



OpenShift Container Platform 4.13

Authentication and authorization

Configuring user authentication and access controls for users and services

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Abstract

This document provides instructions for defining identity providers in OpenShift Container Platform. It also discusses how to configure role-based access control to secure the cluster.

Table of Contents

CHAPTER 1. OVERVIEW OF AUTHENTICATION AND AUTHORIZATION	8
1.1. GLOSSARY OF COMMON TERMS FOR OPENSIFT CONTAINER PLATFORM AUTHENTICATION AND AUTHORIZATION	8
1.2. ABOUT AUTHENTICATION IN OPENSIFT CONTAINER PLATFORM	9
1.3. ABOUT AUTHORIZATION IN OPENSIFT CONTAINER PLATFORM	10
CHAPTER 2. UNDERSTANDING AUTHENTICATION	12
2.1. USERS	12
2.2. GROUPS	12
2.3. API AUTHENTICATION	13
2.3.1. OpenShift Container Platform OAuth server	13
2.3.1.1. OAuth token requests	13
2.3.1.2. API impersonation	14
2.3.1.3. Authentication metrics for Prometheus	14
CHAPTER 3. CONFIGURING THE INTERNAL OAUTH SERVER	16
3.1. OPENSIFT CONTAINER PLATFORM OAUTH SERVER	16
3.2. OAUTH TOKEN REQUEST FLOWS AND RESPONSES	16
3.3. OPTIONS FOR THE INTERNAL OAUTH SERVER	16
3.3.1. OAuth token duration options	17
3.3.2. OAuth grant options	17
3.4. CONFIGURING THE INTERNAL OAUTH SERVER'S TOKEN DURATION	17
3.5. CONFIGURING TOKEN INACTIVITY TIMEOUT FOR THE INTERNAL OAUTH SERVER	18
3.6. CUSTOMIZING THE INTERNAL OAUTH SERVER URL	20
3.7. OAUTH SERVER METADATA	21
3.8. TROUBLESHOOTING OAUTH API EVENTS	22
CHAPTER 4. CONFIGURING OAUTH CLIENTS	24
4.1. DEFAULT OAUTH CLIENTS	24
4.2. REGISTERING AN ADDITIONAL OAUTH CLIENT	24
4.3. CONFIGURING TOKEN INACTIVITY TIMEOUT FOR AN OAUTH CLIENT	25
4.4. ADDITIONAL RESOURCES	26
CHAPTER 5. MANAGING USER-OWNED OAUTH ACCESS TOKENS	27
5.1. LISTING USER-OWNED OAUTH ACCESS TOKENS	27
5.2. VIEWING THE DETAILS OF A USER-OWNED OAUTH ACCESS TOKEN	27
5.3. DELETING USER-OWNED OAUTH ACCESS TOKENS	28
CHAPTER 6. UNDERSTANDING IDENTITY PROVIDER CONFIGURATION	30
6.1. ABOUT IDENTITY PROVIDERS IN OPENSIFT CONTAINER PLATFORM	30
6.2. SUPPORTED IDENTITY PROVIDERS	30
6.3. REMOVING THE KUBEADMIN USER	31
6.4. IDENTITY PROVIDER PARAMETERS	31
6.5. SAMPLE IDENTITY PROVIDER CR	32
CHAPTER 7. CONFIGURING IDENTITY PROVIDERS	33
7.1. CONFIGURING AN HTPASSWD IDENTITY PROVIDER	33
7.1.1. About identity providers in OpenShift Container Platform	33
7.1.2. About htpasswd authentication	33
7.1.3. Creating the htpasswd file	33
7.1.3.1. Creating an htpasswd file using Linux	33
7.1.3.2. Creating an htpasswd file using Windows	34
7.1.4. Creating the htpasswd secret	35

7.1.5. Sample htpasswd CR	35
7.1.6. Adding an identity provider to your cluster	36
7.1.7. Updating users for an htpasswd identity provider	37
7.1.8. Configuring identity providers using the web console	38
7.2. CONFIGURING A KEYSTONE IDENTITY PROVIDER	39
7.2.1. About identity providers in OpenShift Container Platform	39
7.2.2. About Keystone authentication	39
7.2.3. Creating the secret	39
7.2.4. Creating a config map	40
7.2.5. Sample Keystone CR	40
7.2.6. Adding an identity provider to your cluster	41
7.3. CONFIGURING AN LDAP IDENTITY PROVIDER	42
7.3.1. About identity providers in OpenShift Container Platform	42
7.3.2. About LDAP authentication	42
7.3.3. Creating the LDAP secret	43
7.3.4. Creating a config map	44
7.3.5. Sample LDAP CR	44
7.3.6. Adding an identity provider to your cluster	46
7.4. CONFIGURING A BASIC AUTHENTICATION IDENTITY PROVIDER	46
7.4.1. About identity providers in OpenShift Container Platform	47
7.4.2. About basic authentication	47
7.4.3. Creating the secret	48
7.4.4. Creating a config map	48
7.4.5. Sample basic authentication CR	49
7.4.6. Adding an identity provider to your cluster	50
7.4.7. Example Apache HTTPD configuration for basic identity providers	50
7.4.7.1. File requirements	51
7.4.8. Basic authentication troubleshooting	51
7.5. CONFIGURING A REQUEST HEADER IDENTITY PROVIDER	52
7.5.1. About identity providers in OpenShift Container Platform	52
7.5.2. About request header authentication	53
7.5.2.1. SSPI connection support on Microsoft Windows	53
7.5.3. Creating a config map	54
7.5.4. Sample request header CR	54
7.5.5. Adding an identity provider to your cluster	56
7.5.6. Example Apache authentication configuration using request header	57
7.5.6.1. Custom proxy configuration	57
7.5.6.2. Configuring Apache authentication using request header	57
7.6. CONFIGURING A GITHUB OR GITHUB ENTERPRISE IDENTITY PROVIDER	61
7.6.1. About identity providers in OpenShift Container Platform	62
7.6.2. About GitHub authentication	62
7.6.3. Registering a GitHub application	62
7.6.4. Creating the secret	62
7.6.5. Creating a config map	63
7.6.6. Sample GitHub CR	64
7.6.7. Adding an identity provider to your cluster	65
7.7. CONFIGURING A GITLAB IDENTITY PROVIDER	66
7.7.1. About identity providers in OpenShift Container Platform	66
7.7.2. About GitLab authentication	66
7.7.3. Creating the secret	66
7.7.4. Creating a config map	67
7.7.5. Sample GitLab CR	68
7.7.6. Adding an identity provider to your cluster	69

7.8. CONFIGURING A GOOGLE IDENTITY PROVIDER	69
7.8.1. About identity providers in OpenShift Container Platform	69
7.8.2. About Google authentication	70
7.8.3. Creating the secret	70
7.8.4. Sample Google CR	70
7.8.5. Adding an identity provider to your cluster	71
7.9. CONFIGURING AN OPENID CONNECT IDENTITY PROVIDER	72
7.9.1. About identity providers in OpenShift Container Platform	72
7.9.2. About OpenID Connect authentication	72
7.9.3. Supported OIDC providers	73
7.9.4. Creating the secret	74
7.9.5. Creating a config map	74
7.9.6. Sample OpenID Connect CRs	75
7.9.7. Adding an identity provider to your cluster	77
7.9.8. Configuring identity providers using the web console	78
CHAPTER 8. USING RBAC TO DEFINE AND APPLY PERMISSIONS	79
8.1. RBAC OVERVIEW	79
8.1.1. Default cluster roles	80
8.1.2. Evaluating authorization	81
8.1.2.1. Cluster role aggregation	82
8.2. PROJECTS AND NAMESPACES	82
8.3. DEFAULT PROJECTS	83
8.4. VIEWING CLUSTER ROLES AND BINDINGS	83
8.5. VIEWING LOCAL ROLES AND BINDINGS	90
8.6. ADDING ROLES TO USERS	92
8.7. CREATING A LOCAL ROLE	94
8.8. CREATING A CLUSTER ROLE	94
8.9. LOCAL ROLE BINDING COMMANDS	95
8.10. CLUSTER ROLE BINDING COMMANDS	96
8.11. CREATING A CLUSTER ADMIN	96
CHAPTER 9. REMOVING THE KUBEADMIN USER	97
9.1. THE KUBEADMIN USER	97
9.2. REMOVING THE KUBEADMIN USER	97
CHAPTER 10. UNDERSTANDING AND CREATING SERVICE ACCOUNTS	98
10.1. SERVICE ACCOUNTS OVERVIEW	98
10.2. CREATING SERVICE ACCOUNTS	98
10.3. EXAMPLES OF GRANTING ROLES TO SERVICE ACCOUNTS	99
CHAPTER 11. USING SERVICE ACCOUNTS IN APPLICATIONS	102
11.1. SERVICE ACCOUNTS OVERVIEW	102
11.2. DEFAULT SERVICE ACCOUNTS	102
11.2.1. Default cluster service accounts	102
11.2.2. Default project service accounts and roles	103
11.2.3. About automatically generated service account token secrets	103
11.3. CREATING SERVICE ACCOUNTS	104
CHAPTER 12. USING A SERVICE ACCOUNT AS AN OAUTH CLIENT	106
12.1. SERVICE ACCOUNTS AS OAUTH CLIENTS	106
12.1.1. Redirect URIs for service accounts as OAuth clients	106
CHAPTER 13. SCOPING TOKENS	109
13.1. ABOUT SCOPING TOKENS	109

13.1.1. User scopes	109
13.1.2. Role scope	109
CHAPTER 14. USING BOUND SERVICE ACCOUNT TOKENS	110
14.1. ABOUT BOUND SERVICE ACCOUNT TOKENS	110
14.2. CONFIGURING BOUND SERVICE ACCOUNT TOKENS USING VOLUME PROJECTION	110
14.3. CREATING BOUND SERVICE ACCOUNT TOKENS OUTSIDE THE POD	113
CHAPTER 15. MANAGING SECURITY CONTEXT CONSTRAINTS	115
15.1. ABOUT SECURITY CONTEXT CONSTRAINTS	115
15.1.1. Default security context constraints	116
15.1.2. Security context constraints settings	120
15.1.3. Security context constraints strategies	121
15.1.4. Controlling volumes	123
15.1.5. Admission control	124
15.1.6. Security context constraints prioritization	125
15.2. ABOUT PRE-ALLOCATED SECURITY CONTEXT CONSTRAINTS VALUES	125
15.3. EXAMPLE SECURITY CONTEXT CONSTRAINTS	127
15.4. CREATING SECURITY CONTEXT CONSTRAINTS	129
15.5. ROLE-BASED ACCESS TO SECURITY CONTEXT CONSTRAINTS	130
15.6. REFERENCE OF SECURITY CONTEXT CONSTRAINTS COMMANDS	131
15.6.1. Listing security context constraints	131
15.6.2. Examining security context constraints	132
15.6.3. Deleting security context constraints	133
15.6.4. Updating security context constraints	134
15.7. ADDITIONAL RESOURCES	134
CHAPTER 16. UNDERSTANDING AND MANAGING POD SECURITY ADMISSION	135
16.1. POD SECURITY ADMISSION AND SECURITY CONTEXT CONSTRAINTS	135
16.2. SECURITY CONTEXT CONSTRAINT SYNCHRONIZATION WITH POD SECURITY STANDARDS	135
16.3. CONTROLLING POD SECURITY ADMISSION SYNCHRONIZATION	136
16.4. ABOUT POD SECURITY ADMISSION ALERTS	136
16.4.1. Identifying pod security violations	137
16.5. ADDITIONAL RESOURCES	137
CHAPTER 17. IMPERSONATING THE SYSTEM:ADMIN USER	138
17.1. API IMPERSONATION	138
17.2. IMPERSONATING THE SYSTEM:ADMIN USER	138
17.3. IMPERSONATING THE SYSTEM:ADMIN GROUP	138
CHAPTER 18. SYNCING LDAP GROUPS	139
18.1. ABOUT CONFIGURING LDAP SYNC	139
18.1.1. About the RFC 2307 configuration file	141
18.1.2. About the Active Directory configuration file	142
18.1.3. About the augmented Active Directory configuration file	143
18.2. RUNNING LDAP SYNC	144
18.2.1. Syncing the LDAP server with OpenShift Container Platform	144
18.2.2. Syncing OpenShift Container Platform groups with the LDAP server	144
18.2.3. Syncing subgroups from the LDAP server with OpenShift Container Platform	144
18.3. RUNNING A GROUP PRUNING JOB	145
18.4. AUTOMATICALLY SYNCING LDAP GROUPS	146
18.5. LDAP GROUP SYNC EXAMPLES	150
18.5.1. Syncing groups using the RFC 2307 schema	150
18.5.2. Syncing groups using the RFC2307 schema with user-defined name mappings	152

18.5.3. Syncing groups using RFC 2307 with user-defined error tolerances	153
18.5.4. Syncing groups using the Active Directory schema	156
18.5.5. Syncing groups using the augmented Active Directory schema	158
18.5.5.1. LDAP nested membership sync example	159
18.6. LDAP SYNC CONFIGURATION SPECIFICATION	163
18.6.1. v1.LDAPSyncConfig	163
18.6.2. v1.StringSource	165
18.6.3. v1.LDAPQuery	165
18.6.4. v1.RFC2307Config	166
18.6.5. v1.ActiveDirectoryConfig	168
18.6.6. v1.AugmentedActiveDirectoryConfig	169
CHAPTER 19. MANAGING CLOUD PROVIDER CREDENTIALS	171
19.1. ABOUT THE CLOUD CREDENTIAL OPERATOR	171
19.1.1. Modes	171
19.1.2. Determining the Cloud Credential Operator mode	172
19.1.2.1. Determining the Cloud Credential Operator mode by using the web console	173
19.1.2.2. Determining the Cloud Credential Operator mode by using the CLI	176
19.1.3. Default behavior	177
19.1.4. Additional resources	178
19.2. USING MINT MODE	178
19.2.1. Mint mode permissions requirements	178
19.2.1.1. Amazon Web Services (AWS) permissions	178
19.2.1.2. Google Cloud Platform (GCP) permissions	179
19.2.2. Admin credentials root secret format	179
19.2.3. Mint mode with removal or rotation of the administrator-level credential	180
19.2.3.1. Rotating cloud provider credentials manually	180
19.2.3.2. Removing cloud provider credentials	182
19.2.4. Additional resources	183
19.3. USING PASSTHROUGH MODE	183
19.3.1. Passthrough mode permissions requirements	183
19.3.1.1. Amazon Web Services (AWS) permissions	183
19.3.1.2. Microsoft Azure permissions	183
19.3.1.3. Google Cloud Platform (GCP) permissions	184
19.3.1.4. Red Hat OpenStack Platform (RHOSP) permissions	184
19.3.1.5. Red Hat Virtualization (RHV) permissions	184
19.3.1.6. VMware vSphere permissions	184
19.3.2. Admin credentials root secret format	185
19.3.3. Passthrough mode credential maintenance	187
19.3.3.1. Rotating cloud provider credentials manually	187
19.3.4. Reducing permissions after installation	188
19.3.5. Additional resources	189
19.4. USING MANUAL MODE	189
19.4.1. Manual mode with cloud credentials created and managed outside of the cluster	189
19.4.2. Updating cloud provider resources with manually maintained credentials	190
19.4.2.1. Indicating that the cluster is ready to upgrade	191
19.4.3. Additional resources	192
19.5. USING MANUAL MODE WITH AMAZON WEB SERVICES SECURITY TOKEN SERVICE	192
19.5.1. About manual mode with AWS Security Token Service	192
19.5.1.1. AWS Security Token Service authentication process	192
19.5.1.2. Authentication flow for AWS STS	193
19.5.1.3. Token refreshing for AWS STS	194
19.5.1.4. OpenID Connect requirements for AWS STS	194

19.5.1.5. AWS component secret formats	195
19.5.2. Installing an OpenShift Container Platform cluster configured for manual mode with STS	195
19.5.2.1. Configuring the Cloud Credential Operator utility	196
19.5.2.2. Creating AWS resources with the Cloud Credential Operator utility	200
19.5.2.2.1. Creating AWS resources individually	200
19.5.2.2.2. Creating AWS resources with a single command	203
19.5.2.3. Running the installer	205
19.5.2.4. Verifying the installation	206
19.5.3. Additional resources	207
19.6. USING MANUAL MODE WITH GCP WORKLOAD IDENTITY	207
19.6.1. About manual mode with GCP Workload Identity	207
19.6.2. Installing an OpenShift Container Platform cluster configured for manual mode with GCP Workload Identity	209
19.6.2.1. Configuring the Cloud Credential Operator utility	210
19.6.2.2. Creating GCP resources with the Cloud Credential Operator utility	211
19.6.2.3. Running the installer	213
19.6.2.4. Verifying the installation	214
19.6.3. Additional resources	215

CHAPTER 1. OVERVIEW OF AUTHENTICATION AND AUTHORIZATION

1.1. GLOSSARY OF COMMON TERMS FOR OPENSIFT CONTAINER PLATFORM AUTHENTICATION AND AUTHORIZATION

This glossary defines common terms that are used in OpenShift Container Platform authentication and authorization.

authentication

An authentication determines access to an OpenShift Container Platform cluster and ensures only authenticated users access the OpenShift Container Platform cluster.

authorization

Authorization determines whether the identified user has permissions to perform the requested action.

bearer token

Bearer token is used to authenticate to API with the header **Authorization: Bearer <token>**.

Cloud Credential Operator

The Cloud Credential Operator (CCO) manages cloud provider credentials as custom resource definitions (CRDs).

config map

A config map provides a way to inject configuration data into the pods. You can reference the data stored in a config map in a volume of type **ConfigMap**. Applications running in a pod can use this data.

containers

Lightweight and executable images that consist software and all its dependencies. Because containers virtualize the operating system, you can run containers in a data center, public or private cloud, or your local host.

Custom Resource (CR)

A CR is an extension of the Kubernetes API.

group

A group is a set of users. A group is useful for granting permissions to multiple users one time.

HTPasswd

HTPasswd updates the files that store usernames and password for authentication of HTTP users.

Keystone

Keystone is an Red Hat OpenStack Platform (RHOSP) project that provides identity, token, catalog, and policy services.

Lightweight directory access protocol (LDAP)

LDAP is a protocol that queries user information.

manual mode

In manual mode, a user manages cloud credentials instead of the Cloud Credential Operator (CCO).

mint mode

Mint mode is the default and recommended best practice setting for the Cloud Credential Operator (CCO) to use on the platforms for which it is supported. In this mode, the CCO uses the provided administrator-level cloud credential to create new credentials for components in the cluster with

only the specific permissions that are required.

namespace

A namespace isolates specific system resources that are visible to all processes. Inside a namespace, only processes that are members of that namespace can see those resources.

node

A node is a worker machine in the OpenShift Container Platform cluster. A node is either a virtual machine (VM) or a physical machine.

OAuth client

OAuth client is used to get a bearer token.

OAuth server

The OpenShift Container Platform control plane includes a built-in OAuth server that determines the user's identity from the configured identity provider and creates an access token.

OpenID Connect

The OpenID Connect is a protocol to authenticate the users to use single sign-on (SSO) to access sites that use OpenID Providers.

passthrough mode

In passthrough mode, the Cloud Credential Operator (CCO) passes the provided cloud credential to the components that request cloud credentials.

pod

A pod is the smallest logical unit in Kubernetes. A pod is comprised of one or more containers to run in a worker node.

regular users

Users that are created automatically in the cluster upon first login or via the API.

request header

A request header is an HTTP header that is used to provide information about HTTP request context, so that the server can track the response of the request.

role-based access control (RBAC)

A key security control to ensure that cluster users and workloads have access to only the resources required to execute their roles.

service accounts

Service accounts are used by the cluster components or applications.

system users

Users that are created automatically when the cluster is installed.

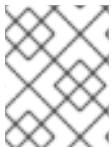
users

Users is an entity that can make requests to API.

1.2. ABOUT AUTHENTICATION IN OPENSIFT CONTAINER PLATFORM

To control access to an OpenShift Container Platform cluster, a cluster administrator can configure [user authentication](#) and ensure only approved users access the cluster.

To interact with an OpenShift Container Platform cluster, users must first authenticate to the OpenShift Container Platform API in some way. You can authenticate by providing an [OAuth access token](#) or an [X.509 client certificate](#) in your requests to the OpenShift Container Platform API.

**NOTE**

If you do not present a valid access token or certificate, your request is unauthenticated and you receive an HTTP 401 error.

An administrator can configure authentication through the following tasks:

- Configuring an identity provider: You can define any [supported identity provider in OpenShift Container Platform](#) and add it to your cluster.
- [Configuring the internal OAuth server](#): The OpenShift Container Platform control plane includes a built-in OAuth server that determines the user's identity from the configured identity provider and creates an access token. You can configure the token duration and inactivity timeout, and customize the internal OAuth server URL.

**NOTE**

Users can [view and manage OAuth tokens owned by them](#).

- Registering an OAuth client: OpenShift Container Platform includes several [default OAuth clients](#). You can [register and configure additional OAuth clients](#).

**NOTE**

When users send a request for an OAuth token, they must specify either a default or custom OAuth client that receives and uses the token.

- Managing cloud provider credentials using the [Cloud Credentials Operator](#): Cluster components use cloud provider credentials to get permissions required to perform cluster-related tasks.
- Impersonating a system admin user: You can grant cluster administrator permissions to a user by [impersonating a system admin user](#).

1.3. ABOUT AUTHORIZATION IN OPENSIFT CONTAINER PLATFORM

Authorization involves determining whether the identified user has permissions to perform the requested action.

Administrators can define permissions and assign them to users using the [RBAC objects, such as rules, roles, and bindings](#). To understand how authorization works in OpenShift Container Platform, see [Evaluating authorization](#).

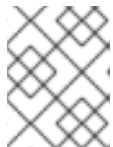
You can also control access to an OpenShift Container Platform cluster through [projects and namespaces](#).

Along with controlling user access to a cluster, you can also control the actions a pod can perform and the resources it can access using [security context constraints \(SCCs\)](#).

You can manage authorization for OpenShift Container Platform through the following tasks:

- Viewing [local](#) and [cluster](#) roles and bindings.
- Creating a [local role](#) and assigning it to a user or group.

- Creating a cluster role and assigning it to a user or group: OpenShift Container Platform includes a set of [default cluster roles](#). You can create additional [cluster roles](#) and [add them to a user or group](#).
- Creating a cluster-admin user: By default, your cluster has only one cluster administrator called **kubeadmin**. You can [create another cluster administrator](#). Before creating a cluster administrator, ensure that you have configured an identity provider.



NOTE

After creating the cluster admin user, [delete the existing kubeadmin user](#) to improve cluster security.

- Creating service accounts: [Service accounts](#) provide a flexible way to control API access without sharing a regular user's credentials. A user can [create and use a service account in applications](#) and also as [an OAuth client](#).
- [Scoping tokens](#): A scoped token is a token that identifies as a specific user who can perform only specific operations. You can create scoped tokens to delegate some of your permissions to another user or a service account.
- Syncing LDAP groups: You can manage user groups in one place by [syncing the groups stored in an LDAP server](#) with the OpenShift Container Platform user groups.

CHAPTER 2. UNDERSTANDING AUTHENTICATION

For users to interact with OpenShift Container Platform, they must first authenticate to the cluster. The authentication layer identifies the user associated with requests to the OpenShift Container Platform API. The authorization layer then uses information about the requesting user to determine if the request is allowed.

As an administrator, you can configure authentication for OpenShift Container Platform.

2.1. USERS

A *user* in OpenShift Container Platform is an entity that can make requests to the OpenShift Container Platform API. An OpenShift Container Platform **User** object represents an actor which can be granted permissions in the system by adding roles to them or to their groups. Typically, this represents the account of a developer or administrator that is interacting with OpenShift Container Platform.

Several types of users can exist:

User type	Description
Regular users	This is the way most interactive OpenShift Container Platform users are represented. Regular users are created automatically in the system upon first login or can be created via the API. Regular users are represented with the User object. Examples: joe alice
System users	Many of these are created automatically when the infrastructure is defined, mainly for the purpose of enabling the infrastructure to interact with the API securely. They include a cluster administrator (with access to everything), a per-node user, users for use by routers and registries, and various others. Finally, there is an anonymous system user that is used by default for unauthenticated requests. Examples: system:admin system:openshift-registry system:node:node1.example.com
Service accounts	These are special system users associated with projects; some are created automatically when the project is first created, while project administrators can create more for the purpose of defining access to the contents of each project. Service accounts are represented with the ServiceAccount object. Examples: system:serviceaccount:default:deployer system:serviceaccount:foo:builder

Each user must authenticate in some way to access OpenShift Container Platform. API requests with no authentication or invalid authentication are authenticated as requests by the **anonymous** system user. After authentication, policy determines what the user is authorized to do.

2.2. GROUPS

A user can be assigned to one or more *groups*, each of which represent a certain set of users. Groups are useful when managing authorization policies to grant permissions to multiple users at once, for example allowing access to objects within a project, versus granting them to users individually.

In addition to explicitly defined groups, there are also system groups, or *virtual groups*, that are automatically provisioned by the cluster.

The following default virtual groups are most important:

Virtual group	Description
system:authenticated	Automatically associated with all authenticated users.
system:authenticated:oauth	Automatically associated with all users authenticated with an OAuth access token.
system:unauthenticated	Automatically associated with all unauthenticated users.

2.3. API AUTHENTICATION

Requests to the OpenShift Container Platform API are authenticated using the following methods:

OAuth access tokens

- Obtained from the OpenShift Container Platform OAuth server using the `<namespace_route>/oauth/authorize` and `<namespace_route>/oauth/token` endpoints.
- Sent as an **Authorization: Bearer...** header.
- Sent as a websocket subprotocol header in the form **base64url.bearer.authorization.k8s.io.<base64url-encoded-token>** for websocket requests.

