Red Hat build of Keycloak 24.0

Authorization Services Guide

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Legal Notice

Abstract

This guide consists of information for authorization services for Red Hat build of Keycloak 24.0.

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CHAPTER 1. AUTHORIZATION SERVICES OVERVIEW

Red Hat build of Keycloak supports fine-grained authorization policies and is able to combine different access control mechanisms such as:

- **Attribute-based access control (ABAC)**
- **Role-based access control (RBAC)**
- **User-based access control (UBAC)**
- **Context-based access control (CBAC)**
- **Rule-based access control**
  - Using JavaScript
- **Time-based access control**
- **Support for custom access control mechanisms (ACMs) through a Service Provider Interface (SPI)**

Red Hat build of Keycloak is based on a set of administrative UIs and a RESTful API, and provides the necessary means to create permissions for your protected resources and scopes, associate those permissions with authorization policies, and enforce authorization decisions in your applications and services.

Resource servers (applications or services serving protected resources) usually rely on some kind of information to decide if access should be granted to a protected resource. For RESTful-based resource servers, that information is usually obtained from a security token, usually sent as a bearer token on every request to the server. For web applications that rely on a session to authenticate users, that information is usually stored in a user’s session and retrieved from there for each request.

Frequently, resource servers only perform authorization decisions based on role-based access control (RBAC), where the roles granted to the user trying to access protected resources are checked against the roles mapped to these same resources. While roles are very useful and used by applications, they also have a few limitations:

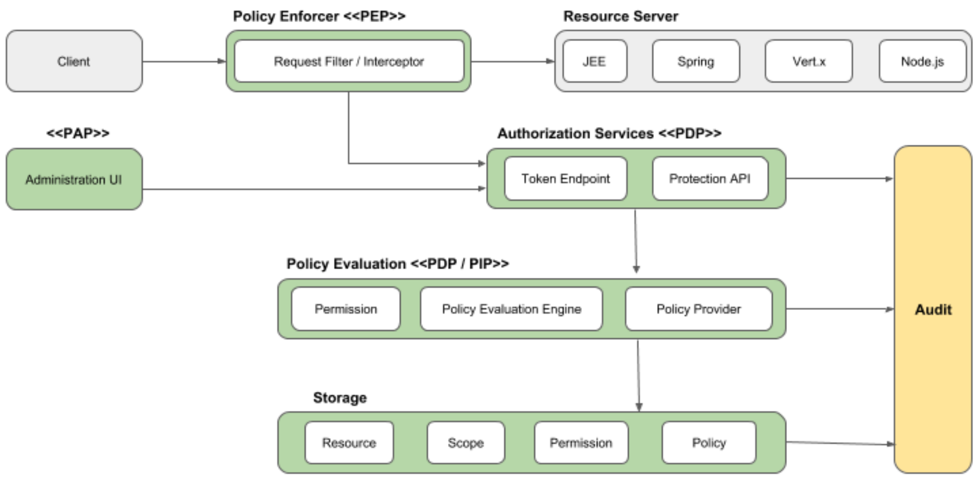
- Resources and roles are tightly coupled and changes to roles (such as adding, removing, or changing an access context) can impact multiple resources
- Changes to your security requirements can imply deep changes to application code to reflect these changes
- Depending on your application size, role management might become difficult and error-prone
- It is not the most flexible access control mechanism. Roles do not represent who you are and lack contextual information. If you have been granted a role, you have at least some access.

Considering that today we need to consider heterogeneous environments where users are distributed across different regions, with different local policies, using different devices, and with a high demand for information sharing, Red Hat build of Keycloak Authorization Services can help you improve the authorization capabilities of your applications and services by providing:

- Resource protection using fine-grained authorization policies and different access control mechanisms

- Centralized Resource, Permission, and Policy Management
- Centralized Policy Decision Point
- REST security based on a set of REST-based authorization services
- Authorization workflows and User-Managed Access
- The infrastructure to help avoid code replication across projects (and redeploys) and quickly adapt to changes in your security requirements.

1.1. ARCHITECTURE



From a design perspective, Authorization Services is based on a well-defined set of authorization patterns providing these capabilities:

- **Policy Administration Point (PAP)**
  Provides a set of UIs based on the Red Hat build of Keycloak Administration Console to manage resource servers, resources, scopes, permissions, and policies. Part of this is also accomplished remotely through the use of the Protection API.
- **Policy Decision Point (PDP)**
  Provides a distributable policy decision point to where authorization requests are sent and policies are evaluated accordingly with the permissions being requested. For more information, see Obtaining Permissions.
- **Policy Enforcement Point (PEP)**
  Provides implementations for different environments to actually enforce authorization decisions at the resource server side. Red Hat build of Keycloak provides some built-in Policy Enforcers.
- **Policy Information Point (PIP)**
  Being based on Red Hat build of Keycloak Authentication Server, you can obtain attributes from identities and runtime environment during the evaluation of authorization policies.

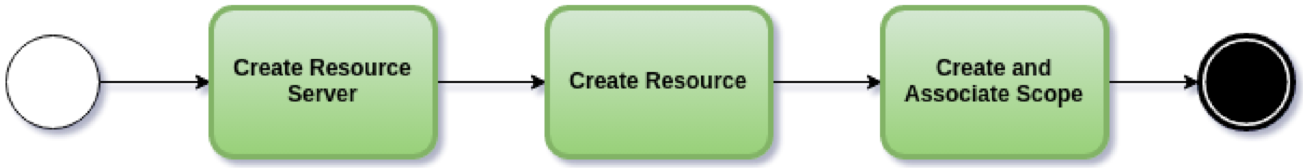
1.1.1. The authorization process

Three main processes define the necessary steps to understand how to use Red Hat build of Keycloak to enable fine-grained authorization to your applications:

- **Resource Management**
- **Permission and Policy Management**
- **Policy Enforcement**

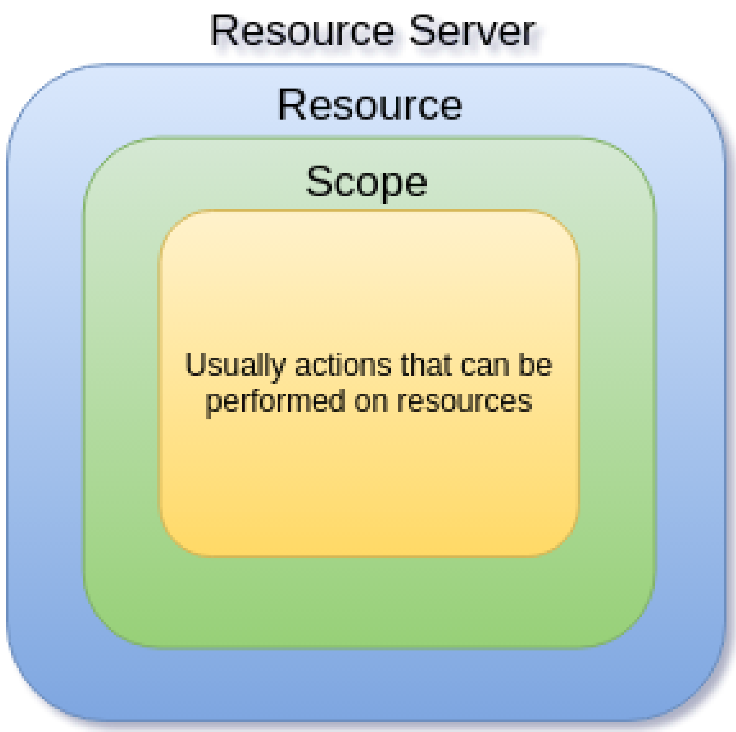
1.1.1.1. Resource management

Resource Management involves all the necessary steps to define what is being protected.



First, you need to specify Red Hat build of Keycloak what are you looking to protect, which usually represents a web application or a set of one or more services. For more information on resource servers see Terminology.

Resource servers are managed using the Red Hat build of Keycloak Administration Console. There you can enable any registered client application as a resource server and start managing the resources and scopes you want to protect.



A resource can be a web page, a RESTFul resource, a file in your file system, an EJB, and so on. They can represent a group of resources (just like a Class in Java) or they can represent a single and specific resource.

For instance, you might have a *Bank Account* resource that represents all banking accounts and use it to define the authorization policies that are common to all banking accounts. However, you might want to define specific policies for *Alice Account* (a resource instance that belongs to a customer), where only the owner is allowed to access some information or perform an operation.

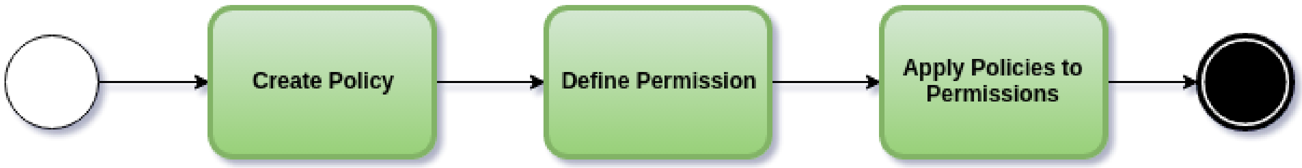
Resources can be managed using the Red Hat build of Keycloak Administration Console or the Protection API. In the latter case, resource servers are able to manage their resources remotely.

Scopes usually represent the actions that can be performed on a resource, but they are not limited to that. You can also use scopes to represent one or more attributes within a resource.

1.1.1.2. Permission and policy management

Once you have defined your resource server and all the resources you want to protect, you must set up permissions and policies.

This process involves all the necessary steps to actually define the security and access requirements that govern your resources.



Policies define the conditions that must be satisfied to access or perform operations on something (resource or scope), but they are not tied to what they are protecting. They are generic and can be reused to build permissions or even more complex policies.

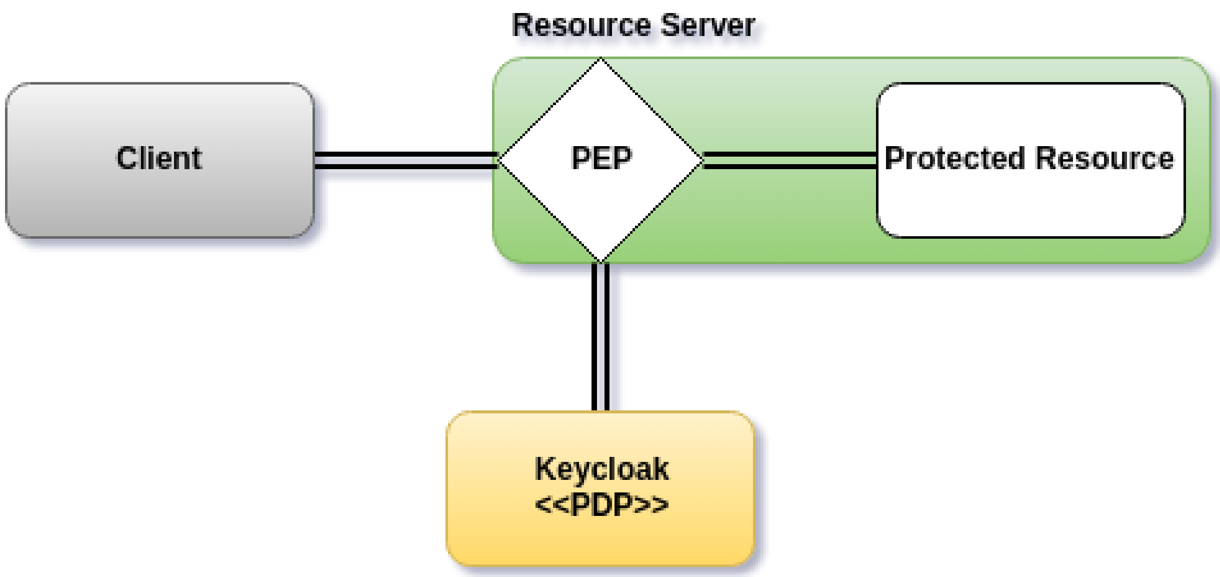
For instance, to allow access to a group of resources only for users granted with a role "User Premium", you can use RBAC (Role-based Access Control).

Red Hat build of Keycloak provides a few built-in policy types (and their respective policy providers) covering the most common access control mechanisms. You can even create policies based on rules written using JavaScript.

Once you have your policies defined, you can start defining your permissions. Permissions are coupled with the resource they are protecting. Here you specify what you want to protect (resource or scope) and the policies that must be satisfied to grant or deny permission.

1.1.1.3. Policy enforcement

Policy Enforcement involves the necessary steps to actually enforce authorization decisions to a resource server. This is achieved by enabling a **Policy Enforcement Point** or PEP at the resource server that is capable of communicating with the authorization server, ask for authorization data and control access to protected resources based on the decisions and permissions returned by the server.



Red Hat build of Keycloak provides some built-in Policy Enforcers implementations that you can use to protect your applications depending on the platform they are running on.

1.1.2. Authorization services

Authorization services consist of the following RESTFul endpoints:

- **Token Endpoint**
- **Resource Management Endpoint**
- **Permission Management Endpoint**

Each of these services provides a specific API covering the different steps involved in the authorization process.

1.1.2.1. Token endpoint

OAuth2 clients (such as front end applications) can obtain access tokens from the server using the token endpoint and use these same tokens to access resources protected by a resource server (such as back end services). In the same way, Red Hat build of Keycloak Authorization Services provide extensions to OAuth2 to allow access tokens to be issued based on the processing of all policies associated with the resource(s) or scope(s) being requested. This means that resource servers can enforce access to their protected resources based on the permissions granted by the server and held by an access token. In Red Hat build of Keycloak Authorization Services the access token with permissions is called a Requesting Party Token or RPT for short.

Additional resources

- Obtaining Permissions

1.1.2.2. Protection API

The **Protection API** is a set of UMA-compliant endpoint-providing operations for resource servers to help them manage their resources, scopes, permissions, and policies associated with them. Only resource servers are allowed to access this API, which also requires a **uma_protection** scope.

The operations provided by the Protection API can be organized in two main groups:

- **Resource Management**
  - Create Resource
  - Delete Resource
  - Find by Id
  - Query
- **Permission Management**
  - Issue Permission Tickets

NOTE

By default, Remote Resource Management is enabled. You can change that using the Red Hat build of Keycloak Administration Console and only allow resource management through the console.

When using the UMA protocol, the issuance of Permission Tickets by the Protection API is an important part of the whole authorization process. As described in a subsequent section, they represent the permissions being requested by the client and that are sent to the server to obtain a final token with all permissions granted during the evaluation of the permissions and policies associated with the resources and scopes being requested.

Additional resources

- Protection API

1.2. TERMINOLOGY

Before going further, it is important to understand these terms and concepts introduced by Red Hat build of Keycloak Authorization Services.

1.2.1. Resource Server

Per OAuth2 terminology, a resource server is the server hosting the protected resources and capable of accepting and responding to protected resource requests.

Resource servers usually rely on some kind of information to decide whether access to a protected resource should be granted. For RESTful-based resource servers, that information is usually carried in a security token, typically sent as a bearer token along with every request to the server. Web applications that rely on a session to authenticate users usually store that information in the user’s session and retrieve it from there for each request.

In Red Hat build of Keycloak, any **confidential** client application can act as a resource server. This client’s resources and their respective scopes are protected and governed by a set of authorization policies.

1.2.2. Resource

A resource is part of the assets of an application and the organization. It can be a set of one or more endpoints, a classic web resource such as an HTML page, and so on. In authorization policy terminology, a resource is the *object* being protected.

Every resource has a unique identifier that can represent a single resource or a set of resources. For instance, you can manage a *Banking Account Resource* that represents and defines a set of authorization policies for all banking accounts. But you can also have a different resource named *Alice's Banking Account*, which represents a single resource owned by a single customer, which can have its own set of authorization policies.

1.2.3. Scope

A resource's scope is a bounded extent of access that is possible to perform on a resource. In authorization policy terminology, a scope is one of the potentially many *verbs* that can logically apply to a resource.

It usually indicates what can be done with a given resource. Example of scopes are view, edit, delete, and so on. However, scope can also be related to specific information provided by a resource. In this case, you can have a project resource and a cost scope, where the cost scope is used to define specific policies and permissions for users to access a project's cost.

1.2.4. Permission

Consider this simple and very common permission:

A permission associates the object being protected with the policies that must be evaluated to determine whether access is granted.

- **X** CAN DO **Y** ON RESOURCE **Z**
  - where …
    - **X** represents one or more users, roles, or groups, or a combination of them. You can also use claims and context here.
    - **Y** represents an action to be performed, for example, write, view, and so on.
    - **Z** represents a protected resource, for example, "/accounts".

Red Hat build of Keycloak provides a rich platform for building a range of permission strategies ranging from simple to very complex, rule-based dynamic permissions. It provides flexibility and helps to:

- Reduce code refactoring and permission management costs
- Support a more flexible security model, helping you to easily adapt to changes in your security requirements
- Make changes at runtime; applications are only concerned about the resources and scopes being protected and not how they are protected.

1.2.5. Policy

A policy defines the conditions that must be satisfied to grant access to an object. Unlike permissions, you do not specify the object being protected but rather the conditions that must be satisfied for access to a given object (for example, resource, scope, or both). Policies are strongly related to the different access control mechanisms (ACMs) that you can use to protect your resources. With policies, you can implement strategies for attribute-based access control (ABAC), role-based access control (RBAC), context-based access control, or any combination of these.

Red Hat build of Keycloak leverages the concept of policies and how you define them by providing the concept of aggregated policies, where you can build a "policy of policies" and still control the behavior of the evaluation. Instead of writing one large policy with all the conditions that must be satisfied for access to a given resource, the policies implementation in Red Hat build of Keycloak Authorization Services follows the divide-and-conquer technique. That is, you can create individual policies, then reuse them with different permissions and build more complex policies by combining individual policies.

1.2.6. Policy provider

Policy providers are implementations of specific policy types. Red Hat build of Keycloak provides built-in policies, backed by their corresponding policy providers, and you can create your own policy types to support your specific requirements.

Red Hat build of Keycloak provides an SPI (Service Provider Interface) that you can use to plug in your own policy provider implementations.

1.2.7. Permission ticket

A permission ticket is a special type of token defined by the User-Managed Access (UMA) specification that provides an opaque structure whose form is determined by the authorization server. This structure represents the resources and/or scopes being requested by a client, the access context, as well as the policies that must be applied to a request for authorization data (requesting party token [RPT]).

In UMA, permission tickets are crucial to support person-to-person sharing and also person-to-organization sharing. Using permission tickets for authorization workflows enables a range of scenarios from simple to complex, where resource owners and resource servers have complete control over their resources based on fine-grained policies that govern the access to these resources.

In the UMA workflow, permission tickets are issued by the authorization server to a resource server, which returns the permission ticket to the client trying to access a protected resource. Once the client receives the ticket, it can make a request for an RPT (a final token holding authorization data) by sending the ticket back to the authorization server.

For more information on permission tickets, see User-Managed Access and the UMA specification.

CHAPTER 2. GETTING STARTED

For certain applications, you can look at the following resources to quickly get started with Red Hat build of Keycloak Authorization Services:

- Securing a JakartaEE Application in Wildfly
- Securing a Spring Boot Application
- Securing Quarkus Applications
- Securing Node.js Applications

CHAPTER 3. MANAGING RESOURCE SERVERS

According to the OAuth2 specification, a resource server is a server hosting the protected resources and capable of accepting and responding to protected resource requests.

In Red Hat build of Keycloak, resource servers are provided with a rich platform for enabling fine-grained authorization for their protected resources, where authorization decisions can be made based on different access control mechanisms.

Any client application can be configured to support fine-grained permissions. In doing so, you are conceptually turning the client application into a resource server.

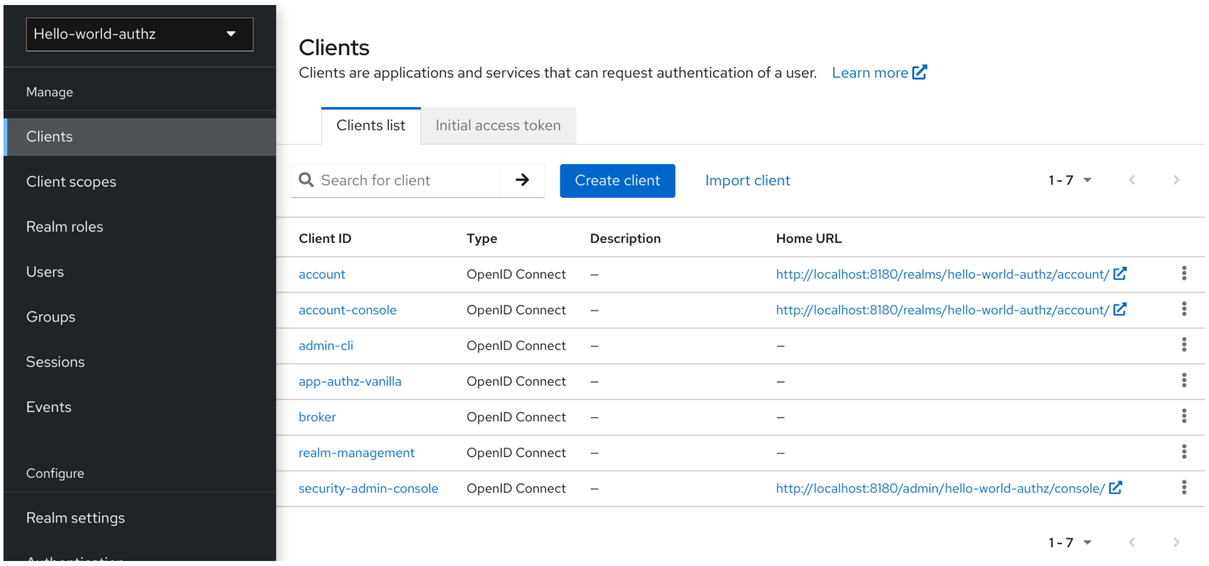
3.1. CREATING A CLIENT APPLICATION

The first step to enable Red Hat build of Keycloak Authorization Services is to create the client application that you want to turn into a resource server.

Procedure

1. Click **Clients**.

Clients

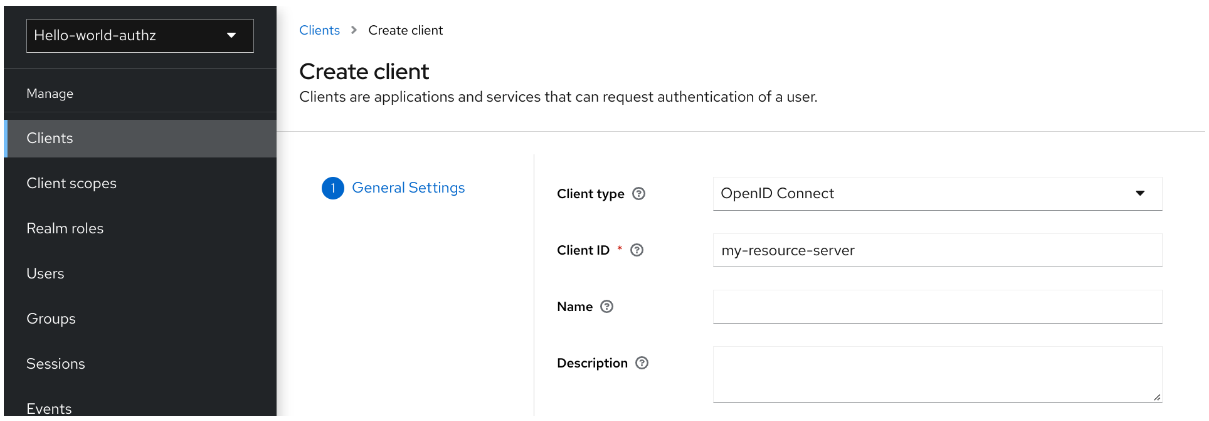


Clients
Clients are applications and services that can request authentication of a user. Learn more

Client ID	Type	Description	Home URL
account	OpenID Connect	–	http://localhost:8180/realms/hello-world-authz/account/
account-console	OpenID Connect	–	http://localhost:8180/realms/hello-world-authz/account/
admin-cli	OpenID Connect	–	–
app-authz-vanilla	OpenID Connect	–	–
broker	OpenID Connect	–	–
realm-management	OpenID Connect	–	–
security-admin-console	OpenID Connect	–	http://localhost:8180/admin/hello-world-authz/console/

2. On this page, click **Create**.

Add Client



Create client
Clients are applications and services that can request authentication of a user.

