Resource Management Service

User Guide

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HUAWEI

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1 My Resources

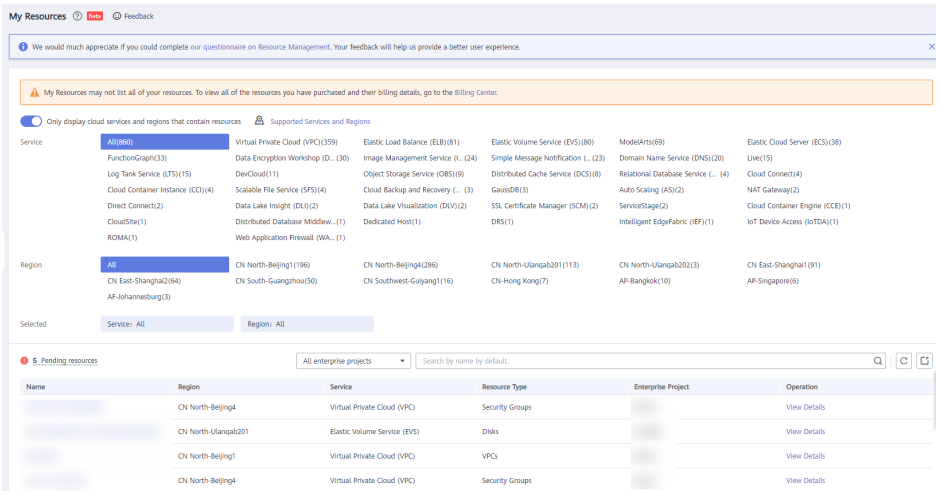
1.1 Viewing Resources

1.1.1 Querying All Resources

Scenarios

On the **My Resources** page, you can view all resources you have permissions on within your account.

Figure 1-1 Querying all resources



Procedure

Step 1 Log in to the management console.

Step 2 In the upper right corner of the page, choose **Resources** > **My Resources**.

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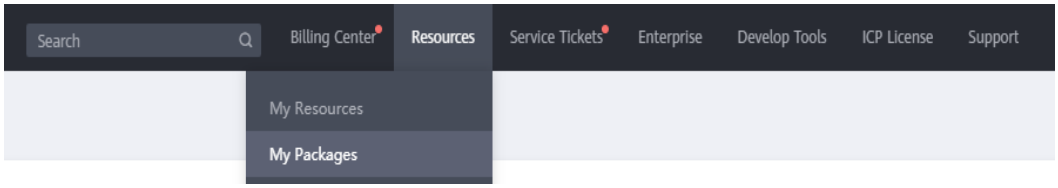
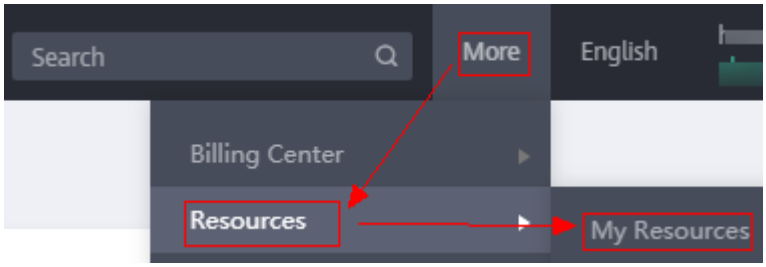
Figure 1-2 RMS service entry



If the resolution of the screen is low, in the upper right corner of the page, choose **More** > **Resources** > **My Resources**.

Figure 1-3 RMS service entry (low resolution)



Alternatively, click ☰ in the upper left corner of the page. In the service list that is displayed, under **Management & Governance**, select **Resource Management**.

Step 3 Only some cloud services are displayed on the **My Resources** page by default. You can click **More** to show all supported cloud services.

You can switch on the button next to **Only display cloud services and regions that contain resources** to show the cloud services with resources associated.

Figure 1-4 My Resources

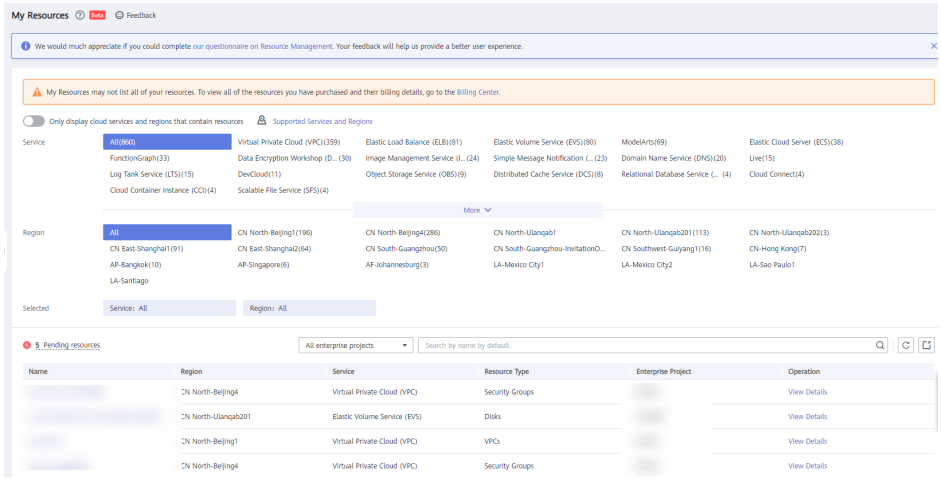


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Figure 1-5 Viewing all supported cloud services

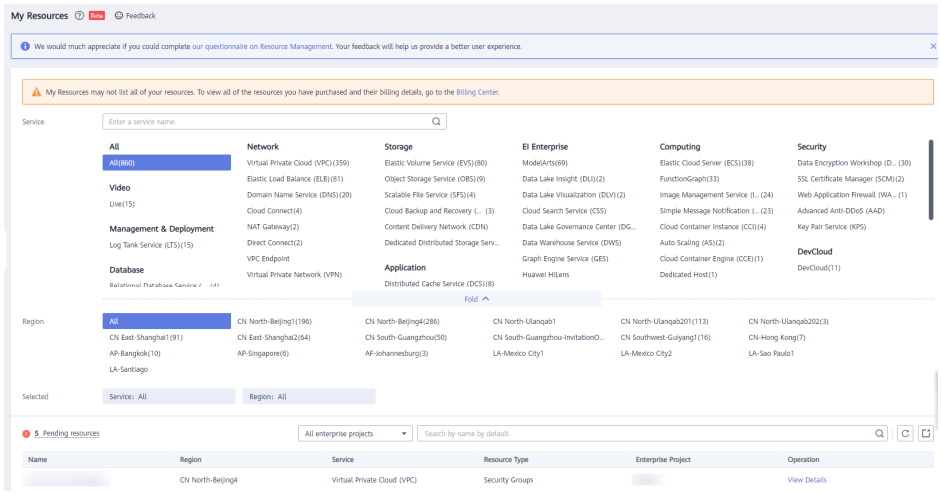
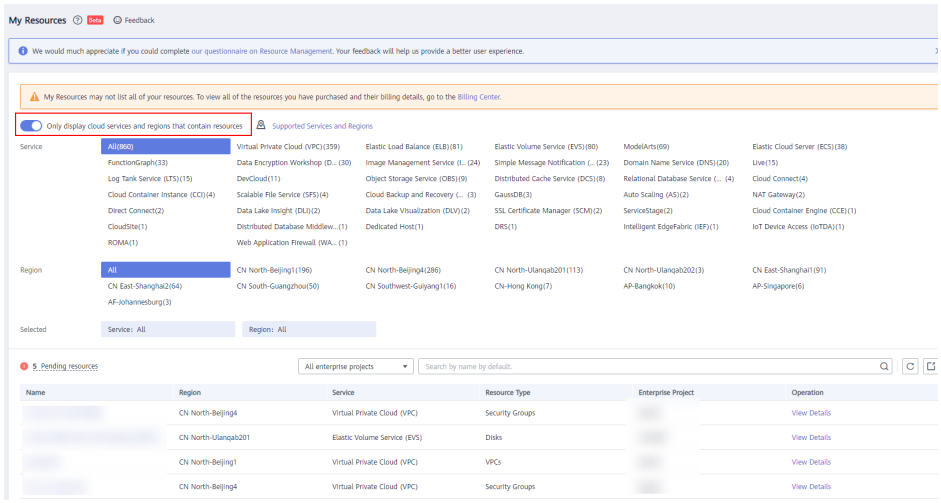


Figure 1-6 Viewing the cloud services with resources associated



----End

NOTE

The **My Resources** page only displays the resources you have permissions on within your account. For details about resource permissions, see **Permissions Management**.

For details about the services and regions supported by RMS, see **Services and Regions Supported by RMS**.

1.1.2 Querying Details About a Resource

Scenarios

By default, part of resource information is displayed on the **My Resources** page. Perform the following operations to view more details about resources.

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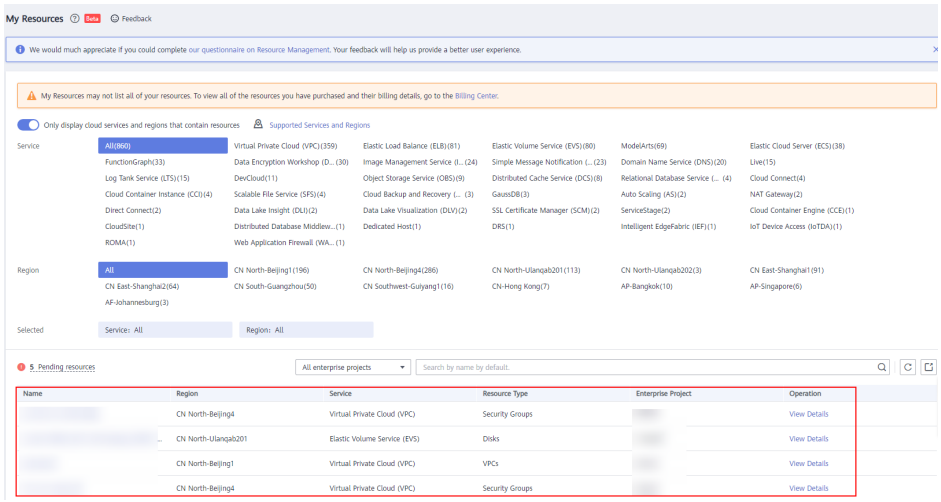
Figure 1-7 Part of resource information displayed

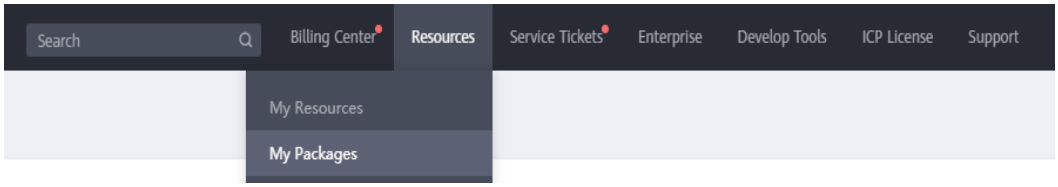


Procedure

Step 1 Log in to the management console.

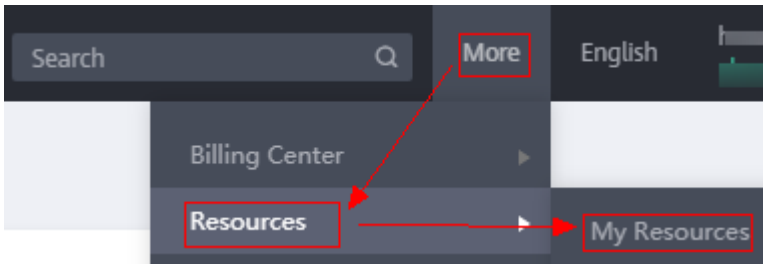
Step 2 In the upper right corner of the page, choose **Resources** > **My Resources**.

Figure 1-8 RMS service entry



If the resolution of the screen is low, in the upper right corner of the page, choose **More** > **Resources** > **My Resources**.

Figure 1-9 RMS service entry (low resolution)



Alternatively, click ☰ in the upper left corner of the page. In the service list that is displayed, under **Management & Governance**, select **Resource Management**.

Step 3 Click the name of the target resource to switch to the resource **Overview** tab.

You can view the resource overview, resource change records, resource compliance, and resource relationship.

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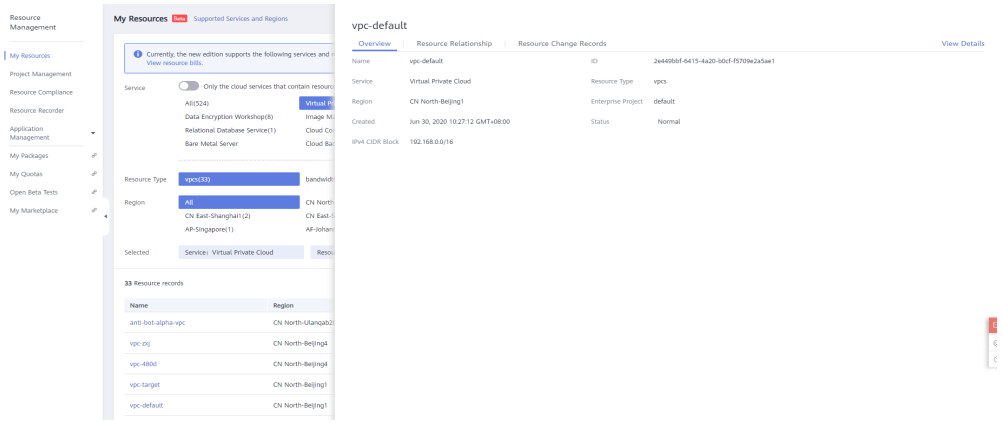
Figure 1-10 Resource overview



Step 4 Click **View Details** in the upper right corner of the **Overview** tab to go to the console of the service associated with the resource and view the resource details.

You can also click **View Details** in the **Operation** column of the row containing the resource on the **My Resources** page to view the resource details.

----End

1.1.3 Filtering Resources

Scenarios

On the **My Resources** page, set criteria in the search box to quickly locate the target resources.

Supported Filter Criteria

Table 1-1 Supported filter criteria

Name	Description
Name	Enter a name in the search box for a fuzzy search. The resource name is case-insensitive.
Resource ID	Enter a resource ID in the search box for a fuzzy search. The resource ID is case-sensitive.
Tags	If you select **Tags** as a search criterion, **Tag key** and **Tag value** are displayed in sequence, and you need to select a tag key and value.
Enterprise Project	If you select **Enterprise Project** as a search criterion, all enterprise projects are displayed for your selection.

NOTE

You need to **enable the enterprise project function** before filtering resources by enterprise project.

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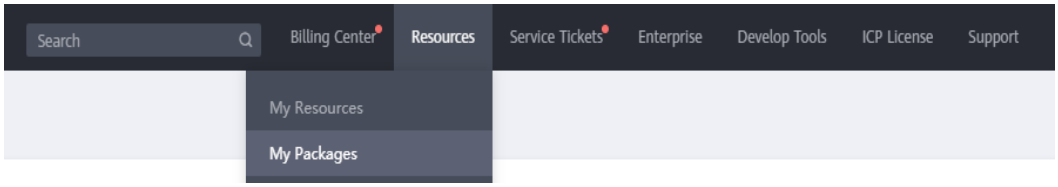
Procedure

Step 1 Log in to the management console.

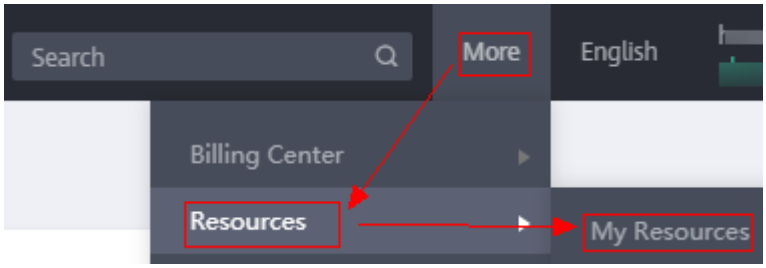
Step 2 In the upper right corner of the page, choose **Resources** > **My Resources**.

Figure 1-11 RMS service entry



If the resolution of the screen is low, in the upper right corner of the page, choose **More** > **Resources** > **My Resources**.

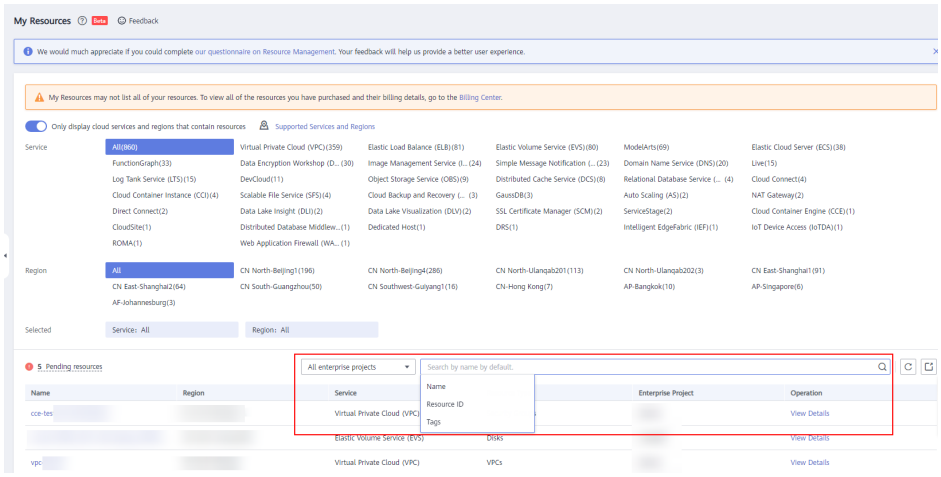
Figure 1-12 RMS service entry (low resolution)



Alternatively, click ☰ in the upper left corner of the page. In the service list that is displayed, under **Management & Governance**, select **Resource Management**.

Step 3 Click the search box, set the filter criterion, and enter the search content.

Figure 1-13 Filtering resources



Step 4 Click 🔍.

