform and receive subscribed messages from the platform based on AMQP.

#### Development Environment

Python 3.0 or later is required. In this example, Python 3.9 is used.

#### Downloading the SDK

In this example, AMQP SDK [python-qpuid-proton](#) (version 0.37.0) is used. You can run the following command to install the SDK of the latest version:

```
pip install python-qpuid-proton
```

You can also manually install it by referring to [Installing Qpid Proton](#).

#### Sample Code

```
import threading
import time

from proton import SSLDomain
```

```
from proton.handlers import MessagingHandler
from proton.reactor import Container

Reconnection times
reconnectTimes = 0

def current_time_millis():
 return str(int(round(time.time() * 1000)))

class AmqpClient(MessagingHandler):
 def __init__(self, host, port, accessKey, accessCode, queueName, instanceId):
 super(AmqpClient, self).__init__()
 self.host = host
 self.port = port
 self.accessKey = accessKey
 self.accessCode = accessCode
 self.queueName = queueName
 self.instanceId = instanceId

 def on_start(self, event):
 # Access domain name. For details, see "AMQP Client Access".
 url = "amqs://%s:%s" % (self.host, self.port)

 timestamp = current_time_millis()
 userName = "accessKey=" + self.accessKey + "|timestamp=" + timestamp + "|instanceId=" +
self.instanceId
 passWord = self.accessCode
 # By default, the server certificate is not verified.
 sslDomain = SSLDomain(SSLDomain.MODE_CLIENT)
 sslDomain.set_peer_authentication(SSLDomain.ANONYMOUS_PEER)
 self.conn = event.container.connect(url, user=userName, password=passWord, heartbeat=60,
ssl_domain=sslDomain,
reconnect=False)
 event.container.create_receiver(self.conn, source=self.queueName)

 # Called when the connection is established.
 def on_connection_opened(self, event):
 global reconnectTimes
 reconnectTimes = 0
 print("Connection established, remoteUrl: %s", event.connection.hostname)

 # Called when the connection is cut off.
 def on_connection_closed(self, event):
 print("Connection closed: %s", self)
 ReconnectThread("reconnectThread").start()

 # Called when the remote end is disconnected due to an error.
 def on_connection_error(self, event):
 print("Connection error:%s", self)
 ReconnectThread("reconnectThread").start()

 # Called when an error occurs during AMQP connection establishment. Such errors include
authentication and socket errors.
 def on_transport_error(self, event):
 if event.transport.condition:
 if event.transport.condition.info:
 print("%s: %s: %s" % (event.transport.condition.name, event.transport.condition.description,
event.transport.condition.info))
 else:
 print("%s: %s" % (event.transport.condition.name, event.transport.condition.description))
 else:
 print("Unspecified transport error")
 ReconnectThread("reconnectThread").start()

 # Called when a message is received.
 def on_message(self, event):
 message = event.message
```

```
content = message.body
print("receive message: content=%s" % content)

class ReconnectThread(threading.Thread):
 def __init__(self, name):
 threading.Thread.__init__(self)
 self.name = name

 def run(self):
 global reconnectTimes
 reconnectTimes = reconnectTimes + 1
 time.sleep(15 if reconnectTimes > 15 else reconnectTimes)
 Container(AmqpClient(amqpHost, amqpPort, amqpAccessKey, amqpAccessCode, amqpQueueName,
instanceld)).run()

For details about how to set the following parameters, see Connection Configuration Parameters.
AMQP access domain name
amqpHost = "127.0.0.1"

AMQP access port
amqpPort = 5671

Access key
amqpAccessKey = 'your AccessKey'

Access code
amqpAccessCode = 'your AccessCode'

Name of the subscription queue
amqpQueueName = 'DefaultQueue'

Instance ID. This parameter is mandatory when multiple instances of the standard edition are purchased
in the same region.
instanceld = ""

Container(AmqpClient(amqpHost, amqpPort, amqpAccessKey, amqpAccessCode, amqpQueueName,
instanceld)).run()
```

### 7.6.3.10 Go SDK Access Example

This topic describes how to use a Go SDK to connect to the Huawei Cloud IoT platform and receive subscribed messages from the platform based on AMQP.

## Development Environment Requirements

Go 1.16 or later has been installed.

## Adding Dependencies

Add the following dependencies to **go.mod**:

```
require (
 pack.ag/amqp v0.12.5 // v0.12.5 is used in this example. Select a version as required.
)
```

## Sample Code

```
package main

import (
 "context"
 "crypto/tls"
 "fmt"
```

```
"pack.ag/amqp"
"time"
)

type AmqpClient struct {
 Title string
 Host string
 AccessKey string
 AccessCode string
 InstanceId string
 QueueName string

 address string
 userName string
 password string

 client *amqp.Client
 session *amqp.Session
 receiver *amqp.Receiver
}

type MessageHandler interface {
 Handle(message *amqp.Message)
}

func (ac *AmqpClient) InitConnect() {
 if ac.QueueName == "" {
 ac.QueueName = "DefaultQueue"
 }
 ac.address = "amqps://" + ac.Host + ":5671"
 ac.userName = fmt.Sprintf("accessKey=%s|timestamp=%d|instanceId=%s", ac.AccessKey,
time.Now().UnixNano()/1000000, ac.InstanceId)
 ac.password = ac.AccessCode
}

func (ac *AmqpClient) StartReceiveMessage(ctx context.Context, handler MessageHandler) {
 childCtx, _ := context.WithCancel(ctx)
 err := ac.generateReceiverWithRetry(childCtx)
 if nil != err {
 return
 }
 defer func() {
 _ = ac.receiver.Close(childCtx)
 _ = ac.session.Close(childCtx)
 _ = ac.client.Close()
 }()

 for {
 // Block message receiving. If ctx is a context created based on the background function, message
receiving will not be blocked.
 message, err := ac.receiver.Receive(ctx)
 if nil == err {
 go handler.Handle(message)
 _ = message.Accept()
 } else {
 fmt.Println("amqp receive data error: ", err)

 // If message receiving is manually disabled, exit the program.
 select {
 case <-childCtx.Done():
 return
 default:
 }

 // If message receiving is not manually disabled, retry the connection.
 err := ac.generateReceiverWithRetry(childCtx)
 if nil != err {
 return
 }
 }
 }
}
```

```
 }
 }
}

func (ac *AmqpClient) generateReceiverWithRetry(ctx context.Context) error {
 // Retries with exponential backoff, from 10 ms to 20s.
 duration := 10 * time.Millisecond
 maxDuration := 20000 * time.Millisecond
 times := 1

 // Retries with exponential backoff
 for {
 select {
 case <-ctx.Done():
 return amqp.ErrConnClosed
 default:
 }

 err := ac.generateReceiver()
 if nil != err {
 fmt.Println("amqp ac.generateReceiver error ", err)
 time.Sleep(duration)
 if duration < maxDuration {
 duration *= 2
 }
 fmt.Println("amqp connect retry,times:", times, ",duration:", duration)
 times++
 return nil
 } else {
 fmt.Println("amqp connect init success")
 return nil
 }
 }
}

// The statuses of the connection and session cannot be determined because the packets are unavailable.
// Retry the connection to obtain the information.
func (ac *AmqpClient) generateReceiver() error {

 if ac.session != nil {
 receiver, err := ac.session.NewReceiver(
 amqp.LinkSourceAddress(ac.QueueName),
 amqp.LinkCredit(20),
)
 // If a network disconnection error occurs, the connection is ended and the session fails to be
 // established. Otherwise, the connection is established.
 if err == nil {
 ac.receiver = receiver
 return nil
 }
 }

 // Delete the previous connection.
 if ac.client != nil {
 _ = ac.client.Close()
 }
 ac.userName = fmt.Sprintf("accessKey=%s|timestamp=%d|instanceId=%s", ac.AccessKey,
 time.Now().UnixNano()/1000000, ac.InstanceId)
 fmt.Println("[" + ac.Title + "] Dial... addr=[" + ac.address + "], username=[" + ac.userName + "],
password=[" + ac.password + "]")
 client, err := amqp.Dial(ac.address,
 amqp.ConnSASLPlain(ac.userName, ac.password),
 amqp.ConnProperty("vhost", "default"),
 amqp.ConnServerHostname("default"),
 amqp.ConnTLSConfig(&tls.Config{InsecureSkipVerify: true,
 MaxVersion: tls.VersionTLS12,
 })),
 amqp.ConnConnectTimeout(8*time.Second))
 if err != nil {
```

```
 fmt.Println("Dial", err)
 return err
}
ac.client = client
session, err := client.NewSession()
if err != nil {
 XDebug("Error: NewSession", err)
 return err
}
ac.session = session

receiver, err := ac.session.NewReceiver(
 amqp.LinkTargetDurability(amqp.DurabilityUnsettledState),
 amqp.LinkSourceAddress(ac.QueueName),
 amqp.LinkCredit(100),
)
if err != nil {
 XDebug("Error: NewReceiver", err)
 return err
}
ac.receiver = receiver

return nil
}

func XDebug(s string, err error) {
 fmt.Println(s, err)
}

type CustomerMessageHandler struct {
}

func (c *CustomerMessageHandler) Handle(message *amqp.Message) {
 fmt.Println("AMQP receives messages.", message.Value)
}

func main() {
 // For details about how to set the following parameters, see Connection Configuration Parameters.
 // AMQP access domain name
 amqpHost := "127.0.0.1"

 // Access key
 amqpAccessKey := "your accessKey"

 // Access code
 amqpAccessCode := "your accessCode"

 // Instance ID
 instanceld := "your intanceld"

 // Name of the subscription queue
 amqpQueueName := "DefaultQueue"

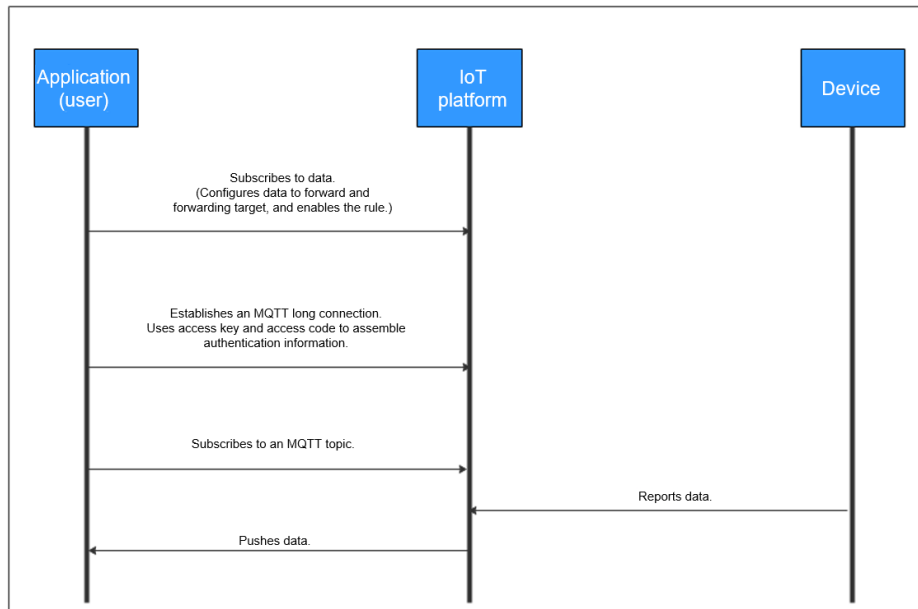
 amqpClient := &AmqpClient{
 Title: "test",
 Host: amqpHost,
 AccessKey: amqpAccessKey,
 AccessCode: amqpAccessCode,
 Instanceld: instanceld,
 QueueName: amqpQueueName,
 }

 handle := CustomerMessageHandler{}
 amqpClient.InitConnect()
 ctx := context.Background()
 amqpClient.StartReceiveMessage(ctx, &handle)
}
```

## 7.6.4 MQTT Data Forwarding

### 7.6.4.1 Overview

The figure below shows the subscription and push process.



**Push mechanism:** The IoT platform pushes QoS 0 messages to users. If a user does not establish a connection or does not subscribe to the topic after the connection is established, the IoT platform will delete expired data and data that exceeds the capacity limit in rolling mode when the maximum cache duration (24 hours) or maximum cache size (1 GB) is reached or exceeded.

### Subscribing to Data

1. You can create a rule and add an MQTT message queue as the forwarding target on the console to subscribe to data. For details, see [MQTT Server Configuration](#).
2. Call APIs to subscribe to data. For details, see [Calling APIs](#), [Creating a Rule Triggering Condition](#), [Creating a Rule Action](#), and [Modifying a Rule Triggering Condition](#).

### Format of Pushed Data

For details on the format of data pushed by the platform to applications after data subscription is created, see [Data Transfer APIs](#).

### Constraints

| Description            | Constraint |
|------------------------|------------|
| Supported MQTT version | 3.1.1      |



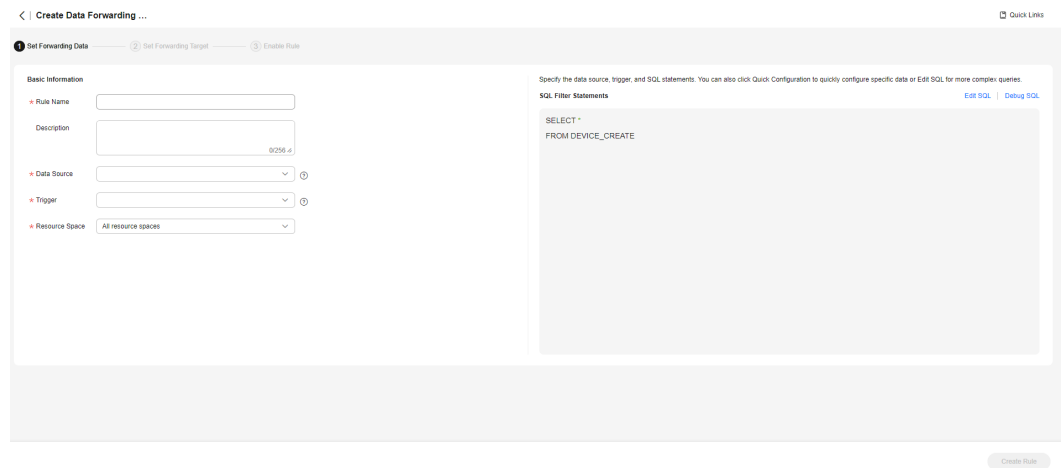
| Description                                                              | Constraint                                                                                                                                                                                                                                                                                                         |
|--------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Differences from the standard MQTT protocol                              | <ul style="list-style-type: none"> <li>• QoS 0 is supported.</li> <li>• Custom topics are supported.</li> <li>• Shared subscription is supported.</li> <li>• QoS 1 and QoS 2 are not supported.</li> <li>• Will and retained messages are not supported.</li> <li>• Client publishing is not supported.</li> </ul> |
| Security level supported by MQTTS                                        | TCP + TLS (TLS v1.2)<br>Supported cipher suites: <ul style="list-style-type: none"> <li>• TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256</li> <li>• TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384</li> </ul>                                                                                                                        |
| MQTT connection requests for an account per second                       | 10                                                                                                                                                                                                                                                                                                                 |
| MQTT connections for an account                                          | 10 per access credential                                                                                                                                                                                                                                                                                           |
| Push rate of an MQTT connection                                          | 1,000 TPS                                                                                                                                                                                                                                                                                                          |
| Message cache duration and size                                          | The maximum duration is one day, and the maximum size is 1 GB. Caching is limited by either of the item. For example, if the cache duration exceeds one day, data will not be cached even if the size does not reach 1 GB.                                                                                         |
| Recommended heartbeat interval for MQTT connections                      | Range: 30s to 1200s; recommended: 120s                                                                                                                                                                                                                                                                             |
| Message publishing and subscription                                      | <ul style="list-style-type: none"> <li>• Shared subscription is supported. Clients that subscribe to the same topic consume pushed data in polling mode. Clients can subscribe to only the topics created in the forwarding rule.</li> <li>• Message publishing is not supported.</li> </ul>                       |
| Subscriptions per subscription request                                   | Maximum number of topics supported by an account                                                                                                                                                                                                                                                                   |
| Topics subscribed to by an account (created during rule action creation) | 100                                                                                                                                                                                                                                                                                                                |

### 7.6.4.2 MQTT Server Configuration

This topic describes how to set and manage MQTT server subscription on the IoT platform.

- Step 1** Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Rules > Data Forwarding**, and click **Create Rule** on the left.

**Figure 7-68** Data forwarding - Creating a rule



- Step 3** Set the parameters based on the table below and click **Create Rule**.

**Table 7-16** Parameters for creating a rule

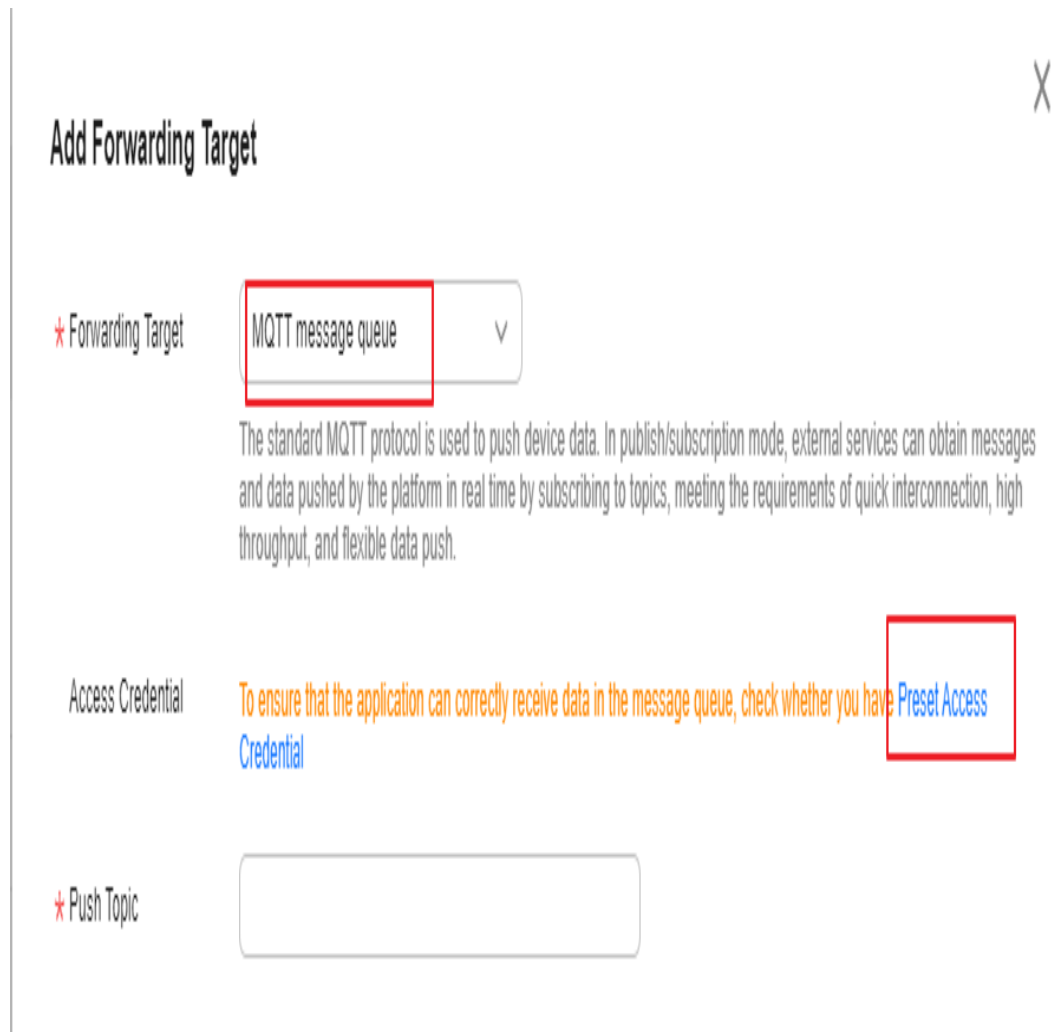
| Parameter   | Description                     |
|-------------|---------------------------------|
| Rule Name   | Name of the rule to be created. |
| Description | Description of the rule.        |

| Parameter      | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Data Source    | <ul style="list-style-type: none"> <li>● <b>Device:</b> Device information, such as device addition, deletion, and update, will be forwarded. When <b>Data Source</b> is set to <b>Device</b>, quick configuration is not supported.</li> <li>● <b>Device property:</b> A property value reported by a device in a resource space will be forwarded. Click <b>Quick Configuration</b> on the right and select the product, property, and service data to forward.</li> <li>● <b>Device message:</b> A message reported by a device in a resource space will be forwarded. Click <b>Quick Configuration</b> on the right and select data of a specified topic to forward. Select the product to which the topic belongs and enter the topic name. You can use a <b>custom topic</b> on the product details page or a <b>preset topic</b>.</li> <li>● <b>Device message status:</b> The status of device messages exchanged between the device and platform will be forwarded. For details on the device message status, see <b>Message Delivery Status</b>. When <b>Data Source</b> is set to <b>Device message status</b>, quick configuration is not supported.</li> <li>● <b>Device status:</b> The status change of a directly or an indirectly connected device in a resource space will be forwarded. Click <b>Quick Configuration</b> on the right to forward information about devices whose status is <b>Online</b>, <b>Offline</b>, or <b>Abnormal</b> to other services. For details on the status of devices directly connected to the platform, see <b>Device Management</b>.</li> <li>● <b>Batch task:</b> The batch task status will be forwarded. When <b>Data Source</b> is set to <b>Batch Task</b>, quick configuration is not supported.</li> <li>● <b>Product:</b> Product information, such as product addition, deletion, and update, will be forwarded. When <b>Data Source</b> is set to <b>Product</b>, quick configuration is not supported.</li> <li>● <b>Asynchronous command status of the device:</b> Status changes of asynchronous commands to devices using LwM2M over CoAP will be forwarded. For details on the asynchronous command status of devices, see <b>Asynchronous Command Delivery</b>. When <b>Data Source</b> is set to <b>Asynchronous command status of the device</b>, quick configuration is not supported.</li> <li>● <b>Run log:</b> Service run logs of MQTT devices will be forwarded. When <b>Data Source</b> is set to <b>Run log</b>, quick configuration is not supported.</li> </ul> |
| Trigger        | After you select a data source, the platform automatically matches trigger events.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Resource Space | You can select a single resource space or all resource spaces. If <b>All resource spaces</b> is selected, quick configuration is not supported.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |

**Step 4** Under **Set Forwarding Target**, click **Add**. On the displayed page, set the parameters based on the table below and click **OK**.

| Parameter         | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Forwarding Target | Select <b>MQTT message queue</b> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| Push Topic        | Enter the MQTT topic to which data is forwarded. <ul style="list-style-type: none"> <li>The topic queue name can be customized and must be unique under an account. It can contain up to 128 characters. Use only letters, digits, underscores (_), hyphens (-), and slashes (/).</li> <li>The topic that is used for the first time belongs to the resource space selected during rule creation. The topic can be used only in the resource space. If <b>All resource spaces</b> is selected during rule creation, the topic can be used in all resource spaces.</li> </ul> |

**Figure 7-69** Creating a forwarding target - to an MQTT push message queue



**Step 5** After the rule is defined, click **Enable Rule** to start forwarding data to the MQTT message queue.

----End

### 7.6.4.3 MQTT Client Access

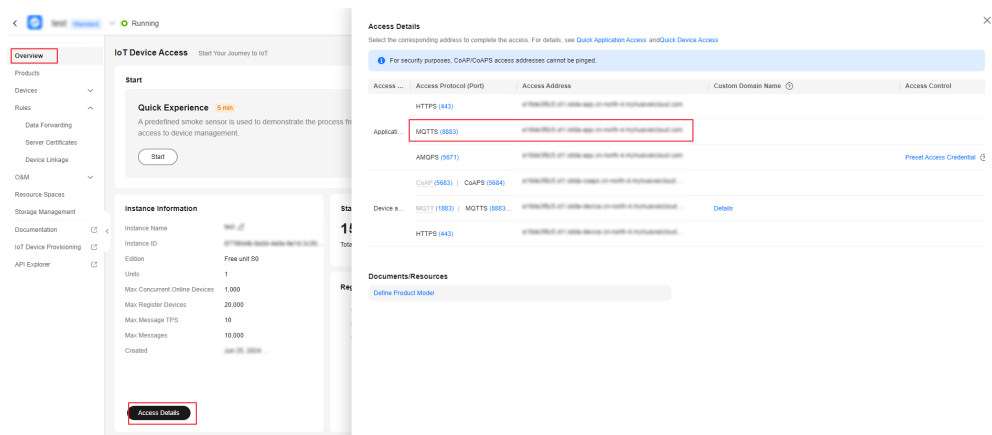
After configuring and activating rules by calling the platform APIs [Creating a Rule Triggering Condition](#), [Creating a Rule Action](#), and [Modifying a Rule Triggering Condition](#), connect the MQTT client to IoTDA. Then run the MQTT client on your server to receive subscribed-to messages.

## Connection Configuration Parameters

The table below describes the connection address and connection authentication parameters for the MQTT client to connect to the platform.

- MQTT access domain name  
It is automatically generated for each account. Log in to the [IoTDA console](#) to obtain it on the **Access Details** page.

**Figure 7-70** Access information - MQTT access address on the application side



- Port: 8883
- Client identity authentication parameters  
clientId: The value must be globally unique. You are advised to use **username**.  
username = "accessKey=\${accessKey}|timestamp=\${timestamp}|instanceId=\${instanceId}"  
password = "\${accessCode}"

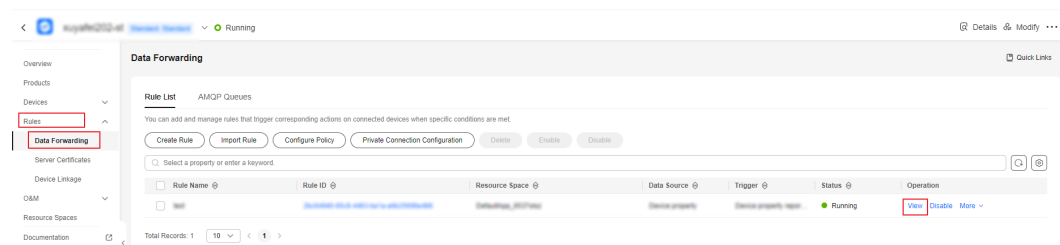
| Parameter              | Mandatory | Description                                                                                                                                                                                                                                            |
|------------------------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| \$<br>{accessKey<br>}  | Yes       | An accessKey can be used to establish a maximum of 10 concurrent connections. When establishing a connection for the first time, preset the parameter by following the instructions provided in <a href="#">Obtaining the AMQP Access Credential</a> . |
| \$<br>{timestamp<br>}  | Yes       | Current time. The value is a 13-digit timestamp, accurate to milliseconds. The server verifies the client timestamp. There is a 5-minute difference between the client timestamp and server timestamp.                                                 |
| instanceId             | Optional  | Instance ID. This parameter is mandatory when multiple instances of the standard edition are purchased in the same region. For details, see <a href="#">Viewing Instance Details</a> .                                                                 |
| \$<br>{accessCode<br>} | Yes       | The value can contain a maximum of 256 characters.                                                                                                                                                                                                     |

## Obtaining the MQTT Access Credential

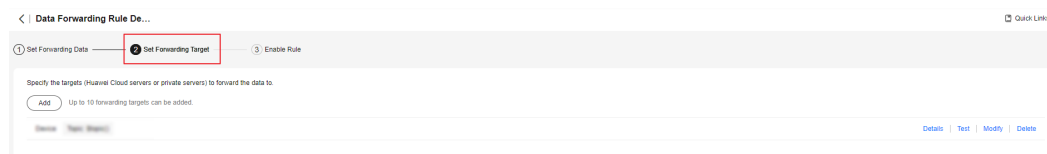
An access credential is required for an application that uses MQTT to connect to the platform for data forwarding. If you use an access credential for the first time or forget it, preset an access credential. You can call the API for [generating an access credential](#) or use the console to preset an access credential. The procedure for using the console to generate an access credential is as follows:

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** Choose **Rules > Data Forwarding**. The **Rule List** page is displayed.

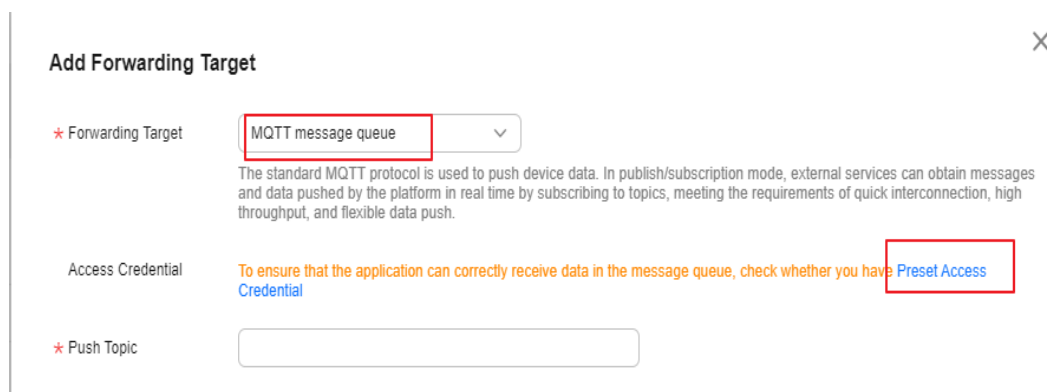
**Figure 7-71** Rule details - Viewing rule details



- Step 3** Click **View**. (If no rule exists, create one.) On the rule details page that is displayed, click the **Set Forwarding Target** tab.

**Figure 7-72** Forwarding target - Setting a target

**Step 4** Click **Add**. On the **Add Forwarding Target** page that is displayed, select **MQTT message queue** for **Forwarding Target**, and click **Preset Access Credential** to preset the access code and access key.

**Figure 7-73** Creating a forwarding target - to an MQTT push message queue with preset credentials**NOTE**

If you already have an access credential, the accessKey cannot be used after you preset the access credential again.

----End

## Receiving Push Messages

After a connection is established between the client and the platform, subscribe to the MQTT topic in the data forwarding rule. When a device reports data and the rule is triggered, the platform pushes the data to the MQTT client.

### 7.6.4.4 Java Demo Usage Guide

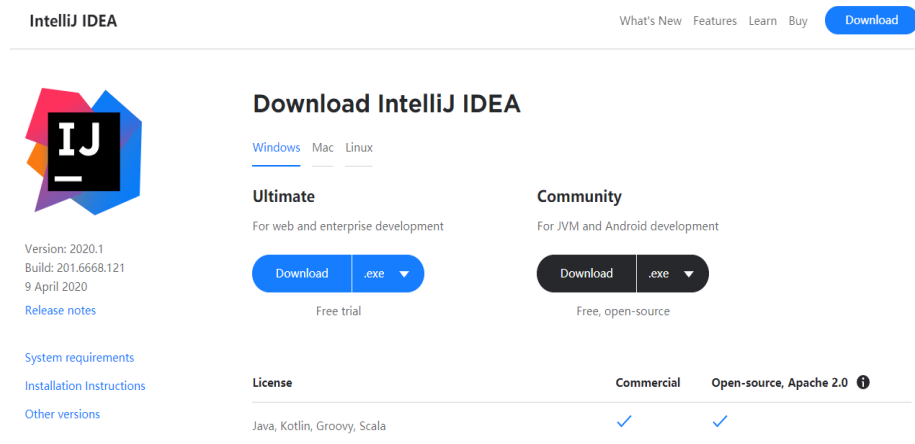
This topic uses Java as an example to describe how to connect an MQTTS client to the platform and receive subscribed messages from the platform.

## Prerequisites

You have installed IntelliJ IDEA by following the instructions provided in For details about the installation, see [Installing IntelliJ IDEA](#).

## Installing IntelliJ IDEA

1. Go to the [IntelliJ IDEA website](#) to download and install a desired version. The following uses 64-bit IntelliJ IDEA 2019.2.3 Ultimate as an example.

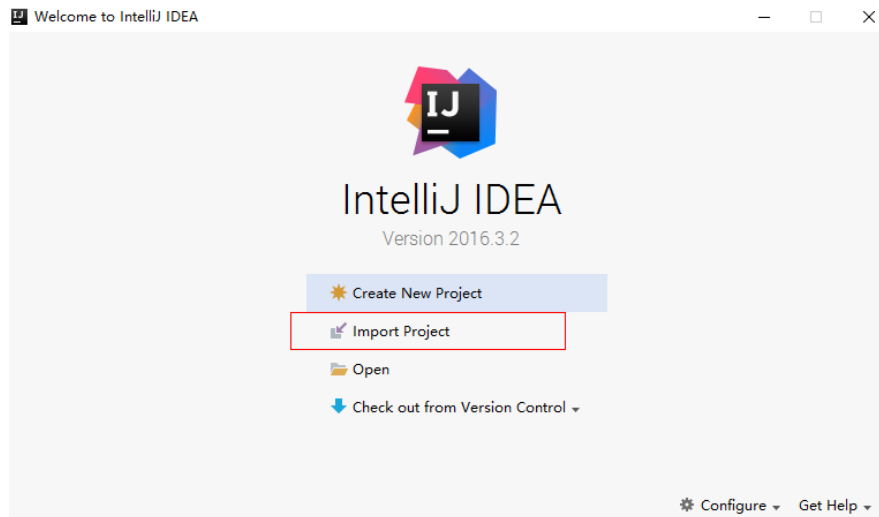


2. After the download is complete, run the installation file and install Node.js as prompted.

## Importing Sample Code

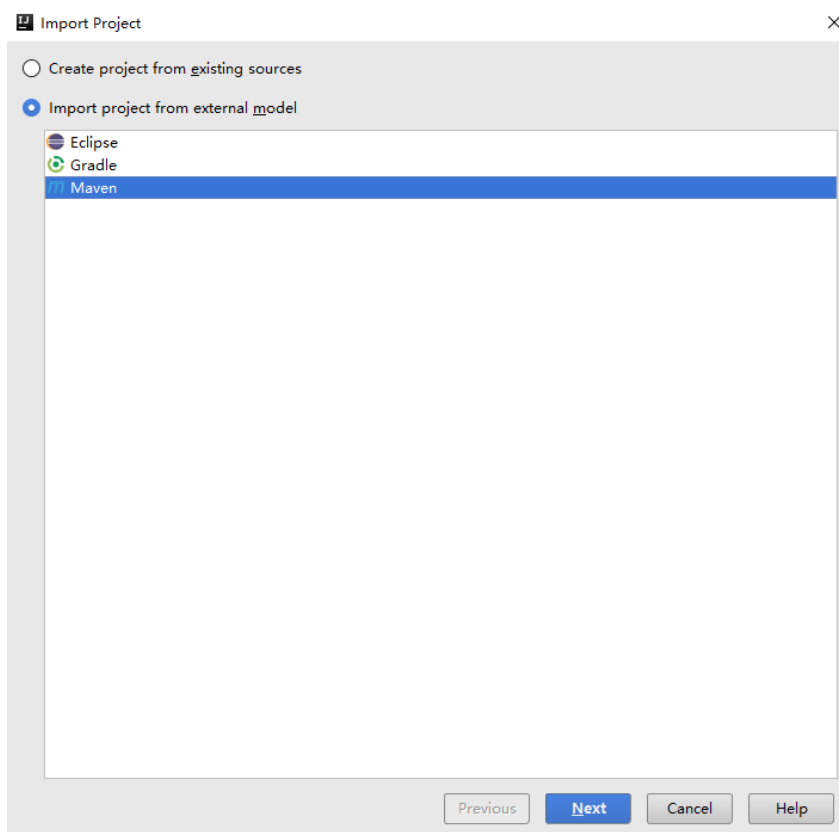
**Step 1** Download the [Java demo](#).