X.509 client certificates

- Requires an HTTPS connection to the API server.
- Verified by the API server against a trusted certificate authority bundle.
- The API server creates and distributes certificates to controllers to authenticate themselves.

Any request with an invalid access token or an invalid certificate is rejected by the authentication layer with a **401** error.

If no access token or certificate is presented, the authentication layer assigns the **system:anonymous** virtual user and the **system:unauthenticated** virtual group to the request. This allows the authorization layer to determine which requests, if any, an anonymous user is allowed to make.

2.3.1. OpenShift Container Platform OAuth server

The OpenShift Container Platform master includes a built-in OAuth server. Users obtain OAuth access tokens to authenticate themselves to the API.

When a person requests a new OAuth token, the OAuth server uses the configured identity provider to determine the identity of the person making the request.

It then determines what user that identity maps to, creates an access token for that user, and returns the token for use.

2.3.1.1. OAuth token requests

Every request for an OAuth token must specify the OAuth client that will receive and use the token. The following OAuth clients are automatically created when starting the OpenShift Container Platform API:

OAuth client	Usage
openshift-browser-client	Requests tokens at <namespace_route>/oauth/token/request with a user-agent that can handle interactive logins. ^[1]
openshift-challenging-client	Requests tokens with a user-agent that can handle WWW-Authenticate challenges.

1. **<namespace_route>** refers to the namespace route. This is found by running the following command:

```
$ oc get route oauth-openshift -n openshift-authentication -o json | jq .spec.host
```

All requests for OAuth tokens involve a request to **<namespace_route>/oauth/authorize**. Most authentication integrations place an authenticating proxy in front of this endpoint, or configure OpenShift Container Platform to validate credentials against a backing identity provider. Requests to **<namespace_route>/oauth/authorize** can come from user-agents that cannot display interactive login pages, such as the CLI. Therefore, OpenShift Container Platform supports authenticating using a **WWW-Authenticate** challenge in addition to interactive login flows.

If an authenticating proxy is placed in front of the **<namespace_route>/oauth/authorize** endpoint, it sends unauthenticated, non-browser user-agents **WWW-Authenticate** challenges rather than displaying an interactive login page or redirecting to an interactive login flow.



NOTE

To prevent cross-site request forgery (CSRF) attacks against browser clients, only send Basic authentication challenges with if a **X-CSRF-Token** header is on the request. Clients that expect to receive Basic **WWW-Authenticate** challenges must set this header to a non-empty value.

If the authenticating proxy cannot support **WWW-Authenticate** challenges, or if OpenShift Container Platform is configured to use an identity provider that does not support WWW-Authenticate challenges, you must use a browser to manually obtain a token from **<namespace_route>/oauth/token/request**.

2.3.1.2. API impersonation

You can configure a request to the OpenShift Container Platform API to act as though it originated from another user. For more information, see [User impersonation](#) in the Kubernetes documentation.

2.3.1.3. Authentication metrics for Prometheus

OpenShift Container Platform captures the following Prometheus system metrics during authentication attempts:

- **openshift_auth_basic_password_count** counts the number of **oc login** user name and password attempts.

- **openshift_auth_basic_password_count_result** counts the number of **oc login** user name and password attempts by result, **success** or **error**.
- **openshift_auth_form_password_count** counts the number of web console login attempts.
- **openshift_auth_form_password_count_result** counts the number of web console login attempts by result, **success** or **error**.
- **openshift_auth_password_total** counts the total number of **oc login** and web console login attempts.

CHAPTER 3. CONFIGURING THE INTERNAL OAUTH SERVER

3.1. OPENSIFT CONTAINER PLATFORM OAUTH SERVER

The OpenShift Container Platform master includes a built-in OAuth server. Users obtain OAuth access tokens to authenticate themselves to the API.

When a person requests a new OAuth token, the OAuth server uses the configured identity provider to determine the identity of the person making the request.

It then determines what user that identity maps to, creates an access token for that user, and returns the token for use.

3.2. OAUTH TOKEN REQUEST FLOWS AND RESPONSES

The OAuth server supports standard [authorization code grant](#) and the [implicit grant](#) OAuth authorization flows.

When requesting an OAuth token using the implicit grant flow (**response_type=token**) with a `client_id` configured to request **WWW-Authenticate challenges** (like **openshift-challenging-client**), these are the possible server responses from **/oauth/authorize**, and how they should be handled:

Status	Content	Client response
302	Location header containing an access_token parameter in the URL fragment (RFC 6749 section 4.2.2)	Use the access_token value as the OAuth token.
302	Location header containing an error query parameter (RFC 6749 section 4.1.2.1)	Fail, optionally surfacing the error (and optional error_description) query values to the user.
302	Other Location header	Follow the redirect, and process the result using these rules.
401	WWW-Authenticate header present	Respond to challenge if type is recognized (e.g. Basic , Negotiate , etc), resubmit request, and process the result using these rules.
401	WWW-Authenticate header missing	No challenge authentication is possible. Fail and show response body (which might contain links or details on alternate methods to obtain an OAuth token).
Other	Other	Fail, optionally surfacing response body to the user.

3.3. OPTIONS FOR THE INTERNAL OAUTH SERVER

Several configuration options are available for the internal OAuth server.

3.3.1. OAuth token duration options

The internal OAuth server generates two kinds of tokens:

Token	Description
Access tokens	Longer-lived tokens that grant access to the API.
Authorize codes	Short-lived tokens whose only use is to be exchanged for an access token.

You can configure the default duration for both types of token. If necessary, you can override the duration of the access token by using an **OAuthClient** object definition.

3.3.2. OAuth grant options

When the OAuth server receives token requests for a client to which the user has not previously granted permission, the action that the OAuth server takes is dependent on the OAuth client's grant strategy.

The OAuth client requesting token must provide its own grant strategy.

You can apply the following default methods:

Grant option	Description
auto	Auto-approve the grant and retry the request.
prompt	Prompt the user to approve or deny the grant.

3.4. CONFIGURING THE INTERNAL OAUTH SERVER'S TOKEN DURATION

You can configure default options for the internal OAuth server's token duration.



IMPORTANT

By default, tokens are only valid for 24 hours. Existing sessions expire after this time elapses.

If the default time is insufficient, then this can be modified using the following procedure.

Procedure

1. Create a configuration file that contains the token duration options. The following file sets this to 48 hours, twice the default.

```
apiVersion: config.openshift.io/v1
kind: OAuth
metadata:
  name: cluster
```

```
spec:
  tokenConfig:
    accessTokenMaxAgeSeconds: 172800 1
```

- 1** Set **accessTokenMaxAgeSeconds** to control the lifetime of access tokens. The default lifetime is 24 hours, or 86400 seconds. This attribute cannot be negative. If set to zero, the default lifetime is used.

- Apply the new configuration file:



NOTE

Because you update the existing OAuth server, you must use the **oc apply** command to apply the change.

```
$ oc apply -f </path/to/file.yaml>
```

- Confirm that the changes are in effect:

```
$ oc describe oauth.config.openshift.io/cluster
```

Example output

```
...
Spec:
  Token Config:
    Access Token Max Age Seconds: 172800
...
```

3.5. CONFIGURING TOKEN INACTIVITY TIMEOUT FOR THE INTERNAL OAUTH SERVER

You can configure OAuth tokens to expire after a set period of inactivity. By default, no token inactivity timeout is set.



NOTE

If the token inactivity timeout is also configured in your OAuth client, that value overrides the timeout that is set in the internal OAuth server configuration.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have configured an identity provider (IDP).

Procedure

- Update the **OAuth** configuration to set a token inactivity timeout.
 - Edit the **OAuth** object:

```
$ oc edit oauth cluster
```

Add the **spec.tokenConfig.accessTokenInactivityTimeout** field and set your timeout value:

```
apiVersion: config.openshift.io/v1
kind: OAuth
metadata:
...
spec:
  tokenConfig:
    accessTokenInactivityTimeout: 400s 1
```

- 1** Set a value with the appropriate units, for example **400s** for 400 seconds, or **30m** for 30 minutes. The minimum allowed timeout value is **300s**.

b. Save the file to apply the changes.

2. Check that the OAuth server pods have restarted:

```
$ oc get clusteroperators authentication
```

Do not continue to the next step until **PROGRESSING** is listed as **False**, as shown in the following output:

Example output

```
NAME          VERSION AVAILABLE PROGRESSING DEGRADED SINCE
authentication 4.13.0 True      False      False 145m
```

3. Check that a new revision of the Kubernetes API server pods has rolled out. This will take several minutes.

```
$ oc get clusteroperators kube-apiserver
```

Do not continue to the next step until **PROGRESSING** is listed as **False**, as shown in the following output:

Example output

```
NAME          VERSION AVAILABLE PROGRESSING DEGRADED SINCE
kube-apiserver 4.13.0 True      False      False 145m
```

If **PROGRESSING** is showing **True**, wait a few minutes and try again.

Verification

1. Log in to the cluster with an identity from your IDP.
2. Execute a command and verify that it was successful.
3. Wait longer than the configured timeout without using the identity. In this procedure's example, wait longer than 400 seconds.

4. Try to execute a command from the same identity's session.
This command should fail because the token should have expired due to inactivity longer than the configured timeout.

Example output

```
error: You must be logged in to the server (Unauthorized)
```

3.6. CUSTOMIZING THE INTERNAL OAUTH SERVER URL

You can customize the internal OAuth server URL by setting the custom hostname and TLS certificate in the **spec.componentRoutes** field of the cluster **Ingress** configuration.



WARNING

If you update the internal OAuth server URL, you might break trust from components in the cluster that need to communicate with the OpenShift OAuth server to retrieve OAuth access tokens. Components that need to trust the OAuth server will need to include the proper CA bundle when calling OAuth endpoints. For example:

```
$ oc login -u <username> -p <password> --certificate-authority=<path_to_ca.crt>
```

1

- 1 For self-signed certificates, the **ca.crt** file must contain the custom CA certificate, otherwise the login will not succeed.

The Cluster Authentication Operator publishes the OAuth server's serving certificate in the **oauth-serving-cert** config map in the **openshift-config-managed** namespace. You can find the certificate in the **data.ca-bundle.crt** key of the config map.

Prerequisites

- You have logged in to the cluster as a user with administrative privileges.
- You have created a secret in the **openshift-config** namespace containing the TLS certificate and key. This is required if the domain for the custom hostname suffix does not match the cluster domain suffix. The secret is optional if the suffix matches.

TIP

You can create a TLS secret by using the **oc create secret tls** command.

Procedure

1. Edit the cluster **Ingress** configuration:

```
$ oc edit ingress.config.openshift.io cluster
```


2. Set the custom hostname and optionally the serving certificate and key:

```

apiVersion: config.openshift.io/v1
kind: Ingress
metadata:
  name: cluster
spec:
  componentRoutes:
  - name: oauth-openshift
    namespace: openshift-authentication
    hostname: <custom_hostname> 1
    servingCertKeyPairSecret:
      name: <secret_name> 2

```

- 1 The custom hostname.
- 2 Reference to a secret in the **openshift-config** namespace that contains a TLS certificate (**tls.crt**) and key (**tls.key**). This is required if the domain for the custom hostname suffix does not match the cluster domain suffix. The secret is optional if the suffix matches.

3. Save the file to apply the changes.

3.7. OAUTH SERVER METADATA

Applications running in OpenShift Container Platform might have to discover information about the built-in OAuth server. For example, they might have to discover what the address of the **<namespace_route>** is without manual configuration. To aid in this, OpenShift Container Platform implements the IETF [OAuth 2.0 Authorization Server Metadata](#) draft specification.

Thus, any application running inside the cluster can issue a **GET** request to **https://openshift.default.svc/.well-known/oauth-authorization-server** to fetch the following information:

```

{
  "issuer": "https://<namespace_route>", 1
  "authorization_endpoint": "https://<namespace_route>/oauth/authorize", 2
  "token_endpoint": "https://<namespace_route>/oauth/token", 3
  "scopes_supported": [ 4
    "user:full",
    "user:info",
    "user:check-access",
    "user:list-scoped-projects",
    "user:list-projects"
  ],
  "response_types_supported": [ 5
    "code",
    "token"
  ],
  "grant_types_supported": [ 6
    "authorization_code",
    "implicit"
  ],
}

```

```
"code_challenge_methods_supported": [ 7
  "plain",
  "S256"
]
```

- 1 The authorization server's issuer identifier, which is a URL that uses the **https** scheme and has no query or fragment components. This is the location where **.well-known RFC 5785** resources containing information about the authorization server are published.
- 2 URL of the authorization server's authorization endpoint. See [RFC 6749](#).
- 3 URL of the authorization server's token endpoint. See [RFC 6749](#).
- 4 JSON array containing a list of the OAuth 2.0 [RFC 6749](#) scope values that this authorization server supports. Note that not all supported scope values are advertised.
- 5 JSON array containing a list of the OAuth 2.0 **response_type** values that this authorization server supports. The array values used are the same as those used with the **response_types** parameter defined by "OAuth 2.0 Dynamic Client Registration Protocol" in [RFC 7591](#).
- 6 JSON array containing a list of the OAuth 2.0 grant type values that this authorization server supports. The array values used are the same as those used with the **grant_types** parameter defined by **OAuth 2.0 Dynamic Client Registration Protocol** in [RFC 7591](#).
- 7 JSON array containing a list of PKCE [RFC 7636](#) code challenge methods supported by this authorization server. Code challenge method values are used in the **code_challenge_method** parameter defined in [Section 4.3 of RFC 7636](#). The valid code challenge method values are those registered in the IANA **PKCE Code Challenge Methods** registry. See [IANA OAuth Parameters](#).

3.8. TROUBLESHOOTING OAUTH API EVENTS

In some cases the API server returns an **unexpected condition** error message that is difficult to debug without direct access to the API master log. The underlying reason for the error is purposely obscured in order to avoid providing an unauthenticated user with information about the server's state.

A subset of these errors is related to service account OAuth configuration issues. These issues are captured in events that can be viewed by non-administrator users. When encountering an **unexpected condition** server error during OAuth, run **oc get events** to view these events under **ServiceAccount**.

The following example warns of a service account that is missing a proper OAuth redirect URI:

```
$ oc get events | grep ServiceAccount
```

Example output

```
1m      1m      1      proxy      ServiceAccount      Warning
NoSAOAuthRedirectURIs  service-account-oauth-client-getter
system:serviceaccount:myproject:proxy has no redirectURIs; set serviceaccounts.openshift.io/oauth-
redirecturi.<some-value>=<redirect> or create a dynamic URI using
serviceaccounts.openshift.io/oauth-redirectreference.<some-value>=<reference>
```

Running **oc describe sa/<service_account_name>** reports any OAuth events associated with the given service account name.

```
$ oc describe sa/proxy | grep -A5 Events
```

Example output

```
Events:
  FirstSeen    LastSeen    Count   From              SubObjectPath  Type           Reason
Message
-----
3m           3m           1      service-account-oauth-client-getter      Warning
NoSAOAuthRedirectURIs system:serviceaccount:myproject:proxy has no redirectURIs; set
serviceaccounts.openshift.io/oauth-redirecturi.<some-value>=<redirect> or create a dynamic URI
using serviceaccounts.openshift.io/oauth-redirectreference.<some-value>=<reference>
```

The following is a list of the possible event errors:

No redirect URI annotations or an invalid URI is specified

```
Reason          Message
NoSAOAuthRedirectURIs system:serviceaccount:myproject:proxy has no redirectURIs; set
serviceaccounts.openshift.io/oauth-redirecturi.<some-value>=<redirect> or create a dynamic URI
using serviceaccounts.openshift.io/oauth-redirectreference.<some-value>=<reference>
```

Invalid route specified

```
Reason          Message
NoSAOAuthRedirectURIs [routes.route.openshift.io "<name>" not found,
system:serviceaccount:myproject:proxy has no redirectURIs; set serviceaccounts.openshift.io/oauth-
redirecturi.<some-value>=<redirect> or create a dynamic URI using
serviceaccounts.openshift.io/oauth-redirectreference.<some-value>=<reference>]
```

Invalid reference type specified

```
Reason          Message
NoSAOAuthRedirectURIs [no kind "<name>" is registered for version "v1",
system:serviceaccount:myproject:proxy has no redirectURIs; set serviceaccounts.openshift.io/oauth-
redirecturi.<some-value>=<redirect> or create a dynamic URI using
serviceaccounts.openshift.io/oauth-redirectreference.<some-value>=<reference>]
```

Missing SA tokens

```
Reason          Message
NoSAOAuthTokens system:serviceaccount:myproject:proxy has no tokens
```

CHAPTER 4. CONFIGURING OAUTH CLIENTS

Several OAuth clients are created by default in OpenShift Container Platform. You can also register and configure additional OAuth clients.

4.1. DEFAULT OAUTH CLIENTS

The following OAuth clients are automatically created when starting the OpenShift Container Platform API:

OAuth client	Usage
openshift-browser-client	Requests tokens at <namespace_route>/oauth/token/request with a user-agent that can handle interactive logins. ^[1]
openshift-challenging-client	Requests tokens with a user-agent that can handle WWW-Authenticate challenges.
openshift-cli-client	Requests tokens by using a local HTTP server fetching an authorization code grant.

1. **<namespace_route>** refers to the namespace route. This is found by running the following command:

```
$ oc get route oauth-openshift -n openshift-authentication -o json | jq .spec.host
```

4.2. REGISTERING AN ADDITIONAL OAUTH CLIENT

If you need an additional OAuth client to manage authentication for your OpenShift Container Platform cluster, you can register one.

Procedure

- To register additional OAuth clients:

```
$ oc create -f <(echo '
kind: OAuthClient
apiVersion: oauth.openshift.io/v1
metadata:
  name: demo 1
  secret: "..." 2
  redirectURIs:
  - "http://www.example.com/" 3
grantMethod: prompt 4
')>
```

- 1 The **name** of the OAuth client is used as the **client_id** parameter when making requests to **<namespace_route>/oauth/authorize** and **<namespace_route>/oauth/token**.

- 2 The **secret** is used as the **client_secret** parameter when making requests to `<namespace_route>/oauth/token`.
- 3 The **redirect_uri** parameter specified in requests to `<namespace_route>/oauth/authorize` and `<namespace_route>/oauth/token` must be equal to or prefixed by one of the URLs listed in the **redirectURIs** parameter value.
- 4 The **grantMethod** is used to determine what action to take when this client requests tokens and has not yet been granted access by the user. Specify **auto** to automatically approve the grant and retry the request, or **prompt** to prompt the user to approve or deny the grant.

4.3. CONFIGURING TOKEN INACTIVITY TIMEOUT FOR AN OAUTH CLIENT

You can configure OAuth clients to expire OAuth tokens after a set period of inactivity. By default, no token inactivity timeout is set.



NOTE

If the token inactivity timeout is also configured in the internal OAuth server configuration, the timeout that is set in the OAuth client overrides that value.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have configured an identity provider (IDP).

Procedure

- Update the **OAuthClient** configuration to set a token inactivity timeout.
 - a. Edit the **OAuthClient** object:

```
$ oc edit oauthclient <oauth_client> 1
```

- 1 Replace `<oauth_client>` with the OAuth client to configure, for example, **console**.

Add the **accessTokenInactivityTimeoutSeconds** field and set your timeout value:

```
apiVersion: oauth.openshift.io/v1
grantMethod: auto
kind: OAuthClient
metadata:
  ...
accessTokenInactivityTimeoutSeconds: 600 1
```

- 1 The minimum allowed timeout value in seconds is **300**.

- b. Save the file to apply the changes.

Verification

1. Log in to the cluster with an identity from your IDP. Be sure to use the OAuth client that you just configured.
2. Perform an action and verify that it was successful.
3. Wait longer than the configured timeout without using the identity. In this procedure's example, wait longer than 600 seconds.
4. Try to perform an action from the same identity's session.
This attempt should fail because the token should have expired due to inactivity longer than the configured timeout.

4.4. ADDITIONAL RESOURCES

- [OAuthClient \[oauth.openshift.io/v1\]](https://oauth.openshift.io/v1)

CHAPTER 5. MANAGING USER-OWNED OAUTH ACCESS TOKENS

Users can review their own OAuth access tokens and delete any that are no longer needed.

5.1. LISTING USER-OWNED OAUTH ACCESS TOKENS

You can list your user-owned OAuth access tokens. Token names are not sensitive and cannot be used to log in.

Procedure

- List all user-owned OAuth access tokens:

```
$ oc get useroauthaccesstokens
```

Example output

```
NAME      CLIENT NAME          CREATED          EXPIRES
REDIRECT URI          SCOPE
<token1> openshift-challenging-client 2021-01-11T19:25:35Z 2021-01-12 19:25:35
+0000 UTC https://oauth-openshift.apps.example.com/oauth/token/implicit user:full
<token2> openshift-browser-client   2021-01-11T19:27:06Z 2021-01-12 19:27:06 +0000
UTC https://oauth-openshift.apps.example.com/oauth/token/display user:full
<token3> console                2021-01-11T19:26:29Z 2021-01-12 19:26:29 +0000 UTC
https://console-openshift-console.apps.example.com/auth/callback user:full
```

- List user-owned OAuth access tokens for a particular OAuth client:

```
$ oc get useroauthaccesstokens --field-selector=clientName="console"
```

Example output

```
NAME      CLIENT NAME          CREATED          EXPIRES
REDIRECT URI          SCOPE
<token3> console                2021-01-11T19:26:29Z 2021-01-12 19:26:29 +0000 UTC
https://console-openshift-console.apps.example.com/auth/callback user:full
```

5.2. VIEWING THE DETAILS OF A USER-OWNED OAUTH ACCESS TOKEN

You can view the details of a user-owned OAuth access token.

Procedure

- Describe the details of a user-owned OAuth access token:

```
$ oc describe useroauthaccesstokens <token_name>
```

Example output

-

```

Name: <token_name> 1
Namespace:
Labels: <none>
Annotations: <none>
API Version: oauth.openshift.io/v1
Authorize Token: sha256~Ksckkug-9Fg_RWn_AUysPolg-_HqmFI9zUL_CgD8wr8
Client Name: openshift-browser-client 2
Expires In: 86400 3
Inactivity Timeout Seconds: 317 4
Kind: UserOAuthAccessToken
Metadata:
  Creation Timestamp: 2021-01-11T19:27:06Z
  Managed Fields:
    API Version: oauth.openshift.io/v1
    Fields Type: FieldsV1
    fieldsV1:
      f:authorizeToken:
      f:clientName:
      f:expiresIn:
      f:redirectURI:
      f:scopes:
      f:userName:
      f:userUID:
    Manager: oauth-server
    Operation: Update
    Time: 2021-01-11T19:27:06Z
  Resource Version: 30535
  Self Link: /apis/oauth.openshift.io/v1/useroauthaccesstokens/<token_name>
  UID: f9d00b67-ab65-489b-8080-e427fa3c6181
  Redirect URI: https://oauth-openshift.apps.example.com/oauth/token/display
  Scopes:
    user:full 5
  User Name: <user_name> 6
  User UID: 82356ab0-95f9-4fb3-9bc0-10f1d6a6a345
  Events: <none>

```

- 1 The token name, which is the sha256 hash of the token. Token names are not sensitive and cannot be used to log in.
- 2 The client name, which describes where the token originated from.
- 3 The value in seconds from the creation time before this token expires.
- 4 If there is a token inactivity timeout set for the OAuth server, this is the value in seconds from the creation time before this token can no longer be used.
- 5 The scopes for this token.
- 6 The user name associated with this token.

5.3. DELETING USER-OWNED OAUTH ACCESS TOKENS

The **oc logout** command only invalidates the OAuth token for the active session. You can use the following procedure to delete any user-owned OAuth tokens that are no longer needed.

Deleting an OAuth access token logs out the user from all sessions that use the token.

Procedure

- Delete the user-owned OAuth access token:

```
$ oc delete useroauthaccesstokens <token_name>
```

Example output

```
useroauthaccesstoken.oauth.openshift.io "<token_name>" deleted
```

CHAPTER 6. UNDERSTANDING IDENTITY PROVIDER CONFIGURATION

The OpenShift Container Platform master includes a built-in OAuth server. Developers and administrators obtain OAuth access tokens to authenticate themselves to the API.

As an administrator, you can configure OAuth to specify an identity provider after you install your cluster.

6.1. ABOUT IDENTITY PROVIDERS IN OPENSIFT CONTAINER PLATFORM

By default, only a **kubeadmin** user exists on your cluster. To specify an identity provider, you must create a custom resource (CR) that describes that identity provider and add it to the cluster.



NOTE

OpenShift Container Platform user names containing `/`, `:`, and `%` are not supported.

6.2. SUPPORTED IDENTITY PROVIDERS

You can configure the following types of identity providers:

Identity provider	Description
htpasswd	Configure the htpasswd identity provider to validate user names and passwords against a flat file generated using htpasswd .
Keystone	Configure the keystone identity provider to integrate your OpenShift Container Platform cluster with Keystone to enable shared authentication with an OpenStack Keystone v3 server configured to store users in an internal database.
LDAP	Configure the ldap identity provider to validate user names and passwords against an LDAPv3 server, using simple bind authentication.
Basic authentication	Configure a basic-authentication identity provider for users to log in to OpenShift Container Platform with credentials validated against a remote identity provider. Basic authentication is a generic backend integration mechanism.
Request header	Configure a request-header identity provider to identify users from request header values, such as X-Remote-User . It is typically used in combination with an authenticating proxy, which sets the request header value.
GitHub or GitHub Enterprise	Configure a github identity provider to validate user names and passwords against GitHub or GitHub Enterprise's OAuth authentication server.
GitLab	Configure a gitlab identity provider to use GitLab.com or any other GitLab instance as an identity provider.