----End

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1.1.4 Exporting Resource Information

Scenarios

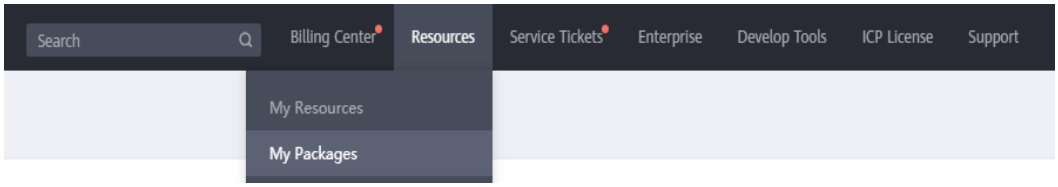
You can export the information of the filtered resources.

Procedure

Step 1 Log in to the management console.

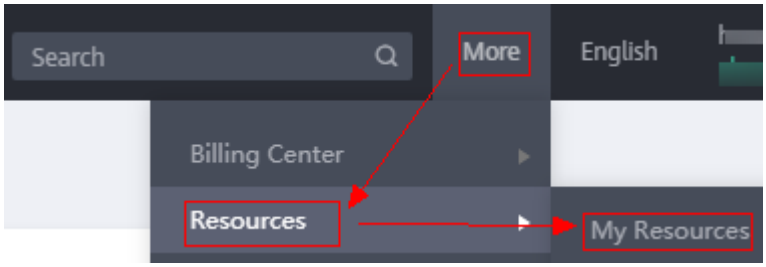
Step 2 In the upper right corner of the page, choose **Resources** > **My Resources**.

Figure 1-14 RMS service entry



If the resolution of the screen is low, in the upper right corner of the page, choose **More** > **Resources** > **My Resources**.

Figure 1-15 RMS service entry (low resolution)



Alternatively, click ☰ in the upper left corner of the page. In the service list that is displayed, under **Management & Governance**, select **Resource Management**.

Step 3 After setting the filter criteria, click 🔍 next to the search box.

You can filter resources by enterprise project, resource name, resource ID, and tag.

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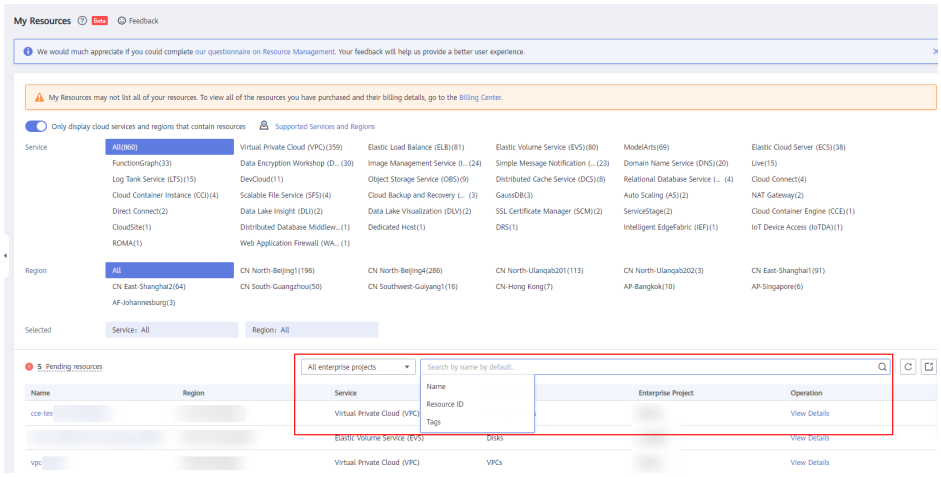
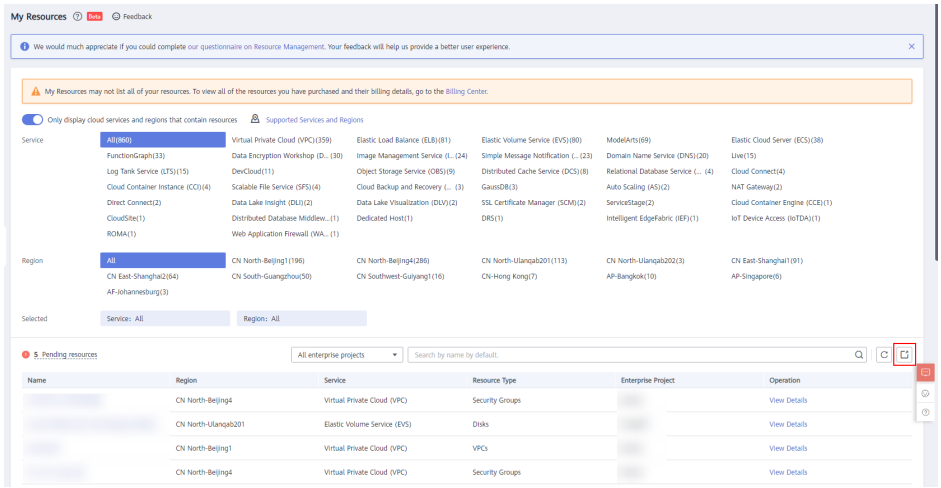
Figure 1-16 Filtering resources



Step 4 Click  on the right of the search box.

Figure 1-17 Exporting resource information



----End

NOTE

The exported file is in CSV format and contains some common attributes of all resources.

1.2 Viewing Relationships of a Resource

Resource relationships record relationships between different resources, for example, EVS disks attached to ECSs and ECSs contained in VPCs.

For details about the resource relationships supported on RMS, see **Relationships with Supported Resources**.

Scenarios

View the associated resources of all your resources and their dependencies.

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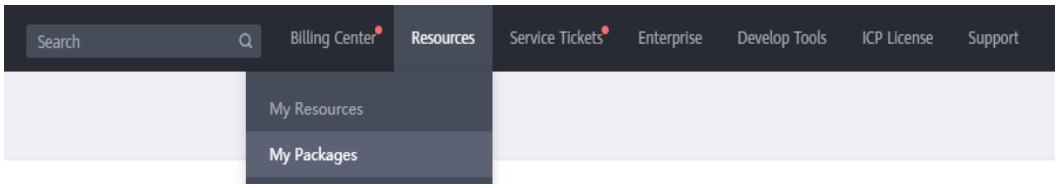
Procedure

Step 1 Log in to the management console.

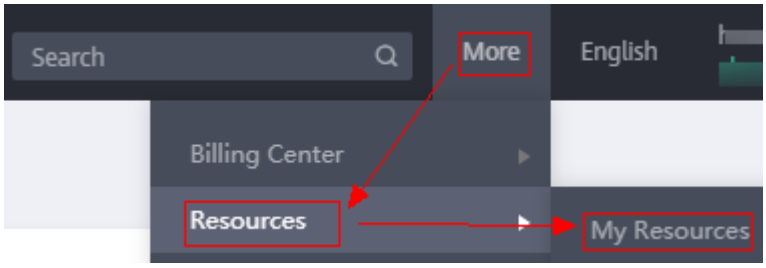
Step 2 In the upper right corner of the page, choose **Resources** > **My Resources**.

Figure 1-18 RMS service entry



If the resolution of the screen is low, in the upper right corner of the page, choose **More** > **Resources** > **My Resources**.

Figure 1-19 RMS service entry (low resolution)

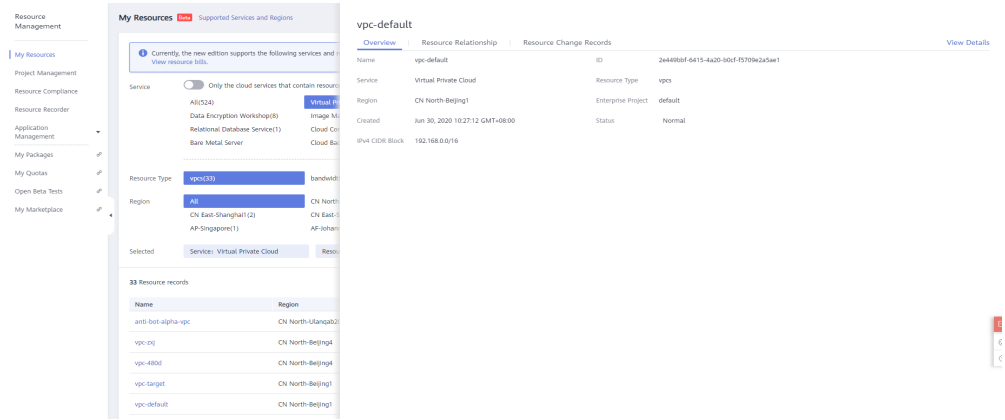


Alternatively, click  in the upper left corner of the page. In the service list that is displayed, under **Management & Governance**, select **Resource Management**.

Step 3 Click the name of the target resource to switch to the resource **Overview** tab.

You can view the resource overview, resource change records, resource compliance, and resource relationship.

Figure 1-20 Resource overview



Step 4 Click the **Resource Relationship** tab.

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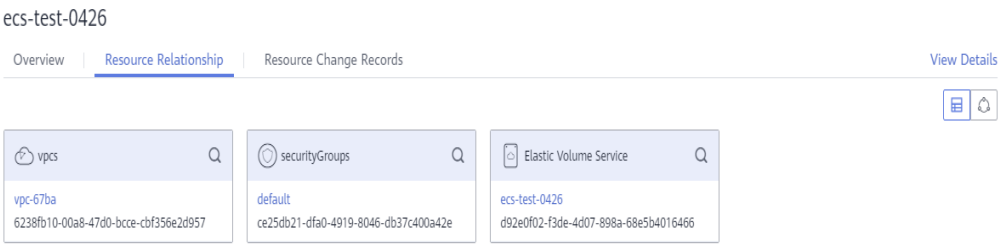
Figure 1-21 Viewing a resource relationship



----End

NOTE

To view details about the resources associated with the resource you are querying, you need to obtain the permissions required for accessing the associated resources. Then you can click the name of an associated resource to switch to its details page.

For details about resource permissions, see **Permissions Management**.

On the **Resource Relationship** tab, you can click the name of a resource associated with the current resource you are querying to switch to the resource details page. Then you can view the resource overview, history, and relationships.

1.3 Viewing Resource Change Records

Prerequisites

- Resource change records are generated only after you enable the resource recorder and set required parameters. For details about the resource recorder, see **Resource Recorder**.
- To view change records of your resources and those of the associated resources, you must have the RMS permissions to view the resource change records and the permissions for the associated resources. For details about RMS permissions, see **Permissions Management**.

Scenarios

Resource change records contain resource changes in a specific period of time.

A record will be generated upon any changes to the properties and relationships of a resource, and the record is stored for seven years by default.

Procedure

Step 1 Log in to the management console.

Step 2 In the upper right corner of the page, choose **Resources** > **My Resources**.

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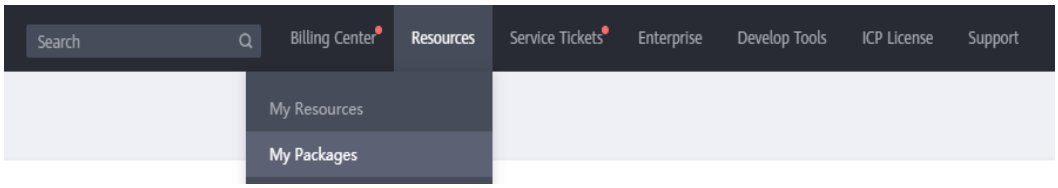
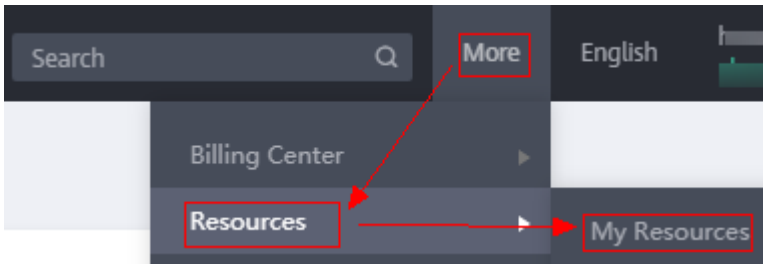
Figure 1-22 RMS service entry



If the resolution of the screen is low, in the upper right corner of the page, choose **More** > **Resources** > **My Resources**.

Figure 1-23 RMS service entry (low resolution)

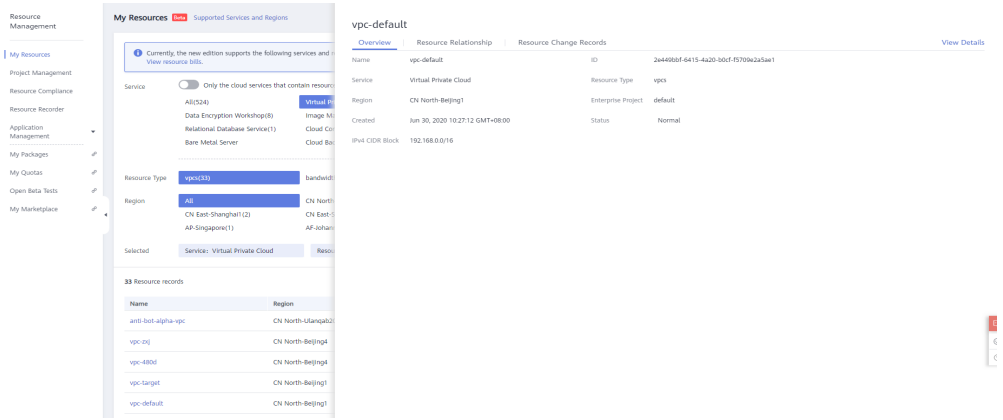


Alternatively, click ☰ in the upper left corner of the page. In the service list that is displayed, under **Management & Governance**, select **Resource Management**.

Step 3 Click the name of the target resource to switch to the resource **Overview** tab.

You can view the resource overview, resource change records, resource compliance, and resource relationship.

Figure 1-24 Resource overview



Step 4 Click the **Resource Change Records** tab.

Step 5 Set the time range in the upper right corner of the displayed page.

The resource change records of the last three months are displayed by default. Click the arrow to expand the details of a change record.

You can click **View JSON File** to view all properties of the resource.

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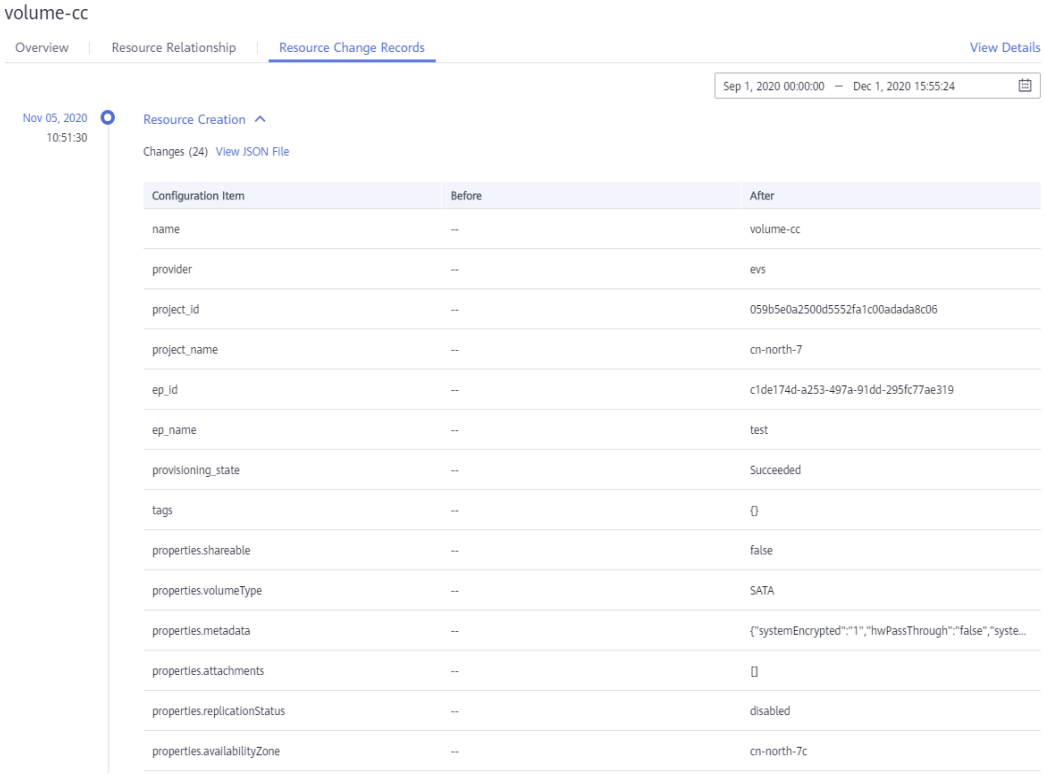
Figure 1-25 Viewing a resource change record



----End

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2 Resource Recorder

2.1 What Is Resource Recorder?

The resource recorder tracks resource changes on the cloud platform.

To be specific, it

- notifies you when resources are created, modified, and deleted.
- notifies you when resource relationships are changed.
- dumps resource change notifications every 6 hours.
- dumps resource snapshots every 24 hours.

For details about resources that can be monitored by the resource recorder, see **Services and Regions Supported by RMS**.

For details about resource relationships that can be monitored by the resource recorder, see **Relationships with Supported Resources**.

2.2 Enabling, Configuring, or Modifying the Resource Recorder

Scenarios

You must enable the resource recorder before configuring it.

The configured resource recorder can be modified or disabled.

Enabling the Resource Recorder

Step 1 Log in to the management console.

Step 2 In the upper right corner of the page, choose **Resources** > **My Resources**.

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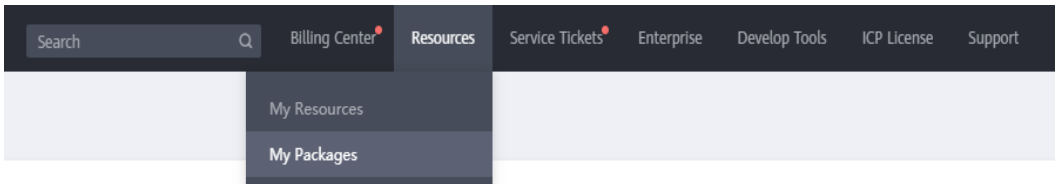
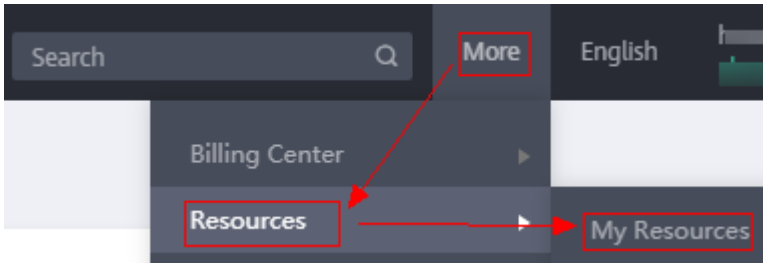
Figure 2-1 RMS service entry



If the resolution of the screen is low, in the upper right corner of the page, choose **More** > **Resources** > **My Resources**.