**Step 2** Open the IDEA developer tool and click **Import Project**.

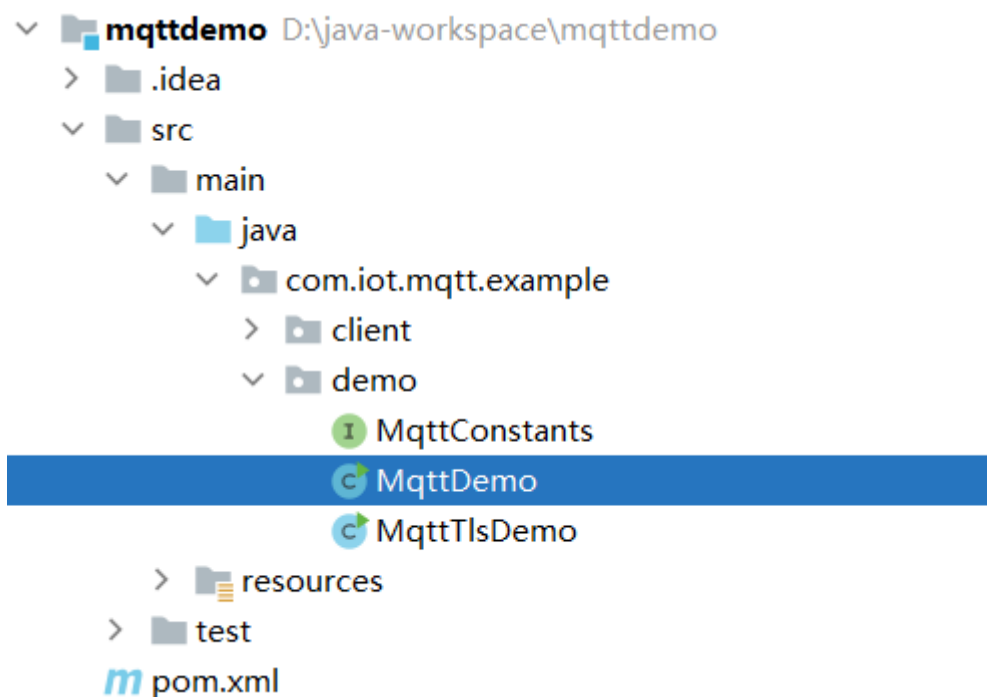


**Step 3** Select the Java demo downloaded in **1** and click **Next**.





**Step 4** Import the sample code.



----End

## Establishing a Connection

- Step 1** Set the access address and authentication parameters in `com.iot.mqtt.example.demo.MqttConstants`.

```
// Address for connecting the MQTT client to the platform. Replace it with the MQTT access domain name in "Connection Configuration Parameters".
String HOST = "${HOST}";
// Access credential. Replace it with the access credential obtained in "Obtaining the MQTT Access Credential".
String ACCESS_KEY = "${accessKey}";
String ACCESS_CODE = "${accessCode}";
// Instance ID. This parameter is mandatory when multiple standard instances are purchased in the same region.
String INSTANCE_ID = "${instanceId}";
// Topic for receiving data. Replace it with the topic used for rule action creation.
String SUBSCRIBE_TOPIC = "${subscribeTopic}";
```

### NOTE

For details about the parameters in the demo, see [Connection Configuration Parameters](#).

- Step 2** Run the sample code (`com.iot.mqtt.example.demo.MqttDemo`) and check whether the subscription is successful based on the log information. This example does not involve the server certificate verification. For details about how to verify the server certificate, see `com.iot.mqtt.example.demo.MqttTlsDemo`.

- Successful subscription

**Figure 7-74** Successful subscription

```
connect success, server url: ssl://[redacted]
Mqtt client connected. address is ssl://[redacted]
ibeListenerImpl - Subscribe mqtt topic onSuccess qos: 0
```

- Failed subscription
  - a. The username or password is incorrect.

**Figure 7-75** Incorrect username or password

```
connect failed, the reason is Bad user name or password (4)
```

- b. The topic does not exist.

**Figure 7-76** The topic does not exist

```
connect success, server url: ssl://[redacted]
Mqtt client connected. address is ssl://[redacted]
ibeListenerImpl - Subscribe mqtt topic qos: 128
ibeListenerImpl - Subscribe mqtt topic [redacted] failed.
```

----End

## Receiving Data

After topic subscription, when a device reports data and a rule is triggered, the MQTT client can receive the forwarded data. The following figure shows the logs generated when the forwarded data is received.

**Figure 7-77** Receiving the forwarded data

```
nt - connect success, server url: ssl://[REDACTED]
nt - Mqtt client connected. address is ssl://[REDACTED]
unsubscribeListenerImpl - Subscribe mqtt topic qos: 0
begin to handler msg. topic = [REDACTED] payload = {"resource":"device.property","event":
```

### 7.6.4.5 Python Demo

This section uses Python as an example to describe how to connect an MQTTS client to the platform and receive subscribed messages from the platform.

#### Prerequisites

Knowledge of basic Python syntax and how to configure development environments.

#### Development Environment

In this example, Python 3.8.8 is used.

#### Dependency

In this example, [paho-mqtt](#) (version 2.0.0) is used. You can run the following command to download the dependency:

```
pip install paho-mqtt==2.0.0
```

#### Sample Code

ClientConf code:

```
from typing import Optional
class ClientConf:
 def __init__(self):
 # MQTT subscription address
 self.__host: Optional[str] = None
 # MQTT subscription port number
 self.__port: Optional[int] = None
 # MQTT access credential access_key
 self.__access_key: Optional[str] = None
 # MQTT access credential access_code
 self.__access_code: Optional[str] = None
 # MQTT subscription topic
 self.__topic: Optional[str] = None
 # Instance ID. This parameter is mandatory when multiple instances of the standard edition are
 # purchased in the same region.
 self.__instance_id: Optional[str] = None
 # mqtt qos
 self.__qos = 1

 @property
 def host(self):
 return self.__host
 @host.setter
 def host(self, host):
 self.__host = host
 @property
 def port(self):
 return self.__port
 @port.setter
```

```
def port(self, port):
 self.__port = port
@property
def access_key(self):
 return self.__access_key
@access_key.setter
def access_key(self, access_key):
 self.__access_key = access_key
@property
def access_code(self):
 return self.__access_code
@access_code.setter
def access_code(self, access_code):
 self.__access_code = access_code
@property
def topic(self):
 return self.__topic
@topic.setter
def topic(self, topic):
 self.__topic = topic
@property
def instance_id(self):
 return self.__instance_id
@instance_id.setter
def instance_id(self, instance_id):
 self.__instance_id = instance_id
@property
def qos(self):
 return self.__qos
@qos.setter
def qos(self, qos):
 self.__qos = qos
```

#### MqttClient code:

```
import os
import ssl
import threading
import time
import traceback
import secrets
from client_conf import ClientConf
import paho.mqtt.client as mqtt
class MqttClient:
 def __init__(self, client_conf: ClientConf):
 self.__host = client_conf.host
 self.__port = client_conf.port
 self.__access_key = client_conf.access_key
 self.__access_code = client_conf.access_code
 self.__topic = client_conf.topic
 self.__instance_id = client_conf.instance_id
 self.__qos = client_conf.qos
 self.__paho_client: Optional[mqtt.Client] = None
 self.__connect_result_code = -1
 self.__default_backoff = 1000
 self.__retry_times = 0
 self.__min_backoff = 1 * 1000 # 1s
 self.__max_backoff = 30 * 1000 # 30s

 def connect(self):
 self.__valid_params()
 rc = self.__connect()
 while rc != 0:
 # Backoff reconnection
 low_bound = int(self.__default_backoff * 0.8)
 high_bound = int(self.__default_backoff * 1.0)
 random_backoff = secrets.randbelow(high_bound - low_bound)
 backoff_with_jitter = int(pow(2, self.__retry_times)) * (random_backoff + low_bound)
 wait_time_ms = self.__max_backoff if (self.__min_backoff + backoff_with_jitter) > self.__max_backoff
 else (
```

```
 self.__min_backoff + backoff_with_jitter)
 wait_time_s = round(wait_time_ms / 1000, 2)
 print("client will try to reconnect after " + str(wait_time_s) + " s")
 time.sleep(wait_time_s)
 self.__retry_times += 1
 self.close() # Release the previous connection.
 rc = self.__connect()
 # If the value of rc is 0, the connection is set up successfully. If not, the connection fails.
 if rc != 0:
 print("connect with result code: " + str(rc))
 if rc == 134:
 print("connect failed with bad username or password, "
 "reconnection will not be performed")
 pass
 return rc
def __connect(self):
 try:
 timestamp = self.current_time_millis()
 user_name = "accessKey=" + self.__access_key + "|timestamp=" + timestamp
 if self.__instance_id:
 user_name = user_name + "|instanceId=" + self.__instance_id
 pass_word = self.__access_code
 self.__paho_client = mqtt.Client(mqtt.CallbackAPIVersion.VERSION2, "mqttClient")
 # Disable automatic retry and update the timestamp by manual retry.
 self.__paho_client.reconnect_on_failure = False
 # Set the callback function.
 self.__set_callback()
 # Topics are stored in userdata. The callback function directly subscribes to topics.
 self.__paho_client.user_data_set(self.__topic)
 self.__paho_client.username_pw_set(user_name, pass_word)
 # Currently, the MQTT broker supports only TLS 1.2.
 context = ssl.SSLContext(ssl.PROTOCOL_TLSv1_2)
 # Not verifying the server certificate.
 context.verify_mode = ssl.CERT_NONE
 context.check_hostname = False
 self.__paho_client.tls_set_context(context)
 rc = self.__paho_client.connect(self.__host, self.__port)
 self.__connect_result_code = rc
 if rc == 0:
 threading.Thread(target=self.__paho_client.loop_forever, args=(1, False),
name="MqttThread").start()
 # Wait for connection establishment.
 time.sleep(1)
 except Exception as e:
 self.__connect_result_code = -1
 print("Mqtt connection error. traceback: " + traceback.format_exc())
 if self.__paho_client.is_connected():
 return 0
 else:
 return self.__connect_result_code
def __valid_params(self):
 assert self.__access_key is not None
 assert self.__access_code is not None
 assert self.__topic is not None

 @staticmethod
 def current_time_millis():
 return str(int(round(time.time() * 1000)))
 def __set_callback(self):
 # Execute self._on_connect() when the platform responds to the connection request.
 self.__paho_client.on_connect = self._on_connect
 # Execute self._on_disconnect() when disconnecting from the platform.
 self.__paho_client.on_disconnect = self._on_disconnect
 # Execute self._on_subscribe when subscribing to a topic.
 self.__paho_client.on_subscribe = self._on_subscribe
 # Execute self._on_message() when an original message is received.
 self.__paho_client.on_message = self._on_message
 def _on_connect(self, client, userdata, flags, rc: mqtt.ReasonCode, properties):
 if rc == 0:
```

```
print("Connected to Mqtt Broker! topic " + self.__topic)
client.subscribe(userdata, 1)
else:
 # Automatic reconnection is not performed only when the username or password is incorrect.
 # If the disconnect() method is not used here, loop_forever keeps reconnecting.
 if rc == 134:
 self.__paho_client.disconnect()
 print("Failed to connect. return code : " + str(rc.value) + ", reason" + rc.getName())
def _on_subscribe(self, client, userdata, mid, granted_qos, properties):
 print("Subscribed: " + str(mid) + " " + str(granted_qos) + " topic: " + self.__topic)
def _on_message(self, client, userdata, message: mqtt.MQTTMessage):
 print("topic " + self.__topic + " Received message: " + message.payload.decode())
def _on_disconnect(self, client, userdata, flags, rc, properties):
 print("Disconnect to Mqtt Broker. topic: " + self.__topic)
 # Shut down the client after the disconnection and manually reconnect the client to refresh the
timestamp.
 try:
 self.__paho_client.disconnect()
 except Exception as e:
 print("Mqtt connection error. traceback: " + traceback.format_exc())
 self.connect()
def close(self):
 if self.__paho_client is not None and self.__paho_client.is_connected():
 try:
 self.__paho_client.disconnect()
 print("Mqtt connection close")
 except Exception as e:
 print("paho client disconnect failed. exception: " + str(e))
 else:
 pass
```

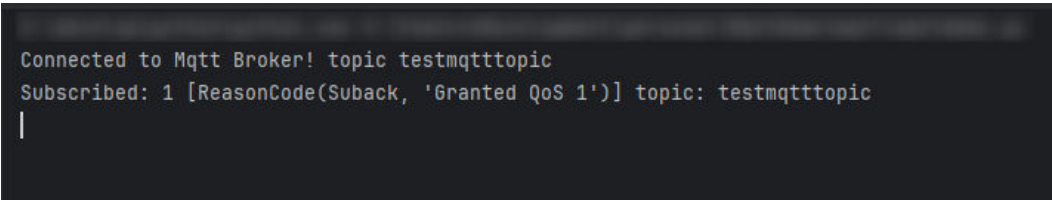
### MqttDemo code:

```
from client_conf import ClientConf
from mqtt_client import MqttClient
import os
from typing import Optional
def main():
 client_conf = ClientConf()
 client_conf.host = "your ip host"
 client_conf.port = 8883
 client_conf.topic = "your mqtt topic"
 # MQTT access credential access_key can be injected using environment variables.
 client_conf.access_key = os.environ.get("MQTT_ACCESS_KEY")
 # MQTT access credential access_code can be injected using environment variables.
 client_conf.access_code = os.environ.get("MQTT_ACCESS_CODE")
 client_conf.instance_id = "your instance id"
 mqtt_client = MqttClient(client_conf)
 if mqtt_client.connect() != 0:
 print("init failed")
 return
if __name__ == "__main__":
 main()
```

## Success Example

After the access is successful, the following information is displayed on the client.

**Figure 7-78** Example of successful MQTT subscription using Python



```
Connected to Mqtt Broker! topic testmqtttopic
Subscribed: 1 [ReasonCode(Suback, 'Granted QoS 1')] topic: testmqtttopic
|
```

## 7.6.4.6 GO Demo

This section uses Go as an example to describe how to connect an MQTTS client to the platform and receive subscribed messages from the platform.

### Prerequisites

Knowledge of basic Go syntax and how to configure development environments.

### Development Environment

In this example, Go 1.18 is used.

### Dependency

In this example, **paho.mqtt.golang** (version 1.4.3) is used. You can run the following command to add the dependency to go.mod.

```
require (
 github.com/eclipse/paho.mqtt.golang v1.4.3
)
```

### Sample Code

```
package main

import (
 "crypto/tls"
 "fmt"
 mqtt "github.com/eclipse/paho.mqtt.golang"
 "os"
 "os/signal"
 "time"
)

type MessageHandler func(message string)
type MqttClient struct {
 Host string
 Port int
 ClientId string
 AccessKey string
 AccessCode string
 Topic string
 InstanceId string
 Qos int
 Client mqtt.Client
 messageHandlers []MessageHandler
}

func (mqttClient *MqttClient) Connect() bool {
 return mqttClient.connectWithRetry()
}

func (mqttClient *MqttClient) connectWithRetry() bool {
 // Retries with exponential backoff, from 10 ms to 20s.
 duration := 10 * time.Millisecond
 maxDuration := 20000 * time.Millisecond
 // Retry upon connection establishment failure.
 internal := mqttClient.connectInternal()
 times := 0
 for !internal {
 time.Sleep(duration)
 if duration < maxDuration {
 duration *= 2
 }
 }
 times++
}
```

```
 fmt.Println("connect mqttgo broker retry. times: ", times)
 internal = mqttClient.connectInternal()
}
return internal
}
func (mqttClient *MqttClient) connectInternal() bool {
 // Close the existing connection before establishing a connection.
 mqttClient.Close()
 options := mqtt.NewClientOptions()
 options.AddBroker(fmt.Sprintf("mqtt://%s:%d", mqttClient.Host, mqttClient.Port))
 options.SetClientId(mqttClient.ClientId)
 userName := fmt.Sprintf("accessKey=%s|timestamp=%d", mqttClient.AccessKey, time.Now().UnixNano()/
1000000)
 if len(mqttClient.InstanceId) != 0 {
 userName = userName + fmt.Sprintf("|instanceId=%s", mqttClient.InstanceId)
 }
 options.SetUsername(userName)
 options.SetPassword(mqttClient.AccessCode)
 options.SetConnectTimeout(10 * time.Second)
 options.SetKeepAlive(120 * time.Second)
 // Disable the SDK internal reconnection and use the custom reconnection to refresh the timestamp.
 options.SetAutoReconnect(false)
 options.SetConnectRetry(false)
 tlsConfig := &tls.Config{
 InsecureSkipVerify: true,
 MaxVersion: tls.VersionTLS12,
 MinVersion: tls.VersionTLS12,
 }
 options.SetTLSConfig(tlsConfig)
 options.OnConnectionLost = mqttClient.createConnectionLostHandler()
 client := mqtt.NewClient(options)
 if token := client.Connect(); token.Wait() && token.Error() != nil {
 fmt.Println("device create bootstrap client failed,error = ", token.Error().Error())
 return false
 }
 mqttClient.Client = client
 fmt.Println("connect mqttgo broker success.")
 mqttClient.subscribeTopic()
 return true
}
func (mqttClient *MqttClient) subscribeTopic() {
 subRes := mqttClient.Client.Subscribe(mqttClient.Topic, 0, mqttClient.createMessageHandler())
 if subRes.Wait() && subRes.Error() != nil {
 fmt.Printf("sub topic failed,error is %s\n", subRes.Error())
 panic("subscribe topic failed.")
 } else {
 fmt.Printf("sub topic success\n")
 }
}
func (mqttClient *MqttClient) createMessageHandler() func(client mqtt.Client, message mqtt.Message) {
 messageHandler := func(client mqtt.Client, message mqtt.Message) {
 fmt.Println("receive message from server.")
 go func() {
 for _, handler := range mqttClient.messageHandlers {
 handler(string(message.Payload()))
 }
 }()
 }
 return messageHandler
}
func (mqttClient *MqttClient) createConnectionLostHandler() func(client mqtt.Client, reason error) {
 // Perform custom reconnection after disconnection.
 connectionLostHandler := func(client mqtt.Client, reason error) {
 fmt.Printf("connection lost from server. begin to reconnect broker. reason: %s\n", reason.Error())
 connected := mqttClient.connectWithRetry()
 if connected {
 fmt.Println("reconnect mqttgo broker success.")
 }
 }
}
```

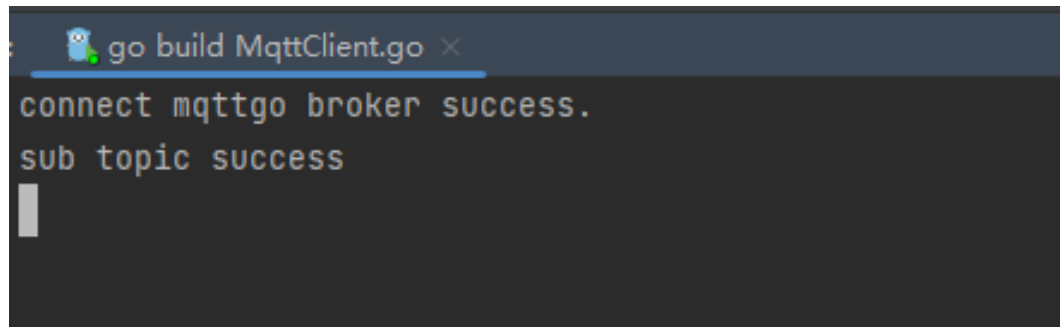


```
 return connectionLostHandler
}
func (mqttClient *MqttClient) Close() {
 if mqttClient.Client != nil {
 mqttClient.Client.Disconnect(1000)
 }
}
func main() {
 // For details about how to set the following parameters, see the connection configuration description.
 // MQTT access domain name
 mqttHost := "your mqtt host"
 // MQTT access port
 mqttPort := 8883
 // Access credential key value
 mqttAccessKey := os.Getenv("MQTT_ACCESS_KEY")
 // Access credential secret
 mqttAccessCode := os.Getenv("MQTT_ACCESS_CODE")
 // Name of the subscribed topic
 mqttTopic := "your mqtt topic"
 // Instance ID
 instanceId := "your instance Id"
 //mqttgo client id
 clientId := "your mqtt client id"

 mqttClient := MqttClient{
 Host: mqttHost,
 Port: mqttPort,
 Topic: mqttTopic,
 ClientId: clientId,
 AccessKey: mqttAccessKey,
 AccessCode: mqttAccessCode,
 InstanceId: instanceId,
 }
 // Customize the handler for processing messages.
 mqttClient.messageHandlers = []MessageHandler{func(message string) {
 fmt.Println(message)
 }}
 connect := mqttClient.Connect()
 if !connect {
 fmt.Println("init mqttgo client failed.")
 return
 }
 // Block method to keep the MQTT client always pulling messages.
 interrupt := make(chan os.Signal, 1)
 signal.Notify(interrupt, os.Interrupt)
 for {
 <-interrupt
 break
 }
}
}
```

## Success Example

After the access is successful, the following information is displayed on the client.

**Figure 7-79** Example of successful MQTT client access using GoA terminal window with a dark background and light text. The window title is "go build MqttClient.go". The output shows two lines: "connect mqttgo broker success." and "sub topic success".

```
go build MqttClient.go
connect mqttgo broker success.
sub topic success
```

### 7.6.4.7 Node.js Demo

This section uses Node.js as an example to describe how to connect an MQTTS client to the platform and receive subscribed messages from the platform

#### Prerequisites

Knowledge of basic Node.js syntax and how to configure development environments.

#### Development Environment

In this example, Node.js 13.14.0 is used. [Download](#) it from the Node.js official website. After installation, run the following command to check the version:

```
node --version
```

#### Dependency

In this example, **mqtt** (version 4.0.0) is used. You can run the following command to download the dependency:

```
npm install mqtt@4.0.0
```

#### Sample Code

```
const mqtt = require('mqtt');
// Name of the subscribed topic
var topic = "your mqtt topic";
// Key value of the access credential, which can be preset using environment variables.
var accessKey = process.env.MQTT_ACCESS_KEY;
// Access credential secret, which can be preset using environment variables.
var accessCode = process.env.MQTT_ACCESS_CODE;
// MQTT access address
var mqttHost = "your mqtt host";
// MQTT access port
var mqttPort = 8883;
// Instance ID
var instancelid = "your instancelid";
// mqtt client id
var clientId = "your clientId";
// MQTT client
var client = null;
connectWithRetry();
async function connectWithRetry() {
 // Retries with exponential backoff, from 1s to 20s.
 var duration = 1000;
```

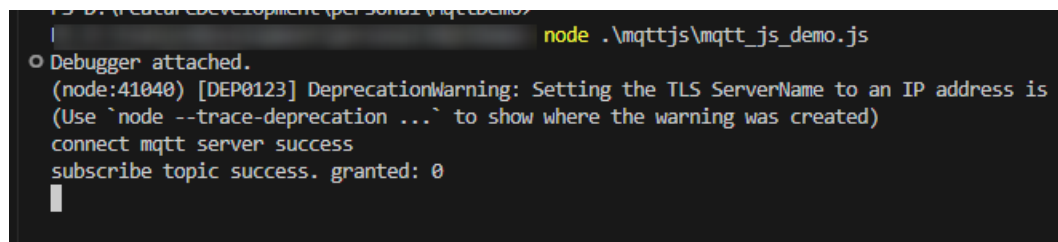
```
var maxDuration = 20000;
var success = connect(topic);
var times = 0;
while (!success) {
 await sleep(duration)
 if (duration < maxDuration) {
 duration *= 2
 }
 times++
 console.log('connect mqtt broker retry. times: ' + times)
 if (client == null) {
 connect(topic)
 continue
 }
 client.end(true, function() {
 connect(topic)
 });
}
}
function sleep(ms) {
 return new Promise(resolve => setTimeout(() => resolve(), ms))
}
function connect(topic) {
 try {
 client = mqtt.connect(getClientOptions())
 if (client == null) {
 return false
 }
 client.on('connect', connectCallBack)
 client.subscribe(topic, subscribeCallBack)
 client.on('message', messageCallBack)
 client.on('error', clientErrorCallBack)
 client.on('close', closeCallBack)
 return true
 } catch (error) {
 console.log('connect to mqtt broker failed. err ' + error)
 }
 return false
}
function getClientOptions() {
 var timestamp = Math.round(new Date);
 const username = 'accessKey=' + accessKey + '|timestamp=' + timestamp + '|instanceId=' + instanceId;
 var options = {
 host: mqttHost,
 port: mqttPort,
 connectTimeout: 4000,
 clientId: clientId,
 protocol: 'mqtts',
 keepalive: 120,
 username: username,
 password: accessCode,
 rejectUnauthorized: false,
 secureProtocol: 'TLsv1_2_method'
 };
 return options;
};
function connectCallBack() {
 console.log('connect mqtt server success');
};
function subscribeCallBack(err, granted) {
 if (err != null || granted[0].qos === 128) {
 console.log('subscribe topic failed. granted: ' + granted[0].qos)
 return
 }
 console.log('subscribe topic success. granted: ' + granted[0].qos);
};
function clientErrorCallBack(err) {
 console.log('mqtt client error ' + err);
};
};
```

```
function messageCallBack(topic, message) {
 console.log('receive message ' + message);
};
function closeCallBack() {
 console.log('Disconnected from mqtt broker')
 client.end(true, function() {
 console.log('close connection');
 connectWithRetry();
 });
}
```

## Success Example

After the access is successful, the following information is displayed on the client.

**Figure 7-80** Example of successful MQTT client access using Node.js



```
node .\mqttjs\mqtt_js_demo.js
Debugger attached.
(node:41040) [DEP0123] DeprecationWarning: Setting the TLS ServerName to an IP address is
(connect mqtt server success
subscribe topic success. granted: 0
```

### 7.6.4.8 C# Demo

This section uses *C#* as an example to describe how to connect an MQTTS client to the platform and receive subscribed messages from the platform

## Prerequisites

Knowledge of basic *C#* syntax and how to configure .NET Framework development environments.

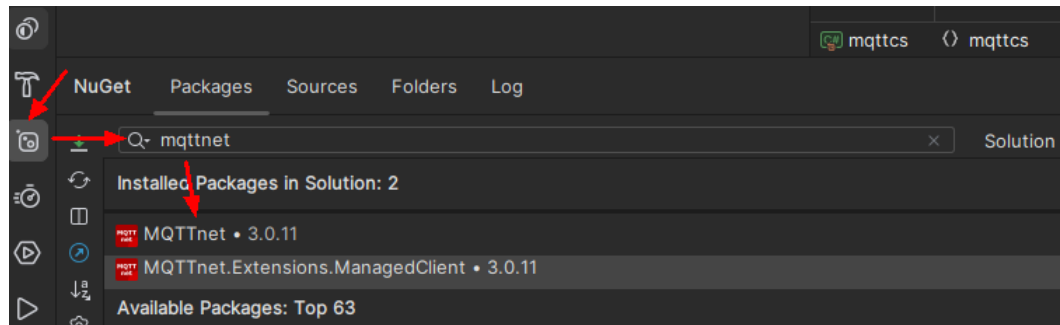
## Development Environment

In this example, .NET Framework 4.6.2 and .NET SDK 6.0.421 are used. [Download](#) them from the .NET official website. After installation, run the following command to check the version:

```
dotnet -v
```

## Dependency

In this example, **MQTTnet** and **MQTTnet.Extension.ManagedClient** (version 3.0.11) are used. You can search for **MQTTnet** in the NuGet manager and install the required version.

**Figure 7-81** nuget installation dependency

## Sample Code

ClientConf.cs code:

```
using MQTTnet.Protocol;

namespace mqtts
{
 public class ClientConf
 {
 // MQTT subscription address
 public string ServerUri { get; set; }

 // MQTT subscription port number
 public int Port { get; set; }

 // MQTT access credential access_key
 public string AccessKey { get; set; }

 // MQTT access credential access_code
 public string AccessCode { get; set; }

 // MQTT client ID
 public string ClientId { get; set; }

 // Instance ID. This parameter is mandatory when multiple instances of the standard edition are
 // purchased in the same region.
 public string InstanceId { get; set; }

 // MQTT subscription topic
 public string Topic { get; set; }

 // mqtt qos
 public MqttQualityOfServiceLevel Qos { get; set; }
 }
}
```

MqttListener code:

```
using System;
using MQTTnet.Client.Connecting;
using MQTTnet.Client.Disconnecting;
using MQTTnet.Extensions.ManagedClient;

namespace mqtts
{
 public interface MqttListener
 {
 // Callback function when the MQTT client is disconnected from the server
 void ConnectionLost(MqttClientDisconnectedEventArgs e);

 // Callback function for successful connection establishment between the MQTT client and server
 }
}
```

```
void ConnectComplete(MqttClientConnectResultCode resultCode, String reason);

// Callback function for consuming messages on the MQTT client
void OnMessageReceived(String message);

// Callback function when the MQTT client fails to establish a connection with the server
void ConnectFail(ManagedProcessFailedEventArgs e);
}
}
```

#### MqttConnection.cs code:

```
using System;
using System.Text;
using System.Threading;
using MQTTnet;
using MQTTnet.Client.Connecting;
using MQTTnet.Client.Disconnecting;
using MQTTnet.Client.Options;
using MQTTnet.Client.Receiving;
using MQTTnet.Extensions.ManagedClient;
using MQTTnet.Formatter;

namespace mqttcs
{
 public class MqttConnection
 {
 private static IManagedMqttClient client = null;

 private static ManualResetEvent mre = new ManualResetEvent(false);

 private static readonly ushort DefaultKeepLive = 120;

 private static int _retryTimes = 0;

 private readonly int _retryTimeWait = 1000;

 private readonly ClientConf _clientConf;

 private MqttListener _listener;

 public MqttConnection(ClientConf clientConf, MqttListener listener)
 {
 _clientConf = clientConf;
 _listener = listener;
 }

 public int Connect()
 {
 {
 client?.StopAsync();
 // Backoff retry from 1s to 20s
 var duration = 1000;
 var maxDuration = 20 * 1000;
 var rc = InternalConnect();
 while (rc != 0)
 {
 {
 Thread.Sleep((int)duration);
 if (duration < maxDuration)
 {
 duration *= 2;
 }
 }
 client?.StopAsync();
 _retryTimes++;
 Console.WriteLine("connect mqtt broker retry. times: " + _retryTimes);
 rc = InternalConnect();
 }
 }

 return rc;
 }
 }
}
```

```
private int InternalConnect()
{
 try
 {
 client = new MqttFactory().CreateManagedMqttClient();
 client.ApplicationMessageReceivedHandler =
 new
MqttApplicationMessageReceivedHandlerDelegate(ApplicationMessageReceiveHandlerMethod);
 client.ConnectedHandler = new MqttClientConnectedHandlerDelegate(OnMqttClientConnected);
 client.DisconnectedHandler = new
MqttClientDisconnectedHandlerDelegate(OnMqttClientDisconnected);
 client.ConnectingFailedHandler = new
ConnectingFailedHandlerDelegate(OnMqttClientConnectingFailed);
 IManagedMqttClientOptions options = GetOptions();
 // Connects to the platform.
 client.StartAsync(options);
 mre.Reset();

 mre.WaitOne();
 if (!client.IsConnected)
 {
 return -1;
 }

 var mqttTopicFilter = new
MqttTopicFilterBuilder().WithTopic(_clientConf.Topic).WithQualityOfServiceLevel(_clientConf.Qos).Build();

 client.SubscribeAsync(mqttTopicFilter).Wait();
 Console.WriteLine("subscribe topic success.");
 return 0;
 }
 catch (Exception e)
 {
 Console.WriteLine("Connect to mqtt server failed. err: " + e);
 return -1;
 }
}

private void ApplicationMessageReceiveHandlerMethod(MqttApplicationMessageReceivedEventArgs e)
{
 string payload = null;
 if (e.ApplicationMessage.Payload != null)
 {
 payload = Encoding.UTF8.GetString(e.ApplicationMessage.Payload);
 }
 try
 {
 _listener?.OnMessageReceived(payload);
 }
 catch (Exception ex)
 {
 Console.WriteLine("Message received error, the message is " + payload);
 }
}

private void OnMqttClientConnected(MqttClientConnectedEventArgs e)
{
 try
 {
 _retryTimes = 0;
 _listener?.ConnectComplete(e.AuthenticateResult.ResultCode, e.AuthenticateResult.ReasonString);
 mre.Set();
 }
 catch (Exception exception)
 {
 Console.WriteLine("handle connect callback failed. e: " + exception.Message);
 }
}
```

```
private void OnMqttClientDisconnected(MqttClientDisconnectedEventArgs e)
{
 try
 {
 _listener?.ConnectionLost(e);
 }
 catch (Exception exception)
 {
 Console.WriteLine("handle disconnect callback failed. e: " + exception.Message);
 }
}

private void OnMqttClientConnectingFailed(ManagedProcessFailedEventArgs e)
{
 try
 {
 if (_listener != null)
 {
 _listener.ConnectFail(e);
 }
 Thread.Sleep(_retryTimeWait);
 Connect();
 }
 catch (Exception exception)
 {
 Console.WriteLine("handle connect failed callback failed. e: " + exception.Message);
 }
}

private IManagedMqttClientOptions GetOptions()
{
 IManagedMqttClientOptions options = null;
 long timestamp = new DateTimeOffset(DateTime.UtcNow).ToUnixTimeMilliseconds();
 string userName = "accessKey=" + _clientConf.AccessKey + "|timestamp=" + timestamp + "|
instanceId=" + _clientConf.InstanceId;

 options = new ManagedMqttClientOptionsBuilder()
 .WithClientOptions(new MqttClientOptionsBuilder()
 .WithTcpServer(_clientConf.ServerUri, _clientConf.Port)
 .WithCredentials(userName, _clientConf.AccessCode)
 .WithClientId(_clientConf.ClientId)
 .WithKeepAlivePeriod(TimeSpan.FromSeconds(DefaultKeepLive))
 .WithTls(new MqttClientOptionsBuilderTlsParameters()
 {
 AllowUntrustedCertificates = true,
 UseTls = true,
 CertificateValidationHandler = delegate { return true; },
 IgnoreCertificateChainErrors = false,
 IgnoreCertificateRevocationErrors = false,
 SslProtocol = System.Security.Authentication.SslProtocols.Tls12,
 })
 .WithProtocolVersion(MqttProtocolVersion.V500)
 .Build())
 .Build();
 return options;
}
}
```

#### MqttClient.cs code:

```
using System;
using System.Threading;
using System.Threading.Tasks;
using MQTTnet.Client.Connecting;
using MQTTnet.Client.Disconnecting;
using MQTTnet.Extensions.ManagedClient;
using MQTTnet.Protocol;
```



```
namespace mqttcs
{
 class MqttClient: MqttListener
 {
 private static ManualResetEvent mre = new ManualResetEvent(false);

 public static async Task Main(string[] args)
 {
 ClientConf clientConf = new ClientConf();
 clientConf.ClientId = "your mqtt clientId";
 clientConf.ServerUri = "your mqtt host";
 clientConf.Port = 8883;
 clientConf.AccessKey = Environment.GetEnvironmentVariable("MQTT_ACCESS_KEY");
 clientConf.AccessCode = Environment.GetEnvironmentVariable("MQTT_ACCESS_CODE");
 clientConf.InstanceId = "your instanceId";
 clientConf.Topic = "your mqtt topic";
 clientConf.Qos = MqttQualityOfServiceLevel.AtMostOnce;

 MqttConnection connection = new MqttConnection(clientConf, new MqttClient());
 var connect = connection.Connect();
 if (connect == 0)
 {
 Console.WriteLine("success to init mqtt connection.");
 mre.WaitOne();
 }
 }

 public void ConnectionLost(MqttClientDisconnectedEventArgs e)
 {
 if (e?.Exception != null)
 {
 Console.WriteLine("connect was lost. exception: " + e.Exception.Message);
 return;
 }
 Console.WriteLine("connect was lost");
 }

 public void ConnectComplete(MqttClientConnectResultCode resultCode, String reason)
 {
 Console.WriteLine("connect success. resultCode: " + resultCode + " reason: " + reason);
 }

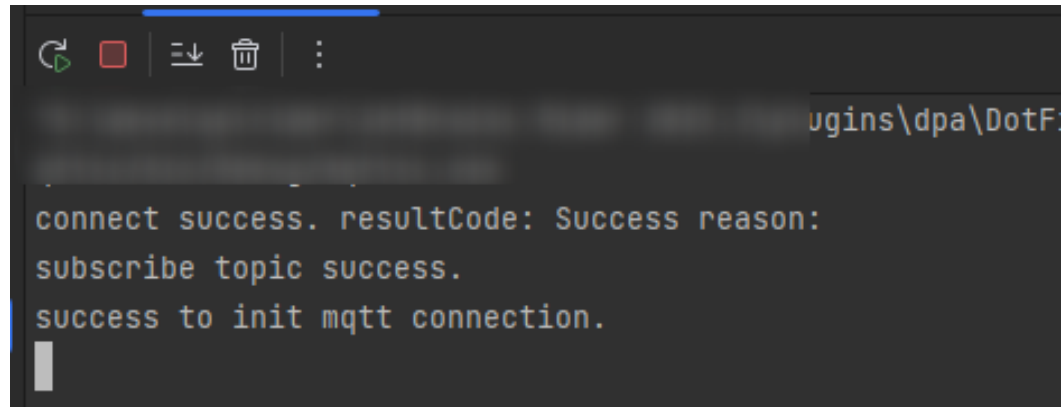
 public void OnMessageReceived(string message)
 {
 Console.WriteLine("receive msg: " + message);
 }

 public void ConnectFail(ManagedProcessFailedEventArgs e)
 {
 Console.WriteLine("connect mqtt broker failed. e: " + e.Exception.Message);
 }
 }
}
```

## Success Example

After the access is successful, the following information is displayed on the client.

