Alibaba Cloud IoT Platform

Product Introduction

Issue: 20181113

Legal disclaimer

Alibaba Cloud reminds you to carefully read and fully understand the terms and conditions of this legal disclaimer before you read or use this document. If you have read or used this document, it shall be deemed as your total acceptance of this legal disclaimer.

1. You shall download and obtain this document from the Alibaba Cloud website or other Alibaba Cloud-authorized channels, and use this document for your own legal business activities only. The content of this document is considered confidential information of Alibaba Cloud. You shall strictly abide by the confidentiality obligations. No part of this document shall be disclosed or provided to any third party for use without the prior written consent of Alibaba Cloud.
2. No part of this document shall be excerpted, translated, reproduced, transmitted, or disseminated by any organization, company, or individual in any form or by any means without the prior written consent of Alibaba Cloud.
3. The content of this document may be changed due to product version upgrades, adjustments, or other reasons. Alibaba Cloud reserves the right to modify the content of this document without notice and the updated versions of this document will be occasionally released through Alibaba Cloud-authorized channels. You shall pay attention to the version changes of this document as they occur and download and obtain the most up-to-date version of this document from Alibaba Cloud-authorized channels.
4. This document serves only as a reference guide for your use of Alibaba Cloud products and services. Alibaba Cloud provides the document in the context that Alibaba Cloud products and services are provided on an "as is", "with all faults" and "as available" basis. Alibaba Cloud makes every effort to provide relevant operational guidance based on existing technologies. However, Alibaba Cloud hereby makes a clear statement that it in no way guarantees the accuracy, integrity, applicability, and reliability of the content of this document, either explicitly or implicitly. Alibaba Cloud shall not bear any liability for any errors or financial losses incurred by any organizations, companies, or individuals arising from their download, use, or trust in this document. Alibaba Cloud shall not, under any circumstances, bear responsibility for any indirect, consequential, exemplary, incidental, special, or punitive damages, including lost profits arising from the use or trust in this document, even if Alibaba Cloud has been notified of the possibility of such a loss.
5. By law, all the content of the Alibaba Cloud website, including but not limited to works, products, images, archives, information, materials, website architecture, website graphic layout, and webpage design, are intellectual property of Alibaba Cloud and/or its affiliates. This intellectual property includes, but is not limited to, trademark rights, patent rights, copyrights, and trade

secrets. No part of the Alibaba Cloud website, product programs, or content shall be used, modified, reproduced, publicly transmitted, changed, disseminated, distributed, or published without the prior written consent of Alibaba Cloud and/or its affiliates. The names owned by Alibaba Cloud shall not be used, published, or reproduced for marketing, advertising, promotion, or other purposes without the prior written consent of Alibaba Cloud. The names owned by Alibaba Cloud include, but are not limited to, "Alibaba Cloud", "Aliyun", "HiChina", and other brands of Alibaba Cloud and/or its affiliates, which appear separately or in combination, as well as the auxiliary signs and patterns of the preceding brands, or anything similar to the company names, trade names, trademarks, product or service names, domain names, patterns, logos, marks, signs, or special descriptions that third parties identify as Alibaba Cloud and/or its affiliates).

6. Please contact Alibaba Cloud directly if you discover any errors in this document.

Generic conventions

Table -1: Style conventions

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

Contents

1 What is 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 (ID²) 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.

