Intelligent EdgeFabric

Service Overview

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Contents

1 What Is Intelligent EdgeFabric?

Why Intelligent EdgeFabric?

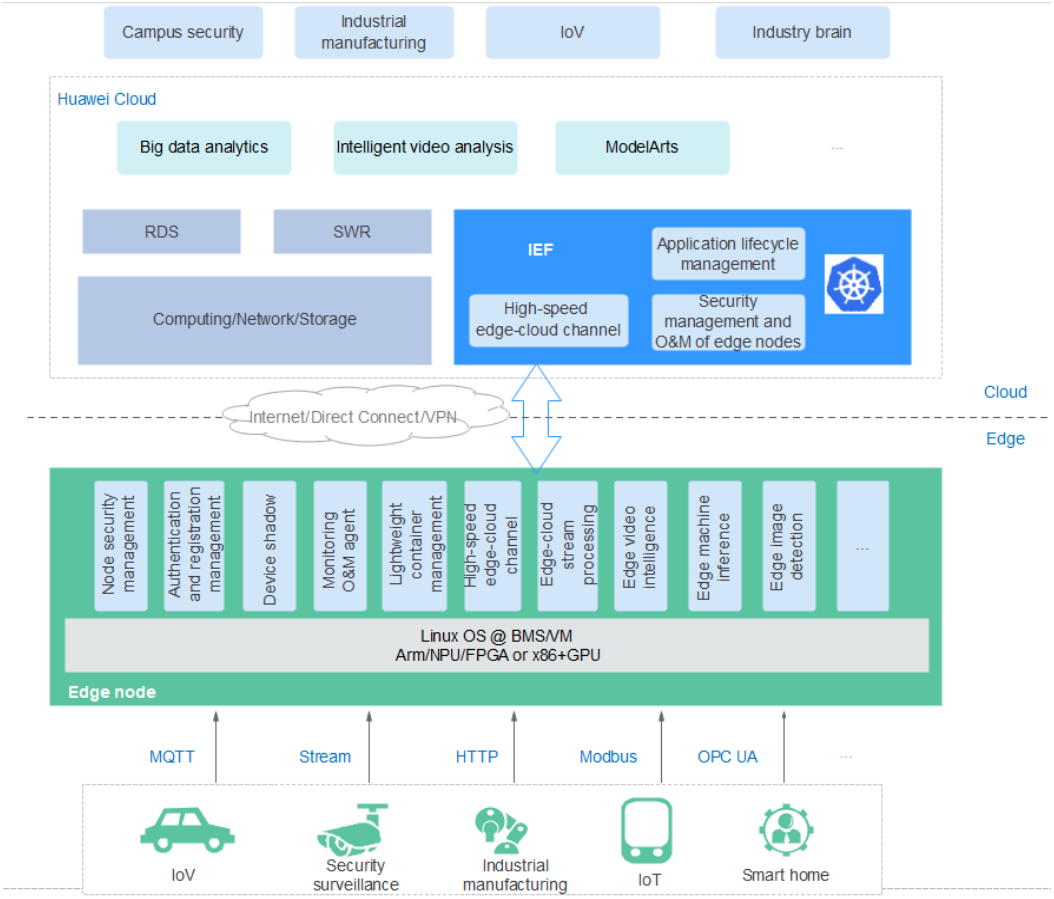
Cloud computing capabilities are centralized, which are far from devices such as cameras and sensors. It will cause long network latency, network congestion, and service quality deterioration in scenarios where high real-time computing performance is required. Furthermore, the computing capabilities of devices are insufficient and far behind those in the cloud. This is where edge computing comes in. By deploying edge nodes near devices, the computing capabilities in the cloud are extended to the edge nodes.

Intelligent EdgeFabric (IEF) provides you a complete edge computing solution, in which cloud applications are extended to the edge. By leveraging edge-cloud synergy, you can manage edge nodes and applications remotely and process data nearby, to meet your requirements for remote control, data processing, analysis, decision-making, and intelligence of edge computing resources. In addition, you can perform O&M in the cloud, including edge node monitoring, application monitoring, and log collection.

System Architecture

As shown in **Figure 1-1**, IEF extends cloud capabilities such as AI applications to edge nodes, which are close to end devices. In this way, the edge nodes have the same capabilities as the cloud and can process device computing requirements in real time.

Figure 1-1 Edge cloud computing



Accessing IEF

IEF provides a web-based service management platform. You can access IEF through HTTPS-compliant application programming interfaces (APIs) or the management console.

- Using APIs

  Use this method if you are required to integrate IEF into a third-party system for secondary development. For detailed operations, see *Intelligent EdgeFabric API Reference*.