Figure 7-82 Example of successful client access using C#



```
connect success. resultCode: Success reason:
subscribe topic success.
success to init mqtt connection.
```

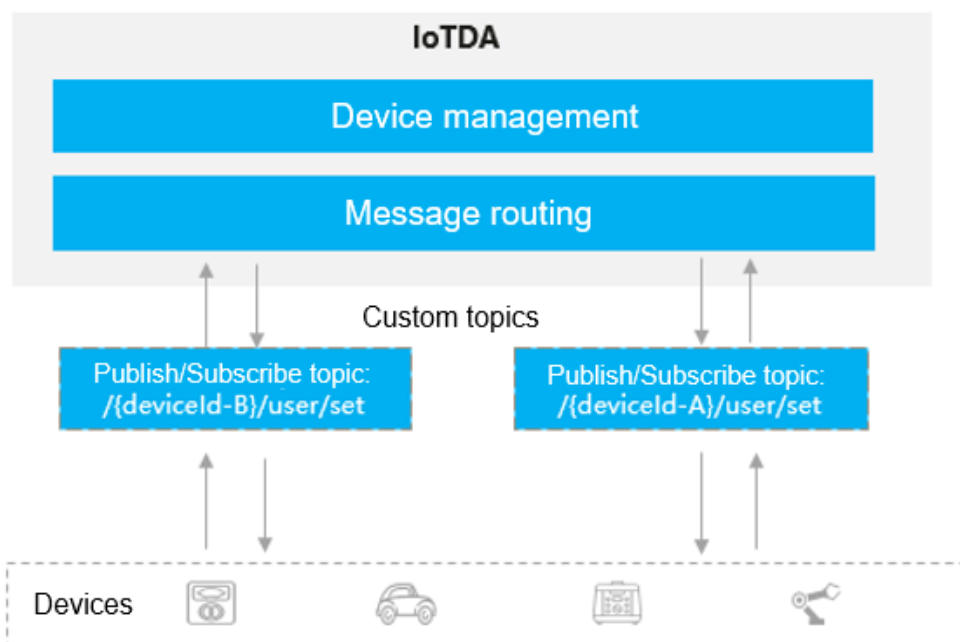
## 7.6.5 M2M Communications

### Overview

**Subscription:** You can create rules on the console or call the platform APIs to configure and activate rules for obtaining messages reported by devices from the platform. Related APIs: [Create a Rule Trigger Condition](#), [Create a Rule Action](#), and [Modify the Rule Triggering Condition](#). Device subscription supports only message reporting.

**Push:** After the subscription is successful, the platform pushes messages reported by devices to the specified MQTT topic. After devices are connected to the platform, you can subscribe to the topic to receive data for inter-device message communications. The following figure shows the message communications process between devices.

Figure 7-83 M2M communications



## Device Subscription

For details, see [Usage](#).

# 7.7 Data Forwarding Channel Details

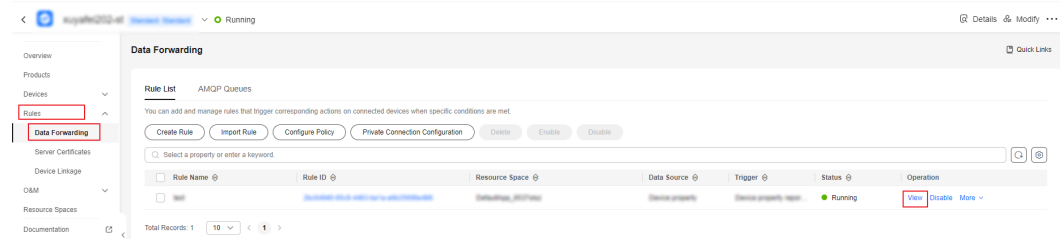
## Overview

When using the data forwarding function, you can check whether the performance of the forwarding target (such as a third-party application) meets service requirements based on the usage of the data forwarding channel. For example, if the data forwarded to the target (third-party application) cannot be quickly processed, the data will be stacked (cached) on the platform. In this case, you can view the channel details. If you find that the message production rate is always higher than the push rate, and the number of stacked messages keeps increasing, it may indicate that the performance of the target (third-party application) cannot meet the service requirements and scale-out is required. In addition, you can clear stacked data in the data forwarding channel.

## Viewing Forwarding Channel Details

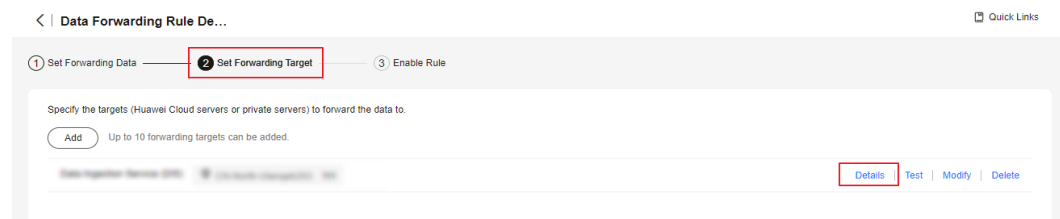
- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Rules > Data Forwarding**, locate the target rule, and click **View** in the **Operation** column.

**Figure 7-84** Rule details - Viewing rule details

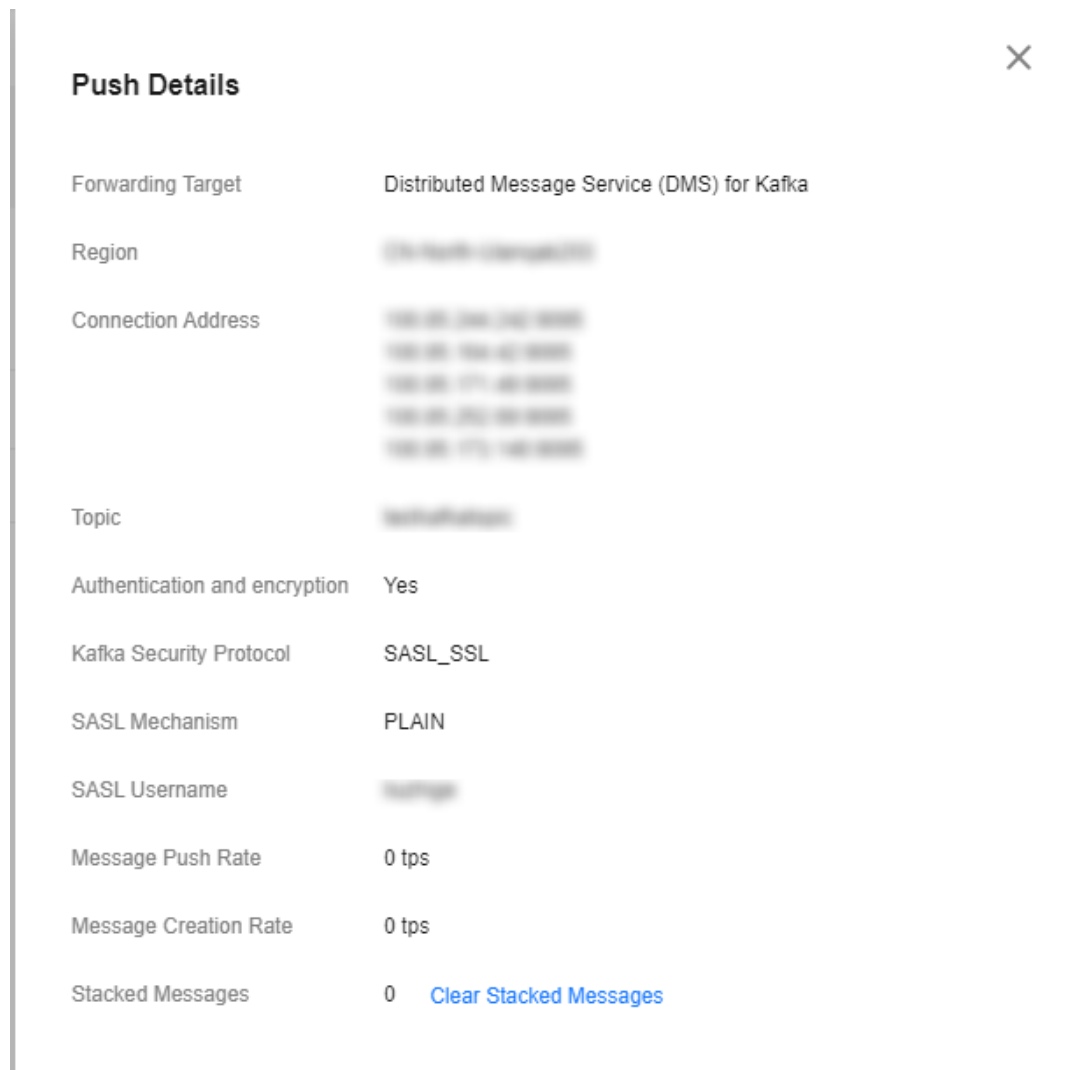


- Step 3** Click **Set Forwarding Target**, find the target data forwarding channel, and click **Details**. View the push details in the displayed dialog box.

**Figure 7-85** Forwarding rule details



**Figure 7-86** Push details - Data forwarding rule



**Table 7-17** Parameter description

| Parameter             | Description                                                                                                                                                                                                                                                                                                          |
|-----------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Message Push Rate     | Number of messages forwarded by the platform to the target per second.                                                                                                                                                                                                                                               |
| Message Creation Rate | Number of messages sent by the device to the platform per second.                                                                                                                                                                                                                                                    |
| Stacked Messages      | Number of messages stacked on the platform when the production rate is higher than the push rate. For a data forwarding rule, the max. stacking (cache) data size is 1 GB, and the max. stacking (cache) duration is 24 hours by default. To change the values, see <a href="#">Data Forwarding Stack Policies</a> . |

----End

## Clearing Stacked Messages

When the rule engine forwards messages to a third-party application, if the application cannot process the data in real time, the data will be stacked on the platform. You can clear the data stacked in the forwarding channel for timely processing.

For example, a water meter periodically reports user usage to a server. When the server is faulty, the forwarded data piles up. In this case, you can clear the stacked data and let the system process the newly reported data.

---

### NOTICE

In the details page of a forwarding target, if you click **Clear Stacked Messages**, all data that has not been transferred to the forwarding target will be cleared. Exercise caution.

---

## 7.8 Data Forwarding Stack Policies

### Overview

If the forwarding target (such as a third-party application server) cannot process data forwarded by IoTDA in a timely manner due to insufficient performance, unprocessed data will be stacked (cached) on IoTDA. By default, the maximum stack (cache) size of data to forward for a single forwarding rule is 1 GB, and the maximum stack duration is 24 hours. If the maximum stack size or stack duration is exceeded, the earliest unprocessed data will be discarded to meet the stack size and duration requirements.

To control data stacking on IoTDA, you can create stack policies based on specific service scenarios and performance of the forwarding target (for example, a third-party application server).

If your service has higher requirements on real-time data than integrity and the performance of the forwarding target is insufficient or the service fails to process forwarded data in a timely manner due to an interruption, a large amount of data will be stacked on IoTDA. As a result, the forwarding target always receives delayed data. You can use a stack policy to configure a small stack size and stack duration. In this way, outdated data will be discarded, and real-time data will be received and processed.

### Constraints

You can create one stack policy for an IoTDA instance.

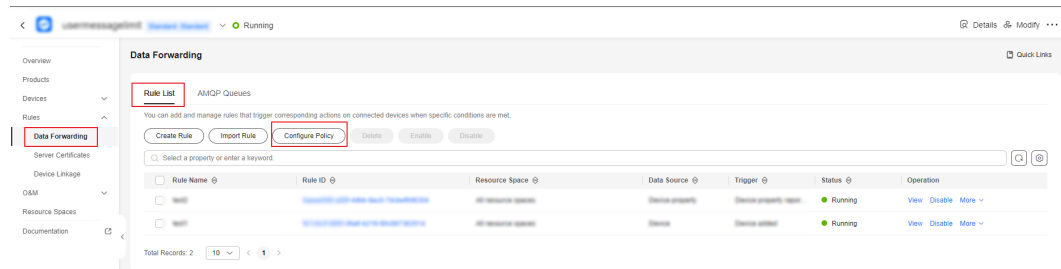
**NOTICE**

1. After a stack policy is created, it applies to all forwarding rules and overwrites the default stack size (1 GB) and stack duration (24 hours).
2. If the maximum stack size or stack duration is exceeded, the earliest unprocessed data will be discarded. Use a stack policy carefully and configure a proper stack size and duration.

**Procedure**

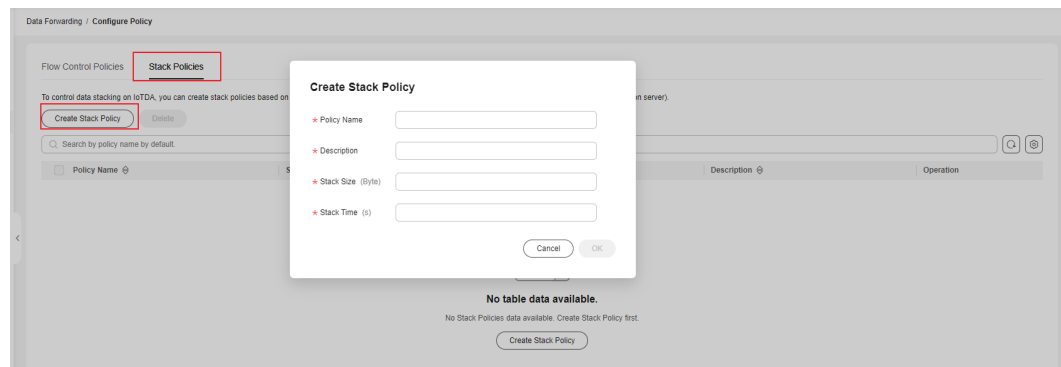
- Step 1** Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Rules > Data Forwarding**, click **Configure Policy**, and click **Stack Policies**.

**Figure 7-87** Data forwarding - Policy configuration



- Step 3** In the displayed dialog box, set **Policy Name**, **Description**, **Stack Size**, and **Stack Time**, and click **OK**.

**Figure 7-88** Data forwarding - Creating a stack policy



**Table 7-18** Parameters

| Parameter   | Description                                                                                                                                   |
|-------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| Policy Name | The value can contain 4 to 256 characters. Only letters, digits, and special characters ( <code>_? '#() , &amp; % @ ! -</code> ) are allowed. |

| Parameter   | Description                                                                                                                                       |
|-------------|---------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | Description of the policy. The value can contain 4 to 256 characters. Only letters, digits, and special characters ( _?'#()., &%@!-) are allowed. |
| Stack Size  | Maximum stack (cache) size of data to forward in a rule on IoTDA. The unit is byte. The maximum value is <b>1073741823</b> bytes (1 GB).          |
| Stack Time  | Maximum stack (cache) duration of data to forward in a rule on IoTDA. The unit is second. The maximum value is <b>86399</b> seconds (24 hours).   |

----End

## 7.9 Data Forwarding Flow Control Policies

### Overview

You can create flow control policies in different dimensions on IoTDA based on your service scenarios and performance of the forwarding target (such as a third-party application server) to control data forwarding flows.

### Dimensions of Flow Control Policies

**Table 7-19** Types of flow control policies

| Policy Type          | Description                                                                                                                            |
|----------------------|----------------------------------------------------------------------------------------------------------------------------------------|
| By instance          | The policy applies to all data forwarding flows on the instance. Data that exceeds the threshold will be discarded.                    |
| By forwarding target | The policy applies to all data forwarding flows of the forwarding target you specify.                                                  |
| By forwarding rule   | The policy applies to all data forwarding flows of the forwarding rule you specify. Data that exceeds the threshold will be discarded. |
| By forwarding action | The policy applies to all data forwarding flows of the forwarding action you specify.                                                  |

**NOTICE**

1. After a flow control policy is created, the policy type cannot be modified.
2. Data that exceeds the threshold set in instance- and rule-level flow control policies will be discarded. Use flow control policies carefully.
3. If you create different types of flow control policies, the policy with the threshold reached first takes effect. For example, if the threshold in the flow control policy for forwarding rule A is 50 TPS, the threshold in the policy for action B of forwarding rule A is 100 TPS, and the actual data flow of forwarding rule A is 80 TPS, the flow control policy for forwarding rule A is triggered.

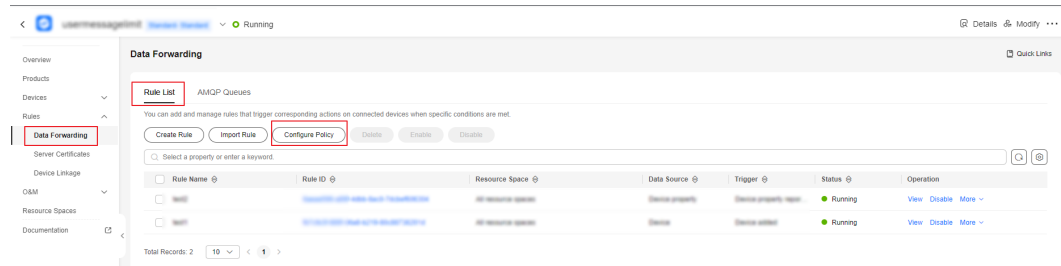
**Constraints**

You can create up to four flow control policies for an IoTDA instance.

**Procedure**

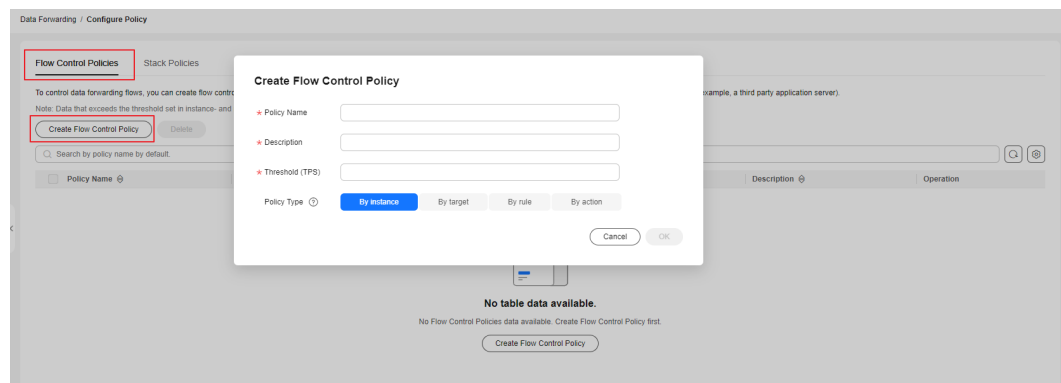
- Step 1** Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Rules > Data Forwarding**, and click **Configure Policy**. The **Flow Control Policies** page is displayed.

**Figure 7-89** Data forwarding - Policy configuration



- Step 3** In the displayed dialog box, configure parameters and click **OK**.

**Figure 7-90** Data forwarding - Creating a flow control policy





**Table 7-20** Parameters

| Parameter         | Description                                                                                                                                     |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| Policy Name       | The value can contain 4 to 256 characters. Only letters, digits, and special characters (_?'#(),.&%@!-) are allowed.                            |
| Description       | Description of the policy. The value can contain 4 to 256 characters. Only letters, digits, and special characters (_?'#(),.&%@!-) are allowed. |
| Threshold         | The value ranges from 1 to 1000.                                                                                                                |
| Policy Type       | The options include <b>By instance</b> , <b>By target</b> , <b>By rule</b> , and <b>By action</b> .                                             |
| Forwarding Target | Forwarding targets supported by the current instance. This parameter is available only when <b>Policy Type</b> is set to <b>By target</b> .     |
| Bound Rule        | Data forwarding rules on IoTDA. This parameter is available only when <b>Policy Type</b> is set to <b>By rule</b> .                             |
| Bound Action      | Data forwarding actions on IoTDA. This parameter is available only when <b>Policy Type</b> is set to <b>By action</b> .                         |

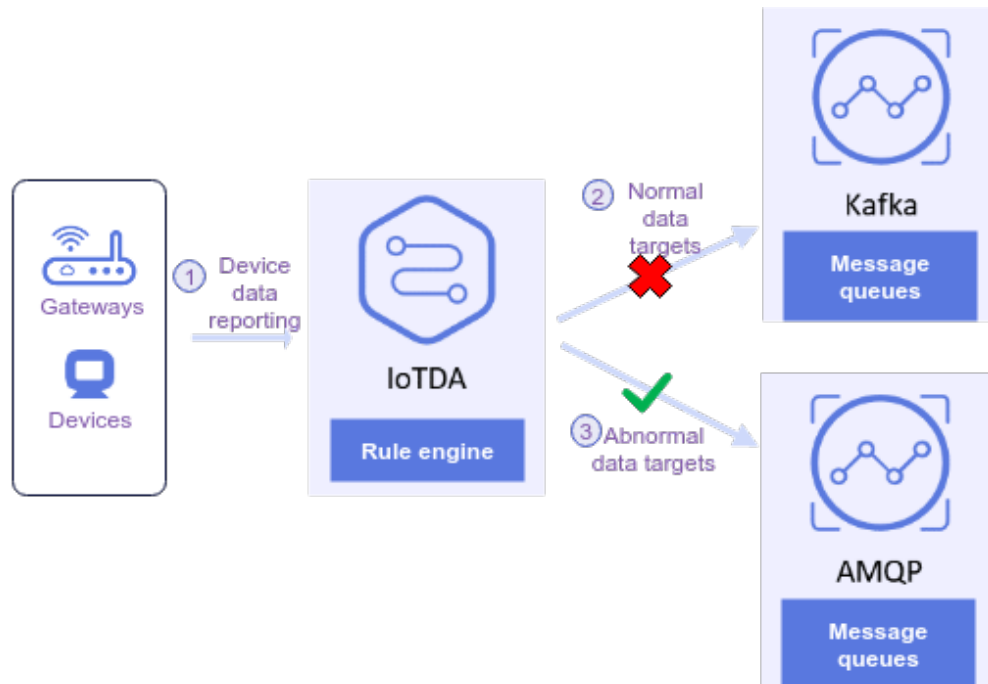
----End

## 7.10 Abnormal Data Target

### Overview

When data is forwarded to other Huawei Cloud services or third-party applications, IoTDA stops message pushing if the target server is unreachable due to insufficient permissions or service unavailability. It checks the channel status every 3 minutes, and if the check result is normal, the channel will be restored. If you require real-time messages, you can configure abnormal data forwarding targets to obtain **abnormal data**. In this way, you can continue service processing and analyze failure causes, reducing the impact of single channel faults on services.

**Figure 7-91** Example of abnormal data targets



**NOTE**

If the normal data target is unreachable within 24 hours, data is directly pushed to the configured abnormal data target. If the normal data target remains unreachable after 24 hours, the platform suspends data push.

**Constraints**

- If there is only 1 normal data target, 1 abnormal data target can be added.
- Up to five abnormal data targets can be created for each IoTDA instance.
- Supported rule data sources for abnormal data targets: device, device property, device message, device message status, device status, batch task, product, and device asynchronous command status.
- Configurable normal data targets for abnormal data forwarding: Data Ingestion Service (DIS), Distributed Message Service for Kafka, Object Storage Service (OBS), ROMA Connect, third-party application service (HTTP push), Distributed Message Service (DMS) for RocketMQ, FunctionGraph, GeminiDB Influx, Relational Database Service (RDS) for MySQL, MapReduce Service (MRS) Kafka, Blockchain Service (BCS), and Document Database Service (DDS).
- AMQP message queues can be used as abnormal data targets.

**Data Format**

The following is an example of the abnormal data forwarding format:

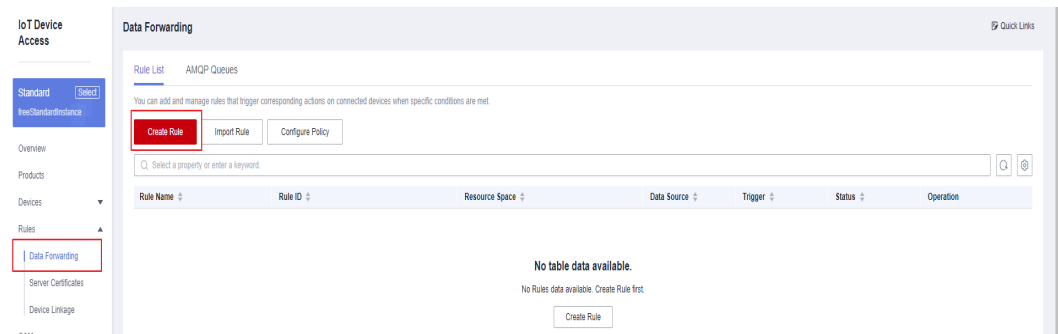
```
{
 "request_id": "2131d048-234f-4564-9190-6030234678ad",
 "rule_id": "6519d048-3b7f-442b-9190-6030773879cc",
 "action_id": "f376ab9f-d060-4fbf-a383-3e52af98ae9d",
 "channel": "MYSQL_FORWARDING",
```



## Procedure

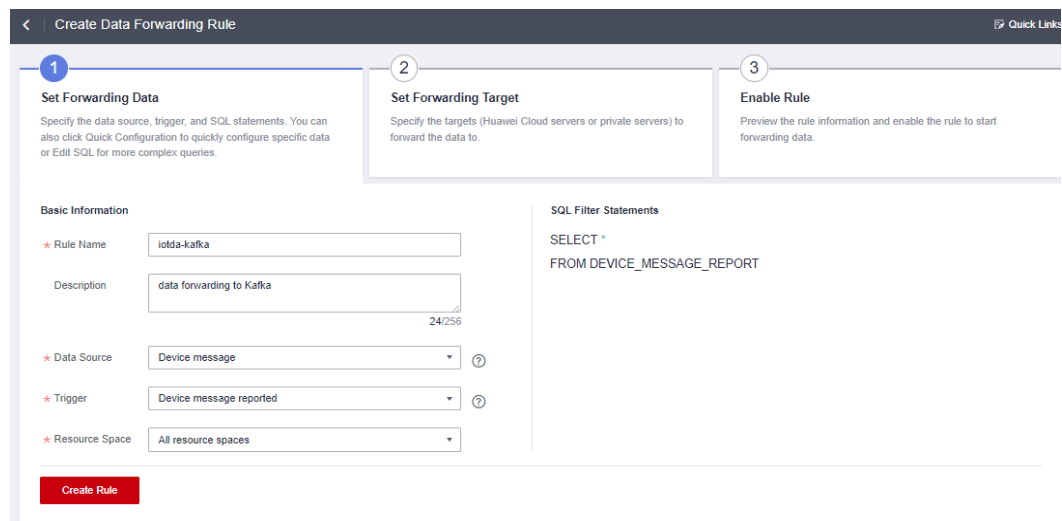
- Step 1** Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Rules > Data Forwarding**. On the displayed page, click **Create Rule**.

**Figure 7-92** Creating a data forwarding rule



- Step 3** On the displayed page, enter related information and click **Create Rule**.

**Figure 7-93** Rules triggered by message reporting - forwarding data to Kafka



- Step 4** Click the **Set Forwarding Target** tab and click **Add** to add a normal data target.

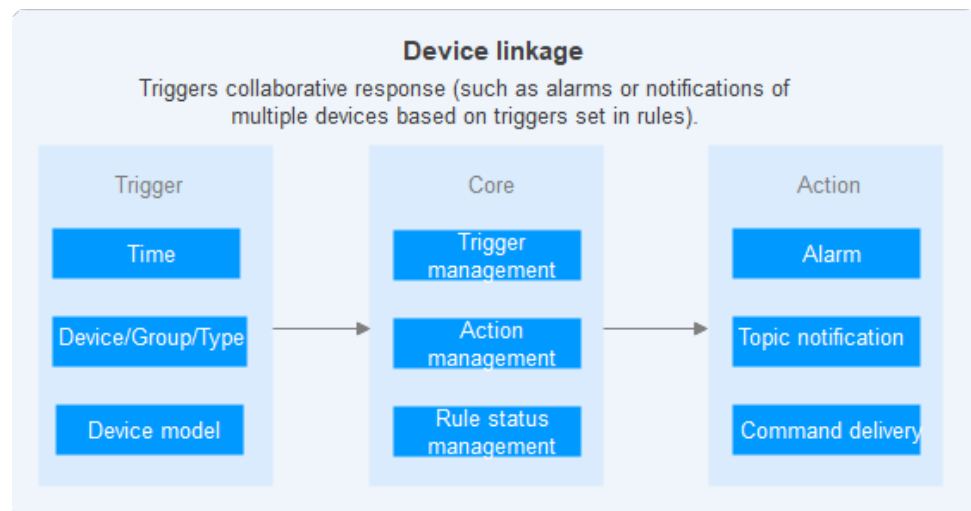


## 7.11 Device Linkage

### Overview

When specific conditions are met, the platform triggers collaborative response of multiple devices to implement device linkage and intelligent control. For example, when the battery level of a water meter drops to 20% or less, a low battery alarm is reported so that the battery can be replaced before it goes dead.

**Figure 7-97** Device linkage architecture



To further explore device linkage, see [Triggering Alarms and Sending Email or SMS Notifications](#).

### 7.11.1 Cloud Rules

#### Overview

If you set a cloud rule, IoTDA determines whether the rule triggering condition is met. If the condition is met, IoTDA performs actions you set, such as alarm reporting, topic notification, and command delivery.