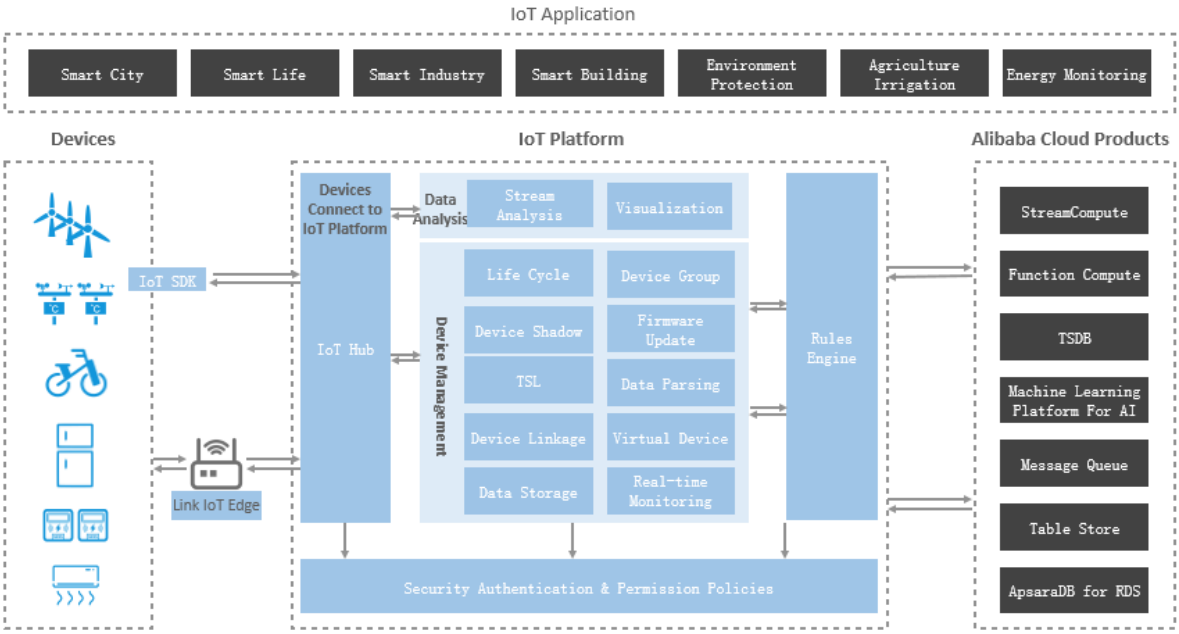
SQL parsing and data forwarding using the Rule Engine

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



IoT Hub

The IoT Hub helps devices connect to the Alibaba Cloud IoT Platform service. The IoT Hub is considered as a data channel for secure communications between devices and the cloud. The IoT Hub supports both the Pub/Sub and Revert-RPC communication modes. The Pub/Sub mode is a message routing mode based on topics.

The IoT Hub has the following features:

- High scalability: supports linear dynamic scaling, and allows one billion devices to be connected simultaneously.
- End-to-end encryption: The entire communication link is encrypted with RSA and AES to ensure that the data transmission is secure.
- Real-time messages: After a data channel is successfully established between the device and the IoT Hub, it becomes a persistent connection to reduce handshake time and to ensure that messages arrive in real time.
- Data passthrough support: The IoT Hub supports binary format data passthrough to the server . To keep data secure and controllable, the IoT Hub does not store device data.
- Various communication modes: The IoT Hub supports both the Pub/Sub and Revert-RPC communication modes in order to meet your communication needs in various scenarios.

- Support for multiple protocols: supports connecting devices to IoT Platform using the CoAP, MQTT, and HTTPS protocols.

Device management

IoT Platform offers various features to manage devices. These features manage the lifecycle, device groups, device shadows, firmware upgrade, Thing Special Language (TSL), data parsing, online debugging, remote maintenance, and real-time monitoring. Device management in different versions of IoT Platform has different features, see *Specifications* for details .

Rules engine

When a device communicates with IoT Platform using a topic, you can write an SQL expression to process the data in the topic. You can then configure rules to transfer data to other topics or Alibaba Cloud services. For example:

- You can transfer and store data to RDS, Table Store, and HiTSDB.
- You can transfer data to the DataHub and then use StreamCompute for stream computing or MaxCompute for large dataset offline computing. You can also transfer data to Function Compute for event-triggered processing.
- You can transfer data to Message Queue (MQ) for highly reliable data consumption.
- You can transfer data in one topic to another topic to establish M2M communication between devices.

