

Graph Engine Service

Service Overview

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1 What Is GES?

Graph Engine Service (GES) uses the Huawei-developed EYWA kernel to facilitate query and analysis of multi-relational graph data structures. It is specifically suited for scenarios requiring analysis of rich relationship data, including social relationship analysis, marketing and recommendations, public opinions and social listening, information communication, and anti-fraud.

Functions

GES has the following functions:

- Extensive Algorithms
Algorithms such as PageRank, K-core, Shortest Path, Label Propagation, Triangle Count, and Link Prediction are all supported.
- Visualized Graph Analysis
A wizard-based exploration environment is included, along with visualized query results.
- Query/Analysis APIs
GES provides APIs for graph query, metrics statistics, Gremlin query, Cypher query, graph algorithms, and graph and backup management.
- Good Compatibility
Compatible with open source Apache TinkerPop Gremlin 3.4
- Graph Management
GES provides graph overview, graph management, graph backup, and metadata management functions.

Accessing GES

A web-based management console on HUAWEI CLOUD and HTTPS-based Application Programming Interfaces (APIs) are available for accessing GES.

- Using APIs
If you need to integrate GES on the cloud platform into a third-party system for secondary development, use APIs to access the service.
- Using the management console

To perform other operations, access the GES using the management console. If you have registered with HUAWEI CLOUD, you can log in to the management console directly. If you have not registered with HUAWEI CLOUD, refer to "Registering with HUAWEI CLOUD" and log in to the console. In the service list, choose **EI Enterprise Intelligence > Graph Engine Service** on the home page.

2 Product Advantages

Large Scale

Efficient data organization facilitates analysis and querying of graphs with tens of billions of vertices and hundreds of billions of edges.

High Performance

Optimized distributed graph processing engine supports high-concurrency, multi-hop, real-time queries in seconds.

Integrated Querying and Analysis

Integrated querying and analysis and graph analytics algorithms facilitate analysis for scenarios such as relationship analysis, route planning, and marketing recommendation.

Ease of Use

Wizard-based GUI and compatibility with Gremlin and Cypher facilitate easy graph analysis.

3 Applicable Scenarios

GES is perfect but not limited to scenarios such as Internet, knowledge graph, financial risk control, urban industry, and enterprise IT applications.

Internet

GES quickly and effectively mines valuable information from large and complex social networks in the mobile Internet era.

In this scenario, GES will help you implement the following functions:

- **Friend, Product, and Information Recommendation**
GES provides personalized and precise recommendations based on friend relationships, user profiles, behavior similarities, product similarities, and propagation paths.
- **User Grouping**
GES groups users based on their profiles, behavior similarities, or relationships to facilitate precise user group management.
- **Abnormal Behavior Analysis**
User behavior, partner relationships, and account/IP login information can all be analyzed to identify abnormal behaviors and reduce fraud.
- **Public Opinion and Social Listening**
GES identifies opinion leaders and hot topics by analyzing propagation paths and relationships, enhancing the quality of public opinion analysis.

Knowledge Graph

GES-based knowledge graphs integrate various kinds of heterogeneous data, enabling larger graph scales and higher performance.

In this scenario, GES will help you implement the following functions:

- **Massive Storage**
Heterogeneous data points can be integrated and stored as hundreds of billions of vertices and edges in graphs.
- **Quick Correlation Query**

You can perform correlation queries of a massive knowledge base and returns accurate results within seconds.

- Knowledge Classification
Similar knowledge points are combined based on graph-based analysis and computing to implement knowledge disambiguation.
- Learning Path Identification and Recommendation
Learning paths can be identified and recommended based on learning relationships between data points.

Financial Risk Control

GES can be used to detect fraudulent user behaviors, minimizing potential financial risks.

In this scenario, GES will help you implement the following functions:

- Real-Time Fraud Detection
Users who share the same personal information such as email addresses or IP addresses, can be identified and cases of known or potential fraud identified.
- Group Detection
Users are grouped and abnormal groups identified based on interpersonal relationship analysis.
- Missing Persons Discovery
Missing persons can be discovered based on various relationships.

Urban Industry

You can better manage the pressure on and balance the loads of urban roads or pipelines (such as water, gas, power, and oil pipelines) to control traffic networks and pipelines with more precision.

In this scenario, GES will help you implement the following functions:

- Pipeline Pressure Adjustment
The throughput of and pressure on the entire pipeline networks can be analyzed based on real-time monitoring data.
- Urban Road Network Control
You can analyze traffic congestion patterns, including traffic, road network, and intersection monitoring data for the entire urban road network, to improve traffic flow throughout the city.
- Path Design
You can design public transportation routes throughout the city based on real-time monitoring of people and vehicle requests. This data backed route design increases seat occupancy rates and reduces operating costs.