#### Procedure

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Rules > Device Linkage**. Click **Create Rule**.
- Step 3** Create a device linkage rule based on the table below.


| Parameter              | Description                                                                                                                                                                                                                                                                                                                       | Best Practice                                                                                                                                                                                                                                                                                                                                                                         |
|------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rule Name              | Specify the name of a rule to create.                                                                                                                                                                                                                                                                                             | <ul style="list-style-type: none"> <li>• <a href="#">Automatic Device Shutdown Upon High Temperature</a></li> <li>• <a href="#">Triggering Alarms and Sending Email or SMS Notifications</a></li> <li>• <a href="#">Automatically Opening the Window upon High Gas Concentration</a></li> <li>• <a href="#">Monitoring Device Status Changes and Sending Notifications</a></li> </ul> |
| Activate upon creation | <ul style="list-style-type: none"> <li>• Selected: The rule is activated upon creation.</li> <li>• Deselected: The rule is not activated after creation.</li> </ul>                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                       |
| Rule Type              | <ul style="list-style-type: none"> <li>• <b>Cloud:</b> The rule to create is executed on the platform.</li> <li>• <b>Device side:</b> The rule to create is delivered to devices for execution. Target devices must have the SDK with the device-side rule engine. For details, see <a href="#">Device-side Rules</a>.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                       |
| Effective Period       | <ul style="list-style-type: none"> <li>• <b>Always effective:</b> There is no time limit. IoTDA always checks whether conditions are met.</li> <li>• <b>Specific time:</b> You can select a time segment during which the platform checks whether the conditions are met.</li> </ul>                                              |                                                                                                                                                                                                                                                                                                                                                                                       |
| Description            | Describe the rule.                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                                                                                                                                                       |

| Parameter    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Best Practice |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Set Triggers | <p>You can set whether all conditions or any of the conditions need to meet.</p> <ul style="list-style-type: none"> <li>● <b>Device Property:</b> Properties reported by devices can be used as a trigger. For example, the device is powered off when the temperature reaches 80°C. <ul style="list-style-type: none"> <li>– <b>Select product:</b> Select a specific product.</li> <li>– Select the device range: <ul style="list-style-type: none"> <li>▪ <b>All Devices:</b> Set the trigger for all devices under the selected product.</li> <li>▪ <b>Specified device:</b> Set the trigger for a specified device under the selected product.</li> </ul> </li> <li>– <b>Select service:</b> Select a service type.</li> <li>– <b>Select property:</b> Select a property.</li> </ul> </li> </ul> <p><b>NOTE</b></p> <ul style="list-style-type: none"> <li>▪ If the data type of a property is <b>int</b>, <b>long</b>, or <b>decimal</b>, you can select multiple operators.</li> <li>▪ If the data type of a property is <b>string</b>, <b>date time</b>, or <b>jsonObject</b>, you can only select the equal sign (=) as the operator.</li> </ul> <ul style="list-style-type: none"> <li>– <b>Triggering Mechanism:</b> Select a trigger strategy. <b>Repetition suppression</b> is recommended.</li> <li>– <b>Data Validity Period (s):</b> Specify the data validity period. For example, if <b>Data Validity Period</b> is set to 30 minutes, a device generates data at 19:00, and the platform receives the data at 20:00, the action is not triggered even if the conditions are met.</li> </ul> <ul style="list-style-type: none"> <li>● <b>Timer:</b> Set the time at which the rule is triggered. It is usually used for periodic triggering conditions, such as turning off street lights at 07:00 every day.</li> </ul> <p><b>NOTE</b></p> <p>If <b>Timer</b> is selected, <b>Send notifications</b>, <b>Report alarms</b>, and <b>Clear alarms</b> cannot be selected for <b>Actions</b>.</p> <ul style="list-style-type: none"> <li>– <b>Triggered every day:</b> The rule is triggered at a specified time every day.</li> <li>– <b>Triggered by policy:</b> <ul style="list-style-type: none"> <li>▪ <b>Select a date and time:</b> start time for triggering the rule.</li> <li>▪ <b>Repeat:</b> number of times that the rule can be triggered. The value ranges from 1 to 1440.</li> </ul> </li> </ul> |               |



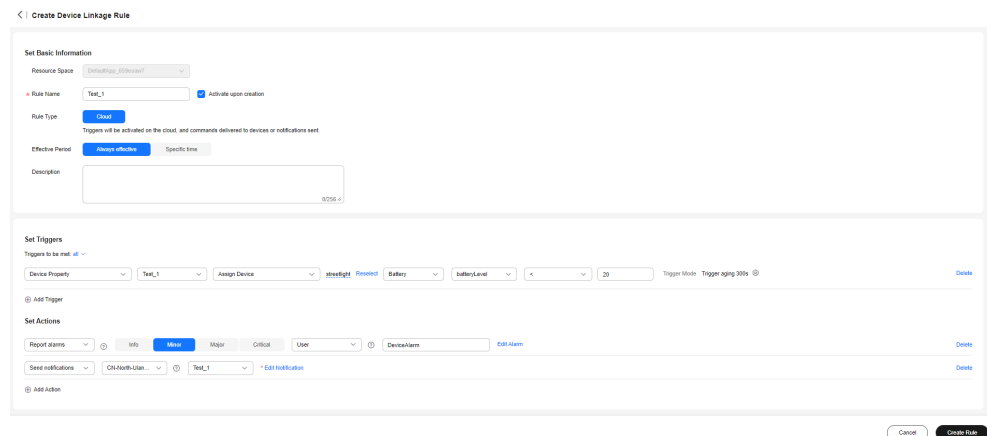
| Parameter | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Best Practice |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
|           | <ul style="list-style-type: none"> <li>▪ <b>Interval:</b> interval for triggering the rule after the start time. The value ranges from 1 to 1440, in units of minutes.</li> <li>• <b>Device Status:</b> The online/offline status of a device can be used as a trigger. For example, if a device has been offline for 5 minutes, an alarm will be reported.               <ul style="list-style-type: none"> <li>– <b>Select product:</b> Select a specific product.</li> <li>– Select the device range:                   <ul style="list-style-type: none"> <li>▪ <b>All Devices:</b> Set the trigger for all devices under the selected product.</li> <li>▪ <b>Specified device:</b> Set the trigger for a specified device under the selected product.</li> </ul> </li> <li>– Select the device status:                   <ul style="list-style-type: none"> <li>▪ <b>Online:</b> The device status changes from offline to online.</li> <li>▪ <b>Offline:</b> The device status changes from online to offline.</li> <li>▪ <b>Online and Offline:</b> The device status changes.</li> </ul> </li> <li>– <b>Duration:</b> duration of the new status after the device status change, in minutes. The value range is 0–60.</li> </ul> </li> </ul> |               |

| Parameter  | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Best Practice |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Set Action | <p>Click <b>Add Action</b> to set the action to execute after the rule is triggered.</p> <ul style="list-style-type: none"> <li>● <b>Deliver commands:</b> Select the device, service, and command to be delivered in sequence, and set the command delivery parameters.</li> <li>● <b>Send notifications:</b> Select the region where the SMN service is located. If the platform has not been granted with the permissions to access SMN, perform the authorization as prompted. Click the corresponding link to go to the SMN console and set the topic. <ul style="list-style-type: none"> <li>– <b>Message Title:</b> used as the email subject when an email is sent to an email subscriber.</li> <li>– <b>Message Type:</b> Use a template or customize the settings.</li> <li>– <b>Message Content:</b> content of the message to be sent.</li> <li>– <b>Template:</b> Use the template defined by SMN. When sending messages, the variables in the template is replaced with corresponding parameter values. IoTDA defines some common template variables. After a rule is triggered, the following template variables will be replaced with specific values. <ul style="list-style-type: none"> <li><i>{ruleName}</i>: name of the triggered rule</li> <li><i>{ruleId}</i>: ID of the triggered rule</li> <li><i>{deviceId}</i>: ID of the device that triggers the rule</li> <li><i>{deviceName}</i>: name of the device that triggers the rule</li> <li><i>{productId}</i>: ID of the product to which the device that triggers the rule belongs</li> <li><i>{productName}</i>: name of the product to which the device that triggers the rule belongs</li> <li><i>{YYYY}</i>: year (UTC) when the rule is triggered.</li> <li><i>{MM}</i>: month when the rule is triggered (UTC)</li> <li><i>{DD}</i>: date when the rule is triggered (UTC)</li> <li><i>{HH}</i>: hour (UTC) when the rule is triggered.</li> <li><i>{mm}</i>: minute (UTC) when the rule is triggered</li> <li><i>{ss}</i>: second (UTC) when the rule is triggered</li> </ul> </li> </ul> </li> </ul> |               |

| Parameter | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Best Practice |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
|           | <p><b>NOTE</b><br/>Example SMN template:<br/>Time: {YYYY}-{MM}-{DD} {HH}:{mm}:{ss}<br/>Rule name: {ruleName}<br/>Rule ID: {ruleId}<br/>Product ID: {productId}<br/>Product name: {productName}<br/>Device ID: {deviceId}<br/>Device name: {deviceName}<br/>Event: device going online and offline</p> <p>After the device goes online and the rule is triggered, the received message is shown in the following figure.</p>  <ul style="list-style-type: none"> <li>● <b>Report alarms:</b> Define the alarm severity, name, isolation dimension, and content. When the configured condition is met, a device alarm is generated on the <b>Application Operations Management (AOM)</b> console. <ul style="list-style-type: none"> <li>– Alarm severity: Options include <b>Info</b>, <b>Minor</b>, <b>Major</b>, and <b>Critical</b>.</li> <li>– Alarm isolation dimension: Options include <b>User</b>, <b>Resource Space</b>, and <b>Device</b>. Reported alarms carry different isolation dimension identifiers. If you select <b>Device</b> for the dimension, reported alarms will carry device IDs as isolation dimension identifiers.</li> <li>– Alarm name: name of the reported alarm.</li> <li>– Alarm content: content carried in the reported alarm.</li> </ul> </li> <li>● <b>Clear alarms:</b> Define the alarm severity, name, isolation dimension, and content. If conditions are met, alarms reported by the device to the platform will be cleared. The parameters are the same as those for reporting alarms.</li> </ul> <p><b>NOTE</b><br/>In AOM, the alarm severity, alarm name, and alarm isolation dimension together identify an alarm. When an alarm is cleared, the three attributes must be the same as those specified during alarm reporting.</p> |               |

**Step 4** Click **Create Rule** in the lower right corner. Newly created rules are in the activated state by default. You can disable a rule in the **Status** column of the rule list.

**Figure 7-98** Creating a linkage rule - BatteryProperty



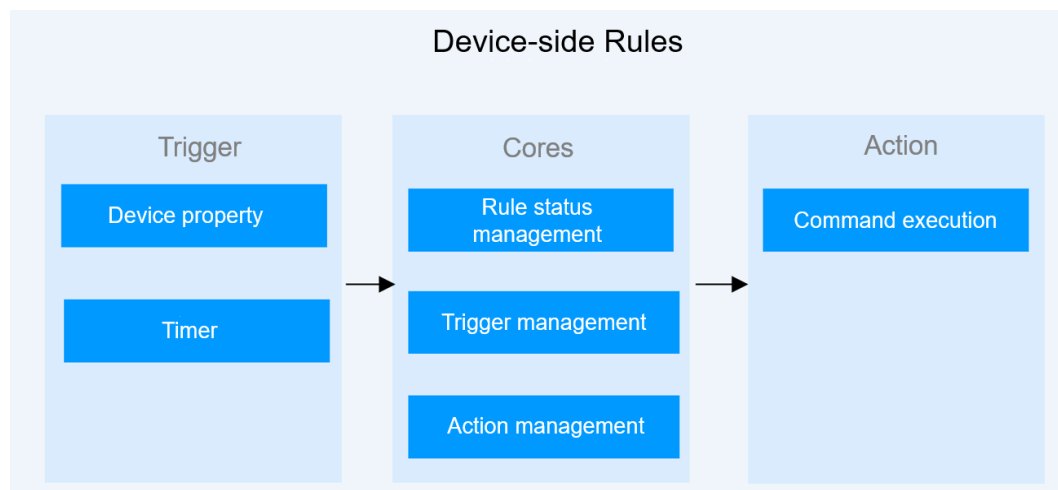
----End

## 7.11.2 Device-side Rules

### Overview

**Cloud rules** are parsed and executed on the cloud. IoTDA determines whether triggering conditions are met and triggers corresponding device linkage actions. Device-side rules are device linkage rules delivered to devices, where the device-side rule engine parses and executes the rules. Device-side rules can still run on devices when the network is interrupted or devices cannot communicate with the platform. Device-side rules can extend application scenarios and improve device running stability and execution efficiency. For example, when the indoor light intensity is lower than 20, lights can be automatically turned on. This implements intelligent control independent of network devices.

**Figure 7-99** Device-side rule architecture



For details, see [Basic Concepts](#).

## Scenarios

There are a large number of surveillance devices in highway tunnels. The network environment is complex and the network quality is unstable. However, emergency handling has high requirements on real-time network performance. Linkage between emergency devices cannot completely depend on cloud rules. Device-side rules are required to implement emergency plan linkage. Device linkage plans can be formulated in advance based on different situations such as fires and traffic accidents. Monitoring personnel can start device linkage plans with one click based on tunnel conditions. Device-side rules enable simultaneous status changes of different types of devices. This reduces dependency on network quality and improves overall device linkage efficiency. For example, if the temperature of a flue pipe is too high, the controller can be linked to open the drainage valve to reduce the temperature. If the concentration of carbon monoxide (CO) is too high, a COVI device can be linked to control fans for ventilation.

## Constraints

- Device-side rules support only command delivery actions.
- Devices must be integrated with IoT Device SDK (C) v1.1.2 or later.
- Devices need to report the SDK version number to IoTDA using the APIs provided by the SDK.

## Procedure

The following uses a smart street light system as an example to describe how to use device-side rules.

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** Create a product and model.
  1. Log in to the [IoTDA console](#) and click the target instance card. Choose **Products** from the navigation pane and click **Create Product**. In the displayed dialog box, select **StreetLampMonitoring** for **Device Type**, enter the product name, and click **OK**.

Figure 7-100 Creating a product - SmartLight

**Create Product**

\* Resource Space ? DefaultApp\_667ai0u8

To create a new resource space, you can [go to the instance details page](#).

\* Product Name SmartLight

Protocol ? MQTT

\* Data Type ? JSON

Device Type Selection **Standard profile** Custom

\* Industry ? PublicUtilities

\* Sub-industry MunicipalFacilityManagement

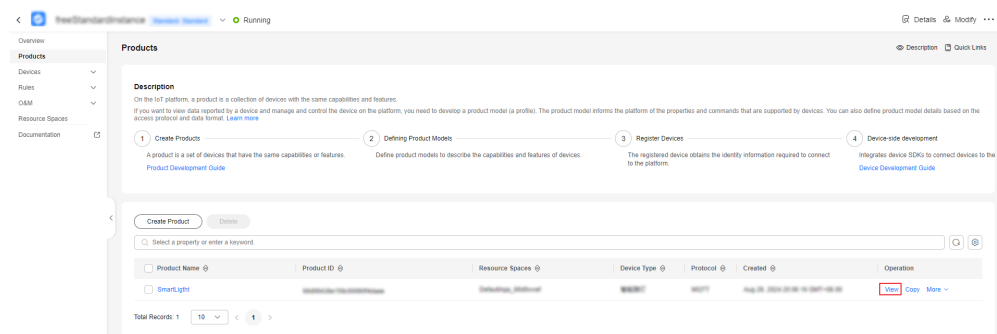
\* Device Type StreetLampMonitoring

Advanced Settings ▼ Custom Product ID | Description

Cancel OK

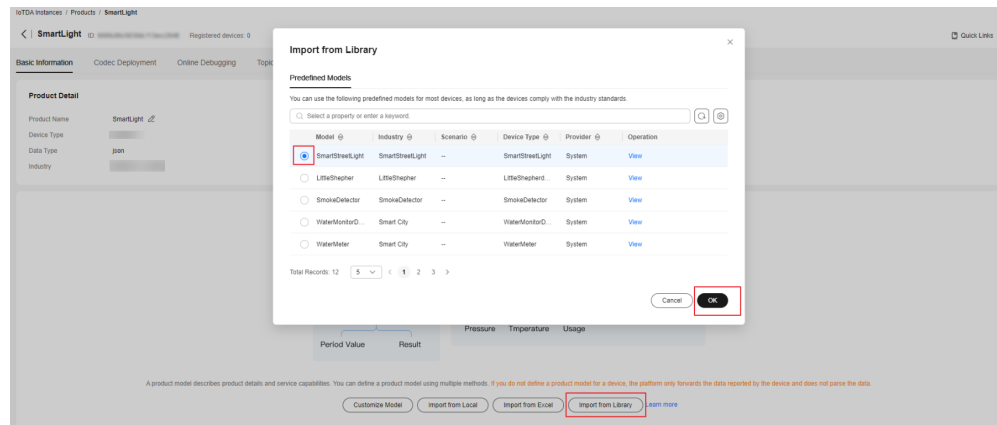
2. Locate the **SmartLight** product and click **View**.

Figure 7-101 Viewing SmartLight details



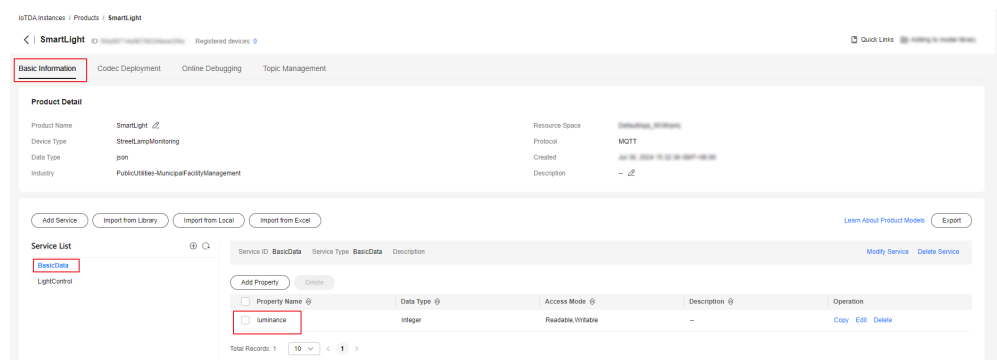
3. On the product details page, click **Import from Library**, select **SmartStreetLight**, and click **OK**.

Figure 7-102 Product - Import model SmartStreetLight



4. On the **Basic Information** page, **BasicData** and **LightControl** services are displayed. The **BasicData** service contains the **luminance** property. The **LightControl** service contains a **switch** command.

Figure 7-103 Model definition - SmartLight



- Step 3** In the navigation pane, choose **Devices > All Devices** and click **Register Device**. Select the resource space you select in **Step 2** and a product, enter a node ID, and click **OK**.

**Figure 7-104** Device - Registering a secret device

**Register Device** ×

\* Resource Space ⓘ

\* Product

\* Node ID ⓘ

Device ID ⓘ

Device Name

Description

Authentication Type ⓘ  Secret  X.509 certificate

Secret

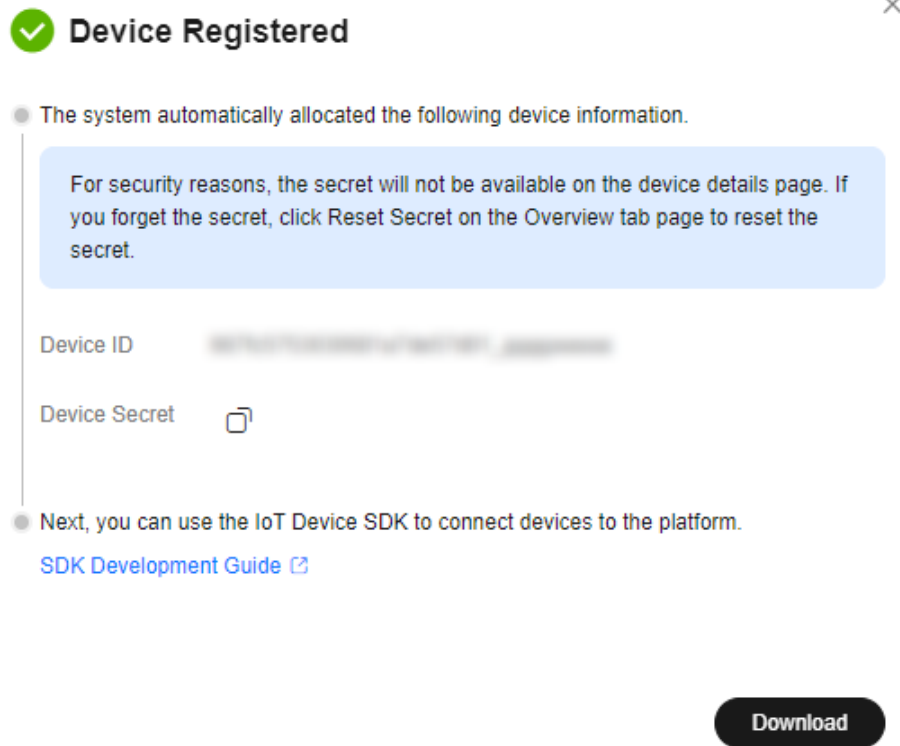
Confirm Secret

Cancel OK

**Step 4** After the device is created, copy and save the device secret for later use.



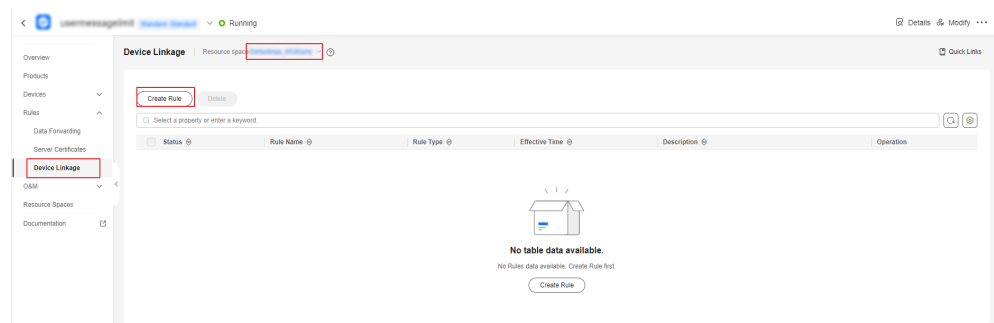
Figure 7-105 Device registered



**Step 5** Create a rule.

1. In the navigation pane, choose **Rules > Device Linkage**. In the upper part of the page, select the resource space of the product to which the device belongs. Click **Create Rule**.

Figure 7-106 Device linkage - Creating a rule



2. On the page for creating a rule, enter a rule name, select **Device Side** for **Rule Type**, and select a device for **Execution Device**. The rule will be delivered to the device you select for parsing and execution.

**Figure 7-107** Creating a linkage rule - Basic information on the device side

The screenshot shows the 'Create Device Linkage Rule' interface. Under the 'Set Basic Information' section, the 'Resource Space' is set to 'IoT Device Access'. The 'Rule Name' is 'test', and the 'Activate upon creation' checkbox is checked. The 'Rule Type' is set to 'Device Side'. Below this, a note states: 'Triggers and actions will be delivered to devices for execution.' The 'Execution Device' is set to 'smartlight001', with a warning icon and text: 'Currently, device rules can be enabled only for devices with IoT Device SDK (C) v1.1.2.' The 'Effective Period' is set to 'Always effective'. There is a 'Description' text area at the bottom, currently empty, with a character count of 0/256.

3. Select **smartlight001** and click **OK**.

**Figure 7-108** Creating a linkage rule - Selecting a device

The screenshot shows the 'Select Device' dialog box. It has search filters for 'All products', 'Device Na...', and 'Keyword'. Below the filters is a table with the following data:

| Device Name   | Node ID | Product | Description | SDK Version |
|---------------|---------|---------|-------------|-------------|
| smartlight001 | ...     | ...     |             | C_v1.2.0    |

At the bottom, it shows 'Total Records: 1' and pagination controls. There are 'Cancel' and 'OK' buttons.

**NOTE**

Device-side rules can be created only for devices with the IoT Device SDK. Currently, only IoT Device SDK (C) v1.1.2 is supported.

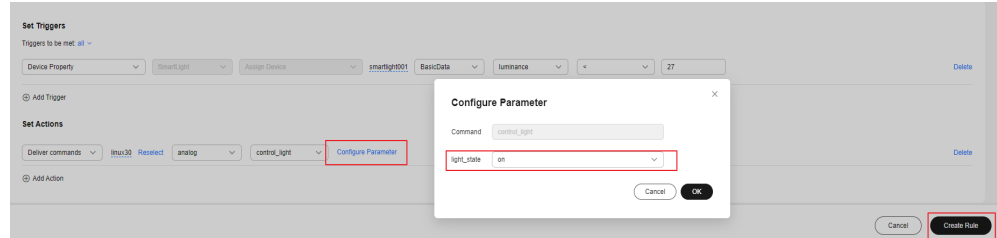
4. Click **Add Trigger**. The current device is used by default, and other devices are not available. Click **Add Action** and select the current device or other devices.

**Figure 7-109** Creating a linkage rule - Conditions and actions

The screenshot shows the 'Set Triggers' and 'Set Actions' sections. Under 'Set Triggers', 'Triggers to be met' is set to 'all'. There are three trigger conditions: 'Device Property', 'SmartLigth', and 'Assign Device'. The 'Assign Device' dropdown is set to 'smartlight001', which is highlighted with a red box. Below this, there is an 'Add Trigger' button with a red box around it and the number '1'. A red text annotation says: 'Trigger device, which is set to the current device and cannot be changed.' Under 'Set Actions', there is an 'Add Action' button with a red box around it and the number '2'. Below it, there is an action 'Deliver commands' with a dropdown set to 'Select device', which is also highlighted with a red box. A red text annotation says: 'Device that executes the action. You can select a device based on site requirements.'

- In **Set Triggers**, set the property trigger to **luminance** ≤ 27. In **Set Actions**, configure the **control\_light** command and configure the parameter to set **light\_state** to **on**.

**Figure 7-110** Creating a linkage rule - Conditions and actions



**Step 6** Create a device linkage rule based on the table below.

**Table 7-22** Parameters

| Parameter              | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Rule Name              | Specify the name of a rule to create.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| Activate upon creation | Selected: The rule is activated upon creation.<br>Deselected: The rule is not activated after creation.                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Effective Period       | <ul style="list-style-type: none"> <li><b>Always effective:</b> There is no time limit. IoTDA always checks whether conditions are met.</li> <li><b>Specific time:</b> You can select a time segment during which the platform checks whether the conditions are met.</li> </ul> <p><b>NOTE</b><br/>Device-side rules are stored in the memory. When a device is powered off, rules stored on the device are cleared. When the device is restarted or powered on, the device updates all historical rules from IoTDA.</p> |
| Description            | Describe the rule.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

| Parameter    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Set Triggers | <p>You can set whether all conditions or any of the conditions need to meet.</p> <p><b>NOTE</b><br/>If all conditions need to meet, <b>Device Property</b> and <b>Timer</b> cannot be both set as triggers at the same time. You can only set multiple device properties as triggers.</p> <p>Trigger type: Currently, only <b>Device Property</b> and <b>Timer</b> are supported.</p> <ul style="list-style-type: none"> <li>● <b>Device Property:</b> The rule will be triggered when a device reports properties. <ul style="list-style-type: none"> <li>- <b>Select service:</b> Select the corresponding service type.</li> <li>- <b>Select property:</b> Select a property in the data reported.</li> </ul> </li> </ul> <p><b>NOTE</b></p> <ul style="list-style-type: none"> <li>- If the data type of a property is <b>int</b> or <b>decimal</b>, you can select multiple operators.</li> <li>- If the data type of a property is <b>string</b>, you can only select the equal sign (=) as the operator.</li> </ul> <ul style="list-style-type: none"> <li>● <b>Timer:</b> You can select <b>Triggered every day</b> or <b>Triggered by policy</b>. <ul style="list-style-type: none"> <li>- <b>Triggered every day:</b> Set the time at which the rule is triggered. It is usually used for periodic triggering conditions, such as turning off street lights at 07:00 every day.</li> <li>- <b>Triggered by policy</b> <ul style="list-style-type: none"> <li>▪ <b>Select a date and time:</b> start time for triggering the rule.</li> <li>▪ <b>Repeat:</b> number of times that the rule can be triggered. The value ranges from 1 to 1440.</li> <li>▪ <b>Interval:</b> interval for triggering the rule after the start time. The value ranges from 1 to 1440, in units of minutes.</li> </ul> </li> </ul> </li> </ul> |
| Set Actions  | <p>Click <b>Add Action</b> to set the action to execute after the rule is triggered.</p> <p><b>Deliver commands:</b> Select the device, service, and command to be delivered in sequence, and set the command delivery parameters.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

**Step 7** Click **Create Rule** in the lower right corner. Newly created rules are in the activated state by default. You can disable a rule in the **Status** column of the rule list.

**Step 8** Compile the device-side code. In SDKs that supports device-side rules (only IoT Device SDK C is supported currently), you only need to implement the callback functions for property reporting and command processing. Click [here](#) to obtain the IoT Device SDK (C) and perform the following operations after the operations in **Preparations** are complete.

1. Open the `src/device_demo/device_demo.c` file and find the `HandleCommandRequest` function.

Figure 7-111 Command processing

```
void HandleCommandRequest(EN_IOTA_COMMAND *command)
{
 if (command == NULL) {
 return;
 }

 PrintFLog(EN_LOG_LEVEL_INFO, "device_demo: HandleCommandRequest(), messageId %d\n",
 command->mqtt_msg_info->messageId);

 PrintFLog(EN_LOG_LEVEL_INFO, "device_demo: HandleCommandRequest(), object_device_id %s\n",
 command->object_device_id);
 PrintFLog(EN_LOG_LEVEL_INFO, "device_demo: HandleCommandRequest(), service_id %s\n", command->service_id);
 PrintFLog(EN_LOG_LEVEL_INFO, "device_demo: HandleCommandRequest(), command_name %s\n", command->command_name);
 PrintFLog(EN_LOG_LEVEL_INFO, "device_demo: HandleCommandRequest(), paras %s\n", command->paras);
 PrintFLog(EN_LOG_LEVEL_INFO, "device_demo: HandleCommandRequest(), request_id %s\n", command->request_id);

 Test_CommandResponse(command->request_id); // response: command
}

```

← Implement the command here.

The following commands are use for demonstration only.

```
printf("----- execute command----- \n");
printf("service_id: %s\n", command->service_id);
printf("command_name: %s\n", command->command_name);
printf("paras: %s\n", command->paras);

```

2. Open the `src/device_demo/device_demo.c` file and find the `TestPropertiesReport` function.

Figure 7-112 Replacing the code

```
void Test_PropertiesReport()
{
 const int serviceNum = 2; // reported services' total count
 ST_IOTA_SERVICE_DATA_INFO services[serviceNum];

 // -----the data of service1-----
 char *service1 = "{\"Load\": \"6\", \"Imba_strVal\": \"7\"}";

 services[0].event_time =
 GetEventTimeStamp(); // if event_time is set to NULL, the time will be the iot-platform's time.
 services[0].service_id = "parameter";
 services[0].properties = service1;

 // -----the data of service2-----
 char *service2 = "{\"PhV_phSA\": \"9\", \"PhV_phB\": \"8\"}";

 services[1].event_time = NULL;
 services[1].service_id = "analog";
 services[1].properties = service2;

 int messageId = IOTA_PropertiesReport(services, serviceNum, 0, NULL);
 if (messageId != 0) {
 PrintFLog(EN_LOG_LEVEL_ERROR, "device_demo: Test_PropertiesReport() failed, messageId %d\n", messageId);
 }

 MemFree(&services[0].event_time);
}

```

Replace the code here.

Use the following code:

```
const int serviceNum = 1; // reported services' total count
ST_IOTA_SERVICE_DATA_INFO services[serviceNum];

#define MAX_BUFFER_LEN 70
char propsBuffer[MAX_BUFFER_LEN];
// This is an example of obtaining a temperature value. Obtain the actual value from a sensor.
if (sprintf_s(propsBuffer, sizeof(propsBuffer), "{\"luminance\": %d}", 20) == -1) {
 printf("can't create string of properties\n");
 return;
}

services[0].event_time = GetEventTimeStamp(); // if event_time is set to NULL, the time will be the

```

```
iot-platform's time.
services[0].service_id = "BasicData";
services[0].properties = propsBuffer;

int messageId = IOTA_PropertiesReport(services, serviceNum, 0, NULL);
if (messageId != 0) {
 printf("report properties failed, messageId %d\n", messageId);
}
free(services[0].event_time);
```

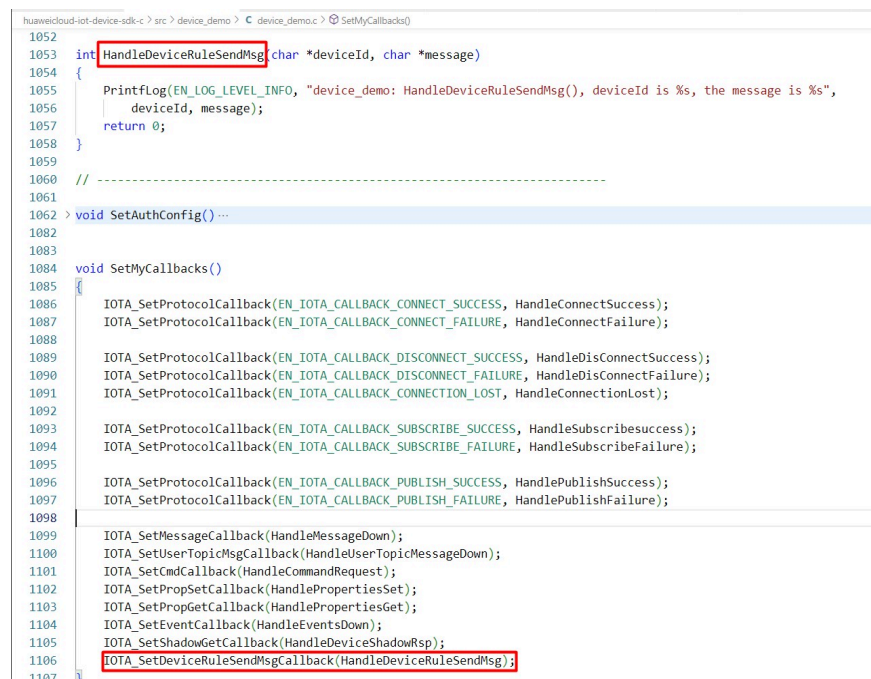
3. Compile and run the SDK. You can see the corresponding command from the output.

```
----- execute command-----
service_id: BasicData
command_name: control_light
paras: {
 "light_state": "on"
}
```

The preceding log is only an example. You need to implement the specific command processing code in [1](#).

Before running commands across devices, ensure that the devices can communicate with each other. You may use different communication protocols, such as Wi-Fi, BLE, and ZigBee, so you need to call **IOTA\_SetDeviceRuleSendMsgCallback** to register a custom sending function. **HandleDeviceRuleSendMsg** is registered in the demo by default. You need to implement message sending in **HandleDeviceRuleSendMsg**. After receiving the message, the target device needs to parse and execute the command.

