Alibaba Cloud
IoT Platform

Product Introduction

MORE THAN JUST CLOUD | Alibaba Cloud

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Generic conventions

Table -1: Style conventions

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

Style	Description	Example
{} or {a|b}	**It indicates that it is a required value, and only one item can be selected.**	`swich` *{stand | slave}*

Contents

1 What is IoT Platform?

IoT Platform is a device management platform on Alibaba Cloud that enables developers of IoT applications to implement two-way communications between end devices (such as sensors, final control elements, embedded devices, and smart household electrical appliances) and the cloud by creating data channels.

IoT Platform has the following benefits:

Device Connection

IoT platform provides device SDKs to help you connect devices to Alibaba Cloud.

· Provides various solutions for connecting network equipment that uses 2G/3G/ 4G, NB-IOT, or LoRa technology, to help streamline the management of devices connected over heterogeneous networks.

· Provides device SDKs that support various protocols, such as the MQTT and CoAP protocols. This achieves not only real-time synchronization capabilities by enabling persistent connections, but also energy efficient requirements by enabling transient connections.

· Supports various open-source programming languages and provides guides for embedding SDKs into different chips using your preferred programming languages . This allows enterprises to connect devices with various chips to IoT Platform.

Device Communication

Devices can use the IoT platform for two-way communication with the cloud through the IoT Hub. The platform enables upload and download channels between devices and the cloud to ensure that two-way communications between the devices and the cloud are smooth and reliable.

Device Management

IoT Platform manages the entire life cycle of devices, including device registration, function definition, script parsing, online debugging, remote configuration, firmware upgrade, remote maintenance, real-time monitoring, grouping, and device removal.

· Provides Thing Specification Language to simplify application development.

· Pushes notifications when a device changes status.

- Provides data storage capabilities, making it easy to read and write massive amounts of device data in real time.
- Supports the remote upgrade of devices based on Over-The-Air (OTA) technology.
- Provides a device shadow feature that decouples devices and applications to address scenarios with unstable wireless connections.

Security

A multi-layered security strategy is provided to ensure the security of devices connected to the cloud.

- Authentication

  - Chip-level security solutions (ID^2) and the DeviceSecret mechanism are provided to prevent DeviceSecret being cracked. Security level: high.
  - The Unique Certificate per Device authentication mechanism is provided to prevent devices from being attacked. This mechanism applies to scenarios where pools of device certificates (consisting of ProductKey, DeviceName, and DeviceSecret) can be installed into device chips in mass production. Security level: high.
  - The Unique Certificate per Product authentication mechanism is provided to reduce the attack risk of devices. This mechanism applies to scenarios where pools of device certificates (consisting of ProductKey, DeviceName, and DeviceSecret) cannot be installed into device chips in mass production. Security level: medium.

- Communication Security

  - Supports various data channels that use TLS (for example, MQTT and HTTP) and DTSL (for example, CoAP) protocols to ensure the privacy and integrity of data. This applies to scenarios where hardware resources are sufficient, and devices are not sensitive to power consumption. Security level: high.
  - Supports custom data symmetric encryption channels that use TCP (for example, MQTT) and UDP (for example, CoAP) protocols. This applies to

scenarios where hardware resources are insufficient, and devices are sensitive to power consumption. Security level: medium.

- Permission management is provided to ensure that communications between the devices and the cloud are secure.

- Device-level isolation of communication resources (such as Topic) is provided to prevent unauthorized operations on devices.

SQL parsing and data forwarding using the Rule Engine

IoT Platform can integrate with other Alibaba Cloud services by using the Rule Engine. You can set simple rules to transfer device data to Alibaba Cloud services for data storage and computing. The Rule Engine has the following features:

· Establishes M2M communications between devices using rules.

· Transfers data to Message Queue (MQ), ensuring that applications can access device data reliably.

· Transfers data to Table Store, supporting the integration of data acquisition and structured storage.

· Transfers data to Function Compute, supporting the integration of data acquisition and event-triggered processing.