Client type	OpenID Connect
Client ID *	my-resource-server
Name	
Description	

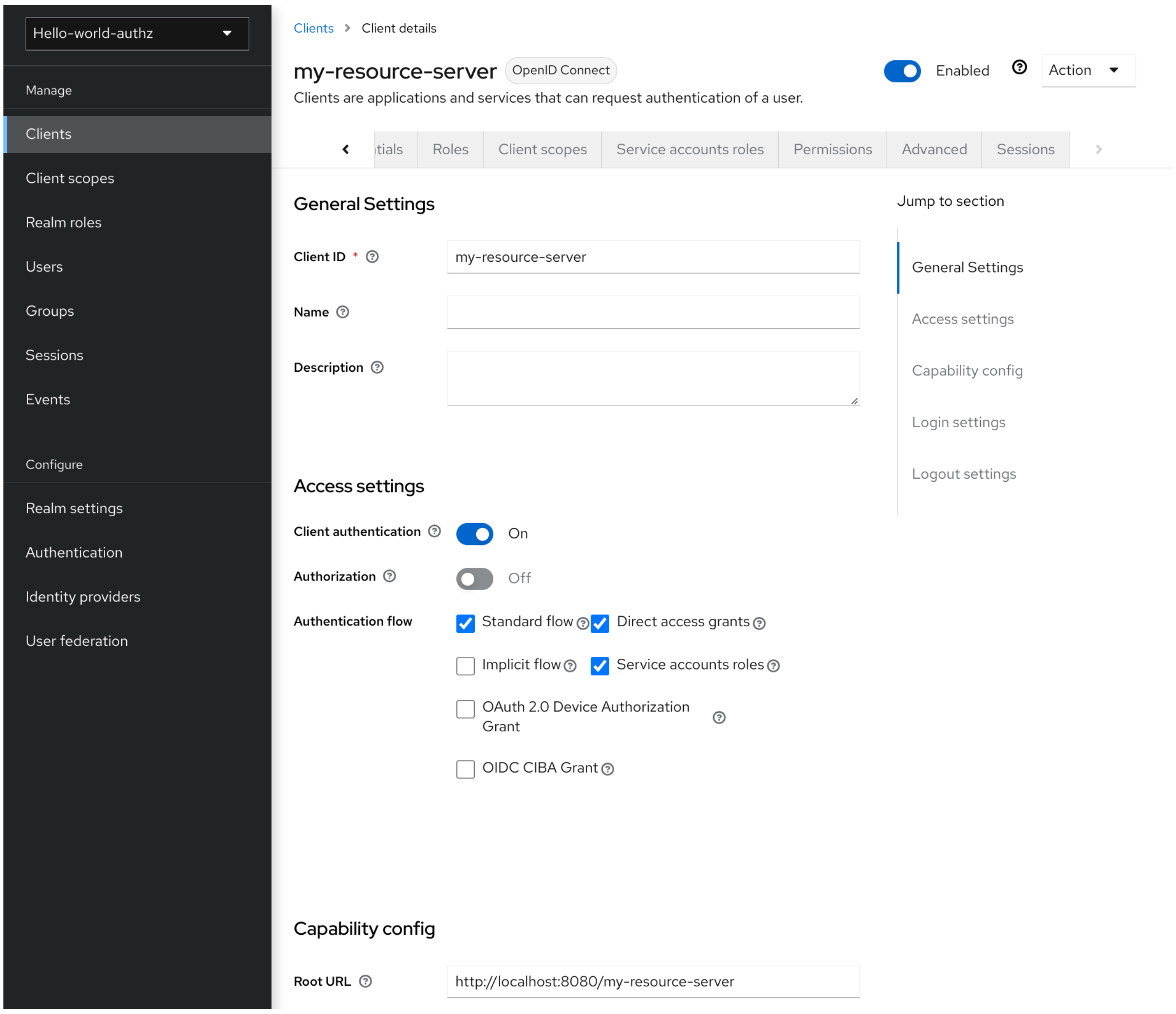
3. Type the **Client ID** of the client. For example, *my-resource-server*.

4. Type the **Root URL** for your application. For example:

   ```
   http://${host}:${port}/my-resource-server
   ```

5. Click **Save**. The client is created and the client Settings page opens. A page similar to the following is displayed:

   Client Settings



my-resource-server OpenID Connect

Clients are applications and services that can request authentication of a user.

General Settings

Client ID *: my-resource-server

Name:

Description:

Access settings

Client authentication: On

Authorization: Off

Authentication flow: [✓ Standard flow] [✓ Direct access grants] Implicit flow [✓ Service accounts roles] OAuth 2.0 Device Authorization Grant, OIDC CIBA Grant

Capability config

Root URL: http://localhost:8080/my-resource-server

3.2. ENABLING AUTHORIZATION SERVICES

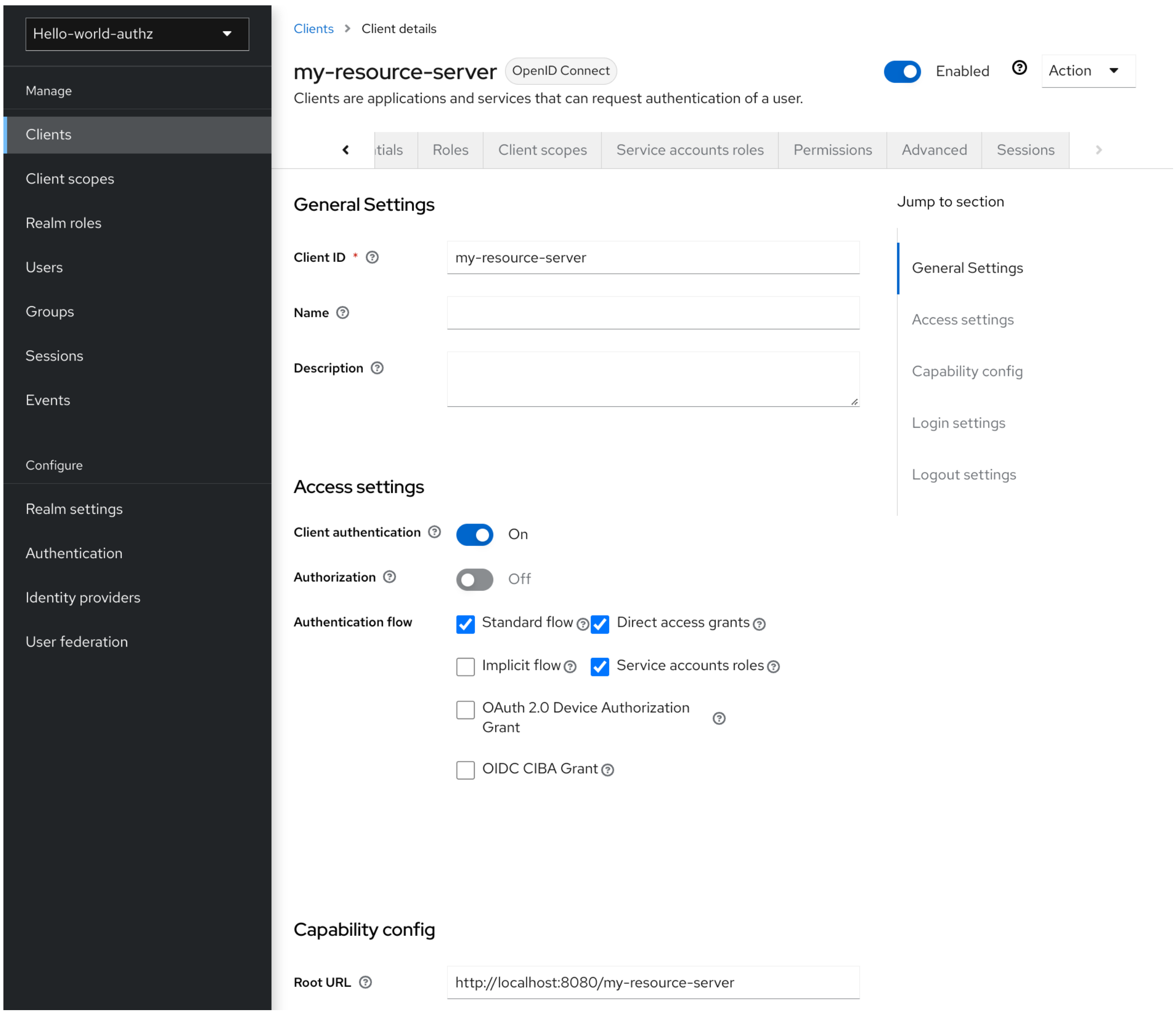
You can turn your OIDC client into a resource server and enable fine-grained authorization.

Procedure

1. Toggle **Authorization Enabled** to **`On**.

2. Click **Save**.

   Enabling authorization services



my-resource-server OpenID Connect

Clients are applications and services that can request authentication of a user.

General Settings

Client ID *: my-resource-server

Name:

Description:

Access settings

Client authentication: On

Authorization: Off

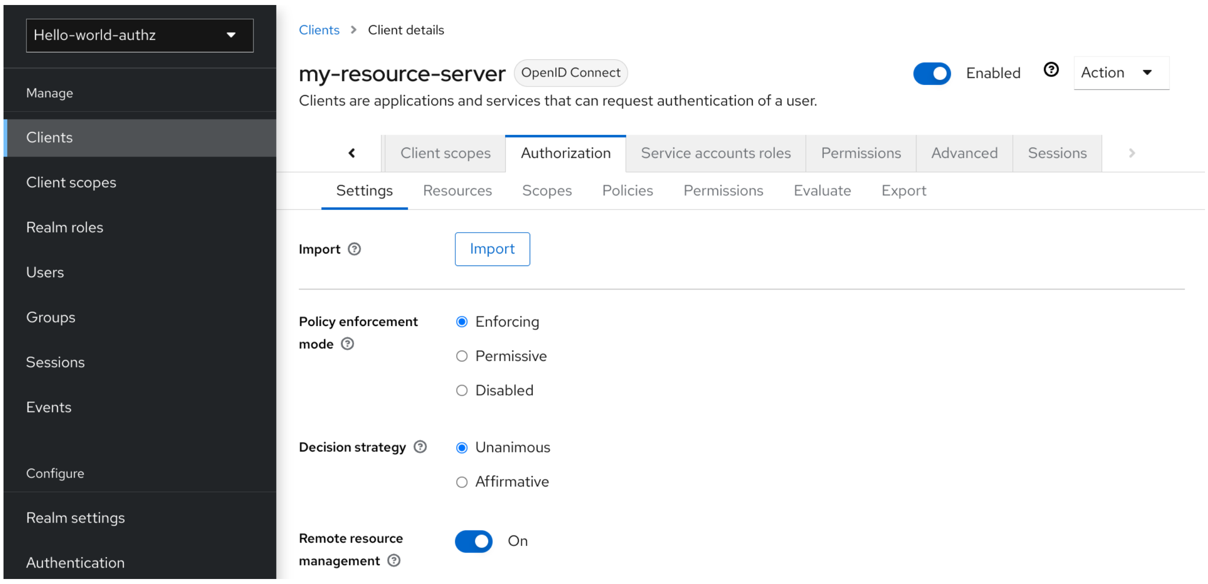
Authentication flow: [✓ Standard flow] [✓ Direct access grants] Implicit flow [✓ Service accounts roles] OAuth 2.0 Device Authorization Grant OIDC CIBA Grant

Capability config

Root URL: http://localhost:8080/my-resource-server

A new Authorization tab is displayed for this client. Click the **Authorization** tab and a page similar to the following is displayed:

Resource server settings



my-resource-server OpenID Connect

Clients are applications and services that can request authentication of a user.

Import: Import

Policy enforcement mode: [✓ Enforcing] Permissive Disabled

Decision strategy: [✓ Unanimous] Affirmative

Remote resource management: On

The Authorization tab contains additional sub-tabs covering the different steps that you must follow to actually protect your application’s resources. Each tab is covered separately by a specific topic in this documentation. But here is a quick description about each one:

- **Settings**

General settings for your resource server. For more details about this page see the Resource Server Settings section.

- **Resource**
  From this page, you can manage your application's resources.

- **Authorization Scopes**
  From this page, you can manage scopes.

- **Policies**
  From this page, you can manage authorization policies and define the conditions that must be met to grant a permission.

- **Permissions**
  From this page, you can manage the permissions for your protected resources and scopes by linking them with the policies you created.

- **Evaluate**
  From this page, you can simulate authorization requests and view the result of the evaluation of the permissions and authorization policies you have defined.

- **Export Settings**
  From this page, you can export the authorization settings to a JSON file.

3.2.1. Resource server settings

On the Resource Server Settings page, you can configure the policy enforcement mode, allow remote resource management, and export the authorization configuration settings.

- **Policy Enforcement Mode**
  Specifies how policies are enforced when processing authorization requests sent to the server.

  - **Enforcing**
    (default mode) Requests are denied by default even when there is no policy associated with a given resource.

  - **Permissive**
    Requests are allowed even when there is no policy associated with a given resource.

  - **Disabled**
    Disables the evaluation of all policies and allows access to all resources.

- **Decision Strategy**
  This configurations changes how the policy evaluation engine decides whether or not a resource or scope should be granted based on the outcome from all evaluated permissions. **Affirmative** means that at least one permission must evaluate to a positive decision in order grant access to a resource and its scopes. **Unanimous** means that all permissions must evaluate to a positive decision in order for the final decision to be also positive. As an example, if two permissions for a same resource or scope are in conflict (one of them is granting access and the other is denying access), the permission to the resource or scope will be granted if the chosen strategy is **Affirmative**. Otherwise, a single deny from any permission will also deny access to the resource or scope.

- **Remote Resource Management**
  Specifies whether resources can be managed remotely by the resource server. If false, resources can be managed only from the administration console.

3.3. DEFAULT CONFIGURATION

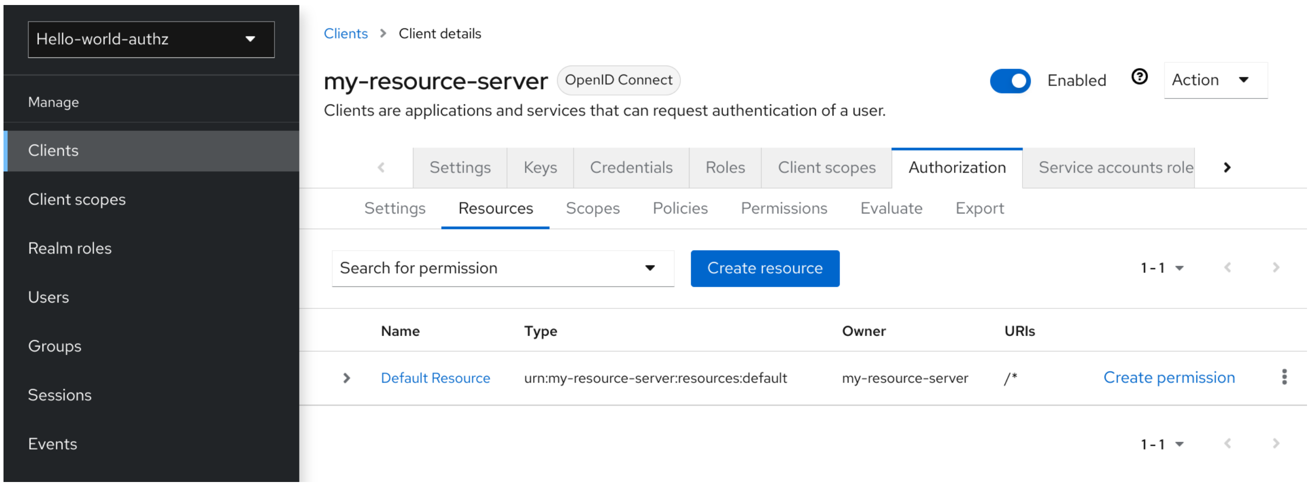
When you create a resource server, Red Hat build of Keycloak creates a default configuration for your newly created resource server.

The default configuration consists of:

- A default protected resource representing all resources in your application.
- A policy that always grants access to the resources protected by this policy.
- A permission that governs access to all resources based on the default policy.

The default protected resource is referred to as the **default resource** and you can view it if you navigate to the **Resources** tab.

Default resource



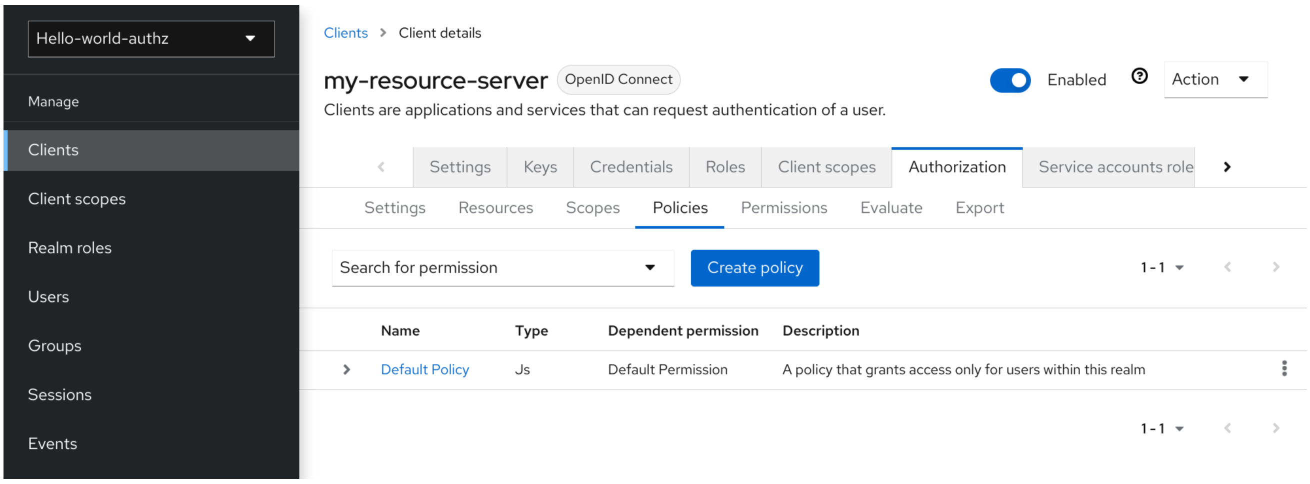
Name	Type	Owner	URIs
Default Resource	urn:my-resource-server:resources:default	my-resource-server	/*

This resource defines a **Type**, namely **urn:my-resource-server:resources:default** and a **URI** /*. Here, the **URI** field defines a wildcard pattern that indicates to Red Hat build of Keycloak that this resource represents all the paths in your application. In other words, when enabling policy enforcement for your application, all the permissions associated with the resource will be examined before granting access.

The **Type** mentioned previously defines a value that can be used to create typed resource permissions that must be applied to the default resource or any other resource you create using the same type.

The default policy is referred to as the **only from realm policy** and you can view it if you navigate to the **Policies** tab.

Default policy



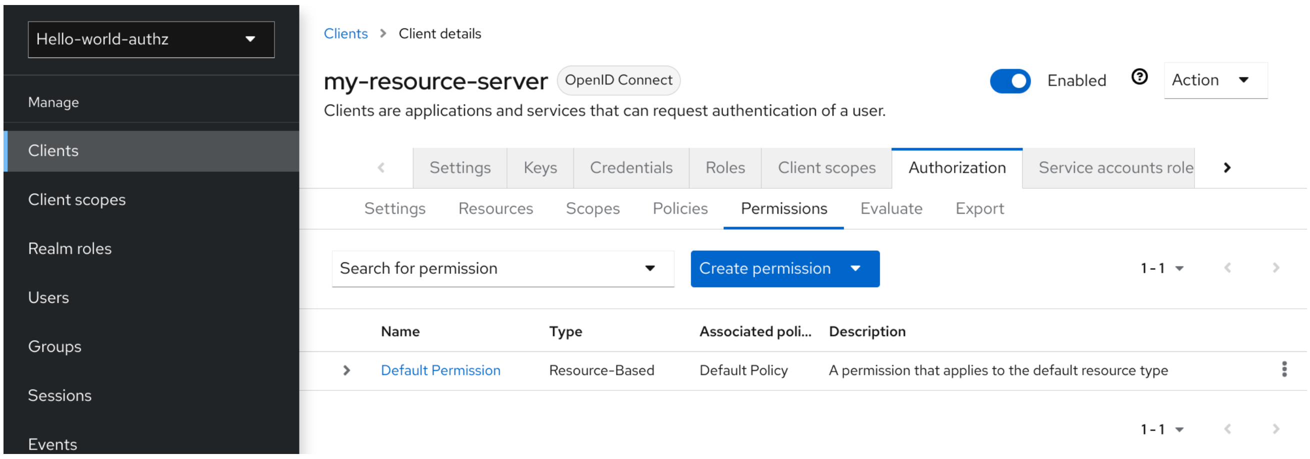
Name	Type	Dependent permission	Description
Default Policy	Js	Default Permission	A policy that grants access only for users within this realm

This policy is a JavaScript-based policy defining a condition that always grants access to the resources protected by this policy. If you click this policy you can see that it defines a rule as follows:

```
// by default, grants any permission associated with this policy
$evaluation.grant();
```

Lastly, the default permission is referred to as the **default permission** and you can view it if you navigate to the **Permissions** tab.

Default Permission



Name	Type	Associated poli...	Description
Default Permission	Resource-Based	Default Policy	A permission that applies to the default resource type

This permission is a resource-based permission, defining a set of one or more policies that are applied to all resources with a given type.

3.3.1. Changing the default configuration

You can change the default configuration by removing the default resource, policy, or permission definitions and creating your own.

The default resource is created with a **URI** that maps to any resource or path in your application using a **/*** pattern. Before creating your own resources, permissions and policies, make sure the default configuration doesn't conflict with your own settings.

NOTE

The default configuration defines a resource that maps to all paths in your application. If you are about to write permissions to your own resources, be sure to remove the **Default Resource** or change its **URIS** fields to a more specific paths in your application. Otherwise, the policy associated with the default resource (which by default always grants access) will allow Red Hat build of Keycloak to grant access to any protected resource.

3.4. EXPORT AND IMPORT AUTHORIZATION CONFIGURATION

The configuration settings for a resource server (or client) can be exported and downloaded. You can also import an existing configuration file for a resource server. Importing and exporting a configuration file is helpful when you want to create an initial configuration for a resource server or to update an existing configuration. The configuration file contains definitions for:

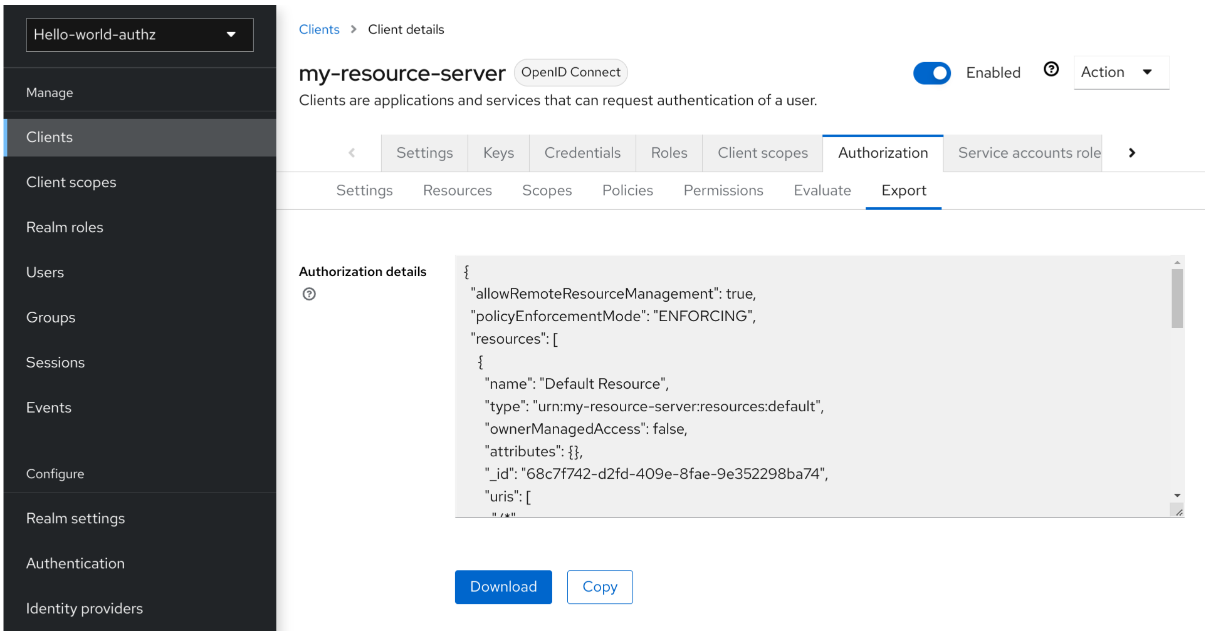
- Protected resources and scopes
- Policies
- Permissions

3.4.1. Exporting a configuration file

Procedure

1. Click **Clients** in the menu.
2. Click the client you created as a resource server.
3. Click the **Export** tab.

Export Settings



Clients are applications and services that can request authentication of a user.

Authorization details

```
{
 "allowRemoteResourceManagement": true,
 "policyEnforcementMode": "ENFORCING",
 "resources": [
  {
   "name": "Default Resource",
   "type": "urn:my-resource-server:resources:default",
   "ownerManagedAccess": false,
   "attributes": {},
   "_id": "68c7f742-d2fd-409e-8fae-9e352298ba74",
   "uris": [
```

The configuration file is exported in JSON format and displayed in a text area, from which you can copy and paste. You can also click **Download** to download the configuration file and save it.

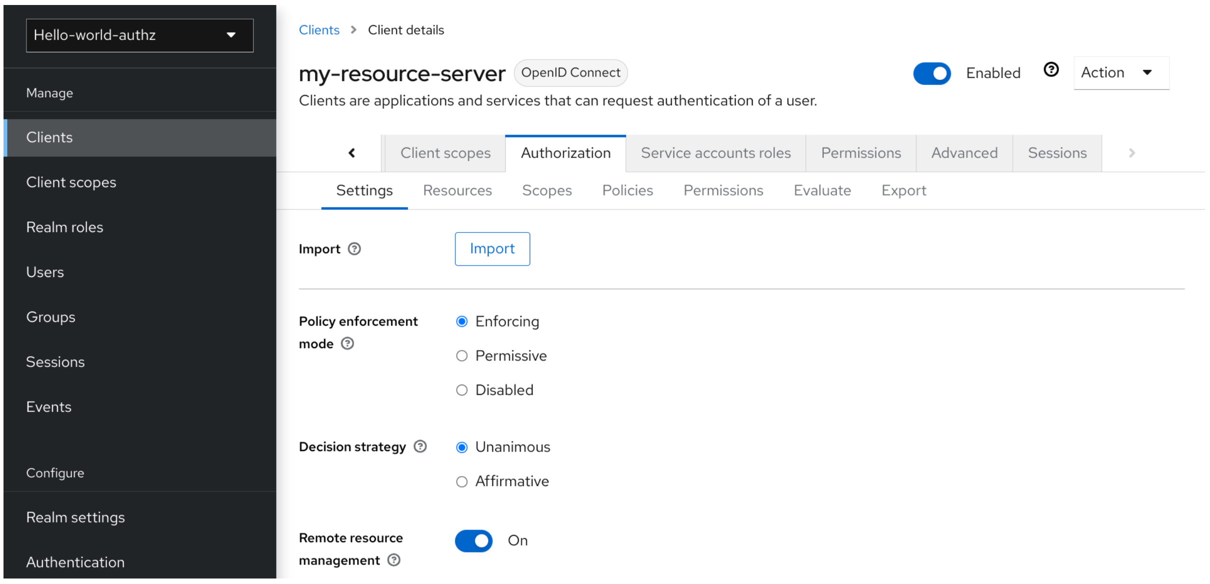
3.4.2. Importing a configuration file

You can import a configuration file for a resource server.