**Figure 7-113** Parsing and executing commands



```
1052
1053 int HandleDeviceRuleSendMsg(char *deviceId, char *message)
1054 {
1055 PrintfLog(EN_LOG_LEVEL_INFO, "device_demo: HandleDeviceRuleSendMsg(), deviceId is %s, the message is %s",
1056 deviceId, message);
1057 return 0;
1058 }
1059
1060 // -----
1061
1062 void SetAuthConfig() ...
1082
1083
1084 void SetMyCallbacks()
1085 {
1086 IOTA_SetProtocolCallback(EN_IOTA_CALLBACK_CONNECT_SUCCESS, HandleConnectSuccess);
1087 IOTA_SetProtocolCallback(EN_IOTA_CALLBACK_CONNECT_FAILURE, HandleConnectFailure);
1088
1089 IOTA_SetProtocolCallback(EN_IOTA_CALLBACK_DISCONNECT_SUCCESS, HandleDisConnectSuccess);
1090 IOTA_SetProtocolCallback(EN_IOTA_CALLBACK_DISCONNECT_FAILURE, HandleDisConnectFailure);
1091 IOTA_SetProtocolCallback(EN_IOTA_CALLBACK_CONNECTION_LOST, HandleConnectionLost);
1092
1093 IOTA_SetProtocolCallback(EN_IOTA_CALLBACK_SUBSCRIBE_SUCCESS, HandleSubscribesuccess);
1094 IOTA_SetProtocolCallback(EN_IOTA_CALLBACK_SUBSCRIBE_FAILURE, HandleSubscribeFailure);
1095
1096 IOTA_SetProtocolCallback(EN_IOTA_CALLBACK_PUBLISH_SUCCESS, HandlePublishSuccess);
1097 IOTA_SetProtocolCallback(EN_IOTA_CALLBACK_PUBLISH_FAILURE, HandlePublishFailure);
1098
1099 IOTA_SetMessageCallback(HandleMessageDown);
1100 IOTA_SetUserTopicMsgCallback(HandleUserTopicMessageDown);
1101 IOTA_SetCmdCallback(HandleCommandRequest);
1102 IOTA_SetPropSetCallback(HandlePropertiesSet);
1103 IOTA_SetPropGetCallback(HandlePropertiesGet);
1104 IOTA_SetEventCallback(HandleEventsDown);
1105 IOTA_SetShadowGetCallback(HandleDeviceShadowRsp);
1106 IOTA_SetDeviceRuleSendMsgCallback(HandleDeviceRuleSendMsg);
1107 }
```

----End

# 8 Monitoring and O&M

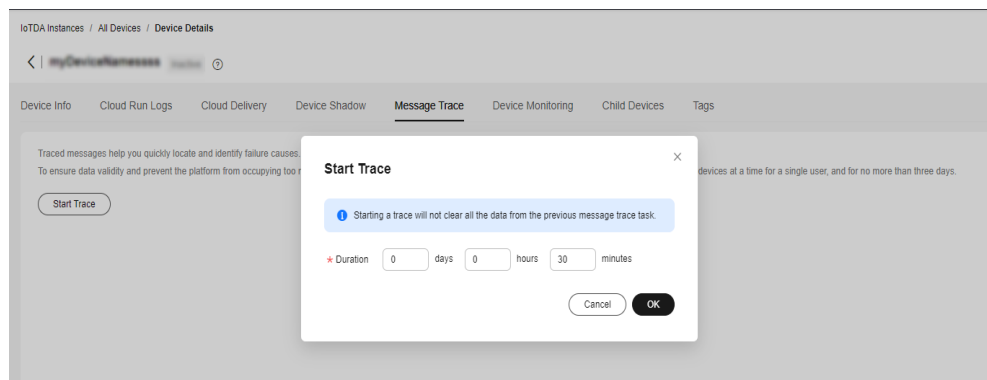
## 8.1 Message Trace

Message trace can be used to quickly locate and analyze faults that occur during device authentication, command delivery, data reporting, and data forwarding. The platform supports message trace for NB-IoT and MQTT devices. You can trace messages for up to 10 devices simultaneously.

### Procedure

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **Devices > All Devices**.
- Step 3** Search for the device to trace and click **View** to access its details page.
- Step 4** On the **Message Trace** tab page, click **Start Trace**, and set the message trace duration, which indicates the duration from the time when message trace starts to the time when message trace ends. You can also click **Edit Configuration** to modify the message trace configuration. The message trace duration is subject to the new one.

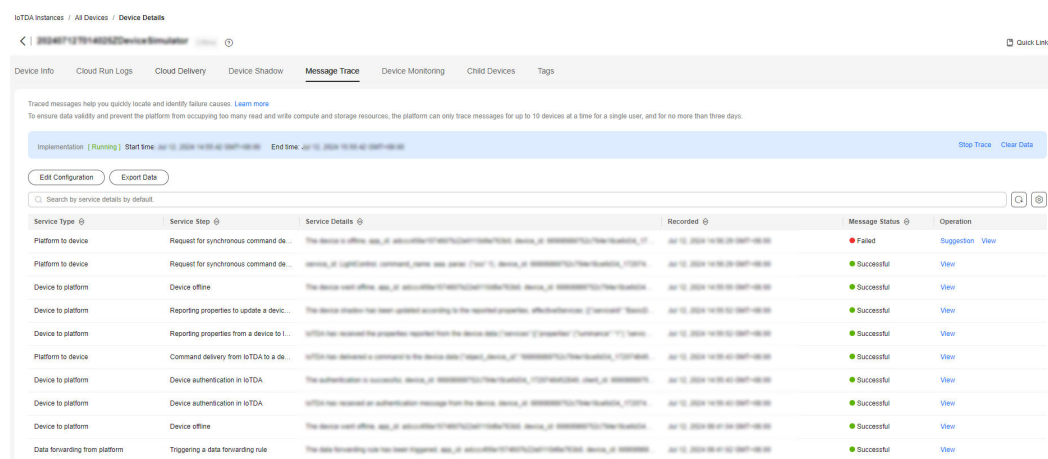
**Figure 8-1** Message tracing - Starting message tracing



**Step 5** View the services that are being traced. You can also click **Stop Trace** to stop the task.

If a large number of message trace records are displayed, you can filter the records by message status, service type, and recording time. If you need to further analyze the result data, you can export the data.

**Figure 8-2** Message tracing - Viewing data



If the message status is **Failed**, you can click **View** to view the result details and locate the fault based on the failure handling suggestions.

----End

**NOTE**

During data reporting, you can specify **request\_id** by adding **?request\_id={request\_id}** after a topic. For example, use **\$oc/devices/{device\_id}/sys/properties/report?request\_id={request\_id}** for property reporting. If you do not specify **request\_id**, the platform automatically generates one.

## 8.2 Reports

IoTDA has various dashboards to intuitively present data.

In the navigation pane of the IoTDA console, choose **Overview**. The multiple reports displayed are from collected data of each instance and are valid for one month. The following table describes each report's name and function.

**Table 8-1** Overview page

| Report Name        | Description                   | Data Update | Time Frame           |
|--------------------|-------------------------------|-------------|----------------------|
| Registered Devices | Number of registered devices. | Every hour  | Hour, day, and month |



| Report Name          | Description                                                                                                                                                                                                                                                                                                        | Data Update  | Time Frame                               |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------------------------------------|
| Online Devices       | Number of online devices. This number is the highest collected in the time period (by hour or by day).                                                                                                                                                                                                             | Every hour   | Hour, day, and month                     |
| Device Messages      | Number of device messages in either direction. Upstream messages are involved in message, property, and event reporting. Downstream messages are involved in message and command delivery, and property setting and query.<br><b>NOTE</b><br>Supported by the basic and enterprise editions.                       | Every hour   | Hour, day, and month                     |
| Upstream Message TPS | Highest throughput of upstream messages per second, that is, the total number of messages sent from all devices to the platform in an instance per second. Only MQTT messages can be reported. The chart data comes from the average value every ten seconds.<br><b>NOTE</b><br>Supported by the standard edition. | Every minute | 10 minutes, 30 minutes, 1 hour, or 1 day |
| User Messages        | Number of user messages. This is mainly messages sent from devices to the cloud and vice versa. Any forward messages in excess of the messages sent from devices to the cloud are also counted.                                                                                                                    | Every hour   | Hour, day, and month                     |

In the navigation pane of the IoTDA console, choose **O&M > Reports** to see multiple O&M reports. Click the + icon in the upper right corner of a report to view data by instance or resource space. Each report is valid for one month. The following table describes each report's name and function.

**Table 8-2** O&M reports

| Report Name              | Description                                                                                                                           | Data Update | Time Frame |
|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-------------|------------|
| Device Connection Status | Number of devices (and percentage of total number of devices) in each status.<br>Statuses: <b>Online, Inactive, Offline, Abnormal</b> | Every hour  | -          |

| Report Name                            | Description                                                                                                                                                                                                                                  | Data Update  | Time Frame                               |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------------------------------------|
| Device Messages                        | <p>Messages reported: number of messages reported by devices to the platform.</p> <p>Downstream messages: number of messages delivered by the platform to devices.</p>                                                                       | Every hour   | Hour and day                             |
| MQTT Reported Messages TPS             | <p>Maximum number of upstream requests sent by MQTT devices to the platform per second in the current instance. The chart data comes from the average value every ten seconds.</p> <p><b>NOTE</b><br/>Supported by the standard edition.</p> | Every minute | 10 minutes, 30 minutes, 1 hour, or 1 day |
| MQTT Concurrent Connection Setup TPS   | <p>The most new connection requests from MQTT devices per second. The chart data comes from the average value every ten seconds.</p> <p><b>NOTE</b><br/>Supported by the standard edition.</p>                                               | Every minute | 10 minutes, 30 minutes, 1 hour, or 1 day |
| General Device Trends                  | Trends in the number of devices. Total and online devices counted separately.                                                                                                                                                                | Every hour   | Hour and day                             |
| Device Online Trends                   | Trends in the number (and percentage of total number devices) of devices. Online and offline devices counted separately.                                                                                                                     | Every hour   | Hour and day                             |
| Devices by Status                      | <p>Trends in the number of devices in each status.</p> <p>Statuses: <b>Inactive, Abnormal, Offline</b></p>                                                                                                                                   | Every hour   | Hour and day                             |
| Number of Online Devices (Accumulated) | <p>Total number of online devices.</p> <p><b>NOTE</b><br/>Supported by the standard edition.</p>                                                                                                                                             | Every hour   | Hour and day                             |

| Report Name                 | Description                                                                                                 | Data Update | Time Frame |
|-----------------------------|-------------------------------------------------------------------------------------------------------------|-------------|------------|
| Software Upgrade Status     | Number of upgrades of device software from the start. Successful and failed upgrades counted separately.    | Every hour  | -          |
| Firmware Upgrade Status     | Number of upgrades of device firmware from the start. Successful and failed upgrades counted separately.    | Every hour  | -          |
| Device Configuration Status | Number of updates of device configuration from the start. Successful and failed updates counted separately. | Every hour  | -          |

For more reports, log in to the [AOM console](#), and choose **Monitoring > Cloud Service Monitoring > IoT > IoT Device Access (IoTDA)**. Currently, AOM shows you the IoTDA monitoring information by instance or resource space.

**Table 8-3** Dashboards

| Report Name           | Description                                                                                        | Data Update      | Time Frame                                  |
|-----------------------|----------------------------------------------------------------------------------------------------|------------------|---------------------------------------------|
| Device Status         | Number of devices in each status.<br>Statuses: <b>Online, Inactive, Offline, Abnormal.</b>         | Every 10 minutes | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| General Device Trends | Trends in the number of devices. Total, online, and offline devices counted separately.            | Every 10 minutes | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| Data Transfer Trend   | Trends in the number of data transfers. AMQP transfers and HTTP message pushes counted separately. | Every minute     | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |

| Report Name       | Description                                                                                                                              | Data Update  | Time Frame                                  |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------------------------------------|
| Data Report Trend | Trends in the number of reporting records. Reporting of NB-IoT data, MQTT events, MQTT properties, and MQTT messages counted separately. | Every minute | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |

**Table 8-4** Metrics

| Report Name              | Description                                                                                                                          | Data Update      | Time Frame                                  |
|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------------------------|
| Total Devices            | Trends in the total number of devices and the number of devices in each status. Statuses: <b>Online, Offline, Abnormal, Inactive</b> | Every 10 minutes | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| Reported NB Data Records | Trends in the number of NB-IoT data reporting records. Total, successful, and failed reporting counted separately.                   | Every minute     | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| Reported MQTT Events     | Trends in the number of MQTT event reporting records. Total, successful, and failed reporting counted separately.                    | Every minute     | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| Reported MQTT Properties | Trends in the number of MQTT property reporting records. Total, successful, and failed reporting counted separately.                 | Every minute     | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| Reported MQTT Messages   | Trends in the number of MQTT message reporting records. Total, successful, and failed reporting counted separately.                  | Every minute     | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| AMQP Transfers           | Trends in the number of AMQP transfers. Total, successful, and failed transfers counted separately.                                  | Every minute     | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| FunctionGraph Transfers  | Trends in the number of FunctionGraph transfers. Total, successful, and failed transfers counted separately.                         | Every minute     | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |

| Report Name         | Description                                                                                                  | Data Update  | Time Frame                                  |
|---------------------|--------------------------------------------------------------------------------------------------------------|--------------|---------------------------------------------|
| MRS Kafka Transfers | Trends in the number of MRS Kafka transfers. Total, successful, and failed transfers counted separately.     | Every minute | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| MQTT Transfers      | Trends in the number of MQTT transfers. Total, successful, and failed transfers counted separately.          | Every minute | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| MySQL Transfers     | Trends in the number of MySQL transfers. Total, successful, and failed transfers counted separately.         | Every minute | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| InfluxDB Transfers  | Trends in the number of InfluxDB transfers. Total, successful, and failed transfers counted separately.      | Every minute | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| HTTP Message Pushes | Trends in the number of HTTP message pushes. Total, successful, and failed pushes counted separately.        | Every minute | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| OBS Transfers       | Trends in the number of OBS transfers. Total, successful, and failed transfers counted separately.           | Every minute | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| DMS Kafka Transfers | Trends in the number of DMS for Kafka transfers. Total, successful, and failed transfers counted separately. | Every minute | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| DIS Transfers       | Trends in the number of DIS transfers. Total, successful, and failed transfers counted separately.           | Every minute | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| ROMA Transfers      | Trends in the number of ROMA Connect transfers. Total, successful, and failed transfers counted separately.  | Every minute | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| LTS Transfers       | Trends in the number of LTS transfers. Total, successful, and failed transfers counted separately.           | Every minute | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |

| Report Name                                       | Description                                                                                                                            | Data Update  | Time Frame                                  |
|---------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------|--------------|---------------------------------------------|
| BCS Huawei Cloud Blockchain Transfers             | Trends in the number of BCS Huawei Cloud Blockchain transfers. Total, successful, and failed transfers counted separately.             | Every minute | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| BCS-Hyperledger Fabric Enhanced Edition Transfers | Trends in the number of BCS-Hyperledger Fabric Enhanced Edition transfers. Total, successful, and failed transfers counted separately. | Every minute | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |
| MongoDB Transfers                                 | Trends in the number of MongoDB transfers. Total, successful, and failed transfers counted separately.                                 | Every minute | 1 hour, 6 hours, 12 hours, 1 day, or 7 days |

To obtain report data using an AOM API, see [Querying Monitoring Data](#). The following tables show the details about custom parameters of IoTDA metrics. In Table 5, **Name** corresponds to `metrics[].metric.dimensions[].name` and **Value** to `metrics[].metric.dimensions[].value`. In Table 6, **Namespace** corresponds to `metrics[].metric.namespace` and **MetricName** to `metrics[].metric.metricName`.

**Table 8-5** Dimensions

| Name     | Value                                                                                                                                                                      |
|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| app      | Resource space ID                                                                                                                                                          |
| instance | Instance ID                                                                                                                                                                |
| taskType | Task type: software upgrade status ( <b>softwareUpgrade</b> ), firmware upgrade status ( <b>firmwareUpgrade</b> ), and device configuration status ( <b>deviceConfig</b> ) |

**Table 8-6** Metrics and namespaces

| Report Name   | Namespace           | MetricName                                                          |
|---------------|---------------------|---------------------------------------------------------------------|
| Total Devices | IoTDA.DEVICE_STATUS | Total number of devices:<br><b>iotda_device_status_totalCount</b>   |
|               |                     | Number of online devices:<br><b>iotda_device_status_onlineCount</b> |

| Report Name              | Namespace               | MetricName                                                                                        |
|--------------------------|-------------------------|---------------------------------------------------------------------------------------------------|
|                          |                         | Number of offline devices:<br><b>iotda_device_status_offlineCount</b>                             |
|                          |                         | Number of abnormal devices:<br><b>iotda_device_status_abnormalCount</b>                           |
|                          |                         | Number of inactive devices:<br><b>iotda_device_status_inactiveCount</b>                           |
| Reported NB Data Records | IoTDA.NB_DATA_REPORT    | Total number of reported NB-IoT data records:<br><b>iotda_south_dataReport_totalCount</b>         |
|                          |                         | Number of NB-IoT data reporting successes:<br><b>iotda_south_dataReport_successCount</b>          |
|                          |                         | Number of NB-IoT data reporting failures:<br><b>iotda_south_dataReport_failedCount</b>            |
| Reported MQTT Events     | IoTDA.EVENT_UP          | Total number of reported MQTT event records:<br><b>iotda_south_eventUp_totalCount</b>             |
|                          |                         | Number of MQTT event reporting successes:<br><b>iotda_south_eventUp_successCount</b>              |
|                          |                         | Number of MQTT event reporting failures:<br><b>iotda_south_eventUp_failedCount</b>                |
| Reported MQTT Properties | IoTDA.PROPERTIES_REPORT | Total number of reported MQTT property records:<br><b>iotda_south_propertiesReport_totalCount</b> |
|                          |                         | Number of MQTT property reporting successes:<br><b>iotda_south_propertiesReport_successCount</b>  |
|                          |                         | Number of MQTT property reporting failures:<br><b>iotda_south_propertiesReport_failedCount</b>    |

| Report Name             | Namespace                      | MetricName                                                                                          |
|-------------------------|--------------------------------|-----------------------------------------------------------------------------------------------------|
| Reported MQTT Messages  | IoTDA.MESSAGE_UP               | Total number of reported MQTT message records:<br><b>iotda_south_messageUp_totalCount</b>           |
|                         |                                | Number of MQTT message reporting successes:<br><b>iotda_south_messageUp_successCount</b>            |
|                         |                                | Number of MQTT message reporting failures:<br><b>iotda_south_messageUp_failedCount</b>              |
| AMQP Transfers          | IoTDA.AMQP_FORWARDING          | Total number of AMQP transfers:<br><b>iotda_amqp_forwarding_totalCount</b>                          |
|                         |                                | Number of successful AMQP transfers:<br><b>iotda_amqp_forwarding_successCount</b>                   |
|                         |                                | Number of failed AMQP transfers:<br><b>iotda_amqp_forwarding_failedCount</b>                        |
| FunctionGraph Transfers | IoTDA.FUNCTIONGRAPH_FORWARDING | Total number of FunctionGraph transfers:<br><b>iotda_functionGraph_forwarding_totalCount</b>        |
|                         |                                | Number of successful FunctionGraph transfers:<br><b>iotda_functionGraph_forwarding_successCount</b> |
|                         |                                | Number of failed FunctionGraph transfers:<br><b>iotda_functionGraph_forwarding_failedCount</b>      |
| MRS Kafka Transfers     | IoTDA.MRS_KAFKA_FORWARDING     | Total number of MRS Kafka transfers:<br><b>iotda_mrsKafka_forwarding_totalCount</b>                 |
|                         |                                | Number of successful MRS Kafka transfers:<br><b>iotda_mrsKafka_forwarding_successCount</b>          |



| Report Name         | Namespace                 | MetricName                                                                                     |
|---------------------|---------------------------|------------------------------------------------------------------------------------------------|
|                     |                           | Number of failed MRS Kafka transfers:<br><b>iotda_mrsKafka_forwarding_failedCount</b>          |
| MQTT Transfers      | IoTDA.MQTT_FORWARDING     | Total number of MQTT transfers:<br><b>iotda_mqtt_forwarding_totalCount</b>                     |
|                     |                           | Number of successful MQTT transfers:<br><b>iotda_mqtt_forwarding_successCount</b>              |
|                     |                           | Number of failed MQTT transfers:<br><b>iotda_mqtt_forwarding_failedCount</b>                   |
| MySQL Transfers     | IoTDA.MYSQL_FORWARDING    | Total number of MySQL transfers:<br><b>iotda_mysql_forwarding_totalCount</b>                   |
|                     |                           | Number of successful MySQL transfers:<br><b>iotda_mysql_forwarding_successCount</b>            |
|                     |                           | Number of failed MySQL transfers:<br><b>iotda_mysql_forwarding_failedCount</b>                 |
| InfluxDB Transfers  | IoTDA.INFLUXDB_FORWARDING | Total number of InfluxDB transfers:<br><b>iotda_influxDB_forwarding_totalCount</b>             |
|                     |                           | Number of successful InfluxDB transfers:<br><b>iotda_influxDB_forwarding_successCount</b>      |
|                     |                           | Number of failed InfluxDB transfers:<br><b>iotda_influxDB_forwarding_failedCount</b>           |
| HTTP Message Pushes | IoTDA.HTTP_FORWARDING     | Total number of HTTP message push transfers:<br><b>iotda_http_forwarding_totalCount</b>        |
|                     |                           | Number of successful HTTP message push transfers:<br><b>iotda_http_forwarding_successCount</b> |

| Report Name         | Namespace                  | MetricName                                                                                     |
|---------------------|----------------------------|------------------------------------------------------------------------------------------------|
|                     |                            | Number of failed HTTP message push transfers:<br><b>iotda_http_forwarding_failedCount</b>      |
| OBS Transfers       | IoTDA.OBS_FORWARDING       | Total number of OBS transfers:<br><b>iotda_obs_forwarding_totalCount</b>                       |
|                     |                            | Number of successful OBS transfers:<br><b>iotda_obs_forwarding_successCount</b>                |
|                     |                            | Number of failed OBS transfers:<br><b>iotda_obs_forwarding_failedCount</b>                     |
| DMS Kafka Transfers | IoTDA.DMS_KAFKA_FORWARDING | Total number of DMS for Kafka transfers:<br><b>iotda_dmsKafka_forwarding_totalCount</b>        |
|                     |                            | Number of successful DMS for Kafka transfers:<br><b>iotda_dmsKafka_forwarding_successCount</b> |
|                     |                            | Number of failed DMS for Kafka transfers:<br><b>iotda_dmsKafka_forwarding_failedCount</b>      |
| DIS Transfers       | IoTDA.DIS_FORWARDING       | Total number of DIS transfers:<br><b>iotda_dis_forwarding_totalCount</b>                       |
|                     |                            | Number of successful DIS transfers:<br><b>iotda_dis_forwarding_successCount</b>                |
|                     |                            | Number of failed DIS transfers:<br><b>iotda_dis_forwarding_failedCount</b>                     |
| ROMA Transfers      | IoTDA.ROMA_FORWARDING      | Total number of ROMA Connect transfers:<br><b>iotda_roma_forwarding_totalCount</b>             |
|                     |                            | Number of successful ROMA Connect transfers:<br><b>iotda_roma_forwarding_successCount</b>      |

| Report Name                                       | Namespace                   | MetricName                                                                                                                |
|---------------------------------------------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------|
|                                                   |                             | Number of failed ROMA Connect transfers:<br><b>iotda_roma_forwarding_failedCount</b>                                      |
| LTS Transfers                                     | IoTDA.LTS_FORWARDING        | Total number of LTS transfers:<br><b>iotda_lts_forwarding_totalCount</b>                                                  |
|                                                   |                             | Number of successful LTS transfers:<br><b>iotda_lts_forwarding_successCount</b>                                           |
|                                                   |                             | Number of failed LTS transfers:<br><b>iotda_lts_forwarding_failedCount</b>                                                |
| BCS Huawei Cloud Blockchain Transfers             | IoTDA.BCS_HW_FORWARDING     | Total number of BCS Huawei Cloud blockchain transfers:<br><b>iotda_bcshw_forwarding_totalCount</b>                        |
|                                                   |                             | Number of successful BCS Huawei Cloud blockchain transfers:<br><b>iotda_bcshw_forwarding_successCount</b>                 |
|                                                   |                             | Number of failed BCS Huawei Cloud blockchain transfers:<br><b>iotda_bcshw_forwarding_failedCount</b>                      |
| BCS-Hyperledger Fabric Enhanced Edition Transfers | IoTDA.BCS_FABRIC_FORWARDING | Total number of BCS-Hyperledger Fabric Enhanced Edition transfers:<br><b>iotda_bcsfabric_forwarding_totalCount</b>        |
|                                                   |                             | Number of successful BCS-Hyperledger Fabric Enhanced Edition transfers:<br><b>iotda_bcsfabric_forwarding_successCount</b> |
|                                                   |                             | Number of failed BCS-Hyperledger Fabric Enhanced Edition transfers:<br><b>iotda_bcsfabric_forwarding_failedCount</b>      |
| MongoDB Transfers                                 | IoTDA.MONGODB_FORWARDING    | Total number of MongoDB transfers:<br><b>iotda_mongodb_forwarding_totalCount</b>                                          |

| Report Name                                          | Namespace | MetricName                                                                              |
|------------------------------------------------------|-----------|-----------------------------------------------------------------------------------------|
|                                                      |           | Number of successful MongoDB transfers:<br><b>iotda_mongodb_forwarding_successCount</b> |
|                                                      |           | Number of failed MongoDB transfers:<br><b>iotda_mongodb_forwarding_failedCount</b>      |
| Software and Firmware Upgrades/ Remote Configuration | AOM.IoTDA | Number of successes: <b>count:</b><br><b>iotda_batchtask_success_count</b>              |
|                                                      |           | Number of failures:<br><b>iotda_batchtask_failure_count</b>                             |

## 8.3 Alarms

The IoT platform generates an alarm when it detects that the alarm triggering condition set in a rule is met or the device message reporting rate exceeds the threshold preset on the platform. Pay close attention to the alarms and handle them in a timely manner to ensure the normal device running.

Alarms are classified into rule alarms, system alarms, and custom metric alarms.

- Rule alarms: If you set the action **Report alarms** when configuring a device linkage **rule** and define the alarm properties and severity, the platform reports an alarm when the trigger condition is met. For example, if a smart water meter does not report data for three consecutive days, the platform generates an alarm to notify maintenance personnel of the water meter fault. Maintenance personnel then locate the faulty water meter based on the alarm information and repair it promptly.
- System alarms: When some resources of a user, for example, the number of devices, reach the upper limit of the user quota, the IoTDA platform reports a system alarm to the AOM. This type of alarm is automatically triggered by the IoTDA platform, but notification rules need to be configured. [Table 8-7](#) lists the system alarms.

**Table 8-7** System alarms

| Alarm                                         | Description                                                                                                                                                                        |
|-----------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| MQTT Message Flow Control for a Single Device | When the volume of data sent by an MQTT device per second exceeds the threshold (3 KB/s by default), the platform starts flow control on the MQTT device and generates this alarm. |

| Alarm                                                                 | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Device Upstream Messages Exceeding the Tenant Flow Control            | The sum of the upstream message rate and connection setup rate exceeds the threshold. (PUBLISH indicates upstream message, CONNECT indicates connection setup, and BANDWIDTH indicates bandwidth.) By default, the rate of upstream messages is 500 messages per second in the basic edition, and the rate of link setup is 100 messages per second in the basic edition. For details about the standard and enterprise editions, see <a href="#">Specifications</a> . If the rate exceeds the default value, flow control will be performed and an alarm will be generated. |
| Number of User Devices Reaching the Threshold                         | This alarm is generated when the number of registered user devices reaches 80% or 100% of the instance threshold (50,000 for the basic edition, and 20 times of the number of online devices for the standard or enterprise edition. For details, see <a href="#">Specifications</a> ).                                                                                                                                                                                                                                                                                      |
| Number of Online User Devices Reaching the Threshold                  | This alarm is generated when the number of online user devices reaches 80% or 100% of the threshold. (The threshold depends on the number of purchased units. For the standard or enterprise edition, see <a href="#">Specifications</a> .) When the number of online user devices exceeds the threshold, device access is rejected. The alarm is triggered once an hour.                                                                                                                                                                                                    |
| Number of Child Devices Under a Gateway Reaching the Threshold        | This alarm is generated when the number of child devices under a gateway reaches 80% or 100% of the threshold.                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| Linkage Rule Triggering Concurrency Threshold                         | This alarm is generated when the number of linkage rules triggered per second exceeds the threshold (10/s for the basic or standard edition and 100/s for the enterprise edition), and flow control is triggered on the excess part. This alarm is triggered only once a day.                                                                                                                                                                                                                                                                                                |
| Number of API Calls from a Tenant Reaching the Flow Control Threshold | This alarm is generated when the TPS of API calls made by a tenant exceeds the threshold. (Unless otherwise specified, the default limit of an API is 50/s. Maximum number of API calls made by an account per second: 100/s for the basic and standard editions.) Flow control is triggered on the excess part. This alarm is triggered only once a day.                                                                                                                                                                                                                    |
| Data Forwarding Target Added to the Blacklist                         | This alarm is generated when the number of data forwarding failures reaches a specified value (10 by default) and the current forwarding target is added to the blacklist.                                                                                                                                                                                                                                                                                                                                                                                                   |

- Custom metric alarms: You can log in to the [AOM 1.0](#) or [AOM 2.0](#) console to configure custom metric alarms. For details, see [Configuration Procedure for AOM 1.0](#). Currently, the following metrics are supported.

**Table 8-8** Custom alarm metrics

| Metric                                        | Name                                      |
|-----------------------------------------------|-------------------------------------------|
| Total number of devices                       | iotda_device_status_totalCount            |
| Number of online devices                      | iotda_device_status_onlineCount           |
| Number of offline devices                     | iotda_device_status_offlineCount          |
| Number of abnormal devices                    | iotda_device_status_abnormalCount         |
| Number of inactive devices                    | iotda_device_status_inactiveCount         |
| Number of activated devices                   | iotda_device_status_activeCount           |
| Number of online devices (accumulated)        | iotda_device_status_dailyOnlineCount      |
| Total number of reported NB-IoT data records  | iotda_south_dataReport_totalCount         |
| Number of NB-IoT data reporting failures      | iotda_south_dataReport_failedCount        |
| Total number of MQTT event reporting times    | iotda_south_eventUp_totalCount            |
| Number of MQTT event reporting successes      | iotda_south_eventUp_successCount          |
| Number of MQTT event reporting failures       | iotda_south_eventUp_failedCount           |
| Total number of MQTT property reporting times | iotda_south_propertiesReport_totalCount   |
| Number of MQTT property reporting successes   | iotda_south_propertiesReport_successCount |
| Number of MQTT property reporting failures    | iotda_south_propertiesReport_failedCount  |
| Total number of MQTT message reporting times  | iotda_south_messageUp_totalCount          |

| Metric                                     | Name                                        |
|--------------------------------------------|---------------------------------------------|
| Number of MQTT message reporting successes | iotda_south_messageUp_successCount          |
| Number of MQTT message reporting failures  | iotda_south_messageUp_failedCount           |
| AMQP transfers                             | iotda_amqp_forwarding_totalCount            |
| Number of AMQP transfer successes          | iotda_amqp_forwarding_successCount          |
| Number of AMQP transfer failures           | iotda_amqp_forwarding_failedCount           |
| FunctionGraph transfers                    | iotda_functionGraph_forwarding_totalCount   |
| Number of FunctionGraph transfer successes | iotda_functionGraph_forwarding_successCount |
| Number of FunctionGraph transfer failures  | iotda_functionGraph_forwarding_failedCount  |
| MRS Kafka transfers                        | iotda_mrsKafka_forwarding_totalCount        |
| Number of MRS Kafka transfer successes     | iotda_mrsKafka_forwarding_successCount      |
| Number of MRS Kafka transfer failures      | iotda_mrsKafka_forwarding_failedCount       |
| MQTT transfers                             | iotda_mqtt_forwarding_totalCount            |
| Number of MQTT transfer successes          | iotda_mqtt_forwarding_successCount          |
| Number of MQTT transfer failures           | iotda_mqtt_forwarding_failedCount           |
| MySQL transfers                            | iotda_mysql_forwarding_totalCount           |
| Number of MySQL transfer successes         | iotda_mysql_forwarding_successCount         |
| Number of MySQL transfer failures          | iotda_mysql_forwarding_failedCount          |
| InfluxDB transfers                         | iotda_influxDB_forwarding_totalCount        |
| Number of InfluxDB transfer successes      | iotda_influxDB_forwarding_successCount      |
| Number of InfluxDB transfer failures       | iotda_influxDB_forwarding_failedCount       |
| HTTP message pushes                        | iotda_http_forwarding_totalCount            |

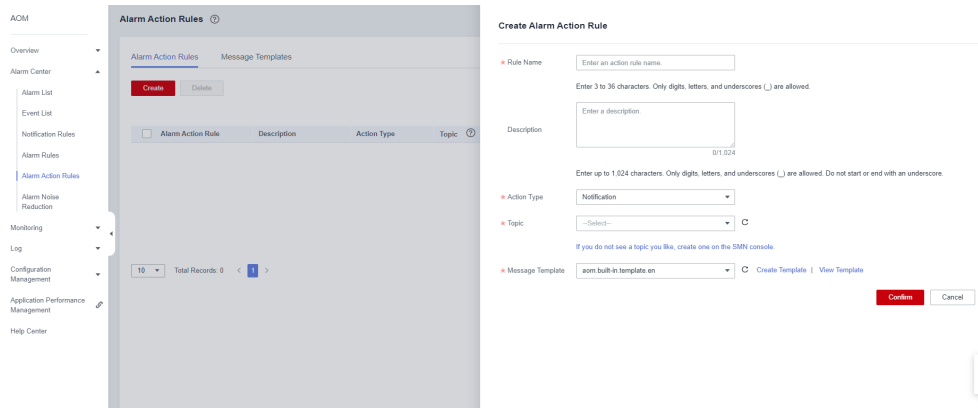
| Metric                                         | Name                                   |
|------------------------------------------------|----------------------------------------|
| Number of HTTP message push transfer successes | iotda_http_forwarding_successCount     |
| Number of HTTP message push transfer failures  | iotda_http_forwarding_failedCount      |
| OBS transfers                                  | iotda_obs_forwarding_totalCount        |
| Number of OBS transfer successes               | iotda_obs_forwarding_successCount      |
| Number of OBS transfer failures                | iotda_obs_forwarding_failedCount       |
| DMS Kafka transfers                            | iotda_dmsKafka_forwarding_totalCount   |
| Number of DMS Kafka transfer successes         | iotda_dmsKafka_forwarding_successCount |
| Number of DMS Kafka transfer failures          | iotda_dmsKafka_forwarding_failedCount  |
| DIS transfers                                  | iotda_dis_forwarding_totalCount        |
| Number of DIS transfer successes               | iotda_dis_forwarding_successCount      |
| Number of DIS transfer failures                | iotda_dis_forwarding_failedCount       |
| ROMA transfers                                 | iotda_roma_forwarding_totalCount       |
| Number of ROMA Connect transfer successes      | iotda_roma_forwarding_successCount     |
| Number of ROMA Connect transfer failures       | iotda_roma_forwarding_failedCount      |
| LTS transfers                                  | iotda_lts_forwarding_totalCount        |
| Number of LTS transfer successes               | iotda_lts_forwarding_successCount      |
| Number of LTS transfer failures                | iotda_lts_forwarding_failedCount       |

## Configuration Procedure for AOM 1.0

**Step 1** Log in to the **AOM** console. In the navigation pane, choose **Alarm Center > Alarm Action Rules**. Click **Create** and configure parameters.