- Using the management console

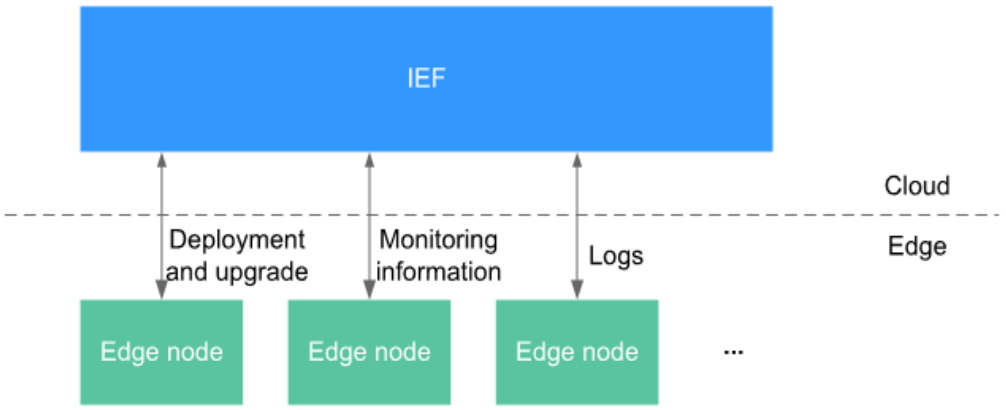
  Log in to the management console and choose **Intelligent EdgeFabric** on the homepage.

2 Functions

Edge Node Management

IEF can connect to a large number of edge nodes, automatically generate configuration information about edge nodes, and efficiently and conveniently manage edge nodes where Edge Agent is installed. In this way, all edge nodes can be managed, monitored, and maintained in the cloud.

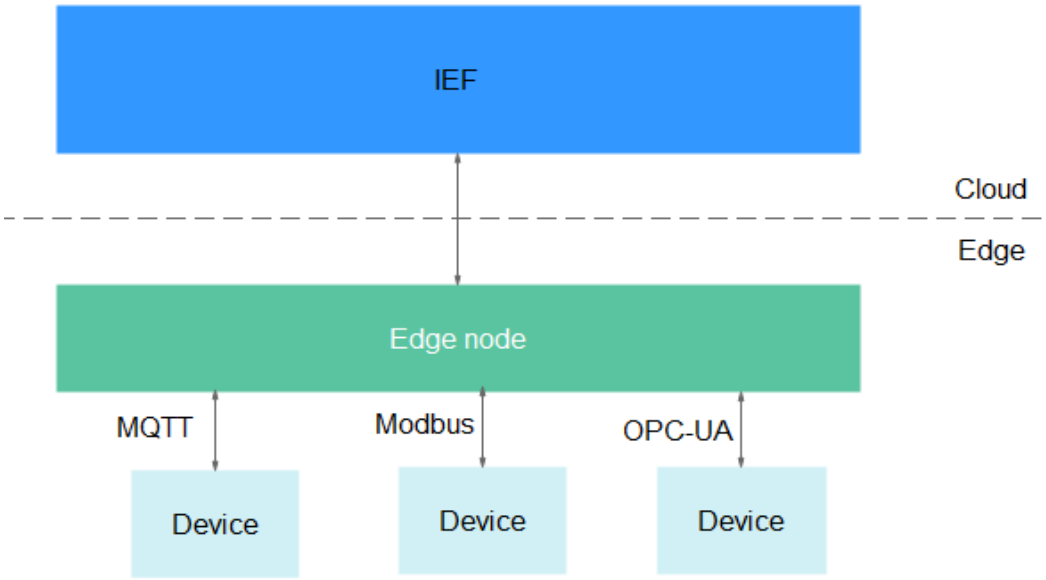
Figure 2-1 Edge node management



End Device Management

End devices can be connected to IEF through edge nodes by using the MQTT, Modbus, or OPC UA protocol. After end devices are connected to IEF, you can manage them on IEF in a unified manner.

Figure 2-2 End device management



Edge Application Management

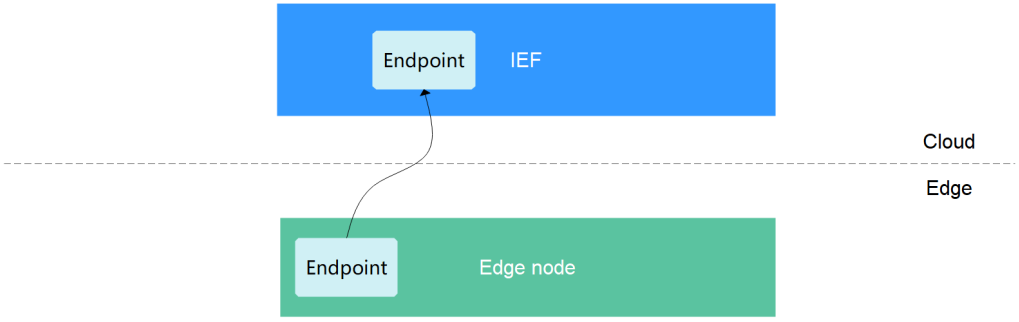
IEF allows you to deploy edge applications on edge nodes as containers. You can package your edge application into a container image, upload the image to SoftWare Repository for Container (SWR), and use IEF to deploy the image on edge nodes. IEF also supports version upgrade, configuration change, uninstallation, monitoring, and log collection for applications.