Identity provider	Description
Google	Configure a google identity provider using Google's OpenID Connect integration .
OpenID Connect	Configure an oidc identity provider to integrate with an OpenID Connect identity provider using an Authorization Code Flow .

Once an identity provider has been defined, you can [use RBAC to define and apply permissions](#) .

6.3. REMOVING THE KUBEADMIN USER

After you define an identity provider and create a new **cluster-admin** user, you can remove the **kubeadmin** to improve cluster security.



WARNING

If you follow this procedure before another user is a **cluster-admin**, then OpenShift Container Platform must be reinstalled. It is not possible to undo this command.

Prerequisites

- You must have configured at least one identity provider.
- You must have added the **cluster-admin** role to a user.
- You must be logged in as an administrator.

Procedure

- Remove the **kubeadmin** secrets:

```
$ oc delete secrets kubeadmin -n kube-system
```

6.4. IDENTITY PROVIDER PARAMETERS

The following parameters are common to all identity providers:

Parameter	Description
name	The provider name is prefixed to provider user names to form an identity name.

Parameter	Description
mappingMethod	<p>Defines how new identities are mapped to users when they log in. Enter one of the following values:</p> <p>claim The default value. Provisions a user with the identity's preferred user name. Fails if a user with that user name is already mapped to another identity.</p> <p>lookup Looks up an existing identity, user identity mapping, and user, but does not automatically provision users or identities. This allows cluster administrators to set up identities and users manually, or using an external process. Using this method requires you to manually provision users.</p> <p>add Provisions a user with the identity's preferred user name. If a user with that user name already exists, the identity is mapped to the existing user, adding to any existing identity mappings for the user. Required when multiple identity providers are configured that identify the same set of users and map to the same user names.</p>

**NOTE**

When adding or changing identity providers, you can map identities from the new provider to existing users by setting the **mappingMethod** parameter to **add**.

6.5. SAMPLE IDENTITY PROVIDER CR

The following custom resource (CR) shows the parameters and default values that you use to configure an identity provider. This example uses the `htpasswd` identity provider.

Sample identity provider CR

```

apiVersion: config.openshift.io/v1
kind: OAuth
metadata:
  name: cluster
spec:
  identityProviders:
  - name: my_identity_provider 1
    mappingMethod: claim 2
    type: HTPasswd
    htpasswd:
      fileData:
        name: htpass-secret 3

```

- 1** This provider name is prefixed to provider user names to form an identity name.
- 2** Controls how mappings are established between this provider's identities and **User** objects.
- 3** An existing secret containing a file generated using `htpasswd`.

CHAPTER 7. CONFIGURING IDENTITY PROVIDERS

7.1. CONFIGURING AN HTPASSWD IDENTITY PROVIDER

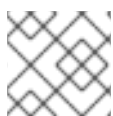
Configure the **htpasswd** identity provider to allow users to log in to OpenShift Container Platform with credentials from an htpasswd file.

To define an htpasswd identity provider, perform the following tasks:

1. Create an [htpasswd file](#) to store the user and password information.
2. Create a [secret](#) to represent the **htpasswd** file.
3. Define an [htpasswd identity provider resource](#) that references the secret.
4. [Apply the resource](#) to the default OAuth configuration to add the identity provider.

7.1.1. About identity providers in OpenShift Container Platform

By default, only a **kubeadmin** user exists on your cluster. To specify an identity provider, you must create a custom resource (CR) that describes that identity provider and add it to the cluster.



NOTE

OpenShift Container Platform user names containing `/`, `:`, and `%` are not supported.

7.1.2. About htpasswd authentication

Using htpasswd authentication in OpenShift Container Platform allows you to identify users based on an htpasswd file. An htpasswd file is a flat file that contains the user name and hashed password for each user. You can use the **htpasswd** utility to create this file.



WARNING

Do not use htpasswd authentication in OpenShift Container Platform for production environments. Use htpasswd authentication only for development environments.

7.1.3. Creating the htpasswd file

See one of the following sections for instructions about how to create the htpasswd file:

- [Creating an htpasswd file using Linux](#)
- [Creating an htpasswd file using Windows](#)

7.1.3.1. Creating an htpasswd file using Linux

To use the `htpasswd` identity provider, you must generate a flat file that contains the user names and passwords for your cluster by using [htpasswd](#).

Prerequisites

- Have access to the **htpasswd** utility. On Red Hat Enterprise Linux this is available by installing the **httpd-tools** package.

Procedure

1. Create or update your flat file with a user name and hashed password:

```
$ htpasswd -c -B -b </path/to/users.htpasswd> <username> <password>
```

The command generates a hashed version of the password.

For example:

```
$ htpasswd -c -B -b users.htpasswd <username> <password>
```

Example output

```
Adding password for user user1
```

2. Continue to add or update credentials to the file:

```
$ htpasswd -B -b </path/to/users.htpasswd> <user_name> <password>
```

7.1.3.2. Creating an `htpasswd` file using Windows

To use the `htpasswd` identity provider, you must generate a flat file that contains the user names and passwords for your cluster by using [htpasswd](#).

Prerequisites

- Have access to **htpasswd.exe**. This file is included in the **\bin** directory of many Apache `httpd` distributions.

Procedure

1. Create or update your flat file with a user name and hashed password:

```
> htpasswd.exe -c -B -b <\path\to\users.htpasswd> <username> <password>
```

The command generates a hashed version of the password.

For example:

```
> htpasswd.exe -c -B -b users.htpasswd <username> <password>
```

Example output

```
Adding password for user user1
```

- Continue to add or update credentials to the file:

```
> htpasswd.exe -b <path\to\users.htpasswd> <username> <password>
```

7.1.4. Creating the htpasswd secret

To use the htpasswd identity provider, you must define a secret that contains the htpasswd user file.

Prerequisites

- Create an htpasswd file.

Procedure

- Create a **Secret** object that contains the htpasswd users file:

```
$ oc create secret generic htpass-secret --from-file=htpasswd=<path_to_users.htpasswd> -n  
openshift-config 1
```

- The secret key containing the users file for the **--from-file** argument must be named **htpasswd**, as shown in the above command.

TIP

You can alternatively apply the following YAML to create the secret:

```
apiVersion: v1  
kind: Secret  
metadata:  
  name: htpass-secret  
  namespace: openshift-config  
type: Opaque  
data:  
  htpasswd: <base64_encoded_htpasswd_file_contents>
```

7.1.5. Sample htpasswd CR

The following custom resource (CR) shows the parameters and acceptable values for an htpasswd identity provider.

htpasswd CR

```
apiVersion: config.openshift.io/v1  
kind: OAuth  
metadata:  
  name: cluster  
spec:  
  identityProviders:  
  - name: my_htpasswd_provider 1
```

```
mappingMethod: claim 2
type: HTPasswd
htpasswd:
  fileData:
    name: htpass-secret 3
```

- 1** This provider name is prefixed to provider user names to form an identity name.
- 2** Controls how mappings are established between this provider's identities and **User** objects.
- 3** An existing secret containing a file generated using [htpasswd](#).

Additional resources

- See [Identity provider parameters](#) for information on parameters, such as **mappingMethod**, that are common to all identity providers.

7.1.6. Adding an identity provider to your cluster

After you install your cluster, add an identity provider to it so your users can authenticate.

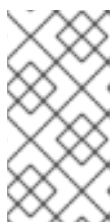
Prerequisites

- Create an OpenShift Container Platform cluster.
- Create the custom resource (CR) for your identity providers.
- You must be logged in as an administrator.

Procedure

1. Apply the defined CR:

```
$ oc apply -f </path/to/CR>
```



NOTE

If a CR does not exist, **oc apply** creates a new CR and might trigger the following warning: **Warning: oc apply should be used on resources created by either oc create --save-config or oc apply**. In this case you can safely ignore this warning.

2. Log in to the cluster as a user from your identity provider, entering the password when prompted.

```
$ oc login -u <username>
```

3. Confirm that the user logged in successfully, and display the user name.

```
$ oc whoami
```


7.1.7. Updating users for an htpasswd identity provider

You can add or remove users from an existing htpasswd identity provider.

Prerequisites

- You have created a **Secret** object that contains the htpasswd user file. This procedure assumes that it is named **htpass-secret**.
- You have configured an htpasswd identity provider. This procedure assumes that it is named **my_htpasswd_provider**.
- You have access to the **htpasswd** utility. On Red Hat Enterprise Linux this is available by installing the **httpd-tools** package.
- You have cluster administrator privileges.

Procedure

1. Retrieve the htpasswd file from the **htpass-secret Secret** object and save the file to your file system:

```
$ oc get secret htpass-secret -ojsonpath={.data.htpasswd} -n openshift-config | base64 --decode > users.htpasswd
```

2. Add or remove users from the **users.htpasswd** file.

- To add a new user:

```
$ htpasswd -bB users.htpasswd <username> <password>
```

Example output

```
Adding password for user <username>
```

- To remove an existing user:

```
$ htpasswd -D users.htpasswd <username>
```

Example output

```
Deleting password for user <username>
```

3. Replace the **htpass-secret Secret** object with the updated users in the **users.htpasswd** file:

```
$ oc create secret generic htpass-secret --from-file=htpasswd=users.htpasswd --dry-run=client -o yaml -n openshift-config | oc replace -f -
```

TIP

You can alternatively apply the following YAML to replace the secret:

```
apiVersion: v1
kind: Secret
metadata:
  name: htpass-secret
  namespace: openshift-config
type: Opaque
data:
  htpasswd: <base64_encoded_htpasswd_file_contents>
```

4. If you removed one or more users, you must additionally remove existing resources for each user.

- a. Delete the **User** object:

```
$ oc delete user <username>
```

Example output

```
user.user.openshift.io "<username>" deleted
```

Be sure to remove the user, otherwise the user can continue using their token as long as it has not expired.

- b. Delete the **Identity** object for the user:

```
$ oc delete identity my_htpasswd_provider:<username>
```

Example output

```
identity.user.openshift.io "my_htpasswd_provider:<username>" deleted
```

7.1.8. Configuring identity providers using the web console

Configure your identity provider (IDP) through the web console instead of the CLI.

Prerequisites

- You must be logged in to the web console as a cluster administrator.

Procedure

1. Navigate to **Administration** → **Cluster Settings**.
2. Under the **Configuration** tab, click **OAuth**.
3. Under the **Identity Providers** section, select your identity provider from the **Add** drop-down menu.

**NOTE**

You can specify multiple IDPs through the web console without overwriting existing IDPs.

7.2. CONFIGURING A KEYSTONE IDENTITY PROVIDER

Configure the **keystone** identity provider to integrate your OpenShift Container Platform cluster with Keystone to enable shared authentication with an OpenStack Keystone v3 server configured to store users in an internal database. This configuration allows users to log in to OpenShift Container Platform with their Keystone credentials.

7.2.1. About identity providers in OpenShift Container Platform

By default, only a **kubeadmin** user exists on your cluster. To specify an identity provider, you must create a custom resource (CR) that describes that identity provider and add it to the cluster.

**NOTE**

OpenShift Container Platform user names containing `/`, `:`, and `%` are not supported.

7.2.2. About Keystone authentication

[Keystone](#) is an OpenStack project that provides identity, token, catalog, and policy services.

You can configure the integration with Keystone so that the new OpenShift Container Platform users are based on either the Keystone user names or unique Keystone IDs. With both methods, users log in by entering their Keystone user name and password. Basing the OpenShift Container Platform users on the Keystone ID is more secure because if you delete a Keystone user and create a new Keystone user with that user name, the new user might have access to the old user's resources.

7.2.3. Creating the secret

Identity providers use OpenShift Container Platform **Secret** objects in the **openshift-config** namespace to contain the client secret, client certificates, and keys.

Procedure

- Create a **Secret** object that contains the key and certificate by using the following command:

```
$ oc create secret tls <secret_name> --key=key.pem --cert=cert.pem -n openshift-config
```

TIP

You can alternatively apply the following YAML to create the secret:

```
apiVersion: v1
kind: Secret
metadata:
  name: <secret_name>
  namespace: openshift-config
type: kubernetes.io/tls
data:
  tls.crt: <base64_encoded_cert>
  tls.key: <base64_encoded_key>
```

7.2.4. Creating a config map

Identity providers use OpenShift Container Platform **ConfigMap** objects in the **openshift-config** namespace to contain the certificate authority bundle. These are primarily used to contain certificate bundles needed by the identity provider.

Procedure

- Define an OpenShift Container Platform **ConfigMap** object containing the certificate authority by using the following command. The certificate authority must be stored in the **ca.crt** key of the **ConfigMap** object.

```
$ oc create configmap ca-config-map --from-file=ca.crt=/path/to/ca -n openshift-config
```

TIP

You can alternatively apply the following YAML to create the config map:

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: ca-config-map
  namespace: openshift-config
data:
  ca.crt: |
    <CA_certificate_PEM>
```

7.2.5. Sample Keystone CR

The following custom resource (CR) shows the parameters and acceptable values for a Keystone identity provider.

Keystone CR

```
apiVersion: config.openshift.io/v1
kind: OAuth
metadata:
  name: cluster
spec:
```

```

identityProviders:
- name: keystoneidp 1
  mappingMethod: claim 2
  type: Keystone
  keystone:
    domainName: default 3
    url: https://keystone.example.com:5000 4
    ca: 5
      name: ca-config-map
    tlsClientCert: 6
      name: client-cert-secret
    tlsClientKey: 7
      name: client-key-secret

```

- 1 This provider name is prefixed to provider user names to form an identity name.
- 2 Controls how mappings are established between this provider's identities and **User** objects.
- 3 Keystone domain name. In Keystone, usernames are domain-specific. Only a single domain is supported.
- 4 The URL to use to connect to the Keystone server (required). This must use https.
- 5 Optional: Reference to an OpenShift Container Platform **ConfigMap** object containing the PEM-encoded certificate authority bundle to use in validating server certificates for the configured URL.
- 6 Optional: Reference to an OpenShift Container Platform **Secret** object containing the client certificate to present when making requests to the configured URL.
- 7 Reference to an OpenShift Container Platform **Secret** object containing the key for the client certificate. Required if **tlsClientCert** is specified.

Additional resources

- See [Identity provider parameters](#) for information on parameters, such as **mappingMethod**, that are common to all identity providers.

7.2.6. Adding an identity provider to your cluster

After you install your cluster, add an identity provider to it so your users can authenticate.

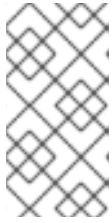
Prerequisites

- Create an OpenShift Container Platform cluster.
- Create the custom resource (CR) for your identity providers.
- You must be logged in as an administrator.

Procedure

1. Apply the defined CR:

```
$ oc apply -f </path/to/CR>
```



NOTE

If a CR does not exist, **oc apply** creates a new CR and might trigger the following warning: **Warning: oc apply should be used on resources created by either oc create --save-config or oc apply.** In this case you can safely ignore this warning.

2. Log in to the cluster as a user from your identity provider, entering the password when prompted.

```
$ oc login -u <username>
```

3. Confirm that the user logged in successfully, and display the user name.

```
$ oc whoami
```

7.3. CONFIGURING AN LDAP IDENTITY PROVIDER

Configure the **ldap** identity provider to validate user names and passwords against an LDAPv3 server, using simple bind authentication.

7.3.1. About identity providers in OpenShift Container Platform

By default, only a **kubeadmin** user exists on your cluster. To specify an identity provider, you must create a custom resource (CR) that describes that identity provider and add it to the cluster.



NOTE

OpenShift Container Platform user names containing `/`, `:`, and `%` are not supported.

7.3.2. About LDAP authentication

During authentication, the LDAP directory is searched for an entry that matches the provided user name. If a single unique match is found, a simple bind is attempted using the distinguished name (DN) of the entry plus the provided password.

These are the steps taken:

1. Generate a search filter by combining the attribute and filter in the configured **url** with the user-provided user name.
2. Search the directory using the generated filter. If the search does not return exactly one entry, deny access.
3. Attempt to bind to the LDAP server using the DN of the entry retrieved from the search, and the user-provided password.
4. If the bind is unsuccessful, deny access.
5. If the bind is successful, build an identity using the configured attributes as the identity, email address, display name, and preferred user name.

The configured **url** is an RFC 2255 URL, which specifies the LDAP host and search parameters to use. The syntax of the URL is:

```
ldap://host:port/basedn?attribute?scope?filter
```

For this URL:

URL component	Description
ldap	For regular LDAP, use the string ldap . For secure LDAP (LDAPS), use ldaps instead.
host:port	The name and port of the LDAP server. Defaults to localhost:389 for ldap and localhost:636 for LDAPS.
basedn	The DN of the branch of the directory where all searches should start from. At the very least, this must be the top of your directory tree, but it could also specify a subtree in the directory.
attribute	The attribute to search for. Although RFC 2255 allows a comma-separated list of attributes, only the first attribute will be used, no matter how many are provided. If no attributes are provided, the default is to use uid . It is recommended to choose an attribute that will be unique across all entries in the subtree you will be using.
scope	The scope of the search. Can be either one or sub . If the scope is not provided, the default is to use a scope of sub .
filter	A valid LDAP search filter. If not provided, defaults to (objectClass=*)

When doing searches, the attribute, filter, and provided user name are combined to create a search filter that looks like:

```
(<filter>(<attribute>=<username>))
```

For example, consider a URL of:

```
ldap://ldap.example.com/o=Acme?cn?sub?(enabled=true)
```

When a client attempts to connect using a user name of **bob**, the resulting search filter will be **(&(enabled=true)(cn=bob))**.

If the LDAP directory requires authentication to search, specify a **bindDN** and **bindPassword** to use to perform the entry search.

7.3.3. Creating the LDAP secret

To use the identity provider, you must define an OpenShift Container Platform **Secret** object that contains the **bindPassword** field.

Procedure

- Create a **Secret** object that contains the **bindPassword** field:

```
$ oc create secret generic ldap-secret --from-literal=bindPassword=<secret> -n openshift-config 1
```

- 1** The secret key containing the bindPassword for the **--from-literal** argument must be called **bindPassword**.

TIP

You can alternatively apply the following YAML to create the secret:

```
apiVersion: v1
kind: Secret
metadata:
  name: ldap-secret
  namespace: openshift-config
type: Opaque
data:
  bindPassword: <base64_encoded_bind_password>
```

7.3.4. Creating a config map

Identity providers use OpenShift Container Platform **ConfigMap** objects in the **openshift-config** namespace to contain the certificate authority bundle. These are primarily used to contain certificate bundles needed by the identity provider.

Procedure

- Define an OpenShift Container Platform **ConfigMap** object containing the certificate authority by using the following command. The certificate authority must be stored in the **ca.crt** key of the **ConfigMap** object.

```
$ oc create configmap ca-config-map --from-file=ca.crt=/path/to/ca -n openshift-config
```

TIP

You can alternatively apply the following YAML to create the config map:

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: ca-config-map
  namespace: openshift-config
data:
  ca.crt: |
    <CA_certificate_PEM>
```

7.3.5. Sample LDAP CR

The following custom resource (CR) shows the parameters and acceptable values for an LDAP identity provider.

LDAP CR

```

apiVersion: config.openshift.io/v1
kind: OAuth
metadata:
  name: cluster
spec:
  identityProviders:
  - name: ldapidp 1
    mappingMethod: claim 2
    type: LDAP
    ldap:
      attributes:
        id: 3
        - dn
        email: 4
        - mail
        name: 5
        - cn
        preferredUsername: 6
        - uid
      bindDN: "" 7
      bindPassword: 8
        name: ldap-secret
      ca: 9
        name: ca-config-map
      insecure: false 10
      url: "ldaps://ldaps.example.com/ou=users,dc=acme,dc=com?uid" 11

```

- 1 This provider name is prefixed to the returned user ID to form an identity name.
- 2 Controls how mappings are established between this provider's identities and **User** objects.
- 3 List of attributes to use as the identity. First non-empty attribute is used. At least one attribute is required. If none of the listed attribute have a value, authentication fails. Defined attributes are retrieved as raw, allowing for binary values to be used.
- 4 List of attributes to use as the email address. First non-empty attribute is used.
- 5 List of attributes to use as the display name. First non-empty attribute is used.
- 6 List of attributes to use as the preferred user name when provisioning a user for this identity. First non-empty attribute is used.
- 7 Optional DN to use to bind during the search phase. Must be set if **bindPassword** is defined.
- 8 Optional reference to an OpenShift Container Platform **Secret** object containing the bind password. Must be set if **bindDN** is defined.
- 9 Optional: Reference to an OpenShift Container Platform **ConfigMap** object containing the PEM-encoded certificate authority bundle to use in validating server certificates for the configured URL. Only used when **insecure** is **false**.
- 10 When **true**, no TLS connection is made to the server. When **false**, **ldaps://** URLs connect using TLS, and **ldap://** URLs are upgraded to TLS. This must be set to **false** when **ldaps://** URLs are in use, as

these URLs always attempt to connect using TLS.

- 11 An RFC 2255 URL which specifies the LDAP host and search parameters to use.



NOTE

To whitelist users for an LDAP integration, use the **lookup** mapping method. Before a login from LDAP would be allowed, a cluster administrator must create an **Identity** object and a **User** object for each LDAP user.

Additional resources

- See [Identity provider parameters](#) for information on parameters, such as **mappingMethod**, that are common to all identity providers.

7.3.6. Adding an identity provider to your cluster

After you install your cluster, add an identity provider to it so your users can authenticate.

Prerequisites

- Create an OpenShift Container Platform cluster.
- Create the custom resource (CR) for your identity providers.
- You must be logged in as an administrator.

Procedure

1. Apply the defined CR:

```
$ oc apply -f </path/to/CR>
```



NOTE

If a CR does not exist, **oc apply** creates a new CR and might trigger the following warning: **Warning: oc apply should be used on resources created by either oc create --save-config or oc apply**. In this case you can safely ignore this warning.

2. Log in to the cluster as a user from your identity provider, entering the password when prompted.

```
$ oc login -u <username>
```

3. Confirm that the user logged in successfully, and display the user name.

```
$ oc whoami
```

7.4. CONFIGURING A BASIC AUTHENTICATION IDENTITY PROVIDER

Configure the **basic-authentication** identity provider for users to log in to OpenShift Container Platform with credentials validated against a remote identity provider. Basic authentication is a generic back-end integration mechanism.

7.4.1. About identity providers in OpenShift Container Platform

By default, only a **kubeadmin** user exists on your cluster. To specify an identity provider, you must create a custom resource (CR) that describes that identity provider and add it to the cluster.



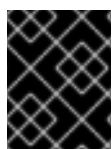
NOTE

OpenShift Container Platform user names containing `/`, `:`, and `%` are not supported.

7.4.2. About basic authentication

Basic authentication is a generic back-end integration mechanism that allows users to log in to OpenShift Container Platform with credentials validated against a remote identity provider.

Because basic authentication is generic, you can use this identity provider for advanced authentication configurations.



IMPORTANT

Basic authentication must use an HTTPS connection to the remote server to prevent potential snooping of the user ID and password and man-in-the-middle attacks.

With basic authentication configured, users send their user name and password to OpenShift Container Platform, which then validates those credentials against a remote server by making a server-to-server request, passing the credentials as a basic authentication header. This requires users to send their credentials to OpenShift Container Platform during login.



NOTE

This only works for user name/password login mechanisms, and OpenShift Container Platform must be able to make network requests to the remote authentication server.

User names and passwords are validated against a remote URL that is protected by basic authentication and returns JSON.

A **401** response indicates failed authentication.

A non-**200** status, or the presence of a non-empty "error" key, indicates an error:

```
{"error": "Error message"}
```

A **200** status with a **sub** (subject) key indicates success:

```
{"sub": "userid"} 1
```

1 The subject must be unique to the authenticated user and must not be able to be modified.

A successful response can optionally provide additional data, such as:

- A display name using the **name** key. For example:

```
{"sub":"userid", "name": "User Name", ...}
```

- An email address using the **email** key. For example:

```
{"sub":"userid", "email":"user@example.com", ...}
```

- A preferred user name using the **preferred_username** key. This is useful when the unique, unchangeable subject is a database key or UID, and a more human-readable name exists. This is used as a hint when provisioning the OpenShift Container Platform user for the authenticated identity. For example:

```
{"sub":"014fbff9a07c", "preferred_username":"bob", ...}
```

7.4.3. Creating the secret

Identity providers use OpenShift Container Platform **Secret** objects in the **openshift-config** namespace to contain the client secret, client certificates, and keys.

Procedure

- Create a **Secret** object that contains the key and certificate by using the following command:

```
$ oc create secret tls <secret_name> --key=key.pem --cert=cert.pem -n openshift-config
```

TIP

You can alternatively apply the following YAML to create the secret:

```
apiVersion: v1
kind: Secret
metadata:
  name: <secret_name>
  namespace: openshift-config
type: kubernetes.io/tls
data:
  tls.crt: <base64_encoded_cert>
  tls.key: <base64_encoded_key>
```

7.4.4. Creating a config map

Identity providers use OpenShift Container Platform **ConfigMap** objects in the **openshift-config** namespace to contain the certificate authority bundle. These are primarily used to contain certificate bundles needed by the identity provider.