**Figure 8-3** Creating an alarm action rule



**Step 2** In the navigation pane, choose **Alarm Center > Alarm Rules**. Click **Create Alarm Rule** in the upper right corner.

**Step 3** Setting a threshold alarm rule

1. Set basic information such as the rule name and description.

**Figure 8-4** Setting basic alarm information

Basic Information

\* Rule Name

Description

0/1,024


2. Set details about the rule.
  - a. Set **Rule Type** to **Threshold alarm**.
  - b. Set **Monitored Object** to **Command input** and enter the corresponding command.

**Figure 8-5** Setting objects to be monitored

\* Monitored Object


Select resource objects **Command input**

Enter a metric name



No data available

**NOTE**

Enter Prometheus commands. For details about Prometheus commands, move the cursor to  next to the search box and click [Learn more](#).

For example, to query the number of DMS Kafka transfer failures in instance A, run the following command:

```
sum(label_replace(sum_over_time(iotda_dmsKafka_forwarding_failedCount{instance="ID of instance A"}[59999ms]), "__name__", "iotda_dmsKafka_forwarding_failedCount", "", ""))by(__name__, instance)
```

`iotda_dmsKafka_forwarding_failedCount` indicates the metric name, which can be obtained from [Table 8-8](#).

- c. Set **Alarm Condition** to **Custom**. In the **Trigger Condition** area, set trigger condition parameters, such as the statistical period, consecutive period, and threshold condition. For details about the parameters, see [Table 8-9](#).

**Figure 8-6** Setting alarm conditions



Taking the preceding figure as an example, a minor alarm will be generated when the total number is greater than 10 in three statistical periods.

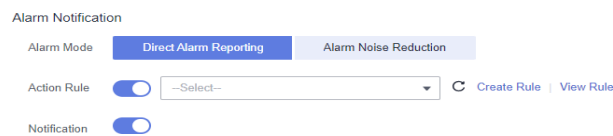
**Table 8-9** Alarm condition parameters

| Category          | Parameter           | Description                                                                                                                             |
|-------------------|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| Trigger Condition | Statistical Period  | Interval at which metric data is collected. By default, only one period is measured. A maximum of five periods can be measured.         |
|                   | Consecutive Periods | When the metric value meets the threshold condition for a specified number of consecutive periods, a threshold alarm will be generated. |
|                   | Statistic           | Method used to measure metrics. Options: <b>Avg.</b> , <b>Min.</b> , <b>Max.</b> , <b>Sum</b> , and <b>Samples</b> .                    |

| Category               | Parameter                          | Description                                                                                                                                                                                                                                                                                                                                                           |
|------------------------|------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                        | Threshold Condition                | Trigger condition of a threshold alarm. A threshold condition consists of two parts: operators ( $\geq$ , $\leq$ , $>$ , and $<$ ) and threshold value. For example, if <b>Threshold Condition</b> is set to $> 85$ and an actual metric value exceeds 85, a threshold alarm will be generated.                                                                       |
|                        | Alarm Severity                     | Severity of a threshold alarm. Options: <b>Critical, Major, Minor, and Warning.</b>                                                                                                                                                                                                                                                                                   |
| Advanced Configuration | Alarm Clearance                    | An alarm will be cleared if the monitored object does not meet the trigger condition within the monitoring period. By default, metrics in only one period are monitored. You can set up to five monitoring periods.                                                                                                                                                   |
|                        | Action Taken for Insufficient Data | Action to be taken when no metric data is generated or metric data is insufficient within the monitoring period. You can configure this option based on your requirements.<br><br>By default, metrics in only one period are monitored. You can set up to five monitoring periods.<br><br>Options: <b>Alarm, Insufficient data, Keep previous status, and Normal.</b> |

3. Configure alarm notifications.
  - a. Set **Alarm Mode** to **Direct Alarm Reporting**.
  - b. Select the action rule created in [Step 1](#).
  - c. Enable **Notification**.

**Figure 8-7** Setting alarm notifications



**NOTE**

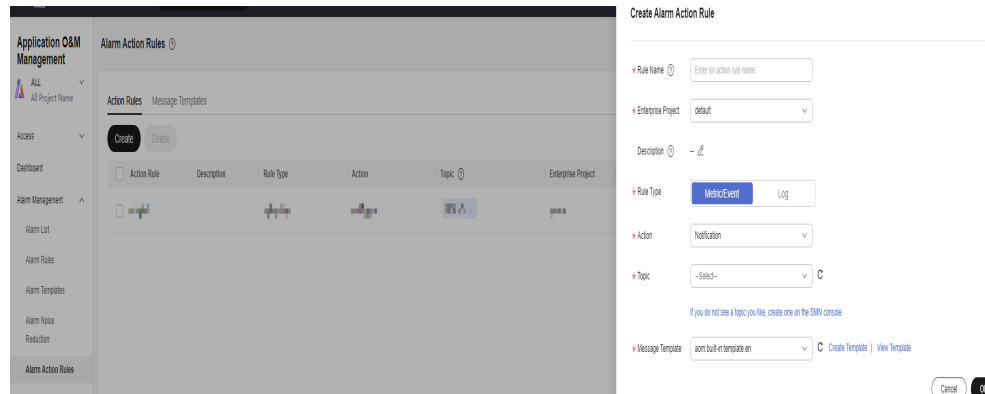
For details about how to use alarm noise reduction, see [Alarm Noise Reduction](#).

----End

## Configuration Procedure for AOM 2.0

- Step 1** Log in to the **AOM** console. In the navigation pane, choose **Alarm Management** > **Alarm Action Rules**. On the displayed page, click **Create** and configure parameters.

**Figure 8-8** Creating an alarm action rule



- Step 2** In the navigation pane, choose **Alarm Management** > **Alarm Rules**. On the displayed page, click **Create**.

- Step 3** Enter a rule name, select an enterprise project from the drop-down list, and enter the rule description as required.

**Figure 8-9** Creating an alarm rule

**Basic Info**

Rule Name:

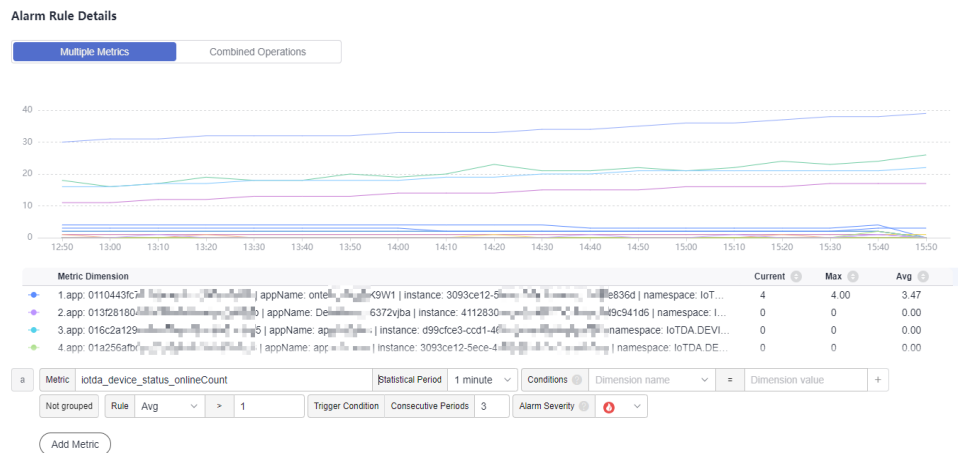
Enterprise Project:

Description:

- Step 4** Set details about the rule.

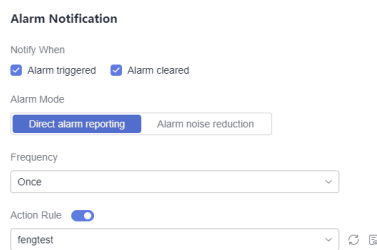
1. **Rule Type:** Select **Metric alarm rule**.
2. **Configuration Mode:** Select **Select from all metrics**.
3. **Prometheus Instance:** Select the target instance.
4. **Alarm Rule Details:** Select **Multiple Metrics**.
5. **Metric:** Enter **iotda** in the **Metric** text box to get related metrics. For details about the metric, see **Table 8-8**.
6. **Conditions:** Specify the dimension name, filter criteria, and dimension value.
7. **Rule:** Enter the metric alarm threshold.
8. **Trigger Condition:** Enter the consecutive periods for triggering the alarm.
9. **Alarm Severity:** Select an alarm severity icon.

**Figure 8-10** Setting alarm rules



**Step 5** Set alarm notification. Enable the alarm action rule and select a rule from the drop-down list. If no action rule is available, click the check icon on the right to go to the page for creating an alarm action rule.

**Figure 8-11** Setting alarm rules

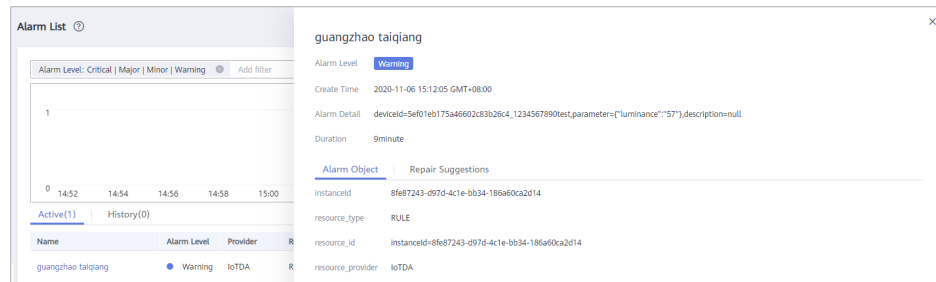



----End

## Checking Alarm Information

You can use AOM to view alarms generated in the last 15 days. For details, see [Viewing Alarms](#).

1. Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
2. In the navigation pane, choose **O&M > Device Alarms**. Click **Application Operations Management (AOM)** to access the AOM console and view alarms generated for IoTDA.
3. Click an alarm to check the alarm details.

**Figure 8-12** Viewing alarm details

4. Clear an alarm. After the fault is rectified, click  in the **Operation** column of the target alarm.

## 8.4 Audit Logs

### Scenarios

After you enable CTS and the management tracker is created, CTS starts recording operations on cloud resources. After a data tracker is created, the system starts to record user operations on data in OBS buckets. CTS retains operation records of the latest seven days.

This section describes how to query and export operation records of the last seven days on the CTS console.


- [Viewing Real-Time Traces in the Trace List of the New Edition](#)
- [Viewing Real-Time Traces in the Trace List of the Old Edition](#)

### Constraints





- Traces of a single account can be viewed on the CTS console. Multi-account traces can be viewed only on the **Trace List** page of each account, or in the OBS bucket or the **CTS/system** log stream configured for the management tracker with the organization function enabled.
- You can only query operation records of the last seven days on the CTS console. To store operation records for more than seven days, you must configure an OBS bucket to transfer records to it. Otherwise, you cannot query the operation records generated seven days ago.
- After performing operations on the cloud, you can query management traces on the CTS console 1 minute later and query data traces on the CTS console 5 minutes later.

### Viewing Real-Time Traces in the Trace List of the New Edition


**Step 1** Log in to the console.

**Step 2** Click  in the upper left corner and choose **Management & Governance > Cloud Trace Service**.

**Step 3** Choose **Trace List** in the navigation pane.

- Step 4** On the **Trace List** page, use advanced search to query traces. You can combine one or more filters.
- **Trace Name:** Enter a trace name.
  - **Trace ID:** Enter a trace ID.
  - **Resource Name:** Enter a resource name. If the cloud resource involved in the trace does not have a resource name or the corresponding API operation does not involve the resource name parameter, leave this field empty.
  - **Resource ID:** Enter a resource ID. Leave this field empty if the resource has no resource ID or if resource creation failed.
  - **Trace Source:** Select a cloud service name from the drop-down list.
  - **Resource Type:** Select a resource type from the drop-down list.
  - **Operator:** Select one or more operators from the drop-down list.
  - **Trace Status:** Select **normal**, **warning**, or **incident**.
    - **normal:** The operation succeeded.
    - **warning:** The operation failed.
    - **incident:** The operation caused a fault that is more serious than the operation failure, for example, causing other faults.
  - **Time range:** Select **Last 1 hour**, **Last 1 day**, or **Last 1 week**, or specify a custom time range.
- Step 5** On the **Trace List** page, you can also export and refresh the trace list, and customize the list display settings.
1. Enter any keyword in the search box and click  to filter desired traces.
  2. Click **Export** to export all traces in the query result as an .xlsx file. The file can contain up to 5,000 records.
  3. Click  to view the latest information about traces.
  4. Click  to customize the information to be displayed in the trace list. If **Auto wrapping** is enabled () , excess text will move down to the next line; otherwise, the text will be truncated. By default, this function is disabled.
- Step 6** For details about key fields in the trace structure, see [Trace Structure](#) and [Example Traces](#).
- Step 7** (Optional) On the **Trace List** page of the new edition, click **Go to Old Edition** in the upper right corner to switch to the **Trace List** page of the old edition.
- End

## Viewing Real-Time Traces in the Trace List of the Old Edition

- Step 1** Log in to the console.
- Step 2** Click  in the upper left corner and choose **Management & Governance > Cloud Trace Service**.
- Step 3** Choose **Trace List** in the navigation pane.


**Step 4** Each time you log in to the CTS console, the new edition is displayed by default. Click **Go to Old Edition** in the upper right corner to switch to the trace list of the old edition.

**Step 5** Specify the filters used for querying traces. The following filters are available:

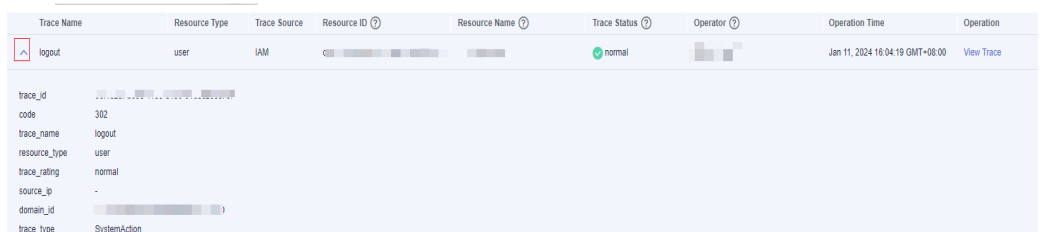
- **Trace Type, Trace Source, Resource Type, and Search By:** Select a filter from the drop-down list.
  - If you select **Resource ID** for **Search By**, specify a resource ID.
  - If you select **Trace name** for **Search By**, specify a trace name.
  - If you select **Resource name** for **Search By**, specify a resource name.
- **Operator:** Select a specific operator (a user other than an account).
- **Trace Status:** Select **All trace statuses, Normal, Warning, or Incident**.
- **Time Range:** You can query traces generated during any time range of the last seven days.
- Click **Export** to export all traces in the query result as a CSV file. The file can contain up to 5,000 records.

**Step 6** Click **Query**.

**Step 7** On the **Trace List** page, you can also export and refresh the trace list.

- Click **Export** to export all traces in the query result as a CSV file. The file can contain up to 5,000 records.
- Click  to view the latest information about traces.

**Step 8** Click  on the left of a trace to expand its details.



| Trace Name | Resource Type | Trace Source | Resource ID | Resource Name | Trace Status | Operator   | Operation Time                  | Operation  |
|------------|---------------|--------------|-------------|---------------|--------------|------------|---------------------------------|------------|
| logout     | user          | IAM          | [REDACTED]  | [REDACTED]    | normal       | [REDACTED] | Jan 11, 2024 16:04:19 GMT+08:00 | View Trace |

|               |              |
|---------------|--------------|
| trace_id      | [REDACTED]   |
| code          | 302          |
| trace_name    | logout       |
| resource_type | user         |
| trace_rating  | normal       |
| source_ip     | [REDACTED]   |
| domain_id     | [REDACTED]   |
| trace_type    | SystemAction |

**Step 9** Click **View Trace** in the **Operation** column. The trace details are displayed.

```
{
 "request": "",
 "trace_id": "676d4ae3-842b-11ee-9299-9159eee6a3ac",
 "code": "200",
 "trace_name": "createDockerConfig",
 "resource_type": "dockerlogincmd",
 "trace_rating": "normal",
 "api_version": "",
 "message": "createDockerConfig, Method: POST Url=/v2/manager/utills/secret. Reason:",
 "source_ip": "[REDACTED]",
 "domain_id": "[REDACTED]",
 "trace_type": "ApiCall",
 "service_type": "SWR",
 "event_type": "system",
 "project_id": "[REDACTED]",
 "response": "",
 "resource_id": "",
 "tracker_name": "system",
 "time": "2023/11/16 10:54:04 GMT+08:00",
 "resource_name": "dockerlogincmd",
 "user": {
 "domain": {
 "name": "[REDACTED]",
 "id": "[REDACTED]"
 }
 }
}
```



- Step 10** For details about key fields in the trace structure, see [Trace Structure](#) and [Example Traces](#).
- Step 11** (Optional) On the **Trace List** page of the old edition, click **New Edition** in the upper right corner to switch to the **Trace List** page of the new edition.

----End

## IoTDA Operations That Can Be Recorded by CTS

Using Cloud Trace Service (CTS), you can view user and platform operations and results. If an exception occurs, you can locate and rectify the fault based on the logs. The table below lists IoTDA operations that are logged.

**Table 8-10** IoTDA operations that can be recorded by CTS

| Category                     | Operation                            | Resource Type | Trace Name             |
|------------------------------|--------------------------------------|---------------|------------------------|
| Linkage rule management      | Creating a rule                      | rules         | createRules            |
|                              | Deleting a rule                      | rules         | deleteRules            |
|                              | Updating a rule                      | rules         | updateRules            |
|                              | Modifying the rule status            | rules         | changeRuleStatus       |
| JavaScript script management | Uploading JavaScript plug-in scripts | scripts       | createScript           |
|                              | Deleting JavaScript plug-in scripts  | scripts       | deleteScript           |
|                              | Debugging JavaScript plug-in scripts | scripts       | runScript              |
| Function plug-in management  | Uploading a Function plug-in         | functions     | createProductFunctions |
|                              | Deleting a Function plug-in          | functions     | deleteProductFunctions |
|                              | Downloading a Function plug-in       | functions     | getProductFunctions    |
| Batch task management        | Creating a batch task                | batchtasks    | createBatchtasks       |
|                              | Retrying a batch task                | batchtasks    | retryBatchtasks        |
|                              | Stopping a batch task                | batchtasks    | stopBatchtasks         |

| Category                           | Operation                                           | Resource Type     | Trace Name              |
|------------------------------------|-----------------------------------------------------|-------------------|-------------------------|
|                                    | Deleting a batch task                               | batchtasks        | deleteBatchtasks        |
| Batch task file management         | Uploading a batch task file                         | batchtask-files   | uploadBatchTask-File    |
|                                    | Deleting a batch task file                          | batchtask-files   | deleteBatchTaskFile     |
| Export tasks                       | Creating an export task                             | export-tasks      | createExportTasks       |
|                                    | Deleting an export task                             | export-tasks      | deleteExportTask        |
|                                    | Downloading an export file                          | export-tasks      | createTaskreport        |
| Application certificate management | Uploading a push CA certificate                     | Certificate       | createCertificate       |
|                                    | Updating a push CA certificate                      | Certificate       | updateCertificate       |
|                                    | Deleting a push CA certificate                      | Certificate       | deleteCertificate       |
| Certificate management             | Uploading a device CA certificate                   | certificate       | addCertificate          |
|                                    | Deleting a device CA certificate                    | certificate       | deleteCertificate       |
|                                    | Commissioning the device CA certificate             | certificate       | debugCertificate        |
|                                    | Verifying a device CA certificate                   | certificate       | verifyCertificate       |
|                                    | Downloading a device CA certificate                 | certificate       | downloadCertificate     |
| Server certificate management      | Creating a certificate for the enterprise edition   | ServerCertificate | addServerCertificate    |
|                                    | Replacing the certificate of the enterprise edition | ServerCertificate | updateServerCertificate |

| Category                                         | Operation                                        | Resource Type     | Trace Name              |
|--------------------------------------------------|--------------------------------------------------|-------------------|-------------------------|
|                                                  | Deleting a certificate of the enterprise edition | ServerCertificate | deleteServerCertificate |
| Resource space management                        | Creating a resource space                        | application       | addApplication          |
|                                                  | Deleting a resource space                        | application       | deleteApplication       |
|                                                  | Modifying a resource space                       | application       | updateApplication       |
| Access code management                           | Creating an access code                          | accessCode        | createAccessCode        |
|                                                  | Verifying an access code                         | accessCode        | verifyAccessCode        |
| Software/<br>Firmware upgrade package management | Creating an OTA upgrade package                  | upgradeTask       | uploadOtaPackages       |
|                                                  | Deleting an OTA upgrade package                  | upgradeTask       | deleteOtaPackages       |
| File storage and management                      | Configuring an OBS bucket for file upload.       | upgradeTask       | createBucket            |
| Forwarding rule management                       | Creating a rule triggering condition             | routing-rule      | addRule                 |
|                                                  | Modifying a rule triggering condition            | routing-rule      | modifyRule              |
|                                                  | Deleting a rule triggering condition             | routing-rule      | deleteRule              |
|                                                  | Testing the SQL connectivity                     | rule-sql          | checkSql                |
| Forwarding rule action management                | Creating a rule action                           | rule-action       | addAction               |
|                                                  | Modifying a rule action                          | rule-action       | modifyAction            |
|                                                  | Deleting a rule action                           | rule-action       | deleteAction            |

| Category                                 | Operation                                     | Resource Type                 | Trace Name                     |
|------------------------------------------|-----------------------------------------------|-------------------------------|--------------------------------|
|                                          | Testing the connectivity interface            | rule-action                   | sendMessage                    |
| Outbound flow control policy management  | Creating an outbound flow control policy      | create-flow-control-policy    | createRoutingFlowControlPolicy |
|                                          | Updating an outbound flow control policy      | update-flow-control-policy    | updateRoutingFlowControlPolicy |
|                                          | Deleting an outbound flow control policy      | delete-flow-control-policy    | deleteRoutingFlowControlPolicy |
| Outbound push stacking policy management | Creating an outbound push stacking policy     | create-routing-backlog-policy | createRoutingBacklogPolicy     |
|                                          | Modifying an outbound push stacking policy    | update-routing-backlog-policy | updateRoutingBacklogPolicy     |
|                                          | Deleting an outbound push stacking policy     | delete-routing-backlog-policy | deleteRoutingBacklogPolicy     |
| Device shadow                            | Configuring desired data in the device shadow | deviceShadow                  | updateDeviceShadow             |
| Plug-in mapping management               | Modifying the mapping                         | plugin                        | addMapping                     |
| Plug-in message management               | Modifying message information                 | plugin                        | addMessage                     |
| Plug-in management                       | Deploying an online plug-in                   | plugin                        | deployPlugin                   |
|                                          | Saving plug-in information                    | plugin                        | savePluginMessage              |
|                                          | Updating plug-in information                  | plugin                        | modifyPluginMessage            |
|                                          | Deploying an offline plug-in                  | plugin                        | bundlePackages                 |
| Simulator management                     | Registering and debugging a device simulator  | plugin                        | registerEmulatedDevice         |

| Category                                       | Operation                                           | Resource Type       | Trace Name                     |
|------------------------------------------------|-----------------------------------------------------|---------------------|--------------------------------|
| Device debugging messages                      | Sending upstream code stream                        | plugin              | simulateReport                 |
| Tunnel management                              | Creating a tunnel                                   | tunnels             | createTunnel                   |
|                                                | Deleting a tunnel                                   | tunnels             | deleteTunnel                   |
|                                                | Modifying a tunnel                                  | tunnels             | updateTunnel                   |
| Product management                             | Creating a product                                  | product             | addProduct                     |
|                                                | Modifying product information                       | product             | updateProduct                  |
|                                                | Deleting a product                                  | product             | deleteProduct                  |
| Custom topic management                        | Modifying a custom topic                            | topic               | updateTopic                    |
|                                                | Deleting a custom topic                             | topic               | deleteTopic                    |
|                                                | Creating a custom topic                             | topic               | addTopic                       |
| Exception detection configuration              | Configuring the exception detection                 | productConfig       | addProductConfig               |
| AMQP queue management                          | Creating an AMQP queue                              | amqp                | addQueue                       |
|                                                | Deleting an AMQP queue                              | amqp                | deleteQueue                    |
|                                                | Terminating the receive-link consumption capability | amqp                | hangUpConnection               |
| Cloud interconnection configuration management | Creating cloud interconnection configurations       | service-integration | addServiceIntegrationConfig    |
|                                                | Deleting cloud interconnection configurations       | service-integration | deleteServiceIntegrationConfig |
|                                                | Modifying cloud interconnection configurations      | service-integration | modifyServiceIntegrationConfig |

| Category                | Operation                          | Resource Type    | Trace Name                 |
|-------------------------|------------------------------------|------------------|----------------------------|
| Group management        | Adding a group                     | device-group     | addDeviceGroup             |
|                         | Modifying a group                  | device-group     | updateDeviceGroup          |
|                         | Deleting a group                   | device-group     | deleteDeviceGroup          |
|                         | Managing devices in a group        | device-group     | manageDevicesInGroup       |
| Device tag management   | Binding a tag                      | tag              | bindTagsToResource         |
|                         | Unbinding a tag                    | tag              | unbindTagsToResource       |
| Device management       | Creating a device                  | device           | addDevice                  |
|                         | Modifying device information       | device           | updateDevice               |
|                         | Deleting a device                  | device           | deleteDevice               |
|                         | Resetting a device secret          | device           | resetDeviceSecret          |
|                         | Freezing a device                  | device           | freeze-device              |
|                         | Unfreezing a device                | device           | unfreeze-device            |
| HarmonyOS soft bus      | Creating a HarmonyOS soft bus      | harmony-soft-bus | create-harmony-soft-bus    |
|                         | Deleting a HarmonyOS soft bus      | harmony-soft-bus | delete-harmony-soft-bus    |
|                         | Resetting a HarmonyOS soft bus key | harmony-soft-bus | reset-harmony-soft-bus-key |
|                         | Synchronizing a HarmonyOS soft bus | harmony-soft-bus | sync-harmony-soft-bus      |
| Device proxy management | Deleting a device proxy            | device-proxy     | deleteDeviceProxy          |
|                         | Creating a device proxy            | device-proxy     | addDeviceProxy             |
|                         | Modifying a device proxy           | device-proxy     | updateDeviceProxy          |

| Category                     | Operation                                | Resource Type | Trace Name               |
|------------------------------|------------------------------------------|---------------|--------------------------|
| Device policy management     | Creating a device policy                 | device-policy | addDevicePolicy          |
|                              | Deleting a device policy                 | device-policy | deleteDevicePolicy       |
|                              | Updating a device policy                 | device-policy | updateDevicePolicy       |
|                              | Binding a device policy                  | device-policy | bindDevicePolicy         |
|                              | Unbinding a device policy                | device-policy | unbindDevicePolicy       |
| Message tracing management   | Modifying message tracing configurations | message-trace | updateMessageTraceConfig |
|                              | Deleting message tracing configurations  | message-trace | deleteMessageTraceConfig |
|                              | Deleting message tracing data            | message-trace | deleteMessageTraceData   |
| O&M configuration management | Modifying O&M configurations             | device-config | updateDeviceConfig       |
| Command management           | Delivering a command                     | command       | sendCommand              |
|                              | Delivering an asynchronous command       | asyncCommand  | sendAsyncCommand         |
| Remote login                 | Creating an SSH channel                  | SshConnect    | SshConnect               |
|                              | Delivering an SSH command                | SshComand     | SshComand                |
|                              | Disabling an SSH channel                 | SshDisconnect | SshDisconnect            |

## 8.5 Run Logs (Old Version)

IoTDA can record the connections with devices and applications and report logs to Log Tank Service (LTS). LTS provides real-time query, massive log storage, log structuring, visualization, and analysis capabilities. It provides a free quota of 500

MB per month. When this quota is used up, you will be billed for any excess usage on a pay-per-use basis. For details, see [What Is Log Tank Service?](#)

Currently, only service run logs of MQTT devices can be recorded. For details, see the following table.

**Table 8-11** Service types

| Service Type    | Service Flow                                                                        |
|-----------------|-------------------------------------------------------------------------------------|
| Device status   | <a href="#">Device going online</a>                                                 |
|                 | Device going offline                                                                |
| Device message  | <a href="#">Application requesting message delivery to devices</a>                  |
|                 | <a href="#">Platform delivering messages to devices</a>                             |
|                 | <a href="#">Device reporting messages</a>                                           |
| Device command  | <a href="#">Application requesting command delivery to devices</a>                  |
|                 | <a href="#">Platform delivering commands to devices</a>                             |
|                 | <a href="#">Platform receiving device response to commands</a>                      |
| Device property | <a href="#">Application requesting device property modification</a>                 |
|                 | <a href="#">Platform delivering property modification to devices</a>                |
|                 | <a href="#">Device reporting properties</a>                                         |
|                 | <a href="#">Gateway reporting device properties in batches</a>                      |
| Device event    | <a href="#">Platform notifying a gateway of new child device connection</a>         |
|                 | <a href="#">Platform notifying a gateway of child device deletion</a>               |
|                 | <a href="#">Gateway synchronizing child device information</a>                      |
|                 | <a href="#">Gateway updating child device statuses</a>                              |
|                 | <a href="#">Gateway requesting for adding child devices</a>                         |
|                 | <a href="#">Platform responding to a request for adding child devices</a>           |
|                 | <a href="#">Gateway requesting for deleting child devices</a>                       |
|                 | <a href="#">Platform responding to a request for deleting child devices</a>         |
|                 | <a href="#">Gateway updating child device statuses</a>                              |
|                 | <a href="#">Platform responding to a request for updating child device statuses</a> |
|                 | <a href="#">Platform delivering a command to obtain version information</a>         |



| Service Type             | Service Flow                                              |
|--------------------------|-----------------------------------------------------------|
|                          | Device reporting the software and firmware versions       |
|                          | Platform delivering an upgrade command                    |
|                          | Device reporting the upgrade status                       |
|                          | Device requesting a URL for file upload                   |
|                          | Platform delivering a temporary URL for file upload       |
|                          | Device reporting file upload results                      |
|                          | Device requesting a URL for file download                 |
|                          | Platform delivering a temporary URL for file download     |
|                          | Device reporting file download results                    |
|                          | Device requesting time synchronization                    |
|                          | Platform responding to a request for time synchronization |
|                          | Device reporting information                              |
|                          | Platform delivering a log collection notification         |
|                          | Device reporting log content                              |
|                          | Platform delivering a configuration notification          |
|                          | Device reporting the configuration response               |
|                          | Device downloading upgrade package                        |
| Batch task               | Subtask execution result of a batch task                  |
| Device self-registration | Device self-registration result.                          |
| Device authentication    | Custom device authentication result                       |

**Table 8-12** Format of batch task run logs

| Field        | Description                                                                                                  |
|--------------|--------------------------------------------------------------------------------------------------------------|
| appld        | Application ID.                                                                                              |
| deviceId     | Device ID.                                                                                                   |
| categoryName | Log type: batch.task.                                                                                        |
| operation    | Action. Set this parameter to the ID of a batch task. For details, see <a href="#">Create a Batch Task</a> . |

| Field    | Description                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| request  | <p>Request content in JSON format.</p> <pre>{ "task_type": "createDevices", // Task type "package_id": "f2303267a6e8f0053037c2a9", // Software/ Firmware upgrade package "package_ids": ["65f3ebe2682b9f4bcc38baad"] // Software/ Firmware upgrade package }</pre> <p><b>NOTE</b><br/>When the batch task type is <b>softwareUpgrade</b> or <b>firmwareUpgrade</b>, the <b>package_id</b> and <b>package_ids</b> parameters are supported.</p> |
| response | <p>Response content in JSON format.</p> <p>Success:</p> <pre>{ "output" : "xxxxxxxxxxxxx" }</pre> <p>Failure:</p> <pre>{ "error" : { "error_code" : "IOTDA.XXXXX", "error_msg" : "XXXXX." } }</pre>                                                                                                                                                                                                                                            |
| status   | <p>Execution result. Subtask status. Options: <b>Success</b>, <b>Fail</b>, <b>Stopped</b>, or <b>Removed</b>.</p>                                                                                                                                                                                                                                                                                                                              |

**Table 8-13** Format of non-batch tasks

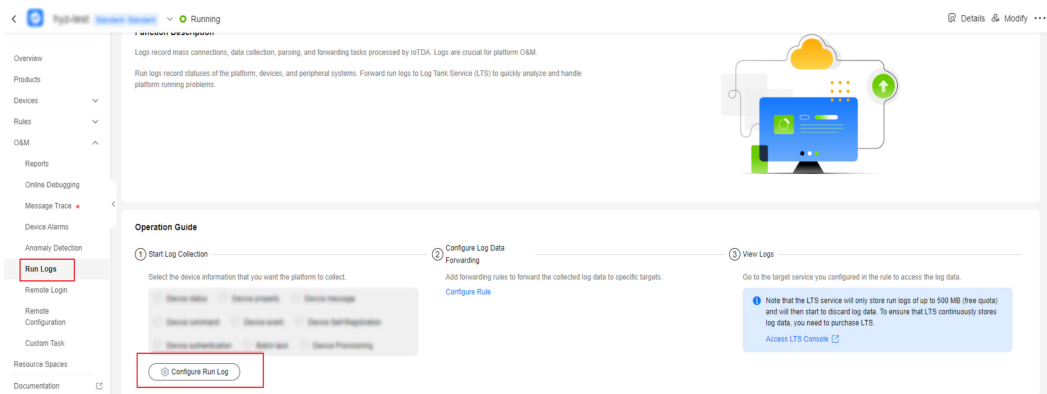
| Field      | Description                                                                                                           |
|------------|-----------------------------------------------------------------------------------------------------------------------|
| recordTime | <p>Log collection time. The time format is yyyy-MM-dd'T'HH:mm:ss,SSS'Z'.</p> <p>Example: 2020-06-16T09:24:45,708Z</p> |
| deviceId   | Device ID.                                                                                                            |
| requestId  | Request ID.                                                                                                           |

| Field        | Description                                                                                                                            |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------|
| categoryName | Options:<br>device.status<br>device.message<br>device.command<br>device.property<br>device.event<br>device.auth<br>device.provisioning |
| operation    | Operation name. Example: API URL or MQTT message topic.                                                                                |
| request      | Request parameter of an operation. Example: API request body.                                                                          |
| response     | Operation result. Example: API response body or error information.                                                                     |
| result       | Operation status code.                                                                                                                 |

## Procedure

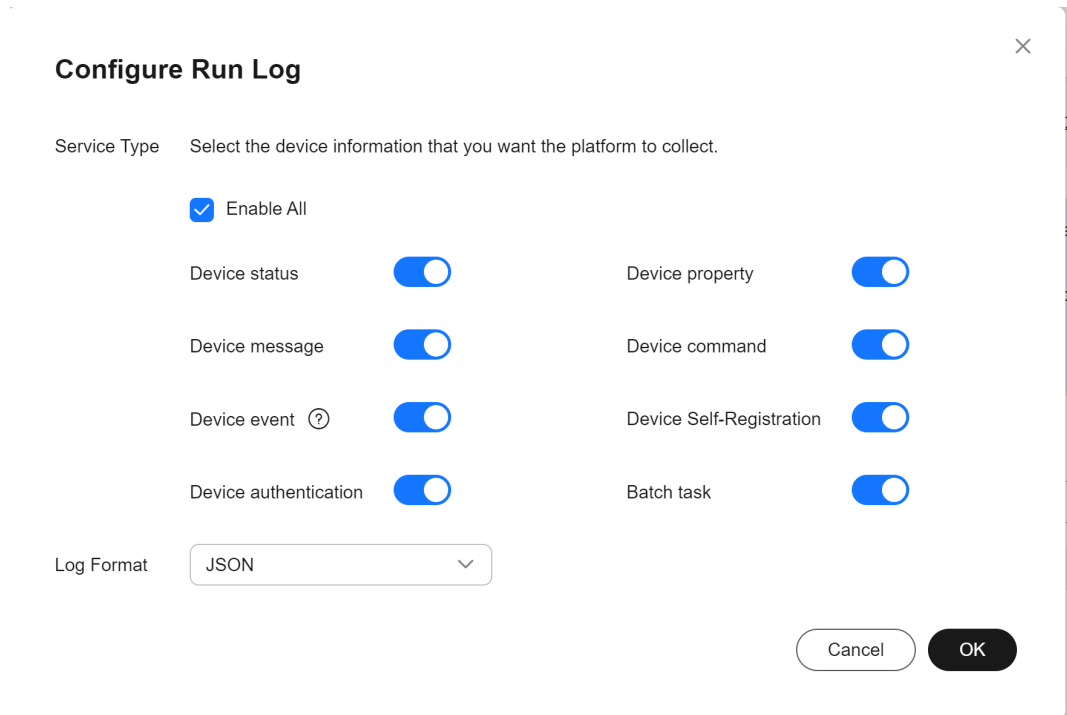
- Step 1** Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **O&M > Run Logs**, and click **Configure Run Log**.