Enterprise IT

Large scale networks and IT infrastructure can be complicated and hard to manage. Intelligent device monitoring and management give you a clearer understanding of your entire network and IT infrastructure.

In this scenario, GES will help you implement the following functions:

- Network Planning
Identifying faulty nodes and recommending backup routers for heavy load makes network planning easier.
- Fault Cause Analysis
Root causes of any network or infrastructure fault can be located quicker.
- IT Infrastructure Management
Visualized relationships between network devices, including device and resource statuses, make for more efficient O&M.

4 Basic Concepts

Vertex

Vertices represent entities in data models, such as vehicles in traffic networks, stations in communication networks, users and commodities in e-commerce transaction networks, and web pages on the Internet.

Edge

Edges represent relationships in data models, such as friend relationships in social networks, user ratings and purchase behavior in e-commerce transaction networks, cooperative relationships between authors of papers, and index relationships between articles.

Gremlin

Gremlin is a graph traversal language in the open source graph calculation framework of Apache TinkerPop. You can use Gremlin to create, read, update, and delete (CRUD) data. For example, you can use Gremlin to load data, manage graphs, and compile complex traversing algorithms.

Cypher

Cypher is a widely used declarative query language for graph databases. Cypher uses graph statistics and label-based vertex and edge indexes during query statement compilation. You can use Cypher statements to query and modify data in GES, and obtain the result.

5 Constraints and Limitations

Browser Versions

You are advised to use the following browsers:

- Google Chrome: 43.0 and later
- Mozilla Firefox: 43.0 and later
- Microsoft Edge: 99.0.1150.39 or later

6 Permissions Management

If you need to assign different permissions to employees in your enterprise to access your GES 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 HUAWEI CLOUD 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 GES 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 GES resources.

If your HUAWEI CLOUD account does not need individual IAM users for permissions management, you may skip over this chapter.

IAM can be used free of charge. You pay only for the resources in your account. For more information about IAM, see *IAM Service Overview*.

GES Permissions

By default, new IAM users do not have permissions assigned. You need to add the users to one or more groups, and attach permissions policies or roles to these groups. The users then inherit permissions from the groups to which they are added. After authorization, the users can perform specified operations on GES based on the permissions.

GES is a project-level service deployed and accessed in specific physical regions. To assign GES 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 GES, the users need to switch to a region where they have been authorized to use GES.

- Type: There are roles and policies.
 - Roles: A type of coarse-grained authorization mechanism that defines permissions related to user responsibilities. This mechanism provides only a limited number of service-level roles for authorization. When using roles to grant permissions, you need to also assign other roles on which

the permissions depend to take effect. However, roles are not an ideal choice for fine-grained authorization and secure access control.

- Policies: A type of fine-grained authorization mechanism that defines permissions required to perform operations on specific cloud resources under certain conditions. This mechanism allows for more flexible policy-based authorization, meeting requirements for secure access control. For example, you can grant GES users only the permissions for managing a certain type of cloud servers. For the API actions supported by GES, see .
- Dependencies: HUAWEI CLOUD services interact with each other. Therefore, if a GES policy depends on the policies of other services, the permissions of GES take effect only after the dependent policies are granted to users. For details, see [Table 6-1](#) and [Table 6-2](#).

 **NOTE**

Because of the cache, it takes about 13 minutes for an OBS role to take effect after being granted to users and user groups. After a policy is granted, it takes about 5 minutes to take effect.

Table 6-1 GES roles

Role Name	Description
Tenant Guest	Common tenant users <ul style="list-style-type: none"> • Permissions: querying GES resources • Scope: project-level service
GES Administrator	GES administrator <ul style="list-style-type: none"> • Permissions: performing any operations on GES resources • Scope: project-level service <p>NOTE</p> <p>If you have the GES Administrator, Tenant Guest, and Server Administrator permissions, you can perform any operations on GES resources. If you do not have the Tenant Guest or Server Administrator permissions, you cannot use GES properly.</p> <ul style="list-style-type: none"> • To bind or unbind an EIP, you must have the Security Administrator permissions to create agencies. • To interact with OBS, such as creating a graph and importing data, you must have the Tenant Administrator permissions of OBS. For details, see Table 6-5.