Procedure

- Define an OpenShift Container Platform **ConfigMap** object containing the certificate authority by using the following command. The certificate authority must be stored in the **ca.crt** key of the **ConfigMap** object.

```
$ oc create configmap ca-config-map --from-file=ca.crt=/path/to/ca -n openshift-config
```

TIP

You can alternatively apply the following YAML to create the config map:

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: ca-config-map
  namespace: openshift-config
data:
  ca.crt: |
    <CA_certificate_PEM>
```

7.4.5. Sample basic authentication CR

The following custom resource (CR) shows the parameters and acceptable values for a basic authentication identity provider.

Basic authentication CR

```
apiVersion: config.openshift.io/v1
kind: OAuth
metadata:
  name: cluster
spec:
  identityProviders:
  - name: basicidp 1
    mappingMethod: claim 2
    type: BasicAuth
    basicAuth:
      url: https://www.example.com/remote-idp 3
      ca: 4
        name: ca-config-map
      tlsClientCert: 5
        name: client-cert-secret
      tlsClientKey: 6
        name: client-key-secret
```

- 1** This provider name is prefixed to the returned user ID to form an identity name.
- 2** Controls how mappings are established between this provider's identities and **User** objects.
- 3** URL accepting credentials in Basic authentication headers.
- 4** Optional: Reference to an OpenShift Container Platform **ConfigMap** object containing the PEM-encoded certificate authority bundle to use in validating server certificates for the configured URL.
- 5** Optional: Reference to an OpenShift Container Platform **Secret** object containing the client certificate to present when making requests to the configured URL.
- 6** Reference to an OpenShift Container Platform **Secret** object containing the key for the client certificate. Required if **tlsClientCert** is specified.

certificate. Required if `tlsCert` is specified.

Additional resources

- See [Identity provider parameters](#) for information on parameters, such as `mappingMethod`, that are common to all identity providers.

7.4.6. Adding an identity provider to your cluster

After you install your cluster, add an identity provider to it so your users can authenticate.

Prerequisites

- Create an OpenShift Container Platform cluster.
- Create the custom resource (CR) for your identity providers.
- You must be logged in as an administrator.

Procedure

1. Apply the defined CR:

```
$ oc apply -f </path/to/CR>
```



NOTE

If a CR does not exist, `oc apply` creates a new CR and might trigger the following warning: **Warning: oc apply should be used on resources created by either oc create --save-config or oc apply.** In this case you can safely ignore this warning.

2. Log in to the cluster as a user from your identity provider, entering the password when prompted.

```
$ oc login -u <username>
```

3. Confirm that the user logged in successfully, and display the user name.

```
$ oc whoami
```

7.4.7. Example Apache HTTPD configuration for basic identity providers

The basic identify provider (IDP) configuration in OpenShift Container Platform 4 requires that the IDP server respond with JSON for success and failures. You can use CGI scripting in Apache HTTPD to accomplish this. This section provides examples.

Example `/etc/httpd/conf.d/login.conf`

```
<VirtualHost *:443>
# CGI Scripts in here
DocumentRoot /var/www/cgi-bin
```

```
# SSL Directives
SSLEngine on
SSLCipherSuite PROFILE=SYSTEM
SSLProxyCipherSuite PROFILE=SYSTEM
SSLCertificateFile /etc/pki/tls/certs/localhost.crt
SSLCertificateKeyFile /etc/pki/tls/private/localhost.key

# Configure HTTPD to execute scripts
ScriptAlias /basic /var/www/cgi-bin

# Handles a failed login attempt
ErrorDocument 401 /basic/fail.cgi

# Handles authentication
<Location /basic/login.cgi>
  AuthType Basic
  AuthName "Please Log In"
  AuthBasicProvider file
  AuthUserFile /etc/httpd/conf/passwords
  Require valid-user
</Location>
</VirtualHost>
```

Example `/var/www/cgi-bin/login.cgi`

```
#!/bin/bash
echo "Content-Type: application/json"
echo ""
echo '{"sub":"userid", "name":"$REMOTE_USER"}'
exit 0
```

Example `/var/www/cgi-bin/fail.cgi`

```
#!/bin/bash
echo "Content-Type: application/json"
echo ""
echo '{"error": "Login failure"}'
exit 0
```

7.4.7.1. File requirements

These are the requirements for the files you create on an Apache HTTPD web server:

- **login.cgi** and **fail.cgi** must be executable (**chmod +x**).
- **login.cgi** and **fail.cgi** must have proper SELinux contexts if SELinux is enabled: **restorecon -RFv /var/www/cgi-bin**, or ensure that the context is **httpd_sys_script_exec_t** using **ls -laZ**.
- **login.cgi** is only executed if your user successfully logs in per **Require** and **Auth** directives.
- **fail.cgi** is executed if the user fails to log in, resulting in an **HTTP 401** response.

7.4.8. Basic authentication troubleshooting

The most common issue relates to network connectivity to the backend server. For simple debugging, run **curl** commands on the master. To test for a successful login, replace the **<user>** and **<password>** in the following example command with valid credentials. To test an invalid login, replace them with false credentials.

```
$ curl --cacert /path/to/ca.crt --cert /path/to/client.crt --key /path/to/client.key -u <user>:<password> -v https://www.example.com/remote-idp
```

Successful responses

A **200** status with a **sub** (subject) key indicates success:

```
{"sub":"userid"}
```

The subject must be unique to the authenticated user, and must not be able to be modified.

A successful response can optionally provide additional data, such as:

- A display name using the **name** key:

```
{"sub":"userid", "name": "User Name", ...}
```

- An email address using the **email** key:

```
{"sub":"userid", "email":"user@example.com", ...}
```

- A preferred user name using the **preferred_username** key:

```
{"sub":"014fbff9a07c", "preferred_username":"bob", ...}
```

The **preferred_username** key is useful when the unique, unchangeable subject is a database key or UID, and a more human-readable name exists. This is used as a hint when provisioning the OpenShift Container Platform user for the authenticated identity.

Failed responses

- A **401** response indicates failed authentication.
- A non-**200** status or the presence of a non-empty "error" key indicates an error: **{"error":"Error message"}**

7.5. CONFIGURING A REQUEST HEADER IDENTITY PROVIDER

Configure the **request-header** identity provider to identify users from request header values, such as **X-Remote-User**. It is typically used in combination with an authenticating proxy, which sets the request header value.

7.5.1. About identity providers in OpenShift Container Platform

By default, only a **kubeadmin** user exists on your cluster. To specify an identity provider, you must create a custom resource (CR) that describes that identity provider and add it to the cluster.

**NOTE**

OpenShift Container Platform user names containing `/`, `:`, and `%` are not supported.

7.5.2. About request header authentication

A request header identity provider identifies users from request header values, such as **X-Remote-User**. It is typically used in combination with an authenticating proxy, which sets the request header value. The request header identity provider cannot be combined with other identity providers that use direct password logins, such as `htpasswd`, `Keystone`, `LDAP` or basic authentication.

**NOTE**

You can also use the request header identity provider for advanced configurations such as the community-supported [SAML authentication](#). Note that this solution is not supported by Red Hat.

For users to authenticate using this identity provider, they must access **`https://<namespace_route>/oauth/authorize`** (and subpaths) via an authenticating proxy. To accomplish this, configure the OAuth server to redirect unauthenticated requests for OAuth tokens to the proxy endpoint that proxies to **`https://<namespace_route>/oauth/authorize`**.

To redirect unauthenticated requests from clients expecting browser-based login flows:

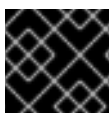
- Set the **`provider.loginURL`** parameter to the authenticating proxy URL that will authenticate interactive clients and then proxy the request to **`https://<namespace_route>/oauth/authorize`**.

To redirect unauthenticated requests from clients expecting **WWW-Authenticate** challenges:

- Set the **`provider.challengeURL`** parameter to the authenticating proxy URL that will authenticate clients expecting **WWW-Authenticate** challenges and then proxy the request to **`https://<namespace_route>/oauth/authorize`**.

The **`provider.challengeURL`** and **`provider.loginURL`** parameters can include the following tokens in the query portion of the URL:

- **`{url}`** is replaced with the current URL, escaped to be safe in a query parameter.
For example: **`https://www.example.com/sso-login?then={url}`**
- **`{query}`** is replaced with the current query string, unescaped.
For example: **`https://www.example.com/auth-proxy/oauth/authorize?{query}`**

**IMPORTANT**

As of OpenShift Container Platform 4.1, your proxy must support mutual TLS.

7.5.2.1. SSPI connection support on Microsoft Windows



IMPORTANT

Using SSPI connection support on Microsoft Windows is a Technology Preview feature only. Technology Preview features are not supported with Red Hat production service level agreements (SLAs) and might not be functionally complete. Red Hat does not recommend using them in production. These features provide early access to upcoming product features, enabling customers to test functionality and provide feedback during the development process.

For more information about the support scope of Red Hat Technology Preview features, see [Technology Preview Features Support Scope](#).

The OpenShift CLI (**oc**) supports the Security Support Provider Interface (SSPI) to allow for SSO flows on Microsoft Windows. If you use the request header identity provider with a GSSAPI-enabled proxy to connect an Active Directory server to OpenShift Container Platform, users can automatically authenticate to OpenShift Container Platform by using the **oc** command line interface from a domain-joined Microsoft Windows computer.

7.5.3. Creating a config map

Identity providers use OpenShift Container Platform **ConfigMap** objects in the **openshift-config** namespace to contain the certificate authority bundle. These are primarily used to contain certificate bundles needed by the identity provider.

Procedure

- Define an OpenShift Container Platform **ConfigMap** object containing the certificate authority by using the following command. The certificate authority must be stored in the **ca.crt** key of the **ConfigMap** object.

```
$ oc create configmap ca-config-map --from-file=ca.crt=/path/to/ca -n openshift-config
```

TIP

You can alternatively apply the following YAML to create the config map:

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: ca-config-map
  namespace: openshift-config
data:
  ca.crt: |
    <CA_certificate_PEM>
```

7.5.4. Sample request header CR

The following custom resource (CR) shows the parameters and acceptable values for a request header identity provider.

Request header CR

```
apiVersion: config.openshift.io/v1
```

```

kind: OAuth
metadata:
  name: cluster
spec:
  identityProviders:
  - name: requestheaderidp 1
    mappingMethod: claim 2
    type: RequestHeader
    requestHeader:
      challengeURL: "https://www.example.com/challenging-proxy/oauth/authorize?${query}" 3
      loginURL: "https://www.example.com/login-proxy/oauth/authorize?${query}" 4
      ca: 5
        name: ca-config-map
        clientCommonNames: 6
        - my-auth-proxy
        headers: 7
        - X-Remote-User
        - SSO-User
        emailHeaders: 8
        - X-Remote-User-Email
        nameHeaders: 9
        - X-Remote-User-Display-Name
        preferredUsernameHeaders: 10
        - X-Remote-User-Login

```

- 1** This provider name is prefixed to the user name in the request header to form an identity name.
- 2** Controls how mappings are established between this provider's identities and **User** objects.
- 3** Optional: URL to redirect unauthenticated **/oauth/authorize** requests to, that will authenticate browser-based clients and then proxy their request to **https://<namespace_route>/oauth/authorize**. The URL that proxies to **https://<namespace_route>/oauth/authorize** must end with **/authorize** (with no trailing slash), and also proxy subpaths, in order for OAuth approval flows to work properly. **\${url}** is replaced with the current URL, escaped to be safe in a query parameter. **\${query}** is replaced with the current query string. If this attribute is not defined, then **loginURL** must be used.
- 4** Optional: URL to redirect unauthenticated **/oauth/authorize** requests to, that will authenticate clients which expect **WWW-Authenticate** challenges, and then proxy them to **https://<namespace_route>/oauth/authorize**. **\${url}** is replaced with the current URL, escaped to be safe in a query parameter. **\${query}** is replaced with the current query string. If this attribute is not defined, then **challengeURL** must be used.
- 5** Reference to an OpenShift Container Platform **ConfigMap** object containing a PEM-encoded certificate bundle. Used as a trust anchor to validate the TLS certificates presented by the remote server.



IMPORTANT

As of OpenShift Container Platform 4.1, the **ca** field is required for this identity provider. This means that your proxy must support mutual TLS.

6

Optional: list of common names (**cn**). If set, a valid client certificate with a Common Name (**cn**) in the specified list must be presented before the request headers are checked for user names. If

- 7 Header names to check, in order, for the user identity. The first header containing a value is used as the identity. Required, case-insensitive.
- 8 Header names to check, in order, for an email address. The first header containing a value is used as the email address. Optional, case-insensitive.
- 9 Header names to check, in order, for a display name. The first header containing a value is used as the display name. Optional, case-insensitive.
- 10 Header names to check, in order, for a preferred user name, if different than the immutable identity determined from the headers specified in **headers**. The first header containing a value is used as the preferred user name when provisioning. Optional, case-insensitive.

Additional resources

- See [Identity provider parameters](#) for information on parameters, such as **mappingMethod**, that are common to all identity providers.

7.5.5. Adding an identity provider to your cluster

After you install your cluster, add an identity provider to it so your users can authenticate.

Prerequisites

- Create an OpenShift Container Platform cluster.
- Create the custom resource (CR) for your identity providers.
- You must be logged in as an administrator.

Procedure

1. Apply the defined CR:

```
$ oc apply -f </path/to/CR>
```



NOTE

If a CR does not exist, **oc apply** creates a new CR and might trigger the following warning: **Warning: oc apply should be used on resources created by either oc create --save-config or oc apply**. In this case you can safely ignore this warning.

2. Log in to the cluster as a user from your identity provider, entering the password when prompted.

```
$ oc login -u <username>
```

3. Confirm that the user logged in successfully, and display the user name.

\$ oc whoami

7.5.6. Example Apache authentication configuration using request header

This example configures an Apache authentication proxy for the OpenShift Container Platform using the request header identity provider.

Custom proxy configuration

Using the **mod_auth_gssapi** module is a popular way to configure the Apache authentication proxy using the request header identity provider; however, it is not required. Other proxies can easily be used if the following requirements are met:

- Block the **X-Remote-User** header from client requests to prevent spoofing.
- Enforce client certificate authentication in the **RequestHeaderIdentityProvider** configuration.
- Require the **X-Csrf-Token** header be set for all authentication requests using the challenge flow.
- Make sure only the **/oauth/authorize** endpoint and its subpaths are proxied; redirects must be rewritten to allow the backend server to send the client to the correct location.
- The URL that proxies to **https://<namespace_route>/oauth/authorize** must end with **/authorize** with no trailing slash. For example, **https://proxy.example.com/login-proxy/authorize?...** must proxy to **https://<namespace_route>/oauth/authorize?...**
- Subpaths of the URL that proxies to **https://<namespace_route>/oauth/authorize** must proxy to subpaths of **https://<namespace_route>/oauth/authorize**. For example, **https://proxy.example.com/login-proxy/authorize/approve?...** must proxy to **https://<namespace_route>/oauth/authorize/approve?...**



NOTE

The **https://<namespace_route>** address is the route to the OAuth server and can be obtained by running **oc get route -n openshift-authentication**.

Configuring Apache authentication using request header

This example uses the **mod_auth_gssapi** module to configure an Apache authentication proxy using the request header identity provider.

Prerequisites

- Obtain the **mod_auth_gssapi** module from the [Optional channel](#). You must have the following packages installed on your local machine:
 - **httpd**
 - **mod_ssl**
 - **mod_session**
 - **apr-util-openssl**
 - **mod_auth_gssapi**

- Generate a CA for validating requests that submit the trusted header. Define an OpenShift Container Platform **ConfigMap** object containing the CA. This is done by running:

```
$ oc create configmap ca-config-map --from-file=ca.crt=/path/to/ca -n openshift-config 1
```

- 1** The CA must be stored in the **ca.crt** key of the **ConfigMap** object.

TIP

You can alternatively apply the following YAML to create the config map:

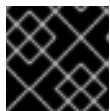
```
apiVersion: v1
kind: ConfigMap
metadata:
  name: ca-config-map
  namespace: openshift-config
data:
  ca.crt: |
    <CA_certificate_PEM>
```

- Generate a client certificate for the proxy. You can generate this certificate by using any x509 certificate tooling. The client certificate must be signed by the CA you generated for validating requests that submit the trusted header.
- Create the custom resource (CR) for your identity providers.

Procedure

This proxy uses a client certificate to connect to the OAuth server, which is configured to trust the **X-Remote-User** header.

1. Create the certificate for the Apache configuration. The certificate that you specify as the **SSLProxyMachineCertificateFile** parameter value is the proxy's client certificate that is used to authenticate the proxy to the server. It must use **TLS Web Client Authentication** as the extended key type.
2. Create the Apache configuration. Use the following template to provide your required settings and values:



IMPORTANT

Carefully review the template and customize its contents to fit your environment.

```
LoadModule request_module modules/mod_request.so
LoadModule auth_gssapi_module modules/mod_auth_gssapi.so
# Some Apache configurations might require these modules.
# LoadModule auth_form_module modules/mod_auth_form.so
# LoadModule session_module modules/mod_session.so

# Nothing needs to be served over HTTP. This virtual host simply redirects to
# HTTPS.
<VirtualHost *:80>
  DocumentRoot /var/www/html
```

```

RewriteEngine On
RewriteRule ^(.*)$ https://%{HTTP_HOST}$1 [R,L]
</VirtualHost>

<VirtualHost *:443>
# This needs to match the certificates you generated. See the CN and X509v3
# Subject Alternative Name in the output of:
# openssl x509 -text -in /etc/pki/tls/certs/localhost.crt
ServerName www.example.com

DocumentRoot /var/www/html
SSLEngine on
SSLCertificateFile /etc/pki/tls/certs/localhost.crt
SSLCertificateKeyFile /etc/pki/tls/private/localhost.key
SSLCACertificateFile /etc/pki/CA/certs/ca.crt

SSLProxyEngine on
SSLProxyCACertificateFile /etc/pki/CA/certs/ca.crt
# It is critical to enforce client certificates. Otherwise, requests can
# spoof the X-Remote-User header by accessing the /oauth/authorize endpoint
# directly.
SSLProxyMachineCertificateFile /etc/pki/tls/certs/authproxy.pem

# To use the challenging-proxy, an X-Csrft-Token must be present.
RewriteCond %{REQUEST_URI} ^/challenging-proxy
RewriteCond %{HTTP:X-Csrft-Token} ^$ [NC]
RewriteRule ^.* - [F,L]

<Location /challenging-proxy/oauth/authorize>
# Insert your backend server name/ip here.
ProxyPass https://<namespace_route>/oauth/authorize
AuthName "SSO Login"
# For Kerberos
AuthType GSSAPI
Require valid-user
RequestHeader set X-Remote-User %{REMOTE_USER}s

GssapiCredStore keytab:/etc/httpd/protected/auth-proxy.keytab
# Enable the following if you want to allow users to fallback
# to password based authentication when they do not have a client
# configured to perform kerberos authentication.
GssapiBasicAuth On

# For ldap:
# AuthBasicProvider ldap
# AuthLDAPURL "ldap://ldap.example.com:389/ou=People,dc=my-domain,dc=com?uid?
sub?(objectClass=*)"
</Location>

<Location /login-proxy/oauth/authorize>
# Insert your backend server name/ip here.
ProxyPass https://<namespace_route>/oauth/authorize

AuthName "SSO Login"
AuthType GSSAPI
Require valid-user

```

```

RequestHeader set X-Remote-User %{REMOTE_USER}s env=REMOTE_USER

GssapiCredStore keytab:/etc/httpd/protected/auth-proxy.keytab
# Enable the following if you want to allow users to fallback
# to password based authentication when they do not have a client
# configured to perform kerberos authentication.
GssapiBasicAuth On

ErrorDocument 401 /login.html
</Location>

</VirtualHost>

RequestHeader unset X-Remote-User

```



NOTE

The **https://<namespace_route>** address is the route to the OAuth server and can be obtained by running **oc get route -n openshift-authentication**.

- Update the **identityProviders** stanza in the custom resource (CR):

```

identityProviders:
- name: requestheaderidp
  type: RequestHeader
  requestHeader:
    challengeURL: "https://<namespace_route>/challenging-proxy/oauth/authorize?${query}"
    loginURL: "https://<namespace_route>/login-proxy/oauth/authorize?${query}"
  ca:
    name: ca-config-map
  clientCommonNames:
  - my-auth-proxy
  headers:
  - X-Remote-User

```

- Verify the configuration.

- Confirm that you can bypass the proxy by requesting a token by supplying the correct client certificate and header:

```

# curl -L -k -H "X-Remote-User: joe" \
  --cert /etc/pki/tls/certs/authproxy.pem \
  https://<namespace_route>/oauth/token/request

```

- Confirm that requests that do not supply the client certificate fail by requesting a token without the certificate:

```

# curl -L -k -H "X-Remote-User: joe" \
  https://<namespace_route>/oauth/token/request

```

- Confirm that the **challengeURL** redirect is active:


```
# curl -k -v -H 'X-Csrf-Token: 1' \
  https://<namespace_route>/oauth/authorize?client_id=openshift-challenging-
  client&response_type=token
```

Copy the **challengeURL** redirect to use in the next step.

- d. Run this command to show a **401** response with a **WWW-Authenticate** basic challenge, a negotiate challenge, or both challenges:

```
# curl -k -v -H 'X-Csrf-Token: 1' \
  <challengeURL_redirect + query>
```

- e. Test logging in to the OpenShift CLI (**oc**) with and without using a Kerberos ticket:
- i. If you generated a Kerberos ticket by using **kinit**, destroy it:

```
# kdestroy -c cache_name 1
```

- 1 Make sure to provide the name of your Kerberos cache.

- ii. Log in to the **oc** tool by using your Kerberos credentials:

```
# oc login -u <username>
```

Enter your Kerberos password at the prompt.

- iii. Log out of the **oc** tool:

```
# oc logout
```

- iv. Use your Kerberos credentials to get a ticket:

```
# kinit
```

Enter your Kerberos user name and password at the prompt.

- v. Confirm that you can log in to the **oc** tool:

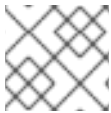
```
# oc login
```

If your configuration is correct, you are logged in without entering separate credentials.

7.6. CONFIGURING A GITHUB OR GITHUB ENTERPRISE IDENTITY PROVIDER

Configure the **github** identity provider to validate user names and passwords against GitHub or GitHub Enterprise's OAuth authentication server. OAuth facilitates a token exchange flow between OpenShift Container Platform and GitHub or GitHub Enterprise.

You can use the GitHub integration to connect to either GitHub or GitHub Enterprise. For GitHub Enterprise integrations, you must provide the **hostname** of your instance and can optionally provide a **ca** certificate bundle to use in requests to the server.

**NOTE**

The following steps apply to both GitHub and GitHub Enterprise unless noted.

7.6.1. About identity providers in OpenShift Container Platform

By default, only a **kubeadmin** user exists on your cluster. To specify an identity provider, you must create a custom resource (CR) that describes that identity provider and add it to the cluster.

**NOTE**

OpenShift Container Platform user names containing `/`, `:`, and `%` are not supported.

7.6.2. About GitHub authentication

Configuring [GitHub authentication](#) allows users to log in to OpenShift Container Platform with their GitHub credentials. To prevent anyone with any GitHub user ID from logging in to your OpenShift Container Platform cluster, you can restrict access to only those in specific GitHub organizations.

7.6.3. Registering a GitHub application

To use GitHub or GitHub Enterprise as an identity provider, you must register an application to use.

Procedure

1. Register an application on GitHub:
 - For GitHub, click [Settings](#) → [Developer settings](#) → [OAuth Apps](#) → [Register a new OAuth application](#).
 - For GitHub Enterprise, go to your GitHub Enterprise home page and then click [Settings](#) → [Developer settings](#) → [Register a new application](#).
2. Enter an application name, for example **My OpenShift Install**.
3. Enter a homepage URL, such as **`https://oauth-openshift.apps.<cluster-name>.<cluster-domain>`**.
4. Optional: Enter an application description.
5. Enter the authorization callback URL, where the end of the URL contains the identity provider **name**:

```
https://oauth-openshift.apps.<cluster-name>.<cluster-domain>/oauth2callback/<idp-provider-name>
```

For example:

```
https://oauth-openshift.apps.openshift-cluster.example.com/oauth2callback/github
```

6. Click **Register application**. GitHub provides a client ID and a client secret. You need these values to complete the identity provider configuration.

7.6.4. Creating the secret

Identity providers use OpenShift Container Platform **Secret** objects in the **openshift-config** namespace to contain the client secret, client certificates, and keys.

Procedure

- Create a **Secret** object containing a string by using the following command:

```
$ oc create secret generic <secret_name> --from-literal=clientSecret=<secret> -n openshift-config
```

TIP

You can alternatively apply the following YAML to create the secret:

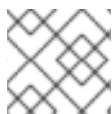
```
apiVersion: v1
kind: Secret
metadata:
  name: <secret_name>
  namespace: openshift-config
type: Opaque
data:
  clientSecret: <base64_encoded_client_secret>
```

- You can define a **Secret** object containing the contents of a file, such as a certificate file, by using the following command:

```
$ oc create secret generic <secret_name> --from-file=<path_to_file> -n openshift-config
```

7.6.5. Creating a config map

Identity providers use OpenShift Container Platform **ConfigMap** objects in the **openshift-config** namespace to contain the certificate authority bundle. These are primarily used to contain certificate bundles needed by the identity provider.



NOTE

This procedure is only required for GitHub Enterprise.