Figure 2-2 RMS service entry (low resolution)

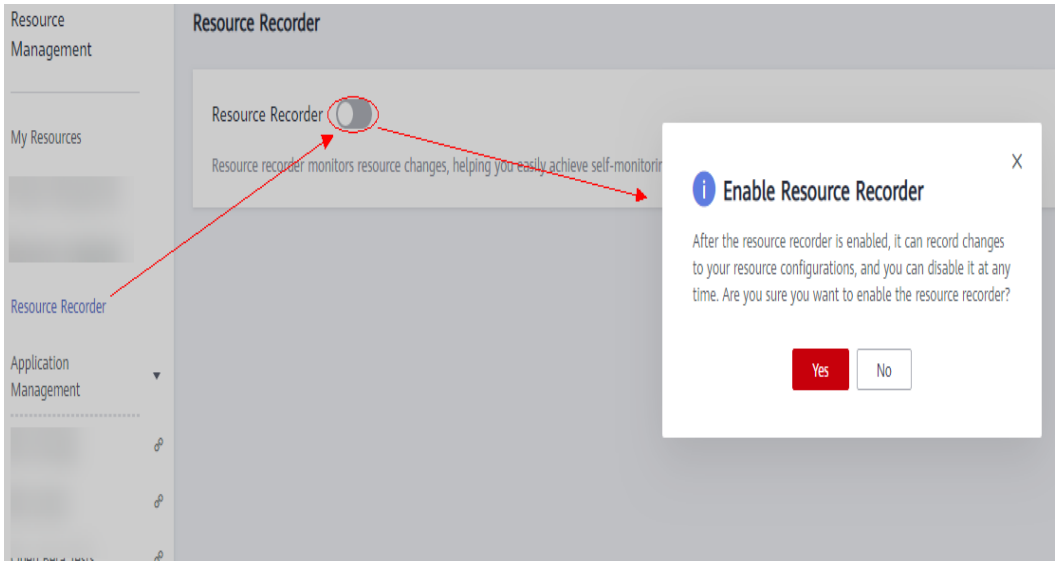


Alternatively, click ☰ in the upper left corner of the page. In the service list that is displayed, under **Management & Governance**, select **Resource Management**.

Step 3 In the left navigation pane, choose **Resource Recorder**.

Step 4 Enable the resource recorder.

Figure 2-3 Enable Resource Recorder



----End

Configuring the Resource Recorder

Step 1 Enable the resource recorder.

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Step 2 Select the monitoring scope.

All resources supported by RMS are monitored by default. You can modify the monitoring scope by selecting specific resources.

Step 3 Select an SMN topic.

Select a region and an SMN topic for receiving notifications of any changes to resources. If no SMN topics are available, create one. For details about how to create an SMN topic, see ***Simple Message Notification User Guide***.

NOTE

After you create a topic, you must add subscriptions to the topic and confirm the subscriptions. For details, see ***Simple Message Notification User Guide***.

Step 4 Enable **Data Dump**.

Select an OBS bucket in the current region for storing resource change notifications and resource snapshots. If no OBS bucket is available, create one. For details about how to create an OBS bucket, see ***Object Storage Service User Guide***.

Step 5 Grant permissions. Select **Quick granting** or **Custom granting**.

- **Quick granting**: This option will automatically create an agency named **rms_tracker_agency** to grant the minimum permissions required for the resource recorder to work properly. The permissions include permissions for sending notifications through SMN and for writing data into OBS.
- **Custom granting**: This option allows you to create an agency and assign permissions in IAM. The permissions assigned must include those required for sending notifications through SMN and for writing data into OBS. For details about how to create an agency, see ***Identity and Access Management User Guide***.

  NOTE

  In **Customer granting**, permissions for using SMN to send notifications to topic subscribers and dumping resource change notifications and resource snapshots into the OBS bucket are granted to RMS.

----End

Modifying the Resource Recorder

Step 1 In the left navigation pane, choose **Resource Recorder**.

Step 2 Click **Modify Resource Recorder**.

Step 3 Modify the resource recorder configurations as needed.

Step 4 Click **Save**.

----End

NOTE

You need to obtain the permissions required for performing operations on the resource recorder before you enable, configure, and modify it. For details about RMS permissions, see **Permissions Management**.

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2.3 Notifications

Notifications of any changes to your resources will be sent to the SMN topic subscriber after you enable the resource recorder and configure the SMN topic. If no topics are available, you need to create a topic, add subscriptions to the topic, and request confirmation for the subscriptions.

For details about SMN operations, see ***Simple Message Notification User Guide***.

RMS uses SMN to send notifications of:

- resource changes (creation, modification, and deletion)
- resource relationship changes
- resource change notification dump completed
- resource snapshot dump completed

For details about example codes for resource change notifications, see **Message Notification Models**.

2.4 Dumping Resources

Your resource snapshots will be dumped into the OBS bucket every 24 hours after you enable the resource recorder.

For details about example codes for dumping resources, see **Resource Dump Models**.

2.5 Dumping Resource Change Notifications

After you enable the resource recorder, configure the SMN topic (create a topic, add a subscription, and request confirmation), and configure the OBS bucket, RMS dumps your resource change notifications to the OBS bucket every 6 hours.

For details about example codes for dumping resource change notifications, see **Models of Resource Change Notification Dump**.

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3 Resource Compliance

You can add assignments to evaluate the compliance of your resources. You need to select a built-in RMS policy, and specify the resources to be evaluated. After an assignment is created, multiple mechanisms are available to trigger resource evaluation. For details, see **Triggering Resource Compliance Evaluation**.

3.1 Adding an Assignment

Scenarios

Add an assignment and view its details.

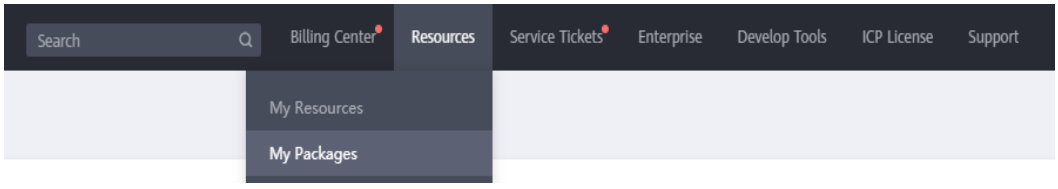
You can use one account to add up to 30 assignments.

Adding an Assignment

Step 1 Log in to the management console.

Step 2 In the upper right corner of the page, choose **Resources** > **My Resources**.

Figure 3-1 RMS service entry



If the resolution of the screen is low, in the upper right corner of the page, choose **More** > **Resources** > **My Resources**.

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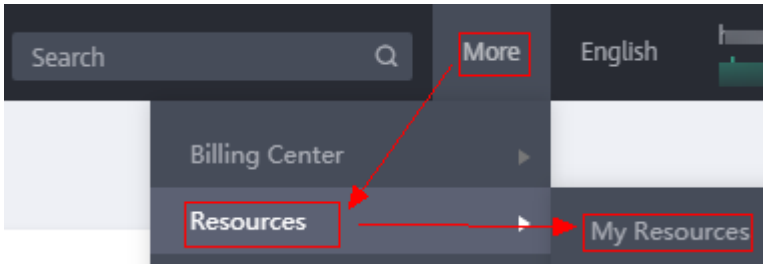
Figure 3-2 RMS service entry (low resolution)

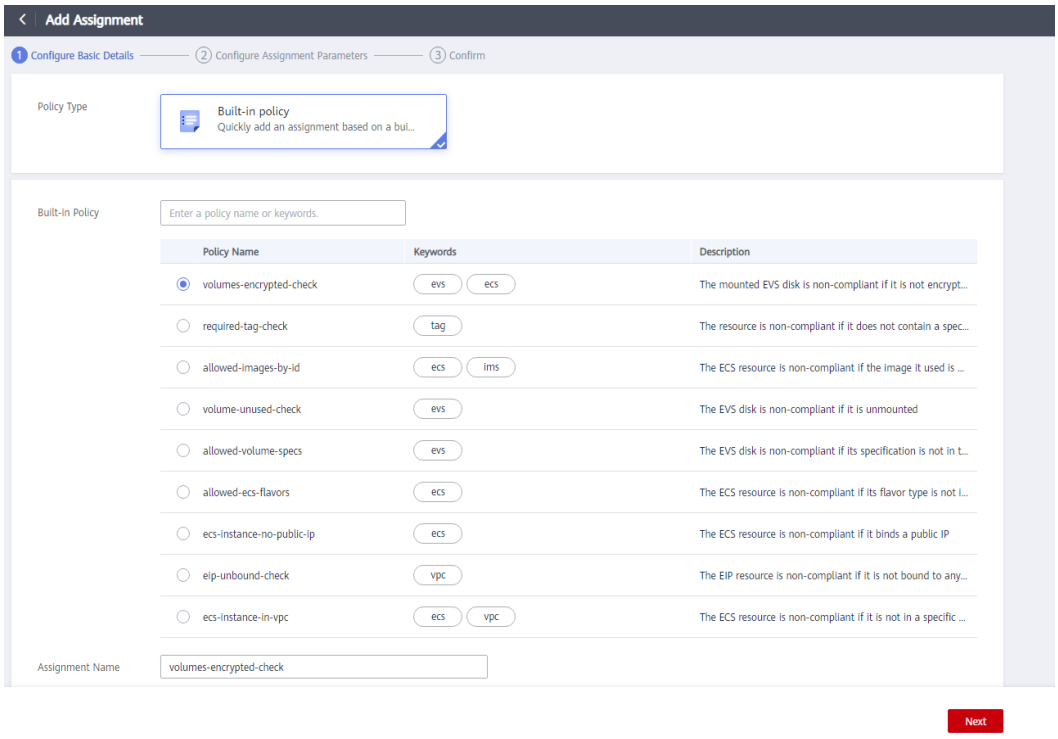


Alternatively, click ☰ in the upper left corner of the page. In the service list that is displayed, under **Management & Governance**, select **Resource Management**.

Step 3 In the left navigation pane, choose **Resource Compliance**.

Step 4 In the middle of the page, click **Add Assignment**. On the displayed **Configure Basic Details** page, select a policy, specify **Assignment Name** and **Description**, and click **Next**.

Figure 3-3 Configure Basic Details



For details about parameter settings, see **Table 3-1**.

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Table 3-1 Basic configuration parameters

Parameter	Description	Example Value
Policy Type	Only **Built-in policy** is supported.	Built-in policy
Built-in Policy	Specifies the policy that has been developed for a service. You can use built-in policies to quickly add assignments. For details about the preset policies, see **Built-in Policies**.	volumes-encrypted-check
Assignment Name	By default, the assignment name is the same as the name of the selected policy. You can also customize the assignment name. There are no restrictions on the assignment name.	volumes-encrypted-check
Description	By default, the assignment description is the same as the description about the selected policy. You can also customize the assignment description. There are no restrictions on the assignment description.	The mounted EVS disk is non-compliant if it is not encrypted

Step 5 On the displayed **Configure Assignment Parameters** page, configure required parameters and click **Next**.

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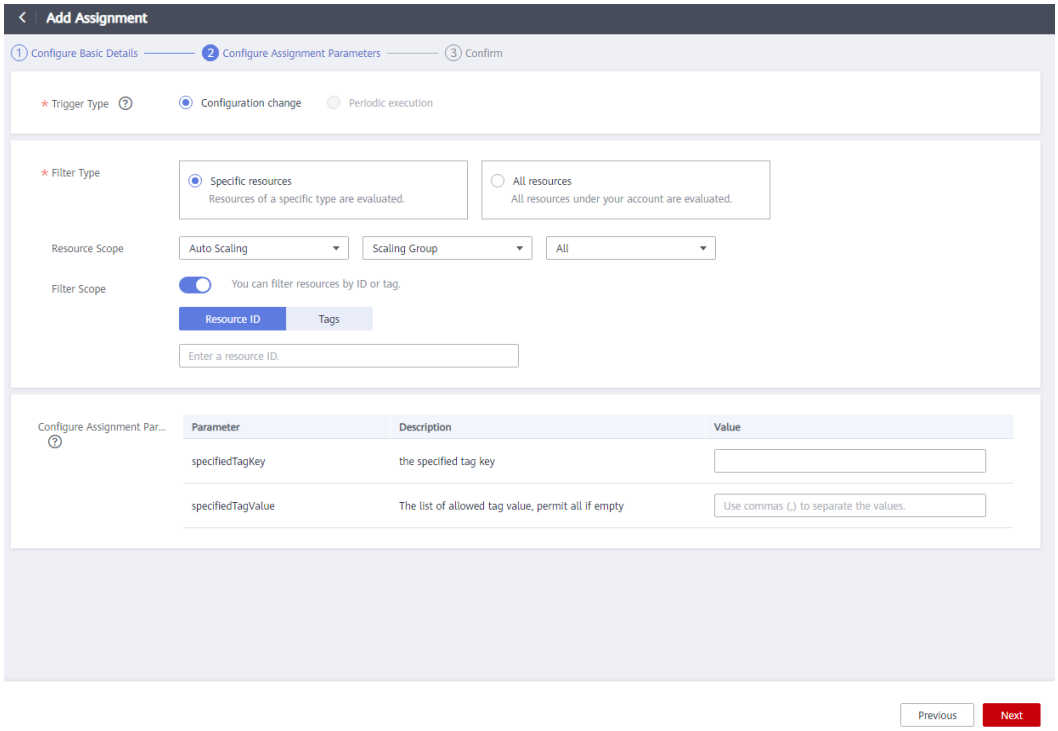
Figure 3-4 Configure Assignment Parameters



For details about parameter settings, see **Table 3-2**.

Table 3-2 Parameter descriptions

Parameter	Description	Example Value
Trigger Type	Specifies the condition for triggering the assignment. Only **Configuration change** is supported, indicating that the assignment will be triggered when a specific cloud resource is changed.	Configuration change
Filter Type	Specifies the resources to evaluate. Possible types are: • **Specific resources**: Resources of a specific type will be evaluated. • **All resources**: All resources under your account will be evaluated.	Specific resources

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Parameter	Description	Example Value
Resource Scope	If you set **Filter Type** to **Specific resources**, you need to specify a resource scope. • Service: Select the service the resource belongs to. • Resource type: Select the resource type of the corresponding service. • Region: Select the region where the resource is located.	N/A
Filter Scope	After you enable **Filter Scope**, you can filter resources by resource ID or tag. You can specify a specific resource for compliance evaluation.	**Filter Scope** is disabled by default.
Configure Assignment Parameters	Specifies the parameter configuration for the built-in policy you selected in step **Configure Basic Details**. For example, if you select policy **required-tag-check** and **Keywords** is **tag**, you need to specify a tag key and a tag value here. Then, resources that do not have this tag are non-compliant. Not all built-in policies have parameters to be configured. For example, if you select policy **volumes-encrypted-check**, you do not need to configure any assignment parameters.	-

Step 6 On the **Confirm** page displayed, confirm the assignment information and click **Submit**.

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Figure 3-5 Confirm

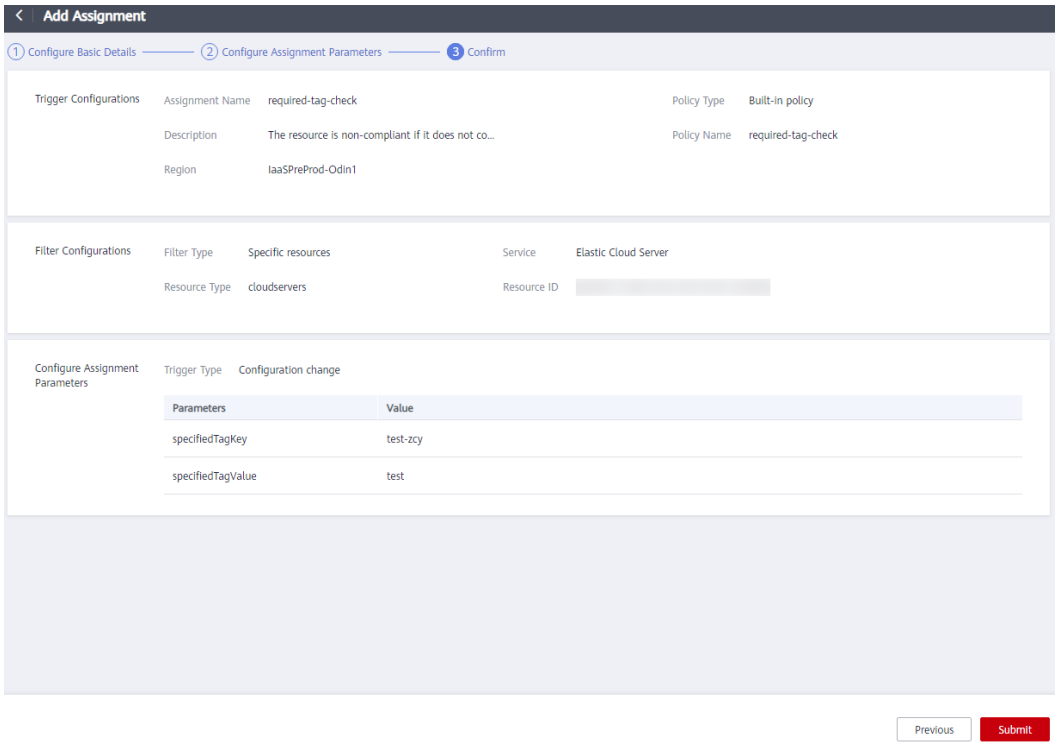
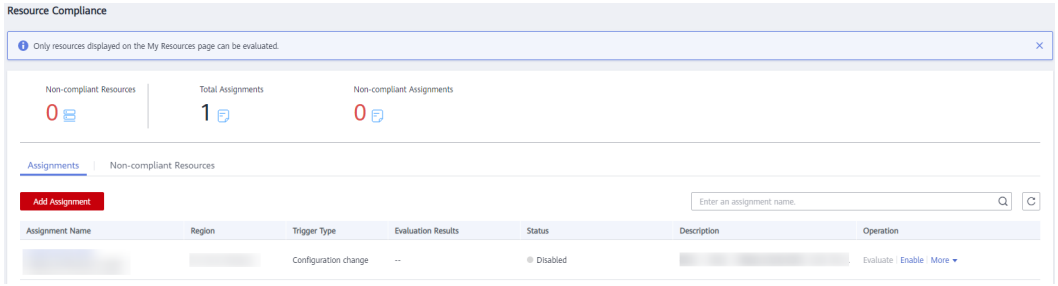


Figure 3-6 Querying an assignment



NOTE

After you add an assignment, the first evaluation is automatically triggered immediately.