Role Name	Description
GES Manager	<p>GES manager</p> <ul style="list-style-type: none"> Permissions: performing any operations on GES resources other than creating and deleting graphs. Scope: project-level service <p>NOTE If you have both the GES Manager and Tenant Guest permissions, you can perform any operations on GES resources except for creating and deleting graphs. If you do not have the Tenant Guest permissions, you cannot use GES properly.</p> <ul style="list-style-type: none"> To bind or unbind an EIP, you must have the Security Administrator and Server Administrator permissions. To interact with OBS, such as importing data, you must have the OBS permissions. For details, see Table 6-5.
GES Operator	<p>GES common users</p> <ul style="list-style-type: none"> Permissions: viewing and accessing GES resources Scope: project-level service <p>NOTE If you have both the GES Operator and Tenant Guest permissions, you can view and access GES resources. If you do not have the Tenant Guest permissions, you cannot view resources or access graphs.</p> <p>To interact with OBS, such as viewing the metadata, you must have the OBS permissions. For details, see Table 6-5.</p>

Table 6-2 GES policies

Policy Name	Description
GES FullAccess	<p>Administrator permissions for GES. Users granted these permissions can perform all operations on GES, including creating, deleting, accessing, and updating graphs.</p> <p>NOTE</p> <ul style="list-style-type: none"> To bind or unbind an EIP, the users must have the Security Administrator permissions to create agencies. To interact with OBS, such as creating a graph and importing data, the users must have the OBS permissions. For details, see Table 6-5.
GES Development	<p>Use permissions for GES. Users granted these permissions can perform any operations on GES except for graph creation and deletion.</p> <p>NOTE</p> <ul style="list-style-type: none"> To bind or unbind an EIP, the users must have the Security Administrator and Server Administrator permissions. To interact with OBS, such as creating a graph and importing data, the users must have the OBS permissions. For details, see Table 6-5.

Policy Name	Description
GES ReadOnlyAccess	<p>Read-only permissions for ECS. Users granted these permissions can only perform resource querying operations, such as viewing the graph list, metadata, and backups.</p> <p>NOTE To interact with OBS, such as viewing the metadata, you must have the OBS permissions. For details, see Table 6-5.</p>

Table 6-3 Common GES operations supported by each role

Operation	GES Administrator	GES Manager	GES Operator	Tenant Guest
Creating graphs	√	×	×	×
Deleting graphs	√	×	×	×
Querying graphs	√	√	√	√
Accessing graphs	√	√	√	×
Importing data	√	√	×	×
Creating metadata	√	√	×	×
Viewing metadata	√	√	√	√
Copying metadata	√	√	×	×
Editing metadata	√	√	×	×
Deleting metadata	√	√	×	×
Clearing data	√	√	×	×
Backing up graphs	√	√	×	×
Loading backups	√	√	×	×
Deleting backups	√	√	×	×
Viewing backups	√	√	√	√
Starting graphs	√	√	×	×
Stopping graphs	√	√	×	×
Upgrading graphs	√	√	×	×
Resizing graphs	√	√	×	×
Exporting graphs	√	√	×	×
Binding EIPs	√	√	×	×

Operation	GES Administrator	GES Manager	GES Operator	Tenant Guest
Unbinding EIPs	√	√	×	×
Viewing results in the Task Center	√	√	√	√

Table 6-4 Common GES operations supported by each policy

Operation	GES FullAccess	GES Development	GES ReadOnlyAccess	Resource
Querying the graph list	√	√	√	-
Querying graph details	√	√	√	graphName
Creating graphs	√	×	×	graphName
Accessing graphs	√	×	×	graphName
Stopping graphs	√	√	×	graphName
Starting graphs	√	√	×	graphName
Deleting graphs	√	×	×	graphName
Incrementally importing data to graphs	√	√	×	graphName
Exporting graphs	√	√	×	graphName
Clearing graphs	√	√	×	graphName
Resizing graphs	√	√	×	graphName
Upgrading graphs	√	√	×	graphName
Binding EIPs	√	√	×	graphName
Unbinding EIPs	√	√	×	graphName
Viewing the list of all backups	√	√	√	-
Viewing the backup list of a graph	√	√	√	-
Adding backups	√	√	×	backupName

Operation	GES FullAccess	GES Development	GES ReadOnlyAccess	Resource
Deleting backups	√	√	x	backupName
Querying the metadata list	√	√	√	-
Querying metadata	√	√	√	metadataName
Verifying metadata	√	√	x	-
Adding metadata	√	√	x	metadataName
Deleting metadata	√	√	x	metadataName
Querying task status	√	√	√	-
Querying the task list	√	√	√	-

Table 6-5 Common GES operations supported by each OBS policy

GES Operation	Dependent OBS Permission
Viewing metadata	OBS Viewer policy or OBS Buckets Viewer role
Creating/Importing/ Copying/Editing/Deleting metadata	OBS Operator policy or Tenant Administrator role
Creating a graph (with initial data), and importing or exporting the graph	OBS Operator policy or Tenant Administrator role

7 Related Services

IAM

Identity and Access Management (IAM) authenticates access to GES on HUAWEI CLOUD.