Procedure

- Define an OpenShift Container Platform **ConfigMap** object containing the certificate authority by using the following command. The certificate authority must be stored in the **ca.crt** key of the **ConfigMap** object.

```
$ oc create configmap ca-config-map --from-file=ca.crt=/path/to/ca -n openshift-config
```

TIP

You can alternatively apply the following YAML to create the config map:

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: ca-config-map
  namespace: openshift-config
data:
  ca.crt: |
    <CA_certificate_PEM>
```

7.6.6. Sample GitHub CR

The following custom resource (CR) shows the parameters and acceptable values for a GitHub identity provider.

GitHub CR

```
apiVersion: config.openshift.io/v1
kind: OAuth
metadata:
  name: cluster
spec:
  identityProviders:
  - name: githubidp 1
    mappingMethod: claim 2
    type: GitHub
    github:
      ca: 3
        name: ca-config-map
      clientID: {...} 4
      clientSecret: 5
        name: github-secret
      hostname: ... 6
      organizations: 7
        - myorganization1
        - myorganization2
      teams: 8
        - myorganization1/team-a
        - myorganization2/team-b
```

- 1** This provider name is prefixed to the GitHub numeric user ID to form an identity name. It is also used to build the callback URL.
- 2** Controls how mappings are established between this provider's identities and **User** objects.
- 3** Optional: Reference to an OpenShift Container Platform **ConfigMap** object containing the PEM-encoded certificate authority bundle to use in validating server certificates for the configured URL. Only for use in GitHub Enterprise with a non-publicly trusted root certificate.
- 4** The client ID of a [registered GitHub OAuth application](#). The application must be configured with a callback URL of **https://oauth-openshift.apps.<cluster-name>.<cluster-namespace>.svc.cluster.local**.

domain>/oauth2callback/<idp-provider-name>.

- 5 Reference to an OpenShift Container Platform **Secret** object containing the client secret issued by GitHub.
- 6 For GitHub Enterprise, you must provide the hostname of your instance, such as **example.com**. This value must match the GitHub Enterprise **hostname** value in in the **/setup/settings** file and cannot include a port number. If this value is not set, then either **teams** or **organizations** must be defined. For GitHub, omit this parameter.
- 7 The list of organizations. Either the **organizations** or **teams** field must be set unless the **hostname** field is set, or if **mappingMethod** is set to **lookup**. Cannot be used in combination with the **teams** field.
- 8 The list of teams. Either the **teams** or **organizations** field must be set unless the **hostname** field is set, or if **mappingMethod** is set to **lookup**. Cannot be used in combination with the **organizations** field.



NOTE

If **organizations** or **teams** is specified, only GitHub users that are members of at least one of the listed organizations will be allowed to log in. If the GitHub OAuth application configured in **clientID** is not owned by the organization, an organization owner must grant third-party access to use this option. This can be done during the first GitHub login by the organization's administrator, or from the GitHub organization settings.

Additional resources

- See [Identity provider parameters](#) for information on parameters, such as **mappingMethod**, that are common to all identity providers.

7.6.7. Adding an identity provider to your cluster

After you install your cluster, add an identity provider to it so your users can authenticate.

Prerequisites

- Create an OpenShift Container Platform cluster.
- Create the custom resource (CR) for your identity providers.
- You must be logged in as an administrator.

Procedure

1. Apply the defined CR:

```
$ oc apply -f </path/to/CR>
```

**NOTE**

If a CR does not exist, **oc apply** creates a new CR and might trigger the following warning: **Warning: oc apply should be used on resources created by either oc create --save-config or oc apply.** In this case you can safely ignore this warning.

2. Obtain a token from the OAuth server.

As long as the **kubeadmin** user has been removed, the **oc login** command provides instructions on how to access a web page where you can retrieve the token.

You can also access this page from the web console by navigating to (?) **Help** → **Command Line Tools** → **Copy Login Command**.

3. Log in to the cluster, passing in the token to authenticate.

```
$ oc login --token=<token>
```

**NOTE**

This identity provider does not support logging in with a user name and password.

4. Confirm that the user logged in successfully, and display the user name.

```
$ oc whoami
```

7.7. CONFIGURING A GITLAB IDENTITY PROVIDER

Configure the **gitlab** identity provider using [GitLab.com](https://gitlab.com) or any other GitLab instance as an identity provider.

7.7.1. About identity providers in OpenShift Container Platform

By default, only a **kubeadmin** user exists on your cluster. To specify an identity provider, you must create a custom resource (CR) that describes that identity provider and add it to the cluster.

**NOTE**

OpenShift Container Platform user names containing **/**, **:**, and **%** are not supported.

7.7.2. About GitLab authentication

Configuring GitLab authentication allows users to log in to OpenShift Container Platform with their GitLab credentials.

If you use GitLab version 7.7.0 to 11.0, you connect using the [OAuth integration](#). If you use GitLab version 11.1 or later, you can use [OpenID Connect](#) (OIDC) to connect instead of OAuth.

7.7.3. Creating the secret

Identity providers use OpenShift Container Platform **Secret** objects in the **openshift-config** namespace to contain the client secret, client certificates, and keys.

Procedure

- Create a **Secret** object containing a string by using the following command:

```
$ oc create secret generic <secret_name> --from-literal=clientSecret=<secret> -n openshift-config
```

TIP

You can alternatively apply the following YAML to create the secret:

```
apiVersion: v1
kind: Secret
metadata:
  name: <secret_name>
  namespace: openshift-config
type: Opaque
data:
  clientSecret: <base64_encoded_client_secret>
```

- You can define a **Secret** object containing the contents of a file, such as a certificate file, by using the following command:

```
$ oc create secret generic <secret_name> --from-file=<path_to_file> -n openshift-config
```

7.7.4. Creating a config map

Identity providers use OpenShift Container Platform **ConfigMap** objects in the **openshift-config** namespace to contain the certificate authority bundle. These are primarily used to contain certificate bundles needed by the identity provider.



NOTE

This procedure is only required for GitHub Enterprise.

Procedure

- Define an OpenShift Container Platform **ConfigMap** object containing the certificate authority by using the following command. The certificate authority must be stored in the **ca.crt** key of the **ConfigMap** object.

```
$ oc create configmap ca-config-map --from-file=ca.crt=/path/to/ca -n openshift-config
```

TIP

You can alternatively apply the following YAML to create the config map:

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: ca-config-map
  namespace: openshift-config
data:
  ca.crt: |
    <CA_certificate_PEM>
```

7.7.5. Sample GitLab CR

The following custom resource (CR) shows the parameters and acceptable values for a GitLab identity provider.

GitLab CR

```
apiVersion: config.openshift.io/v1
kind: OAuth
metadata:
  name: cluster
spec:
  identityProviders:
  - name: gitlabidp 1
    mappingMethod: claim 2
    type: GitLab
    gitlab:
      clientID: {...} 3
      clientSecret: 4
        name: gitlab-secret
      url: https://gitlab.com 5
      ca: 6
        name: ca-config-map
```

- 1** This provider name is prefixed to the GitLab numeric user ID to form an identity name. It is also used to build the callback URL.
- 2** Controls how mappings are established between this provider's identities and **User** objects.
- 3** The client ID of a [registered GitLab OAuth application](#). The application must be configured with a callback URL of **https://oauth-openshift.apps.<cluster-name>.<cluster-domain>/oauth2callback/<idp-provider-name>**.
- 4** Reference to an OpenShift Container Platform **Secret** object containing the client secret issued by GitLab.
- 5** The host URL of a GitLab provider. This could either be **https://gitlab.com/** or any other self hosted instance of GitLab.
- 6** Optional: Reference to an OpenShift Container Platform **ConfigMap** object containing the PEM-encoded certificate authority bundle to use in validating server certificates for the configured URL.

Additional resources

- See [Identity provider parameters](#) for information on parameters, such as `mappingMethod`, that are common to all identity providers.

7.7.6. Adding an identity provider to your cluster

After you install your cluster, add an identity provider to it so your users can authenticate.

Prerequisites

- Create an OpenShift Container Platform cluster.
- Create the custom resource (CR) for your identity providers.
- You must be logged in as an administrator.

Procedure

1. Apply the defined CR:

```
$ oc apply -f </path/to/CR>
```



NOTE

If a CR does not exist, **oc apply** creates a new CR and might trigger the following warning: **Warning: oc apply should be used on resources created by either oc create --save-config or oc apply.** In this case you can safely ignore this warning.

2. Log in to the cluster as a user from your identity provider, entering the password when prompted.

```
$ oc login -u <username>
```

3. Confirm that the user logged in successfully, and display the user name.

```
$ oc whoami
```

7.8. CONFIGURING A GOOGLE IDENTITY PROVIDER

Configure the **google** identity provider using the [Google OpenID Connect integration](#).

7.8.1. About identity providers in OpenShift Container Platform

By default, only a **kubeadmin** user exists on your cluster. To specify an identity provider, you must create a custom resource (CR) that describes that identity provider and add it to the cluster.



NOTE

OpenShift Container Platform user names containing `/`, `:`, and `%` are not supported.

7.8.2. About Google authentication

Using Google as an identity provider allows any Google user to authenticate to your server. You can limit authentication to members of a specific hosted domain with the **hostedDomain** configuration attribute.



NOTE

Using Google as an identity provider requires users to get a token using `<namespace_route>/oauth/token/request` to use with command-line tools.

7.8.3. Creating the secret

Identity providers use OpenShift Container Platform **Secret** objects in the **openshift-config** namespace to contain the client secret, client certificates, and keys.

Procedure

- Create a **Secret** object containing a string by using the following command:

```
$ oc create secret generic <secret_name> --from-literal=clientSecret=<secret> -n openshift-config
```

TIP

You can alternatively apply the following YAML to create the secret:

```
apiVersion: v1
kind: Secret
metadata:
  name: <secret_name>
  namespace: openshift-config
type: Opaque
data:
  clientSecret: <base64_encoded_client_secret>
```

- You can define a **Secret** object containing the contents of a file, such as a certificate file, by using the following command:

```
$ oc create secret generic <secret_name> --from-file=<path_to_file> -n openshift-config
```

7.8.4. Sample Google CR

The following custom resource (CR) shows the parameters and acceptable values for a Google identity provider.

Google CR

```
apiVersion: config.openshift.io/v1
kind: OAuth
metadata:
  name: cluster
spec:
```

```
identityProviders:
- name: googleidp 1
  mappingMethod: claim 2
  type: Google
  google:
    clientID: {...} 3
    clientSecret: 4
    name: google-secret
    hostedDomain: "example.com" 5
```

- 1 This provider name is prefixed to the Google numeric user ID to form an identity name. It is also used to build the redirect URL.
- 2 Controls how mappings are established between this provider's identities and **User** objects.
- 3 The client ID of a [registered Google project](#). The project must be configured with a redirect URI of **`https://oauth-openshift.apps.<cluster-name>.<cluster-domain>/oauth2callback/<idp-provider-name>`**.
- 4 Reference to an OpenShift Container Platform **Secret** object containing the client secret issued by Google.
- 5 A [hosted domain](#) used to restrict sign-in accounts. Optional if the **lookup mappingMethod** is used. If empty, any Google account is allowed to authenticate.

Additional resources

- See [Identity provider parameters](#) for information on parameters, such as **mappingMethod**, that are common to all identity providers.

7.8.5. Adding an identity provider to your cluster

After you install your cluster, add an identity provider to it so your users can authenticate.

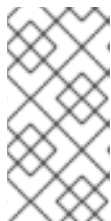
Prerequisites

- Create an OpenShift Container Platform cluster.
- Create the custom resource (CR) for your identity providers.
- You must be logged in as an administrator.

Procedure

1. Apply the defined CR:

```
$ oc apply -f </path/to/CR>
```

**NOTE**

If a CR does not exist, **oc apply** creates a new CR and might trigger the following warning: **Warning: oc apply should be used on resources created by either oc create --save-config or oc apply.** In this case you can safely ignore this warning.

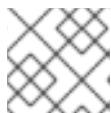
2. Obtain a token from the OAuth server.

As long as the **kubeadmin** user has been removed, the **oc login** command provides instructions on how to access a web page where you can retrieve the token.

You can also access this page from the web console by navigating to (?) **Help** → **Command Line Tools** → **Copy Login Command**.

3. Log in to the cluster, passing in the token to authenticate.

```
$ oc login --token=<token>
```

**NOTE**

This identity provider does not support logging in with a user name and password.

4. Confirm that the user logged in successfully, and display the user name.

```
$ oc whoami
```

7.9. CONFIGURING AN OPENID CONNECT IDENTITY PROVIDER

Configure the **oidc** identity provider to integrate with an OpenID Connect identity provider using an [Authorization Code Flow](#).

7.9.1. About identity providers in OpenShift Container Platform

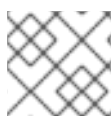
By default, only a **kubeadmin** user exists on your cluster. To specify an identity provider, you must create a custom resource (CR) that describes that identity provider and add it to the cluster.

**NOTE**

OpenShift Container Platform user names containing **/**, **:**, and **%** are not supported.

7.9.2. About OpenID Connect authentication

The Authentication Operator in OpenShift Container Platform requires that the configured OpenID Connect identity provider implements the [OpenID Connect Discovery](#) specification.

**NOTE**

ID Token and **UserInfo** decryptions are not supported.

By default, the **openid** scope is requested. If required, extra scopes can be specified in the **extraScopes** field.

Claims are read from the JWT **id_token** returned from the OpenID identity provider and, if specified, from the JSON returned by the **UserInfo** URL.

At least one claim must be configured to use as the user's identity. The standard identity claim is **sub**.

You can also indicate which claims to use as the user's preferred user name, display name, and email address. If multiple claims are specified, the first one with a non-empty value is used. The following table lists the standard claims:

Claim	Description
sub	Short for "subject identifier." The remote identity for the user at the issuer.
preferred_username	The preferred user name when provisioning a user. A shorthand name that the user wants to be referred to as, such as janedoe . Typically a value that corresponding to the user's login or username in the authentication system, such as username or email.
email	Email address.
name	Display name.

See the [OpenID claims documentation](#) for more information.



NOTE

Unless your OpenID Connect identity provider supports the resource owner password credentials (ROPC) grant flow, users must get a token from **<namespace_route>/oauth/token/request** to use with command-line tools.

7.9.3. Supported OIDC providers

Red Hat tests and supports specific OpenID Connect (OIDC) providers with OpenShift Container Platform. The following OpenID Connect (OIDC) providers are tested and supported with OpenShift Container Platform. Using an OIDC provider that is not on the following list might work with OpenShift Container Platform, but the provider was not tested by Red Hat and therefore is not supported by Red Hat.

- Active Directory Federation Services for Windows Server



NOTE

Currently, it is not supported to use Active Directory Federation Services for Windows Server with OpenShift Container Platform when custom claims are used.

- GitLab
- Google
- Keycloak

- Microsoft identity platform (Azure Active Directory v2.0)

**NOTE**

Currently, it is not supported to use Microsoft identity platform when group names are required to be synced.

- Okta
- Ping Identity
- Red Hat Single Sign-On

7.9.4. Creating the secret

Identity providers use OpenShift Container Platform **Secret** objects in the **openshift-config** namespace to contain the client secret, client certificates, and keys.

Procedure

- Create a **Secret** object containing a string by using the following command:

```
$ oc create secret generic <secret_name> --from-literal=clientSecret=<secret> -n openshift-config
```

TIP

You can alternatively apply the following YAML to create the secret:

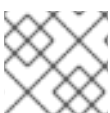
```
apiVersion: v1
kind: Secret
metadata:
  name: <secret_name>
  namespace: openshift-config
type: Opaque
data:
  clientSecret: <base64_encoded_client_secret>
```

- You can define a **Secret** object containing the contents of a file, such as a certificate file, by using the following command:

```
$ oc create secret generic <secret_name> --from-file=<path_to_file> -n openshift-config
```

7.9.5. Creating a config map

Identity providers use OpenShift Container Platform **ConfigMap** objects in the **openshift-config** namespace to contain the certificate authority bundle. These are primarily used to contain certificate bundles needed by the identity provider.

**NOTE**

This procedure is only required for GitHub Enterprise.

Procedure

- Define an OpenShift Container Platform **ConfigMap** object containing the certificate authority by using the following command. The certificate authority must be stored in the **ca.crt** key of the **ConfigMap** object.

```
$ oc create configmap ca-config-map --from-file=ca.crt=/path/to/ca -n openshift-config
```

TIP

You can alternatively apply the following YAML to create the config map:

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: ca-config-map
  namespace: openshift-config
data:
  ca.crt: |
    <CA_certificate_PEM>
```

7.9.6. Sample OpenID Connect CRs

The following custom resources (CRs) show the parameters and acceptable values for an OpenID Connect identity provider.

If you must specify a custom certificate bundle, extra scopes, extra authorization request parameters, or a **userInfo** URL, use the full OpenID Connect CR.

Standard OpenID Connect CR

```
apiVersion: config.openshift.io/v1
kind: OAuth
metadata:
  name: cluster
spec:
  identityProviders:
  - name: oidcidp 1
    mappingMethod: claim 2
    type: OpenID
    openID:
      clientID: ... 3
      clientSecret: 4
        name: idp-secret
      claims: 5
        preferredUsername:
          - preferred_username
        name:
          - name
      email:
          - email
```

```

groups:
- groups
issuer: https://www.idp-issuer.com 6

```

- 1 This provider name is prefixed to the value of the identity claim to form an identity name. It is also used to build the redirect URL.
- 2 Controls how mappings are established between this provider's identities and **User** objects.
- 3 The client ID of a client registered with the OpenID provider. The client must be allowed to redirect to **https://oauth-openshift.apps.<cluster_name>.<cluster_domain>/oauth2callback/<idp_provider_name>**.
- 4 A reference to an OpenShift Container Platform **Secret** object containing the client secret.
- 5 The list of claims to use as the identity. The first non-empty claim is used.
- 6 The **Issuer Identifier** described in the OpenID spec. Must use **https** without query or fragment component.

Full OpenID Connect CR

```

apiVersion: config.openshift.io/v1
kind: OAuth
metadata:
  name: cluster
spec:
  identityProviders:
  - name: oidcidp
    mappingMethod: claim
    type: OpenID
    openID:
      clientID: ...
      clientSecret:
        name: idp-secret
      ca: 1
        name: ca-config-map
      extraScopes: 2
        - email
        - profile
      extraAuthorizeParameters: 3
        include_granted_scopes: "true"
      claims:
        preferredUsername: 4
          - preferred_username
          - email
        name: 5
          - nickname
          - given_name
          - name
        email: 6
          - custom_email_claim
          - email

```



```
groups: 7
- groups
issuer: https://www.idp-issuer.com
```

- 1 Optional: Reference to an OpenShift Container Platform config map containing the PEM-encoded certificate authority bundle to use in validating server certificates for the configured URL.
- 2 Optional: The list of scopes to request, in addition to the **openid** scope, during the authorization token request.
- 3 Optional: A map of extra parameters to add to the authorization token request.
- 4 The list of claims to use as the preferred user name when provisioning a user for this identity. The first non-empty claim is used.
- 5 The list of claims to use as the display name. The first non-empty claim is used.
- 6 The list of claims to use as the email address. The first non-empty claim is used.
- 7 The list of claims to use to synchronize groups from the OpenID Connect provider to OpenShift Container Platform upon user login. The first non-empty claim is used.

Additional resources

- See [Identity provider parameters](#) for information on parameters, such as **mappingMethod**, that are common to all identity providers.

7.9.7. Adding an identity provider to your cluster

After you install your cluster, add an identity provider to it so your users can authenticate.

Prerequisites

- Create an OpenShift Container Platform cluster.
- Create the custom resource (CR) for your identity providers.
- You must be logged in as an administrator.

Procedure

1. Apply the defined CR:

```
$ oc apply -f </path/to/CR>
```



NOTE

If a CR does not exist, **oc apply** creates a new CR and might trigger the following warning: **Warning: oc apply should be used on resources created by either oc create --save-config or oc apply.** In this case you can safely ignore this warning.

2. Obtain a token from the OAuth server.

As long as the **kubeadmin** user has been removed, the **oc login** command provides instructions on how to access a web page where you can retrieve the token.

You can also access this page from the web console by navigating to (?) **Help** → **Command Line Tools** → **Copy Login Command**.

3. Log in to the cluster, passing in the token to authenticate.

```
$ oc login --token=<token>
```



NOTE

If your OpenID Connect identity provider supports the resource owner password credentials (ROPC) grant flow, you can log in with a user name and password. You might need to take steps to enable the ROPC grant flow for your identity provider.

After the OIDC identity provider is configured in OpenShift Container Platform, you can log in by using the following command, which prompts for your user name and password:

```
$ oc login -u <identity_provider_username> --server=
<api_server_url_and_port>
```

4. Confirm that the user logged in successfully, and display the user name.