The prosperous container ecosystem can help you seamlessly switch your containerized applications to other runtime environments and enhance their portability. In addition, containers can isolate resources better and support CPU/GPU scheduling.

Message Route Management

IEF provides the message routing function. Based on configured routes, IEF forwards edge messages to the corresponding message endpoint (sender or recipient). In this way, messages can be forwarded based on specified paths, enhancing flexibility in data routing control and improving data security.

Figure 2-3 Message forwarding paths



Batch Job Management

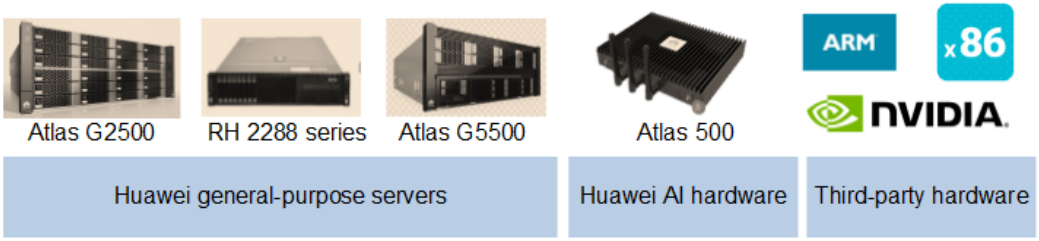
IEF provides the batch job management function, allowing you to register edge nodes, upgrade edge node versions, deploy applications, and upgrade applications (change container images and access configurations) in batches. For details, see **User Guide > Batch Management**.

3 Advantages

High-Performance Intelligent Edge Hardware

IEF provides a software and hardware integrated solution, which offers users with low-cost, out-of-the-box, and centralized on-cloud O&M services. It uses Huawei general-purpose servers and AI hardware and is deeply integrated with Huawei Ascend chips to provide high-performance, low-cost edge AI inference computing power. IEF also supports TaiShan servers that use Huawei Kunpeng processors.

Figure 3-1 Edge hardware



Security and Reliability

- IAM authentication

  Agencies can be created in Identity and Access Management (IAM) to allow edge nodes to access resources such as Application Operations Management (AOM), Data Ingestion Service (DIS), and SoftWare Repository for Container (SWR).

- Edge node security

  Edge Agent creates dedicated service users whose accessible directories and permissions are limited. Users can upload logs and monitoring information to the cloud based on their requirements.

- Edge-cloud synergy communication security

  Edge Agent initiates a request to IEF for establishing a bidirectional encrypted channel. Messages exchanged between devices and IEF are authenticated and encrypted by certificates.

- Cloud security

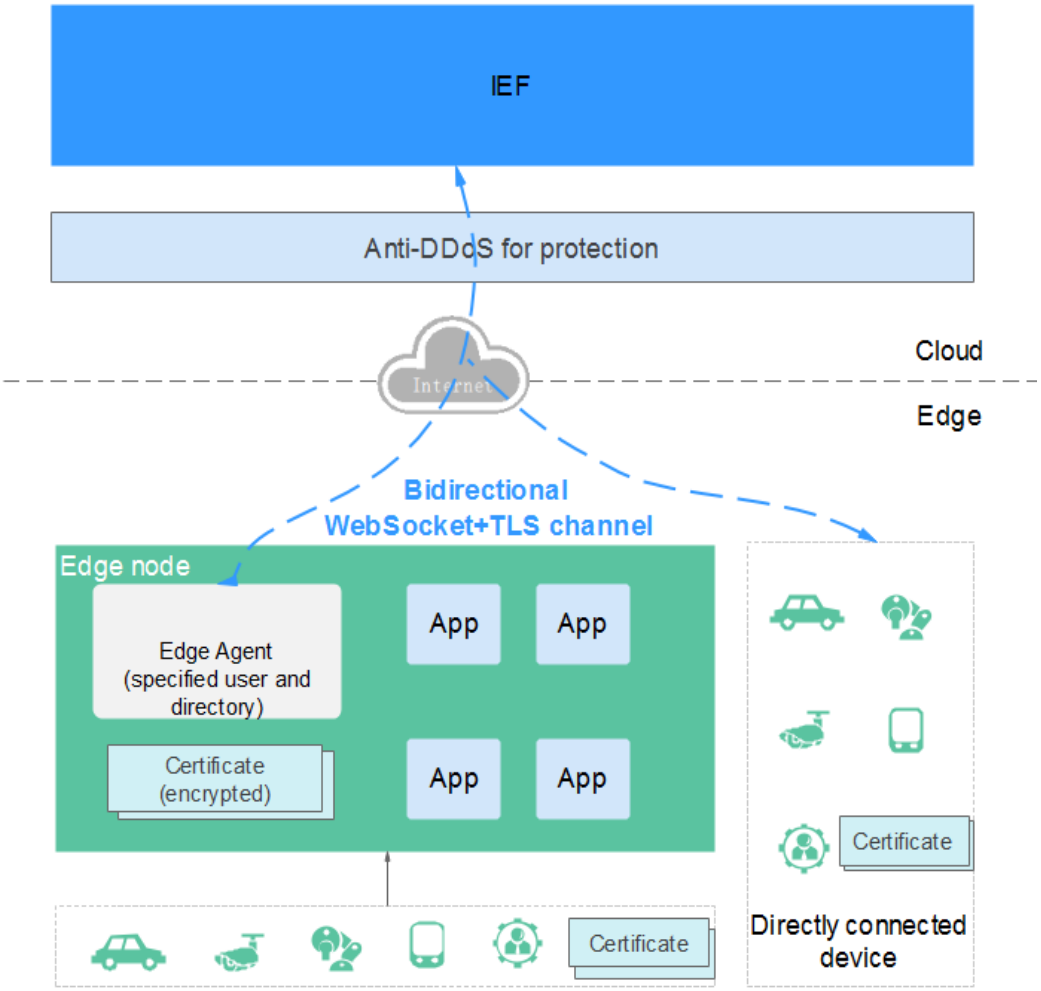
  The frontend anti-DDoS protects the cloud against malicious attacks.