Procedure

1. Navigate to the **Resource Server Settings** page.

   Import Settings



Clients are applications and services that can request authentication of a user.

Import: Import

Policy enforcement mode: (● Enforcing) ○ Permissive ○ Disabled

Decision strategy: (● Unanimous) ○ Affirmative

Remote resource management: On

2. Click **Import** and choose a file containing the configuration that you want to import.

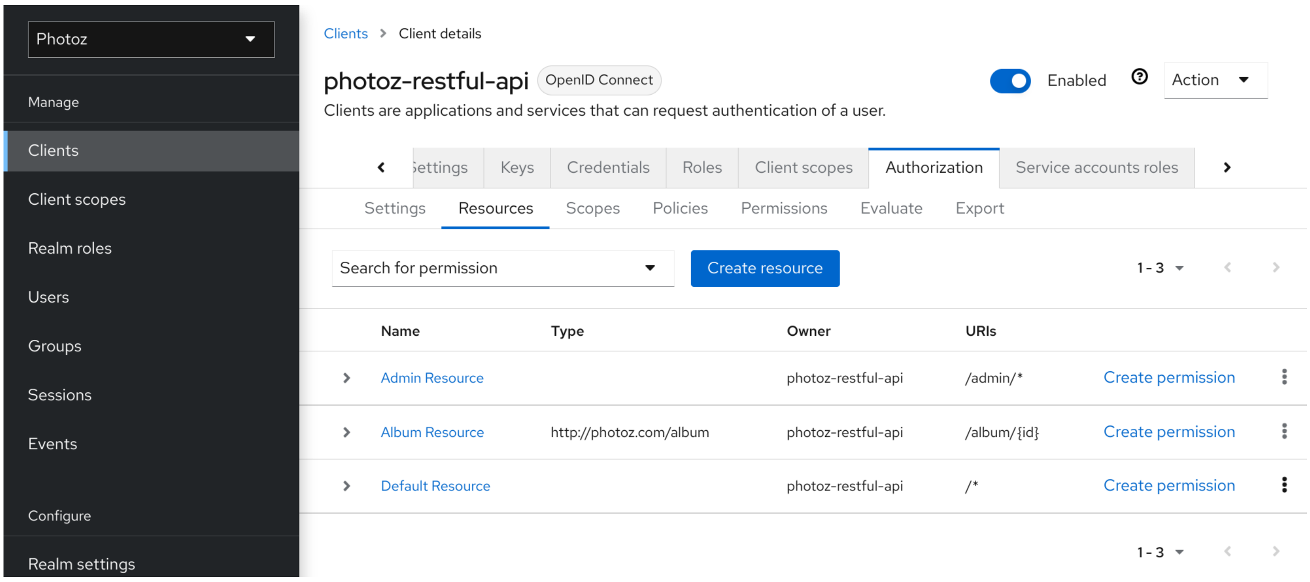
CHAPTER 4. MANAGING RESOURCES AND SCOPES

Resource management is straightforward and generic. After creating a resource server, you can start creating the resources and scopes that you want to protect. Resources and scopes can be managed by navigating to the **Resource** and **Authorization Scopes** tabs, respectively.

4.1. VIEWING RESOURCES

On the **Resource** page, you see a list of the resources associated with a resource server.

Resources



Clients are applications and services that can request authentication of a user.

Name	Type	Owner	URIs	
Admin Resource		photoz-restful-api	/admin/*	Create permission
Album Resource	http://photoz.com/album	photoz-restful-api	/album/{id}	Create permission
Default Resource		photoz-restful-api	/*	Create permission

The resource list provides information about the protected resources, such as:

- Type
- URIS
- Owner
- Associated scopes, if any
- Associated permissions

From this list, you can also directly create a permission by clicking **Create Permission** for the resource for which you want to create the permission.

NOTE

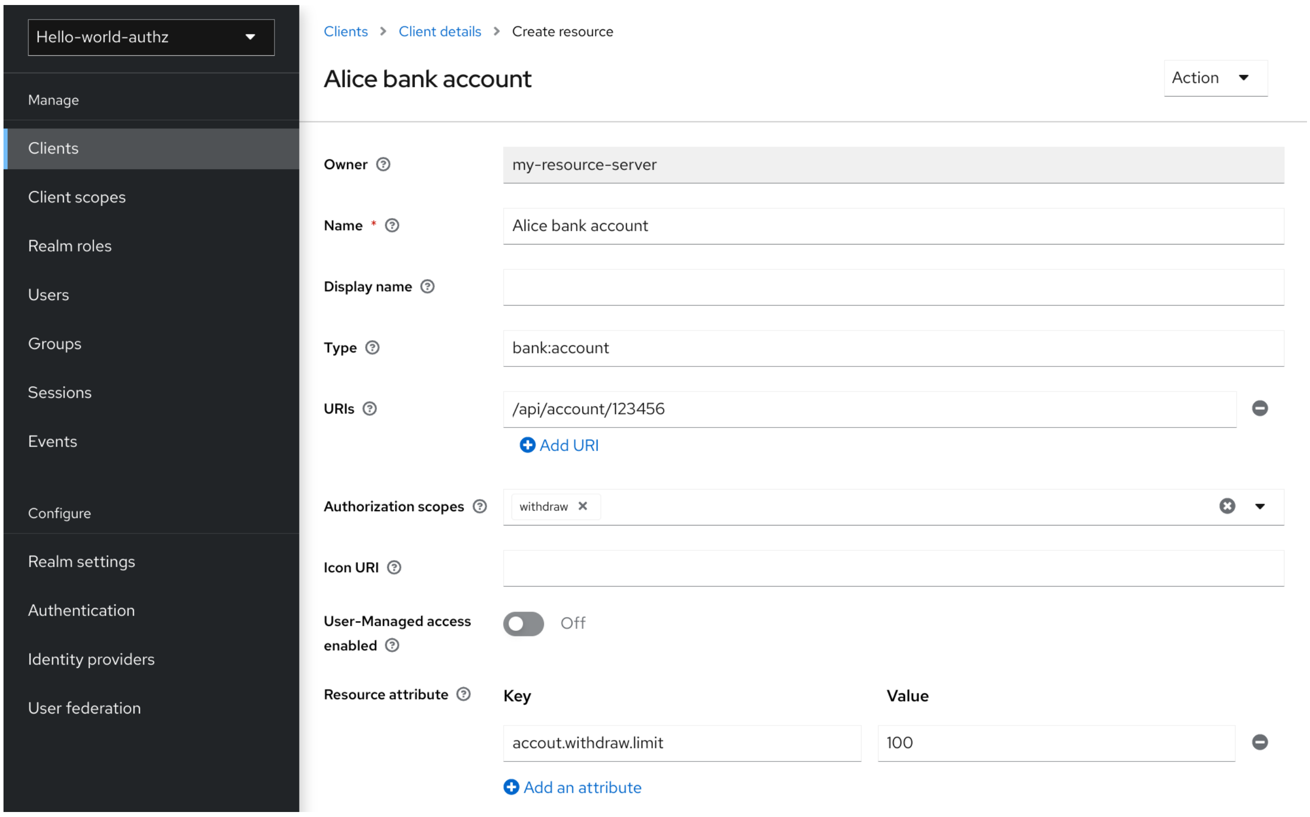
Before creating permissions for your resources, be sure you have already defined the policies that you want to associate with the permission.

4.2. CREATING RESOURCES

Creating a resource is straightforward and generic. Your main concern is the granularity of the resources you create. In other words, resources can be created to represent a set of one or more resources and the way you define them is crucial to managing permissions.

To create a new resource, click **Create resource**.

Add resource



Alice bank account

Owner	my-resource-server
Name *	Alice bank account
Display name	
Type	bank:account
URIs	/api/account/123456
Authorization scopes	withdraw
Icon URI	
User-Managed access enabled	Off

Resource attribute

Key	Value
accout.withdraw.limit	100

In Red Hat build of Keycloak, a resource defines a small set of information that is common to different types of resources, such as:

- **Name**
  A human-readable and unique string describing this resource.
- **Type**
  A string uniquely identifying the type of a set of one or more resources. The type is a *string* used to group different resource instances. For example, the default type for the default resource that is automatically created is **urn:resource-server-name:resources:default**
- **URIS**
  URIS that provides the locations/addresses for the resource. For HTTP resources, the URIS are usually the relative paths used to serve these resources.
- **Scopes**
  One or more scopes to associate with the resource.

4.2.1. Resource attributes

Resources may have attributes associated with them. These attributes can be used to provide additional information about a resource and to provide additional information to policies when evaluating permissions associated with a resource.

Each attribute is a key and value pair where the value can be a set of one or many strings. Multiple values can be defined for an attribute by separating each value with a comma.

4.2.2. Typed resources

The type field of a resource can be used to group different resources together, so they can be protected using a common set of permissions.

4.2.3. Resource owners

Resources also have an owner. By default, resources are owned by the resource server.

However, resources can also be associated with users, so you can create permissions based on the resource owner. For example, only the resource owner is allowed to delete or update a given resource.

4.2.4. Managing resources remotely

Resource management is also exposed through the Protection API to allow resource servers to remotely manage their resources.

When using the Protection API, resource servers can be implemented to manage resources owned by their users. In this case, you can specify the user identifier to configure a resource as belonging to a specific user.

NOTE

Red Hat build of Keycloak provides resource servers complete control over their resources. In the future, we should be able to allow users to control their own resources as well as approve authorization requests and manage permissions, especially when using the UMA protocol.

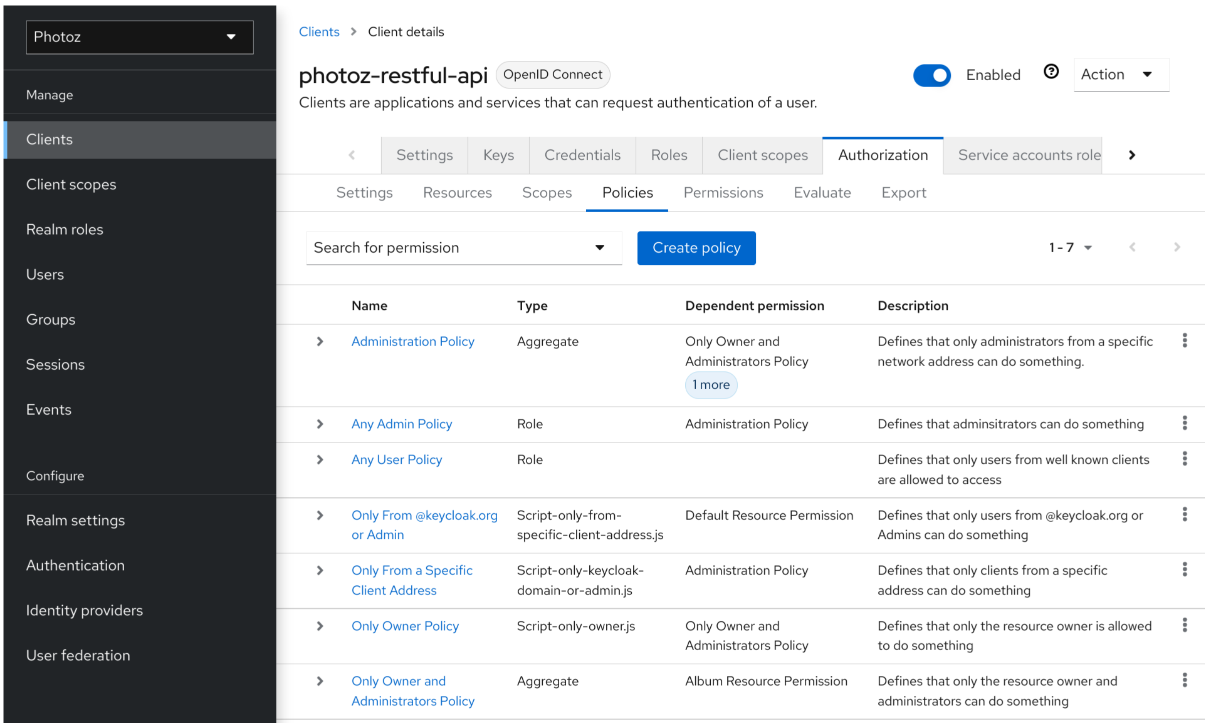
CHAPTER 5. MANAGING POLICIES

As mentioned previously, policies define the conditions that must be satisfied before granting access to an object.

Procedure

1. Click the **Policy** tab to view all policies associated with a resource server.

Policies



photoz-restful-api OpenID Connect

Clients are applications and services that can request authentication of a user.

Name	Type	Dependent permission	Description
Administration Policy	Aggregate	Only Owner and Administrators Policy 1 more	Defines that only administrators from a specific network address can do something.
Any Admin Policy	Role	Administration Policy	Defines that adminsitrators can do something
Any User Policy	Role		Defines that only users from well known clients are allowed to access
Only From @keycloak.org or Admin	Script-only-from-specific-client-address.js	Default Resource Permission	Defines that only users from @keycloak.org or Admins can do something
Only From a Specific Client Address	Script-only-keycloak-domain-or-admin.js	Administration Policy	Defines that only clients from a specific address can do something
Only Owner Policy	Script-only-owner.js	Only Owner and Administrators Policy	Defines that only the resource owner is allowed to do something
Only Owner and Administrators Policy	Aggregate	Album Resource Permission	Defines that only the resource owner and administrators can do something

On this tab, you can view the list of previously created policies as well as create and edit a policy.

To create a new policy, click **Create policy**, then select a policy type from the list.

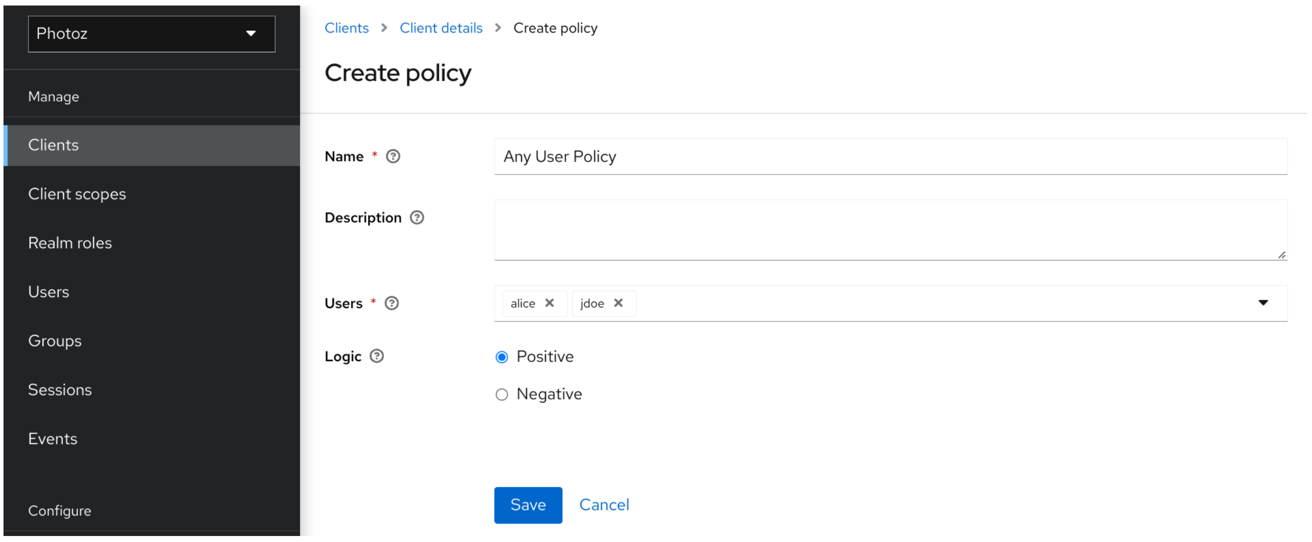
Details about each policy type are described in this section.

5.1. USER-BASED POLICY

You can use this type of policy to define conditions for your permissions where a set of one or more users is permitted to access an object.

To create a new user-based policy, select **User** in the item list in the upper right corner of the policy listing.

Add a User Policy



Create policy

Name *	Any User Policy
Description	
Users *	alice ✕ jdoe ✕
Logic	[✓ Positive] Negative

5.1.1. Configuration

- **Name**
  A human-readable and unique string identifying the policy. A best practice is to use names that are closely related to your business and security requirements, so you can identify them more easily.

- **Description**
  A string containing details about this policy.

- **Users**
  Specifies which users are given access by this policy.

- **Logic**
  The logic of this policy to apply after the other conditions have been evaluated.

Additional resources

- Positive and negative logic

5.2. ROLE-BASED POLICY

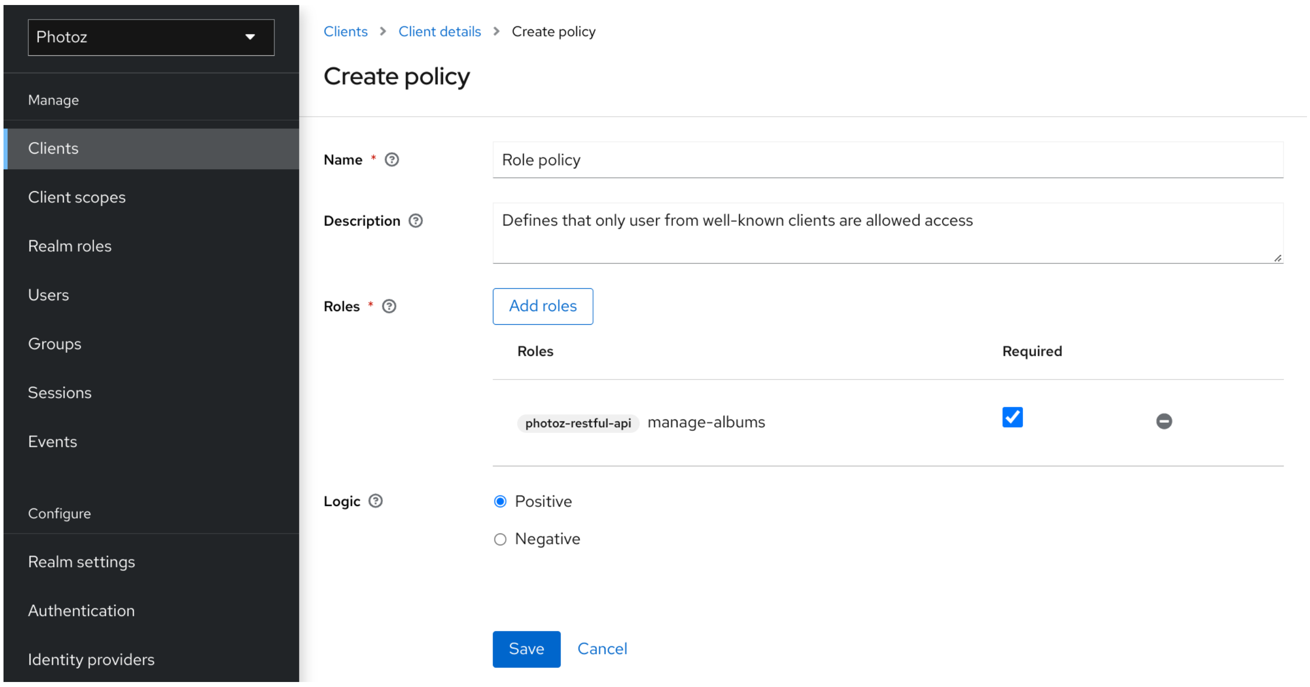
You can use this type of policy to define conditions for your permissions where a set of one or more roles is permitted to access an object.

By default, roles added to this policy are not specified as required and the policy will grant access if the user requesting access has been granted any of these roles. However, you can specify a specific role as required if you want to enforce a specific role. You can also combine required and non-required roles, regardless of whether they are realm or client roles.

Role policies can be useful when you need more restricted role-based access control (RBAC), where specific roles must be enforced to grant access to an object. For instance, you can enforce that a user must consent to allowing a client application (which is acting on the user’s behalf) to access the user’s resources. You can use Red Hat build of Keycloak Client Scope Mapping to enable consent pages or even enforce clients to explicitly provide a scope when obtaining access tokens from a Red Hat build of Keycloak server.

To create a new role-based policy, select **Role** from the policy type list.

Add Role Policy



Create policy

Name *: Role policy

Description: Defines that only user from well-known clients are allowed access

Roles *: Add roles

Roles	Required
photoz-restful-api manage-albums	✓

Logic: [✓ Positive] Negative

Save Cancel

5.2.1. Configuration

- **Name**
  A human-readable and unique string describing the policy. A best practice is to use names that are closely related to your business and security requirements, so you can identify them more easily.
- **Description**
  A string containing details about this policy.
- **Realm Roles**
  Specifies which **realm** roles are permitted by this policy.
- **Client Roles**
  Specifies which **client** roles are permitted by this policy. To enable this field must first select a **Client**.
- **Logic**
  The logic of this policy to apply after the other conditions have been evaluated.

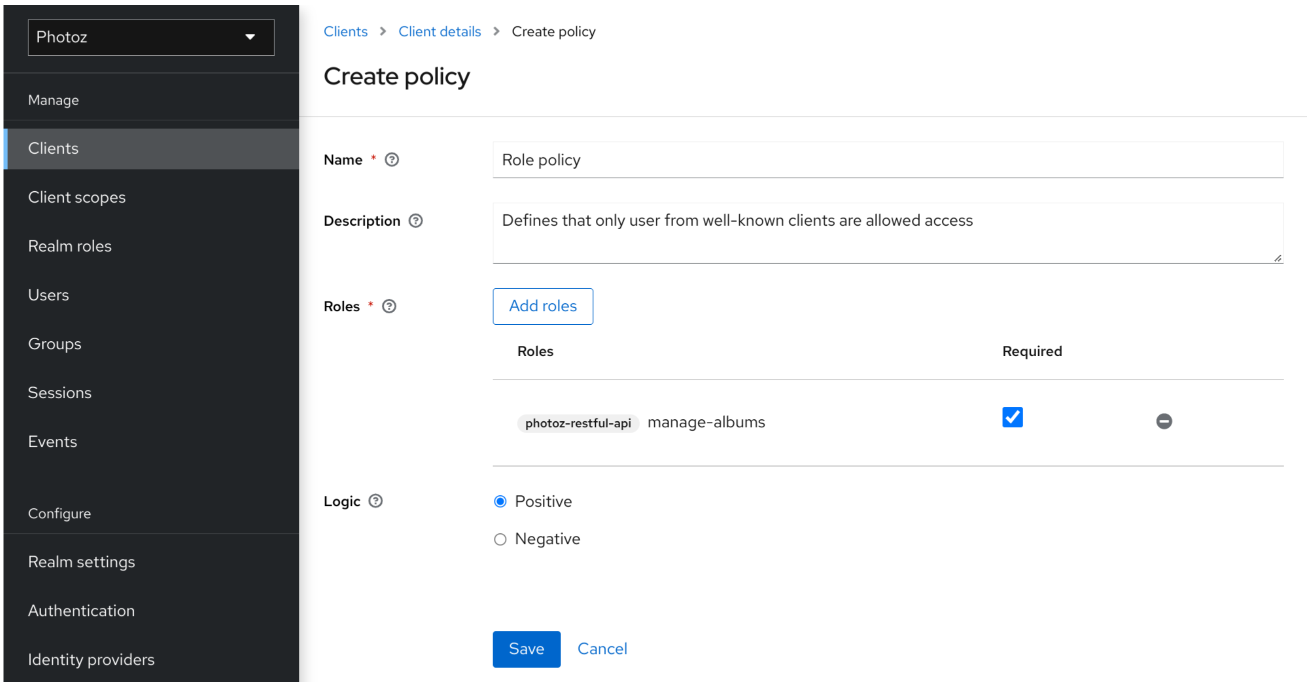
Additional resources

- Positive and negative logic

5.2.2. Defining a role as required

When creating a role-based policy, you can specify a specific role as **Required**. When you do that, the policy will grant access only if the user requesting access has been granted **all** the **required** roles. Both realm and client roles can be configured as such.

Example of a required role



Create policy

Name *	Role policy
Description	Defines that only user from well-known clients are allowed access
Roles *	Add roles

Roles	Required
photoz-restful-api manage-albums	✓

Logic: [✓ Positive] Negative

To specify a role as required, select the **Required** checkbox for the role you want to configure as required.

Required roles can be useful when your policy defines multiple roles but only a subset of them are mandatory. In this case, you can combine realm and client roles to enable an even more fine-grained role-based access control (RBAC) model for your application. For example, you can have policies specific for a client and require a specific client role associated with that client. Or you can enforce that access is granted only in the presence of a specific realm role. You can also combine both approaches within the same policy.

5.3. JAVASCRIPT-BASED POLICY

WARNING

If your policy implementation is using Attribute based access control (ABAC) as in the examples below, then please make sure that users are not able to edit the protected attributes and the corresponding attributes are read-only. See the details in the Threat model mitigation chapter.

You can use this type of policy to define conditions for your permissions using JavaScript. It is one of the rule-based policy types supported by Red Hat build of Keycloak, and provides flexibility to write any policy based on the Evaluation API.

To create a new JavaScript-based policy, select **JavaScript** in the item list in the upper right corner of the policy listing.

NOTE

By default, JavaScript Policies can not be uploaded to the server. You should prefer deploying your JS Policies directly to the server as described in JavaScript Providers.

5.3.1. Creating a JS policy from a deployed JAR file

Red Hat build of Keycloak allows you to deploy a JAR file in order to deploy scripts to the server. Please, take a look at JavaScript Providers for more details.