**Figure 8-13** Run log - Old version configuration



- Step 3** On the displayed dialog box, select the service type for data collection and click **OK**.

**Figure 8-14** Run log - Log switch of old version configuration



**Step 4** Create a run log forwarding rule to forward the collected log data to other cloud services, so that you can view and process it. You are advised to forward log data to LTS. The following uses LTS as an example.

1. In the navigation pane, choose **Rules > Data Forwarding**, and click **Create Rule**.
2. Configure parameters by referring to the following table, and click **Create Rule**.

**Table 8-14** Creating a rule

| Parameter      | Description                                                                              |
|----------------|------------------------------------------------------------------------------------------|
| Rule Name      | Specify the name of a rule to create.                                                    |
| Description    | Describe the rule.                                                                       |
| Data Source    | Select <b>Run log</b> .                                                                  |
| Trigger        | After the data source is selected, the platform automatically matches the trigger event. |
| Resource Space | You can select a single resource space or all resource spaces.                           |

3. Click the **Set Forwarding Target** tab, and then click **Add** to set a forwarding target.

**Table 8-15** Setting the forwarding target

| Parameter            | Description                                                                                                                                                                                      |
|----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Forwarding Target    | Select <b>Log Tank Service (LTS)</b> .                                                                                                                                                           |
| Region               | Currently, log data can be forwarded only to LTS in the same region.                                                                                                                             |
| Log Group/log Stream | Select a log group and log stream of LTS. If no log group or log stream is available, create them by referring to <a href="#">Managing Log Groups</a> and <a href="#">Managing Log Streams</a> . |

**NOTE**

Logs are retained in the log group for 7 days by default. Logs older than the retention period will be automatically deleted. For long-term storage, you can transfer logs to Object Storage Service (OBS) buckets. For details, see [Transferring Logs to OBS](#).

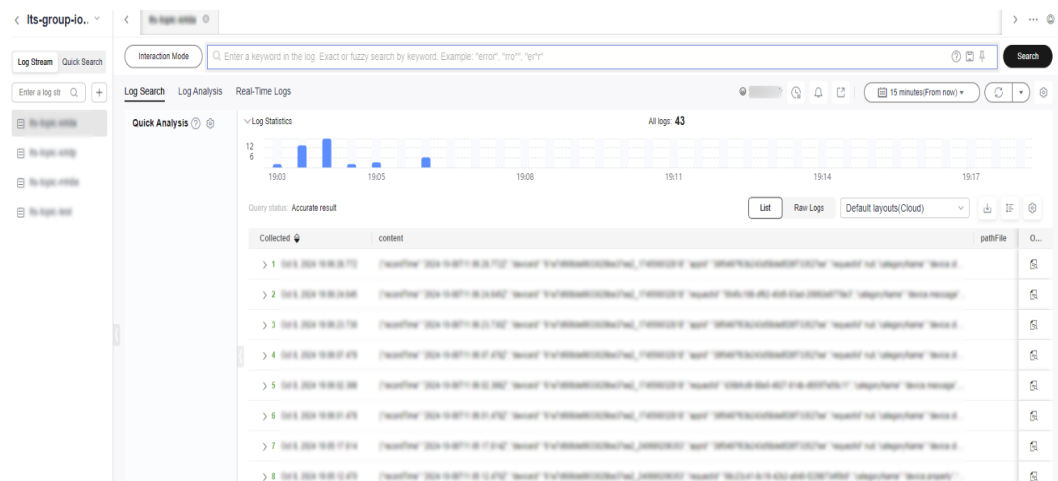
LTS provides a free quota of 500 MB per month. By default, it continues to collect logs when the quota is used up. You will be billed for the excess usage on a pay-per-use basis. You can log in to the LTS console and choose **Configuration Center** to disable this function.

- Click **OK**, and then click **Enable Rule** to forward run logs to LTS.

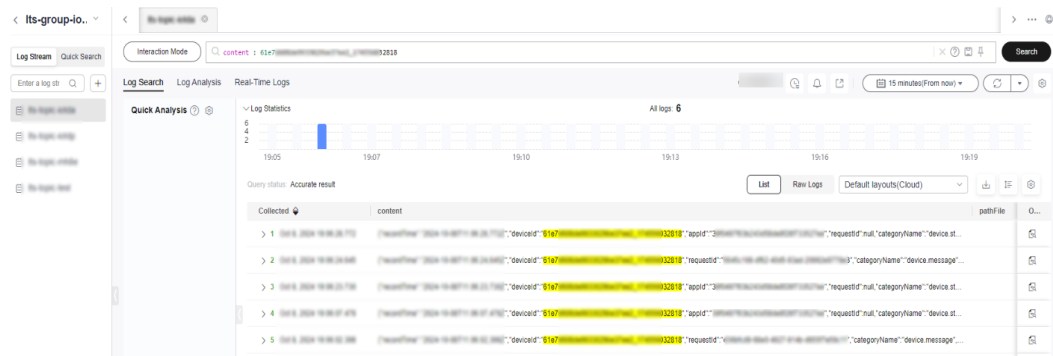
**Step 5** Log in to the [LTS console](#) and choose **Log Management**.

**Step 6** Select the log group and log stream created in **3** to view the logs reported by IoTDA. Search for raw and target logs by referring to [Log Search](#). For example, search for logs by device ID and service type.

**Figure 8-15** Run logs - Checking the log list

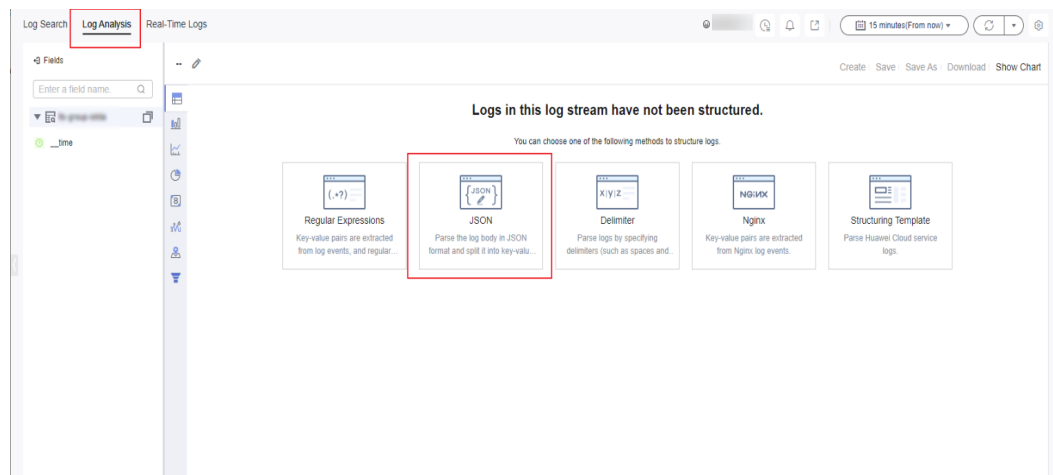


**Figure 8-16** Run logs - Searching for run logs



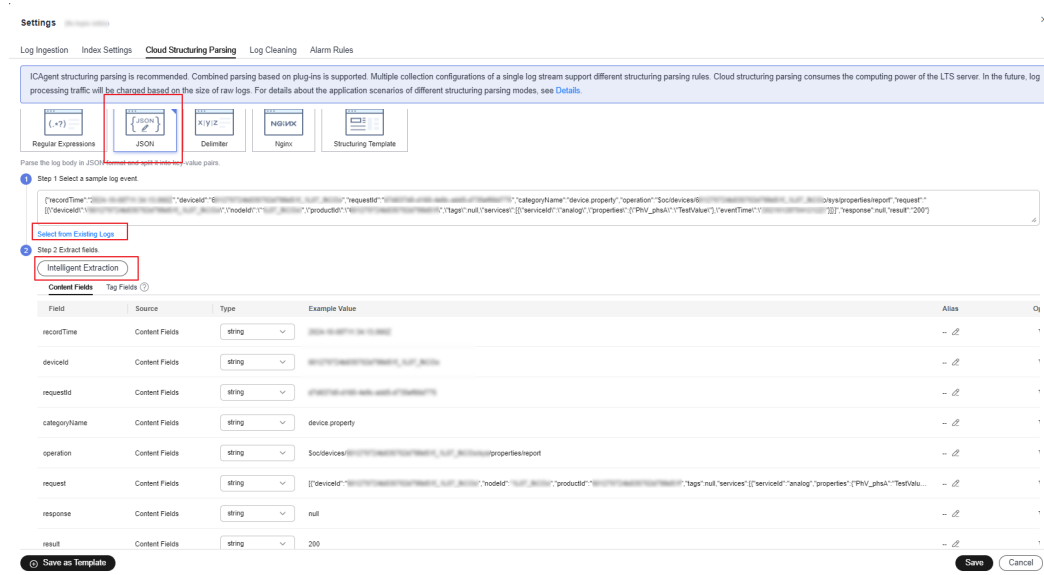
**Step 7** On the log stream details page, click the **Log Analysis** tab. On the log structuring page that is displayed, select **JSON**.

**Figure 8-17** Run logs - Log analysis



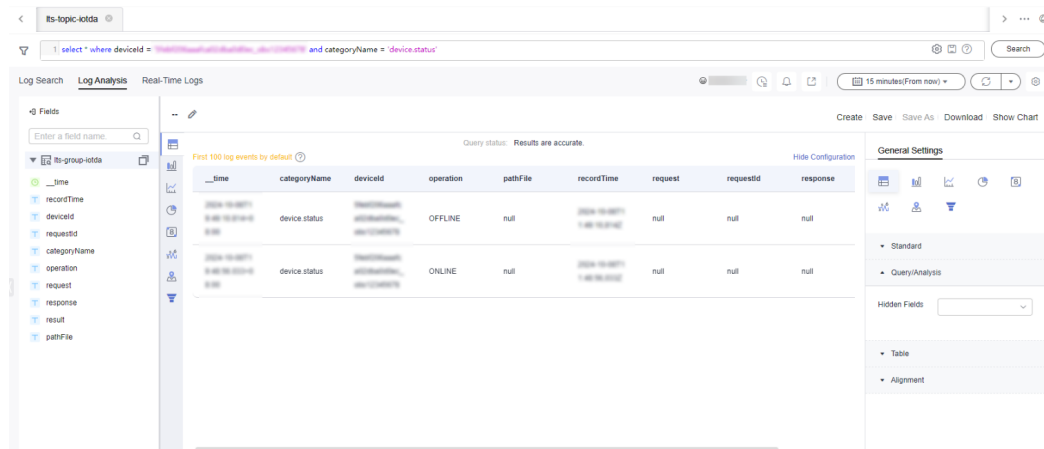
**Step 8** Select a sample log that contains time, device ID, request ID, service type, operation, request parameter, result information, and execution status. Click the button of intelligent extraction to modify the field names, for example, recordTime, requestId, deviceId, categoryName, operation, request, response and result. Change the field type to string. Click **Save** to complete the log structuring configuration. For details, see [Structuring Logs](#).

**Figure 8-18** Run logs - Configuring log structuring



**Step 9** After the raw logs are structured, the service will respond. On the **Log Management** page, select the log group and log stream created in **3**, and click the button for log analysis to check the structured target logs. You can query logs using SQL statements. For example, to query logs by device ID and service type, run **select \* where deviceId = '{{deviceId}}' and categoryName = 'device.status'**.

**Figure 8-19** Run logs - Log analysis and search



----End

## 8.6 Run Logs (New Version)

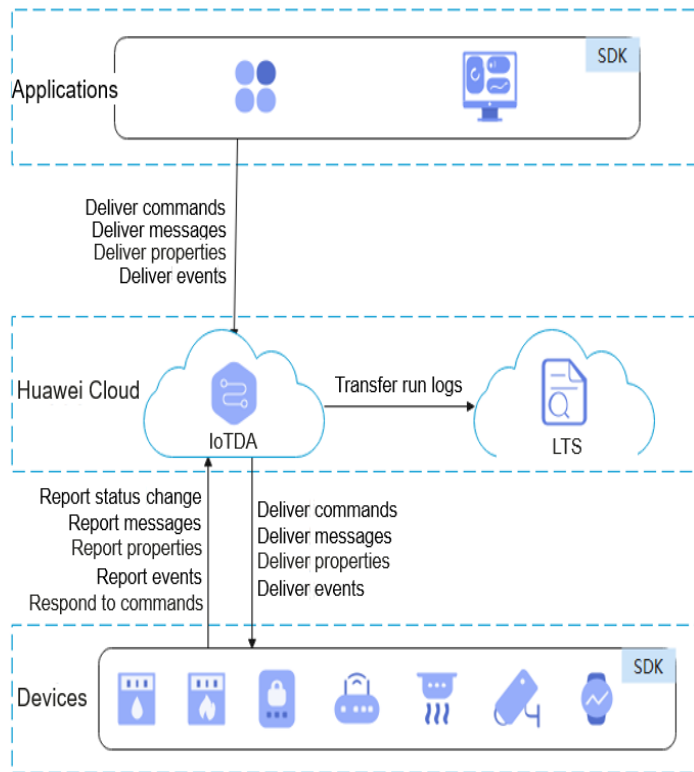
### Overview

IoTDA records connections with devices and applications and reports them as logs to Log Tank Service (LTS). LTS provides real-time query, mass storage, structured processing, and visualized chart analysis.

You do not need to manually create log groups, log streams, and forwarding rule action when using the new version of run logs. The IoT platform automatically

completes configurations for you. You can long in to the IoT platform to view the run logs.

**Figure 8-20** Process of run logs



## Constraints

Currently, only service run logs of MQTT devices can be recorded. For details, see [Table 1](#).

**Table 8-16** Service type

| Service Type   | Service Process                                           |
|----------------|-----------------------------------------------------------|
| Device status  | <b>Device going online</b>                                |
|                | Device going offline                                      |
| Device message | <b>Application requesting message delivery to devices</b> |
|                | <b>Platform delivering messages to devices</b>            |
|                | <b>Device reporting messages</b>                          |
| Device command | <b>Application requesting command delivery to devices</b> |
|                | <b>Platform delivering commands to devices</b>            |



| Service Type                           | Service Process                                                     |
|----------------------------------------|---------------------------------------------------------------------|
|                                        | Platform receiving device response to commands                      |
| Device property                        | Application requesting device property modification                 |
|                                        | Platform delivering property modification to devices                |
|                                        | Device reporting properties                                         |
|                                        | Gateway reporting device properties in batches                      |
| Device event                           | Platform notifying a gateway of new child device connection         |
|                                        | Platform notifying a gateway of child device deletion               |
|                                        | Gateway synchronizing child device information                      |
|                                        | Gateway updating child device status                                |
|                                        | Gateway requesting for adding child devices                         |
|                                        | Platform responding to a request for adding child devices           |
|                                        | Gateway requesting for deleting child devices                       |
|                                        | Platform responding to a request for deleting child devices         |
|                                        | Gateway updating child device status                                |
|                                        | Platform responding to a request for updating child device statuses |
|                                        | Platform delivering a command to obtain version information         |
|                                        | Device reporting the software and firmware versions                 |
|                                        | Platform delivering an upgrade command                              |
|                                        | Device reporting the upgrade status                                 |
|                                        | Device requesting a URL for file upload                             |
|                                        | Platform delivering a temporary URL for file upload                 |
|                                        | Device reporting file upload results                                |
|                                        | Device requesting a URL for file download                           |
|                                        | Platform delivering a temporary URL for file download               |
|                                        | Device reporting file download results                              |
| Device requesting time synchronization |                                                                     |

| Service Type             | Service Process                                           |
|--------------------------|-----------------------------------------------------------|
|                          | Platform responding to a request for time synchronization |
|                          | Device reporting information                              |
|                          | Platform delivering a log collection notification         |
|                          | Device reporting log content                              |
|                          | Platform delivering a configuration notification          |
|                          | Device reporting the configuration response               |
|                          | Device downloading upgrade package                        |
| Batch task               | Subtask execution result of a batch task                  |
| Device self-registration | Device self-registration result.                          |
| Device authentication    | Custom device authentication result                       |

**Table 8-17** Format of batch task run logs

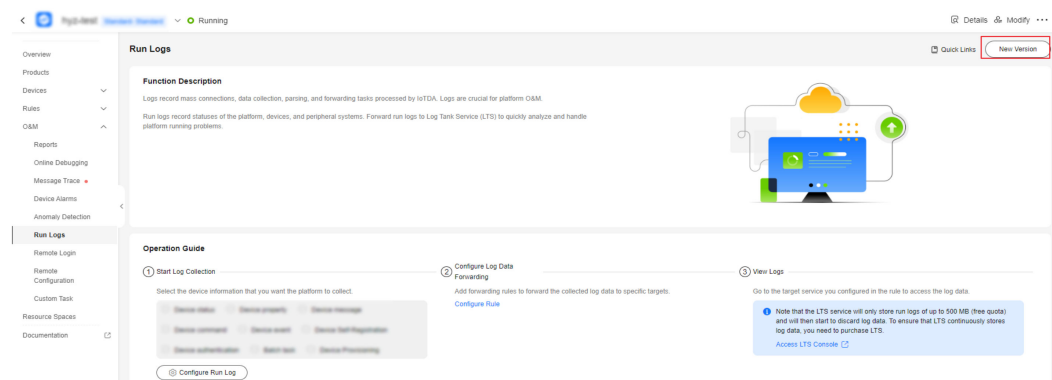
| Field        | Description                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| appId        | Application ID.                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| deviceId     | Device ID.                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| categoryName | Log type: batch.task.                                                                                                                                                                                                                                                                                                                                                                                                                                |
| operation    | Action. Set this parameter to the ID of a batch task. For details, see <a href="#">Create a Batch Task</a> .                                                                                                                                                                                                                                                                                                                                         |
| request      | Request content in JSON format.<br><pre>{   "task_type": "createDevices", // Task type   "package_id": "f2303267a6e8f0053037c2a9", // Software/   Firmware upgrade package   "package_ids": ["65f3ebe2682b9f4bcc38baad"] // Software/   Firmware upgrade package }</pre> <p><b>NOTE</b><br/>When the batch task type is <b>softwareUpgrade</b> or <b>firmwareUpgrade</b>, the <b>package_id</b> and <b>package_ids</b> parameters are supported.</p> |

| Field    | Description                                                                                                                                                                                           |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| response | Response content in JSON format.<br>Success:<br><pre>{   "output" : "xxxxxxxxxxxxx" }</pre> Failure:<br><pre>{   "error" : {     "error_code" : "IOTDA.XXXXX",     "error_msg" : "XXXXX."   } }</pre> |
| status   | Execution result. Subtask status. Options: <b>Success</b> , <b>Fail</b> , <b>Stopped</b> , or <b>Removed</b> .                                                                                        |

## Procedure

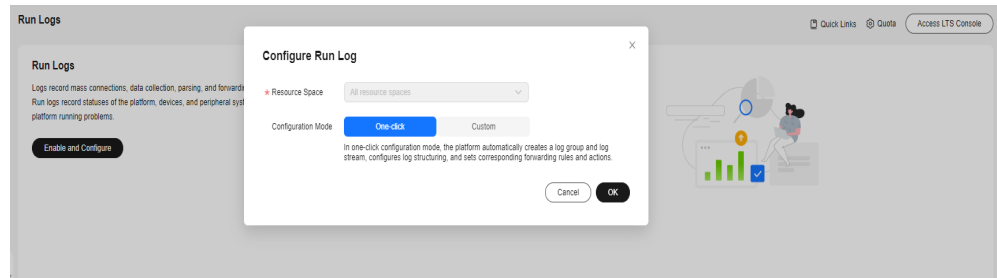
- Step 1** Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **O&M > Run Logs**.
- Step 3** If you are using run logs of an earlier version, you can click **New Version** in the upper right corner. The new **Run Logs** page is displayed. If you have used the new version, the new version page is auto displayed.

**Figure 8-21** Run logs - Going to new version



- Step 4** If you use the function for the first time, you need to click **Enable and Configure**. Two configuration modes are available.
  1. One-click configuration:  
The platform automatically creates a log group and log stream, configures log structuring, and sets corresponding forwarding rules and actions.

**Figure 8-22** Run log - One-click configuration



2. Custom configuration

You can flexibly set rules, log groups, and log streams for run logs.

If you configure a structuring rule for the log stream, the platform will modify the structuring automatically.

**Figure 8-23** Run log - Custom configuration

**Configure Run Log**

✕

★ Resource Space

Configuration Mode

In custom configuration mode, you can flexibly set rules, log groups, and log streams for run logs.  
If you configure a structuring rule for the log stream, the platform will modify the structuring automatically.

★ Forwarding Rule

No run log rule is found for the selected resource space. Enter a rule name and the system will create a run log rule.

★ Log Group  [Creating a Log Group](#)

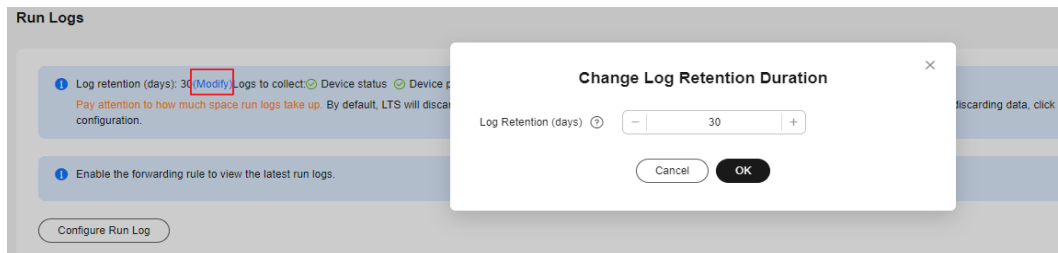
★ Log Stream

**NOTE**

Deleting a forwarding rule whose **Data Source** is **Run log** may affect functions. Exercise caution.

**Step 5** After configuration, you can view or search for run logs (by time, log type, device ID, action, and request content) to analyze services. Run logs are stored in the LTS for 30 days by default. You can modify the retention duration to 365 days at most on the console.

**Figure 8-24** Run log - Modifying the storage time

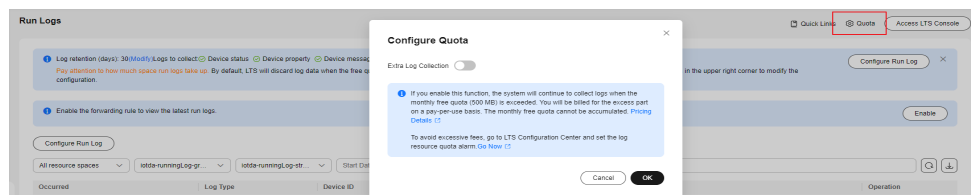


**NOTE**

Run logs are stored in LTS. LTS provides a free quota of 500 MB per month. You can click **Quota** in the upper right corner to configure the **Extra Log Collection** function. You can also go to [LTS Configuration Center](#) and set the log resource quota alarm. For details, see [What Is Log Tank Service?](#)

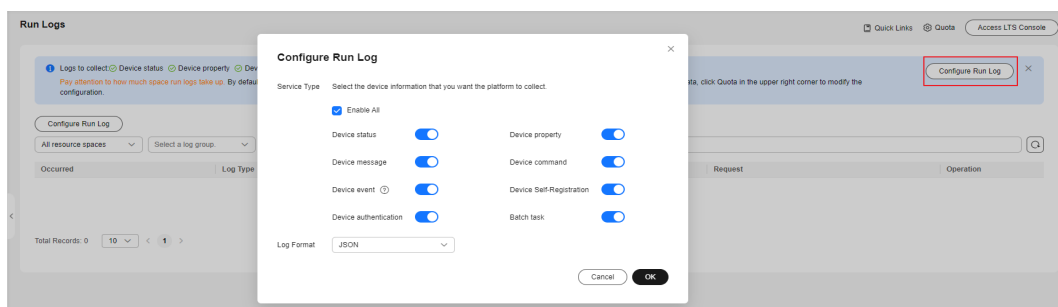
- If you enable **Extra Log Collection**, LTS will continue to collect log data when the monthly free quota (500 MB) is reached. You will be billed for the excess part on a pay-per-use basis. For details, see [Billing](#).
- If you disable **Extra Log Collection**, LTS will discard log data when the monthly free quota (500 MB) is reached.

**Figure 8-25** Run log - Quota setting



**Step 6** One or more service types can be enabled for run logs. You can click **Configure Run Log** and change the log collection type in the displayed dialog box. If you do not select any type, the function of collecting logs is disabled.

**Figure 8-26** Run log - Configuring the log switch



----End

## Example of Run Logs

This section describes how to use the [Java SDK](#) to report messages, trigger run logs to be transferred to LTS, and check message reporting logs on IoTDA. JDK 1.8 or later is used.

Prerequisites:

1. The device has been registered on IoTDA.
2. The run logs of the new version has been enabled and configured, and the device message log switch has been enabled.

Configure the SDK on the device side:

### Step 1 Configure the Maven dependency of the SDK on devices.

```
<dependency>
 <groupId>com.huaweicloud</groupId>
 <artifactId>iot-device-sdk-java</artifactId>
 <version>1.1.4</version>
</dependency>
```

### Step 2 Configure the SDK and device connection parameters on devices. Note: Replace the domain name (domain), device ID (deviceId), and device secret (secret) in the actual code.

```
// Load the CA certificate of the IoT platform. For details about how to obtain the certificate, visit https://support.huaweicloud.com/intl/en-us/devg-iot-hub/iot_02_1004.html.
URL resource = BroadcastMessageSample.class.getClassLoader().getResource("ca.jks");
File file = new File(resource.getPath());

// The format is ssl://Domain name.Port number.
// To obtain the domain name, log in to the Huawei Cloud IoTDA console. In the navigation pane, choose Overview and click Access Details in the Instance Information area. Select the access domain name corresponding to port 8883.
String serverUrl = "ssl://{domain}:8883";
// Device ID created on the IoT platform
String deviceId = "{deviceId}";
// Secret corresponding to the device ID
String deviceSecret = "{secret}";
// Create a device.
IoTDevice device = new IoTDevice(serverUrl, deviceId, deviceSecret, file);
if (device.init() != 0) {
 return;
}
```

### Step 3 Report a message.

```
device.getClient().reportDeviceMessage(new DeviceMessage("hello"), new ActionListener() {
 @Override
 public void onSuccess(Object context) {
 log.info("reportDeviceMessage ok");
 }

 @Override
 public void onFailure(Object context, Throwable var2) {
 log.error("reportDeviceMessagefail: "+ var2);
 }
});
```

----End

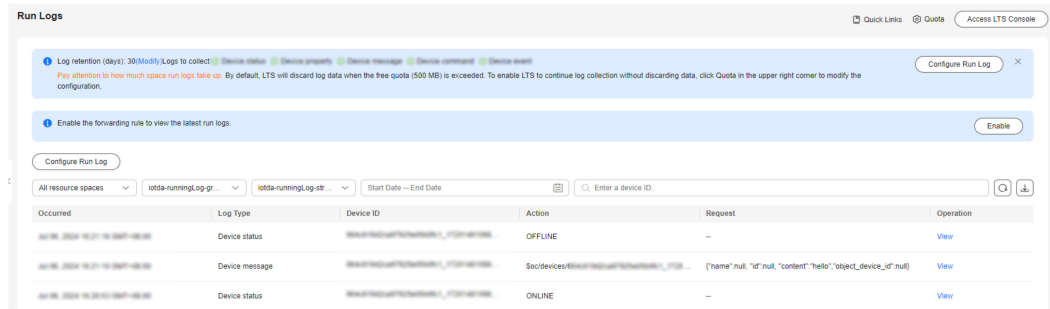
Verify the setting:

### Step 1 Run the SDK code on the device. If the following information is displayed on the console, the device goes online and reports messages successfully.

```
2023-04-27 17:05:26 INFO MqttConnection:88 - Mqtt client connected. address :ssl://{domain}:8883
2023-04-27 17:05:26 INFO MqttConnection:214 - publish message topic = $oc/devices/{deviceId}/sys/messages/up, msg = {"name":null,"id":null,"content":"hello","object_device_id":null}
2023-04-27 17:05:26 INFO MessageSample:43 - reportDeviceMessage ok
```

### Step 2 Check run logs on the console. You can check the records of device login and logout and messages reported by devices.

**Figure 8-27** Run logs - Log example



----End

## 8.7 Anomaly Detection

IoTDA provides device anomaly detection functions, including security checks and disconnection analysis.

### Security Checks

IoTDA continuously detects device security threats. This section describes security check items and how to view and handle detected security risks.

#### Common detection items

| Item                          | Description                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Connection mode               | No encryption protocol is used to establish secure connections between devices and IoTDA. This may cause man-in-the-middle and replay attacks and affect services.                                                                                                                                                                                                  |
| TLS version                   | Insecure TLS protocol versions (TLS v1.0 and v1.1) have security vulnerabilities, which may cause security risks such as device data leakage.                                                                                                                                                                                                                       |
| Cryptographic algorithm suite | Currently, IoTDA checks the following insecure cryptographic algorithm suites:<br>TLS_ECDHE_PSK_WITH_AES_128_CBC_SHA,<br>TLS_ECDHE_PSK_WITH_AES_256_CBC_SHA,<br>TLS_PSK_WITH_AES_128_CBC_SHA,<br>TLS_PSK_WITH_AES_256_CBC_SHA<br>Insecure cryptographic algorithm suites have security vulnerabilities, which may cause security risks such as device data leakage. |
| Device connection             | If a device attempts to establish connections with IoTDA multiple times within 1 second, the device may be cracked with brute force. As a result, identity information may be leaked, normal devices may be forced to go offline, and service data may be stolen.                                                                                                   |

| Item                  | Description                                                                                                       |
|-----------------------|-------------------------------------------------------------------------------------------------------------------|
| Device authentication | Incorrect device identity authentication information causes device connection failures. This may affect services. |

The preceding common check items are enabled by default. You can manually enable other non-common check items as required.

**Table 8-18 Non-common detection items**

| Item                       | Description                                                                            |
|----------------------------|----------------------------------------------------------------------------------------|
| Memory leak check          | Checks device memory leaks.                                                            |
| Abnormal port              | Checks whether abnormal ports are enabled on the device.                               |
| CPU usage                  | Checks whether the CPU usage of the device is too high.                                |
| Disk space                 | Checks whether the disk space of the device is insufficient.                           |
| Battery level              | Checks whether the battery level of the device is too low.                             |
| Malicious IP address       | Checks whether the device communicates with malicious IP addresses.                    |
| Local login                | Checks whether attackers log in to the device through non-SSH networks.                |
| Brute-force cracking login | Checks whether attackers attempt to log in to the device through brute force cracking. |
| Device file tampering      | Checks whether files in a specified directory of a device are tampered with.           |

## Disconnection Analysis

IoTDA help you analyze device disconnection causes by collecting statistics on the disconnection time range and characteristics of disconnected devices.