A unique access certificate is issued for each edge node. Bidirectional communication is authenticated and encrypted by certificates.

- Device security

  End devices use certificates for identity authentication.

Figure 3-2 IEF security solution



Open Compatibility

IEF is based on the open-source software **KubeEdge**. Based on Kubernetes, KubeEdge provides fundamental infrastructure support for network, application deployment, and metadata synchronization between the cloud and edge.

By using KubeEdge, developers can customize and tailor the edge node runtime (Edge Agent, an edge node manager) to reduce the difficulty in using edge nodes.

Cost-effective

- The combination of cloud and edge computing implements data filtering and analysis on edge nodes, which greatly improves efficiency and reduces cloud computing costs.

- During cloud transmission, simple data processing is performed by edge nodes, so that the response time of end devices is shortened, data traffic from end devices to the cloud is decreased, and bandwidth costs are reduced.

4 Service Instance Editions

IEF offers two service instance editions for you to choose.

- Professional edition: The management plane cluster is shared by multiple users. Professional service instances allow you to manage nodes, devices, containerized applications, batch jobs, and edge-cloud messages.
- Platinum edition: Users have their own management plane clusters. Platinum service instances allow you to manage large-scale nodes and deliver higher performance. In addition to the functions provided by professional service instances, functions such as node group and application mesh are supported by platinum service instances.

Table 4-1 lists the differences between the two editions.

Table 4-1 Functions provided by the two editions

Function	Description	Professional Edition	Platinum Edition
Edge node management	Registers and manages edge nodes.	√	√
End device management	Registers end devices and binds an end device to an edge node.	√	√
Containerized application management	Delivers containerized applications to an edge node.	√	√
Edge-cloud message routing	Provides an edge-cloud message channel and supports edge-cloud message forwarding.	√	√

Function	Description	Professional Edition	Platinum Edition
Multi-network access	Supports access to IEF through Internet, VPN, and Direct Connect.	√	√
Monitoring and O&M	Supports monitoring and O&M.	√	√
Batch job management	Creates and updates containerized applications in batches, and registers and updates edge nodes in batches.	√	√
Edge node group	Creates edge node groups. Multiple edge nodes with the same attributes (such as the hardware architecture) can form an edge node group for unified management.	×	√
Multi-instance	Supports multiple containerized application instances.	×	√
Exclusive clusters	Supports exclusive management plane clusters.	×	√
Application mesh	Supports service discovery and application traffic governance, such as load balancing.	×	√
Add-ons	Supports add-on management.	√	√
Kubernetes native API openness	Supports operating Kubernetes clusters of a service instance through kubectl.	×	√

5 Application Scenarios

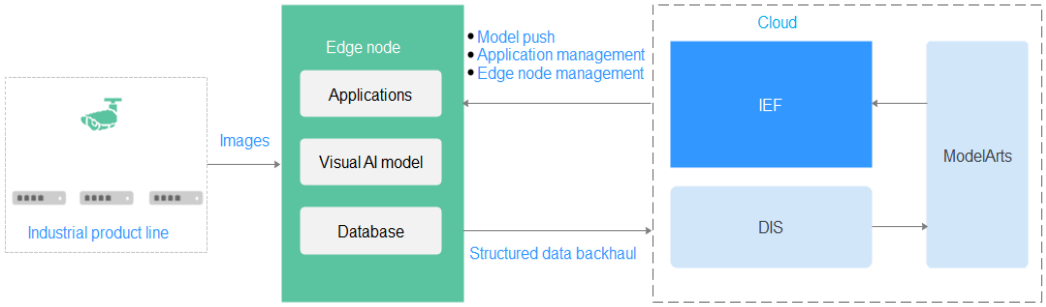
Visual Product Inspections

Traditional approaches in industrial manufacturing relied on naked eyes to detect product defects. This method was inefficient and often failed to detect flaws and even ejected products without defects from the pool of qualified products, causing losses in revenue and brand image. IEF combines cloud modeling and edge decision-making to achieve automatic visual inspection, moving away from traditional manual visual inspections.