Once you have your scripts deployed, you should be able to select the scripts you deployed from the list of available policy providers.

5.3.2. Examples

5.3.2.1. Checking for attributes from the evaluation context

Here is a simple example of a JavaScript-based policy that uses attribute-based access control (ABAC) to define a condition based on an attribute obtained from the execution context:

```
const context = $evaluation.getContext();
const contextAttributes = context.getAttributes();

if (contextAttributes.containsValue('kc.client.network.ip_address', '127.0.0.1')) {
    $evaluation.grant();
}
```

5.3.2.2. Checking for attributes from the current identity

Here is a simple example of a JavaScript-based policy that uses attribute-based access control (ABAC) to define a condition based on an attribute obtained associated with the current identity:

```
const context = $evaluation.getContext();
const identity = context.getIdentity();
const attributes = identity.getAttributes();
const email = attributes.getValue('email').asString(0);

if (email.endsWith('@keycloak.org')) {
    $evaluation.grant();
}
```

Where these attributes are mapped from whatever claim is defined in the token that was used in the authorization request.

5.3.2.3. Checking for roles granted to the current identity

You can also use Role-Based Access Control (RBAC) in your policies. In the example below, we check if a user is granted with a **keycloak_user realm** role:

```
const context = $evaluation.getContext();
const identity = context.getIdentity();

if (identity.hasRealmRole('keycloak_user')) {
    $evaluation.grant();
}
```

Or you can check if a user is granted with a **my-client-role client** role, where **my-client** is the client id of the client application:

```
const context = $evaluation.getContext();
const identity = context.getIdentity();

if (identity.hasClientRole('my-client', 'my-client-role')) {
    $evaluation.grant();
}
```

5.3.2.4. Checking for roles granted to a user

To check for realm roles granted to a user:

```
const realm = $evaluation.getRealm();

if (realm.isUserInRealmRole('marta', 'role-a')) {
    $evaluation.grant();
}
```

Or for client roles granted to a user:

```
const realm = $evaluation.getRealm();

if (realm.isUserInClientRole('marta', 'my-client', 'some-client-role')) {
    $evaluation.grant();
}
```

5.3.2.5. Checking for roles granted to a group

To check for realm roles granted to a group:

```
const realm = $evaluation.getRealm();

if (realm.isGroupInRole('/Group A/Group D', 'role-a')) {
    $evaluation.grant();
}
```

5.3.2.6. Pushing arbitrary claims to the resource server

To push arbitrary claims to the resource server in order to provide additional information on how permissions should be enforced:

```
const permission = $evaluation.getPermission();

// decide if permission should be granted

if (granted) {
    permission.addClaim('claim-a', 'claim-a');
    permission.addClaim('claim-a', 'claim-a1');
    permission.addClaim('claim-b', 'claim-b');
}
```

5.3.2.7. Checking for group membership

```
const realm = $evaluation.getRealm();

if (realm.isUserInGroup('marta', '/Group A/Group B')) {
    $evaluation.grant();
}
```

5.3.2.8. Mixing different access control mechanisms

You can also use a combination of several access control mechanisms. The example below shows how roles(RBAC) and claims/attributes(ABAC) checks can be used within the same policy. In this case we check if user is granted with **admin** role or has an e-mail from **keycloak.org** domain:

```
const context = $evaluation.getContext();
const identity = context.getIdentity();
const attributes = identity.getAttributes();
const email = attributes.getValue('email').asString(0);

if (identity.hasRealmRole('admin') || email.endsWith('@keycloak.org')) {
    $evaluation.grant();
}
```

NOTE

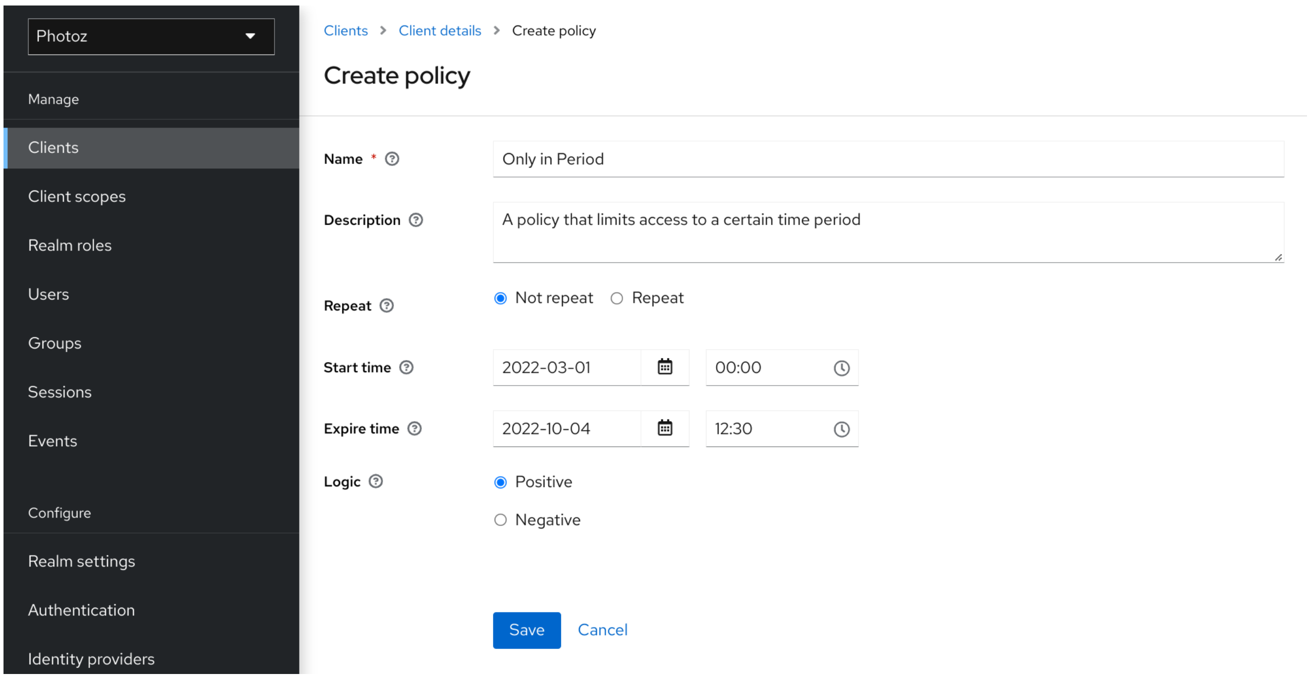
When writing your own rules, keep in mind that the **$evaluation** object is an object implementing **org.keycloak.authorization.policy.evaluation.Evaluation**. For more information about what you can access from this interface, see the Evaluation API.

5.4. TIME-BASED POLICY

You can use this type of policy to define time conditions for your permissions.

To create a new time-based policy, select **Time** in the item list in the upper right corner of the policy listing.

Add Time Policy



Create policy

Name * : Only in Period

Description: A policy that limits access to a certain time period

Repeat: [✓ Not repeat] Repeat

Start time: 2022-03-01 00:00

Expire time: 2022-10-04 12:30

Logic: [✓ Positive] Negative

5.4.1. Configuration

- **Name**
  A human-readable and unique string describing the policy. A best practice is to use names that are closely related to your business and security requirements, so you can identify them more easily.

- **Description**
  A string containing details about this policy.

- **Start time**
  Defines the time before which access must **not** be granted. Permission is granted only if the current date/time is later than or equal to this value.

- **Expire time**
  Defines the time after which access must **not** be granted. Permission is granted only if the current date/time is earlier than or equal to this value. Select **Repeat** to repeat access being granted on a specific **Day of Month**, **Month**, **Year**, **Hour** or **Minute**.

- **Day of Month**
  Defines the day of month that access must be granted. You can also specify a range of dates. In this case, permission is granted only if the current day of the month is between or equal to the two values specified.

- **Month**
  Defines the month that access must be granted. You can also specify a range of months. In this case, permission is granted only if the current month is between or equal to the two values specified.

- **Year**
  Defines the year that access must be granted. You can also specify a range of years. In this case, permission is granted only if the current year is between or equal to the two values specified.

- **Hour**
  Defines the hour that access must be granted. You can also specify a range of hours. In this case, permission is granted only if current hour is between or equal to the two values specified.

- **Minute**
  Defines the minute that access must be granted. You can also specify a range of minutes. In this case, permission is granted only if the current minute is between or equal to the two values specified.

- **Logic**
  The logic of this policy to apply after the other conditions have been evaluated.

Access is only granted if all conditions are satisfied. Red Hat build of Keycloak will perform an *AND* based on the outcome of each condition.

Additional resources

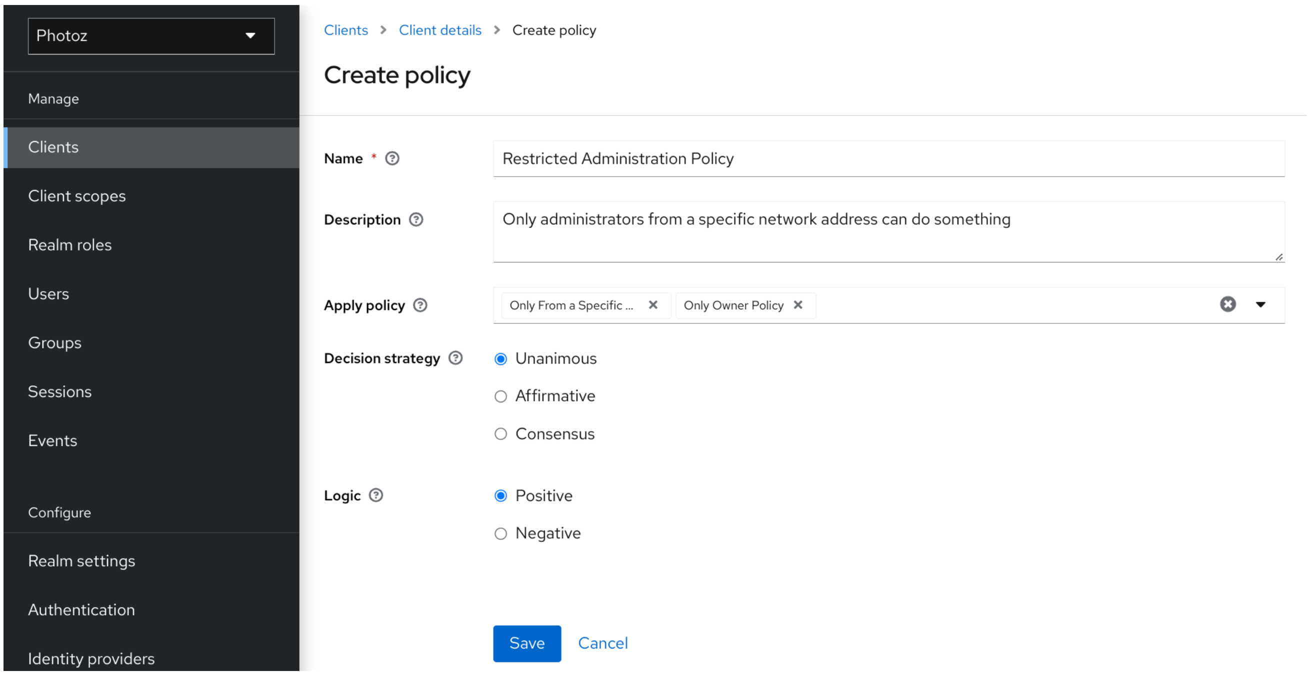
- Positive and negative logic

5.5. AGGREGATED POLICY

As mentioned previously, Red Hat build of Keycloak allows you to build a policy of policies, a concept referred to as policy aggregation. You can use policy aggregation to reuse existing policies to build more complex ones and keep your permissions even more decoupled from the policies that are evaluated during the processing of authorization requests.

To create a new aggregated policy, select **Aggregated** in the item list located in the right upper corner of the policy listing.

Add an aggregated policy



Create policy

Name *	Restricted Administration Policy
Description	Only administrators from a specific network address can do something
Apply policy	Only From a Specific ... ×, Only Owner Policy ×
Decision strategy	[✓ Unanimous] Affirmative Consensus
Logic	[✓ Positive] Negative

Let’s suppose you have a resource called *Confidential Resource* that can be accessed only by users from the *keycloak.org* domain and from a certain range of IP addresses. You can create a single policy with both conditions. However, you want to reuse the domain part of this policy to apply to permissions that operates regardless of the originating network.

You can create separate policies for both domain and network conditions and create a third policy based on the combination of these two policies. With an aggregated policy, you can freely combine other policies and then apply the new aggregated policy to any permission you want.

NOTE

When creating aggregated policies, be mindful that you are not introducing a circular reference or dependency between policies. If a circular dependency is detected, you cannot create or update the policy.

5.5.1. Configuration

- **Name**
  A human-readable and unique string describing the policy. We strongly suggest that you use names that are closely related with your business and security requirements, so you can identify them more easily and also know what they mean.

- **Description**
  A string with more details about this policy.

- **Apply Policy**
  Defines a set of one or more policies to associate with the aggregated policy. To associate a policy you can either select an existing policy or create a new one by selecting the type of the policy you want to create.

- **Decision Strategy**
  The decision strategy for this permission.

- **Logic**
  The logic of this policy to apply after the other conditions have been evaluated.

Additional resources

- Positive and negative logic

5.5.2. Decision strategy for aggregated policies

When creating aggregated policies, you can also define the decision strategy that will be used to determine the final decision based on the outcome from each policy.

- **Unanimous**
  The default strategy if none is provided. In this case, *all* policies must evaluate to a positive decision for the final decision to be also positive.

- **Affirmative**
  In this case, *at least one* policy must evaluate to a positive decision in order for the final decision to be also positive.

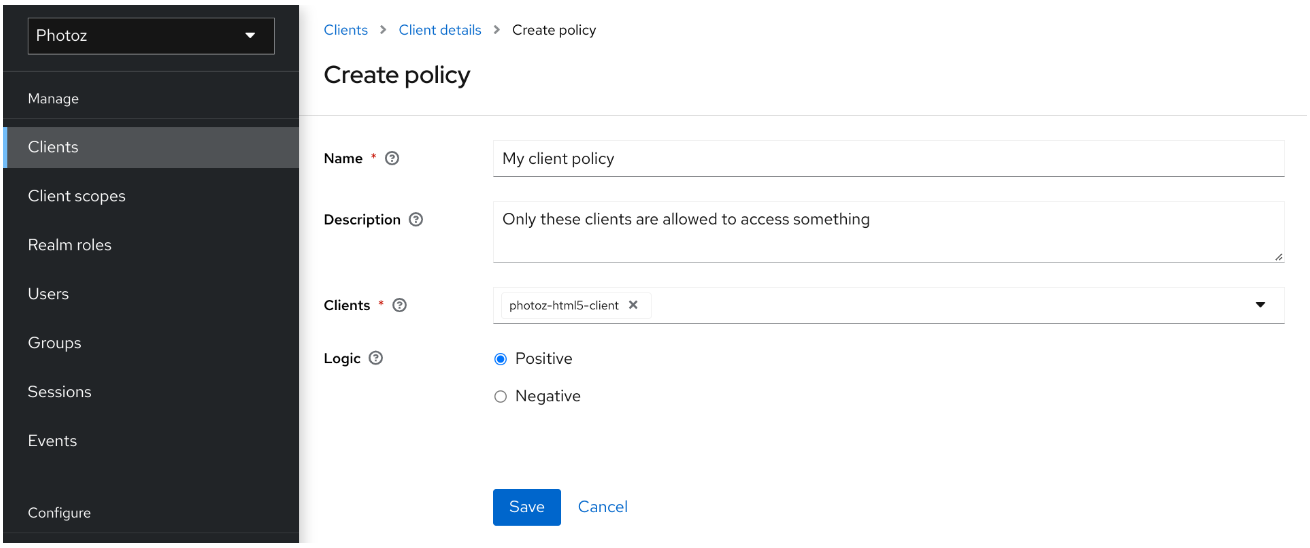
- **Consensus**
  In this case, the number of positive decisions must be greater than the number of negative decisions. If the number of positive and negative decisions is the same, the final decision will be negative.

5.6. CLIENT-BASED POLICY

You can use this type of policy to define conditions for your permissions where a set of one or more clients is permitted to access an object.

To create a new client-based policy, select **Client** from the policy type list.

Add a Client Policy



Create policy

Name * : My client policy

Description: Only these clients are allowed to access something

Clients * : photoz-html5-client

Logic: [✓ Positive] Negative

5.6.1. Configuration

- **Name**
  A human-readable and unique string identifying the policy. A best practice is to use names that are closely related to your business and security requirements, so you can identify them more easily.

- **Description**
  A string containing details about this policy.

- **Clients**
  Specifies which clients have givenGroup-based policy access by this policy.

- **Logic**
  The logic of this policy to apply after the other conditions have been evaluated.

Additional resources

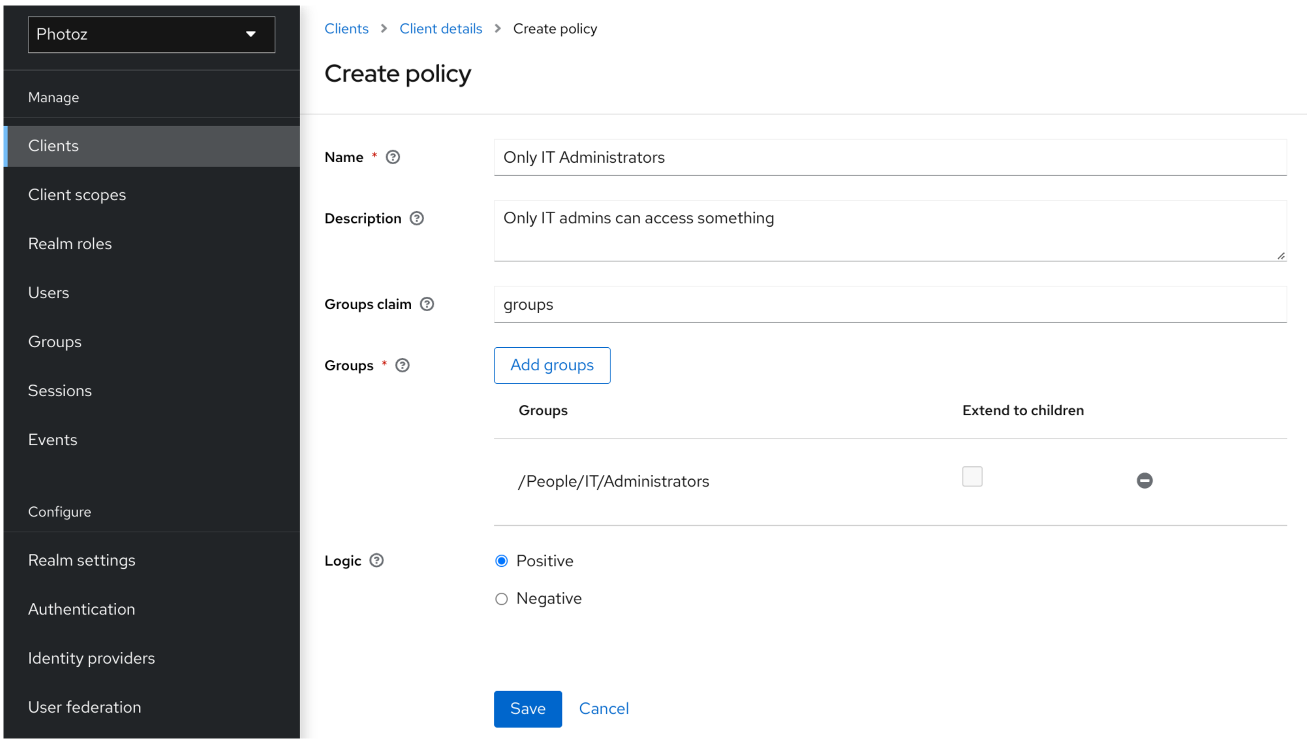
- Positive and negative logic

5.7. GROUP-BASED POLICY

You can use this type of policy to define conditions for your permissions where a set of one or more groups (and their hierarchies) is permitted to access an object.

To create a new group-based policy, select **Group** from the policy type list.

Group Policy



Create policy

Name *	Only IT Administrators
Description	Only IT admins can access something
Groups claim	groups
Groups *	

Groups	Extend to children
/People/IT/Administrators	☐

Logic: [✓ Positive] Negative

5.7.1. Configuration

- **Name**
  A human-readable and unique string describing the policy. A best practice is to use names that are closely related to your business and security requirements, so you can identify them more easily.

- **Description**
  A string containing details about this policy.

- **Groups Claim**
  Specifies the name of the claim in the token holding the group names and/or paths. Usually, authorization requests are processed based on an ID Token or Access Token previously issued to a client acting on behalf of some user. If defined, the token must include a claim from where this policy is going to obtain the groups the user is a member of. If not defined, user's groups are obtained from your realm configuration.

- **Groups**
  Allows you to select the groups that should be enforced by this policy when evaluating permissions. After adding a group, you can extend access to children of the group by marking the checkbox **Extend to Children**. If left unmarked, access restrictions only applies to the selected group.

- **Logic**
  The logic of this policy to apply after the other conditions have been evaluated.

Additional resources

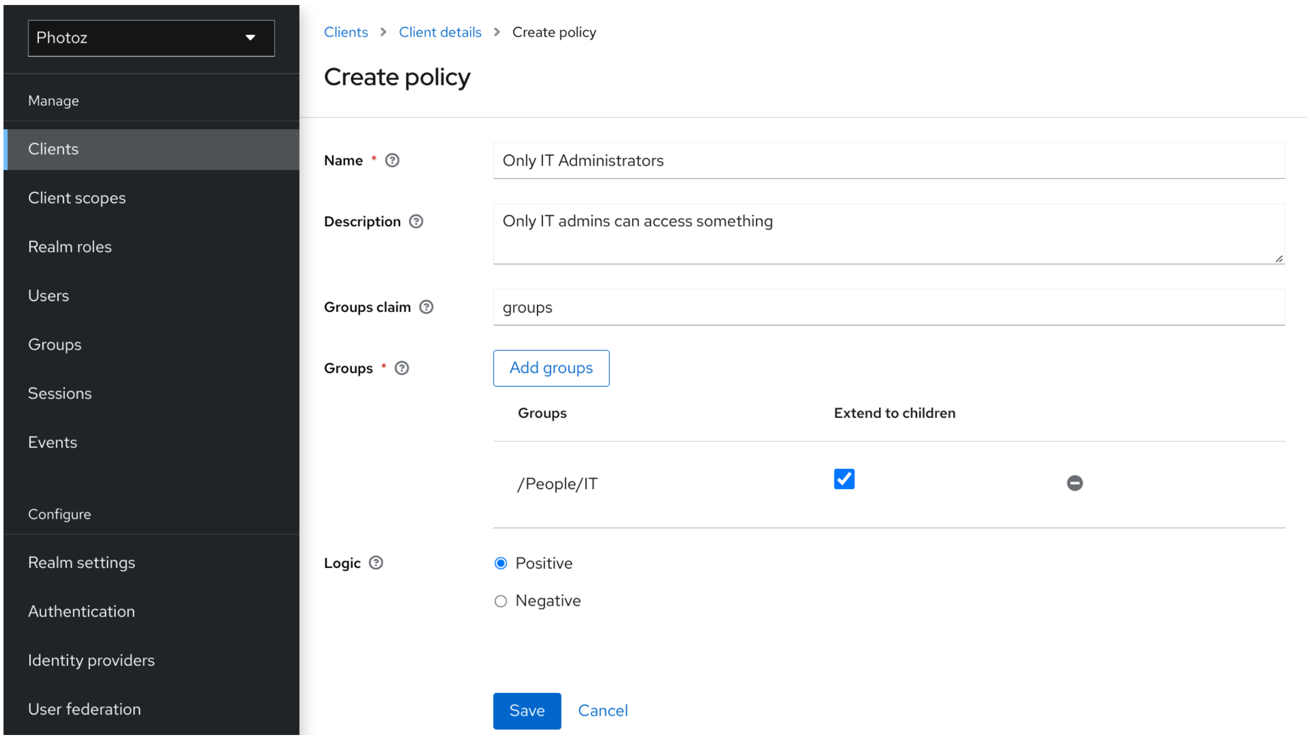
- Positive and negative logic

5.7.2. Extending access to child groups

By default, when you add a group to this policy, access restrictions will only apply to members of the selected group.

Under some circumstances, it might be necessary to allow access not only to the group itself but to any child group in the hierarchy. For any group added you can mark a checkbox **Extend to Children** in order to extend access to child groups.

Extending access to child groups



Name *	Only IT Administrators
Description	Only IT admins can access something
Groups claim	groups
Groups *	Add groups

Groups	Extend to children
/People/IT	✓

Logic: (●) Positive ( ) Negative

In the example above, the policy is granting access for any user member of **IT** or any of its children.