----End

Viewing Assignment Details

After you add an assignment, you can view its details.

Step 1 Go to the **Resource Compliance** page.

Step 2 Click the name of the assignment you want to view.

Step 3 In the **Assignment Details** area, view the assignment details.

----End

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3.2 Triggering Resource Compliance Evaluation

Scenarios

Assignments can be triggered automatically or manually.

- **Automatic**

  Assignments are automatically triggered for resource compliance evaluation if you perform any of the following operations:

  - Adding a new assignment
  - Modifying an assignment
  - Enabling an assignment
  - Setting **Trigger Type** to **Configuration change** and the configurations of the resource in your specified filter scope are changed

- **Manual**

  For details about how to manually trigger an assignment, see **Manually Triggering the Assignment to Evaluate Resources**.

  When you call the **run-evaluation** API, the assignment is triggered.

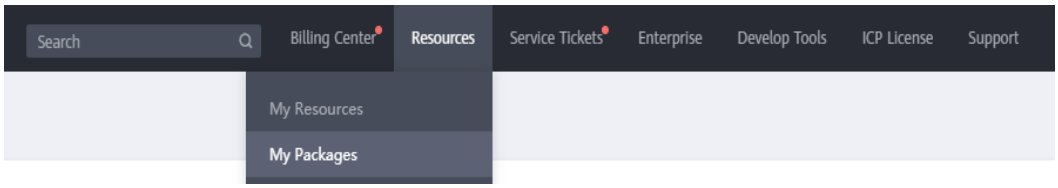
Manually Triggering the Assignment to Evaluate Resources

If you want to use an existing assignment to evaluate resource compliance, you can perform the following operations.

Step 1 Log in to the management console.

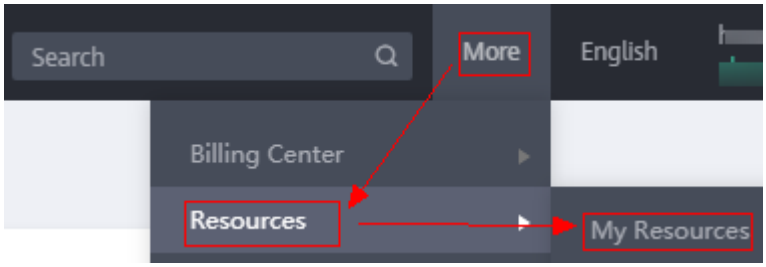
Step 2 In the upper right corner of the page, choose **Resources** > **My Resources**.

Figure 3-7 RMS service entry



If the resolution of the screen is low, in the upper right corner of the page, choose **More** > **Resources** > **My Resources**.

Figure 3-8 RMS service entry (low resolution)



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Alternatively, click ☰ in the upper left corner of the page. In the service list that is displayed, under **Management & Governance**, select **Resource Management**.

Step 3 In the left navigation pane, choose **Resource Compliance**.

Step 4 In the assignment list, locate the row that contains the assignment you want to use, and click **Evaluate** in the **Operation** column.

Step 5 In the displayed **Evaluate Resources** dialog box, confirm the information and click **OK**.

----End

Viewing Evaluation Results

After the resource compliance evaluation is complete, you can view the evaluation results.

Step 1 Go to the **Resource Compliance** page.

Step 2 Click the name of the assignment you want to view.

Step 3 View the evaluation results on the displayed **Assignment Details** page.

----End

NOTE

An assignment has the following states:

- **Running**: The assignment is available.
- **Disabled**: The assignment is disabled.
- **Evaluating**: The assignment is being used for resource compliance evaluation.

During the evaluation, the assignment is in the **Evaluating** state. After the evaluation is complete, the assignment status changes to **Running**. At this time, you can view the evaluation results.

3.3 Managing an Assignment

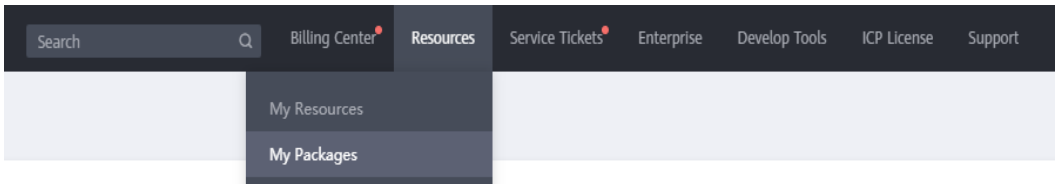
You can disable, modify, or delete an assignment.

Disabling an Assignment

Step 1 Log in to the management console.

Step 2 In the upper right corner of the page, choose **Resources** > **My Resources**.

Figure 3-9 RMS service entry



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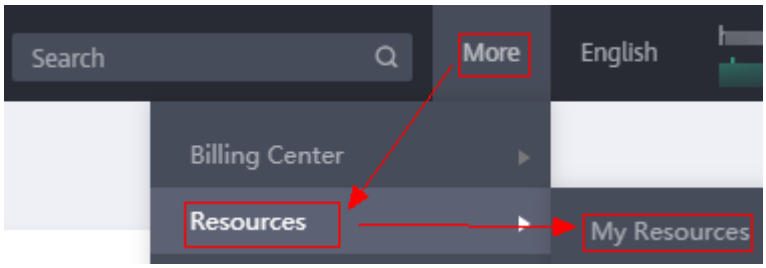
If the resolution of the screen is low, in the upper right corner of the page, choose **More** > **Resources** > **My Resources**.

Figure 3-10 RMS service entry (low resolution)



Alternatively, click ☰ in the upper left corner of the page. In the service list that is displayed, under **Management & Governance**, select **Resource Management**.

Step 3 In the left navigation pane, choose **Resource Compliance**.

Step 4 In the assignment list, locate the row that contains the assignment you want to disable, and click **Disable** in the **Operation** column.

Step 5 In the displayed **Disable Assignment** dialog box, confirm the information and click **OK**.

----End

Modifying an Assignment

You can modify the description or parameters of an assignment.

Step 1 Go to the **Resource Compliance** page.

Step 2 In the assignment list, locate the row that contains the assignment you want to modify, click **More** in the **Operation** column, and choose **Modify**.

Step 3 On the **Modify Assignment** page, modify the assignment description and click **Next**.

Step 4 Modify the assignment parameters and click **Next**.

Step 5 Confirm the assignment information and click **Submit**.

----End

Deleting an Assignment

If you no longer need an assignment, you can delete it.

Step 1 Go to the **Resource Compliance** page.

Step 2 In the assignment list, locate the row that contains the assignment you want to modify, click **More** in the **Operation** column, and choose **Delete**.

Step 3 In the displayed **Delete Assignment** dialog box, confirm the information and click **OK**.

----End

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NOTE

You can also manage an assignment on the **Assignment Details** page by clicking **Evaluate**, **Modify**, **Disable**, and **Delete** respectively.

3.4 Resource Compliance Concepts

3.4.1 Compliance Policies

A compliance policy is a static logical expression for resource compliance evaluation.

To make it take effect, you must specify a specific resource scope (by setting the filter), that is, generate a specific assignment.

You can use a JSON expression to represent a compliance policy, as shown in **Table 3-3**.

Table 3-3 Compliance policy in JSON

Parameter	Description	Remarks
id	Specifies the ID that uniquely identifies a compliance policy.	N/A
name	Specifies the compliance policy name.	You can set a name of up to 128 characters.
description	Provides supplementary information about the compliance policy.	You can set the description of up to 512 characters.

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Parameter	Description	Remarks
parameters	Specifies the parameters (parameter names and values) contained in each compliance policy. **parameters** has the following properties: • **name** • **description** • **type** • **default_value** • **allowed_values**	The parameter properties, such as **name** and **description** contained in the compliance policy remain unchanged, and you can set them to different values as needed.
	name	Specifies the parameter name, which is used to distinguish multiple parameters. When you create a compliance policy, use **name** in **policy_rule**. When you add an assignment, specify the parameter values as required.
	description	Specifies the supplementary information about **parameters**.
	type	Specifies the type of the **parameters** value, which can be **String**, **Array**, **Object**, **Boolean**, **Integer**, **Float**, and **Datetime**. **NOTE** **Datetime** is a UTC time in a fixed format complying with ISO-8601 (for example, **2018-11-14T08:59:14Z**).
	default_value	Specifies the default value of **parameters**. If the default value is specified, you use the default value when you add an assignment.
	allowed_values	Specifies the list of allowed **parameters** values. If **allowed_values** is specified, you can only select the **parameters** values from the list.
keywords	Specifies the compliance policy keywords.	Generally, it is the abbreviation of the product related to the compliance policy.
domain_id	Specifies the account ID.	**domain_id** of the built-in policies is **null**.

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Parameter	Description	Remarks
policy_type	Specifies the compliance policy type. Possible values are: • **builtin**	• **builtin**: Specifies the preset policies provided and maintained by RMS. For details, see **Built-in Policies**.
policy_rule_type	Specifies the syntax type of the compliance policy.	Domain Specific Language (**DSL**): is a compliance policy description language provided by the RMS service. You can describe the compliance judgment logic as a specific compliance policy based on this syntax.
policy_rule	Specifies the logical expression of the compliance policy syntax.	For details about how to use DSL to write compliance policies, see **DSL Syntax**.

The following JSON indicates a compliance policy used to check whether the image ID of an ECS is within the specified range.

```
{
 "id": "5fa265c0aa1e6afc05a0ff07",
 "name": "allowed-images-by-id",
 "description": "An ECS image is non-compliant if its ID is not within the specific image ID range.",
 "parameters": {
  "listOfAllowedImages": {
   "name": "listOfAllowedImages",
   "description": "The list of allowed image IDs",
   "type": "Array"
   "allowed_values": null,
   "default_value": null,
  }
 },
 "keywords": [
  "ecs",
  "ims"
 ],
 "domain_id": null,
 "policy_type": "builtin",
 "policy_rule_type": "dsl",
 "policy_rule": {
  "allOf": [
   {
    "value": "${resource().provider}",
    "comparator": "equals",
    "pattern": "ecs"
   },
   {
    "value": "${resource().type}",
    "comparator": "equals",
    "pattern": "cloudservers"
   },
   {
    "value": "${resource().properties.metadata.meteringImageId}",
    "comparator": "notIn",
    "pattern": "${parameters('listOfAllowedImages')}"
```

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```
    }
   ]
  },
}
```

For more examples, see **Compliance Policy Examples**.

3.4.2 Assignments

Assignments are formed after you specify a compliance policy and the application scope of the compliance policy (for example, some resources in a region).

You can use a JSON expression to represent an assignment, as shown in **Table 3-4**.

Table 3-4 Assignment in JSON

Parameter	Description	Limitations	Remarks
id	Specifies the ID that uniquely identifies an assignment.	N/A	N/A
name	Specifies the assignment name.	Its value must be a string with up to 128 characters.	By default, the assignment name is the same as the selected policy name. You can customize the assignment name. You can set a name of up to 128 characters.
description	Provides supplementary information about the assignment.	Its value must be a string with up to 512 characters.	By default, the assignment description is the same as the description of the selected policy. You can customize the assignment description. You can set the description of up to 512 characters.

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Parameter	Description	Limitations	Remarks
policy_filter	Specifies the assignment filter, which is used to filter the resources that will be evaluated by this assignment. A filter has the following properties: • **region_id**: Specifies the region ID. • **resource_provider**: Specifies the service. • **resource_type**: Specifies the resource type of the service. • **resource_id**: Specifies the resource ID. • **tag_key**: Specifies the resource tag key. • **tag_value**: Specifies the resource tag value.	**policy_filter**: Its value must be an object. • **region_id**: Its value must be a string with up to 128 characters. Only letters, digits, and hyphens (-) are allowed. • **resource_provider**: Its value must be a string with up to 128 characters. Only letters and digits are allowed. • **resource_type**: Its value must be a string with up to 128 characters. Only letters and digits are allowed. • **resource_id**: Its value must be a string with up to 256 characters. • **tag_key**: Its value must be a string with up to 128 characters. • **tag_value**: Its value must be a string with up to 256 characters.	**NOTE** **resource_provider** is used to determine the filter type (**Specific resources** or **All resources**). • If **resource_provider** exists in **policy_filter**, the filter type is **Specific resources**. • If **resource_provider** does not exist in **policy_filter**, the filter type is **All resources**. Therefore, no separate filter type property is set in **policy_filter**.
state	Specifies the assignment state.	N/A	Possible values are: • **Enabled**: The assignment is available. • **Disabled**: The assignment is disabled. • **Evaluating**: The assignment is being used for resource compliance evaluation.

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Parameter	Description	Limitations	Remarks
created	Specifies the time when the assignment was created.	N/A	**NOTE** The time is a UTC time in a fixed format that complies with ISO-8601 (for example, **2018-11-14T08:59:14Z**).
updated	Specifies the time when the assignment was updated.	N/A	
policy_definition_id	Specifies the ID of the compliance policy bound to the assignment.	Its value must be a string with up to 64 characters. Only letters, digits, and hyphens (-) are allowed.	Each assignment must have a compliance policy bound. **policy_definition_id** specifies the ID of the compliance policy bound to the assignment.
parameters	Specifies the values of assignment parameters.	**parameters**: Its value must be an object. • The key of **parameters** must be a string with up to 64 characters. Only letters and digits are allowed. • The value of **parameters** must be an object, and the value restrictions vary depending on the parameter type.	The compliance policy bound to the assignment has corresponding parameters. The number, type, and value range of those parameters depend on the selected compliance policy.

The following JSON indicates an assignment used to check whether an ECS in region 1 has tag (**env**: **production**).

```
{
  "id": "5fcd8696dfb78231e6f2f899",
  "name": "required-tag-check",
  "description": "A resource is non-compliant if it does not contain the specific tag.",
  "policy_filter": {
        "region_id": "regionid_1",
        "resource_provider": "ecs",
        "resource_type": "cloudservers",
        "tag_key": "env",
        "tag_value": "production"
  },
  "state": "Enabled",
  "created": "2020-12-07T01:34:14.266Z",
  "updated": "2020-12-07T01:34:14.266Z",
```

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```
 "policy_definition_id": "5fa9f89b6eed194ccb2c04db",
 "parameters": {
       "specifiedTagKey": {
       "value": "a"     },
       "specifiedTagValue": {
       "value": []
   }
 }
}
```

3.4.3 Evaluation Results

After an evaluation is triggered, the corresponding evaluation result (**PolicyState**) will be generated.

You can use a JSON expression to represent an evaluation result, as shown in **Table 3-5**.

Table 3-5 Evaluation result in JSON

Parameter	Description	Remarks
information	Specifies the evaluation result.	• If the compliance result is **NonCompliant**, this parameter indicates the specific cause for non-compliance. • If the compliance result is **Compliant**, this parameter is left blank.
domain_id	Specifies the account ID.	This parameter is used to distinguish users. **domain_id** in the evaluation result will not be left blank.
resource_id	Specifies the ID of the evaluated resource.	N/A
resource_name	Specifies the name of the evaluated resource.	N/A
resource_provider	Specifies the service the resource belongs to.	N/A
resource_type	Specifies the resource type.	N/A
compliance_state	Specifies the compliance result.	Possible values are: • **Compliant** • **NonCompliant**
policy_assignment_id	Specifies the ID of the assignment used for evaluation.	N/A

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Parameter	Description	Remarks
policy_definition_id	Specifies the ID of the policy used for evaluation.	N/A
evaluation_time	Specifies the evaluation timestamp.	N/A

The following JSON indicates a non-compliant evaluation result:

```
{
  "information": "ecs instances cannot have public ip",
  "domain_id": "domainidforpolicy",
  "resource_id": "special-ecs1-with-public-ip-with-tag",
  "resource_name": "ecs1-with-public-ip-with-tag",
  "resource_provider": "ecs",
  "resource_type": "cloudservers",
  "compliance_state": "NonCompliant",
  "policy_assignment_id": "5fa9f8a2501013093a192b07",
  "policy_definition_id": "5fa9f8a2501013093a192b06",
  "evaluation_time": 1604974757084
}
```

3.5 Compliance Policy Examples

3.5.1 Built-in Policies

allowed-ecs-flavors

The ECS resource is non-compliant if its flavor type is not in the allowed list

Parameter

- **listOfAllowedFlavors**: Specifies the list of allowed ECS specifications. The value is an array containing up to 10 elements.

allowed-images-by-id

The ECS resource is non-compliant if the image it used is not in the allowed list

Parameter

- **listOfAllowedImages**: Specifies the list of allowed image IDs. The value is an array containing up to 10 elements.

ecs-instance-in-vpc

The ECS resource is non-compliant if it is not in a specific VPC

Parameter

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- **vpcId**: Specifies the VPC ID, which is a string.

ecs-instance-no-public-ip

The ECS resource is non-compliant if it binds a public IP

Parameter

None

eip-unbound-check

The EIP resource is non-compliant if it is not bound to any other resources

Parameter

None

allowed-volume-specs

The EVS disk is non-compliant if its specification is not in the allowed list

Parameter

- **listOfAllowedSpecs**: Specifies the list of allowed EVS disk specifications. The value is an array containing up to 10 elements.

volumes-encrypted-check

The mounted EVS disk is non-compliant if it is not encrypted

Parameter

None

volume-unused-check

The EVS disk is non-compliant if it is unmounted

Parameter

None

required-tag-check

The resource is non-compliant if it does not contain a specific tag

Parameter

- **specifiedTagKey**: Specifies the tag key, which is a string.
- **specifiedTagValue**: Specifies the list of tag values. If the list is left blank, all values are allowed. The value is an array that can contain up to 10 elements.

3.5.2 Custom Policies

None

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4 Advanced Query

4.1 Overview

Advanced queries allow you to use ResourceQL to query how your resources in one or more regions are configured.

Advanced Queries allows you to query and browse your resources on Huawei Cloud. You can use ResourceQL to edit SQL statements and query resources in the query editor.