Advantages

- **High efficiency**: Edge-side deployment of visual models trained in the cloud enables real-time product prediction, improving detection efficiency and product quality.
- **Excellent models**: Model training in the cloud, data processing at the edge, and incremental model training optimization achieve excellent models.
- **Unified control**: IEF delivers models and monitors node status in a unified manner.

Figure 5-1 Visual product inspections



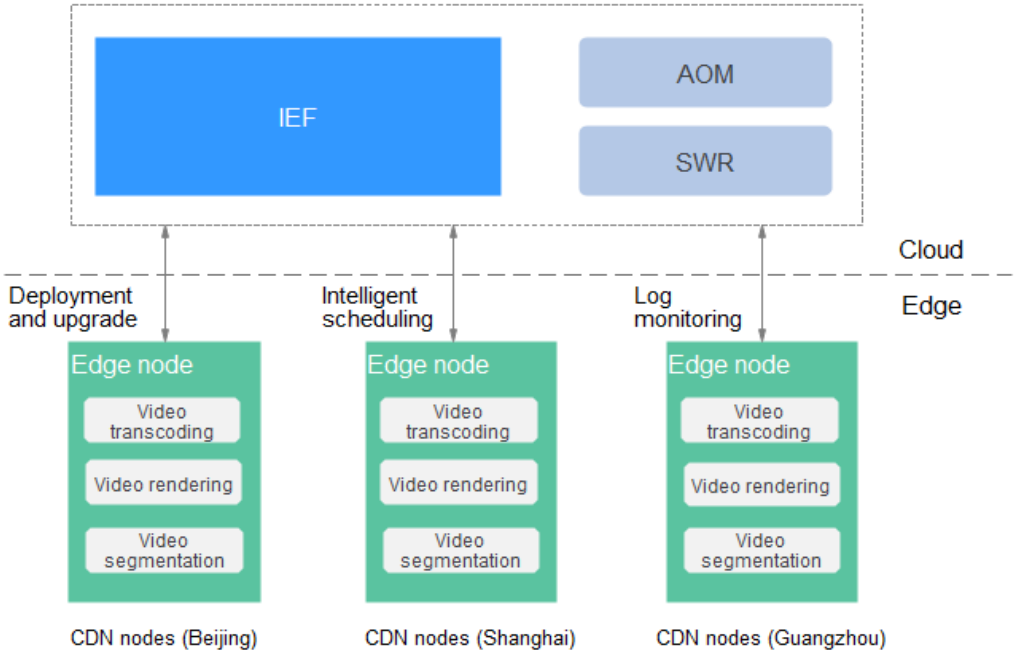
CDN Node Management

Unified management of CDN nodes deployed across the country helps users implement automatic application scheduling, auto scaling, and O&M of edge nodes and applications.

Advantages

- **Auto scaling**: IEF automatically adapts the amount of computing resources to fluctuating service load according to custom auto-scaling policies. To scale computing resources at the cluster level, IEF adds or reduces cloud servers. To scale computing resources at the workload level, IEF adds or reduces containers.
- **Intelligent scheduling**: Inter-node and inter-application affinity scheduling is supported.
- **Dimensional O&M**: Service status and edge node status are monitored in real time to ensure stable running of applications.
- **Local autonomy**: Services can run properly even when edge nodes are disconnected from cloud center networks.

Figure 5-2 CDN node management

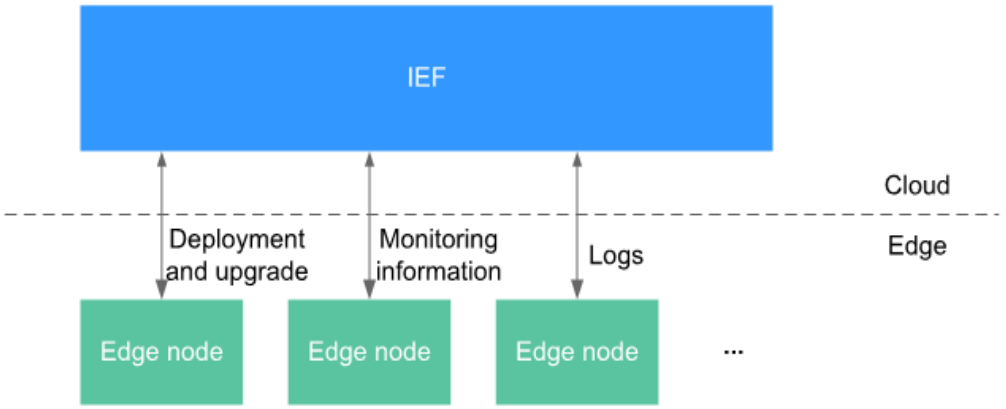


6 Basic Concepts

Edge Node

An edge computing device used to run edge applications, process data, and collaborate with cloud applications securely and conveniently.