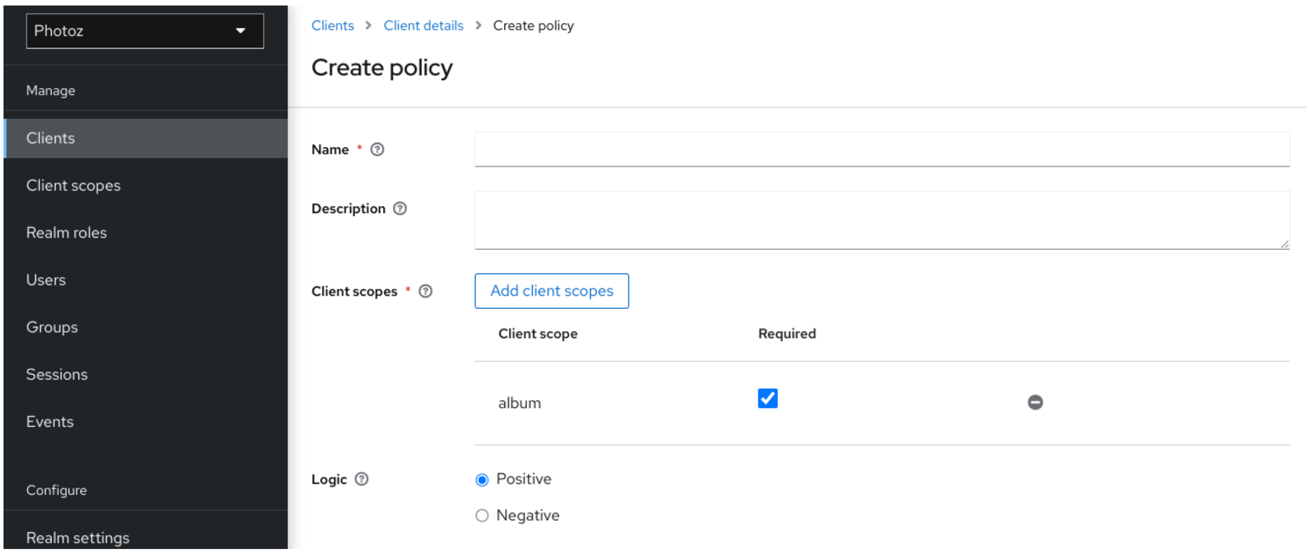
5.8. CLIENT SCOPE-BASED POLICY

You can use this type of policy to define conditions for your permissions where a set of one or more client scopes is permitted to access an object.

By default, client scopes added to this policy are not specified as required and the policy will grant access if the client requesting access has been granted any of these client scopes. However, you can specify a specific client scope as required if you want to enforce a specific client scope.

To create a new client scope-based policy, select **Client Scope** from the policy type list.

Add Client Scope Policy



Create policy

Name *	
Description	
Client scopes *	Client scope: album — Required: ✓
Logic	[✓ Positive] Negative

5.8.1. Configuration

- **Name**
  A human-readable and unique string describing the policy. A best practice is to use names that are closely related to your business and security requirements, so you can identify them more easily.

- **Description**
  A string containing details about this policy.

- **Client Scopes**
  Specifies which client scopes are permitted by this policy.

- **Logic**
  The logic of this policy to apply after the other conditions have been evaluated.

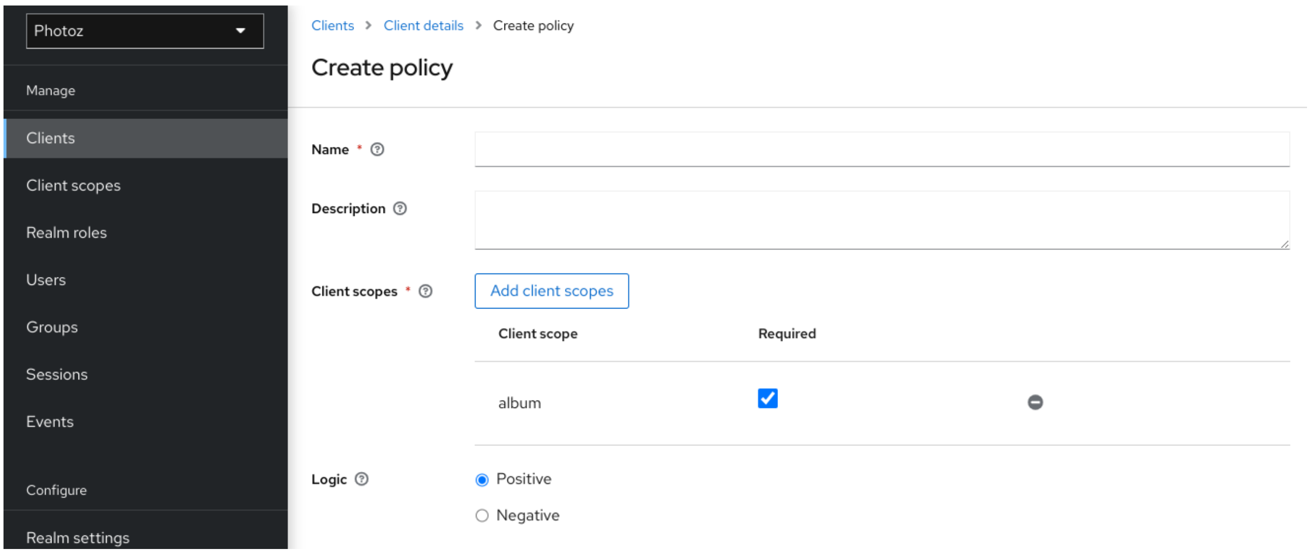
Additional resources

- Positive and negative logic

5.8.2. Defining a client scope as required

When creating a client scope-based policy, you can specify a specific client scope as **Required**. When you do that, the policy will grant access only if the client requesting access has been granted **all** the **required** client scopes.

Example of required client scope



Create policy

Name *	
Description	
Client scopes *	Add client scopes

Client scope	Required
album	✓

Logic: [✓ Positive] Negative

To specify a client scope as required, select the **Required** checkbox for the client scope you want to configure as required.

Required client scopes can be useful when your policy defines multiple client scopes but only a subset of them are mandatory.

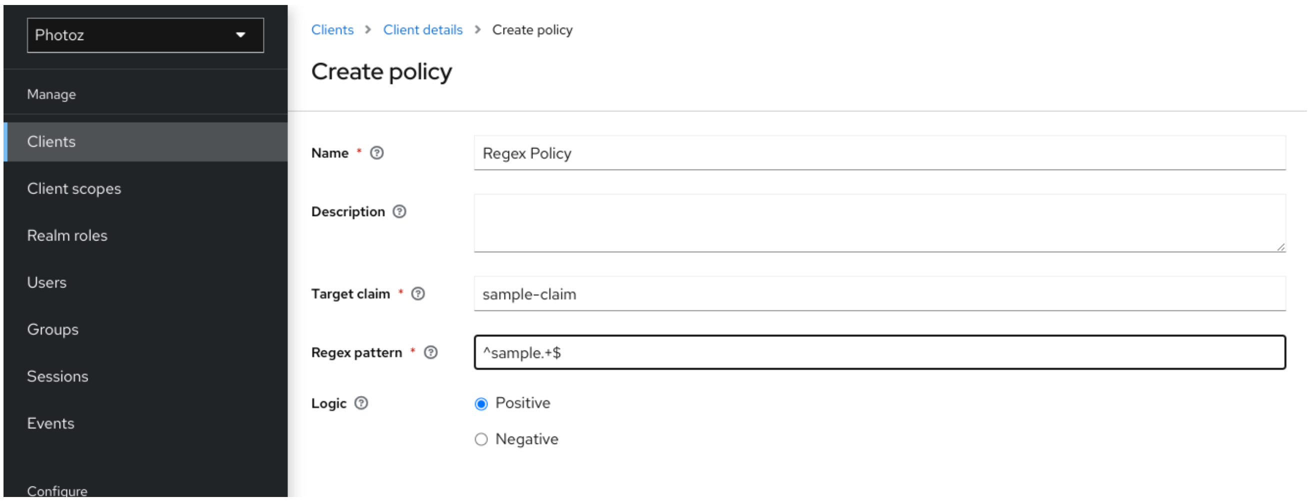
5.9. REGEX-BASED POLICY

You can use this type of policy to define regex conditions for your permissions.

To create a new regex-based policy, select **Regex** from the policy type list.

This policy resolves attributes available from the current identity.

Add Regex Policy



Create policy

Name *	Regex Policy
Description	
Target claim *	sample-claim
Regex pattern *	^sample.+$
Logic	[✓ Positive] Negative

5.9.1. Configuration

- **Name**
  A human-readable and unique string describing the policy. A best practice is to use names that are closely related to your business and security requirements, so you can identify them more easily.

- **Description**
  A string containing details about this policy.

- **Target Claim**
  Specifies the name of the target claim in the token. For JSON-based claims, you can use dot notation for nesting and square brackets to access array fields by index. For example, contact.address[0].country. If the target claim references a JSON object, the first path (for example, **contact**) should map to the attribute name holding the JSON object.

- **Regex Pattern**
  Specifies the regex pattern.

- **Logic**
  The Logic of this policy to apply after the other conditions have been evaluated.

5.10. POSITIVE AND NEGATIVE LOGIC

Policies can be configured with positive or negative logic. Briefly, you can use this option to define whether the policy result should be kept as it is or be negated.

For example, suppose you want to create a policy where only users **not** granted with a specific role should be given access. In this case, you can create a role-based policy using that role and set its **Logic** field to **Negative**. If you keep **Positive**, which is the default behavior, the policy result will be kept as it is.

5.11. POLICY EVALUATION API

When writing rule-based policies using JavaScript, Red Hat build of Keycloak provides an Evaluation API that provides useful information to help determine whether a permission should be granted.

This API consists of a few interfaces that provide you access to information, such as

- The permission being evaluated, representing both the resource and scopes being requested.
- The attributes associated with the resource being requested
- Runtime environment and any other attribute associated with the execution context
- Information about users such as group membership and roles

The main interface is **org.keycloak.authorization.policy.evaluation.Evaluation**, which defines the following contract:

```
public interface Evaluation {

    /**
     * Returns the {@link ResourcePermission} to be evaluated.
     *
     * @return the permission to be evaluated
     */
    ResourcePermission getPermission();

    /**
     * Returns the {@link EvaluationContext}. Which provides access to the whole evaluation runtime
context.
     *
     * @return the evaluation context
     */
    EvaluationContext getContext();
    /**
     * Returns a {@link Realm} that can be used by policies to query information.
     *
     * @return a {@link Realm} instance
     */
    Realm getRealm();

    /**
     * Grants the requested permission to the caller.
     */
    void grant();

    /**
     * Denies the requested permission.
     */
    void deny();
}
```

When processing an authorization request, Red Hat build of Keycloak creates an **Evaluation** instance before evaluating any policy. This instance is then passed to each policy to determine whether access is **GRANT** or **DENY**.

Policies determine this by invoking the **grant()** or **deny()** methods on an **Evaluation** instance. By default, the state of the **Evaluation** instance is denied, which means that your policies must explicitly invoke the **grant()** method to indicate to the policy evaluation engine that permission should be granted.

Additional resources

- JavaDocs Documentation.

5.11.1. The evaluation context

The evaluation context provides useful information to policies during their evaluation.

```
public interface EvaluationContext {

    /**
     * Returns the {@link Identity} that represents an entity (person or non-person) to which the
permissions must be granted, or not.
     *
     * @return the identity to which the permissions must be granted, or not
     */
    Identity getIdentity();

    /**
     * Returns all attributes within the current execution and runtime environment.
     *
     * @return the attributes within the current execution and runtime environment
     */
    Attributes getAttributes();
}
```

From this interface, policies can obtain:

- The authenticated **Identity**
- Information about the execution context and runtime environment

The **Identity** is built based on the OAuth2 Access Token that was sent along with the authorization request, and this construct has access to all claims extracted from the original token. For example, if you are using a *Protocol Mapper* to include a custom claim in an OAuth2 Access Token you can also access this claim from a policy and use it to build your conditions.

The **EvaluationContext** also gives you access to attributes related to both the execution and runtime environments. For now, there only a few built-in attributes.

Table 5.1. Execution and Runtime Attributes

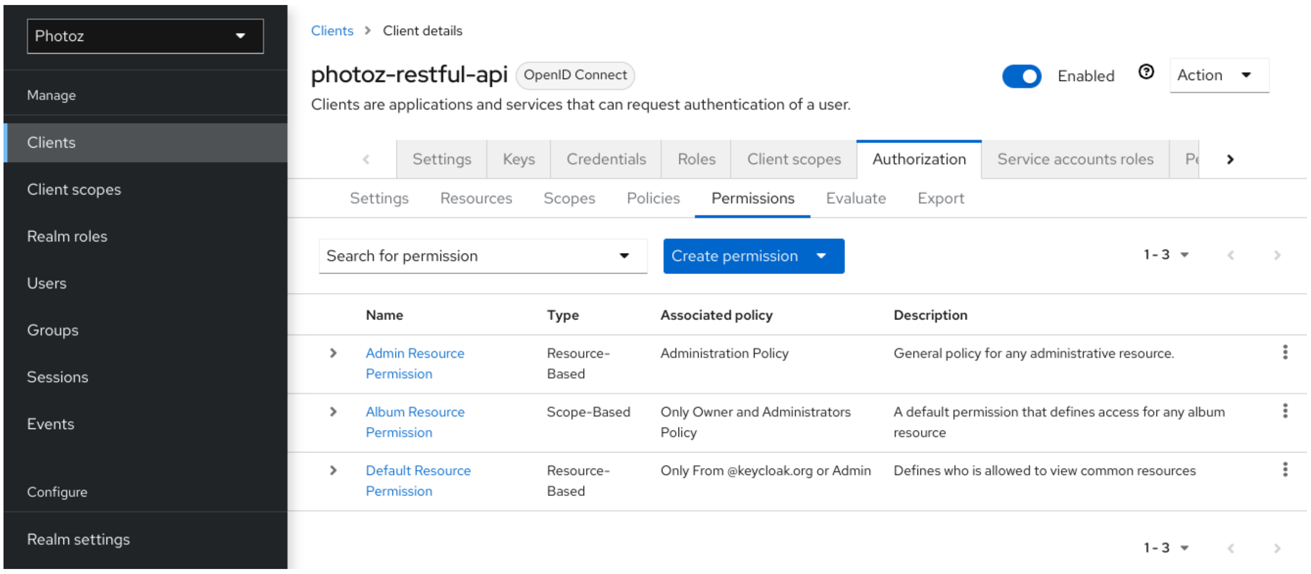
Name	Description	Type
kc.time.date_time	Current date and time	String. Format **MM/dd/yyyy hh:mm:ss**
kc.client.network.ip_address	IPv4 address of the client	String
kc.client.network.host	Client’s host name	String
kc.client.id	The client id	String
kc.client.user_agent	The value of the 'User-Agent' HTTP header	String[]
kc.realm.name	The name of the realm	String

CHAPTER 6. MANAGING PERMISSIONS

A permission associates the object being protected and the policies that must be evaluated to decide whether access should be granted.

After creating the resources you want to protect and the policies you want to use to protect these resources, you can start managing permissions. To manage permissions, click the **Permissions** tab when editing a resource server.

Permissions



Clients are applications and services that can request authentication of a user.

Name	Type	Associated policy	Description
Admin Resource Permission	Resource-Based	Administration Policy	General policy for any administrative resource.
Album Resource Permission	Scope-Based	Only Owner and Administrators Policy	A default permission that defines access for any album resource
Default Resource Permission	Resource-Based	Only From @keycloak.org or Admin	Defines who is allowed to view common resources

Permissions can be created to protect two main types of objects:

- **Resources**
- **Scopes**

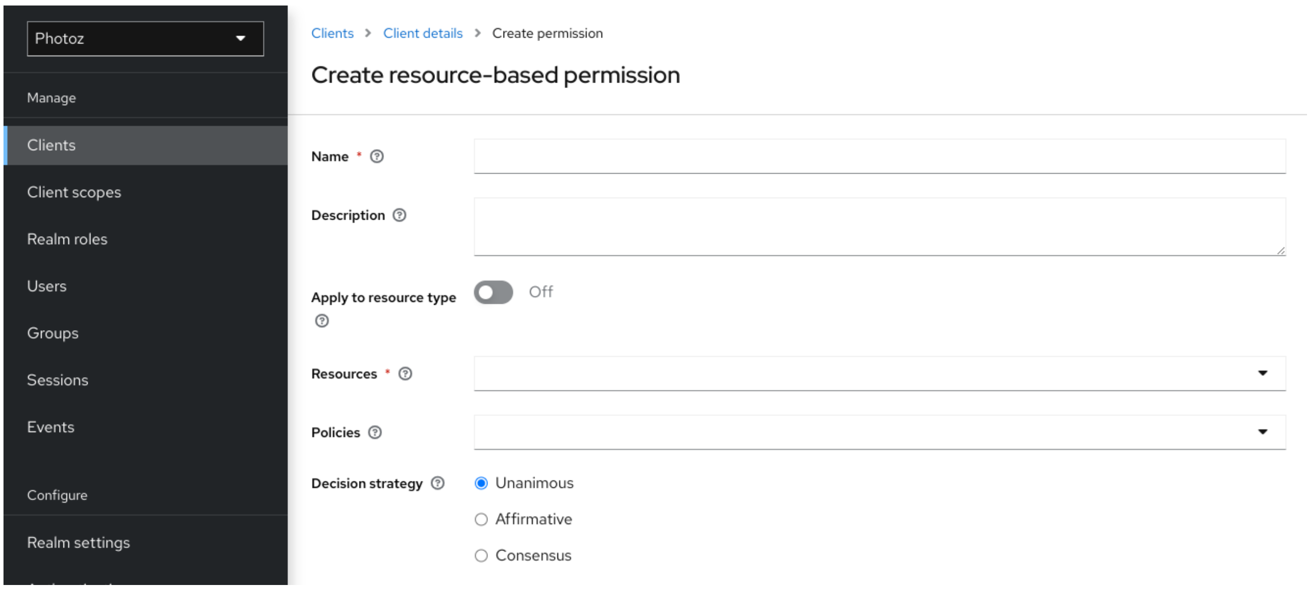
To create a permission, select the permission type you want to create from the item list in the upper right corner of the permission listing. The following sections describe these two types of objects in more detail.

6.1. CREATING RESOURCE-BASED PERMISSION

A resource-based permission defines a set of one or more resources to protect using a set of one or more authorization policies.

To create a new resource-based permission, select **Create resource-based permission** from the **Create permission** dropdown.

Add Resource Permission



Create resource-based permission

Name *	
Description	
Apply to resource type	Off
Resources *	
Policies	
Decision strategy	[✓ Unanimous] Affirmative Consensus

6.1.1. Configuration

- **Name**
  A human-readable and unique string describing the permission. A best practice is to use names that are closely related to your business and security requirements, so you can identify them more easily.

- **Description**
  A string containing details about this permission.

- **Apply To Resource Type**
  Specifies if the permission is applied to all resources with a given type. When selecting this field, you are prompted to enter the resource type to protect.

  - Resource Type
    Defines the resource type to protect. When defined, this permission is evaluated for all resources matching that type.

- **Resources**
  Defines a set of one or more resources to protect.

- **Policy**
  Defines a set of one or more policies to associate with a permission. To associate a policy you can either select an existing policy or create a new one by selecting the type of the policy you want to create.

- **Decision Strategy**
  The Decision Strategy for this permission.

6.1.2. Typed resource permission

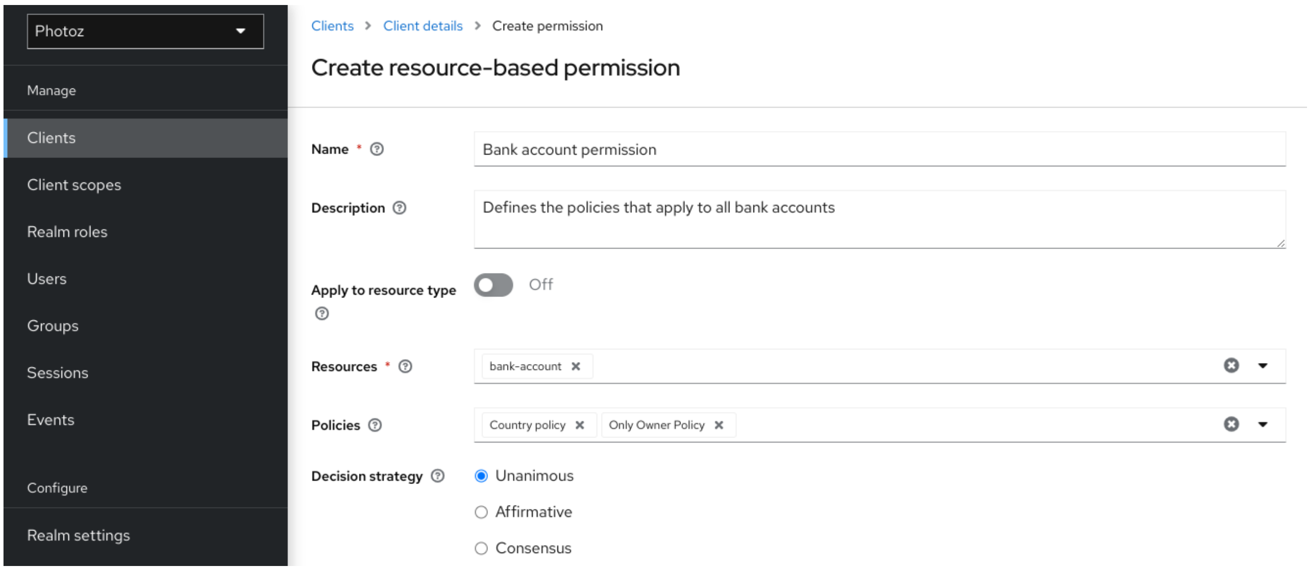
Resource permissions can also be used to define policies that are to be applied to all resources with a given type. This form of resource-based permission can be useful when you have resources sharing common access requirements and constraints.

Frequently, resources within an application can be categorized (or typed) based on the data they encapsulate or the functionality they provide. For example, a financial application can manage different banking accounts where each one belongs to a specific customer. Although they are different banking accounts, they share common security requirements and constraints that are globally defined by the banking organization. With typed resource permissions, you can define common policies to apply to all banking accounts, such as:

- Only the owner can manage his account
- Only allow access from the owner's country and/or region
- Enforce a specific authentication method

To create a typed resource permission, click Apply to Resource Type when creating a new resource-based permission. With **Apply to Resource Type** set to **On**, you can specify the type that you want to protect as well as the policies that are to be applied to govern access to all resources with type you have specified.

Example of a typed resource permission



Create resource-based permission

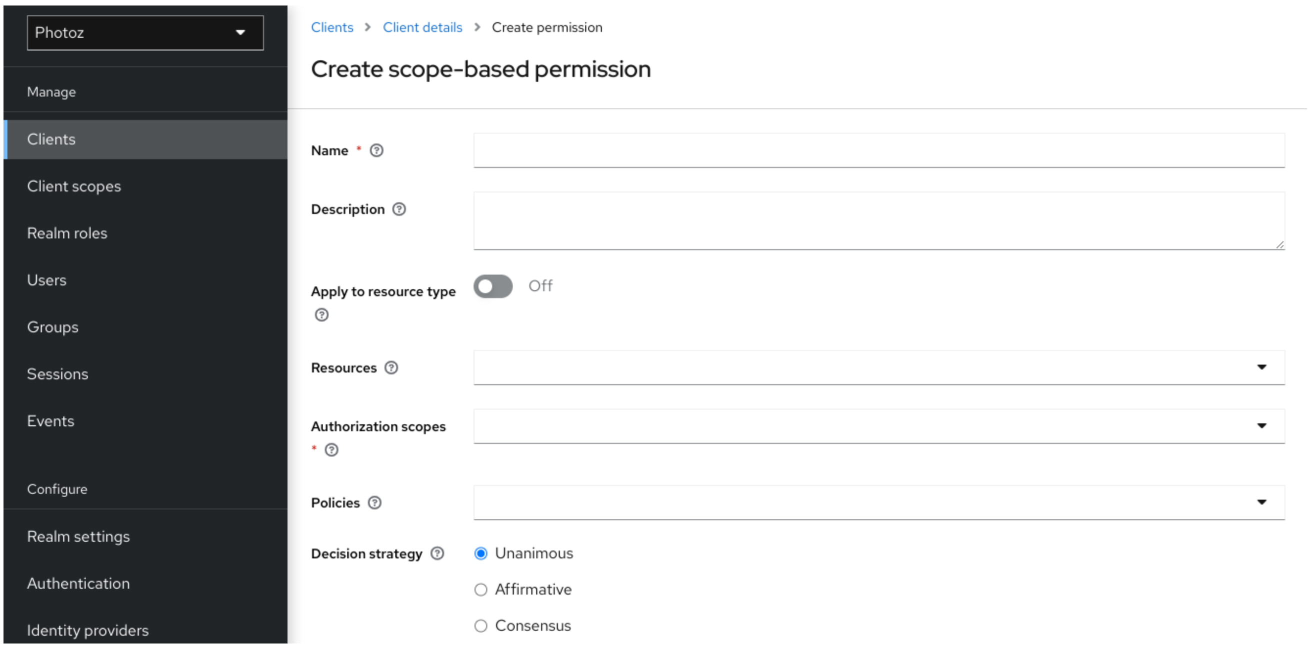
Name *	Bank account permission
Description	Defines the policies that apply to all bank accounts
Apply to resource type	Off
Resources *	bank-account
Policies	Country policy, Only Owner Policy
Decision strategy	[✓ Unanimous] Affirmative Consensus

6.2. CREATING SCOPE-BASED PERMISSIONS

A scope-based permission defines a set of one or more scopes to protect using a set of one or more authorization policies. Unlike resource-based permissions, you can use this permission type to create permissions not only for a resource, but also for the scopes associated with it, providing more granularity when defining the permissions that govern your resources and the actions that can be performed on them.

To create a new scope-based permission, select **Create scope-based permission** from the **Create permission** dropdown.

Add Scope Permission



Create scope-based permission

Name *

Description

Apply to resource type: Off

Resources

Authorization scopes *

Policies

Decision strategy: Unanimous [✓] / Affirmative / Consensus

6.2.1. Configuration

- **Name**
  A human-readable and unique string describing the permission. A best practice is to use names that are closely related to your business and security requirements, so you can identify them more easily.

- **Description**
  A string containing details about this permission.

- **Resource**
  Restricts the scopes to those associated with the selected resource. If none is selected, all scopes are available.

- **Scopes**
  Defines a set of one or more scopes to protect.

- **Policy**
  Defines a set of one or more policies to associate with a permission. To associate a policy you can either select an existing policy or create a new one by selecting the type of the policy you want to create.

- **Decision Strategy**
  The Decision Strategy for this permission.