2 Architecture

Devices connect to IoT Platform, and communicate with IoT Platform. IoT Platform can forward device data to other Alibaba Cloud services for storage and processing. This is the basis to build IoT applications.
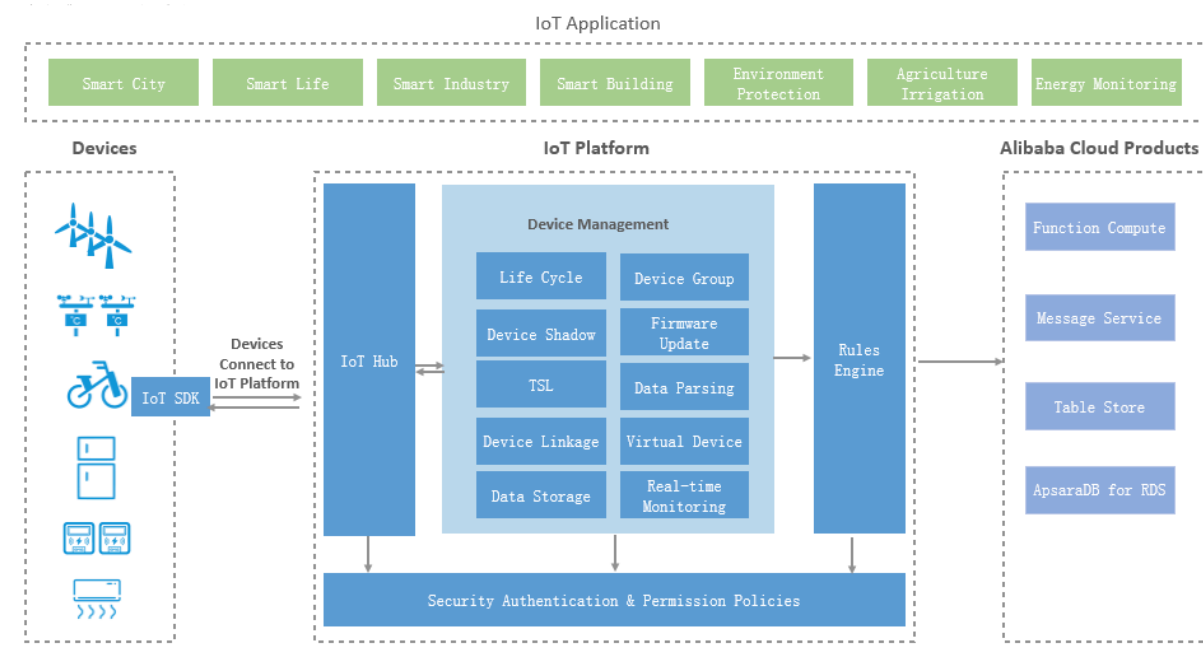
IoT SDK

IoT Platform provides multiple device SDKs to help you develop your devices and connect them to IoT Platform. After a device is integrated with a device SDK, you can securely connect the device to IoT Platform and use features such as device management, data analytics, and data forwarding.

Only devices that support the TCP/IP protocol can integrate with the provided SDKs.

For more information, see *Device SDK Developer Guide*.

IoT Hub

IoT Hub helps devices connect to Alibaba Cloud IoT Platform. IoT Hub acts as a data channel for secure communications between devices and IoT Platform. IoT Hub supports both the Pub/Sub and RRPC communication modes. The Pub/Sub mode is a topic-based message routing mode.

IoT Hub has the following features:

- High scalability: Supports linear dynamic scaling, and allows up to one billion devices to connect to IoT Platform simultaneously.

- End-to-end encryption: The entire communication link is encrypted with RSA or AES to ensure secure data transmission.

- Real-time messages: After a data channel is established between a device and IoT Hub, the channel becomes a persistent connection that can minimize the handshake time and ensure real-time arrival of messages.

- Support for data passthrough: IoT Hub supports binary data passthrough to the IoT Platform server. To keep data manageable and secure, IoT Hub does not store device data.

- Support for multiple communication modes: IoT Hub supports both the Pub/Sub and RRPC communication modes to meet your communication needs in various scenarios.

- Support for multiple protocols: Allows you to use the CoAP, MQTT, or HTTPS protocol to connect devices to IoT Platform.

Device management

IoT Platform provides you with multiple device management services, including: lifecycle, *device grouping*, *device shadow*, *TSL models*, *data parsing*, *data storage*, *online debugging*, *firmware upgrade*, *remote configuration*, and real-time monitoring. For more information, see related documentation.

Data forwarding

When a device communicates with IoT Platform by using a topic, you can write an SQL expression to process the data in the topic. You can then configure rules to forward data to other topics or other Alibaba Cloud services for processing and storage. Examples:

- Forward data to ApsaraDB for RDS and Table Store for storage.
- Forward data to Function Compute for event computing.
- Forward data to Message Service for consumption of highly available data.
- Forward data to another topic to implement M2M communication.