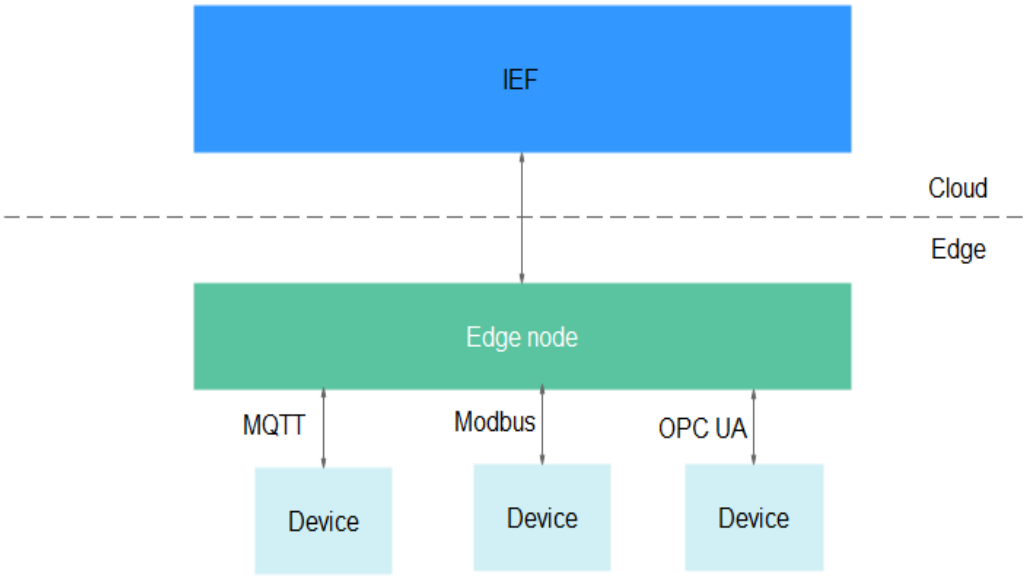
Figure 6-1 Edge node



End Device

End devices can be as small as a sensor or controller or as large as a smart camera or computer numerical control (CNC) machine tool. They can connect to IEF through edge nodes by using the MQTT, Modbus, or OPC UA protocol.

Figure 6-2 End device



Containerized Application

A functional module that runs on edge nodes. Deploying the required applications builds your own edge computing capabilities.

In the professional edition, a containerized application can have only one instance. In the platinum edition, a containerized application can have multiple instances.

Message Endpoint

Node that sends or receives data. For example, if data is sent from an end device to a cloud service, the end device is the source endpoint and the cloud service is the destination endpoint.

Message Route

A route defines source and destination endpoints and resources. The system forwards messages from the specified source endpoint resource to the specified destination endpoint resource based on the route.

Certificate

A certificate is a credential for an edge application or end device to access the MQTT broker of an edge node.

7 Related Services

Figure 7-1 shows the relationships between IEF and other services.

Figure 7-1 Relationships between IEF and other services

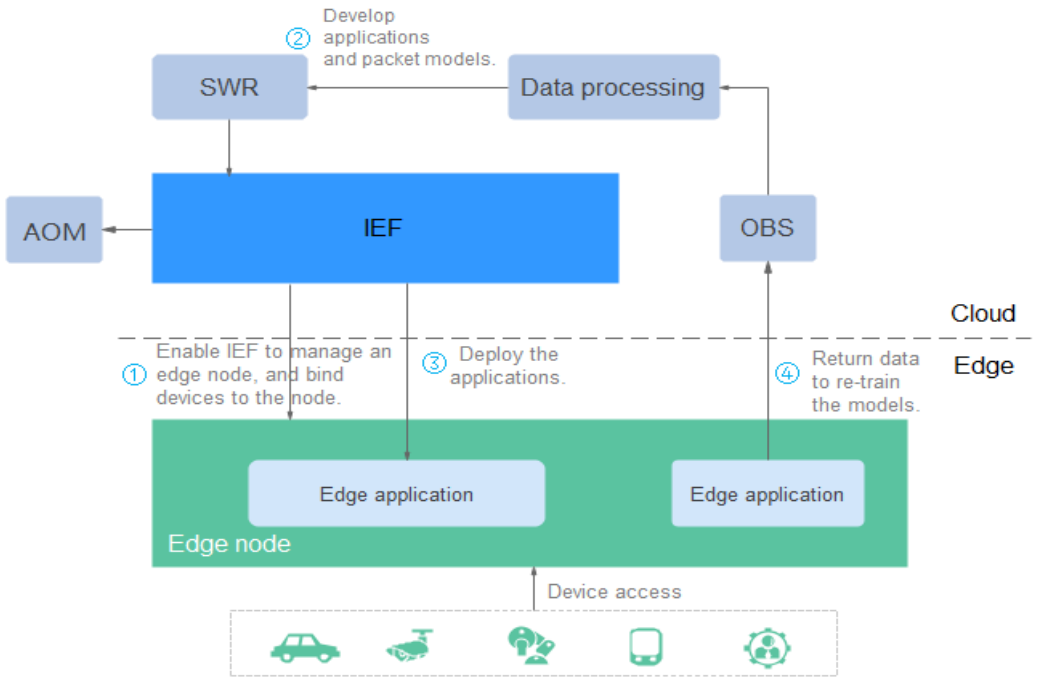


Table 7-1 Relationships between IEF and other services

Service	Description
SWR	Edge nodes pull container images from SWR.
OBS	You can upload the data generated by edge nodes to OBS for further processing on the cloud.
AOM	Logs, monitoring and alarms about edge nodes are reported to AOM.