6.3. POLICY DECISION STRATEGIES

When associating policies with a permission, you can also define a decision strategy to specify how to evaluate the outcome of the associated policies to determine access.

- **Unanimous**
  The default strategy if none is provided. In this case, *all* policies must evaluate to a positive decision for the final decision to be also positive.

- **Affirmative**

In this case, *at least one* policy must evaluate to a positive decision for the final decision to be also positive.

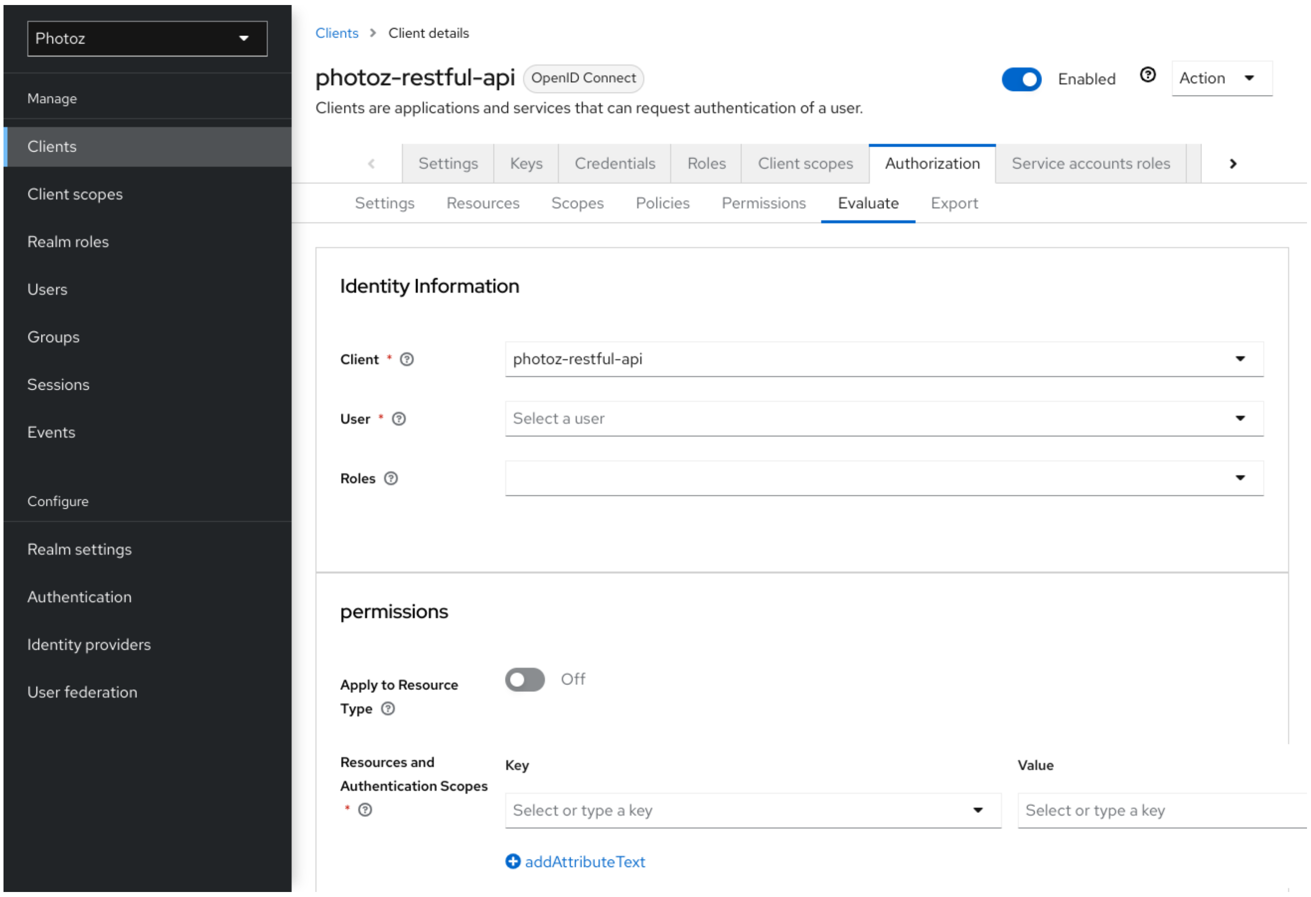
- **Consensus**
  In this case, the number of positive decisions must be greater than the number of negative decisions. If the number of positive and negative decisions is equal, the final decision will be negative.

CHAPTER 7. EVALUATING AND TESTING POLICIES

When designing your policies, you can simulate authorization requests to test how your policies are being evaluated.

You can access the Policy Evaluation Tool by clicking the **Evaluate** tab when editing a resource server. There you can specify different inputs to simulate real authorization requests and test the effect of your policies.

Policy evaluation tool



Clients are applications and services that can request authentication of a user.

Identity Information

Client * photoz-restful-api

User * Select a user

Roles

permissions

Apply to Resource Type Off

Resources and Authentication Scopes *

Key: Select or type a key

Value: Select or type a key

7.1. PROVIDING IDENTITY INFORMATION

The **Identity Information** filters can be used to specify the user requesting permissions.

7.2. PROVIDING CONTEXTUAL INFORMATION

The **Contextual Information** filters can be used to define additional attributes to the evaluation context, so that policies can obtain these same attributes.

7.3. PROVIDING THE PERMISSIONS

The **Permissions** filters can be used to build an authorization request. You can request permissions for a set of one or more resources and scopes. If you want to simulate authorization requests based on all protected resources and scopes, click **Add** without specifying any **Resources** or **Scopes**.

When you've specified your desired values, click **Evaluate**.

CHAPTER 8. AUTHORIZATION SERVICES

Red Hat build of Keycloak Authorization Services are built on top of well-known standards such as the OAuth2 and User-Managed Access specifications.

OAuth2 clients (such as front end applications) can obtain access tokens from the server using the token endpoint and use these same tokens to access resources protected by a resource server (such as back end services). In the same way, Red Hat build of Keycloak Authorization Services provide extensions to OAuth2 to allow access tokens to be issued based on the processing of all policies associated with the resource(s) or scope(s) being requested. This means that resource servers can enforce access to their protected resources based on the permissions granted by the server and held by an access token. In Red Hat build of Keycloak Authorization Services the access token with permissions is called a Requesting Party Token or RPT for short.

In addition to the issuance of RPTs, Red Hat build of Keycloak Authorization Services also provides a set of RESTful endpoints that allow resources servers to manage their protected resources, scopes, permissions and policies, helping developers to extend or integrate these capabilities into their applications in order to support fine-grained authorization.

8.1. DISCOVERING AUTHORIZATION SERVICES ENDPOINTS AND METADATA

Red Hat build of Keycloak provides a discovery document from which clients can obtain all necessary information to interact with Red Hat build of Keycloak Authorization Services, including endpoint locations and capabilities.

The discovery document can be obtained from:

```
curl -X GET \
  http://${host}:${port}/realms/${realm}/.well-known/uma2-configuration
```

Where **${host}:${port}** is the hostname (or IP address) and port where Red Hat build of Keycloak is running and **${realm}** is the name of a realm in Red Hat build of Keycloak.

As a result, you should get a response as follows:

```
{

    // some claims are expected here

    // these are the main claims in the discovery document about Authorization Services endpoints location
    "token_endpoint": "http://${host}:${port}/realms/${realm}/protocol/openid-connect/token",
    "token_introspection_endpoint": "http://${host}:${port}/realms/${realm}/protocol/openid-connect/token/introspect",
    "resource_registration_endpoint": "http://${host}:${port}/realms/${realm}/authz/protection/resource_set",
    "permission_endpoint": "http://${host}:${port}/realms/${realm}/authz/protection/permission",
    "policy_endpoint": "http://${host}:${port}/realms/${realm}/authz/protection/uma-policy"
}
```

Each of these endpoints expose a specific set of capabilities:

- **token_endpoint**

A OAuth2-compliant Token Endpoint that supports the **urn:ietf:params:oauth:grant-type:uma-ticket** grant type. Through this endpoint clients can send authorization requests and obtain an RPT with all permissions granted by Red Hat build of Keycloak.

- **token_introspection_endpoint**
  A OAuth2-compliant Token Introspection Endpoint which clients can use to query the server to determine the active state of an RPT and to determine any other information associated with the token, such as the permissions granted by Red Hat build of Keycloak.

- **resource_registration_endpoint**
  A UMA-compliant Resource Registration Endpoint which resource servers can use to manage their protected resources and scopes. This endpoint provides operations create, read, update and delete resources and scopes in Red Hat build of Keycloak.

- **permission_endpoint**
  A UMA-compliant Permission Endpoint which resource servers can use to manage permission tickets. This endpoint provides operations create, read, update, and delete permission tickets in Red Hat build of Keycloak.

8.2. OBTAINING PERMISSIONS

To obtain permissions from Red Hat build of Keycloak you send an authorization request to the token endpoint. As a result, Red Hat build of Keycloak will evaluate all policies associated with the resource(s) and scope(s) being requested and issue an RPT with all permissions granted by the server.

Clients are allowed to send authorization requests to the token endpoint using the following parameters:

- **grant_type**
  This parameter is **required**. Must be **urn:ietf:params:oauth:grant-type:uma-ticket**.

- **ticket**
  This parameter is **optional**. The most recent permission ticket received by the client as part of the UMA authorization process.

- **claim_token**
  This parameter is **optional**. A string representing additional claims that should be considered by the server when evaluating permissions for the resource(s) and scope(s) being requested. This parameter allows clients to push claims to Red Hat build of Keycloak. For more details about all supported token formats see **claim_token_format** parameter.

- **claim_token_format**
  This parameter is **optional**. A string indicating the format of the token specified in the **claim_token** parameter. Red Hat build of Keycloak supports two token formats: **urn:ietf:params:oauth:token-type:jwt** and **https://openid.net/specs/openid-connect-core-1_0.html#IDToken**. The **urn:ietf:params:oauth:token-type:jwt** format indicates that the **claim_token** parameter references an access token. The **https://openid.net/specs/openid-connect-core-1_0.html#IDToken** indicates that the **claim_token** parameter references an OpenID Connect ID Token.

- **rpt**
  This parameter is **optional**. A previously issued RPT which permissions should also be evaluated and added in a new one. This parameter allows clients in possession of an RPT to perform incremental authorization where permissions are added on demand.

- **permission**
  This parameter is **optional**. A string representing a set of one or more resources and scopes the

client is seeking access. This parameter can be defined multiple times in order to request permission for multiple resource and scopes. This parameter is an extension to **urn:ietf:params:oauth:grant-type:uma-ticket** grant type in order to allow clients to send authorization requests without a permission ticket. The format of the string must be: **RESOURCE_ID#SCOPE_ID**. For instance: **Resource A#Scope A**, **Resource A#Scope A, Scope B, Scope C**, **Resource A**, **#Scope A**.

- permission_resource_format
  This parameter is **optional**. A string representing a format indicating the resource in the **permission** parameter. Possible values are **id** and **uri**. **id** indicates the format is **RESOURCE_ID**. **uri** indicates the format is **URI**. If not specified, the default is **id**.

- permission_resource_matching_uri
  This parameter is **optional**. A boolean value that indicates whether to use path matching when representing resources in URI format in the **permission** parameter. If not specified, the default is false.

- audience
  This parameter is **optional**. The client identifier of the resource server to which the client is seeking access. This parameter is mandatory in case the **permission** parameter is defined. It serves as a hint to Red Hat build of Keycloak to indicate the context in which permissions should be evaluated.

- response_include_resource_name
  This parameter is **optional**. A boolean value indicating to the server whether resource names should be included in the RPT's permissions. If false, only the resource identifier is included.

- response_permissions_limit
  This parameter is **optional**. An integer N that defines a limit for the amount of permissions an RPT can have. When used together with **rpt** parameter, only the last N requested permissions will be kept in the RPT.

- submit_request
  This parameter is **optional**. A boolean value indicating whether the server should create permission requests to the resources and scopes referenced by a permission ticket. This parameter only has effect if used together with the **ticket** parameter as part of a UMA authorization process.

- response_mode
  This parameter is **optional**. A string value indicating how the server should respond to authorization requests. This parameter is specially useful when you are mainly interested in either the overall decision or the permissions granted by the server, instead of a standard OAuth2 response. Possible values are:

  - **decision**
    Indicates that responses from the server should only represent the overall decision by returning a JSON with the following format:

    ```
    {
        'result': true
    }
    ```

    If the authorization request does not map to any permission, a **403** HTTP status code is returned instead.

  - **permissions**

Indicates that responses from the server should contain any permission granted by the server by returning a JSON with the following format:

```
[
    {
        'rsid': 'My Resource'
        'scopes': ['view', 'update']
    },

    ...
]
```

If the authorization request does not map to any permission, a **403** HTTP status code is returned instead.

Example of an authorization request when a client is seeking access to two resources protected by a resource server.

```
curl -X POST \
  http://${host}:${port}/realms/${realm}/protocol/openid-connect/token \
  -H "Authorization: Bearer ${access_token}" \
  --data "grant_type=urn:ietf:params:oauth:grant-type:uma-ticket" \
  --data "audience={resource_server_client_id}" \
  --data "permission=Resource A#Scope A" \
  --data "permission=Resource B#Scope B"
```

Example of an authorization request when a client is seeking access to any resource and scope protected by a resource server. NOTE: This will not evaluate the permissions for all resources. Instead, the permissions for resources owned by the resource server, owned by the requesting user, and explicitly granted to the requesting user by other owners are evaluated.

```
curl -X POST \
  http://${host}:${port}/realms/${realm}/protocol/openid-connect/token \
  -H "Authorization: Bearer ${access_token}" \
  --data "grant_type=urn:ietf:params:oauth:grant-type:uma-ticket" \
  --data "audience={resource_server_client_id}"
```

Example of an authorization request when a client is seeking access to a UMA protected resource after receiving a permission ticket from the resource server as part of the authorization process:

```
curl -X POST \
  http://${host}:${port}/realms/${realm}/protocol/openid-connect/token \
  -H "Authorization: Bearer ${access_token}" \
  --data "grant_type=urn:ietf:params:oauth:grant-type:uma-ticket" \
  --data "ticket=${permission_ticket}
```

If Red Hat build of Keycloak assessment process results in issuance of permissions, it issues the RPT with which it has associated the permissions:

Red Hat build of Keycloak responds to the client with the RPT

```
HTTP/1.1 200 OK
Content-Type: application/json
...
```

```
{
  "access_token": "${rpt}",
}
```

The response from the server is just like any other response from the token endpoint when using some other grant type. The RPT can be obtained from the **access_token** response parameter. If the client is not authorized, Red Hat build of Keycloak responds with a **403** HTTP status code:

Red Hat build of Keycloak denies the authorization request

```
HTTP/1.1 403 Forbidden
Content-Type: application/json
...
{
  "error": "access_denied",
  "error_description": "request_denied"
}
```

8.2.1. Client authentication methods

Clients need to authenticate to the token endpoint in order to obtain an RPT. When using the **urn:ietf:params:oauth:grant-type:uma-ticket** grant type, clients can use any of these authentication methods:

- **Bearer Token**
  Clients should send an access token as a Bearer credential in an HTTP Authorization header to the token endpoint.

  Example: an authorization request using an access token to authenticate to the token endpoint

  ```
  curl -X POST \
    http://${host}:${port}/realms/${realm}/protocol/openid-connect/token \
    -H "Authorization: Bearer ${access_token}" \
    --data "grant_type=urn:ietf:params:oauth:grant-type:uma-ticket"
  ```

  This method is especially useful when the client is acting on behalf of a user. In this case, the bearer token is an access token previously issued by Red Hat build of Keycloak to some client acting on behalf of a user (or on behalf of itself). Permissions will be evaluated considering the access context represented by the access token. For instance, if the access token was issued to Client A acting on behalf of User A, permissions will be granted depending on the resources and scopes to which User A has access.

- **Client Credentials**
  Clients can use any of the client authentication methods supported by Red Hat build of Keycloak. For instance, client_id/client_secret or JWT.

  Example: an authorization request using client id and client secret to authenticate to the token endpoint

  ```
  curl -X POST \
    http://${host}:${port}/realms/${realm}/protocol/openid-connect/token \
    -H "Authorization: Basic cGhvdGg6L7Jl13RmfWgtkk==pOnNlY3JldA==" \
    --data "grant_type=urn:ietf:params:oauth:grant-type:uma-ticket"
  ```

8.2.2. Pushing claims

When obtaining permissions from the server you can push arbitrary claims in order to have these claims available to your policies when evaluating permissions.

If you are obtaining permissions from the server **without** using a permission ticket (UMA flow), you can send an authorization request to the token endpoint as follows:

```
curl -X POST \
  http://${host}:${port}/realms/${realm}/protocol/openid-connect/token \
  --data "grant_type=urn:ietf:params:oauth:grant-type:uma-ticket" \
  --data "claim_token=ewogICAib3JnYW5pemF0aW9uIjogWyJhY21lIl0KfQ==" \
  --data "claim_token_format=urn:ietf:params:oauth:token-type:jwt" \
  --data "client_id={resource_server_client_id}" \
  --data "client_secret={resource_server_client_secret}" \
  --data "audience={resource_server_client_id}"
```

The **claim_token** parameter expects a BASE64 encoded JSON with a format similar to the example below:

```
{
    "organization" : ["acme"]
}
```

The format expects one or more claims where the value for each claim must be an array of strings.

8.2.2.1. Pushing claims Using UMA

For more details about how to push claims when using UMA and permission tickets, please take a look at Permission API

8.3. USER-MANAGED ACCESS

Red Hat build of Keycloak Authorization Services is based on User-Managed Access or UMA for short. UMA is a specification that enhances OAuth2 capabilities in the following ways:

- **Privacy**
  Nowadays, user privacy is becoming a huge concern, as more and more data and devices are available and connected to the cloud. With UMA and Red Hat build of Keycloak, resource servers can enhance their capabilities in order to improve how their resources are protected in respect to user privacy where permissions are granted based on policies defined by the user.

- **Party-to-Party Authorization**
  Resource owners (e.g.: regular end-users) can manage access to their resources and authorize other parties (e.g: regular end-users) to access these resources. This is different than OAuth2 where consent is given to a client application acting on behalf of a user, with UMA resource owners are allowed to consent access to other users, in a completely asynchronous manner.

- **Resource Sharing**
  Resource owners are allowed to manage permissions to their resources and decide who can access a particular resource and how. Red Hat build of Keycloak can then act as a sharing management service from which resource owners can manage their resources.

Red Hat build of Keycloak is a UMA 2.0 compliant authorization server that provides most UMA capabilities.

As an example, consider a user Alice (resource owner) using an Internet Banking Service (resource server) to manage her Bank Account (resource). One day, Alice decides to open her bank account to Bob (requesting party), an accounting professional. However, Bob should only have access to view (scope) Alice's account.

As a resource server, the Internet Banking Service must be able to protect Alice's Bank Account. For that, it relies on Red Hat build of Keycloak Resource Registration Endpoint to create a resource in the server representing Alice's Bank Account.

At this moment, if Bob tries to access Alice's Bank Account, access will be denied. The Internet Banking Service defines a few default policies for banking accounts. One of them is that only the owner, in this case Alice, is allowed to access her bank account.

However, Internet Banking Service in respect to Alice's privacy also allows her to change specific policies for the banking account. One of these policies that she can change is to define which people are allowed to view her bank account. For that, Internet Banking Service relies on Red Hat build of Keycloak to provide to Alice a space where she can select individuals and the operations (or data) they are allowed to access. At any time, Alice can revoke access or grant additional permissions to Bob.

8.3.1. Authorization process

In UMA, the authorization process starts when a client tries to access a UMA protected resource server.

A UMA protected resource server expects a bearer token in the request where the token is an RPT. When a client requests a resource at the resource server without an RPT:

Client requests a protected resource without sending an RPT

```
curl -X GET \
  http://${host}:${port}/my-resource-server/resource/1bfdfe78-a4e1-4c2d-b142-fc92b75b986f
```

The resource server sends a response back to the client with a permission **ticket** and a **as_uri** parameter with the location of a Red Hat build of Keycloak server to where the ticket should be sent in order to obtain an RPT.

Resource server responds with a permission ticket

```
HTTP/1.1 401 Unauthorized
WWW-Authenticate: UMA realm="${realm}",
    as_uri="https://${host}:${port}/realms/${realm}",
    ticket="016f84e8-f9b9-11e0-bd6f-0021cc6004de"
```

The permission ticket is a special type of token issued by Red Hat build of Keycloak Permission API. They represent the permissions being requested (e.g.: resources and scopes) as well any other information associated with the request. Only resource servers are allowed to create those tokens.

Now that the client has a permission ticket and also the location of a Red Hat build of Keycloak server, the client can use the discovery document to obtain the location of the token endpoint and send an authorization request.

Client sends an authorization request to the token endpoint to obtain an RPT

```
curl -X POST \
  http://${host}:${port}/realms/${realm}/protocol/openid-connect/token \
  -H "Authorization: Bearer ${access_token}" \
  --data "grant_type=urn:ietf:params:oauth:grant-type:uma-ticket" \
  --data "ticket=${permission_ticket}
```

If Red Hat build of Keycloak assessment process results in issuance of permissions, it issues the RPT with which it has associated the permissions:

Red Hat build of Keycloak responds to the client with the RPT

```
HTTP/1.1 200 OK
Content-Type: application/json
...
{
  "access_token": "${rpt}",
}
```

The response from the server is just like any other response from the token endpoint when using some other grant type. The RPT can be obtained from the **access_token** response parameter. In case the client is not authorized to have permissions Red Hat build of Keycloak responds with a **403** HTTP status code:

Red Hat build of Keycloak denies the authorization request

```
HTTP/1.1 403 Forbidden
Content-Type: application/json
...
{
  "error": "access_denied",
  "error_description": "request_denied"
}
```

8.3.2. Submitting permission requests

As part of the authorization process, clients need first to obtain a permission ticket from a UMA protected resource server in order to exchange it with an RPT at the Red Hat build of Keycloak Token Endpoint.

By default, Red Hat build of Keycloak responds with a **403** HTTP status code and a **request_denied** error in case the client can not be issued with an RPT.

Red Hat build of Keycloak denies the authorization request

```
HTTP/1.1 403 Forbidden
Content-Type: application/json
...
{
  "error": "access_denied",
  "error_description": "request_denied"
}
```

Such response implies that Red Hat build of Keycloak could not issue an RPT with the permissions represented by a permission ticket.

In some situations, client applications may want to start an asynchronous authorization flow and let the owner of the resources being requested decide whether or not access should be granted. For that, clients can use the **submit_request** request parameter along with an authorization request to the token endpoint:

```
curl -X POST \
  http://${host}:${port}/realms/${realm}/protocol/openid-connect/token \
  -H "Authorization: Bearer ${access_token}" \
  --data "grant_type=urn:ietf:params:oauth:grant-type:uma-ticket" \
  --data "ticket=${permission_ticket} \
  --data "submit_request=true"
```

When using the **submit_request** parameter, Red Hat build of Keycloak will persist a permission request for each resource to which access was denied. Once created, resource owners can check their account and manage their permissions requests.

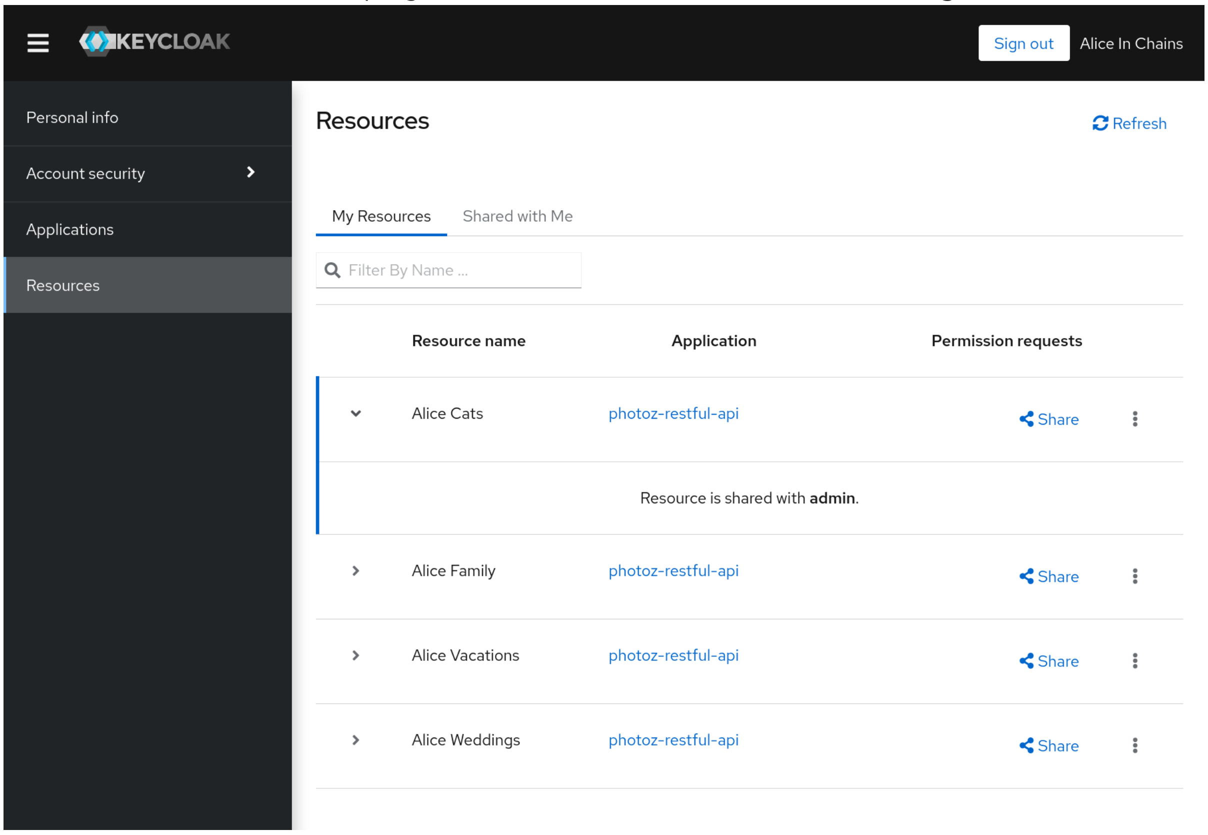
You can think about this functionality as a **Request Access** button in your application, where users can ask other users for access to their resources.