```
$ oc whoami
```

7.9.8. Configuring identity providers using the web console

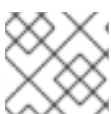
Configure your identity provider (IDP) through the web console instead of the CLI.

Prerequisites

- You must be logged in to the web console as a cluster administrator.

Procedure

1. Navigate to **Administration** → **Cluster Settings**.
2. Under the **Configuration** tab, click **OAuth**.
3. Under the **Identity Providers** section, select your identity provider from the **Add** drop-down menu.



NOTE

You can specify multiple IDPs through the web console without overwriting existing IDPs.

CHAPTER 8. USING RBAC TO DEFINE AND APPLY PERMISSIONS

8.1. RBAC OVERVIEW

Role-based access control (RBAC) objects determine whether a user is allowed to perform a given action within a project.

Cluster administrators can use the cluster roles and bindings to control who has various access levels to the OpenShift Container Platform platform itself and all projects.

Developers can use local roles and bindings to control who has access to their projects. Note that authorization is a separate step from authentication, which is more about determining the identity of who is taking the action.

Authorization is managed using:

Authorization object	Description
Rules	Sets of permitted verbs on a set of objects. For example, whether a user or service account can create pods.
Roles	Collections of rules. You can associate, or bind, users and groups to multiple roles.
Bindings	Associations between users and/or groups with a role.

There are two levels of RBAC roles and bindings that control authorization:

RBAC level	Description
Cluster RBAC	Roles and bindings that are applicable across all projects. <i>Cluster roles</i> exist cluster-wide, and <i>cluster role bindings</i> can reference only cluster roles.
Local RBAC	Roles and bindings that are scoped to a given project. While <i>local roles</i> exist only in a single project, local role bindings can reference <i>both</i> cluster and local roles.

A cluster role binding is a binding that exists at the cluster level. A role binding exists at the project level. The cluster role *view* must be bound to a user using a local role binding for that user to view the project. Create local roles only if a cluster role does not provide the set of permissions needed for a particular situation.

This two-level hierarchy allows reuse across multiple projects through the cluster roles while allowing customization inside of individual projects through local roles.

During evaluation, both the cluster role bindings and the local role bindings are used. For example:

1. Cluster-wide "allow" rules are checked.
2. Locally-bound "allow" rules are checked.

- Deny by default.

8.1.1. Default cluster roles

OpenShift Container Platform includes a set of default cluster roles that you can bind to users and groups cluster-wide or locally.



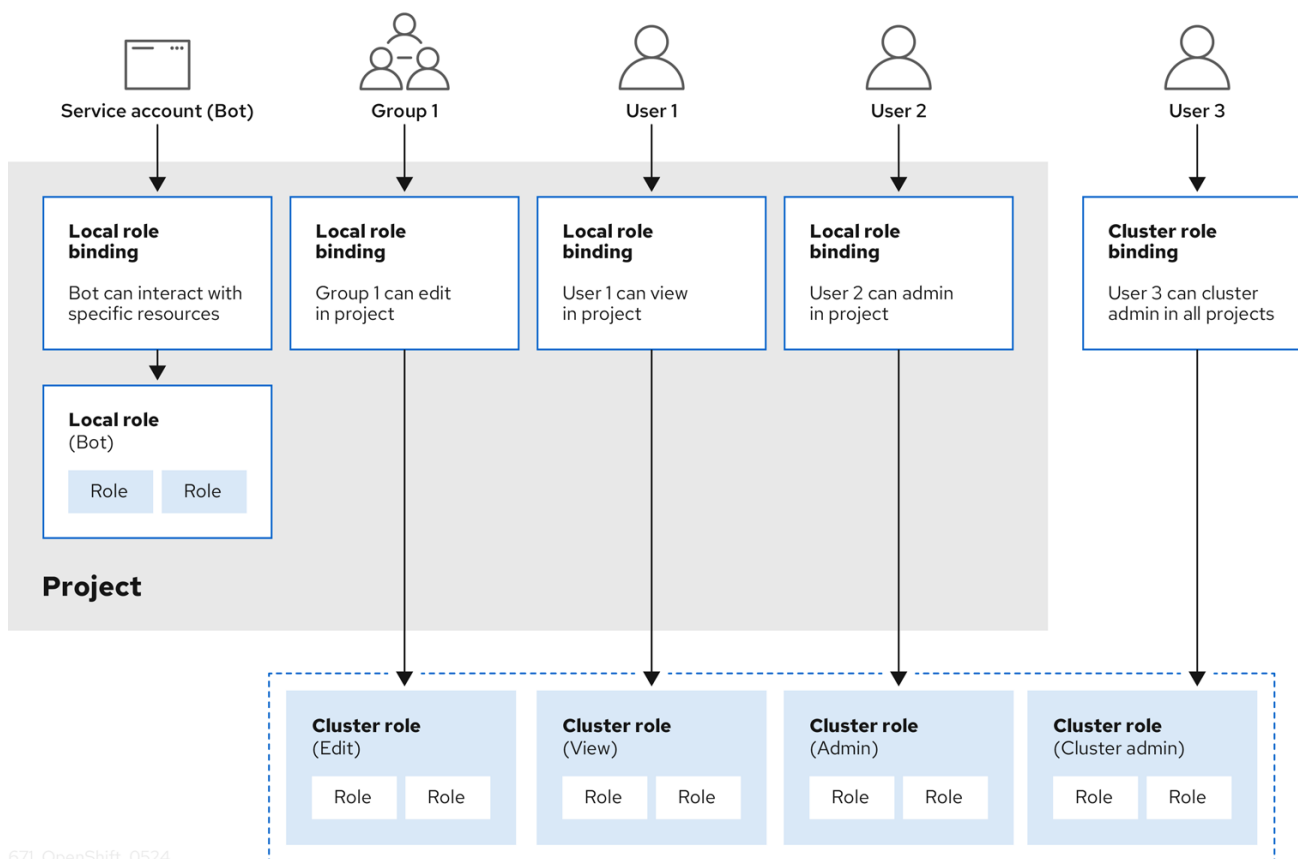
IMPORTANT

It is not recommended to manually modify the default cluster roles. Modifications to these system roles can prevent a cluster from functioning properly.

Default cluster role	Description
admin	A project manager. If used in a local binding, an admin has rights to view any resource in the project and modify any resource in the project except for quota.
basic-user	A user that can get basic information about projects and users.
cluster-admin	A super-user that can perform any action in any project. When bound to a user with a local binding, they have full control over quota and every action on every resource in the project.
cluster-status	A user that can get basic cluster status information.
cluster-reader	A user that can get or view most of the objects but cannot modify them.
edit	A user that can modify most objects in a project but does not have the power to view or modify roles or bindings.
self-provisioner	A user that can create their own projects.
view	A user who cannot make any modifications, but can see most objects in a project. They cannot view or modify roles or bindings.

Be mindful of the difference between local and cluster bindings. For example, if you bind the **cluster-admin** role to a user by using a local role binding, it might appear that this user has the privileges of a cluster administrator. This is not the case. Binding the **cluster-admin** to a user in a project grants super administrator privileges for only that project to the user. That user has the permissions of the cluster role **admin**, plus a few additional permissions like the ability to edit rate limits, for that project. This binding can be confusing via the web console UI, which does not list cluster role bindings that are bound to true cluster administrators. However, it does list local role bindings that you can use to locally bind **cluster-admin**.

The relationships between cluster roles, local roles, cluster role bindings, local role bindings, users, groups and service accounts are illustrated below.



WARNING

The **get pods/exec**, **get pods/***, and **get *** rules grant execution privileges when they are applied to a role. Apply the principle of least privilege and assign only the minimal RBAC rights required for users and agents. For more information, see [RBAC rules allow execution privileges](#).

8.1.2. Evaluating authorization

OpenShift Container Platform evaluates authorization by using:

Identity

The user name and list of groups that the user belongs to.

Action

The action you perform. In most cases, this consists of:

- **Project:** The project you access. A project is a Kubernetes namespace with additional annotations that allows a community of users to organize and manage their content in isolation from other communities.
- **Verb :** The action itself: **get**, **list**, **create**, **update**, **delete**, **deletecollection**, or **watch**.
- **Resource name:** The API endpoint that you access.

Bindings

The full list of bindings, the associations between users or groups with a role.

OpenShift Container Platform evaluates authorization by using the following steps:

1. The identity and the project-scoped action is used to find all bindings that apply to the user or their groups.
2. Bindings are used to locate all the roles that apply.
3. Roles are used to find all the rules that apply.
4. The action is checked against each rule to find a match.
5. If no matching rule is found, the action is then denied by default.

TIP

Remember that users and groups can be associated with, or bound to, multiple roles at the same time.

Project administrators can use the CLI to view local roles and bindings, including a matrix of the verbs and resources each are associated with.



IMPORTANT

The cluster role bound to the project administrator is limited in a project through a local binding. It is not bound cluster-wide like the cluster roles granted to the **cluster-admin** or **system:admin**.

Cluster roles are roles defined at the cluster level but can be bound either at the cluster level or at the project level.

8.1.2.1. Cluster role aggregation

The default admin, edit, view, and cluster-reader cluster roles support [cluster role aggregation](#), where the cluster rules for each role are dynamically updated as new rules are created. This feature is relevant only if you extend the Kubernetes API by creating custom resources.

8.2. PROJECTS AND NAMESPACES

A Kubernetes *namespace* provides a mechanism to scope resources in a cluster. The [Kubernetes documentation](#) has more information on namespaces.

Namespaces provide a unique scope for:

- Named resources to avoid basic naming collisions.
- Delegated management authority to trusted users.
- The ability to limit community resource consumption.

Most objects in the system are scoped by namespace, but some are excepted and have no namespace, including nodes and users.

A *project* is a Kubernetes namespace with additional annotations and is the central vehicle by which

access to resources for regular users is managed. A project allows a community of users to organize and manage their content in isolation from other communities. Users must be given access to projects by administrators, or if allowed to create projects, automatically have access to their own projects.

Projects can have a separate **name**, **displayName**, and **description**.

- The mandatory **name** is a unique identifier for the project and is most visible when using the CLI tools or API. The maximum name length is 63 characters.
- The optional **displayName** is how the project is displayed in the web console (defaults to **name**).
- The optional **description** can be a more detailed description of the project and is also visible in the web console.

Each project scopes its own set of:

Object	Description
Objects	Pods, services, replication controllers, etc.
Policies	Rules for which users can or cannot perform actions on objects.
Constraints	Quotas for each kind of object that can be limited.
Service accounts	Service accounts act automatically with designated access to objects in the project.

Cluster administrators can create projects and delegate administrative rights for the project to any member of the user community. Cluster administrators can also allow developers to create their own projects.

Developers and administrators can interact with projects by using the CLI or the web console.

8.3. DEFAULT PROJECTS

OpenShift Container Platform comes with a number of default projects, and projects starting with **openshift-** are the most essential to users. These projects host master components that run as pods and other infrastructure components. The pods created in these namespaces that have a [critical pod annotation](#) are considered critical, and they have guaranteed admission by kubelet. Pods created for master components in these namespaces are already marked as critical.



NOTE

You cannot assign an SCC to pods created in one of the default namespaces: **default**, **kube-system**, **kube-public**, **openshift-node**, **openshift-infra**, and **openshift**. You cannot use these namespaces for running pods or services.

8.4. VIEWING CLUSTER ROLES AND BINDINGS

You can use the **oc** CLI to view cluster roles and bindings by using the **oc describe** command.

Prerequisites

- Install the **oc** CLI.
- Obtain permission to view the cluster roles and bindings.

Users with the **cluster-admin** default cluster role bound cluster-wide can perform any action on any resource, including viewing cluster roles and bindings.

Procedure

1. To view the cluster roles and their associated rule sets:

```
$ oc describe clusterrole.rbac
```

Example output

```
Name:      admin
Labels:    kubernetes.io/bootstrapping=rbac-defaults
Annotations: rbac.authorization.kubernetes.io/autoupdate: true
PolicyRule:
  Resources                                Non-Resource URLs  Resource Names  Verbs
-----
.packages.apps.redhat.com                 []               []              [* create update
patch delete get list watch]
  imagestreams                             []               []              [create delete
deletecollection get list patch update watch create get list watch]
  imagestreams.image.openshift.io          []               []              [create delete
deletecollection get list patch update watch create get list watch]
  secrets                                   []               []              [create delete deletecollection
get list patch update watch get list watch create delete deletecollection patch update]
  buildconfigs/webhooks                    []               []              [create delete
deletecollection get list patch update watch get list watch]
  buildconfigs                             []               []              [create delete
deletecollection get list patch update watch get list watch]
  buildlogs                                 []               []              [create delete deletecollection
get list patch update watch get list watch]
  deploymentconfigs/scale                  []               []              [create delete
deletecollection get list patch update watch get list watch]
  deploymentconfigs                        []               []              [create delete
deletecollection get list patch update watch get list watch]
  imagestreamimages                        []               []              [create delete
deletecollection get list patch update watch get list watch]
  imagestreammappings                      []               []              [create delete
deletecollection get list patch update watch get list watch]
  imagestreamtags                          []               []              [create delete
deletecollection get list patch update watch get list watch]
  processedtemplates                      []               []              [create delete
deletecollection get list patch update watch get list watch]
  routes                                    []               []              [create delete deletecollection
get list patch update watch get list watch]
  templateconfigs                         []               []              [create delete
deletecollection get list patch update watch get list watch]
  templateinstances                       []               []              [create delete
deletecollection get list patch update watch get list watch]
```



```

templates [] [] [create delete]
deletecollection get list patch update watch get list watch]
deploymentconfigs.apps.openshift.io/scale [] [] [create delete]
deletecollection get list patch update watch get list watch]
deploymentconfigs.apps.openshift.io [] [] [create delete]
deletecollection get list patch update watch get list watch]
buildconfigs.build.openshift.io/webhooks [] [] [create delete]
deletecollection get list patch update watch get list watch]
buildconfigs.build.openshift.io [] [] [create delete]
deletecollection get list patch update watch get list watch]
buildlogs.build.openshift.io [] [] [create delete]
deletecollection get list patch update watch get list watch]
imagestreamimages.image.openshift.io [] [] [create delete]
deletecollection get list patch update watch get list watch]
imagestreammappings.image.openshift.io [] [] [create delete]
deletecollection get list patch update watch get list watch]
imagestreamtags.image.openshift.io [] [] [create delete]
deletecollection get list patch update watch get list watch]
routes.route.openshift.io [] [] [create delete]
deletecollection get list patch update watch get list watch]
processedtemplates.template.openshift.io [] [] [create delete]
deletecollection get list patch update watch get list watch]
templateconfigs.template.openshift.io [] [] [create delete]
deletecollection get list patch update watch get list watch]
templateinstances.template.openshift.io [] [] [create delete]
deletecollection get list patch update watch get list watch]
templates.template.openshift.io [] [] [create delete]
deletecollection get list patch update watch get list watch]
serviceaccounts [] [] [create delete]
deletecollection get list patch update watch impersonate create delete deletecollection patch
update get list watch]
imagestreams/secrets [] [] [create delete]
deletecollection get list patch update watch]
rolebindings [] [] [create delete]
deletecollection get list patch update watch]
roles [] [] [create delete deletecollection
get list patch update watch]
rolebindings.authorization.openshift.io [] [] [create delete]
deletecollection get list patch update watch]
roles.authorization.openshift.io [] [] [create delete]
deletecollection get list patch update watch]
imagestreams.image.openshift.io/secrets [] [] [create delete]
deletecollection get list patch update watch]
rolebindings.rbac.authorization.k8s.io [] [] [create delete]
deletecollection get list patch update watch]
roles.rbac.authorization.k8s.io [] [] [create delete]
deletecollection get list patch update watch]
networkpolicies.extensions [] [] [create delete]
deletecollection patch update create delete deletecollection get list patch update watch get
list watch]
networkpolicies.networking.k8s.io [] [] [create delete]
deletecollection patch update create delete deletecollection get list patch update watch get
list watch]
configmaps [] [] [create delete]
deletecollection patch update get list watch]
endpoints [] [] [create delete]

```

deletecollection patch update get list watch]			
persistentvolumeclaims	[]	[]	[create delete
deletecollection patch update get list watch]			
pods	[]	[]	[create delete deletecollection
patch update get list watch]			
replicationcontrollers/scale	[]	[]	[create delete
deletecollection patch update get list watch]			
replicationcontrollers	[]	[]	[create delete
deletecollection patch update get list watch]			
services	[]	[]	[create delete deletecollection
patch update get list watch]			
daemonsets.apps	[]	[]	[create delete
deletecollection patch update get list watch]			
deployments.apps/scale	[]	[]	[create delete
deletecollection patch update get list watch]			
deployments.apps	[]	[]	[create delete
deletecollection patch update get list watch]			
replicasets.apps/scale	[]	[]	[create delete
deletecollection patch update get list watch]			
replicasets.apps	[]	[]	[create delete
deletecollection patch update get list watch]			
statefulsets.apps/scale	[]	[]	[create delete
deletecollection patch update get list watch]			
statefulsets.apps	[]	[]	[create delete
deletecollection patch update get list watch]			
horizontalpodautoscalers.autoscaling	[]	[]	[create delete
deletecollection patch update get list watch]			
cronjobs.batch	[]	[]	[create delete
deletecollection patch update get list watch]			
jobs.batch	[]	[]	[create delete
deletecollection patch update get list watch]			
daemonsets.extensions	[]	[]	[create delete
deletecollection patch update get list watch]			
deployments.extensions/scale	[]	[]	[create delete
deletecollection patch update get list watch]			
deployments.extensions	[]	[]	[create delete
deletecollection patch update get list watch]			
ingresses.extensions	[]	[]	[create delete
deletecollection patch update get list watch]			
replicasets.extensions/scale	[]	[]	[create delete
deletecollection patch update get list watch]			
replicasets.extensions	[]	[]	[create delete
deletecollection patch update get list watch]			
replicationcontrollers.extensions/scale	[]	[]	[create delete
deletecollection patch update get list watch]			
poddisruptionbudgets.policy	[]	[]	[create delete
deletecollection patch update get list watch]			
deployments.apps/rollback	[]	[]	[create delete
deletecollection patch update]			
deployments.extensions/rollback	[]	[]	[create delete
deletecollection patch update]			
catalogsources.operators.coreos.com	[]	[]	[create update
patch delete get list watch]			
clusterserviceversions.operators.coreos.com	[]	[]	[create update
patch delete get list watch]			
installplans.operators.coreos.com	[]	[]	[create update

```

patch delete get list watch]
  packagemanifests.operators.coreos.com          []          []          [create update
patch delete get list watch]
  subscriptions.operators.coreos.com            []          []          [create update
patch delete get list watch]
  buildconfigs/instantiate                      []          []          [create]
  buildconfigs/instantiatebinary                []          []          [create]
  builds/clone                                  []          []          [create]
  deploymentconfigrollbacks                    []          []          [create]
  deploymentconfigs/instantiate                 []          []          [create]
  deploymentconfigs/rollback                   []          []          [create]
  imagestreamimports                           []          []          [create]
  localresourceaccessreviews                   []          []          [create]
  localsubjectaccessreviews                    []          []          [create]
  podsecuritypolicyreviews                     []          []          [create]
  podsecuritypolicyselfsubjectreviews          []          []          [create]
  podsecuritypolicysubjectreviews              []          []          [create]
  resourceaccessreviews                        []          []          [create]
  routes/custom-host                           []          []          [create]
  subjectaccessreviews                         []          []          [create]
  subjectrulesreviews                          []          []          [create]
  deploymentconfigrollbacks.apps.openshift.io []          []          [create]
  deploymentconfigs.apps.openshift.io/instantiate []        []          [create]
  deploymentconfigs.apps.openshift.io/rollback []        []          [create]
  localsubjectaccessreviews.authorization.k8s.io []        []          [create]
  localresourceaccessreviews.authorization.openshift.io []        []          [create]
  localsubjectaccessreviews.authorization.openshift.io []        []          [create]
  resourceaccessreviews.authorization.openshift.io []        []          [create]
  subjectaccessreviews.authorization.openshift.io []        []          [create]
  subjectrulesreviews.authorization.openshift.io []        []          [create]
  buildconfigs.build.openshift.io/instantiate  []          []          [create]
  buildconfigs.build.openshift.io/instantiatebinary []        []          [create]
  builds.build.openshift.io/clone              []          []          [create]
  imagestreamimports.image.openshift.io       []          []          [create]
  routes.route.openshift.io/custom-host        []          []          [create]
  podsecuritypolicyreviews.security.openshift.io []        []          [create]
  podsecuritypolicyselfsubjectreviews.security.openshift.io []        []          [create]
  podsecuritypolicysubjectreviews.security.openshift.io []        []          [create]
  jenkins.build.openshift.io                   []          []          [edit view view admin
edit view]
  builds                                        []          []          [get create delete
deletecollection get list patch update watch get list watch]
  builds.build.openshift.io                    []          []          [get create delete
deletecollection get list patch update watch get list watch]
  projects                                      []          []          [get delete get delete get patch
update]
  projects.project.openshift.io                []          []          [get delete get delete
get patch update]
  namespaces                                    []          []          [get get list watch]
  pods/attach                                  []          []          [get list watch create delete
deletecollection patch update]
  pods/exec                                    []          []          [get list watch create delete
deletecollection patch update]
  pods/portforward                              []          []          [get list watch create
delete deletecollection patch update]
  pods/proxy                                    []          []          [get list watch create delete

```

deletecollection patch update]				
services/proxy	[]	[]		[get list watch create delete]
deletecollection patch update]				
routes/status	[]	[]		[get list watch update]
routes.route.openshift.io/status		[]	[]	[get list watch update]
appliedclusterresourcequotas		[]	[]	[get list watch]
bindings	[]	[]		[get list watch]
builds/log	[]	[]		[get list watch]
deploymentconfigs/log		[]	[]	[get list watch]
deploymentconfigs/status		[]	[]	[get list watch]
events	[]	[]		[get list watch]
imagestreams/status		[]	[]	[get list watch]
limitranges	[]	[]		[get list watch]
namespaces/status		[]	[]	[get list watch]
Pods/log	[]	[]		[get list watch]
Pods/status	[]	[]		[get list watch]
replicationcontrollers/status		[]	[]	[get list watch]
resourcequotas/status		[]	[]	[get list watch]
resourcequotas	[]	[]		[get list watch]
resourcequotausages		[]	[]	[get list watch]
rolebindingrestrictions	[]	[]		[get list watch]
deploymentconfigs.apps.openshift.io/log			[]	[get list watch]
deploymentconfigs.apps.openshift.io/status			[]	[get list watch]
controllerrevisions.apps	[]		[]	[get list watch]
rolebindingrestrictions.authorization.openshift.io		[]	[]	[get list watch]
builds.build.openshift.io/log	[]		[]	[get list watch]
imagestreams.image.openshift.io/status			[]	[get list watch]
appliedclusterresourcequotas.quota.openshift.io			[]	[get list watch]
imagestreams/layers	[]		[]	[get update get]
imagestreams.image.openshift.io/layers			[]	[get update get]
builds/details	[]		[]	[update]
builds.build.openshift.io/details			[]	[update]

Name: basic-user

Labels: <none>

Annotations: openshift.io/description: A user that can get basic information about projects.
rbac.authorization.kubernetes.io/autoupdate: true

PolicyRule:

Resources	Non-Resource URLs	Resource Names	Verbs
-----	-----	-----	-----
selfsubjectrulesreviews	[]	[]	[create]
selfsubjectaccessreviews.authorization.k8s.io	[]	[]	[create]
selfsubjectrulesreviews.authorization.openshift.io	[]	[]	[create]
clusterroles.rbac.authorization.k8s.io	[]	[]	[get list watch]
clusterroles	[]	[]	[get list]
clusterroles.authorization.openshift.io	[]	[]	[get list]
storageclasses.storage.k8s.io	[]	[]	[get list]
users	[]	[~]	[get]
users.user.openshift.io	[]	[~]	[get]
projects	[]	[]	[list watch]
projects.project.openshift.io	[]	[]	[list watch]
projectrequests	[]	[]	[list]
projectrequests.project.openshift.io	[]	[]	[list]

Name: cluster-admin

```

Labels:    kubernetes.io/bootstrapping=rbac-defaults
Annotations: rbac.authorization.kubernetes.io/autoupdate: true
PolicyRule:
Resources Non-Resource URLs Resource Names Verbs
-----
*: *      []      []      [*]
      [*]      []      [*]
...

```

- To view the current set of cluster role bindings, which shows the users and groups that are bound to various roles:

```
$ oc describe clusterrolebinding.rbac
```

Example output

```

Name:      alertmanager-main
Labels:    <none>
Annotations: <none>
Role:
  Kind: ClusterRole
  Name: alertmanager-main
Subjects:
  Kind      Name      Namespace
  ----      -
  ServiceAccount alertmanager-main openshift-monitoring

Name:      basic-users
Labels:    <none>
Annotations: rbac.authorization.kubernetes.io/autoupdate: true
Role:
  Kind: ClusterRole
  Name: basic-user
Subjects:
  Kind Name      Namespace
  ---- ----      -
  Group system:authenticated

Name:      cloud-credential-operator-rolebinding
Labels:    <none>
Annotations: <none>
Role:
  Kind: ClusterRole
  Name: cloud-credential-operator-role
Subjects:
  Kind      Name      Namespace
  ----      -
  ServiceAccount default openshift-cloud-credential-operator

Name:      cluster-admin
Labels:    kubernetes.io/bootstrapping=rbac-defaults

```

```

Annotations: rbac.authorization.kubernetes.io/autoupdate: true
Role:
  Kind: ClusterRole
  Name: cluster-admin
Subjects:
  Kind  Name          Namespace
  ----  ---          -
  Group system:masters

Name:      cluster-admins
Labels:    <none>
Annotations: rbac.authorization.kubernetes.io/autoupdate: true
Role:
  Kind: ClusterRole
  Name: cluster-admin
Subjects:
  Kind  Name          Namespace
  ----  ---          -
  Group system:cluster-admins
  User  system:admin

Name:      cluster-api-manager-rolebinding
Labels:    <none>
Annotations: <none>
Role:
  Kind: ClusterRole
  Name: cluster-api-manager-role
Subjects:
  Kind      Name      Namespace
  ----      ---      -
  ServiceAccount default openshift-machine-api

...

```

8.5. VIEWING LOCAL ROLES AND BINDINGS

You can use the **oc** CLI to view local roles and bindings by using the **oc describe** command.

Prerequisites

- Install the **oc** CLI.
- Obtain permission to view the local roles and bindings:
 - Users with the **cluster-admin** default cluster role bound cluster-wide can perform any action on any resource, including viewing local roles and bindings.
 - Users with the **admin** default cluster role bound locally can view and manage roles and bindings in that project.

Procedure

1. To view the current set of local role bindings, which show the users and groups that are bound to various roles for the current project:

```
$ oc describe rolebinding.rbac
```

2. To view the local role bindings for a different project, add the `-n` flag to the command:

```
$ oc describe rolebinding.rbac -n joe-project
```

Example output

```
Name:      admin
Labels:    <none>
Annotations: <none>
```

Role:

```
Kind: ClusterRole
```

```
Name: admin
```

Subjects:

```
Kind Name      Namespace
---- ----      -
```

```
-----
```

```
User kube:admin
```

```
Name:      system:deployers
```

```
Labels:    <none>
```

```
Annotations: openshift.io/description:
```

```
Allows deploymentconfigs in this namespace to rollout pods in
this namespace. It is auto-managed by a controller; remove
subjects to disa...
```

Role:

```
Kind: ClusterRole
```

```
Name: system:deployer
```

Subjects:

```
Kind      Name      Namespace
----      -
```

```
-----
```

```
ServiceAccount deployer joe-project
```

```
Name:      system:image-builders
```

```
Labels:    <none>
```

```
Annotations: openshift.io/description:
```

```
Allows builds in this namespace to push images to this
namespace. It is auto-managed by a controller; remove subjects
to disable.
```

Role:

```
Kind: ClusterRole
```

```
Name: system:image-builder
```

Subjects:

```
Kind      Name      Namespace
----      -
```

```
-----
```

```
ServiceAccount builder joe-project
```

```
Name:      system:image-pullers
```

```
Labels:    <none>
```

Annotations: openshift.io/description:

Allows all pods in this namespace to pull images from this namespace. It is auto-managed by a controller; remove subjects to disable.

Role:

Kind: ClusterRole

Name: system:image-puller

Subjects:

Kind	Name	Namespace
----	----	-----
Group	system:serviceaccounts:	joe-project

8.6. ADDING ROLES TO USERS

You can use the **oc adm** administrator CLI to manage the roles and bindings.

Binding, or adding, a role to users or groups gives the user or group the access that is granted by the role. You can add and remove roles to and from users and groups using **oc adm policy** commands.

You can bind any of the default cluster roles to local users or groups in your project.

Procedure

1. Add a role to a user in a specific project:

```
$ oc adm policy add-role-to-user <role> <user> -n <project>
```

For example, you can add the **admin** role to the **alice** user in **joe** project by running:

```
$ oc adm policy add-role-to-user admin alice -n joe
```

TIP

You can alternatively apply the following YAML to add the role to the user:

```
apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
  name: admin-0
  namespace: joe
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: admin
subjects:
- apiGroup: rbac.authorization.k8s.io
  kind: User
  name: alice
```

2. View the local role bindings and verify the addition in the output:

```
$ oc describe rolebinding.rbac -n <project>
```


For example, to view the local role bindings for the **joe** project:

```
$ oc describe rolebinding.rbac -n joe
```

Example output

```
Name:      admin
Labels:    <none>
Annotations: <none>
```

Role:

```
Kind: ClusterRole
```

```
Name: admin
```

Subjects:

```
Kind Name      Namespace
---- ----      -
```

```
User kube:admin
```

```
Name:      admin-0
Labels:    <none>
Annotations: <none>
```

Role:

```
Kind: ClusterRole
```

```
Name: admin
```

Subjects:

```
Kind Name      Namespace
---- ----      -
```

```
User alice 1
```

```
Name:      system:deployers
Labels:    <none>
Annotations: openshift.io/description:
```

```
Allows deploymentconfigs in this namespace to rollout pods in
this namespace. It is auto-managed by a controller; remove
subjects to disa...
```

Role:

```
Kind: ClusterRole
```

```
Name: system:deployer
```

Subjects:

```
Kind      Name      Namespace
----      -
```

```
ServiceAccount deployer joe
```

```
Name:      system:image-builders
Labels:    <none>
Annotations: openshift.io/description:
```

```
Allows builds in this namespace to push images to this
namespace. It is auto-managed by a controller; remove subjects
to disable.
```

Role:

```
Kind: ClusterRole
```

```
Name: system:image-builder
```

Subjects:

```

Kind      Name      Namespace
----      -
ServiceAccount builder joe

Name:      system:image-pullers
Labels:    <none>
Annotations: openshift.io/description:
           Allows all pods in this namespace to pull images from this
           namespace. It is auto-managed by a controller; remove subjects
           to disable.