8 Constraints

Edge Node Specification Requirements

An edge node can be a physical device or a virtual machine (VM). It must meet the specifications described in **Table 8-1**.

Table 8-1 Edge node requirements

Item	Specifications
OS	The language of the operating system must be **English**. • x86_64 architecture Ubuntu LTS (Xenial Xerus), Ubuntu LTS (Bionic Beaver), CentOS, EulerOS, RHEL, Kylin, NewStart CGS Linux, NeoKylin, openEuler, Unity Operating System (UOS), Oracle Linux (OL), Huawei Cloud Euler (HCE), openEuler 23.09 Edge • Armv7i (Arm32) architecture Raspbian GNU/Linux (stretch) • AArch64 (Arm64) architecture Ubuntu LTS (Xenial Xerus), Ubuntu LTS (Bionic Beaver), CentOS, EulerOS, RHEL, Kylin, NewStart CGS Linux, NeoKylin, openEuler, Unity Operating System (UOS), Oracle Linux (OL), Huawei Cloud Euler (HCE), openEuler 23.09 Edge **NOTE** The openEuler 23.09 Edge operating system is recommended for edge computing scenarios.
Memory	More than 256 MB of memory is recommended as 128 MB of memory is required to run the edge software.
CPU	≥ 1 core
Hard disk	≥ 1 GB

Item	Specifications
GPU (optional)	The GPU models on the same edge node must be the same. **NOTE** Currently, NVIDIA Tesla GPUs such as P4, P40, and T4 are supported. If an edge node is equipped with GPUs, you can choose not to enable its GPUs when registering it on IEF. If you choose to enable GPUs of an edge node, the GPU driver has to be installed on the edge node before you can manage it on IEF. Currently, only x86-based GPU nodes can be managed by IEF.
NPU (optional)	Ascend AI processors **NOTE** Currently, edge nodes integrated with Ascend Processors are supported, such as Atlas 300 inference cards, and Atlas 800 inference servers. Supported NPU specifications include Ascend 310P, 310B, Ascend 310P-share, and virtualization partition NPUs.. If you choose to enable NPUs of an edge node, ensure that the NPU driver has been installed on it. Currently, Ascend 310 supports only firmware versions 1.3.*x.x* and 1.32.*x.x*, for example, 1.3.2.B893. You can run the **npu-smi info** command to view your firmware version.The NPU driver version must be 22.0.4 or later. You can go to the driver path, for example, **/usr/local/Ascend/driver**, and run the **cat version.info** command to view your driver version. If the driver is not installed, contact the device manufacturer for assistance.
Container engine	The Docker version must be later than 17.06. If Docker 1.23 or later is used, set the docker cgroupfs version to 1. Docker HTTP API v2 is not supported. (However, Docker 18.09.0 is not recommended as it has a serious bug. For details, see **https://github.com/docker/for-linux/issues/543**. If this version has been installed, upgrade it at the earliest possible opportunity.) **NOTICE** After Docker is installed, configure the Docker process to start at host startup. This configuration prevents system exceptions caused by Docker startup failures after the host is restarted. Docker **Cgroup Driver** must be set to **cgroupfs**. For details, see **How Do I Set Docker Cgroup Driver After Installing Docker on an Edge Node?**.
Glibc	The Glibc version must be later than 2.17.
Port	Edge nodes require port 8883, which is the listening port of the built-in MQTT broker on edge nodes. Ensure that this port works properly.

Item	Specifications
Time synchronization	The time on an edge node must be consistent with the UTC time. Otherwise, the monitoring data and logs of the edge node may be inaccurate. You can select an NTP server for time synchronization. For details, see **How Do I Synchronize Time with the NTP Server?**

MQTT Usage Constraints

Table 8-2 MQTT usage constraints

Description	Constraint
Supported MQTT version	3.1.1
Differences from the standard MQTT protocol	• Quality of Service (QoS) 0 is supported. • Topic customization is supported. • QoS 1 and QoS 2 are not supported. • **will** and **retain msg** are not supported.
MQTTS security levels	TCP channel basic + TLS protocol (TLS v1.2)

9 Permissions Management

If you need to assign different permissions to employees in your enterprise to access your IEF resources, Identity and Access Management (IAM) is a good choice for fine-grained permissions management. IAM provides identity authentication, permissions management, and access control, helping you secure access to your Huawei Cloud resources.

With IAM, you can use your account to create IAM users for your employees, and assign permissions to the users to control their access to specific resource types. For example, some software developers in your enterprise need to use IEF resources but must not delete them or perform any high-risk operations. To achieve this result, you can create IAM users for the software developers and grant them only the permissions required for using IEF resources.

If your Huawei Cloud account does not require individual IAM users for permissions management, skip this section.