8.3.3. Managing access to users resources

Users can manage access to their resources using the Red Hat build of Keycloak Account Console. To enable this functionality, you must first enable User-Managed Access for your realm.

Procedure

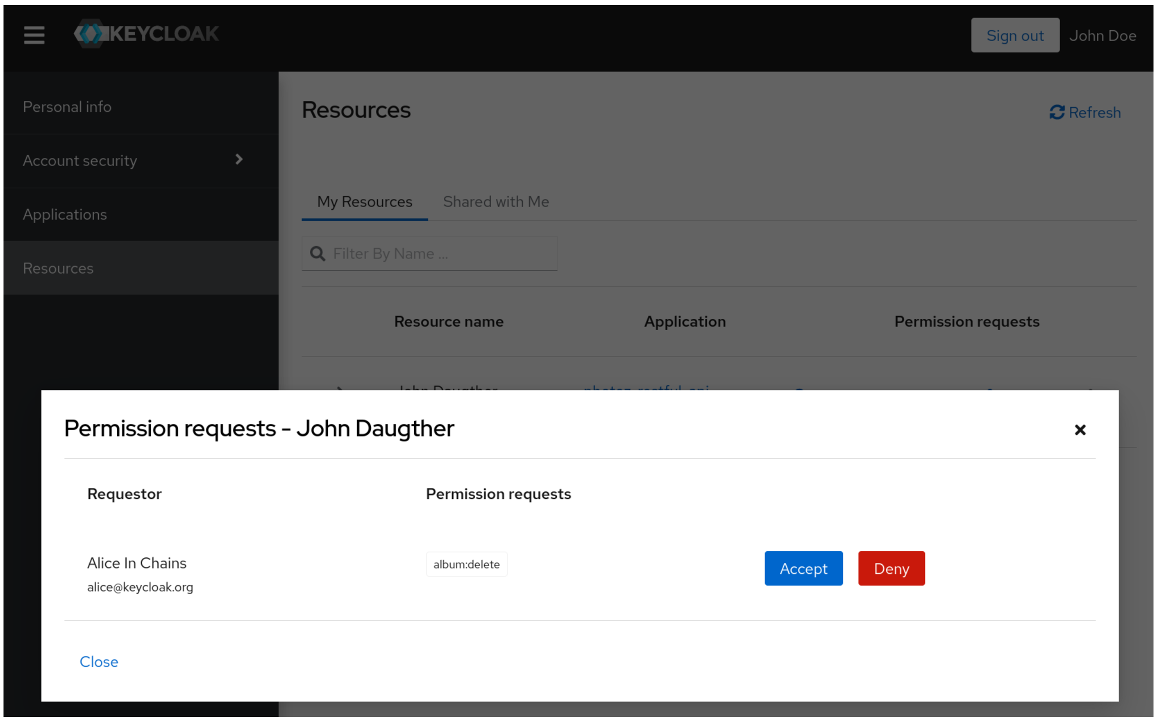
1. Log into the Admin Console.
2. Click **Realm Settings** in the menu.
3. Toggle **User-Managed Access** to **ON**.
4. Click the user name at the top right of the Admin Console and select **Manage Account**.



Resource name	Application	Permission requests
Alice Cats	photoz-restful-api	Share
Resource is shared with **admin**.		
Alice Family	photoz-restful-api	Share
Alice Vacations	photoz-restful-api	Share
Alice Weddings	photoz-restful-api	Share

5. Click **My Resources** in the menu option. A page displays with the following options.

    - Manage **My resources**
      This section contains a list of all resources owned by the user. Users can click on a resource for more details and share the resource with others. When there is a permission requests awaiting approval an icon is put next to the name of the resource. These requests are connected to the parties (users) requesting access to a particular resource. Users are allowed to approve or deny these requests. You can do so by clicking the icon



Resources

Resource name	Application	Permission requests

Permission requests - John Daugther

Requestor	Permission requests
Alice In Chains alice@keycloak.org	album:delete

    - Manage **Resources shared with me**
      This section contains a list of all resources shared with the user.

    - Manage **People with access to this resource**
      This section contains a list of people with access to this resource. Users are allowed to revoke access by clicking on the **Revoke** button or by removing a specific **Permission**.

    - Share the resource with others
      By typing the username or e-mail of another user, the user is able to share the resource and select the permissions he wants to grant access.

8.4. PROTECTION API

The Protection API provides a UMA-compliant set of endpoints providing:

- **Resource Management**
  With this endpoint, resource servers can manage their resources remotely and enable policy enforcers to query the server for the resources that need protection.

- **Permission Management**
  In the UMA protocol, resource servers access this endpoint to create permission tickets. Red Hat build of Keycloak also provides endpoints to manage the state of permissions and query permissions.

- **Policy API**
  Red Hat build of Keycloak leverages the UMA Protection API to allow resource servers to

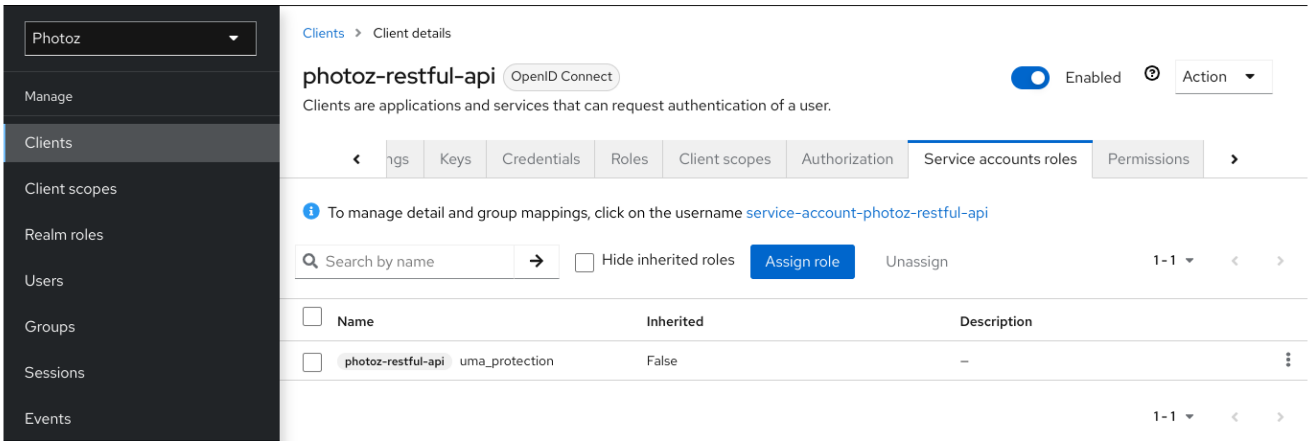
manage permissions for their users. In addition to the Resource and Permission APIs, Red Hat build of Keycloak provides a Policy API from where permissions can be set to resources by resource servers on behalf of their users.

An important requirement for this API is that *only* resource servers are allowed to access its endpoints using a special OAuth2 access token called a protection API token (PAT). In UMA, a PAT is a token with the scope **uma_protection**.

8.4.1. What is a PAT and how to obtain it

A **protection API token** (PAT) is a special OAuth2 access token with a scope defined as **uma_protection**. When you create a resource server, Red Hat build of Keycloak automatically creates a role, *uma_protection*, for the corresponding client application and associates it with the client's service account.

Service Account granted with uma_protection role



Clients are applications and services that can request authentication of a user.

To manage detail and group mappings, click on the username service-account-photoz-restful-api

Name	Inherited	Description
photoz-restful-api uma_protection	False	–

Resource servers can obtain a PAT from Red Hat build of Keycloak like any other OAuth2 access token. For example, using curl:

```
curl -X POST \
    -H "Content-Type: application/x-www-form-urlencoded" \
    -d 'grant_type=client_credentials&client_id=${client_id}&client_secret=${client_secret}' \
    "http://${host}:${port}/realms/${realm_name}/protocol/openid-connect/token"
```

The example above is using the **client_credentials** grant type to obtain a PAT from the server. As a result, the server returns a response similar to the following:

```
{
  "access_token": ${PAT},
  "expires_in": 300,
  "refresh_expires_in": 1800,
  "refresh_token": ${refresh_token},
  "token_type": "bearer",
  "id_token": ${id_token},
  "not-before-policy": 0,
  "session_state": "ccea4a55-9aec-4024-b11c-44f6f168439e"
}
```

NOTE

Red Hat build of Keycloak can authenticate your client application in different ways. For simplicity, the **client_credentials** grant type is used here, which requires a *client_id* and a *client_secret*. You can choose to use any supported authentication method.

8.4.2. Managing resources

Resource servers can manage their resources remotely using a UMA-compliant endpoint.

```
http://${host}:${port}/realms/${realm_name}/authz/protection/resource_set
```

This endpoint provides operations outlined as follows (entire path omitted for clarity):

- Create resource set description: POST /resource_set
- Read resource set description: GET /resource_set/{_id}
- Update resource set description: PUT /resource_set/{_id}
- Delete resource set description: DELETE /resource_set/{_id}
- List resource set descriptions: GET /resource_set

For more information about the contract for each of these operations, see UMA Resource Registration API.

8.4.2.1. Creating a resource

To create a resource you must send an HTTP POST request as follows:

```
curl -v -X POST \
  http://${host}:${port}/realms/${realm_name}/authz/protection/resource_set \
  -H 'Authorization: Bearer '$pat \
  -H 'Content-Type: application/json' \
  -d '{
     "name":"Tweedl Social Service",
     "type":"http://www.example.com/rsrcs/socialstream/140-compatible",
     "icon_uri":"http://www.example.com/icons/sharesocial.png",
     "resource_scopes":[
         "read-public",
         "post-updates",
         "read-private",
         "http://www.example.com/scopes/all"
      ]
  }'
```

By default, the owner of a resource is the resource server. If you want to define a different owner, such as a specific user, you can send a request as follows:

```
curl -v -X POST \
  http://${host}:${port}/realms/${realm_name}/authz/protection/resource_set \
  -H 'Authorization: Bearer '$pat \
  -H 'Content-Type: application/json' \
  -d '{
      "name":"Alice Resource",
      "owner": "alice"
    }'
```

Where the property **owner** can be set with the username or the identifier of the user.

8.4.2.2. Creating user-managed resources

By default, resources created via Protection API can not be managed by resource owners through the Account Console.

To create resources and allow resource owners to manage these resources, you must set **ownerManagedAccess** property as follows:

```
curl -v -X POST \
  http://${host}:${port}/realms/${realm_name}/authz/protection/resource_set \
  -H 'Authorization: Bearer '$pat \
  -H 'Content-Type: application/json' \
  -d '{
      "name":"Alice Resource",
      "owner": "alice",
      "ownerManagedAccess": true
    }'
```

8.4.2.3. Updating resources

To update an existing resource, send an HTTP PUT request as follows:

```
curl -v -X PUT \
  http://${host}:${port}/realms/${realm_name}/authz/protection/resource_set/{resource_id} \
  -H 'Authorization: Bearer '$pat \
  -H 'Content-Type: application/json' \
  -d '{
      "_id": "Alice Resource",
      "name":"Alice Resource",
      "resource_scopes": [
        "read"
      ]
    }'
```

8.4.2.4. Deleting resources

To delete an existing resource, send an HTTP DELETE request as follows:

```
curl -v -X DELETE \
  http://${host}:${port}/realms/${realm_name}/authz/protection/resource_set/{resource_id} \
  -H 'Authorization: Bearer '$pat
```

8.4.2.5. Querying resources

To query the resources by **id**, send an HTTP GET request as follows:

```
http://${host}:${port}/realms/${realm_name}/authz/protection/resource_set/{resource_id}
```

–

To query resources given a **name**, send an HTTP GET request as follows:

```
http://${host}:${port}/realms/${realm_name}/authz/protection/resource_set?name=Alice Resource
```

By default, the **name** filter will match any resource with the given pattern. To restrict the query to only return resources with an exact match, use:

```
http://${host}:${port}/realms/${realm_name}/authz/protection/resource_set?name=Alice
Resource&exactName=true
```

To query resources given an **uri**, send an HTTP GET request as follows:

```
http://${host}:${port}/realms/${realm_name}/authz/protection/resource_set?uri=/api/alice
```

To query resources given an **owner**, send an HTTP GET request as follows:

```
http://${host}:${port}/realms/${realm_name}/authz/protection/resource_set?owner=alice
```

To query resources given an **type**, send an HTTP GET request as follows:

```
http://${host}:${port}/realms/${realm_name}/authz/protection/resource_set?type=albums
```

To query resources given an **scope**, send an HTTP GET request as follows:

```
http://${host}:${port}/realms/${realm_name}/authz/protection/resource_set?scope=read
```

When querying the server for permissions use parameters **first** and **max** results to limit the result.

8.4.3. Managing permission requests

Resource servers using the UMA protocol can use a specific endpoint to manage permission requests. This endpoint provides a UMA-compliant flow for registering permission requests and obtaining a permission ticket.

```
http://${host}:${port}/realms/${realm_name}/authz/protection/permission
```

A permission ticket is a special security token type representing a permission request. Per the UMA specification, a permission ticket is:

A correlation handle that is conveyed from an authorization server to a resource server, from a resource server to a client, and ultimately from a client back to an authorization server, to enable the authorization server to assess the correct policies to apply to a request for authorization data.

In most cases, you won’t need to deal with this endpoint directly. Red Hat build of Keycloak provides a policy enforcer that enables UMA for your resource server so it can obtain a permission ticket from the authorization server, return this ticket to client application, and enforce authorization decisions based on a final requesting party token (RPT).

The process of obtaining permission tickets from Red Hat build of Keycloak is performed by resource servers and not regular client applications, where permission tickets are obtained when a client tries to access a protected resource without the necessary grants to access the resource. The issuance of permission tickets is an important aspects when using UMA as it allows resource servers to:

- Abstract from clients the data associated with the resources protected by the resource server
- Register in the Red Hat build of Keycloak authorization requests which in turn can be used later in workflows to grant access based on the resource's owner consent
- Decouple resource servers from authorization servers and allow them to protect and manage their resources using different authorization servers

Client wise, a permission ticket has also important aspects that its worthy to highlight:

- Clients don't need to know about how authorization data is associated with protected resources. A permission ticket is completely opaque to clients.
- Clients can have access to resources on different resource servers and protected by different authorization servers

These are just some of the benefits brought by UMA where other aspects of UMA are strongly based on permission tickets, specially regarding privacy and user controlled access to their resources.

8.4.3.1. Creating permission ticket

To create a permission ticket, send an HTTP POST request as follows:

```
curl -X POST \
  http://${host}:${port}/realms/${realm_name}/authz/protection/permission \
  -H 'Authorization: Bearer '$pat \
  -H 'Content-Type: application/json' \
  -d '[
  {
    "resource_id": "{resource_id}",
    "resource_scopes": [
      "view"
    ]
  }
]'
```

When creating tickets you can also push arbitrary claims and associate these claims with the ticket:

```
curl -X POST \
  http://${host}:${port}/realms/${realm_name}/authz/protection/permission \
  -H 'Authorization: Bearer '$pat \
  -H 'Content-Type: application/json' \
  -d '[
  {
    "resource_id": "{resource_id}",
    "resource_scopes": [
      "view"
    ],
    "claims": {
        "organization": ["acme"]
    }
  }
]'
```

Where these claims will be available to your policies when evaluating permissions for the resource and scope(s) associated with the permission ticket.

8.4.3.2. Other non UMA-compliant endpoints

8.4.3.2.1. Creating permission ticket

To grant permissions for a specific resource with id {resource_id} to a user with id {user_id}, as an owner of the resource send an HTTP POST request as follows:

```
curl -X POST \
     http://${host}:${port}/realms/${realm_name}/authz/protection/permission/ticket \
     -H 'Authorization: Bearer '$access_token \
     -H 'Content-Type: application/json' \
     -d '{
       "resource": "{resource_id}",
       "requester": "{user_id}",
       "granted": true,
       "scopeName": "view"
     }'
```

8.4.3.2.2. Getting permission tickets

```
curl http://${host}:${port}/realms/${realm_name}/authz/protection/permission/ticket \
     -H 'Authorization: Bearer '$access_token
```

You can use any of these query parameters:

- **scopeId**
- **resourceId**
- **owner**
- **requester**
- **granted**
- **returnNames**
- **first**
- **max**

8.4.3.2.3. Updating permission ticket

```
curl -X PUT \
     http://${host}:${port}/realms/${realm_name}/authz/protection/permission/ticket \
     -H 'Authorization: Bearer '$access_token \
     -H 'Content-Type: application/json' \
     -d '{
       "id": "{ticket_id}"
       "resource": "{resource_id}",
       "requester": "{user_id}",
      "granted": false,
      "scopeName": "view"
    }'
```

8.4.3.2.4. Deleting permission ticket

```
curl -X DELETE
http://${host}:${port}/realms/${realm_name}/authz/protection/permission/ticket/{ticket_id} \
    -H 'Authorization: Bearer '$access_token
```

8.4.4. Managing resource permissions using the Policy API

Red Hat build of Keycloak leverages the UMA Protection API to allow resource servers to manage permissions for their users. In addition to the Resource and Permission APIs, Red Hat build of Keycloak provides a Policy API from where permissions can be set to resources by resource servers on behalf of their users.

The Policy API is available at:

```
http://${host}:${port}/realms/${realm_name}/authz/protection/uma-policy/{resource_id}
```

This API is protected by a bearer token that must represent a consent granted by the user to the resource server to manage permissions on his behalf. The bearer token can be a regular access token obtained from the token endpoint using:

- Resource Owner Password Credentials Grant Type
- Token Exchange, in order to exchange an access token granted to some client (public client) for a token where audience is the resource server

8.4.4.1. Associating a permission with a resource

To associate a permission with a specific resource you must send a HTTP POST request as follows:

```
curl -X POST \
  http://localhost:8180/realms/photoz/authz/protection/uma-policy/{resource_id} \
  -H 'Authorization: Bearer '$access_token \
  -H 'Cache-Control: no-cache' \
  -H 'Content-Type: application/json' \
  -d '{
 "name": "Any people manager",
 "description": "Allow access to any people manager",
 "scopes": ["read"],
 "roles": ["people-manager"]
}'
```

In the example above we are creating and associating a new permission to a resource represented by **resource_id** where any user with a role **people-manager** should be granted with the **read** scope.

You can also create policies using other access control mechanisms, such as using groups:

```
curl -X POST \
  http://localhost:8180/realms/photoz/authz/protection/uma-policy/{resource_id} \
  -H 'Authorization: Bearer '$access_token \
  -H 'Cache-Control: no-cache' \
  -H 'Content-Type: application/json' \
  -d '{
 "name": "Any people manager",
 "description": "Allow access to any people manager",
 "scopes": ["read"],
 "groups": ["/Managers/People Managers"]
}'
```

Or a specific client:

```
curl -X POST \
  http://localhost:8180/realms/photoz/authz/protection/uma-policy/{resource_id} \
  -H 'Authorization: Bearer '$access_token \
  -H 'Cache-Control: no-cache' \
  -H 'Content-Type: application/json' \
  -d '{
 "name": "Any people manager",
 "description": "Allow access to any people manager",
 "scopes": ["read"],
 "clients": ["my-client"]
}'
```

Or even using a custom policy using JavaScript:

NOTE

Upload Scripts is **Deprecated** and will be removed in future releases. This feature is disabled by default.

To enable start the server with **-Dkeycloak.profile.feature.upload_scripts=enabled** . For more details see the Enabling and disabling features chapter.

```
curl -X POST \
  http://localhost:8180/realms/photoz/authz/protection/uma-policy/{resource_id} \
  -H 'Authorization: Bearer '$access_token \
  -H 'Cache-Control: no-cache' \
  -H 'Content-Type: application/json' \
  -d '{
 "name": "Any people manager",
 "description": "Allow access to any people manager",
 "scopes": ["read"],
 "condition": "my-deployed-script.js"
}'
```

It is also possible to set any combination of these access control mechanisms.

To update an existing permission, send an HTTP PUT request as follows:

```
curl -X PUT \
  http://localhost:8180/realms/photoz/authz/protection/uma-policy/{permission_id} \
  -H 'Authorization: Bearer '$access_token \
  -H 'Content-Type: application/json' \
  -d '{
    "id": "21eb3fed-02d7-4b5a-9102-29f3f09b6de2",
    "name": "Any people manager",
    "description": "Allow access to any people manager",
    "type": "uma",
    "scopes": [
        "album:view"
    ],
    "logic": "POSITIVE",
    "decisionStrategy": "UNANIMOUS",
    "owner": "7e22131a-aa57-4f5f-b1db-6e82babcd322",
    "roles": [
        "user"
    ]
}'
```

8.4.4.2. Removing a permission

To remove a permission associated with a resource, send an HTTP DELETE request as follows:

```
curl -X DELETE \
  http://localhost:8180/realms/photoz/authz/protection/uma-policy/{permission_id} \
  -H 'Authorization: Bearer '$access_token
```

8.4.4.3. Querying permission

To query the permissions associated with a resource, send an HTTP GET request as follows:

```
http://${host}:${port}/realms/${realm}/authz/protection/uma-policy?resource={resource_id}
```

To query the permissions given its name, send an HTTP GET request as follows:

```
http://${host}:${port}/realms/${realm}/authz/protection/uma-policy?name=Any people manager
```

To query the permissions associated with a specific scope, send an HTTP GET request as follows:

```
http://${host}:${port}/realms/${realm}/authz/protection/uma-policy?scope=read
```

To query all permissions, send an HTTP GET request as follows:

```
http://${host}:${port}/realms/${realm}/authz/protection/uma-policy
```

When querying the server for permissions use parameters **first** and **max** results to limit the result.

8.5. REQUESTING PARTY TOKEN

A requesting party token (RPT) is a JSON web token (JWT) digitally signed using JSON web signature (JWS). The token is built based on the OAuth2 access token previously issued by Red Hat build of Keycloak to a specific client acting on behalf of a user or on its own behalf.

When you decode an RPT, you see a payload similar to the following:

```
{
  "authorization": {
      "permissions": [
        {
          "resource_set_id": "d2fe9843-6462-4bfc-baba-b5787bb6e0e7",
          "resource_set_name": "Hello World Resource"
        }
      ]
  },
  "jti": "d6109a09-78fd-4998-bf89-95730dfd0892-1464906679405",
  "exp": 1464906971,
  "nbf": 0,
  "iat": 1464906671,
  "sub": "f1888f4d-5172-4359-be0c-af338505d86c",
  "typ": "kc_ett",
  "azp": "hello-world-authz-service"
}
```

From this token you can obtain all permissions granted by the server from the **permissions** claim.

Also note that permissions are directly related with the resources/scopes you are protecting and completely decoupled from the access control methods that were used to actually grant and issue these same permissions.

8.5.1. Introspecting a requesting party token

Sometimes you might want to introspect a requesting party token (RPT) to check its validity or obtain the permissions within the token to enforce authorization decisions on the resource server side.

There are two main use cases where token introspection can help you:

- When client applications need to query the token validity to obtain a new one with the same or additional permissions
- When enforcing authorization decisions at the resource server side, especially when none of the built-in policy enforcers fits your application

8.5.2. Obtaining Information about an RPT

The token introspection is essentially a OAuth2 token introspection-compliant endpoint from which you can obtain information about an RPT.

```
http://${host}:${port}/realms/${realm_name}/protocol/openid-connect/token/introspect
```

To introspect an RPT using this endpoint, you can send a request to the server as follows:

```
curl -X POST \
    -H "Authorization: Basic aGVsbG8td29ybGQtYXV0aHotc2VydmljZTpzZWNyZXQ=" \
    -H "Content-Type: application/x-www-form-urlencoded" \
    -d 'token_type_hint=requesting_party_token&token=${RPT}' \
    "http://localhost:8080/realms/hello-world-authz/protocol/openid-connect/token/introspect"
```

NOTE

The request above is using HTTP BASIC and passing the client's credentials (client ID and secret) to authenticate the client attempting to introspect the token, but you can use any other client authentication method supported by Red Hat build of Keycloak.

The introspection endpoint expects two parameters:

- **token_type_hint**
  Use **requesting_party_token** as the value for this parameter, which indicates that you want to introspect an RPT.

- **token**
  Use the token string as it was returned by the server during the authorization process as the value for this parameter.

As a result, the server response is:

```
{
  "permissions": [
    {
      "resource_id": "90ccc6fc-b296-4cd1-881e-089e1ee15957",
      "resource_name": "Hello World Resource"
    }
  ],
  "exp": 1465314139,
  "nbf": 0,
  "iat": 1465313839,
  "aud": "hello-world-authz-service",
  "active": true
}
```

If the RPT is not active, this response is returned instead:

```
{
  "active": false
}
```

8.5.3. Do I need to invoke the server every time I want to introspect an RPT?

No. Just like a regular access token issued by a Red Hat build of Keycloak server, RPTs also use the JSON web token (JWT) specification as the default format.

If you want to validate these tokens without a call to the remote introspection endpoint, you can decode the RPT and query for its validity locally. Once you decode the token, you can also use the permissions within the token to enforce authorization decisions.

This is essentially what the policy enforcers do. Be sure to:

- Validate the signature of the RPT (based on the realm's public key)
- Query for token validity based on its *exp*, *iat*, and *aud* claims

Additional resources

- JSON web token (JWT)
- policy enforcers

8.6. AUTHORIZATION CLIENT JAVA API

Depending on your requirements, a resource server should be able to manage resources remotely or even check for permissions programmatically. If you are using Java, you can access the Red Hat build of Keycloak Authorization Services using the Authorization Client API.