Role:
  Kind: ClusterRole
  Name: system:image-puller
Subjects:
  Kind Name      Namespace
  ---- ----      -
  Group system:serviceaccounts:joe

```

- 1 The **alice** user has been added to the **admins RoleBinding**.

8.7. CREATING A LOCAL ROLE

You can create a local role for a project and then bind it to a user.

Procedure

1. To create a local role for a project, run the following command:

```
$ oc create role <name> --verb=<verb> --resource=<resource> -n <project>
```

In this command, specify:

- **<name>**, the local role's name
- **<verb>**, a comma-separated list of the verbs to apply to the role
- **<resource>**, the resources that the role applies to
- **<project>**, the project name

For example, to create a local role that allows a user to view pods in the **blue** project, run the following command:

```
$ oc create role podview --verb=get --resource=pod -n blue
```

2. To bind the new role to a user, run the following command:

```
$ oc adm policy add-role-to-user podview user2 --role-namespace=blue -n blue
```

8.8. CREATING A CLUSTER ROLE

You can create a cluster role.

Procedure

1. To create a cluster role, run the following command:

```
$ oc create clusterrole <name> --verb=<verb> --resource=<resource>
```

In this command, specify:

- **<name>**, the local role's name
- **<verb>**, a comma-separated list of the verbs to apply to the role
- **<resource>**, the resources that the role applies to

For example, to create a cluster role that allows a user to view pods, run the following command:

```
$ oc create clusterrole podviewonly --verb=get --resource=pod
```

8.9. LOCAL ROLE BINDING COMMANDS

When you manage a user or group's associated roles for local role bindings using the following operations, a project may be specified with the **-n** flag. If it is not specified, then the current project is used.

You can use the following commands for local RBAC management.

Table 8.1. Local role binding operations

Command	Description
\$ oc adm policy who-can <verb> <resource>	Indicates which users can perform an action on a resource.
\$ oc adm policy add-role-to-user <role> <username>	Binds a specified role to specified users in the current project.
\$ oc adm policy remove-role-from-user <role> <username>	Removes a given role from specified users in the current project.
\$ oc adm policy remove-user <username>	Removes specified users and all of their roles in the current project.
\$ oc adm policy add-role-to-group <role> <groupname>	Binds a given role to specified groups in the current project.
\$ oc adm policy remove-role-from-group <role> <groupname>	Removes a given role from specified groups in the current project.
\$ oc adm policy remove-group <groupname>	Removes specified groups and all of their roles in the current project.

8.10. CLUSTER ROLE BINDING COMMANDS

You can also manage cluster role bindings using the following operations. The **-n** flag is not used for these operations because cluster role bindings use non-namespaced resources.

Table 8.2. Cluster role binding operations

Command	Description
\$ oc adm policy add-cluster-role-to-user <role> <username>	Binds a given role to specified users for all projects in the cluster.
\$ oc adm policy remove-cluster-role-from-user <role> <username>	Removes a given role from specified users for all projects in the cluster.
\$ oc adm policy add-cluster-role-to-group <role> <groupname>	Binds a given role to specified groups for all projects in the cluster.
\$ oc adm policy remove-cluster-role-from-group <role> <groupname>	Removes a given role from specified groups for all projects in the cluster.

8.11. CREATING A CLUSTER ADMIN

The **cluster-admin** role is required to perform administrator level tasks on the OpenShift Container Platform cluster, such as modifying cluster resources.

Prerequisites

- You must have created a user to define as the cluster admin.

Procedure

- Define the user as a cluster admin:

```
$ oc adm policy add-cluster-role-to-user cluster-admin <user>
```

CHAPTER 9. REMOVING THE KUBEADMIN USER

9.1. THE KUBEADMIN USER

OpenShift Container Platform creates a cluster administrator, **kubeadmin**, after the installation process completes.

This user has the **cluster-admin** role automatically applied and is treated as the root user for the cluster. The password is dynamically generated and unique to your OpenShift Container Platform environment. After installation completes the password is provided in the installation program's output. For example:

```
INFO Install complete!
INFO Run 'export KUBECONFIG=<your working directory>/auth/kubeconfig' to manage the cluster
with 'oc', the OpenShift CLI.
INFO The cluster is ready when 'oc login -u kubeadmin -p <provided>' succeeds (wait a few minutes).
INFO Access the OpenShift web-console here: https://console-openshift-
console.apps.demo1.openshift4-beta-abcorp.com
INFO Login to the console with user: kubeadmin, password: <provided>
```

9.2. REMOVING THE KUBEADMIN USER

After you define an identity provider and create a new **cluster-admin** user, you can remove the **kubeadmin** to improve cluster security.



WARNING

If you follow this procedure before another user is a **cluster-admin**, then OpenShift Container Platform must be reinstalled. It is not possible to undo this command.

Prerequisites

- You must have configured at least one identity provider.
- You must have added the **cluster-admin** role to a user.
- You must be logged in as an administrator.

Procedure

- Remove the **kubeadmin** secrets:

```
$ oc delete secrets kubeadmin -n kube-system
```

CHAPTER 10. UNDERSTANDING AND CREATING SERVICE ACCOUNTS

10.1. SERVICE ACCOUNTS OVERVIEW

A service account is an OpenShift Container Platform account that allows a component to directly access the API. Service accounts are API objects that exist within each project. Service accounts provide a flexible way to control API access without sharing a regular user's credentials.

When you use the OpenShift Container Platform CLI or web console, your API token authenticates you to the API. You can associate a component with a service account so that they can access the API without using a regular user's credentials. For example, service accounts can allow:

- Replication controllers to make API calls to create or delete pods.
- Applications inside containers to make API calls for discovery purposes.
- External applications to make API calls for monitoring or integration purposes.

Each service account's user name is derived from its project and name:

```
system:serviceaccount:<project>:<name>
```

Every service account is also a member of two groups:

Group	Description
system:serviceaccounts	Includes all service accounts in the system.
system:serviceaccounts:<project>	Includes all service accounts in the specified project.

Each service account automatically contains two secrets:

- An API token
- Credentials for the OpenShift Container Registry

The generated API token and registry credentials do not expire, but you can revoke them by deleting the secret. When you delete the secret, a new one is automatically generated to take its place.

10.2. CREATING SERVICE ACCOUNTS

You can create a service account in a project and grant it permissions by binding it to a role.

Procedure

1. Optional: To view the service accounts in the current project:

```
$ oc get sa
```

Example output

```

NAME      SECRETS  AGE
builder   2        2d
default   2        2d
deployer  2        2d

```

- To create a new service account in the current project:

```
$ oc create sa <service_account_name> 1
```

- To create a service account in a different project, specify **-n <project_name>**.

Example output

```
serviceaccount "robot" created
```

TIP

You can alternatively apply the following YAML to create the service account:

```

apiVersion: v1
kind: ServiceAccount
metadata:
  name: <service_account_name>
  namespace: <current_project>

```

- Optional: View the secrets for the service account:

```
$ oc describe sa robot
```

Example output

```

Name:          robot
Namespace:     project1
Labels:        <none>
Annotations:   <none>
Image pull secrets: robot-dockercfg-qzbhb
Mountable secrets: robot-dockercfg-qzbhb
Tokens:        robot-token-f4khf
Events:        <none>

```

10.3. EXAMPLES OF GRANTING ROLES TO SERVICE ACCOUNTS

You can grant roles to service accounts in the same way that you grant roles to a regular user account.

- You can modify the service accounts for the current project. For example, to add the **view** role to the **robot** service account in the **top-secret** project:

```
$ oc policy add-role-to-user view system:serviceaccount:top-secret:robot
```

TIP

You can alternatively apply the following YAML to add the role:

```
apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
  name: view
  namespace: top-secret
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: view
subjects:
- kind: ServiceAccount
  name: robot
  namespace: top-secret
```

- You can also grant access to a specific service account in a project. For example, from the project to which the service account belongs, use the **-z** flag and specify the **<service_account_name>**

```
$ oc policy add-role-to-user <role_name> -z <service_account_name>
```

**IMPORTANT**

If you want to grant access to a specific service account in a project, use the **-z** flag. Using this flag helps prevent typos and ensures that access is granted to only the specified service account.

TIP

You can alternatively apply the following YAML to add the role:

```
apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
  name: <rolebinding_name>
  namespace: <current_project_name>
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: <role_name>
subjects:
- kind: ServiceAccount
  name: <service_account_name>
  namespace: <current_project_name>
```

- To modify a different namespace, you can use the **-n** option to indicate the project namespace it applies to, as shown in the following examples.
 - For example, to allow all service accounts in all projects to view resources in the **my-project** project:


```
$ oc policy add-role-to-group view system:serviceaccounts -n my-project
```

TIP

You can alternatively apply the following YAML to add the role:

```
apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
  name: view
  namespace: my-project
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: view
subjects:
- apiGroup: rbac.authorization.k8s.io
  kind: Group
  name: system:serviceaccounts
```

- To allow all service accounts in the **managers** project to edit resources in the **my-project** project:

```
$ oc policy add-role-to-group edit system:serviceaccounts:managers -n my-project
```

TIP

You can alternatively apply the following YAML to add the role:

```
apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
  name: edit
  namespace: my-project
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: edit
subjects:
- apiGroup: rbac.authorization.k8s.io
  kind: Group
  name: system:serviceaccounts:managers
```

CHAPTER 11. USING SERVICE ACCOUNTS IN APPLICATIONS

11.1. SERVICE ACCOUNTS OVERVIEW

A service account is an OpenShift Container Platform account that allows a component to directly access the API. Service accounts are API objects that exist within each project. Service accounts provide a flexible way to control API access without sharing a regular user's credentials.

When you use the OpenShift Container Platform CLI or web console, your API token authenticates you to the API. You can associate a component with a service account so that they can access the API without using a regular user's credentials. For example, service accounts can allow:

- Replication controllers to make API calls to create or delete pods.
- Applications inside containers to make API calls for discovery purposes.
- External applications to make API calls for monitoring or integration purposes.

Each service account's user name is derived from its project and name:

```
system:serviceaccount:<project>:<name>
```

Every service account is also a member of two groups:

Group	Description
system:serviceaccounts	Includes all service accounts in the system.
system:serviceaccounts:<project>	Includes all service accounts in the specified project.

Each service account automatically contains two secrets:

- An API token
- Credentials for the OpenShift Container Registry

The generated API token and registry credentials do not expire, but you can revoke them by deleting the secret. When you delete the secret, a new one is automatically generated to take its place.

11.2. DEFAULT SERVICE ACCOUNTS

Your OpenShift Container Platform cluster contains default service accounts for cluster management and generates more service accounts for each project.

11.2.1. Default cluster service accounts

Several infrastructure controllers run using service account credentials. The following service accounts are created in the OpenShift Container Platform infrastructure project (**openshift-infra**) at server start, and given the following roles cluster-wide:

Service Account	Description
replication-controller	Assigned the system:replication-controller role
deployment-controller	Assigned the system:deployment-controller role
build-controller	Assigned the system:build-controller role. Additionally, the build-controller service account is included in the privileged security context constraint to create privileged build pods.

11.2.2. Default project service accounts and roles

Three service accounts are automatically created in each project:

Service Account	Usage
builder	Used by build pods. It is given the system:image-builder role, which allows pushing images to any imagestream in the project using the internal Docker registry.
deployer	Used by deployment pods and given the system:deployer role, which allows viewing and modifying replication controllers and pods in the project.
default	Used to run all other pods unless they specify a different service account.

All service accounts in a project are given the **system:image-puller** role, which allows pulling images from any imagestream in the project using the internal container image registry.

11.2.3. About automatically generated service account token secrets

When a service account is created, a service account token secret is automatically generated for it. This service account token secret, along with an automatically generated docker configuration secret, is used to authenticate to the internal OpenShift Container Platform registry. Do not rely on these automatically generated secrets for your own use; they might be removed in a future OpenShift Container Platform release.

**NOTE**

Prior to OpenShift Container Platform 4.11, a second service account token secret was generated when a service account was created. This service account token secret was used to access the Kubernetes API.

Starting with OpenShift Container Platform 4.11, this second service account token secret is no longer created. This is because the **LegacyServiceAccountTokenNoAutoGeneration** upstream Kubernetes feature gate was enabled, which stops the automatic generation of secret-based service account tokens to access the Kubernetes API.

After upgrading to 4.13, any existing service account token secrets are not deleted and continue to function.

Workloads are automatically injected with a projected volume to obtain a bound service account token. If your workload needs an additional service account token, add an additional projected volume in your workload manifest. Bound service account tokens are more secure than service account token secrets for the following reasons:

- Bound service account tokens have a bounded lifetime.
- Bound service account tokens contain audiences.
- Bound service account tokens can be bound to pods or secrets and the bound tokens are invalidated when the bound object is removed.

For more information, see *Configuring bound service account tokens using volume projection*.

You can also manually create a service account token secret to obtain a token, if the security exposure of a non-expiring token in a readable API object is acceptable to you. For more information, see *Creating a service account token secret*.

Additional resources

- For information about requesting bound service account tokens, see [Configuring bound service account tokens using volume projection](#).
- For information about creating a service account token secret, see [Creating a service account token secret](#).

11.3. CREATING SERVICE ACCOUNTS

You can create a service account in a project and grant it permissions by binding it to a role.

Procedure

1. Optional: To view the service accounts in the current project:

```
$ oc get sa
```

Example output

```
NAME      SECRETS  AGE
builder   2        2d
```

```
default 2 2d
deployer 2 2d
```

- To create a new service account in the current project:

```
$ oc create sa <service_account_name> 1
```

- 1** To create a service account in a different project, specify **-n <project_name>**.

Example output

```
serviceaccount "robot" created
```

TIP

You can alternatively apply the following YAML to create the service account:

```
apiVersion: v1
kind: ServiceAccount
metadata:
  name: <service_account_name>
  namespace: <current_project>
```

- Optional: View the secrets for the service account:

```
$ oc describe sa robot
```

Example output

```
Name:          robot
Namespace:     project1
Labels:        <none>
Annotations:   <none>
Image pull secrets: robot-dockercfg-qzbhb
Mountable secrets: robot-dockercfg-qzbhb
Tokens:        robot-token-f4khf
Events:        <none>
```

CHAPTER 12. USING A SERVICE ACCOUNT AS AN OAUTH CLIENT

12.1. SERVICE ACCOUNTS AS OAUTH CLIENTS

You can use a service account as a constrained form of OAuth client. Service accounts can request only a subset of scopes that allow access to some basic user information and role-based power inside of the service account's own namespace:

- **user:info**
- **user:check-access**
- **role:<any_role>:<service_account_namespace>**
- **role:<any_role>:<service_account_namespace>:!**

When using a service account as an OAuth client:

- **client_id** is **system:serviceaccount:<service_account_namespace>:<service_account_name>**.
- **client_secret** can be any of the API tokens for that service account. For example:

```
$ oc sa get-token <service_account_name>
```

- To get **WWW-Authenticate** challenges, set an **serviceaccounts.openshift.io/oauth-want-challenges** annotation on the service account to **true**.
- **redirect_uri** must match an annotation on the service account.

12.1.1. Redirect URIs for service accounts as OAuth clients

Annotation keys must have the prefix **serviceaccounts.openshift.io/oauth-redirecturi.** or **serviceaccounts.openshift.io/oauth-redirectreference.** such as:

```
serviceaccounts.openshift.io/oauth-redirecturi.<name>
```

In its simplest form, the annotation can be used to directly specify valid redirect URIs. For example:

```
"serviceaccounts.openshift.io/oauth-redirecturi.first": "https://example.com"  
"serviceaccounts.openshift.io/oauth-redirecturi.second": "https://other.com"
```

The **first** and **second** postfixes in the above example are used to separate the two valid redirect URIs.

In more complex configurations, static redirect URIs may not be enough. For example, perhaps you want all Ingresses for a route to be considered valid. This is where dynamic redirect URIs via the **serviceaccounts.openshift.io/oauth-redirectreference.** prefix come into play.

For example:

```
"serviceaccounts.openshift.io/oauth-redirectreference.first": "
{"kind":"OAuthRedirectReference","apiVersion":"v1","reference":
{"kind":"Route","name":"jenkins"}}"
```

Since the value for this annotation contains serialized JSON data, it is easier to see in an expanded format:

```
{
  "kind": "OAuthRedirectReference",
  "apiVersion": "v1",
  "reference": {
    "kind": "Route",
    "name": "jenkins"
  }
}
```

Now you can see that an **OAuthRedirectReference** allows us to reference the route named **jenkins**. Thus, all Ingresses for that route will now be considered valid. The full specification for an **OAuthRedirectReference** is:

```
{
  "kind": "OAuthRedirectReference",
  "apiVersion": "v1",
  "reference": {
    "kind": ..., 1
    "name": ..., 2
    "group": ... 3
  }
}
```

- 1** **kind** refers to the type of the object being referenced. Currently, only **route** is supported.
- 2** **name** refers to the name of the object. The object must be in the same namespace as the service account.
- 3** **group** refers to the group of the object. Leave this blank, as the group for a route is the empty string.

Both annotation prefixes can be combined to override the data provided by the reference object. For example:

```
"serviceaccounts.openshift.io/oauth-redirecturi.first": "custompath"
"serviceaccounts.openshift.io/oauth-redirectreference.first": "
{"kind":"OAuthRedirectReference","apiVersion":"v1","reference":
{"kind":"Route","name":"jenkins"}}"
```

The **first** postfix is used to tie the annotations together. Assuming that the **jenkins** route had an Ingress of **https://example.com**, now **https://example.com/custompath** is considered valid, but **https://example.com** is not. The format for partially supplying override data is as follows:

Type	Syntax
Scheme	"https://"
Hostname	"//website.com"
Port	"//:8000"
Path	"examplepath"



NOTE

Specifying a hostname override will replace the hostname data from the referenced object, which is not likely to be desired behavior.

Any combination of the above syntax can be combined using the following format:

<scheme>://<hostname><:port>/<path>

The same object can be referenced more than once for more flexibility:

```
"serviceaccounts.openshift.io/oauth-redirecturi.first": "custompath"
"serviceaccounts.openshift.io/oauth-redirectreference.first": "
{"kind":"OAuthRedirectReference","apiVersion":"v1","reference":
{"kind":"Route","name":"jenkins"}}"
"serviceaccounts.openshift.io/oauth-redirecturi.second": "//:8000"
"serviceaccounts.openshift.io/oauth-redirectreference.second": "
{"kind":"OAuthRedirectReference","apiVersion":"v1","reference":
{"kind":"Route","name":"jenkins"}}"
```

Assuming that the route named **jenkins** has an Ingress of **https://example.com**, then both **https://example.com:8000** and **https://example.com/custompath** are considered valid.

Static and dynamic annotations can be used at the same time to achieve the desired behavior:

```
"serviceaccounts.openshift.io/oauth-redirectreference.first": "
{"kind":"OAuthRedirectReference","apiVersion":"v1","reference":
{"kind":"Route","name":"jenkins"}}"
"serviceaccounts.openshift.io/oauth-redirecturi.second": "https://other.com"
```


CHAPTER 13. SCOPING TOKENS

13.1. ABOUT SCOPING TOKENS

You can create scoped tokens to delegate some of your permissions to another user or service account. For example, a project administrator might want to delegate the power to create pods.

A scoped token is a token that identifies as a given user but is limited to certain actions by its scope. Only a user with the **cluster-admin** role can create scoped tokens.

Scopes are evaluated by converting the set of scopes for a token into a set of **PolicyRules**. Then, the request is matched against those rules. The request attributes must match at least one of the scope rules to be passed to the "normal" authorizer for further authorization checks.

13.1.1. User scopes

User scopes are focused on getting information about a given user. They are intent-based, so the rules are automatically created for you:

- **user:full** - Allows full read/write access to the API with all of the user's permissions.
- **user:info** - Allows read-only access to information about the user, such as name and groups.
- **user:check-access** - Allows access to **self-localsubjectaccessreviews** and **self-subjectaccessreviews**. These are the variables where you pass an empty user and groups in your request object.
- **user:list-projects** - Allows read-only access to list the projects the user has access to.

13.1.2. Role scope

The role scope allows you to have the same level of access as a given role filtered by namespace.

- **role:<cluster-role name>:<namespace or * for all>** - Limits the scope to the rules specified by the cluster-role, but only in the specified namespace .



NOTE

Caveat: This prevents escalating access. Even if the role allows access to resources like secrets, rolebindings, and roles, this scope will deny access to those resources. This helps prevent unexpected escalations. Many people do not think of a role like **edit** as being an escalating role, but with access to a secret it is.

- **role:<cluster-role name>:<namespace or * for all>!** - This is similar to the example above, except that including the bang causes this scope to allow escalating access.

CHAPTER 14. USING BOUND SERVICE ACCOUNT TOKENS

You can use bound service account tokens, which improves the ability to integrate with cloud provider identity access management (IAM) services, such as AWS IAM.

14.1. ABOUT BOUND SERVICE ACCOUNT TOKENS

You can use bound service account tokens to limit the scope of permissions for a given service account token. These tokens are audience and time-bound. This facilitates the authentication of a service account to an IAM role and the generation of temporary credentials mounted to a pod. You can request bound service account tokens by using volume projection and the TokenRequest API.

14.2. CONFIGURING BOUND SERVICE ACCOUNT TOKENS USING VOLUME PROJECTION

You can configure pods to request bound service account tokens by using volume projection.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have created a service account. This procedure assumes that the service account is named **build-robot**.

Procedure

1. Optional: Set the service account issuer.
This step is typically not required if the bound tokens are used only within the cluster.



IMPORTANT

If you change the service account issuer to a custom one, the previous service account issuer is still trusted for the next 24 hours.

You can force all holders to request a new bound token either by manually restarting all pods in the cluster or by performing a rolling node restart. Before performing either action, wait for a new revision of the Kubernetes API server pods to roll out with your service account issuer changes.

- a. Edit the **cluster Authentication** object:

```
$ oc edit authentications cluster
```

- b. Set the **spec.serviceAccountIssuer** field to the desired service account issuer value:

```
spec:
  serviceAccountIssuer: https://test.default.svc 1
```

- 1** This value should be a URL from which the recipient of a bound token can source the public keys necessary to verify the signature of the token. The default is **https://kubernetes.default.svc**.

- c. Save the file to apply the changes.
- d. Wait for a new revision of the Kubernetes API server pods to roll out. It can take several minutes for all nodes to update to the new revision. Run the following command:

```
$ oc get kubeapiserver -o=jsonpath='{range .items[0].status.conditions[?(@.type=="NodeInstallerProgressing")]}{.reason}\n}{.message}\n}'
```

Review the **NodeInstallerProgressing** status condition for the Kubernetes API server to verify that all nodes are at the latest revision. The output shows **AllNodesAtLatestRevision** upon successful update:

```
AllNodesAtLatestRevision
3 nodes are at revision 12 1
```

- 1** In this example, the latest revision number is **12**.

If the output shows a message similar to one of the following messages, the update is still in progress. Wait a few minutes and try again.

- **3 nodes are at revision 11; 0 nodes have achieved new revision 12**
 - **2 nodes are at revision 11; 1 nodes are at revision 12**
- e. Optional: Force the holder to request a new bound token either by performing a rolling node restart or by manually restarting all pods in the cluster.
 - Perform a rolling node restart:



WARNING

It is not recommended to perform a rolling node restart if you have custom workloads running on your cluster, because it can cause a service interruption. Instead, manually restart all pods in the cluster.

Restart nodes sequentially. Wait for the node to become fully available before restarting the next node. See *Rebooting a node gracefully* for instructions on how to drain, restart, and mark a node as schedulable again.

- Manually restart all pods in the cluster:

**WARNING**

Be aware that running this command causes a service interruption, because it deletes every running pod in every namespace. These pods will automatically restart after they are deleted.

Run the following command:

```
$ for I in $(oc get ns -o jsonpath='{range .items[*]} {.metadata.name}{"\n"} {end}'); \
do oc delete pods --all -n $I; \
sleep 1; \
done
```

2. Configure a pod to use a bound service account token by using volume projection.
 - a. Create a file called **pod-projected-svc-token.yaml** with the following contents:

```
apiVersion: v1
kind: Pod
metadata:
  name: nginx
spec:
  containers:
  - image: nginx
    name: nginx
    volumeMounts:
    - mountPath: /var/run/secrets/tokens
      name: vault-token
  serviceAccountName: build-robot 1
  volumes:
  - name: vault-token
    projected:
      sources:
      - serviceAccountToken:
          path: vault-token 2
          expirationSeconds: 7200 3
          audience: vault 4
```

- 1** A reference to an existing service account.
- 2** The path relative to the mount point of the file to project the token into.
- 3** Optionally set the expiration of the service account token, in seconds. The default is 3600 seconds (1 hour) and must be at least 600 seconds (10 minutes). The kubelet will start trying to rotate the token if the token is older than 80 percent of its time to live or if the token is older than 24 hours.
- 4** Optionally set the intended audience of the token. The recipient of a token should verify that the recipient identity matches the audience claim of the token, and should otherwise reject the token. The audience defaults to the identifier of the API server.