ResourceQL is part of the Structured Query Language (SQL) SELECT syntax. It can perform attribute-based query and aggregation on the current resource data. The query complexity varies. You can query resources by tag or resource identifier, or by using complex SQL statements. For example, you can query an ECS with a specified OS version.

You can use Advanced Queries to:

- Manage inventory. For example, you can query ECSs with certain specifications.
- Check security compliance of your resources. For example, you can query resources for which specific configuration attributes (EIP and encrypted EVS disks) have been enabled or disabled.
- Optimize costs. For example, query EVS disks that are not attached to any ECS.

4.2 Restrictions

To use Advanced Queries, you must have the **rms:resources:runQuery** permission.

To prevent a single user from occupying resources for queries for a long time and affecting other users:

- If the execution duration of a query statement exceeds 5 seconds, a timeout error will be returned.

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- If the query results of a query generate a large amount of data and exceed the upper limit of memory, an error indicating that the memory limit is exceeded will be returned.
- Only the first 1000 records are returned for a single query.

4.3 Creating a Query

Scenarios

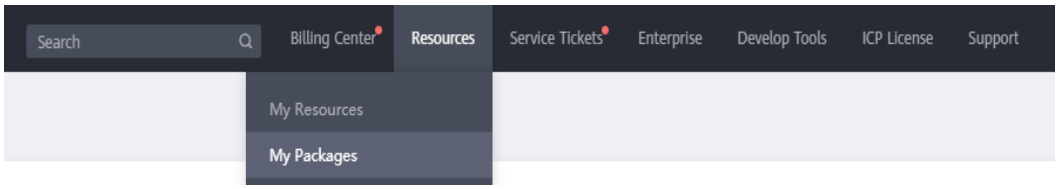
Before using Advanced Queries to query how a specific Huawei Cloud resource is configured, you need to create your own query and customize query statements based on resource configuration attributes.

Procedure

Step 1 Log in to the management console.

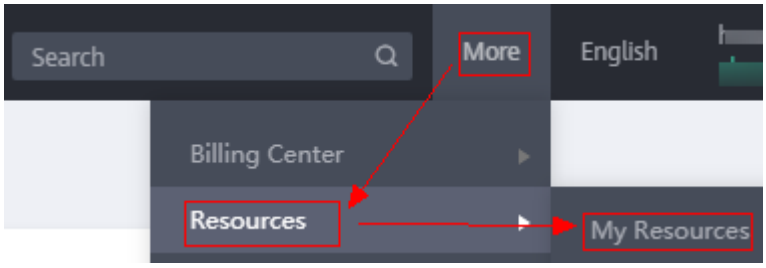
Step 2 In the upper right corner of the page, choose **Resources** > **My Resources**.

Figure 4-1 RMS service entry



If the resolution of the screen is low, in the upper right corner of the page, choose **More** > **Resources** > **My Resources**.

Figure 4-2 RMS service entry (low resolution)



Alternatively, click ☰ in the upper left corner of the page. In the service list that is displayed, under **Management & Governance**, select **Resource Management**.

Step 3 In the navigation pane on the left, choose **Advanced Queries**.

Step 4 Click **Create Query** in the upper right corner of the page.

Step 5 In the query editor, enter the query statement as prompted.

For details, see **Configuration Examples of Advanced Queries**.

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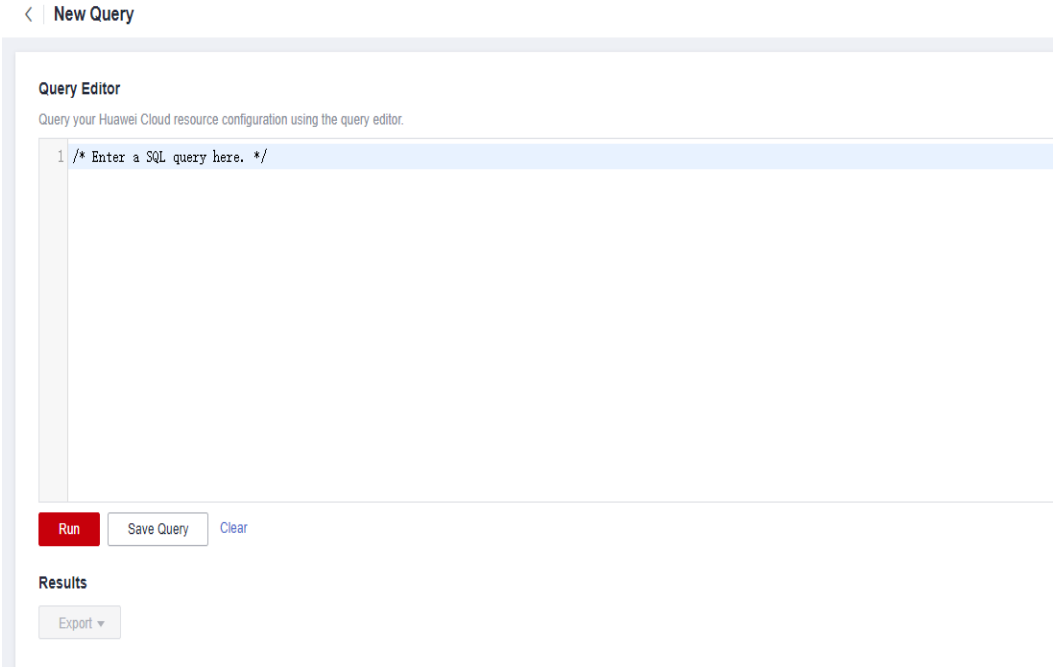
Figure 4-3 Query Editor

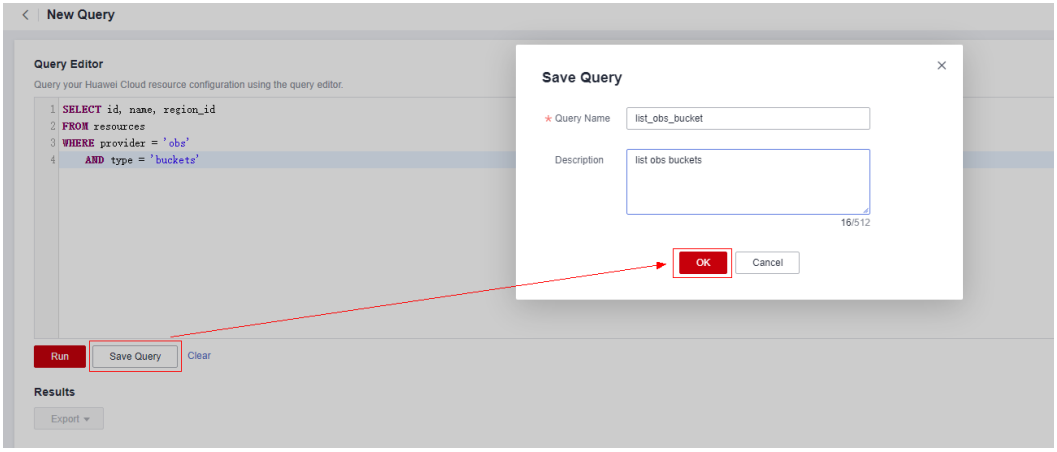


Step 6 Click **Save Query** and enter the query name and description.

The query name can contain only digits, letters, underscores (_), and hyphens (-).

Step 7 Click **OK**.

Figure 4-4 Save Query



NOTE

If the maximum number of custom queries has been reached, you cannot click **Save Query**. In addition, message **The maximum number of custom queries has been reached. Delete unnecessary queries.** is displayed in the upper right corner of the page.

When the maximum number of custom queries has been reached, you can run the queries and export the query results.

Step 8 Click **Run** and then view the query results. Only the first 1000 query results can be displayed and saved.

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Step 9 Click **Export** and select the format of the file to be exported (CSV or JSON).

----End

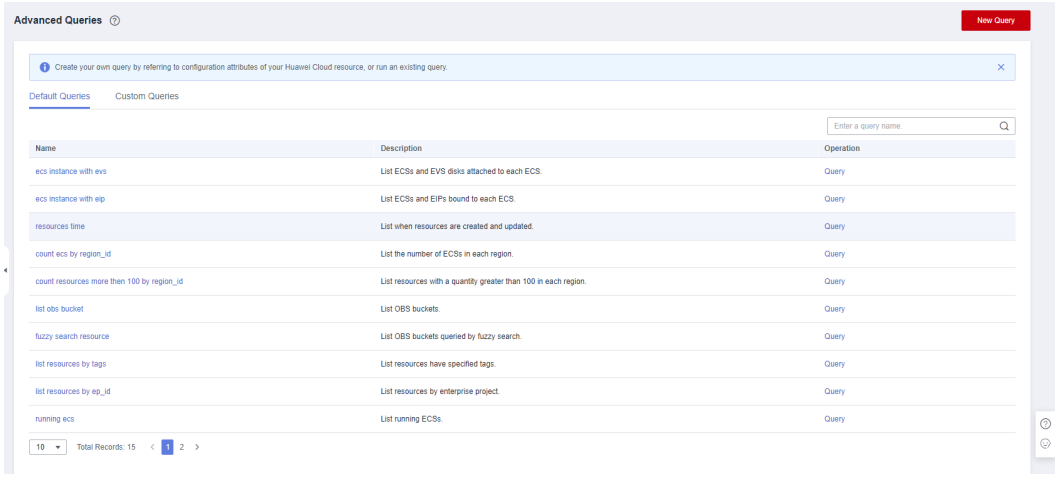
Other Operations

You can modify the name, description, and query statement of a query. After you click **Save As**, a new query is created. The following procedure uses a default query as an example to describe how to modify a query.

Step 1 In the navigation pane on the left, choose **Advanced Queries**.

By default, the default query list is displayed.

Figure 4-5 Default Queries



Step 2 Locate the default query and click **Query** in the **Operation**.

Alternatively, click the query name to go to the query overview page, and then click **Query** in the lower right corner to go to the **Query** page.

Step 3 In the query editor, modify the query statement as prompted.

For details, see **Configuration Examples of Advanced Queries**.

Step 4 Click **Save As** and enter the query name and description.

Step 5 In the dialog box that is displayed, click **OK**.

NOTE

New queries generated through the **Save As** operation is updated in the custom query list.

----End

Configuration Examples of Advanced Queries

ResourceQL uses a subset of the SQL SELECT syntax to query how your Huawei Cloud resources are configured and how they are related to one another. You do not need to call specific APIs for the query or use multiple APIs to download full data and manually analyze the data. ResourceQL can only query data from the **resources** table.

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Table 4-1 Parameter descriptions in table **resources**

Parameter	Type	Description
id	String	Specifies the resource ID.
name	String	Specifies the resource name.
provider	String	Specifies the cloud service name.
type	String	Specifies the resource type.
region_id	String	Specifies the region ID.
project_id	String	Specifies the project ID.
ep_id	String	Specifies the enterprise project ID.
checksum	String	Specifies the resource checksum.
created	Date	Specifies the time when the resource was created.
updated	Date	Specifies the time when the resource was updated.
provisioning_state	String	Specifies the status of the operation that causes the resource change.
tag	Array(Map<String,String>)	Specifies the resource tag.
properties	Map<String,Object>	Specifies the detailed properties of the resource.

Example quires are as follows:

- Example 1: List ECSs in the **Stopped** state.

```
SELECT name
FROM resources
WHERE provider = 'ecs'
    AND type = 'cloudservers'
    AND properties.status = 'SHUTOFF'
```

- Example 2: List EVS disks with certain specifications.

```
SELECT *
FROM resources
WHERE provider = 'evs'
    AND type = 'volumes'
    AND properties.size = 100
```

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- Example 3: List OBS buckets queried by fuzzy search.

```
SELECT *
FROM resources
WHERE provider = 'obs'
   AND 'type' = 'buckets'
   AND name LIKE '%figure%'
```

- Example 4: List ECSs and the EVS disks attached to each ECS.

```
SELECT ECS_EVS.id AS ecs_id, EVS.id AS evs_id
FROM (
   SELECT id, evs_id
   FROM (
   SELECT id, transform(properties.ExtVolumesAttached, x -> x.id) AS evs_list
   FROM resources
   WHERE provider = 'ecs'
      AND type = 'cloudservers'
   ) ECS
     CROSS JOIN UNNEST(evs_list) AS t (evs_id)
) ECS_EVS, (
   SELECT id
   FROM resources
   WHERE provider = 'evs'
      AND type = 'volumes'
   ) EVS
WHERE ECS_EVS.evs_id = EVS.id
```

- Example 5: List ECSs and the EIPs bound to each ECS.

```
SELECT ECS.id AS ECS_id, publicIpAddress AS ip_address
FROM (
   SELECT id, transform(properties.addresses, x -> x.addr) AS ip_list
   FROM resources
   WHERE provider = 'ecs'
      AND type = 'cloudservers'
) ECS, (
      SELECT name, properties.publicIpAddress
      FROM resources
      WHERE provider = 'vpc'
         AND type = 'publicips'
         AND properties.type = 'EIP'
         AND properties.status = 'ACTIVE'
   ) EIP
WHERE CONTAINS (ECS.ip_list, EIP.name)
```

- Example 6: List resources with a quantity greater than 100 in each region.

```
WITH counts AS (
   SELECT region_id, provider, type, count(*) AS number
   FROM resources
   GROUP BY region_id, provider, type
)
SELECT *
FROM counts
WHERE number > 100
```

For details about query statements, see **ResourceQL Syntax**.

4.4 Viewing a Query

Scenarios

You can view the name, description, and SQL statement of a query.

Procedure

Step 1 Log in to the management console.

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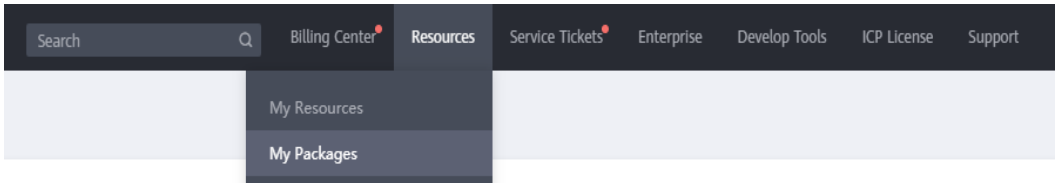
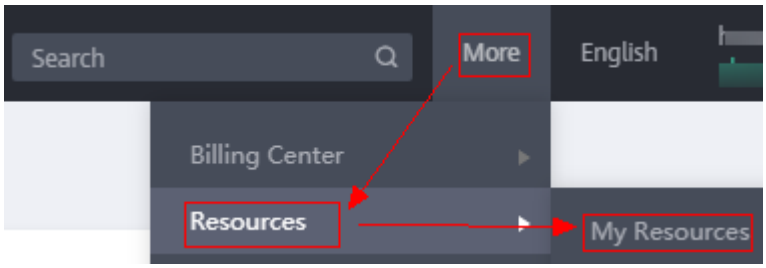
Step 2 In the upper right corner of the page, choose **Resources** > **My Resources**.

Figure 4-6 RMS service entry



If the resolution of the screen is low, in the upper right corner of the page, choose **More** > **Resources** > **My Resources**.

Figure 4-7 RMS service entry (low resolution)



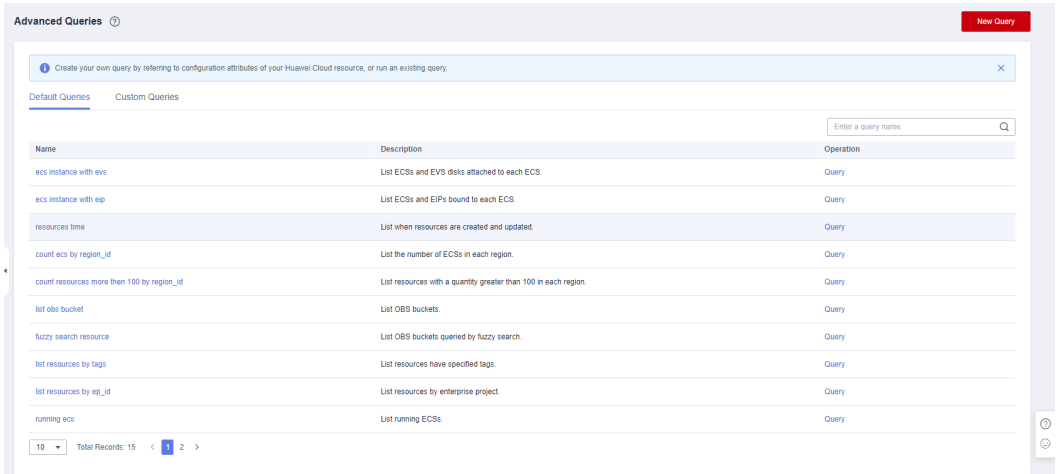
Alternatively, click ☰ in the upper left corner of the page. In the service list that is displayed, under **Management & Governance**, select **Resource Management**.

Step 3 In the navigation pane on the left, choose **Advanced Queries**.

By default, the default query list is displayed. To access the **Custom Queries** tab, click **Custom Queries**.

You can view the name and description of a query in the query list.

Figure 4-8 Default Queries



Step 4 Locate the query and click its name.

The SQL statement details in the query are displayed.

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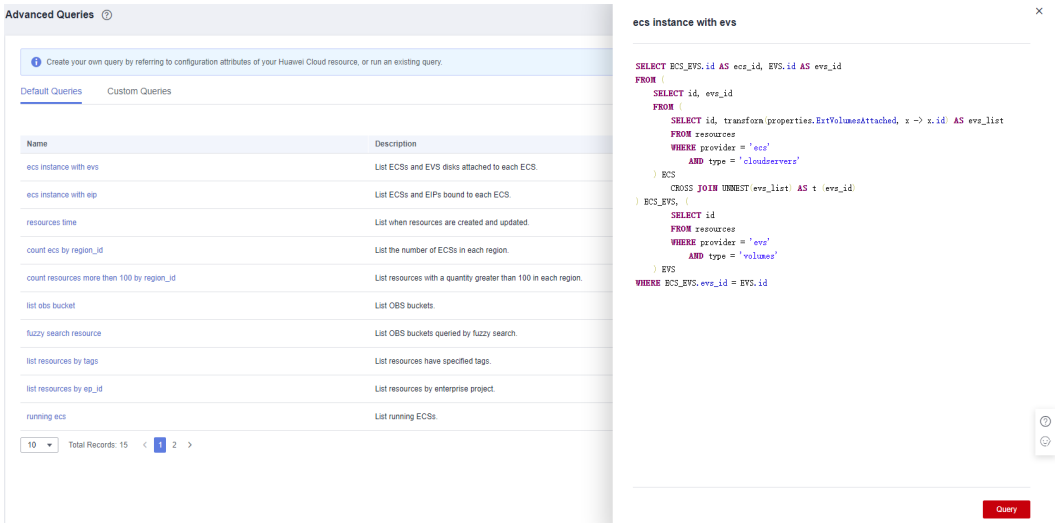
Figure 4-9 Query details



----End

4.5 Modifying a Query

Scenarios

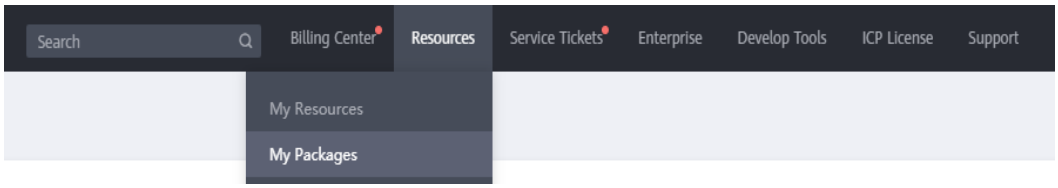
You can modify the statement of a custom query if needed.