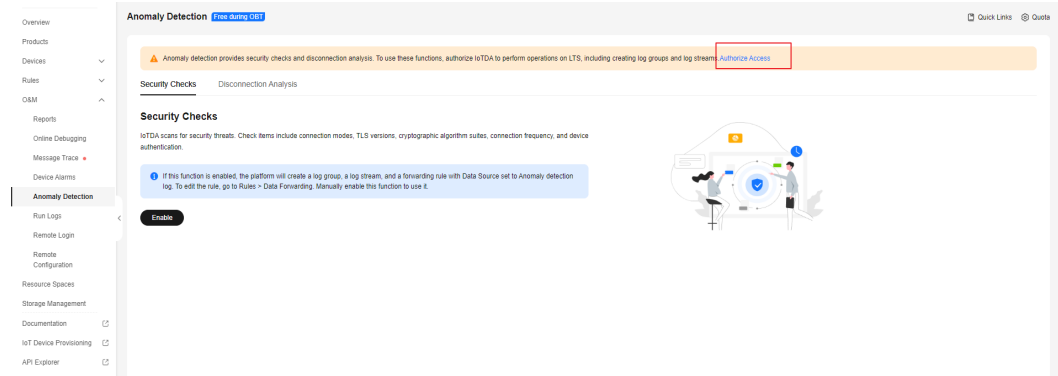


| Disconnection Cause                    | Description                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Disconnection requested by device      | The device sends an MQTT disconnect packet to IoTDA for disconnection.                                                                                                                                                                                                                                                                                                                 |
| Device heartbeat timed out             | The device does not comply with the MQTT protocol. It sends MQTT heartbeat packets to IoTDA within 1.5 times the configured heartbeat interval. As a result, IoTDA considers that the device connection is invalid and cuts off the connection according to protocol requirements.<br>(Note: The heartbeat interval is specified when the device establishes a connection with IoTDA.) |
| Device-platform TCP connection cut off | IoTDA receives a TCP disconnection packet from the device. As a result, the TCP connection between the device and IoTDA is cut off.                                                                                                                                                                                                                                                    |
| Device deleted                         | The device is deleted from IoTDA, and IoTDA cuts off the connection with the device.                                                                                                                                                                                                                                                                                                   |
| Device frozen                          | The device is frozen on IoTDA, and IoTDA cuts off the connection with the device.                                                                                                                                                                                                                                                                                                      |
| Connection cut off by IoTDA            | IoTDA cuts off the connection with the device during upgrade.                                                                                                                                                                                                                                                                                                                          |
| Earlier connection cut off             | The device establishes connections with IoTDA repeatedly. IoTDA cuts off the existing connection and retains the new connection.                                                                                                                                                                                                                                                       |
| Device secret reset                    | When the device secret is reset and the connection is manually cut off, IoTDA cuts off the connection with the device.                                                                                                                                                                                                                                                                 |

## Procedure

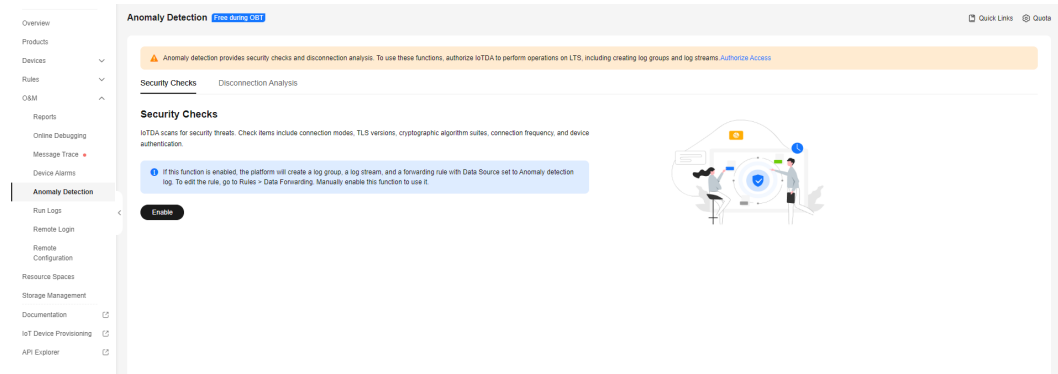
- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **O&M > Anomaly Detection** and click **Authorize**. To use anomaly detection, authorize IoTDA service to perform operations on LTS.

**Figure 8-28** Anomaly detection - Access authorization



**Step 3** After authorization, **Security Checks** and **Disconnection Analysis** pages are available. Click **Enable** to enable the two functions. Otherwise, they cannot be used.

**Figure 8-29** Anomaly detection - Security checks



**Figure 8-30** Anomaly detection - Offline analysis



**NOTE**

1. When this function is enabled, IoTDA automatically creates a log group, a log stream, and a data forwarding rule with the data source set to run logs of all resource spaces.

The log group name is *{domainName}-device-exception-group*, the log stream name is *{domainName}-device-exception-stream*, and the forwarding rule name is *{domainName}-device-exception-rule*.

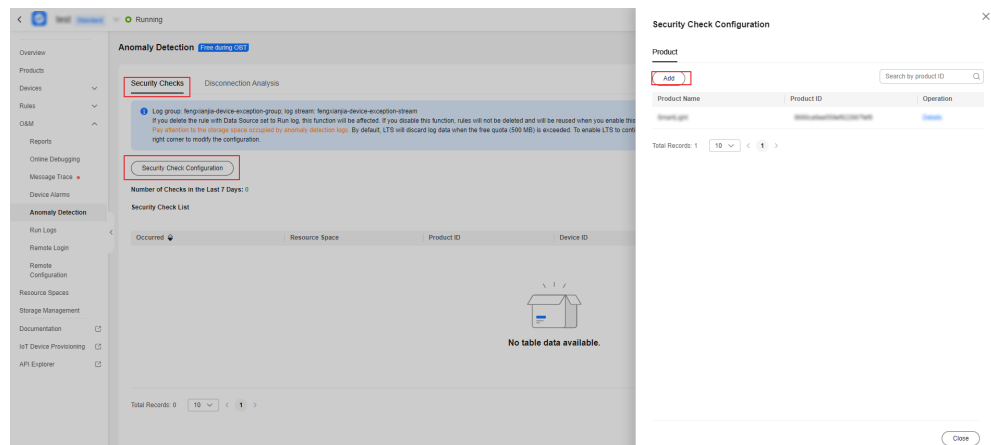
If you delete the rule with the data source set to run logs, this function will be affected. If you disable this function, rules will not be deleted and will be reused when you enable this function again.

2. Pay attention to the storage space occupied by anomaly detection logs. When the free quota (500 MB) is used up, LTS will discard data or continue collecting data after you purchase LTS. You can click **Quota** in the upper right corner to modify the quota.

**Step 4** To enable **Security Checks**, perform the following steps. Otherwise, skip them.

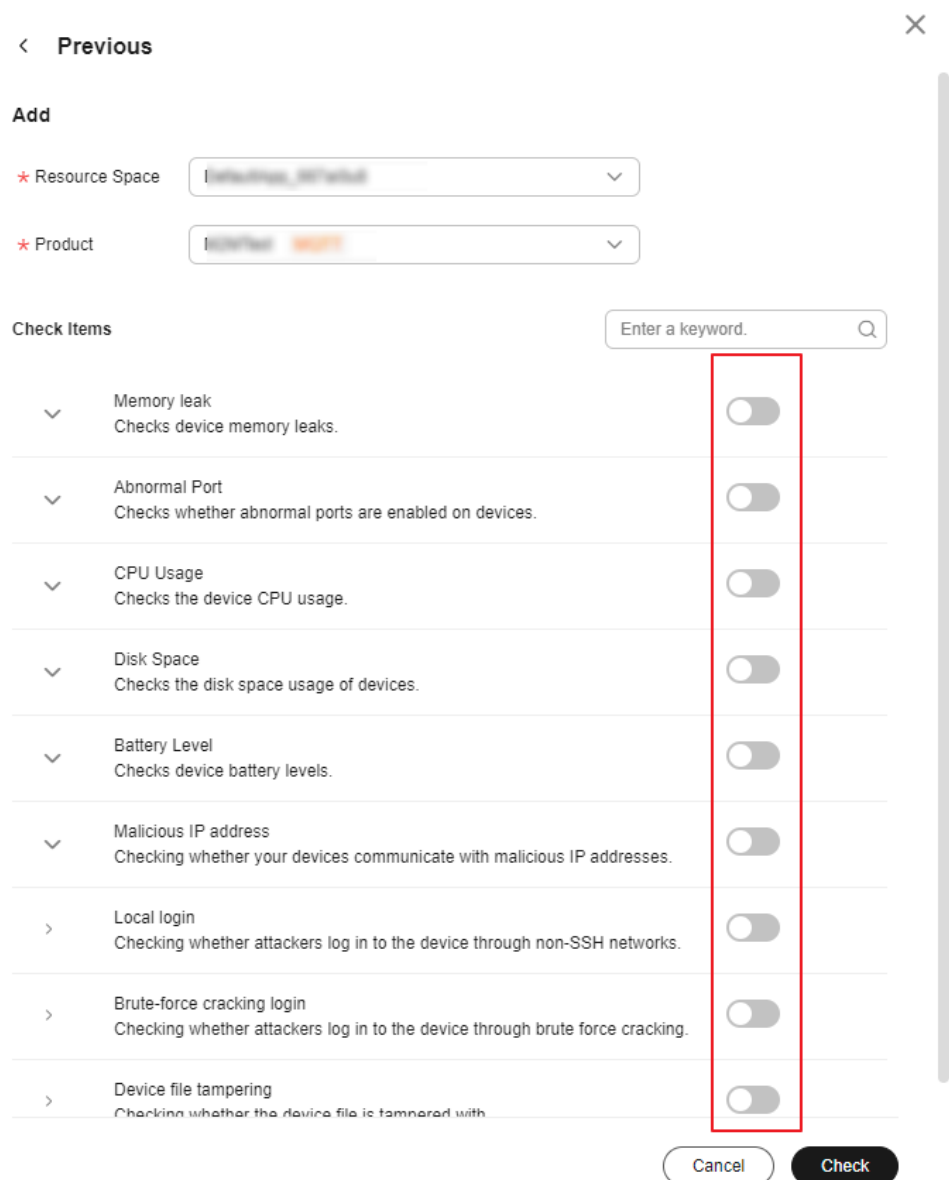
1. On the **Security Checks** tab page, click **Security Check Configuration**. In the displayed dialog box, click **Add**.

**Figure 8-31** Anomaly detection - Security check configuration



2. On the configuration page, select the resource space and product name to be configured, and enable the corresponding check items as required.

Figure 8-32 Anomaly detection - Security check item configuration

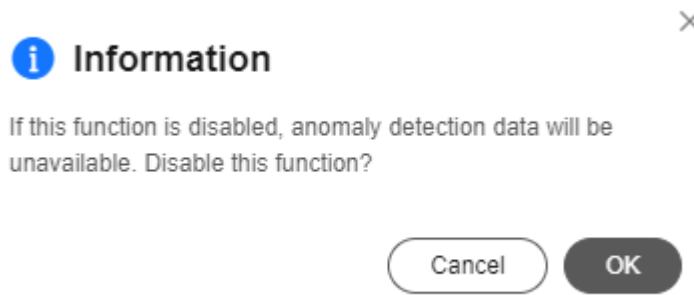


**NOTE**

Memory/CPU usage/Disk space/Battery level checks: The system compares the values reported by the device with the thresholds configured in the check items to determine whether to generate alarms. Abnormal port/Malicious IP address checks: Enter whitelisted ports or IP addresses for checks. The system compares the parameters reported by the device and the configured whitelist members. You can add IP address segments to the whitelist, for example, 192.168.1.10/24.

**Step 5** You can click **Disable** on the corresponding pages to manually disable the security check and disconnection analysis functions, and click **Enable** to use them again.

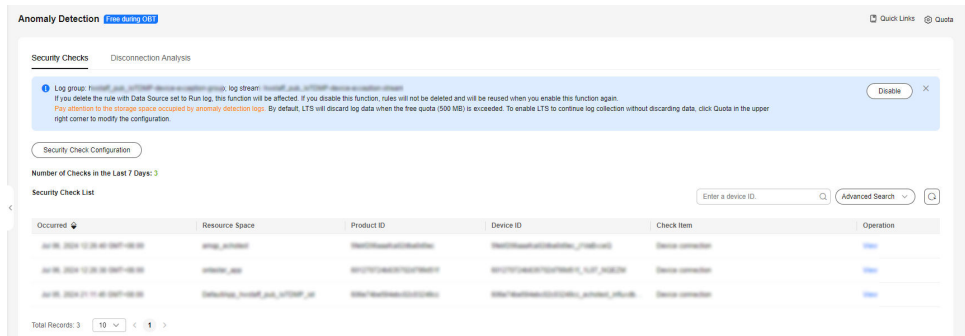
Figure 8-33 Anomaly detection - Disabling the function



**NOTE**

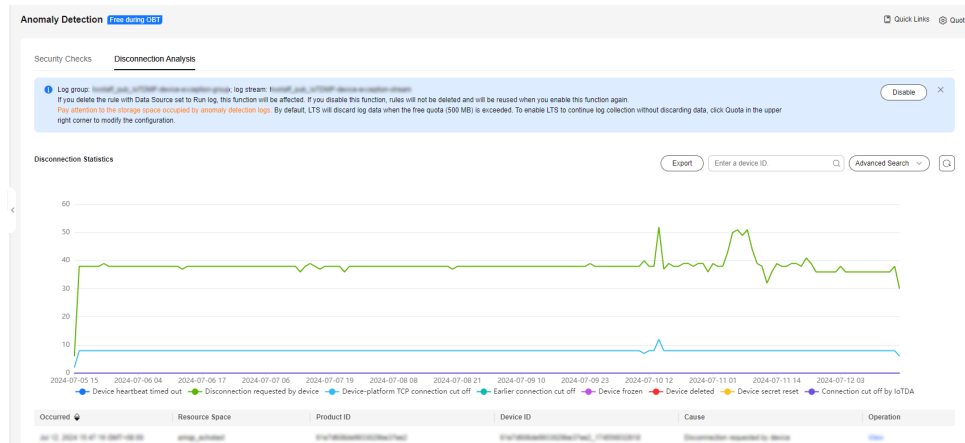
- After you enable security checks, IoTDA starts security checks on devices. Security check data of the last seven days can be stored at most. You can search for anomaly records by device ID, resource space, product, check item, and time range, and click the button to check record details.

Figure 8-34 Anomaly detection - Security check overview



- After you enable disconnection analysis, IoTDA automatically analyzes the causes of device disconnections. Disconnection analysis data of the last seven days can be stored at most. You can search for disconnection data by device ID, resource space, product, cause, and time range, and click the button to check record details.

Figure 8-35 Anomaly detection - Offline analysis overview



----End

## 8.8 Remote Login

IoTDA allows you to remotely log in to devices from the console over the Secure Shell Protocol (SSH). You can enter commands supported by devices to debug functions and locate faults. This facilitates device management and remote O&M. The following describes how to use this function.

### Prerequisites

1. The device runs on Linux.
2. An SSH server has been installed on the device.
3. The device has been IoTDA SDK integrated. IoT Device SDK C v1.1.1 or later is supported. For details, see [IoT Device SDK \(C\)](#).
4. The device is online.

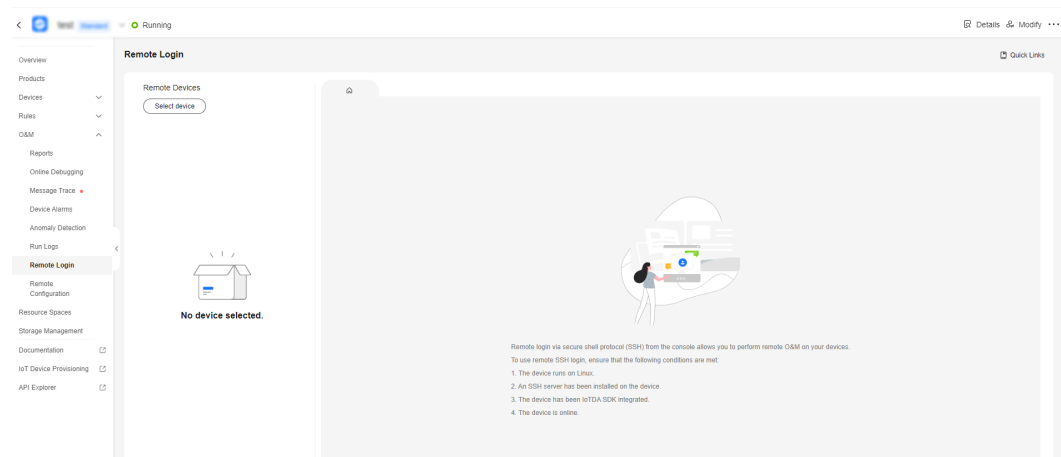
### Constraints

1. Remote connections are based on SSH. IoTDA only establishes SSH channels for devices. You need to develop the management capabilities supported by the console on the device side.
2. Only the standard and enterprise editions support remote login. The domain name access mode must be provided for application access of the enterprise edition.
3. Only one remote connection can be enabled for a device at a time. Up to 100 devices can be remotely logged in at a time for each instance of a tenant.

### Procedure

- Step 1** Access the [IoTDA](#) service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **O&M > Remote Login**.

**Figure 8-36** Remote login - Remote login page

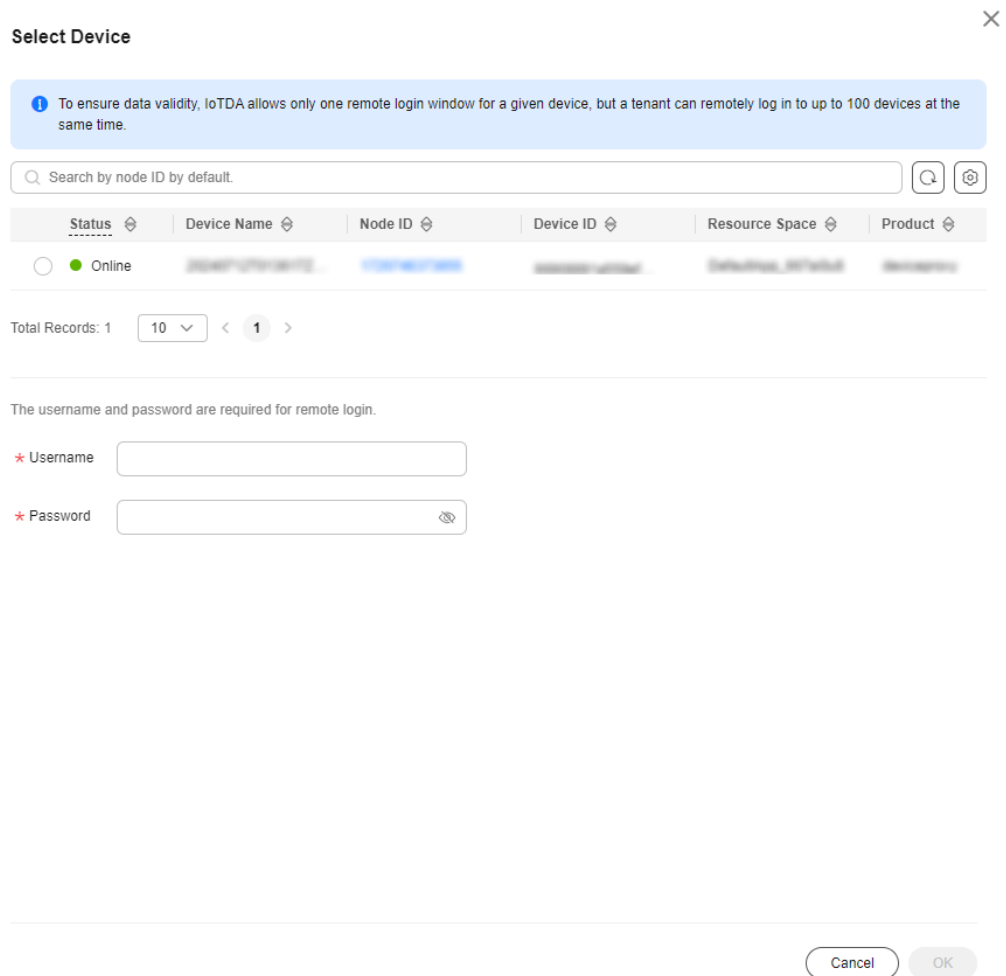


- Step 3** Click **Select device** to select the device you want to log in, and enter the username and password for SSH login.

 **NOTE**

IoTDA does not save the username and password but transparently transfers them to the device.

**Figure 8-37** Remote login - Selecting a device



**Select Device** ✕

**Info:** To ensure data validity, IoTDA allows only one remote login window for a given device, but a tenant can remotely log in to up to 100 devices at the same time.

Search by node ID by default.

| Status | Device Name | Node ID | Device ID | Resource Space | Product |
|--------|-------------|---------|-----------|----------------|---------|
| Online |             |         |           |                |         |

Total Records: 1    10    < 1 >

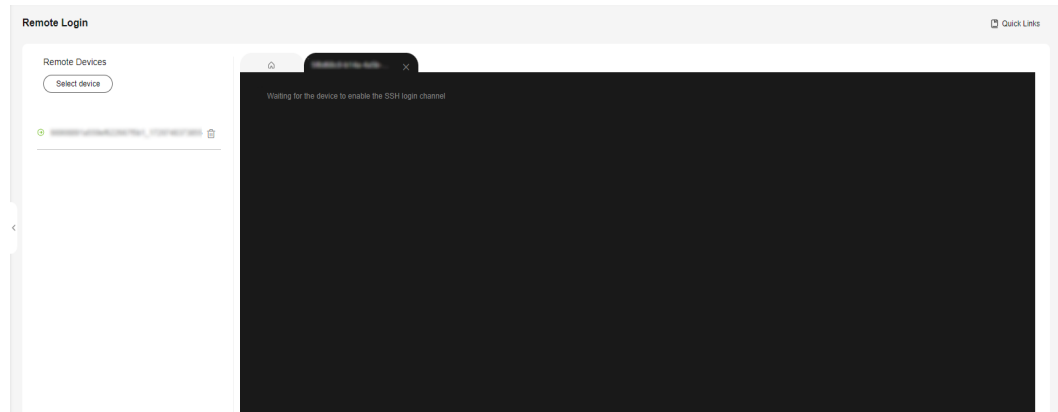
The username and password are required for remote login.

\* Username

\* Password

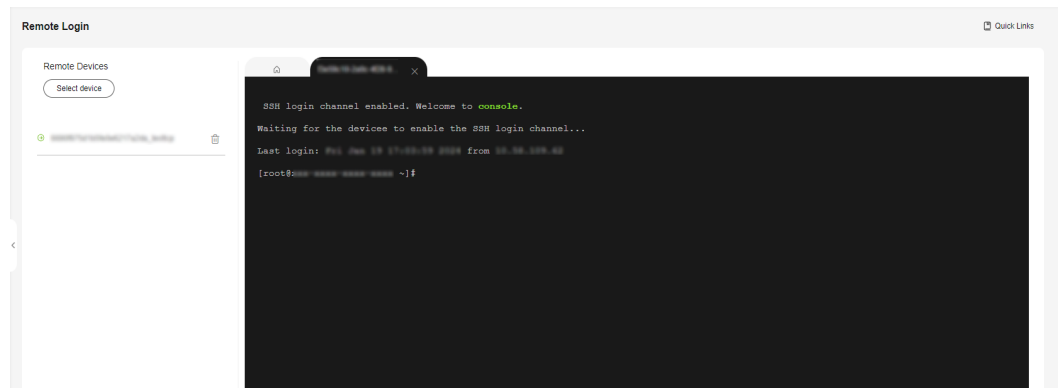
**Step 4** Click **OK**, the following remote console page is displayed, prompting you to wait for SSH to be enabled on the device.

**Figure 8-38** Remote login - Waiting for the SSH function to be enabled on the device



**Step 5** After the login is successful, the following page is displayed. You can manage the device based on its functions.

**Figure 8-39** Remote login - Successful remote login



----End

## 8.9 Remote Device Configuration

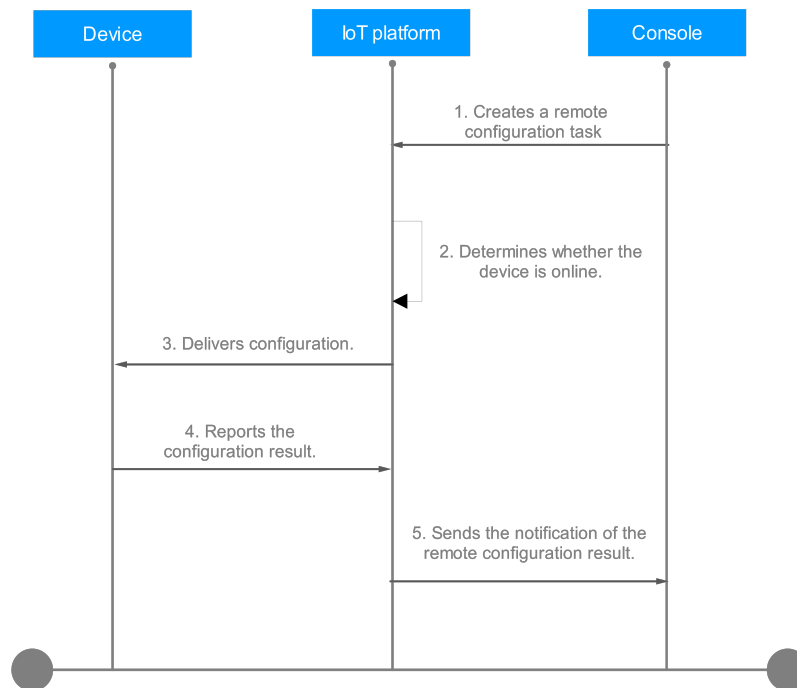
### Overview

The platform allows you to perform remote configuration. You can remotely update device configuration items such as system and running parameters without interrupting device running.

For example, you can remotely modify system parameters of cashiers running in Windows and the data reporting frequency of T-Boxes in the Internet of Vehicles (IoV) scenarios.



## Service Flow



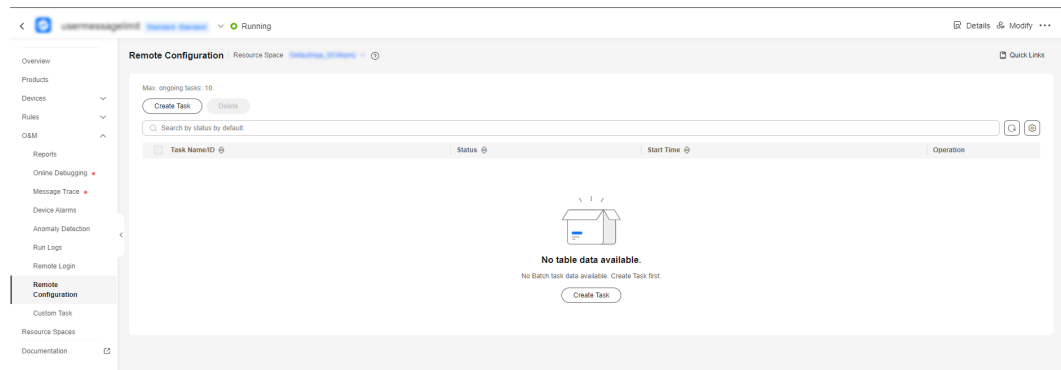
The remote device configuration process is described as follows:

1. A remote configuration task is created on the IoTDA console. Up to 10 remote configuration tasks can run concurrently under an application. Each task can deliver configurations to up to 100,000 devices. If a device is already in an existing remote configuration task and the remote configuration is not complete, a new remote configuration task that contains the device will fail.
2. The platform checks whether the device is online and delivers configurations immediately when the device is online. When the device is offline, the platform waits for the device to go online and subscribe to the **remote configuration topic**. After detecting that the device goes online, the platform delivers configurations. When creating a remote configuration task, you can configure a timeout interval (1 to 30 days). The default timeout interval is 30 days.
3. After configurations are updated, the device calls the API for **reporting the configuration result**.

## Procedure

- Step 1** Access the **IoTDA** service page and click **Access Console**. Click the target instance card.
- Step 2** In the navigation pane, choose **O&M > Remote Configuration**.
- Step 3** Click **Create Task**.

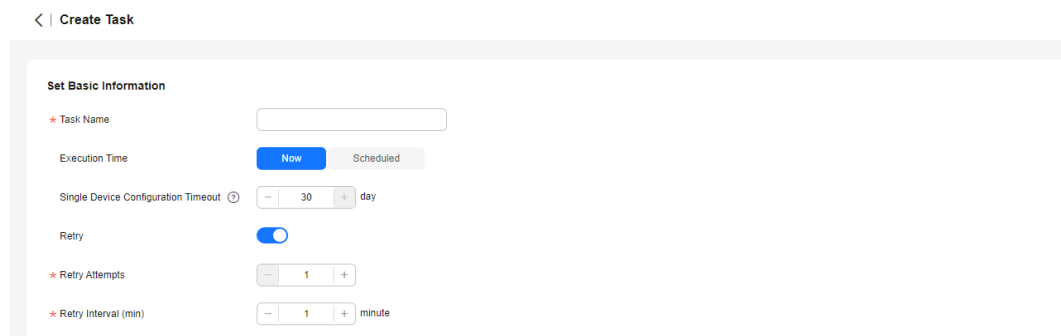
**Figure 8-40** Remote configuration - Remote configuration page



**Step 4** On the page for creating a remote configuration task, enter a task name, select the execution time, and configure the timeout interval and retry policy.

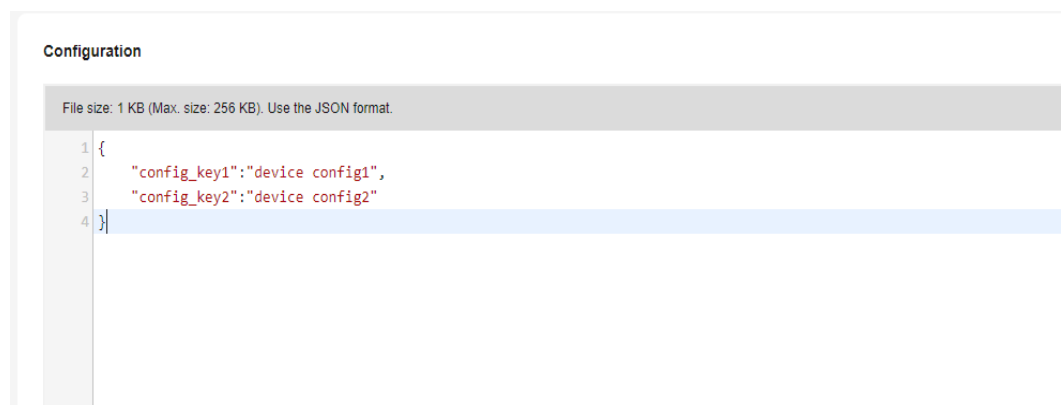
If **Retry** is enabled, you can set the number of retry attempts and retry interval. You are advised to set **Retry Attempts** to **2** and **Retry Interval (min)** to **5**. That is, if the remote configuration fails, the remote configuration will be retried in 5 minutes. (The maximum number of retry attempts is 5 and the maximum retry interval is 1,440 minutes.)

**Figure 8-41** Adding remote configuration - Basic information



**Step 5** Enter the configuration content in JSON format.

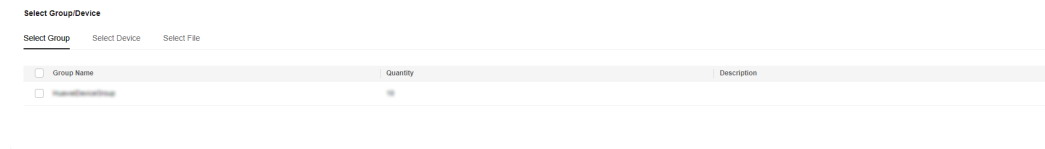
**Figure 8-42** Adding remote configuration - Configuration content



**Step 6** Select the devices to which the configuration to deliver. You can select a group, upload a file (up to 100,000 devices), or select target devices (up to 30,000)

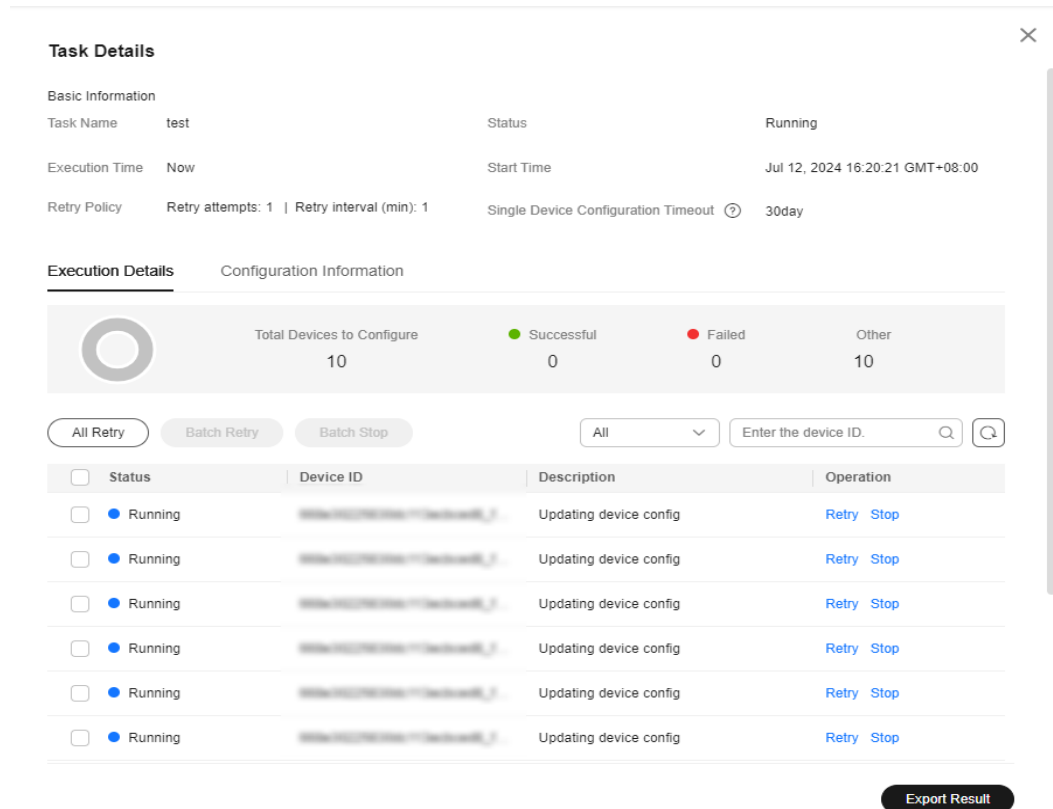
devices) manually. If a large number of devices need to be configured, select a group or upload a file.

**Figure 8-43** Adding remote configuration - Device selection



**Step 7** After a remote configuration task is created and the device goes online, the device can receive a configuration notification delivered by the platform. After the device updates its configuration and reports the result, you can view the remote configuration result on the task details page. You can stop an executing remote configuration task for a single device or multiple devices (up to 100 devices at a time) in batches. You can also retry a task for a single device or multiple devices (up to 100 devices at a time), or retry all failed remote configuration tasks.

**Figure 8-44** Remote configuration - Viewing tasks



----End