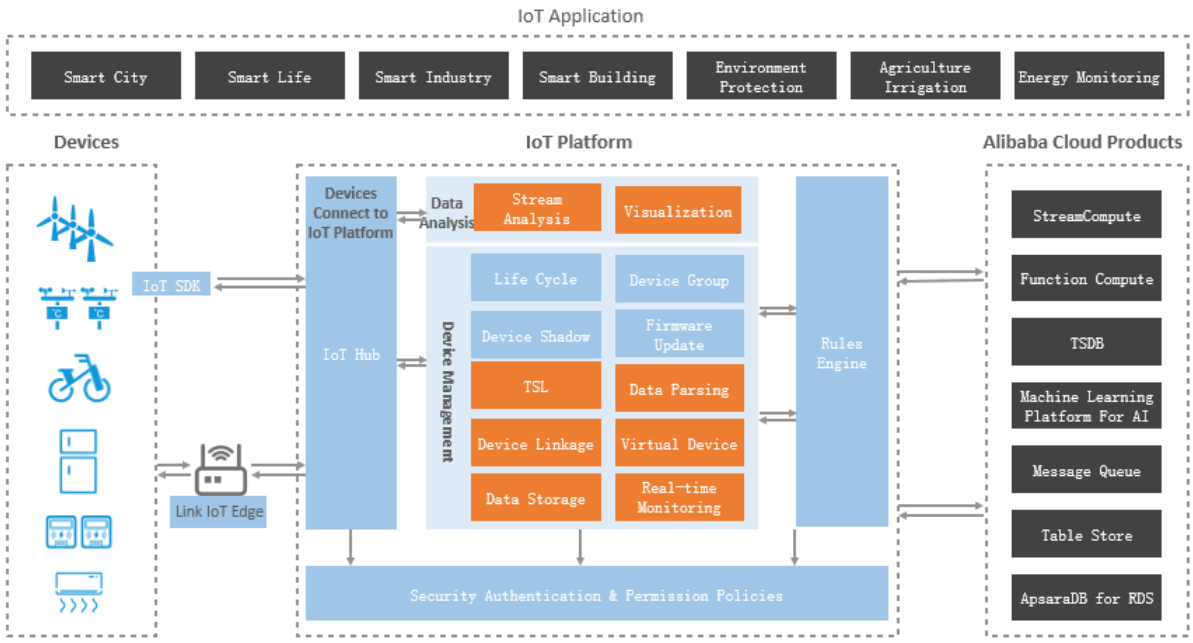
Security authentication and authorization policies

Security is very important to IoT. Alibaba Cloud IoT Platform offers a multi-layered security strategy to ensure that the connection between devices and the cloud is secure.

- Iot Platform issues a unique certificate for each device, and each device will use its unique certificate for authentication while connecting to the IoT Hub.
- IoT Platform provides various device authentication methods for developers to address different security needs and production line requirements.
- Authorization is provided at the device level. A device can only publish or subscribe to topics associated with that particular device. The server handles data through topics under the Alibaba Cloud account using the AccessKey.

3 Specifications

Two editions of IoT Platform are provided, IoT Platform Basic and IoT Platform Pro. The yellow modules in the following figure are features exclusive to the Pro Edition.



IoT Platform Basic

- Description: IoT Platform Basic provides secure and reliable connectivity between several hundred million devices along with basic device management and firmware upgrade capabiliti es. The Basic Edition also supports data streaming using the rule engine. The Basic Edition does not support data parsing or data storage. If you need other Alibaba Cloud services such as storage services and Message Service, you will need to purchase these services separately.
- Scenario: The Basic Edition is suitable for developers who have well-developed hardware and software resources, and want to build business systems by flexibly combining Alibaba Cloud services.

IoT Platform Pro

- Description: In addition to all the features included with IoT Platform Basic, IoT Platform Pro also supports the Alink protocol, device model definition, data parsing, online debugging, and remote management. The Pro Edition also provides comprehensive lifecycle management, data storage, real-time device running status, and historical device data.
- The Pro Edition is ideal for developers who have a short development timeline for smart devices that deliver actionable intelligence. The Pro Edition is also ideal for solving issues

concerning device data formats and storage. It is the best option when establishing vertical business systems, or when a fast approach to digital transformation is required.