Procedure

Step 1 Log in to the management console.

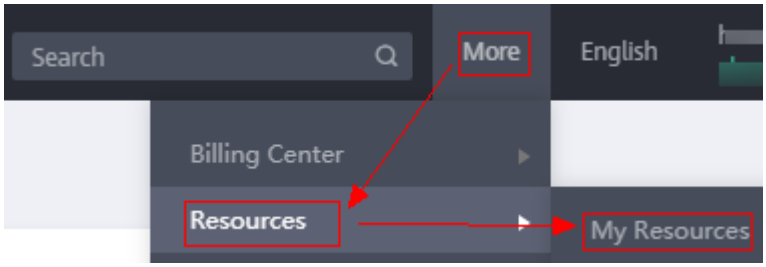
Step 2 In the upper right corner of the page, choose **Resources** > **My Resources**.

Figure 4-10 RMS service entry



If the resolution of the screen is low, in the upper right corner of the page, choose **More** > **Resources** > **My Resources**.

Figure 4-11 RMS service entry (low resolution)



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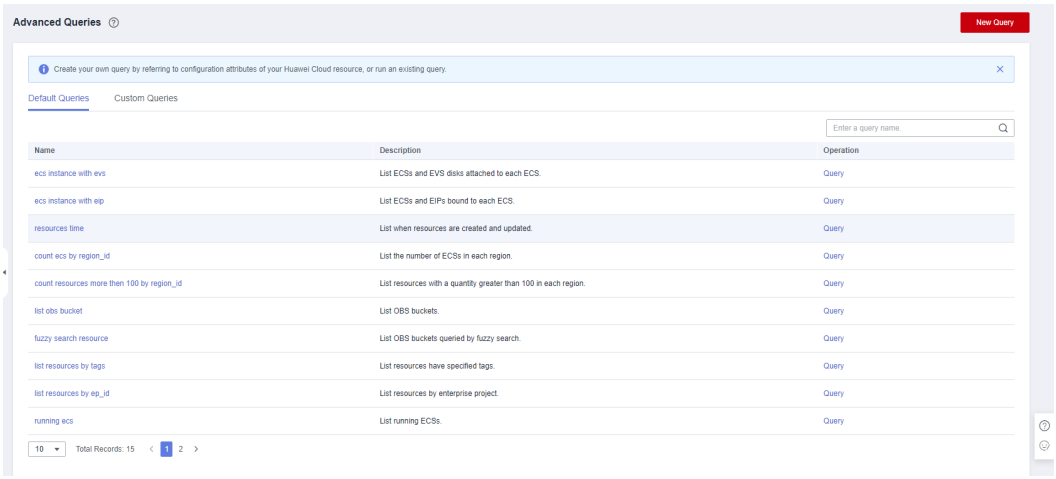
Alternatively, click ☰ in the upper left corner of the page. In the service list that is displayed, under **Management & Governance**, select **Resource Management**.

Step 3 In the navigation pane on the left, choose **Advanced Queries**.

Figure 4-12 Default Queries



Step 4 Click **Custom Queries**.

Step 5 Locate the default query and click **Query** in the **Operation**.

Alternatively, click the query name to go to the query overview page, and then click **Query** in the lower right corner to go to the **Query** page.

Step 6 In the query editor, modify the query statement as prompted.

For details, see **Configuration Examples of Advanced Queries**.

Step 7 Click **Save**.

----End

4.6 Deleting a Query

Scenarios

You can delete a custom query if you no longer need it.

Preset queries cannot be deleted.

Procedure

Step 1 Log in to the management console.

Step 2 In the upper right corner of the page, choose **Resources** > **My Resources**.

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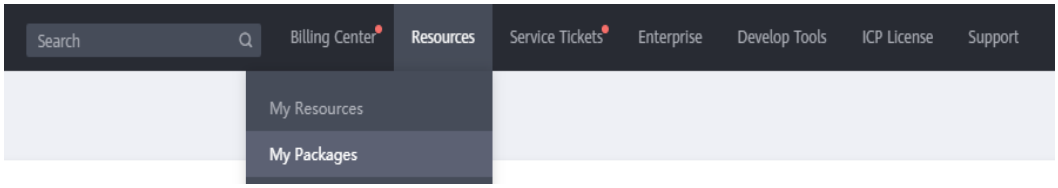
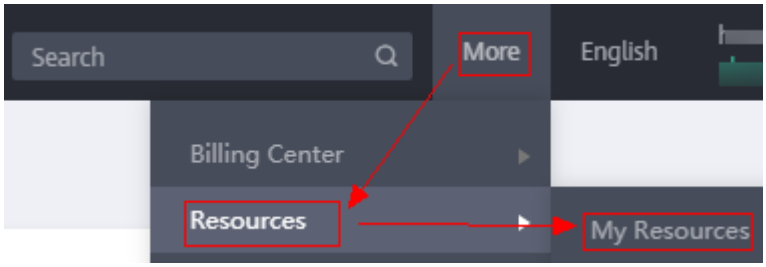
Figure 4-13 RMS service entry



If the resolution of the screen is low, in the upper right corner of the page, choose **More** > **Resources** > **My Resources**.

Figure 4-14 RMS service entry (low resolution)



Alternatively, click ☰ in the upper left corner of the page. In the service list that is displayed, under **Management & Governance**, select **Resource Management**.

Step 3 In the navigation pane on the left, choose **Advanced Queries**.

Step 4 Click **Custom Queries**.

Step 5 Locate the custom query to be deleted and click **Delete** in the **Operation** column.

Step 6 In the dialog box that is displayed, click **OK**.

----End

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5 Recording Resource Management Operations in CTS

5.1 Supported CTS Operations

Scenarios

With CTS, you can record operations associated with RMS for later query, audit, and backtrack operations.

Prerequisites

You have enabled CTS.

Key RMS Operations Recorded by CTS

Table 5-1 RMS operations recorded by CTS

Operation	Resource Type	Event Name
Adding an assignment	policy	createPolicyAssignments
Deleting an assignment	policy	deletePolicyAssignment
Modifying an assignment	policy	updatePolicyAssignment
Triggering a resource compliance evaluation	policy	runEvaluation
Disabling an assignment	policy	disablePolicyAssignment
Enabling an assignment	policy	enablePolicyAssignment
Creating or modifying the tracker configuration	trackerConfig	createOrUpdateTracker-Config

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Operation	Resource Type	Event Name
Deleting the tracker configuration	trackerConfig	deleteTrackerConfig
Creating an advanced query	storedQuery	createStoredQuery
Updating an advanced query	storedQuery	updateStoredQuery
Deleting an advanced query	storedQuery	deleteStoredQuery

5.2 Viewing Tracing Logs

Scenarios

After you enable CTS, the system starts recording operations on cloud resources. You can view the operation records of the last seven days on the CTS console.

This topic describes how to query or export the operation records of the past seven days on the CTS console.

Procedure

1. Log in to the management console.
2. Click  in the upper left corner and choose **Management & GovernanceManagement & Deployment** > **Cloud Trace Service**. The CTS console is displayed.
3. In the navigation pane on the left, choose **Trace List**.
4. Specify the search criteria as needed.
   - Search time range: In the upper right corner, choose **Last 1 hour**, **Last 1 day**, or **Last 1 week**, or specify a custom time range.
   - **Trace Type**, **Trace Source**, **Resource Type**, and **Search By**: Select a filter from the drop-down list.

     If you select **Resource ID** for **Search By**, specify a resource ID.

     If you select **Data** for **Trace Type**, you can only filter traces by tracker.
   - **Operator**: Select one or more operators from the drop-down list.
   - **Trace Status**: Available options include **All trace statuses**, **Normal**, **Warning**, and **Incident**.
5. Click **Query**.
6. Click **Export** on the right to export all traces in the query result as a CSV file. The file can contain up to 5000 records.
7. Click on the left of a trace to expand its details.

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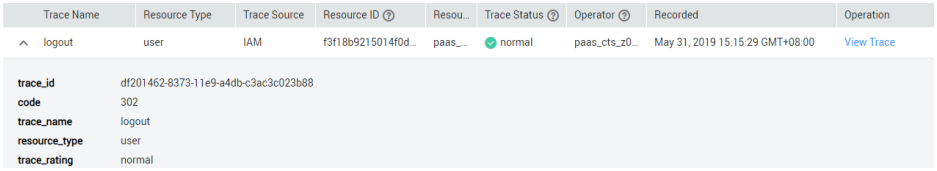

8. Click **View Trace** in the **Operation** column. The trace details are displayed.



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6 Appendix

6.1 Services and Regions Supported by RMS

For details, see **Supported Services and Regions**.

6.2 Relationships with Supported Resources

Table 6-1 Relationships with supported resources

Service	Resource Type	Relationship	Related Service	Related Resource Type
ECS	cloudservers	isContainedIn	VPC	vpcs
			MRS	mrs
		isAttachedTo	VPC	publicips
			EVS	volumes
		isAssociatedWith	VPC	securityGroups
			IMS	images
BMS	servers	isContainedIn	VPC	vpcs
		contains	VPC	publicips
		isAttachedTo	EVS	volumes
		isAssociatedWith	VPC	securityGroups
			IMS	images

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Service	Resource Type	Relationship	Related Service	Related Resource Type
HECS	hcloudservers	isContainedIn	VPC	vpcs
		contains	VPC	publicips
		isAttachedTo	EVS	volumes
		isAssociatedWith	VPC	securityGroups
			IMS	images
AS	Scaling Group	isContainedIn	VPC	vpcs
		isAssociatedWith	VPC	securityGroups
DCS	Memcached Instances	isContainedIn	VPC	vpcs
		isAssociatedWith	VPC	securityGroups
	Redis Instances	isContainedIn	VPC	vpcs
		isAssociatedWith	VPC	securityGroups
ELB	loadbalancers	contains	ELB	listeners
	listeners	isAttachedTo	ELB	loadbalancers
			VPC	publicips
VPC	vpcs	contains	ECS	cloudservers
			BMS	servers
			HECS	hcloudservers
			AS	Scaling Group
			DCS	Memcached Instances
			DCS	Redis Instances
			MRS	mrs
			VPC	publicips

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Service	Resource Type	Relationship	Related Service	Related Resource Type
	securityGroups	isAssociatedWith	ECS	cloudservers
			BMS	servers
			HECS	hcloudservers
			AS	Scaling Group
			DCS	Memcached Instances
			MRS	mrs
			DCS	Redis Instances
	bandwidths	contains	VPC	publicips
	publicips	isContainedIn	VPC	vpcs
			VPC	bandwidths
		isAttachedTo	ECS	cloudservers
			BMS	servers
			HECS	hcloudservers
			ELB	loadbalancers
			MRS	mrs
			NAT Gateway	Public NAT Gateway
EVS	volumes	isAttachedTo	ECS	cloudservers
			BMS	servers
			HECS	hcloudservers
IMS	images	isAssociatedWith	ECS	cloudservers
			BMS	servers

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Service	Resource Type	Relationship	Related Service	Related Resource Type
			HECS	hcloudservers
NAT Gateway	Public NAT Gateway	isAttachedTo	VPC	publicips
GaussDB NoSQL	instances	contains	GaussDB NoSQL	nodes
	nodes	isContainedIn	GaussDB NoSQL	instances
GaussDB	instance	contains	GaussDB	nodes
	nodes	isContainedIn	GaussDB	instance
MRS	mrs	isContainedIn	VPC	vpcs
		isAttachedTo	VPC	publicips
		isAssociatedWith	VPC	securityGroups
		contains	ECS	cloudservers

6.3 Message Notification Models

RMS uses SMN to send notifications of:

- resource changes (creation, modification, and deletion)
- resource relationship changes
- resource change notification dump completed
- resource snapshot dump completed

Notification Model of Resource Changes

Table 6-2 Parameter description

Parameter	Type	Description
notification_type	String	Specifies the message notification type.

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Parameter	Type	Description
notification_creation_time	String	Specifies the time when the message was sent. • The value is a UTC time complies with the ISO8601 format. • Example: **2018-11-14T08:59:14Z**
domain_id	String	Specifies the account ID.
detail	Object	Specifies the message details.

Table 6-3 detail parameters

Parameter	Type	Description
resource_id	String	Specifies the resource ID.
resource_type	String	Specifies the resource type.
event_type	Enum	Specifies the event type. Possible values are **CREATE**, **UPDATE**, and **DELETE**.
capture_time	String	Specifies the time when the event was captured. • The value is a UTC time complies with the ISO8601 format. • Example: **2018-11-14T08:59:14Z**
resource	Object	Specifies the resource details.

Table 6-4 resource parameters

Parameter	Type	Description
id	String	Specifies the resource ID.
name	String	Specifies the resource name.
provider	String	Specifies the cloud service name.
type	String	Specifies the cloud resource type.
region_id	String	Specifies the ID of the region where the resource is located.

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Parameter	Type	Description
project_id	String	Specifies the IAM project ID.
project_name	String	Specifies the IAM project name.
ep_id	String	Specifies the enterprise project ID.
ep_name	String	Specifies the enterprise project name.
checksum	String	Specifies the checksum.
created	String	Specifies the time when the cloud resource was created. • The value is a UTC time complies with the ISO8601 format. • Example: **2018-11-14T08:59:14Z**
updated	String	Specifies the last time when the cloud resource was updated. • The value is a UTC time complies with the ISO8601 format. • Example: **2018-11-14T08:59:14Z**
provisioning_state	String	Specifies the status of the operation that causes the resource change.
tags	Map	Specifies the cloud resource tag.
properties	Map	Specifies the cloud resource properties.

Notification Example of Resource Changes


```
{
  "detail": {
    "resource": {
      "id": "3e62c0e6-e779-469e-b0f2-35743f6229d1",
      "name": "ecs-51c8",
      "provider": "evs",
      "type": "volumes",
      "checksum": "b3bcc019cecbb701e324e0dcf2f283236685885236b49f5ba5ea2f5f788170a1",
      "created": "2020-08-12T07:14:41.638Z",
      "updated": "2020-08-12T07:14:44.423Z",
      "tags": {},
      "properties": {
        "shareable": false,
        "volumeType": "SATA",
        "metadata": {},
        "attachments": [],
        "replicationStatus": "disabled",
```

```
      "availabilityZone": "regionid1a",
      "bootable": "true",
      "userId": "059b5c937d80d3e41ff3c00a3c883d16",
      "volTenantAttrTenantId": "059b5e0a2500d5552fa1c00adada8c06",
      "size": "40",
      "encrypted": false,
      "volumeImageMetadata": {
        "virtualEnvType": "FusionCompute",
        "isregistered": "true",
        "imageSourceType": "uds",
        "minDisk": "40",
        "platform": "CentOS",
        "size": 0,
        "osVersion": "CentOS 7.5 64bit",
        "minRam": "0",
        "name": "CentOS 7.5 64bit",
        "checksum": "d41d8cd98f00b204e9800998ecf8427e",
        "osBit": "64",
        "osType": "Linux",
        "containerFormat": "bare",
        "supportXen": "true",
        "id": "e0adce3a-a4d2-4207-9018-69ce64b4426a",
        "supportKvm": "true",
        "diskFormat": "zvhd2",
        "imageType": "gold"
      },
      "links": [
        {
          "rel": "self",
          "href": "https://evs.regionid1.xxxxxx.com/v2/059b5e0a2500d5552fa1c00adada8c06/os-vendor-
volumes/3e62c0e6-e779-469e-b0f2-35743f6229d1"
        },
        {
          "rel": "bookmark",
          "href": "https://evs."regionid1.xxxxxx.com/059b5e0a2500d5552fa1c00adada8c06/os-vendor-
volumes/3e62c0e6-e779-469e-b0f2-35743f6229d1"
        }
      ],
      "volHostAttrHost": ""regionid1a-pod01."regionid1#0",
      "multiattach": false,
      "status": "available"
    },
    "region_id": ""regionid1",
    "project_id": "059b5e0a2500d5552fa1c00adada8c06",
    "project_name": ""regionid1",
    "ep_id": "0",
    "ep_name": "default",
    "provisioning_state": "Succeeded"
  },
  "resource_id": "3e62c0e6-e779-469e-b0f2-35743f6229d1",
  "resource_type": "evs.volumes",
  "event_type": "CREATE",
  "capture_time": "2020-08-12T07:15:15.116Z"
 },
 "notification_type": "ResourceChanged",
 "notification_creation_time": "2020-08-12T07:14:47.192Z",
 "domain_id": "059b5c937100d3e40ff0c00a7675a0a0"
}
```


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Notification Model of Resource Relationship Changes

Table 6-5 Parameter description

Parameter	Type	Description
notification_type	String	Specifies the message notification type.
notification_creation_time	String	Specifies the time when the message was sent. ● The value is a UTC time complies with the ISO8601 format. ● Example: **2018-11-14T08:59:14Z**
domain_id	String	Specifies the account ID.
detail	Object	Specifies the message details.