Security authentication and authorization policies

Security is very important to IoT. Alibaba Cloud IoT Platform provides multiple security policies to ensure secure communications between devices and IoT Platform.

· IoT Platform issues a unique certificate to each device. Each device uses its unique certificate for authentication when they try to connect to IoT Platform.

· IoT Platform provides multiple device authentication methods for developers to address different security needs and production requirements.

· IoT Platform grants permissions on a device basis. A device can publish messages and subscribe only to its own topic. IoT Platform identifies user permissions according to AccessKey information and allows users to operate only on authorized topics.

3 Terms

The section describes the terms that are used in Alibaba Cloud IoT Platform.

Terms

Term	Description
Product	A product is a set of devices that have the same features. IoT Platform issues a unique ProductKey for each product. One product may consist of thousands of devices.
Device	A physical device that constitutes a product. IoT Platform issues a DeviceName that is unique under the same product for each device. Devices can connect directly to IoT Platform, or be mounted as sub-devices to a gateway that is connected to IoT Platform.
Gateway	A gateway can connect directly to IoT Platform and provide sub-device management features. Sub-devices can only communicate with IoT Platform through a gateway.
Sub-device	A sub-device is essentially a device. Sub-devices cannot connect directly to IoT Platform and can only get connected through a gateway.
Three key fields	The three key fields are `ProductKey`, `DeviceName`, and `DeviceSecr et`. · `ProductKey` is the unique identifier of a product in IoT Platform. This parameter is very important and used in device authentication and communication. You should keep this parameter safe. · `DeviceName` is the device name that is automatically generated or defined by the user during device registration. Each device has a unique DeviceName under the same product. This parameter is very important and used in device authentication and communication. You must keep this parameter safe. · `DeviceSecr et` is the private key issued by IoT Platform for each device. DeviceSecret is used in pair with DeviceName. This parameter is very important and used in device authentication. You must keep this parameter safe and never disclose this parameter.

Term	Description
ProductSecret	ProductSecret is the private key issued by IoT Platform for each product. ProductSecret is usually used in pair with ProductKey for unique-certificate-per-product authentication. This parameter is very important. You must keep this parameter safe and never disclose this parameter.
Topic	A topic is a UTF-8 character string that is used as a transmission medium during Pub/Sub communication. A device can publish messages to a topic or subscribe to messages from a topic.
Topic category	A topic category is a set of topics associated with different devices under the same product. ${productKey} and ${deviceName} can be combined to specify a unique device. A topic category is applicable to all devices under the same product.
Publish	The operation permission that allows a device to publish messages to a topic.
Subscribe	The operation permission that allows a device to subscribe to messages from a topic.
RRPC	RRPC is short for Revert-RPC. RPC (Remote Procedure Call) uses a form of client–server interaction, and allows you to execute a procedure in a remote place without knowing the details for the remote interaction. RRPC allows you to send a request to a specified device and receive a response from the device.
Tag	Tags consist of product tags and device tags. · Product tags describe the information that is common to all devices under the same product. · Device tags describe the unique features of devices. You can add custom tags based on your needs.
Alink	The protocol for communication between the devices and IoT Platform.
TSL model	IoT Platform uses the Thing Specification Language (TSL) to describe devices. A TSL model includes properties, services and events. TSL models use JSON format. You can organize data based on TSL and report data to the Cloud.
Property	A feature that describes the running status of a device, such as the temperature information collected by an environmental monitoring equipment. Properties support GET and SET request methods. Application systems can send requests to retrieve and set properties.

Term	Description
Service	A feature that describes the capabilities or methods provided by a device that can be used by external requesters. You can specify the input and output parameters. Compared with properties, services can use one command to implement more complex business logic, such as performing a specific task.
Event	A feature that describes the events that are generated when a device is running. Events usually contain notifications that require action or attention, and may contain multiple output parameters. For example, an event may be a notification that a task is completed, a device fault that has occurred, or a temperature alert. You can subscribe to or push events.
Data parsing script	For devices under a product created in IoT Platform Pro, if the passthrough or custom mode is used to send data to IoT Platform, you need to write data parsing scripts to convert the binary data or custom JSON data that is sent by the device to Alink JSON data.
Device shadow	A device shadow is a JSON file that is used to store the status information for a device or application. Each device has a unique device shadow in IoT Platform. Regardless of whether the device is connected to the Internet, you can use the device shadow to retrieve and set the device status through MQTT or HTTP.
Rules engine	Rules engine provides a SQL-based language that enables you to filter the data from topics and send processed data to other Alibaba Cloud services, such as Message Service and Table Store.