It is targeted for resource servers that want to access the different endpoints provided by the server such as the Token Endpoint, Resource, and Permission management endpoints.

8.6.1. Maven dependency

```
<dependencies>
    <dependency>
        <groupId>org.keycloak</groupId>
        <artifactId>keycloak-authz-client</artifactId>
        <version>${KEYCLOAK_VERSION}</version>
    </dependency>
</dependencies>
```

8.6.2. Configuration

The client configuration is defined in a **keycloak.json** file as follows:

```
{
  "realm": "hello-world-authz",
  "auth-server-url" : "http://localhost:8080",
  "resource" : "hello-world-authz-service",
  "credentials": {
    "secret": "secret"
  }
}
```

- **realm** (required)
  The name of the realm.
- **auth-server-url** (required)
  The base URL of the Red Hat build of Keycloak server. All other Red Hat build of Keycloak pages and REST service endpoints are derived from this. It is usually in the form https://host:port.
- **resource** (required)
  The client-id of the application. Each application has a client-id that is used to identify the application.
- **credentials** (required)
  Specifies the credentials of the application. This is an object notation where the key is the credential type and the value is the value of the credential type.

The configuration file is usually located in your application's classpath, the default location from where the client is going to try to find a **keycloak.json** file.

8.6.3. Creating the authorization client

Considering you have a **keycloak.json** file in your classpath, you can create a new **AuthzClient** instance as follows:

```
    // create a new instance based on the configuration defined in a keycloak.json located in your classpath
    AuthzClient authzClient = AuthzClient.create();
```

8.6.4. Obtaining user entitlements

Here is an example illustrating how to obtain user entitlements:

```
// create a new instance based on the configuration defined in keycloak.json
AuthzClient authzClient = AuthzClient.create();

// create an authorization request
AuthorizationRequest request = new AuthorizationRequest();

// send the entitlement request to the server in order to
// obtain an RPT with all permissions granted to the user
AuthorizationResponse response = authzClient.authorization("alice", "alice").authorize(request);
String rpt = response.getToken();

System.out.println("You got an RPT: " + rpt);

// now you can use the RPT to access protected resources on the resource server
```

Here is an example illustrating how to obtain user entitlements for a set of one or more resources:

```
// create a new instance based on the configuration defined in keycloak.json
AuthzClient authzClient = AuthzClient.create();

// create an authorization request
AuthorizationRequest request = new AuthorizationRequest();

// add permissions to the request based on the resources and scopes you want to check access
request.addPermission("Default Resource");

// send the entitlement request to the server in order to
// obtain an RPT with permissions for a single resource
AuthorizationResponse response = authzClient.authorization("alice", "alice").authorize(request);
String rpt = response.getToken();

System.out.println("You got an RPT: " + rpt);

// now you can use the RPT to access protected resources on the resource server
```

8.6.5. Creating a resource using the protection API

```
// create a new instance based on the configuration defined in keycloak.json
AuthzClient authzClient = AuthzClient.create();
```

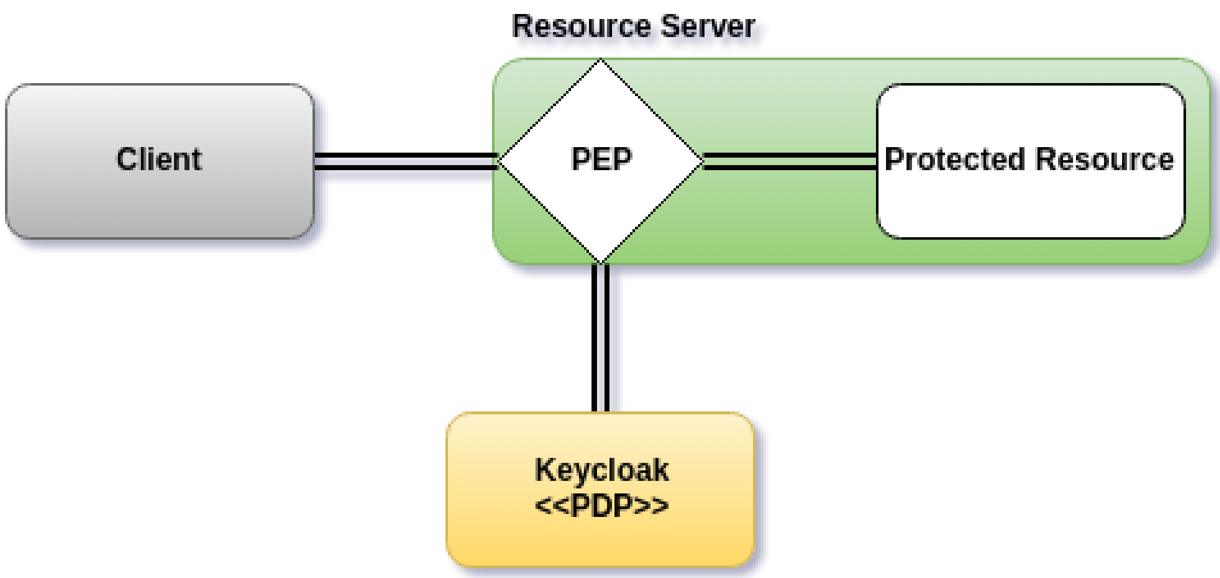
```
// create a new resource representation with the information we want
ResourceRepresentation newResource = new ResourceRepresentation();

newResource.setName("New Resource");
newResource.setType("urn:hello-world-authz:resources:example");

newResource.addScope(new ScopeRepresentation("urn:hello-world-authz:scopes:view"));

ProtectedResource resourceClient = authzClient.protection().resource();
ResourceRepresentation existingResource = resourceClient.findByName(newResource.getName());

if (existingResource != null) {
    resourceClient.delete(existingResource.getId());
}

// create the resource on the server
ResourceRepresentation response = resourceClient.create(newResource);
String resourceId = response.getId();

// query the resource using its newly generated id
ResourceRepresentation resource = resourceClient.findById(resourceId);

System.out.println(resource);
```

8.6.6. Introspecting an RPT

```
// create a new instance based on the configuration defined in keycloak.json
AuthzClient authzClient = AuthzClient.create();

// send the authorization request to the server in order to
// obtain an RPT with all permissions granted to the user
AuthorizationResponse response = authzClient.authorization("alice", "alice").authorize();
String rpt = response.getToken();

// introspect the token
TokenIntrospectionResponse requestingPartyToken =
authzClient.protection().introspectRequestingPartyToken(rpt);

System.out.println("Token status is: " + requestingPartyToken.getActive());
System.out.println("Permissions granted by the server: ");

for (Permission granted : requestingPartyToken.getPermissions()) {
    System.out.println(granted);
}
```

CHAPTER 9. POLICY ENFORCERS

Policy Enforcement Point (PEP) is a design pattern and as such you can implement it in different ways. Red Hat build of Keycloak provides all the necessary means to implement PEPs for different platforms, environments, and programming languages. Red Hat build of Keycloak Authorization Services presents a RESTful API, and leverages OAuth2 authorization capabilities for fine-grained authorization using a centralized authorization server.



A PEP is responsible for enforcing access decisions from the Red Hat build of Keycloak server where these decisions are taken by evaluating the policies associated with a protected resource. It acts as a filter or interceptor in your application in order to check whether or not a particular request to a protected resource can be fulfilled based on the permissions granted by these decisions.

Red Hat build of Keycloak provides built-in support for enabling the **Red Hat build of Keycloak Policy Enforcer** to Java applications with built-in support to secure JakartaEE-compliant frameworks and web containers. If you are using Maven, you should configure the following dependency to your project:

```
<dependency>
    <groupId>org.keycloak</groupId>
    <artifactId>keycloak-policy-enforcer</artifactId>
    <version>${keycloak.version}</version>
</dependency>
```

When you enable the policy enforcer all requests sent to your application are intercepted and access to protected resources will be granted depending on the permissions granted by Red Hat build of Keycloak to the identity making the request.

Policy enforcement is strongly linked to your application's paths and the resources you created for a resource server using the Red Hat build of Keycloak Administration Console. By default, when you create a resource server, Red Hat build of Keycloak creates a default configuration for your resource server so you can enable policy enforcement quickly.

9.1. CONFIGURATION

The policy enforcer configuration uses a JSON format and most of the time you don't need to set anything if you want to automatically resolve the protected paths based on the resources available from your resource server.

If you want to manually define the resources being protected, you can use a slightly more verbose format:

```
{
  "enforcement-mode" : "ENFORCING",
  "paths": [
    {
      "path" : "/users/*",
      "methods" : [
        {
          "method": "GET",
          "scopes" : ["urn:app.com:scopes:view"]
        },
        {
          "method": "POST",
          "scopes" : ["urn:app.com:scopes:create"]
        }
      ]
    }
  ]
}
```

The following is a description of each configuration option:

- **enforcement-mode**
  Specifies how policies are enforced.
  - **ENFORCING**
    (default mode) Requests are denied by default even when no policy is associated with a given resource.
  - **PERMISSIVE**
    Requests are allowed even when no policy is associated with a given resource.
  - **DISABLED**
    Completely disables the evaluation of policies and allows access to any resource. When **enforcement-mode** is **DISABLED**, applications are still able to obtain all permissions granted by Red Hat build of Keycloak through the Authorization Context
- **on-deny-redirect-to**
  Defines a URL where a client request is redirected when an "access denied" message is obtained from the server. By default, the adapter responds with a 403 HTTP status code.
- **path-cache**
  Defines how the policy enforcer should track associations between paths in your application and resources defined in Red Hat build of Keycloak. The cache is needed to avoid unnecessary requests to a Red Hat build of Keycloak server by caching associations between paths and protected resources.
  - **lifespan**
    Defines the time in milliseconds when the entry should be expired. If not provided, default value is **30000**. A value equal to 0 can be set to completely disable the cache. A value equal to -1 can be set to disable the expiry of the cache.
  - **max-entries**

Defines the limit of entries that should be kept in the cache. If not provided, default value is 1000.

- **paths**
  Specifies the paths to protect. This configuration is optional. If not defined, the policy enforcer discovers all paths by fetching the resources you defined to your application in Red Hat build of Keycloak, where these resources are defined with **URIS** representing some paths in your application.
  - **name**
    The name of a resource on the server that is to be associated with a given path. When used in conjunction with a **path**, the policy enforcer ignores the resource's **URIS** property and uses the path you provided instead.
  - **path**
    (required) A URI relative to the application's context path. If this option is specified, the policy enforcer queries the server for a resource with a **URI** with the same value. Currently a very basic logic for path matching is supported. Examples of valid paths are:
    - Wildcards: /*
    - Suffix: /***.html**
    - Sub-paths: /**path**/*
    - Path parameters: /resource/{id}
    - Exact match: /resource
    - Patterns: /{version}/resource, /api/{version}/resource, /api/{version}/resource/*
  - **methods**
    The HTTP methods (for example, GET, POST, PATCH) to protect and how they are associated with the scopes for a given resource in the server.
    - **method**
      The name of the HTTP method.
    - **scopes**
      An array of strings with the scopes associated with the method. When you associate scopes with a specific method, the client trying to access a protected resource (or path) must provide an RPT that grants permission to all scopes specified in the list. For example, if you define a method *POST* with a scope *create*, the RPT must contain a permission granting access to the *create* scope when performing a POST to the path.
    - **scopes-enforcement-mode**
      A string referencing the enforcement mode for the scopes associated with a method. Values can be **ALL** or **ANY**. If **ALL**, all defined scopes must be granted in order to access the resource using that method. If **ANY**, at least one scope should be granted in order to gain access to the resource using that method. By default, enforcement mode is set to **ALL**.
  - **enforcement-mode**
    Specifies how policies are enforced.
    - **ENFORCING**

(default mode) Requests are denied by default even when there is no policy associated with a given resource.

    - DISABLED

  - **claim-information-point**
    Defines a set of one or more claims that must be resolved and pushed to the Red Hat build of Keycloak server in order to make these claims available to policies. See Claim Information Point for more details.

- **lazy-load-paths**
  Specifies how the adapter should fetch the server for resources associated with paths in your application. If **true**, the policy enforcer is going to fetch resources on-demand accordingly with the path being requested. This configuration is specially useful when you do not want to fetch all resources from the server during deployment (in case you have provided no **paths**) or in case you have defined only a sub set of **paths** and want to fetch others on-demand.

- **http-method-as-scope**
  Specifies how scopes should be mapped to HTTP methods. If set to **true**, the policy enforcer will use the HTTP method from the current request to check whether or not access should be granted. When enabled, make sure your resources in Red Hat build of Keycloak are associated with scopes representing each HTTP method you are protecting.

- **claim-information-point**
  Defines a set of one or more **global** claims that must be resolved and pushed to the Red Hat build of Keycloak server in order to make these claims available to policies. See Claim Information Point for more details.

9.2. CLAIM INFORMATION POINT

A Claim Information Point (CIP) is responsible for resolving claims and pushing these claims to the Red Hat build of Keycloak server in order to provide more information about the access context to policies. They can be defined as a configuration option to the policy-enforcer in order to resolve claims from different sources, such as:

- HTTP Request (parameters, headers, body, etc)
- External HTTP Service
- Static values defined in configuration
- Any other source by implementing the Claim Information Provider SPI

When pushing claims to the Red Hat build of Keycloak server, policies can base decisions not only on who a user is but also by taking context and contents into account, based on who, what, why, when, where, and which for a given transaction. It is all about Contextual-based Authorization and how to use runtime information in order to support fine-grained authorization decisions.

9.2.1. Obtaining information from the HTTP request

Here are several examples showing how you can extract claims from an HTTP request:

keycloak.json

```
{
  "paths": [
    {
      "path": "/protected/resource",
      "claim-information-point": {
        "claims": {
          "claim-from-request-parameter": "{request.parameter['a']}",
          "claim-from-header": "{request.header['b']}",
          "claim-from-cookie": "{request.cookie['c']}",
          "claim-from-remoteAddr": "{request.remoteAddr}",
          "claim-from-method": "{request.method}",
          "claim-from-uri": "{request.uri}",
          "claim-from-relativePath": "{request.relativePath}",
          "claim-from-secure": "{request.secure}",
          "claim-from-json-body-object": "{request.body['/a/b/c']}",
          "claim-from-json-body-array": "{request.body['/d/1']}",
          "claim-from-body": "{request.body}",
          "claim-from-static-value": "static value",
          "claim-from-multiple-static-value": ["static", "value"],
          "param-replace-multiple-placeholder": "Test {keycloak.access_token['/custom_claim/0']} and
{request.parameter['a']}"
        }
      }
    }
  ]
}
```

9.2.2. Obtaining information from an external HTTP service

Here are several examples showing how you can extract claims from an external HTTP Service:

keycloak.json

```
{
  "paths": [
    {
      "path": "/protected/resource",
      "claim-information-point": {
        "http": {
          "claims": {
            "claim-a": "/a",
            "claim-d": "/d",
            "claim-d0": "/d/0",
            "claim-d-all": [
              "/d/0",
              "/d/1"
            ]
          },
          "url": "http://mycompany/claim-provider",
          "method": "POST",
          "headers": {
            "Content-Type": "application/x-www-form-urlencoded",
            "header-b": [
              "header-b-value1",
              "header-b-value2"
            ],
            "Authorization": "Bearer {keycloak.access_token}"
          },
          "parameters": {
            "param-a": [
              "param-a-value1",
              "param-a-value2"
            ],
            "param-subject": "{keycloak.access_token['/sub']}",
            "param-user-name": "{keycloak.access_token['/preferred_username']}",
            "param-other-claims": "{keycloak.access_token['/custom_claim']}"
          }
        }
      }
    }
  ]
}
```

9.2.3. Static claims

keycloak.json

```
{
  "paths": [
    {
      "path": "/protected/resource",
      "claim-information-point": {
        "claims": {
          "claim-from-static-value": "static value",
          "claim-from-multiple-static-value": ["static", "value"]
        }
      }
    }
  ]
}
```

9.2.4. Claim information provider SPI

The Claim Information Provider SPI can be used by developers to support different claim information points in case none of the built-ins providers are enough to address their requirements.

For example, to implement a new CIP provider you need to implement **org.keycloak.adapters.authorization.ClaimInformationPointProviderFactory** and **ClaimInformationPointProvider** and also provide the file **META-INF/services/org.keycloak.adapters.authorization.ClaimInformationPointProviderFactory** in your application`s classpath.

Example of **org.keycloak.adapters.authorization.ClaimInformationPointProviderFactory**:

```
public class MyClaimInformationPointProviderFactory implements
ClaimInformationPointProviderFactory<MyClaimInformationPointProvider> {

    @Override
    public String getName() {
        return "my-claims";
    }
    @Override
    public void init(PolicyEnforcer policyEnforcer) {

    }

    @Override
    public MyClaimInformationPointProvider create(Map<String, Object> config) {
        return new MyClaimInformationPointProvider(config);
    }
}
```

Every CIP provider must be associated with a name, as defined above in the **MyClaimInformationPointProviderFactory.getName** method. The name will be used to map the configuration from the **claim-information-point** section in the **policy-enforcer** configuration to the implementation.

When processing requests, the policy enforcer will call the MyClaimInformationPointProviderFactory.create method in order to obtain an instance of MyClaimInformationPointProvider. When called, any configuration defined for this particular CIP provider (via claim-information-point) is passed as a map.

Example of **ClaimInformationPointProvider**:

```
public class MyClaimInformationPointProvider implements ClaimInformationPointProvider {

    private final Map<String, Object> config;

    public MyClaimInformationPointProvider(Map<String, Object> config) {
        this.config = config;
    }

    @Override
    public Map<String, List<String>> resolve(HttpFacade httpFacade) {
        Map<String, List<String>> claims = new HashMap<>();

        // put whatever claim you want into the map

        return claims;
    }
}
```

9.3. OBTAINING THE AUTHORIZATION CONTEXT

When policy enforcement is enabled, the permissions obtained from the server are available through **org.keycloak.AuthorizationContext**. This class provides several methods you can use to obtain permissions and ascertain whether a permission was granted for a particular resource or scope.

Obtaining the Authorization Context in a Servlet Container

```
    HttpServletRequest request = // obtain javax.servlet.http.HttpServletRequest
    AuthorizationContext authzContext = (AuthorizationContext)
request.getAttribute(AuthorizationContext.class.getName());
```

NOTE

The authorization context helps give you more control over the decisions made and returned by the server. For example, you can use it to build a dynamic menu where items are hidden or shown depending on the permissions associated with a resource or scope.

```
if (authzContext.hasResourcePermission("Project Resource")) {
    // user can access the Project Resource
}

if (authzContext.hasResourcePermission("Admin Resource")) {
    // user can access administration resources
}

if (authzContext.hasScopePermission("urn:project.com:project:create")) {
    // user can create new projects
}
```

The **AuthorizationContext** represents one of the main capabilities of Red Hat build of Keycloak Authorization Services. From the examples above, you can see that the protected resource is not directly associated with the policies that govern them.

Consider some similar code using role-based access control (RBAC):

```
if (User.hasRole('user')) {
    // user can access the Project Resource
}

if (User.hasRole('admin')) {
    // user can access administration resources
}

if (User.hasRole('project-manager')) {
    // user can create new projects
}
```

Although both examples address the same requirements, they do so in different ways. In RBAC, roles only *implicitly* define access for their resources. With Red Hat build of Keycloak, you gain the capability to create more manageable code that focuses directly on your resources whether you are using RBAC, attribute-based access control (ABAC), or any other BAC variant. Either you have the permission for a given resource or scope, or you do not have that permission.

Now, suppose your security requirements have changed and in addition to project managers, PMOs can also create new projects.

Security requirements change, but with Red Hat build of Keycloak there is no need to change your application code to address the new requirements. Once your application is based on the resource and scope identifier, you need only change the configuration of the permissions or policies associated with a particular resource in the authorization server. In this case, the permissions and policies associated with the **Project Resource** and/or the scope **urn:project.com:project:create** would be changed.

9.4. USING THE AUTHORIZATIONCONTEXT TO OBTAIN AN AUTHORIZATION CLIENT INSTANCE

The **AuthorizationContext** can also be used to obtain a reference to the Authorization Client API configured to your application:

```
ClientAuthorizationContext clientContext = ClientAuthorizationContext.class.cast(authzContext);
AuthzClient authzClient = clientContext.getClient();
```

In some cases, resource servers protected by the policy enforcer need to access the APIs provided by the authorization server. With an **AuthzClient** instance in hands, resource servers can interact with the server in order to create resources or check for specific permissions programmatically.

9.5. JAVASCRIPT INTEGRATION

The Red Hat build of Keycloak Server comes with a JavaScript library you can use to interact with a resource server protected by a policy enforcer. This library is based on the Red Hat build of Keycloak JavaScript adapter, which can be integrated to allow your client to obtain permissions from a Red Hat build of Keycloak Server.

You can obtain this library from a running a Red Hat build of Keycloak Server instance by including the following **script** tag in your web page:

```
<script src="http://.../js/keycloak-authz.js"></script>
```

Next, you can create a **KeycloakAuthorization** instance as follows:

```
const keycloak = ... // obtain a Keycloak instance from keycloak.js library
const authorization = new KeycloakAuthorization(keycloak);
```

The **keycloak-authz.js** library provides two main features:

- Obtain permissions from the server using a permission ticket, if you are accessing a UMA protected resource server.
- Obtain permissions from the server by sending the resources and scopes the application wants to access.

In both cases, the library allows you to easily interact with both resource server and Red Hat build of Keycloak Authorization Services to obtain tokens with permissions your client can use as bearer tokens to access the protected resources on a resource server.

9.5.1. Handling authorization responses from a UMA-Protected resource server

If a resource server is protected by a policy enforcer, it responds to client requests based on the permissions carried along with a bearer token. Typically, when you try to access a resource server with a bearer token that is lacking permissions to access a protected resource, the resource server responds with a **401** status code and a **WWW-Authenticate** header.

```
HTTP/1.1 401 Unauthorized
WWW-Authenticate: UMA realm="${realm}",
    as_uri="https://${host}:${port}/realms/${realm}",
    ticket="016f84e8-f9b9-11e0-bd6f-0021cc6004de"
```

See UMA Authorization Process for more information.

What your client needs to do is extract the permission ticket from the **WWW-Authenticate** header returned by the resource server and use the library to send an authorization request as follows:

```
// prepare a authorization request with the permission ticket
const authorizationRequest = {};
authorizationRequest.ticket = ticket;

// send the authorization request, if successful retry the request
Identity.authorization.authorize(authorizationRequest).then(function (rpt) {
    // onGrant
}, function () {
    // onDeny
}, function () {
    // onError
});
```

The **authorize** function is completely asynchronous and supports a few callback functions to receive notifications from the server:

- **onGrant**: The first argument of the function. If authorization was successful and the server returned an RPT with the requested permissions, the callback receives the RPT.
- **onDeny**: The second argument of the function. Only called if the server has denied the authorization request.
- **onError**: The third argument of the function. Only called if the server responds unexpectedly.

Most applications should use the **onGrant** callback to retry a request after a 401 response. Subsequent requests should include the RPT as a bearer token for retries.

9.5.2. Obtaining entitlements

The **keycloak-authz.js** library provides an **entitlement** function that you can use to obtain an RPT from the server by providing the resources and scopes your client wants to access.

Example about how to obtain an RPT with permissions for all resources and scopes the user can access

```
authorization.entitlement('my-resource-server-id').then(function (rpt) {
    // onGrant callback function.
    // If authorization was successful you'll receive an RPT
    // with the necessary permissions to access the resource server
});
```

Example about how to obtain an RPT with permissions for specific resources and scopes

```
authorization.entitlement('my-resource-server', {
    "permissions": [
        {
            "id" : "Some Resource"
        }
    ]
}).then(function (rpt) {
    // onGrant
});
```

When using the **entitlement** function, you must provide the *client_id* of the resource server you want to access.

The **entitlement** function is completely asynchronous and supports a few callback functions to receive notifications from the server:

- **onGrant**: The first argument of the function. If authorization was successful and the server returned an RPT with the requested permissions, the callback receives the RPT.
- **onDeny**: The second argument of the function. Only called if the server has denied the authorization request.
- **onError**: The third argument of the function. Only called if the server responds unexpectedly.

9.5.3. Authorization request

Both **authorize** and **entitlement** functions accept an authorization request object. This object can be set with the following properties:

- **permissions**
  An array of objects representing the resource and scopes. For instance:

  ```
  const authorizationRequest = {
    "permissions": [
       {
          "id" : "Some Resource",
          "scopes" : ["view", "edit"]
       }
    ]
  }
  ```

- **metadata**
  An object where its properties define how the authorization request should be processed by the server.
  - **response_include_resource_name**
    A boolean value indicating to the server if resource names should be included in the RPT's permissions. If false, only the resource identifier is included.
  - **response_permissions_limit**
    An integer N that defines a limit for the amount of permissions an RPT can have. When used together with **rpt** parameter, only the last N requested permissions will be kept in the RPT
- **submit_request**
  A boolean value indicating whether the server should create permission requests to the resources and scopes referenced by a permission ticket. This parameter will only take effect when used together with the **ticket** parameter as part of a UMA authorization process.

9.5.4. Obtaining the RPT

If you have already obtained an RPT using any of the authorization functions provided by the library, you can always obtain the RPT as follows from the authorization object (assuming that it has been initialized by one of the techniques shown earlier):

```
const rpt = authorization.rpt;
```

–

9.6. CONFIGURING TLS/HTTPS

When the server is using HTTPS, ensure your policy enforcer is configured as follows:

```
{
  "truststore": "path_to_your_trust_store",
  "truststore-password": "trust_store_password"
}
```

The configuration above enables TLS/HTTPS to the Authorization Client, making possible to access a Red Hat build of Keycloak Server remotely using the HTTPS scheme.

NOTE

It is strongly recommended that you enable TLS/HTTPS when accessing the Red Hat build of Keycloak Server endpoints.