Table 6-6 detail parameters

Parameter	Type	Description
resource_id	String	Specifies the resource ID.
resource_type	String	Specifies the resource type.
event_type	Enum	Specifies the event type (**CHANGE**).
capture_time	String	Specifies the time when the event was captured. ● The value is a UTC time complies with the ISO8601 format. ● Example: **2018-11-14T08:59:14Z**

Notification Example of Resource Relationship Changes

```
{
  "detail": {
    "resource_id": "f65b06d1-d63b-438a-93cc-bdd55b304f0a",
    "resource_type": "ecs.cloudservers",
    "event_type": "CHANGE",
    "capture_time": "2020-08-12T07:15:14.257Z"
  },
  "notification_type": "ResourceRelationChanged",
  "notification_creation_time": "2020-08-12T07:14:56.296Z",
  "domain_id": "059b5c937100d3e40ff0c00a7675a0a0"
}
```

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Notification Model of Resource Snapshot Dump Completed

Table 6-7 Parameter description

Parameter	Type	Description
notification_type	String	Specifies the message notification type.
notification_creation_time	String	Specifies the time when the message was sent. • The value is a UTC time complies with the ISO8601 format. • Example: **2018-11-14T08:59:14Z**
domain_id	String	Specifies the domain ID.
detail	Object	Specifies the message details.

Table 6-8 detail parameters

Parameter	Type	Description
snapshot_id	String	Specifies the resource snapshot ID.
region_id	String	Specifies the ID of the region where the resource snapshot is located.
bucket_name	String	Specifies the name of the OBS bucket where the resource snapshot is dumped.
object_keys	Array of String	Specifies the resource snapshot path list.

Notification Example of Resource Snapshot Dump Completed

```
{
  "detail": {
    "snapshot_id": "474f85e6-72cd-442b-af4e-517120a5c669",
    "region_id": ""regionid1",
    "bucket_name": "test",
    "object_keys": [
      "RMSLogs/059b5c937100d3e40ff0c00a7675a0a0/Snapshot/
2020/8/11/059b5c937100d3e40ff0c00a7675a0a0_Snapshot_"regionid1_ResourceSnapshot_2020-08-10T170901_474f85e6-72cd-442b-af4e-517120a5c669_part-1.json.gz"
    ]
  },
  "notification_type": "SnapshotArchiveCompleted",
  "notification_creation_time": "2020-08-10T17:09:27.314Z",
```

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```
  "domain_id": "059b5c937100d3e40ff0c00a7675a0a0"
}
```

Notification Model of Resource Change Notification Dump Completed

Table 6-9 Parameter description

Parameter	Type	Description
notification_type	String	Specifies the message notification type.
notification_creation_time	String	Specifies the time when the message was sent. • The value is a UTC time complies with the ISO8601 format. • Example: **2018-11-14T08:59:14Z**
domain_id	String	Specifies the account ID.
detail	Object	Specifies the message details.

Table 6-10 detail parameters

Parameter	Type	Description
region_id	String	Specifies the ID of the region where the resource snapshot is located.
bucket_name	String	Specifies the name of the OBS bucket where the resource snapshot is dumped.
object_key	String	Specifies the resource snapshot path.

Notification Example of Resource Change Notification Dump Completed

```
{
   "detail": {
      "region_id": ""regionid1",
      "bucket_name": "test",
      "object_key": "RMSLogs/059b5c937100d3e40ff0c00a7675a0a0/Notification/2020/12/10/
NotificationChunk/
059b5c937100d3e40ff0c00a7675a0a0_Notification_"regionid2_NotificationChunk_VPC_VPCS_2020-12-10T02
4612Z_2020-12-10T050621Z.json.gz"
   },
   "notification_type": "NotificationArchiveCompleted",
   "notification_creation_time": "2020-12-10T05:09:28.002Z",
   "domain_id": "059b5c937100d3e40ff0c00a7675a0a0"
}
```

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6.4 Resource Dump Models

Table 6-11 Parameter description

Parameter	Type	Description
snapshot_id	String	Specifies the resource snapshot ID.
items	Array of Object	Specifies the item list of the resource snapshot.
snapshot_time	String	Specifies the time when the resource snapshot was dumped. • The value is a UTC time complies with the ISO8601 format. • Example: **2018-11-14T08:59:14Z**

Table 6-12 Resource snapshot items

Parameter	Type	Description
resource	Object	Specifies the resource itself.
relations	Array of Object	Specifies the item list of the resource relationship.

Table 6-13 resource parameters

Parameter	Type	Description
id	String	Specifies the resource ID.
name	String	Specifies the resource name.
provider	String	Specifies the cloud service name.
type	String	Specifies the cloud resource type.
region_id	String	Specifies the ID of the region where the resource is located.
project_id	String	Specifies the IAM project ID.
project_name	String	Specifies the IAM project name.
ep_id	String	Specifies the enterprise project ID.

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Parameter	Type	Description
ep_name	String	Specifies the enterprise project name.
checksum	String	Specifies the checksum.
created	String	Specifies the time when the cloud resource was created. • The value is a UTC time complies with the ISO8601 format. • Example: **2018-11-14T08:59:14Z**
updated	String	Specifies the last time when the cloud resource was updated. • The value is a UTC time complies with the ISO8601 format. • Example: **2018-11-14T08:59:14Z**
provisioning_state	String	Specifies the status of the operation that causes the resource change.
tags	Map	Specifies the cloud resource tag.
properties	Map	Specifies the cloud resource properties.

Table 6-14 Resource relationship items

Parameter	Type	Description
from_resource_id	String	Specifies the ID of the source resource.
to_resource_id	String	Specifies the ID of the associated resource.
from_resource_type	String	Specifies the type of the source resource.
to_resource_type	String	Specifies the type of the associated resource.
relation_type	String	Specifies the resource relationship type.

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Resource Dump Example


```
{
  "items": [
    {
      "resource": {
        "id": "c25ee8b3-c907-4cd4-9869-6c4b07c61a0b",
        "name": "rse-cdk-07-cdk-3sbz",
        "provider": "vpc",
        "type": "securityGroups",
        "region_id": ""regionid1",
        "project_id": "fc6d40abe7e54492b7c7aa5a29d6cbab",
        "project_name": "demo_project",
        "ep_id": "0",
        "ep_name": "default",
        "checksum": "4098715092c762b3eafe25be8eeda33a10b547033f9d59b6e18f5a960a1f805d",
        "updated": "2020-05-25T10:27:17.000Z",
        "created": "2020-05-25T10:27:17.000Z",
        "provisioning_state": "Succeeded",
        "tags": {},
        "properties": {}
      },
      "relations": [
        {
          "from_resource_id": "c25ee8b3-c907-4cd4-9869-6c4b07c61a0b",
          "to_resource_id": "0088a276-162b-4f07-aa40-f6ed8b801ca1",
          "from_resource_type": "vpc.securityGroups",
          "to_resource_type": "ecs.cloudservers",
          "relation_type": "isAssociatedWith"
        }
      ]
    }
  ],
  "snapshot_id": "6e40483d-5499-4440-a369-284e528f3d85",
  "snapshot_time": "2020-06-30T06:56:00.018Z"
}
```


6.5 Models of Resource Change Notification Dump

Table 6-15 Parameter description

Parameter	Type	Description
notification_items	Array of Object	Specifies the list of resource change notifications.

Notification Model of Resource Changes

Table 6-16 Parameter description

Parameter	Type	Description
notification_type	String	Specifies the message notification type.

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Parameter	Type	Description
notification_creation_time	String	Specifies the time when the message was sent. • The value is a UTC time complies with the ISO8601 format. • Example: **2018-11-14T08:59:14Z**
domain_id	String	Specifies the account ID.
detail	Object	Specifies the message details.

Table 6-17 detail parameters

Parameter	Type	Description
resource_id	String	Specifies the resource ID.
resource_type	String	Specifies the resource type.
event_type	Enum	Specifies the event type. Possible values are **CREATE**, **UPDATE**, and **DELETE**.
capture_time	String	Specifies the time when the event was captured. • The value is a UTC time complies with the ISO8601 format. • Example: **2018-11-14T08:59:14Z**
resource	Object	Specifies the resource details.

Table 6-18 resource parameters

Parameter	Type	Description
id	String	Specifies the resource ID.
name	String	Specifies the resource name.
provider	String	Specifies the cloud service name.
type	String	Specifies the cloud resource type.
region_id	String	Specifies the ID of the region where the resource is located.

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Parameter	Type	Description
project_id	String	Specifies the IAM project ID.
project_name	String	Specifies the IAM project name.
ep_id	String	Specifies the enterprise project ID.
ep_name	String	Specifies the enterprise project name.
checksum	String	Specifies the checksum.
created	String	Specifies the time when the cloud resource was created. • The value is a UTC time complies with the ISO8601 format. • Example: **2018-11-14T08:59:14Z**
updated	String	Specifies the last time when the cloud resource was updated. • The value is a UTC time complies with the ISO8601 format. • Example: **2018-11-14T08:59:14Z**
provisioning_state	String	Specifies the status of the operation that causes the resource change.
tags	Map	Specifies the cloud resource tag.
properties	Map	Specifies the cloud resource properties.

Example of Resource Change Notification Dump

```
{
   "notification_items": [
      {
         "detail": {
            "resource": {
               "id": "ea05ef41-8bd6-4a9c-af39-244e1ec448eb",
               "name": "as-group-test",
               "provider": "as",
               "type": "scalingGroups",
               "checksum": "",
               "region_id": ""regionid1",
               "project_id": "068d54ceca00d5302f70c00aaf6a471c",
               "project_name": "test",
               "ep_id": "0",
               "ep_name": "default"
            },
            "resource_id": "ea05ef41-8bd6-4a9c-af39-244e1ec448eb",
```

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```
            "resource_type": "as.scalingGroups",
            "event_type": "DELETE",
            "capture_time": "2020-12-08T09:30:27.158Z"
        },
        "notification_type": "ResourceChanged",
        "notification_creation_time": "2020-12-08T09:30:27.272Z",
        "domain_id": "059b5c937100d3e40ff0c00a7675a0a0"
    }
  ]
}
```

6.6 DSL Syntax

DSL consists of a logical operator shown in the following figure. Finally, a Boolean value is returned.

```
{
  <logical operator>: <condition> | [<condition>, ..., <condition>]
}
```

6.6.1 Logical Operators

Supported logical operators are:

- "not": <condition>
- "allOf": [<condition>, ..., <condition>]
- "anyOf": [<condition>, ..., <condition>]

not inverts the result of the condition.

allOf evaluates true only if all included conditions are true, and evaluates false as long as one included condition is false.

anyOf evaluates true as long as one included condition is true, and evaluates false if all included conditions are false.

allOf and **anyOf** both implement short-circuit evaluation. They evaluate the conditions in the subsequent list in sequence.

If the return result of a condition is false, **allOf** returns false and the subsequent conditions are not calculated.

If the return result of a condition is true, **anyOf** returns true and the subsequent conditions are not calculated.

6.6.2 Conditions

A condition can be a single judgment statement or a nested logical operator.

The format of the judgment statement is as follows. The returned value is a Boolean value. The judgment statement is used to determine whether a specific value meets a specific requirement.

```
{
  "value": "...",
  "comparator": "...",
  "pattern": "..."
}
```

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NOTE

- **value** can be a constant or an expression. Its value type depends on the selected comparison operator. Example: **true**, **1**, **"hello"**, or **"${resource().properties.metadata}"**
- **comparator**: specifies the comparison operator.
- **pattern** can be a constant or an expression.

The following comparators are supported:

- **equals** compares whether **value** is equal to **pattern**. **value** can be a string, an integer, or a Boolean, so is **pattern**.
- **notEquals**: Its result is opposite to the **equals** result.
- **equalsIgnoreCase** compares whether **value** is equal to **pattern** in case-insensitive mode. **value** must be a string, so is **pattern**.
- **like** performs fuzzy match of **value** and **pattern**. You can add an asterisk (*) to **pattern** to match zero or multiple random characters, or add a question mark (?) to **pattern** to match any random character. **value** must be a string, so is **pattern**.
- **notLike**: Its result is opposite to the **like** result.
- **likeIgnoreCase** performs fuzzy match of **value** and **pattern** in case-insensitive mode. **value** must be a string, so is **pattern**.
- **contains** determines whether **pattern** is a substring of **value**. **value** must be a string, so is **pattern**.
- **notContains**: Its result is opposite to the **contains** result.
- **in** determines whether **value** is in **pattern**. **Pattern** must be an array. **value** can be a string or an integer.
- **notIn**: Its result is opposite to the **in** result.
- **containsKey** determines whether **value** contains the key-value pattern. **value** must be an object. **pattern** must be a string.
- **notContainsKey**: Its result is opposite to the **containsKey** result.
- **less** determines whether **value** is smaller than **pattern**. **value** can be a string or an integer, so is **pattern**.
- **lessOrEquals** determines whether **value** is smaller than or equal to **pattern**. **value** can be a string or an integer, so is **pattern**.
- **greater** determines whether **value** is greater than **pattern**. **value** can be a string or an integer, so is **pattern**.
- **greaterOrEquals** determines whether **value** is greater than or equal to **pattern**. **value** can be a string or an integer, so is **pattern**.

The following is an example of nested logical operators in a condition:

```
{
  "not": {
    "anyOf": [
      {
        "value": "${resource().properties.metadata}",
        "comparator": "notContainsKey",
        "pattern": "systemEncrypted"
      },
      {
        "value": "${resource().properties.metadata.systemEncrypted}",
        "comparator": "equals",
```

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```
      "pattern": "0"
    }
   ]
  }
}
```

6.6.3 Expressions

value and **pattern** can be a constant or an expression. An expression is contained in ${}. You can use the following functions in the expression.

Table 6-19 String functions

Function	Parameter	Returned Value	Description
base64()	string	string	Encodes a specific string using Base64.
base64ToString()	string	string	Decodes a Base64-encoded string.
concat()	string, string	string	Concatenates two strings.
contains()	string, string	bool	Determines whether parameter 2 is a substring of parameter 1.
empty()	string	bool	Determines whether a string is left blank.
endsWith()	string, string	bool	Determines whether parameter 1 ends with parameter 2.
indexOf()	string, string	int	Returns the position of parameter 2 when it appears for the first time in parameter 1. If parameter 2 does not appear, -1 is returned.
lastIndexOf()	string, string	int	Returns the position of parameter 2 when it appears for the last time in parameter 1. If parameter 2 does not appear, -1 is returned.
length()	string	int	Returns the length of a string.
replace()	string, string, string	string	Replaces parameter 2 in parameter 1 with parameter 3.
startsWith()	string, string	bool	Determines whether parameter 1 starts with parameter 2.
toLower()	string	string	Converts all letters in a string into lowercase letters.
toUpper()	string	string	Converts all letters in a string into uppercase letters.

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Function	Parameter	Returned Value	Description
equals()	string, string	bool	Checks whether two strings are the same.
greater()	string, string	bool	Determines whether parameter 1 is greater than parameter 2.
greaterOrEquals()	string, string	bool	Determines whether parameter 1 is greater than or equal to parameter 2.
less()	string, string	bool	Determines whether parameter 1 is smaller than parameter 2.
lessOrEquals()	string, string	bool	Determines whether parameter 1 is no more than parameter 2.
split()	string, string	array	Returns the result of separating parameter 1 by parameter 2.
substring()	string, int, int	string	Obtains the substring of parameter 1. The start position of the substring is determined by parameter 2 and the length is determined by parameter 3.

Table 6-20 Numeric functions

Function	Parameter	Returned Value	Description
add()	int, int	int	Adds two integers.
max()	int, int	int	Uses the greater of the two integers.
min()	int, int	int	Uses the smaller of the two integers.
sub()	int, int	int	Calculates the result of parameter 1 minus parameter 2.
equals()	int, int	bool	Determines whether two integers are the same.
greater()	int, int	bool	Determines whether parameter 1 is greater than parameter 2.

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Function	Parameter	Returned Value	Description
greaterOrEquals()	int, int	bool	Determines whether parameter 1 is greater than or equal to parameter 2.
less()	int, int	bool	Determines whether parameter 1 is smaller than parameter 2.
lessOrEquals()	int, int	bool	Determines whether parameter 1 is no more than parameter 2.

Table 6-21 Array functions

Function	Parameter	Returned Value	Description
concat()	array, array	array	Concatenates two arrays.
contains()	array, any	bool	Determines whether parameter 2 is in array parameter 1.
empty()	array	bool	Determines whether the array is left blank.
first()	array	any	Returns the first element in the array.
last()	array	any	Returns the last element in the array.
length()	array	int	Returns the number of elements in the array.

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Table 6-22 Object functions

Function	Parameter	Returned Value	Description
contains()	object, string	bool	Determines whether parameter 1 contains key-value parameter 2.
getValue()	object, string	any	Obtains the value corresponding to the key-value parameter 2 in parameter 1.
empty()	object	bool	Determines whether the object is left blank.
length()	object	int	Returns the number of key-value pairs in the object.

Table 6-23 Logical functions

Function	Parameter	Returned Value	Description
if()	bool, any, any	any	Determines whether parameter 1 is true. If yes, parameter 2 is returned. If no, parameter 3 is returned.
and()	bool, bool	bool	Determines whether both parameter 1 and parameter 2 are true.
or()	bool, bool	bool	Determines whether at least one of parameter 1 and parameter 2 is true.
not()	bool	bool	Inverts the input Boolean value.

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Table 6-24 Functions related to resource compliance

Function	Parameter	Returned Value	Description
resource()	None	object	Returns the structure of the current evaluated resource.
parameters()	string	any	Returns a parameter defined in the **parameters** section.

In addition to use function computing in expressions, you can use:

- a dot (.) to access a field in an object, for example, **resource().properties.metadata.systemEncrypted**.
- **CASE WHEN** statement

```
CASE WHEN condition1 THEN value1
    WHEN condition2 THEN value2
    ...
    ELSE defaultValue END
```

6.7 ResourceQL Syntax

6.7.1 Syntax Overview

ResourceQL provides SQL-like functions, allowing you to flexibly query your cloud resources.