4 Benefits

More and more enterprises are employing Internet of Things (IoT) solutions to collect and manage data from devices and increase returns. However, transforming the IoT eco-system and building a powerful IoT platform is facing challenges. Alibaba Cloud IoT Platform offers the solutions to these issues.

The following table describes the differences between traditional IoT development and IoT development based on Alibaba Cloud IoT Platform:

	Traditional IoT development	Development based on Alibaba Cloud IoT Platform
Connect devices to IoT Platform	Requires infrastructure and support from embedded system developers and cloud developers. The development is heavy and inefficient.	Provides Software Development Kits (SDKs) for quick connections between devices and the cloud. IoT Platform supports connections to worldwide devices, devices in heterogeneous networks, devices running in multiple environments, and devices operating based on multiple protocols.
Performance	Requires manual architecture scaling. This results in difficulties in dispatching servers, load balancers, and other infrastructure at device level.	Supports persistent connections with more than 100 million devices and millions of concurrent connections, and allows horizontal architecture scaling.
Security	Requires the development and deployment of additional security measures. Securing device data can be challenging.	Provides multiple measures to secure data in the cloud: · Device authentication to guarantee the security and uniqueness of devices · Transmission encryption to prevent data tampering · Alibaba Cloud Security and authorization checks to secure the cloud

	Traditional IoT development	Development based on Alibaba Cloud IoT Platform
Stability	Requires manual detection of server faults and migrates services, and interrupts services during migration, resulting in service instability.	Ensures the service availability of up to 99.9%, and allows auto migration in a single point of failure.
Ease of use	Demands extra servers to build distributed architecture for load balancing, and requires costly development of a complete IoT system that handles connections, computing, and storage.	Supports device management on the same platform, real-time monitoring of devices, and seamless connections to Alibaba Cloud services, and enables flexible and easy implementation of complex IoT applications.

5 Limits

IoT Platform has the following restrictions.

Products and devices

Item	Description	Limit
Number of tags	The maximum number of tags that a product, device, or device group can support.	100
Number of products	The maximum number of products that an account can support.	1,000
Number of devices	The maximum number of devices that a product can support. 📋 Note: If your business requires more devices, *open a ticket* in the console and describe your requirements in the ticket.	500,000
	The maximum number of devices that an account can support. 📋 Note: If your business requires more devices, *open a ticket* in the console and describe your requirements in the ticket.	10,000,000
Gateways and sub-devices	The maximum number of sub-devices that a gateway can support.	1,500
Features for TSL modes	The maximum number of features that a product can support.	200
	The maximum number of parameters that can be defined for a struct property.	10
	Depends on the data type: · enum: The number of enumeration items cannot exceed 25. · text: The data cannot contain more than 2,048 bytes. · array: The number of elements in an array cannot exceed 128.	-

Item	Description	Limit
	The maximum number of output or input parameters that can be specified for a service.	20
	The maximum number of output parameters that can be specified for an event.	50
Device groups	The maximum number of groups (including parent groups and subgroups) that an account can support.	1,000
	The maximum number of devices that can be added to a group.	20,000
	The maximum number of groups to which a device can be added.	10
Data parsing	The maximum size of the script file that can be uploaded for data parsing.	48 KB
Remote configuration	The remote configuration file supports only the JSON format. The file size cannot exceed 64 KB.	64 KB
Data storage	The data of properties, events, and services is stored for 30 days.	30 days

Communication

Description	Limit
The maximum number of MQTT requests that an account can send per second.	500
The maximum number of connections per minute for a device.	5
The maximum number of topics to which a device can subscribe. After the maximum number is reached, new subscription requests will be rejected. The device can obtain the request result by verifying the received SUBACK message.	100
The maximum number of requests sent by devices to IoT Platform per second for an account.	10,000
The maximum number of requests sent by IoT Platform to devices per second for an account.	2,000
The maximum number of messages that can be sent to the data forwarding module of the rules engine for an account.	1,000
The maximum number of messages to which you can subscribe per second for an account.	1,000