The following table compares the features supported the by Basic Edition and the Pro Edition:

Features	IoT Platform Basic	IoT Platform Pro
Device authentication	√	√
Device connection	√	√
Device data uploading	√	√
Remote device control	√	√
Remote device disabling	√	√
Device topological relationship maintenance	√	√
Device shadow	√	-
Device model definition	-	√
Data parsing scripts	-	√
Device data storage	-	√
Query of real-time device status	√	√
Query of historical device data	-	√
Device service call	-	√
Reporting of device events	-	√
Online device debugging	-	√
Device location tracking	-	√
Remote configuration of devices	√	√
Firmware upgrade for devices	√	√
Log analysis	√	√
Rule engine	√	√

4 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 **`DeviceSecret`**. • **`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. • **`DeviceSecret`** 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.
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.

Term	Description
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.
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.

Term	Description
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.

5 Limits

The following table describes the limits of IoT Platform:

Limit	Description
Total products	Each account can create up to 1,000 products.
Total devices	Each product can include up to 500,000 devices.
Gateways and sub-devices	• Each gateway can include up to 1,500 sub-devices. • Each gateway can have up to 1,000 sub-device channels.
Total tags	Each product, device, or device group can have up to 100 tags.
Parsing scripts	The size of the parsing script cannot exceed 48 KB.
Remote configuration	The remote configuration file can only be in JSON format and cannot exceed 64 KB.
Features (only for IoT Platform Pro products)	Each product can have up to 100 features.
	When you define a property, the number of parameters for the struct data cannot exceed 10.
	If the feature data type is: • enum, the number of enumeration items cannot exceed 25. • text, the data cannot exceed 1024 bytes. • array, the number of elements in an array cannot exceed 128.
	Each service can have a maximum of 10 input parameters and 10 output parameters.
	Each event can have a maximum of 10 output parameters.
Topic categories	A product can define a maximum of 50 topic categories.
Broadcast topic	A maximum of 1,000 devices can subscribe to the same broadcast topic. The SDKs in the server can only send one broadcast per second.
Topic length	A topic cannot exceed 128 bytes.
Protocol package size	The CoAP protocol package cannot exceed 1 KB.
	The MQTT protocol package cannot exceed 256 KB.
Communications	A device can only publish and subscribe to its own topic.
Topic subscription	After you subscribe to or unsubscribe from a topic, the change will take effect in 10 seconds. Subscriptions remain in effect until you unsubscribe from the topic. We recommend that you subscribe to topics in advance to avoid missing information.

Limit	Description
	Example: A device sends a SUB request to topic A. After 10 seconds, the subscription takes effect and the device starts to receive messages in real time. The device will continue receiving messages from topic A until you unsubscribe from it.
Rule Engine	Each account can set up to 1,000 rules.
	Each rule can include a maximum of 10 data forwarding actions.
	Data forwarding performance depends on the target instance of the cloud product. If the target instance has enough performance resources, Rule Engine can provide a data forwarding capability of 1,000 QPS for a single account. If the request quantity exceeds this limit, or the target instance cannot write in the data in 1 second, data flow forwarding will be restricted.
	Make sure that the target instance of the cloud product is in use. If the target instance crashes or has overdue payments, invalid parameters (such as invalid values and changed authorizations) or incorrect configurations, data flow forwarding will fail.
Throttling	Data per device: • Upload speed: 30 messages/second in QoS0 level; 10 messages/second in QoS1 level. • Download speed: 50 messages/second. • Each device has a maximum download bandwidth of 512 KB. If the TCP write buffer is blocked, an error is returned. For example, if you use the Pub operation to send requests to a device, but the device cannot handle the amount of requests, you will receive an error due to throttling.  **Note:** If you use the MQTT protocol to connect to your devices and IoT Platform, you cannot receive error messages resulting from throttling. However, you can view logs to detect which devices are being throttled. Cloud-side API limits: • For a single IP address, the limit for API calling is 100 QPS. • For a single Alibaba Cloud account, there are different calling limits for different APIs. For RRPC, the limit is 500 QPS; for Pub, the limit is 1,500 QPS; and for other APIs, if not specified, the default limit is 50 QPS.  **Note:** • If any of the limits mentioned in this document affect your business requirements, please submit a ticket and describe your business requirements for IoT Platform.

Limit	Description
	• If you are calling an API and you receive an error (such as 29-31 in *Common errors*), wait and then try the call again.