```
SELECT name, created, updated FROM resources WHERE region_id = 'cn-north-4'
```

The statement is case insensitive. That is, SELECT COUNT(*)... and select CoUnT(*)... are the same. Use single quotation marks to represent the literal of a string.

ResourceQL supports the following data types: For the array type, [] is used to index a position, and the number starts from 1.

Table 6-25 Supported data types

Type Name	Type
Integer	int/integer
Float	float/double
Boolean	boolean
Array	array

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Type Name	Type
String	string
Dictionary	object
Timestamp	date

All your cloud resources form a table. The table name is fixed to **resources**. Each row in the table records a piece of data. The conventions of each column are as follows:

Table 6-26 Parameter descriptions in table **resources**

Parameter	Type	Description
id	String	Specifies the resource ID.
name	String	Specifies the resource name.
provider	String	Specifies the cloud service name.
type	String	Specifies the resource type.
region_id	String	Specifies the region ID.
project_id	String	Specifies the project ID.
ep_id	String	Specifies the enterprise project ID.
checksum	String	Specifies the resource checksum.
created	Date	Specifies the time when the resource was created.
updated	Date	Specifies the time when the resource was updated.
provisioning_state	String	Specifies the status of the operation that causes the resource change.
tag	Array(Map<String,String>)	Specifies the resource tag.
properties	Map<String,Object>	Specifies the detailed properties of the resource.

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Different types of resources can be distinguished by **provider** and **type**, and structures of their **properties** field are different. For example, **cloudservers** of an ECS has **properties** that contain 23 fields, and a VPC has **properties** that contain only three fields.

For a specific resource type, you can use commas (.), a nesting method, to query the specific fields in **properties**. For example, if **properties** of an ECS contain the **status** and **addresses** fields, you can run the following statement to query the running ECS and its address:

```
SELECT name, created, updated, properties.addresses FROM resources
   WHERE provider = 'ecs' AND type = 'cloudservers' AND properties.status = 'ACTIVE'
```

6.7.2 Introduction to Syntax

Symbol Conventions

In this section, the words that need to be typed in the original form are capitalized, and the characters that need to be typed in the original form are enclosed in single quotation marks (').

'[x]' indicates that statement 'x' can be used once or not.

'(x)' indicates that statement 'x' is a whole. '(x, ...)' indicates that statement 'x' can be used once or multiple times. If statement 'x' are used multiple times, use commas (,) to separate them.

'|' indicates all possible alternatives.

'expression' indicates any expression. Specially, 'bool_expression' indicates any Boolean expression.

'identifier' indicates a valid identifier. An identifier can contain letters, digits, and underscores (_), and cannot start with a digit.

'column_name' indicates a valid field name. It can be 'identifier' or multiple identifiers, for example,'A.id'.

'table_name' indicates a valid table name. The ResourceQL syntax specifies that 'table_name' must be 'resources'.

A unit enclosed in double quotation marks ("") is considered as a whole. For example, to indicate a column name containing special characters, add double quotation marks ("") before and after the column name.

Basic Query Syntax

```
[WITH (with_item, ...)]
SELECT [DISTINCT | ALL] (select_item, ...)
[FROM (from_item, ...)]
[WHERE bool_expression]
[GROUP BY [DISTINCT | ALL] (expression, ...)]
[HAVING booleanExpression]
[ORDER BY (expression [ASC | DESC] [NULLS (FIRST | LAST)], ...)]
[LIMIT number]
```

The field in 'select_item' can be renamed. Operation can be performed on the filed values. 'select_item' supports the query of all fields in a table.

```
select_item = (expression [[AS] column_name_aias]) | *
```

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'from_item' support the join function and multiple subqueries, and the table name can be renamed.

```
from_item = table_name [[AS] table_name_aias]
        | (from_item join_type from_item [(ON bool_expression) | USING(column_name, ...)])
        | '(' query ')'
```

'with_item' is used to customize queries to facilitate subsequent invoking.

```
with_item = identifier AS '(' query ')'
```

For example, to list resources with a quantity greater than 100 in each region, run the following SQL statement:

```
WITH counts AS (
   SELECT region_id, provider, type, count(*) AS number FROM resources
   GROUP BY region_id, provider, type
) SELECT * FROM counts WHERE number > 100
```

Numeric Operation and Boolean Operation

ResourceQL supports binary mathematical operations on integers and floating digits. The following operators are supported: +, -, *, /, %

Values of the same type can be compared. The following comparison operators are supported: <, >, <=, >=, =, <>, != (Both <> and != indicate not equal.) Values are compared in size, and strings are compared in lexicographic order. Values and sets can also be compared. In this case, one of 'ALL | SOME | ANY' is on the right of the comparison operator, which is used to specify the comparison range. 'All' indicates that all elements in the set must be met. 'SOME/ANY' indicates that at least one element must be met.

```
expression ('=' | '<>' | '!=' | '<' | '>' | '<=' | '>=')
expression
expression ('=' | '<>' | '!=' | '<' | '>' | '<=' | '>=')
[ALL | SOME | ANY] '(' query ')'
```

'bool_expression' indicates any Boolean expression. (**True** or **False** is returned after the operation.) It includes the following syntax:

```
NOT bool_expression
bool_expression (AND | OR) bool_expression
expression [NOT] BETWEEN expression AND expression
expression [NOT] IN '(' query ')'
EXISTS '(' query ')'
expression [NOT] LIKE pattern [ESCAPE escape_characters]
expression IS [NOT] NULL
expression IS [NOT] DISTINCT FROM expression
```

In particular, operator '||' concatenates the left and right values and returns a new value. The left and right values are of the same type and are both arrays or strings.

Timestamp

ResourceQL supports the query of fields of the time type. The query result is converted to the zero time zone and returned in ISO Date format. The result is saved in milliseconds.

Time types can be connected by comparison operators. If you want to use a literal that indicates time, use timestamps to write 'time'. 'time' can be in any ISODate format or a common time format. The following formats of 'time' are allowed:

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2019-06-17T12:55:42.233Z

2019-06-17T12:55:42Z

2019-06-17 12:55:42

2019-06-17T12:55:42.00 + 08:00

2019-06-17 05:55:40 - 06:00

2019-06-17

2019

If the time zone is not added, the zero time zone is used by default. If the 24-hour time is not added, 0:00 is used by default. If the month is not added, January 1 is used by default.

For example, to sort resources that have been created since 12:55:00 on September 12, 2020 by update time in descending order, run the following statement:

```
select name, created, updated from resources
where created >= timestamp '2020-09-12T12:55:00Z'
order by updated DESC
```

Fuzzy Search

```
string LIKE pattern [ESCAPE escape_characters]
```

'LIKE' is used to determine whether a character string complies with a pattern. If you want to express the literal of ' %' and '_' in the pattern, you can specify an escape character (for example, '#') after 'ESCAPE' and write '# %' and '#_' in the pattern.

Wildcard ' %' indicates that zero or multiple characters are matched.

Wildcard '_' indicates that one character is matched.

The fuzzy query of OBS buckets can be written in the following format:

```
SELECT name, id FROM resources
   WHERE provider = 'obs' AND type = 'buckets' AND name LIKE '%figure%'
```

or

```
SELECT name, id FROM resources
   WHERE provider = 'obs' AND type = 'buckets' AND name LIKE '%figure#_%' ESCAPE '#'
```

Condition Functions

The return value of CASE varies according to the actual situation. It can be used in either of the following ways:

- Calculate the value of a given expression and return the corresponding result based on the value.
- Calculates the value of each bool_expression in sequence, finds the first expression that meets the requirements, and returns the result.

```
CASE expression
   WHEN value1 THEN result1
   [WHEN value2 THEN result2]
   [...]
```

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```
    [ELSE result]
END
CASE
    WHEN condition1 THEN result1
    WHEN condition2 THEN result2
    [...]
    [ELSE result]
END
```

IF can be used in either of the following ways:

- 'IF(bool_expression, value)': If the Boolean expression value is true, 'value' is returned. Otherwise, NULL is returned.
- 'IF(bool_expression, value1, value2)': If the Boolean expression value is true, 'value1' is returned. Otherwise, 'value2' is returned.

Using Functions to Simplify Queries

ResourceQL provides various functions to simplify query. For details about the functions, see **Functions**.

ResourceQL supports lambda expressions. The arguments of some functions may be another function. In this case, it is convenient to use the lambda expression.

For example, to list ECSs and the EVS disks attached to each ECS, run the following SQL statement:

```
SELECT ECS.id AS ecs_id, EVS.id AS evs_id FROM
    (SELECT id, transform(properties.ExtVolumesAttached, x -> x.id) AS evs_list
    FROM resources WHERE provider = 'ecs' AND type = 'cloudservers') ECS
    (SELECT id FROM resources WHERE provider = 'evs' AND type = 'volumes') EVS
    WHERE contains(ecs.evs_list, evs.id)
```

'contains(a, element) → boolean' determines whether an element appears in array a.

'transform(array(T), function(T, S)) → array(S) can convert an array of a certain type into an array of another type.

Join and Unnest

ResourceQL supports 'JOIN' and 'UNNEST'. 'JOIN' can be classified into the following types:

- [INNER] JOIN
- LEFT [OUTER] JOIN
- RIGHT [OUTER] JOIN
- FULL [OUTER] JOIN

'JOIN' must be followed by 'USING(...)' or 'ON <bool_expression>'.

'USING' is used to specify the names of columns to join.

'ON' accepts a Boolean expression and merges values of 'JOIN' if the value of the Boolean expression is true. To ensure performance, at least one equation must exist in the conjunctive normal form (CNF) of a Boolean expression, and the operation content at the left and right ends of the equation is provided by the left and right tables separately.

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You can add 'NATURAL' before 'JOIN' to indicate a connection. In this case, you do not need to add 'USING' or 'ON' after 'JOIN'.

'UNNEST' can unpack an array into a table. With 'WITH ORDINALITY', there is an auto-increment column. The format is as follows:

```
table_name CROSS JOIN UNNEST '(' (expression, ...) ')' [WITH ORDINALITY]
```

Note that 'CROSS JOIN' can only be used to connect to 'UNNEST'. ResourceQL does not support 'CROSS JOIN' in other formats.

The preceding example of querying the association between an ECS and an EVS disk can also be written in the following format:

```
SELECT ECS_EVS.id AS ecs_id, EVS.id AS evs_id FROM
    (SELECT id, evs_id FROM (SELECT id, transform(properties.ExtVolumesAttached, x ->x.id) AS evs_list
FROM resources WHERE provider = 'ecs' AND type = 'cloudservers') ECS
     CROSS JOIN UNNEST(evs_list) AS t (evs_id)) ECS_EVS,
     (SELECT id FROM resources WHERE provider = 'evs' AND type = 'volumes') EVS
     WHERE ECS_EVS.evs_id = EVS.id
```

6.7.3 Functions

ResourceQL supports the following functions:

Table 6-27 Mathematical operation functions

Function	Description
abs(x)	Returns the absolute value of x.
ceil/ceiling(x)	Returns *x* rounded up to the nearest integer.
floor(x)	Returns *x* rounded down to the nearest integer.
pow/power(x, p) → double	Returns *x* raised to the power of *p*.
round(x)	Returns *x* rounded to the nearest integer.
round(x, d)	Returns *x* rounded to *d* decimal places.
sign(x)	Returns the signum function of *x*, that is: • 1 if the argument is greater than 0 • -1 if the argument is less than 0

Table 6-28 String functions

Function	Description
concat(str1, str2, ..., strn) → string	Returns the concatenation of *str1*, *str2*, ..., *strN*.

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Function	Description
chr(n) → string	Returns the Unicode code point *n* as a single character string.
codepoint(str) → int	Returns the Unicode code point of the only character of *str*.
length(str) → int	Returns the length of *str* in characters.
lower/upper(str) → string	Converts *str* to lowercase or uppercase.
position(str, sub) → int	Returns the starting position of the first instance of *sub* in *str*. Positions start with 1. If not found, 0 is returned.
replace(str, sub) → string	Removes all instances of *sub* from *str*.
replace(str, sub, replace) → string	Replaces all instances of *sub* with *replace* in *str*.
reverse(str) → string	Returns *str* with the characters in reverse order.
split(str, delimiter) → array	Splits *str* on *delimiter* and returns an array.
strpos(str, sub) → int	Returns the starting position of the first instance of *sub* in *str*. Positions start with 1. If not found, 0 is returned.
strpos(str, sub, n) -> int	Returns the position of the N-th instance of *sub* in *str*. Positions start with 1. If not found, 0 is returned.
strrpos(str, sub) → int	Returns the starting position of the last instance of *sub* in *str*. Positions start with 1. If not found, 0 is returned.
strrpos(str, sub, n) -> int	Returns the position of the N-th instance of *sub* in *str* starting from the end of the string. Positions start with 1. If not found, 0 is returned.
substr(str, start) → string	Returns the rest of *str* from the starting position *start*.
substr(str, start, length) → string	Returns a substring from *str* of length *length* from the starting position *start*.
trim/lstrim/rstrim(str)	Removes leading and trailing whitespace from *str*.

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Table 6-29 Array functions

Function	Description
all_match(array(T), function(T, boolean)) → boolean	Returns whether all elements of an array match the given predicate.
any_match(array(T), function(T, boolean)) → boolean	Returns whether any elements of an array match the given predicate.
array_average(a) → double	Returns the average of all non-null elements of *a*.
array_distinct(a) → array	Removes duplicate values from array *a*.
array_duplicates(a) → array	Returns a set of elements that occur more than once in array *a*.
array_frequency(a) → map	Returns a map: keys are the unique elements in *array*, values are how many times the key appears.
array_has_duplicates(a) → boolean	Returns a boolean: whether *a* has any elements that occur more than once.
array_intersect(a, b) → array	Returns an array of the elements in the intersection of *a* and *b*, without duplicates.
array_join(x, delimiter) → string	Concatenates the elements of the given array using the delimiter.
array_join(x, delimiter[, null_replacement]) → string	Concatenates the elements of the given array using the delimiter and an optional string to replace nulls.
array_max/array_min(a)	Returns the maximum or minimum value of input array *a*.
array_position(a, element) → int	Returns the position of the first occurrence of the *element* in array *a* (or 0 if not found).
array_position(a, element, instance) → int	Returns the position of the first occurrence of the *element* in array *a*. If no matching element instance is found, 0 is returned. If *instance* > 0, returns the position of the *instance*-th occurrence of the *element* in array *a*. If *instance* < 0, return the position of the *instance*-to-last occurrence of the *element* in array *a*.
array_remove(a, element) → array	Removes all elements that equal *element* from array *a*.

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Function	Description
array_sort(a) → array	Sorts and returns array *a*.
array_sort(array(T), function(<T, T>, int)) → array	Sorts and returns the *array* based on the given comparator *function*. The comparator will take two nullable arguments representing two nullable elements of the *array*. It returns -1, 0, or 1 as the first nullable element is less than, equal to, or greater than the second nullable element.
array_sum(a)	Returns the sum of all non-null elements of *a*.
array_overlap(a, b) → boolean	Tests if arrays *a* and *b* have any non-null elements in common.
array_union(a, b) → array	Returns an array of the elements in the union of *a* and *b*, without duplicates.
cardinality(a) → int	Returns the cardinality (size) of array *a*.
concat(a1, a2, ...) → array	Concatenates the arrays *a1*, *a2*, ... This function provides the same functionality as the SQL-standard concatenation operator (||).
contains(a, element) → boolean	Returns true if the array *a* contains the *element*.
element_at(a, index)	Returns element of *a* at given *index*. If *index* < 0, element_at accesses elements from the last to the first.
filter(array(T), function(T, boolean)) → array(T)	Constructs an array from those elements of *array* for which *function* returns true.
none_match(array(T), function(T, boolean)) → boolean	Returns whether no elements of an array match the given predicate.
reverse(a) → array	Returns an array which has the reversed order of array *a*.
sequence(start, stop, step)	Generates a sequence of timestamps from *start* to *stop*, incrementing by *step*. It is similar to the range() function in Python, which returns a sequence of numbers, starting from 0 by default, and increments by 1 (by default), and stops before a specified number.

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Function	Description
shuffle(a) → array	Generates a random permutation of given array *a*.
slice(a, start, length) → array	Subsets array *a* starting from index *start* (or starting from the end if *start* is negative) with a length of *length*.
transform(array(T), function(T, S)) → array(S)	Returns an array that is the result of applying *function* to each element of *array*.

Table 6-30 Aggregate functions

Function	Description
arbitrary(x)	Returns an arbitrary non-null value of *x*, if one exists.
array_agg(x) → array	Returns an array created from the input *x* elements.
avg(x) → double	Returns the average (arithmetic mean) of all input values.
bool_and/bool_or(x) → boolean	bool_and returns TRUE if every input value is TRUE, otherwise FALSE. bool_or returns TRUE if any input value is TRUE, otherwise FALSE.
coalesce(value1, value2, ...)	Returns the first non-null value in an argument list. Short-circuit evaluation will be used.
count(*)/count(x) → int	count(*) returns the number of input rows. count(x) returns the number of non-null input values.
greatest(value1, value2, ..., valueN)	Returns the largest of the provided values.
histogram(x) → map	Returns a map containing the count of the number of times each input value occurs.
least(value1, value2, ..., valueN)	Returns the smallest of the provided values.
max/min(x, n=1)	Returns *n* largest or smallest values of all input values of *x*.

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Function	Description
max_by/min_by(x, y, n=1)	Returns *n* values of *x* associated with the *n* largest of all input values of *y* in descending order of *y*, or return *n* values of *x* associated with the *n* smallest of all input values of *y* in ascending order of *y*.
geometric_mean(x) → double	Returns the geometric mean of all input values.
set_agg(x) → array	Returns an array created from the distinct input *x* elements.
set_union(x) → array	Returns an array of all the distinct values contained in each array of the input.
sum(x)	Returns the sum of all input values.

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7 Change History

Released On	Description
2022-04-06	This issue is the seventh official release, which incorporates the following changes: • Added **Advanced Query**. • Added **ResourceQL Syntax**.
2021-09-09	This issue is the sixth official release. Added **Why Can't I Delete Resources on the My Resources Page?**
2021-07-16	This issue is the fifth official release. Changed **Management & Deployment** to **Management & Governance** and **Computing** to **Compute** based on changes in the console product catalog.
2020-12-28	This issue is the fourth official release. Added **Recording Resource Management Operations in CTS**. • **Supported CTS Operations** • **Viewing Tracing Logs**
2020-12-16	This issue is the third official release. Added **FAQs**.
2020-12-14	This issue is the second official release. Added the feature of dumping resource change notifications in: • **Dumping Resource Change Notifications** • **Notification Model of Resource Change Notification Dump Completed** • **Models of Resource Change Notification Dump**

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Released On	Description
2020-11-30	This issue is the first official release. • **My Resources**: You can view, filter, and export resources. You can also view resource relationships and resource history. • **Resource Recorder**: You can enable, configure, and modify the resource recorder. • **Resource Compliance**: You can add, trigger, and modify assignments.

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