Description	Limit
The maximum frequency in which a device can send messages to IoT Platform.	QoS0: 30 messages per second. QoS1: 10 messages per second.
A device can receive up to 50 messages per second. The performance is also subject to network conditions. If the maximum TCP write buffer size is exceeded, an error will be returned. For example, when you use the Pub operation to send requests to a device, a throttling error will be returned if the device cannot handle all the requests. 📋 Note: If you use the MQTT protocol to connect your devices to IoT Platform, no throttling error messages will be returned. However, you can view logs to detect which devices are being throttled.	50 messages per second
The maximum throughput per connection (bandwidth).	1,024 KB
IoT Platform limits the number of unacknowledged message publishing requests for a single device. After the maximum number is reached, IoT Platform will not receive any new message publishing requests for the device unless a PUBACK message is returned.	100
The maximum storage period for a message that is sent with the sending method of QoS 1. If no PUBACK message is received before the maximum storage period expires, the request will be discarded.	7 days
The maximum size of a message that is sent over MQTT. Messages that exceed this limit will be rejected.	256 KB
The maximum size of a message that is sent over CoAP. Messages that exceed this limit will be rejected.	1 KB

Description	Limit
The heartbeat interval of an MQTT connection can be from 30 to 1,200 seconds. If the heartbeat interval is out of this range, IoT Platform will reject the connection request. We recommend that you set a value greater than 300 seconds. A timer starts when IoT Platform sends a CONNACK message to respond to a CONNECT message. When a PUBLISH, SUBSCRIBE, PING, or PUBACK message is received, the timer is reset. The timer is the amount of time that is equal to 1.5 times the specified heartbeat interval. If no message is received before the timer expires, the connection will be terminated.	30 seconds to 1,200 seconds

Topics

Description	Limit
You can define a maximum of 50 topic categories for a product.	50
A device can publish messages and subscribe only to its own topic.	N/A
A topic uses UTF-8 encoded characters and cannot contain more than 128 characters.	128 characters
The maximum number of slashes (/) that can be included in a topic.	7
The maximum number of topics that can be included in a subscription request.	8
After you subscribe to or unsubscribe from a topic, the change will take effect in approximately 10 seconds. A subscription remains effective until you unsubscribe from the topic. We recommend that you subscribe to topics in advance to avoid data loss. For example, a device sends a Sub request to topic A. After 10 seconds, the subscription takes effect and the device starts to receive messages from topic A in real time. The device will keep receiving messages from topic A unless you unsubscribe from the topic.	10 seconds
A broadcast topic allows a maximum of 1,000 devices to subscribe to it. A server SDK can send only one broadcast message to the topic per second.	1,000

Device shadow

Description	Limit
The maximum depth level of a device shadow JSON file.	5
The maximum size of a device shadow JSON file.	16 KB
The maximum number of properties in a shadow JSON file for a device.	128
The maximum number of requests that a device can send per second.	20

Data Forwarding

Description	Limit
Each account can have up to 1,000 rules.	1,000
Each rule can include a maximum of 10 data forwarding actions (10 data forwarding destinations).	10
Data forwarding performance depends on the instance of the target cloud service. If the target instance has enough performance resources, Rules engine can provide a data forwarding capability of 1,000 QPS for a single account. RAM users share the quota of the corresponding Alibaba Cloud account. Data forwarding will be throttled if the number of requests exceeds the maximum number or if the target instance takes more than one second to write the received data .	1,000 QPS
Make sure that the instance of the target cloud service is operating correctly. Data forwarding fails if any of the following conditions exists: the crash of the target instance, overdue payments, invalid parameters such as invalid values and changed authorizations, and incorrect configurations.	-
Rules engine may forward messages more than one time. In a distributed environment, message balancing in real time may cause a message to be sent more than one time. The receiver must have the mechanism to ignore duplicate messages.	N/A

Cloud API restrictions

Operation name	QPS per account	QPS per IP address
Pub	1,600	100
RRpc	1,000	100

Operation name	QPS per account	QPS per IP address
PubBroadcast	1	100
Other operations	50	100

· If you receive a throttling error while calling an operation, try the call again. Throttling errors include errors that number from 29 to 31 in *Common errors*.

📋 Note:

· QPS per account refers to the number of calls per second for a single Alibaba Cloud account. RAM users share the quota of the corresponding Alibaba Cloud account .

· QPS per IP address refers to the number of calls per second for a single server that is identified by its IP address.