IAM is a free service. You only pay for the resources in your account. For more information about IAM, see the **IAM Service Overview**.

IEF Permissions

New IAM users do not have any permissions assigned by default. You need to first add them to one or more groups and then attach policies or roles to these groups. The users then inherit permissions from the groups and can perform specified operations on cloud services based on the permissions they have been assigned.

IEF is a project-level service deployed for specific regions. To assign IEF permissions to a user group, specify the scope as region-specific projects and select projects for the permissions to take effect. If **All projects** is selected, the permissions will take effect for the user group in all region-specific projects. When accessing IEF, the users need to switch to the authorized region.

You can grant permissions by using roles and policies.

- Roles: A coarse-grained authorization strategy that defines permissions by job responsibility. Users with the **Tenant Administrator** role can perform operations on all IEF resources.
- Policies: A fine-grained authorization strategy that defines permissions required to perform operations on specific cloud resources under certain

conditions. This type of authorization is more flexible and is ideal for least privilege access. Most policies define permissions based on APIs.

Table 9-1 lists all the system-defined permissions for IEF.

Table 9-1 IEF system permissions

System Role/ Policy Name	Description	Type	Dependencies
IEF FullAccess	Administrator permissions for IEF. Users with these permissions can perform all operations on basic IEF resources. Note: To perform operations on all IEF resources, configure the **Tenant Administrator** role.	System-defined policy	None
IEF ReadOnlyAccess	Read-only permissions for IEF. Users with these permissions can only view IEF resources.	System-defined policy	None

Table 9-2 lists the common operations supported by system-defined permissions for IEF.

Table 9-2 Common operations supported by system-defined permissions

Operation	IEF FullAccess	IEF ReadOnlyAccess	Tenant Administrator
Creating, deleting, or modifying an instance	√	x	√
Querying an instance	√	√	√
Switching an instance	√	√	√
Creating, deleting, or modifying an edge node	√	x	√
Viewing an edge node	√	√	√

Operation	IEF FullAccess	IEF ReadOnlyAccess	Tenant Administrator
Creating, deleting, or modifying an edge node group	√	x	√
Viewing an edge node group	√	√	√
Creating, deleting, or modifying an edge containerized application	√	x	√
Viewing an edge containerized application	√	√	√
Creating, deleting, or modifying a device	√	x	√
Viewing a device	√	√	√
Creating, deleting, or modifying an application deployment	√	x	√
Viewing an application deployment	√	√	√
Creating, deleting, or modifying an application template	√	x	√
Viewing an application template	√	√	√

Operation	IEF FullAccess	IEF ReadOnlyAccess	Tenant Administrator
Creating, deleting, or modifying a node registration job	√	x	√
Viewing a node registration job	√	√	√
Creating, deleting, or modifying a message endpoint	√	x	√
Viewing a message endpoint	√	√	√
Creating, deleting, or modifying a message route	√	x	√
Viewing a message route	√	√	√
Creating, deleting, or modifying a batch job	√	x	√
Viewing a batch job	√	√	√
Creating, deleting, or modifying a ConfigMap	√	x	√
Viewing a ConfigMap	√	√	√
Creating, deleting, or modifying a key	√	x	√
Viewing a key	√	√	√

Operation	IEF FullAccess	IEF ReadOnlyAccess	Tenant Administrator
Creating, deleting, or modifying encrypted data	√	x	√
View encrypted data	√	√	√
Creating, deleting, or modifying a system subscription	√	x	√
Viewing a system subscription	√	√	√
Creating, deleting, or modifying a plug-in	√	x	√
Viewing a plug-in	√	√	√

Helpful Links

- **IAM Service Overview**
- Create a user group and users. Grant IEF permissions to them. For details, see **Creating a User and Granting Permissions**.
- **Permissions Policies and Supported Actions**

10 Quotas

IEF restricts the maximum amount of resources that a user can use. For details about quotas, see **Table 10-1** and **Table 10-2**.

Table 10-1 Resource quotas for the professional edition

Resource Object	Default Quota
Node	10
End device	500
End device template	10
Containerized application	500
Application template	10
Application template version	10
Tag	A maximum of 20 tags for each resource
ConfigMap	50
Secret	50
Encryption data	50
Message endpoint	20
Message route	100
Node registration job	50
Node certificate	5000

Resource Object	Default Quota
Batch job	20

Table 10-2 Quotas for the platinum edition

Resource Object	Default Quota
Service instance	5
Node	50, 200, or 1,000, which can be selected when you create a platinum service instance
End device	Number of nodes x 50
End device template	Same as the number of nodes
Containerized application	Number of nodes x 50
Application template	Same as the number of nodes
Application template version	10
Tag	A maximum of 20 tags for each resource
ConfigMap	Number of nodes x 5
Secret	Number of nodes x 5
Encryption data	50
Message endpoint	20
Message route	100
Node registration job	50
Node certificate	Number of nodes x 500
Node group	100
Node group certificate	Number of nodes x 50
Service	500
Gateway	500
Virtual service	500
Batch job	20