VPC

GES uses Virtual Private Cloud (VPC) to provide clusters with network topologies to isolate clusters and control access.

OBS

GES stores graph data on Object Storage Service (OBS), satisfying the requirements for secure, reliable, and cost-effective storage.

- When creating a graph, obtain the vertex and edge data sets from OBS buckets. In addition, you can use OBS buckets to store logs.
- When incrementally importing data to a graph on the **Graph Management** page, obtain the data from OBS buckets. You can also export graph data to OBS buckets.
- On the page for creating metadata files, select an OBS bucket as the data storage path.
- You can import the metadata from a local path or an OBS bucket.

8 Quotas

Quotas are enforced for service resources on the platform to prevent unforeseen spikes in resource usage. Quotas can limit the number or amount of resources available to users.

If the existing resource quota cannot meet your requirements, apply for a higher quota.

GES uses the following infrastructure resources:

- IAM
- VPC
- OBS

For details about how to view and increase quotas, see [.](#)

9 Billing

GES billing is simple and predictable. You can either choose the pay-per-use billing mode or prepaid instance billing mode, which is more economic.

Billing Items

In GES, you pay for the graph size (edges), data storage space, and public network traffic you use.

Table 9-1 GES billing items

Billing Item	Description
Graph size (edges)	<ul style="list-style-type: none">You pay for the graph size (edges) you choose.For edge billing, the per-per-use (hourly) and prepaid instance (monthly/yearly) billing modes are available.
Data storage space	GES data is uploaded or exported from Object Storage Service (OBS), so the storage billing is based on the OBS prices.
Public network traffic	GES supports bindings to public IP addresses, which are charged based on the EIP pricing rules of the Virtual Private Cloud (VPC) service. However, the GES traffic generated inside the HUAWEI CLOUD network will not be charged.

Billing Modes

GES provides two billing modes, that is, pay-per-use (hourly) and prepaid instance (monthly/yearly). You can choose either of them. The longer you use, the less you pay.

- Pay per use (hourly)

In this billing mode, you can enable or disable GES as you like. You are billed by the use duration on an hourly basis. It is applicable to customers who need

to perform preliminary operation tests and Proofs-of-Concept verifications, and short-term users.

- Prepaid instance billing (monthly or yearly)
 - In this billing mode, you need to make one-off payment in advance. This offers you significant discounts over pay-per-use mode and saves you 34% to 47% of costs. It is applicable to customers who plan to use GES for a long time.
 - The prepaid instance is a billing concept only. You can regard it as a coupon. Purchasing prepaid instances will not have the system to create graphs. When you are using graphs, the billing system automatically compares the number of valid prepaid instances you purchased with the number of graph instances in the same region and flavor you are using. The graph instances within the prepaid instance quantity range are not charged and the extra graph instances are charged in pay-per-use mode.
 - Prepaid instances are not bound to graph instances in use. For details, see the following descriptions:
 - After you purchase prepaid instances, the system will not automatically create graph instances for you. If you have not run any instances, go to the GES management console to create graph instances of the corresponding region, flavor, and quantity.
 - If your graph instances are billed in pay-per-use mode, the billing system automatically identifies prepaid instances and gives you discount when generating the bill after you purchase prepaid instances of the corresponding region, flavor, and quantity.
 - If you delete existing graph instances and create new ones, your prepaid instances can still be used by the new instances of the same region and node type.

NOTE

- Prepaid instances are bound to a specific region. The purchased prepaid instances can be used in the bound region only.
- Prepaid instances are bound to a specific instance flavor. Instances with different flavors have different prepaid prices.
- Prepaid instances take effect as of the date when they are purchased and automatically end when the validity period expires. For example, if you purchase a package with three million-edge instances on January 1 (the package duration is one year), then the package automatically ends at the end of December 31 in the year. Note that if you do not use the graphs within the validity period, the validity period will not be extended and the fee cannot be refunded. Therefore, to save your costs, you are advised to create graph instances immediately after purchasing prepaid instances, or purchase prepaid packages after creating graph instances.

Overdue

In pay-per-use mode, API fees are deducted every hour. If your account balance is insufficient to pay for the expense occurred in the last hour, your account will be in arrears, and GES APIs have a grace period and retention period.

If the APIs are renewed within the retention period, they will be available and billed from the original expiration date.

 **NOTE**

If your account is in arrears, some operations will be restricted. You are advised to renew your account as soon as possible. The restricted operations are as follows:

- Resource creation operations (such as graph creation and metadata creation)
- Service subscription