```
faD11L3MhUGxw0qygOsPczdXUsoISbefs7OKymzFSIkTAn9sDQ8PHMOsuyxsK8vzfrR-  
E0z7MAeguZ2kaY7cZqbN6WFy0caWgx46hrKem9vCKALefEIRYbCg3hcBmowBcRTOqaFHL  
NnHghhU1LaRpoFzH7OUarqX9SGQ
```

Additional resources

- [Rebooting a node gracefully](#)
- [Creating service accounts](#)

CHAPTER 15. MANAGING SECURITY CONTEXT CONSTRAINTS

In OpenShift Container Platform, you can use security context constraints (SCCs) to control permissions for the pods in your cluster.

Default SCCs are created during installation and when you install some Operators or other components. As a cluster administrator, you can also create your own SCCs by using the OpenShift CLI (**oc**).



IMPORTANT

Do not modify the default SCCs. Customizing the default SCCs can lead to issues when some of the platform pods deploy or OpenShift Container Platform is upgraded. Additionally, the default SCC values are reset to the defaults during some cluster upgrades, which discards all customizations to those SCCs.

Instead of modifying the default SCCs, create and modify your own SCCs as needed. For detailed steps, see [Creating security context constraints](#).

15.1. ABOUT SECURITY CONTEXT CONSTRAINTS

Similar to the way that RBAC resources control user access, administrators can use security context constraints (SCCs) to control permissions for pods. These permissions determine the actions that a pod can perform and what resources it can access. You can use SCCs to define a set of conditions that a pod must run with to be accepted into the system.

Security context constraints allow an administrator to control:

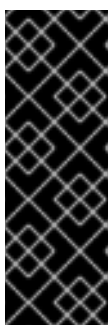
- Whether a pod can run privileged containers with the **allowPrivilegedContainer** flag
- Whether a pod is constrained with the **allowPrivilegeEscalation** flag
- The capabilities that a container can request
- The use of host directories as volumes
- The SELinux context of the container
- The container user ID
- The use of host namespaces and networking
- The allocation of an **FSGroup** that owns the pod volumes
- The configuration of allowable supplemental groups
- Whether a container requires write access to its root file system
- The usage of volume types
- The configuration of allowable **seccomp** profiles

**IMPORTANT**

Do not set the **openshift.io/run-level** label on any namespaces in OpenShift Container Platform. This label is for use by internal OpenShift Container Platform components to manage the startup of major API groups, such as the Kubernetes API server and OpenShift API server. If the **openshift.io/run-level** label is set, no SCCs are applied to pods in that namespace, causing any workloads running in that namespace to be highly privileged.

15.1.1. Default security context constraints


The cluster contains several default security context constraints (SCCs) as described in the table below. Additional SCCs might be installed when you install Operators or other components to OpenShift Container Platform.



**IMPORTANT**


Do not modify the default SCCs. Customizing the default SCCs can lead to issues when some of the platform pods deploy or OpenShift Container Platform is upgraded. Additionally, the default SCC values are reset to the defaults during some cluster upgrades, which discards all customizations to those SCCs.



Instead of modifying the default SCCs, create and modify your own SCCs as needed. For detailed steps, see *Creating security context constraints*.


Table 15.1. Default security context constraints

Security context constraint	Description
anyuid	Provides all features of the restricted SCC, but allows users to run with any UID and any GID.
hostaccess	<p>Allows access to all host namespaces but still requires pods to be run with a UID and SELinux context that are allocated to the namespace.</p> <div style="background-color: #fff9c4; padding: 10px; border: 1px solid #ccc;">  <p>WARNING</p> <p>This SCC allows host access to namespaces, file systems, and PIDs. It should only be used by trusted pods. Grant with caution.</p> </div>

Security context constraint	Description
hostmount-anyuid	<p>Provides all the features of the restricted SCC, but allows host mounts and running as any UID and any GID on the system.</p> <div data-bbox="491 371 1428 663" style="background-color: #fff9c4; padding: 10px; border: 1px solid #ccc;">  <p>WARNING</p> <p>This SCC allows host file system access as any UID, including UID 0. Grant with caution.</p> </div>
hostnetwork	<p>Allows using host networking and host ports but still requires pods to be run with a UID and SELinux context that are allocated to the namespace.</p> <div data-bbox="491 999 1428 1379" style="background-color: #fff9c4; padding: 10px; border: 1px solid #ccc;">  <p>WARNING</p> <p>If additional workloads are run on control plane hosts, use caution when providing access to hostnetwork. A workload that runs hostnetwork on a control plane host is effectively root on the cluster and must be trusted accordingly.</p> </div>
hostnetwork-v2	<p>Like the hostnetwork SCC, but with the following differences:</p> <ul style="list-style-type: none"> ● ALL capabilities are dropped from containers. ● The NET_BIND_SERVICE capability can be added explicitly. ● seccompProfile is set to runtime/default by default. ● allowPrivilegeEscalation must be unset or set to false in security contexts.

Security context constraint	Description
node-exporter	<p>Used for the Prometheus node exporter.</p> <div data-bbox="491 338 1428 629" style="background-color: #fff9c4; padding: 10px; border: 1px solid #ccc;">  <p>WARNING</p> <p>This SCC allows host file system access as any UID, including UID 0. Grant with caution.</p> </div>
nonroot	<p>Provides all features of the restricted SCC, but allows users to run with any non-root UID. The user must specify the UID or it must be specified in the manifest of the container runtime.</p>
nonroot-v2	<p>Like the nonroot SCC, but with the following differences:</p> <ul style="list-style-type: none"> ● ALL capabilities are dropped from containers. ● The NET_BIND_SERVICE capability can be added explicitly. ● seccompProfile is set to runtime/default by default. ● allowPrivilegeEscalation must be unset or set to false in security contexts.

Security context constraint	Description
privileged	<p>Allows access to all privileged and host features and the ability to run as any user, any group, any FSGroup, and with any SELinux context.</p> <div data-bbox="491 371 1428 663" style="background-color: #fff9c4; padding: 10px; border: 1px solid #ccc;">  <p>WARNING</p> <p>This is the most relaxed SCC and should be used only for cluster administration. Grant with caution.</p> </div> <p>The privileged SCC allows:</p> <ul style="list-style-type: none"> ● Users to run privileged pods ● Pods to mount host directories as volumes ● Pods to run as any user ● Pods to run with any MCS label ● Pods to use the host's IPC namespace ● Pods to use the host's PID namespace ● Pods to use any FSGroup ● Pods to use any supplemental group ● Pods to use any seccomp profiles ● Pods to request any capabilities <div data-bbox="491 1406 662 1637" style="background-color: #e0e0e0; padding: 10px; border: 1px solid #ccc;">  <p>NOTE</p> <p>Setting privileged: true in the pod specification does not necessarily select the privileged SCC. The SCC that has allowPrivilegedContainer: true and has the highest prioritization will be chosen if the user has the permissions to use it.</p> </div>

Security context constraint	Description
restricted	<p>Denies access to all host features and requires pods to be run with a UID, and SELinux context that are allocated to the namespace.</p> <p>The restricted SCC:</p> <ul style="list-style-type: none"> ● Ensures that pods cannot run as privileged ● Ensures that pods cannot mount host directory volumes ● Requires that a pod is run as a user in a pre-allocated range of UIDs ● Requires that a pod is run with a pre-allocated MCS label ● Requires that a pod is run with a pre-allocated FSGroup ● Allows pods to use any supplemental group <p>In clusters that were upgraded from OpenShift Container Platform 4.10 or earlier, this SCC is available for use by any authenticated user. The restricted SCC is no longer available to users of new OpenShift Container Platform 4.11 or later installations, unless the access is explicitly granted.</p>
restricted-v2	<p>Like the restricted SCC, but with the following differences:</p> <ul style="list-style-type: none"> ● ALL capabilities are dropped from containers. ● The NET_BIND_SERVICE capability can be added explicitly. ● seccompProfile is set to runtime/default by default. ● allowPrivilegeEscalation must be unset or set to false in security contexts. <p>This is the most restrictive SCC provided by a new installation and will be used by default for authenticated users.</p> <div data-bbox="488 1413 596 1637" style="display: inline-block; vertical-align: top;">  </div> <p>NOTE</p> <p>The restricted-v2 SCC is the most restrictive of the SCCs that is included by default with the system. However, you can create a custom SCC that is even more restrictive. For example, you can create an SCC that restricts readOnlyRootFilesystem to true.</p>

15.1.2. Security context constraints settings

Security context constraints (SCCs) are composed of settings and strategies that control the security features a pod has access to. These settings fall into three categories:

Category	Description
Controlled by a boolean	Fields of this type default to the most restrictive value. For example, AllowPrivilegedContainer is always set to false if unspecified.

Category	Description
Controlled by an allowable set	Fields of this type are checked against the set to ensure their value is allowed.
Controlled by a strategy	Items that have a strategy to generate a value provide: <ul style="list-style-type: none"> • A mechanism to generate the value, and • A mechanism to ensure that a specified value falls into the set of allowable values.

CRI-O has the following default list of capabilities that are allowed for each container of a pod:

- **CHOWN**
- **DAC_OVERRIDE**
- **FSETID**
- **FOWNER**
- **SETGID**
- **SETUID**
- **SETPCAP**
- **NET_BIND_SERVICE**
- **KILL**

The containers use the capabilities from this default list, but pod manifest authors can alter the list by requesting additional capabilities or removing some of the default behaviors. Use the **allowedCapabilities**, **defaultAddCapabilities**, and **requiredDropCapabilities** parameters to control such requests from the pods. With these parameters you can specify which capabilities can be requested, which ones must be added to each container, and which ones must be forbidden, or dropped, from each container.



NOTE

You can drop all capabilities from containers by setting the **requiredDropCapabilities** parameter to **ALL**. This is what the **restricted-v2** SCC does.

15.1.3. Security context constraints strategies

RunAsUser

- **MustRunAs** - Requires a **runAsUser** to be configured. Uses the configured **runAsUser** as the default. Validates against the configured **runAsUser**.

Example MustRunAs snippet

```

...
runAsUser:
  type: MustRunAs
  uid: <id>
...

```

- **MustRunAsRange** - Requires minimum and maximum values to be defined if not using pre-allocated values. Uses the minimum as the default. Validates against the entire allowable range.

Example MustRunAsRange snippet

```

...
runAsUser:
  type: MustRunAsRange
  uidRangeMax: <maxvalue>
  uidRangeMin: <minvalue>
...

```

- **MustRunAsNonRoot** - Requires that the pod be submitted with a non-zero **runAsUser** or have the **USER** directive defined in the image. No default provided.

Example MustRunAsNonRoot snippet

```

...
runAsUser:
  type: MustRunAsNonRoot
...

```

- **RunAsAny** - No default provided. Allows any **runAsUser** to be specified.

Example RunAsAny snippet

```

...
runAsUser:
  type: RunAsAny
...

```

SELinuxContext

- **MustRunAs** - Requires **seLinuxOptions** to be configured if not using pre-allocated values. Uses **seLinuxOptions** as the default. Validates against **seLinuxOptions**.
- **RunAsAny** - No default provided. Allows any **seLinuxOptions** to be specified.

SupplementalGroups

- **MustRunAs** - Requires at least one range to be specified if not using pre-allocated values. Uses the minimum value of the first range as the default. Validates against all ranges.
- **RunAsAny** - No default provided. Allows any **supplementalGroups** to be specified.

FSGroup

- **MustRunAs** - Requires at least one range to be specified if not using pre-allocated values. Uses the minimum value of the first range as the default. Validates against the first ID in the first range.
- **RunAsAny** - No default provided. Allows any **fsGroup** ID to be specified.

15.1.4. Controlling volumes

The usage of specific volume types can be controlled by setting the **volumes** field of the SCC.

The allowable values of this field correspond to the volume sources that are defined when creating a volume:

- [awsElasticBlockStore](#)
- [azureDisk](#)
- [azureFile](#)
- [cephFS](#)
- [cinder](#)
- [configMap](#)
- [csi](#)
- [downwardAPI](#)
- [emptyDir](#)
- [fc](#)
- [flexVolume](#)
- [flocker](#)
- [gcePersistentDisk](#)
- [ephemeral](#)
- [gitRepo](#)
- [glusterfs](#)
- [hostPath](#)
- [iscsi](#)
- [nfs](#)
- [persistentVolumeClaim](#)
- [photonPersistentDisk](#)
- [portworxVolume](#)
- [projected](#)

- [quobyte](#)
- [rbd](#)
- [scaleIO](#)
- [secret](#)
- [storageos](#)
- [vsphereVolume](#)
- * (A special value to allow the use of all volume types.)
- **none** (A special value to disallow the use of all volumes types. Exists only for backwards compatibility.)

The recommended minimum set of allowed volumes for new SCCs are **configMap**, **downwardAPI**, **emptyDir**, **persistentVolumeClaim**, **secret**, and **projected**.



NOTE

This list of allowable volume types is not exhaustive because new types are added with each release of OpenShift Container Platform.



NOTE

For backwards compatibility, the usage of **allowHostDirVolumePlugin** overrides settings in the **volumes** field. For example, if **allowHostDirVolumePlugin** is set to false but allowed in the **volumes** field, then the **hostPath** value will be removed from **volumes**.

15.1.5. Admission control

Admission control with SCCs allows for control over the creation of resources based on the capabilities granted to a user.

In terms of the SCCs, this means that an admission controller can inspect the user information made available in the context to retrieve an appropriate set of SCCs. Doing so ensures the pod is authorized to make requests about its operating environment or to generate a set of constraints to apply to the pod.

The set of SCCs that admission uses to authorize a pod are determined by the user identity and groups that the user belongs to. Additionally, if the pod specifies a service account, the set of allowable SCCs includes any constraints accessible to the service account.



NOTE

When you create a workload resource, such as deployment, only the service account is used to find the SCCs and admit the pods when they are created.

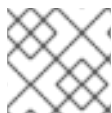
Admission uses the following approach to create the final security context for the pod:

1. Retrieve all SCCs available for use.
2. Generate field values for security context settings that were not specified on the request.

3. Validate the final settings against the available constraints.

If a matching set of constraints is found, then the pod is accepted. If the request cannot be matched to an SCC, the pod is rejected.

A pod must validate every field against the SCC. The following are examples for just two of the fields that must be validated:



NOTE

These examples are in the context of a strategy using the pre-allocated values.

An FSGroup SCC strategy of MustRunAs

If the pod defines a **fsGroup** ID, then that ID must equal the default **fsGroup** ID. Otherwise, the pod is not validated by that SCC and the next SCC is evaluated.

If the **SecurityContextConstraints.fsGroup** field has value **RunAsAny** and the pod specification omits the **Pod.spec.securityContext.fsGroup**, then this field is considered valid. Note that it is possible that during validation, other SCC settings will reject other pod fields and thus cause the pod to fail.

A SupplementalGroups SCC strategy of MustRunAs

If the pod specification defines one or more **supplementalGroups** IDs, then the pod's IDs must equal one of the IDs in the namespace's **openshift.io/sa.scc.supplemental-groups** annotation. Otherwise, the pod is not validated by that SCC and the next SCC is evaluated.

If the **SecurityContextConstraints.supplementalGroups** field has value **RunAsAny** and the pod specification omits the **Pod.spec.securityContext.supplementalGroups**, then this field is considered valid. Note that it is possible that during validation, other SCC settings will reject other pod fields and thus cause the pod to fail.

15.1.6. Security context constraints prioritization

Security context constraints (SCCs) have a priority field that affects the ordering when attempting to validate a request by the admission controller.

A priority value of **0** is the lowest possible priority. A nil priority is considered a **0**, or lowest, priority. Higher priority SCCs are moved to the front of the set when sorting.

When the complete set of available SCCs is determined, the SCCs are ordered in the following manner:

1. The highest priority SCCs are ordered first.
2. If the priorities are equal, the SCCs are sorted from most restrictive to least restrictive.
3. If both the priorities and restrictions are equal, the SCCs are sorted by name.

By default, the **anyuid** SCC granted to cluster administrators is given priority in their SCC set. This allows cluster administrators to run pods as any user by specifying **RunAsUser** in the pod's **SecurityContext**.

15.2. ABOUT PRE-ALLOCATED SECURITY CONTEXT CONSTRAINTS VALUES

The admission controller is aware of certain conditions in the security context constraints (SCCs) that trigger it to look up pre-allocated values from a namespace and populate the SCC before processing the pod. Each SCC strategy is evaluated independently of other strategies, with the pre-allocated values, where allowed, for each policy aggregated with pod specification values to make the final values for the various IDs defined in the running pod.

The following SCCs cause the admission controller to look for pre-allocated values when no ranges are defined in the pod specification:

1. A **RunAsUser** strategy of **MustRunAsRange** with no minimum or maximum set. Admission looks for the **openshift.io/sa.scc.uid-range** annotation to populate range fields.
2. An **SELinuxContext** strategy of **MustRunAs** with no level set. Admission looks for the **openshift.io/sa.scc.mcs** annotation to populate the level.
3. A **FSGroup** strategy of **MustRunAs**. Admission looks for the **openshift.io/sa.scc.supplemental-groups** annotation.
4. A **SupplementalGroups** strategy of **MustRunAs**. Admission looks for the **openshift.io/sa.scc.supplemental-groups** annotation.

During the generation phase, the security context provider uses default values for any parameter values that are not specifically set in the pod. Default values are based on the selected strategy:

1. **RunAsAny** and **MustRunAsNonRoot** strategies do not provide default values. If the pod needs a parameter value, such as a group ID, you must define the value in the pod specification.
2. **MustRunAs** (single value) strategies provide a default value that is always used. For example, for group IDs, even if the pod specification defines its own ID value, the namespace's default parameter value also appears in the pod's groups.
3. **MustRunAsRange** and **MustRunAs** (range-based) strategies provide the minimum value of the range. As with a single value **MustRunAs** strategy, the namespace's default parameter value appears in the running pod. If a range-based strategy is configurable with multiple ranges, it provides the minimum value of the first configured range.



NOTE

FSGroup and **SupplementalGroups** strategies fall back to the **openshift.io/sa.scc.uid-range** annotation if the **openshift.io/sa.scc.supplemental-groups** annotation does not exist on the namespace. If neither exists, the SCC is not created.



NOTE

By default, the annotation-based **FSGroup** strategy configures itself with a single range based on the minimum value for the annotation. For example, if your annotation reads **1/3**, the **FSGroup** strategy configures itself with a minimum and maximum value of **1**. If you want to allow more groups to be accepted for the **FSGroup** field, you can configure a custom SCC that does not use the annotation.



NOTE

The **openshift.io/sa.scc.supplemental-groups** annotation accepts a comma-delimited list of blocks in the format of **<start>/<length** or **<start>-<end>**. The **openshift.io/sa.scc.uid-range** annotation accepts only a single block.

15.3. EXAMPLE SECURITY CONTEXT CONSTRAINTS

The following examples show the security context constraints (SCC) format and annotations:

Annotated privileged SCC

```

allowHostDirVolumePlugin: true
allowHostIPC: true
allowHostNetwork: true
allowHostPID: true
allowHostPorts: true
allowPrivilegedContainer: true
allowedCapabilities: ❶
- '*'
apiVersion: security.openshift.io/v1
defaultAddCapabilities: [] ❷
fsGroup: ❸
  type: RunAsAny
groups: ❹
- system:cluster-admins
- system:nodes
kind: SecurityContextConstraints
metadata:
  annotations:
    kubernetes.io/description: 'privileged allows access to all privileged and host
      features and the ability to run as any user, any group, any fsGroup, and with
      any SELinux context. WARNING: this is the most relaxed SCC and should be used
      only for cluster administration. Grant with caution.'
  creationTimestamp: null
  name: privileged
priority: null
readOnlyRootFilesystem: false
requiredDropCapabilities: ❺
- KILL
- MKNOD
- SETUID
- SETGID
runAsUser: ❻
  type: RunAsAny
seLinuxContext: ❼
  type: RunAsAny
seccompProfiles:
- '*'
supplementalGroups: ❽
  type: RunAsAny
users: ❾
- system:serviceaccount:default:registry
- system:serviceaccount:default:router
- system:serviceaccount:openshift-infra:build-controller
volumes: ❿
- '*'

```

- ❶ A list of capabilities that a pod can request. An empty list means that none of capabilities can be requested while the special symbol * allows any capabilities.

- 2 A list of additional capabilities that are added to any pod.
- 3 The **FSGroup** strategy, which dictates the allowable values for the security context.
- 4 The groups that can access this SCC.
- 5 A list of capabilities to drop from a pod. Or, specify **ALL** to drop all capabilities.
- 6 The **runAsUser** strategy type, which dictates the allowable values for the security context.
- 7 The **seLinuxContext** strategy type, which dictates the allowable values for the security context.
- 8 The **supplementalGroups** strategy, which dictates the allowable supplemental groups for the security context.
- 9 The users who can access this SCC.
- 10 The allowable volume types for the security context. In the example, * allows the use of all volume types.

The **users** and **groups** fields on the SCC control which users can access the SCC. By default, cluster administrators, nodes, and the build controller are granted access to the privileged SCC. All authenticated users are granted access to the **restricted-v2** SCC.

Without explicit runAsUser setting

```
apiVersion: v1
kind: Pod
metadata:
  name: security-context-demo
spec:
  securityContext: 1
  containers:
  - name: sec-ctx-demo
    image: gcr.io/google-samples/node-hello:1.0
```

- 1 When a container or pod does not request a user ID under which it should be run, the effective UID depends on the SCC that emits this pod. Because the **restricted-v2** SCC is granted to all authenticated users by default, it will be available to all users and service accounts and used in most cases. The **restricted-v2** SCC uses **MustRunAsRange** strategy for constraining and defaulting the possible values of the **securityContext.runAsUser** field. The admission plugin will look for the **openshift.io/sa.scc.uid-range** annotation on the current project to populate range fields, as it does not provide this range. In the end, a container will have **runAsUser** equal to the first value of the range that is hard to predict because every project has different ranges.

With explicit runAsUser setting

```
apiVersion: v1
kind: Pod
metadata:
  name: security-context-demo
spec:
  securityContext:
    runAsUser: 1000 1
```

```
containers:
- name: sec-ctx-demo
  image: gcr.io/google-samples/node-hello:1.0
```

- 1 A container or pod that requests a specific user ID will be accepted by OpenShift Container Platform only when a service account or a user is granted access to a SCC that allows such a user ID. The SCC can allow arbitrary IDs, an ID that falls into a range, or the exact user ID specific to the request.

This configuration is valid for SELinux, fsGroup, and Supplemental Groups.

15.4. CREATING SECURITY CONTEXT CONSTRAINTS

You can create security context constraints (SCCs) by using the OpenShift CLI (**oc**).



IMPORTANT

Creating and modifying your own SCCs are advanced operations that might cause instability to your cluster. If you have questions about using your own SCCs, contact Red Hat Support. For information about contacting Red Hat support, see *Getting support*.

Prerequisites

- Install the OpenShift CLI (**oc**).
- Log in to the cluster as a user with the **cluster-admin** role.

Procedure

1. Define the SCC in a YAML file named **scc-admin.yaml**:

```
kind: SecurityContextConstraints
apiVersion: security.openshift.io/v1
metadata:
  name: scc-admin
allowPrivilegedContainer: true
runAsUser:
  type: RunAsAny
seLinuxContext:
  type: RunAsAny
fsGroup:
  type: RunAsAny
supplementalGroups:
  type: RunAsAny
users:
- my-admin-user
groups:
- my-admin-group
```

Optionally, you can drop specific capabilities for an SCC by setting the **requiredDropCapabilities** field with the desired values. Any specified capabilities are dropped from the container. To drop all capabilities, specify **ALL**. For example, to create an SCC that drops the **KILL**, **MKNOD**, and **SYS_CHROOT** capabilities, add the following to the SCC object:

■

```
requiredDropCapabilities:
```

- KILL
- MKNOD
- SYS_CHROOT



NOTE

You cannot list a capability in both **allowedCapabilities** and **requiredDropCapabilities**.

CRI-O supports the same list of capability values that are found in the [Docker documentation](#).

2. Create the SCC by passing in the file:

```
$ oc create -f scc-admin.yaml
```

Example output

```
securitycontextconstraints "scc-admin" created
```

Verification

- Verify that the SCC was created:

```
$ oc get scc scc-admin
```

Example output

```
NAME      PRIV  CAPS  SELINUX  RUNASUSER  FSGROUP  SUPGROUP  PRIORITY  READONLYROOTFS  VOLUMES
scc-admin true  []    RunAsAny RunAsAny  RunAsAny RunAsAny  <none>    false
[awsElasticBlockStore azureDisk azureFile cephFS cinder configMap downwardAPI
emptyDir fc flexVolume flocker gcePersistentDisk gitRepo glusterfs iscsi nfs
persistentVolumeClaim photonPersistentDisk quobyte rbd secret vsphere]
```

15.5. ROLE-BASED ACCESS TO SECURITY CONTEXT CONSTRAINTS

You can specify SCCs as resources that are handled by RBAC. This allows you to scope access to your SCCs to a certain project or to the entire cluster. Assigning users, groups, or service accounts directly to an SCC retains cluster-wide scope.



NOTE

You cannot assign a SCC to pods created in one of the default namespaces: **default**, **kube-system**, **kube-public**, **openshift-node**, **openshift-infra**, **openshift**. These namespaces should not be used for running pods or services.

To include access to SCCs for your role, specify the **scc** resource when creating a role.

```
$ oc create role <role-name> --verb=use --resource=scc --resource-name=<scc-name> -n
<namespace>
```

This results in the following role definition:

```
apiVersion: rbac.authorization.k8s.io/v1
kind: Role
metadata:
  ...
  name: role-name 1
  namespace: namespace 2
  ...
rules:
- apiGroups:
  - security.openshift.io 3
  resourceNames:
  - scc-name 4
  resources:
  - securitycontextconstraints 5
  verbs: 6
  - use
```

- 1** The role's name.
- 2** Namespace of the defined role. Defaults to **default** if not specified.
- 3** The API group that includes the **SecurityContextConstraints** resource. Automatically defined when **scc** is specified as a resource.
- 4** An example name for an SCC you want to have access.
- 5** Name of the resource group that allows users to specify SCC names in the **resourceNames** field.
- 6** A list of verbs to apply to the role.

A local or cluster role with such a rule allows the subjects that are bound to it with a role binding or a cluster role binding to use the user-defined SCC called **scc-name**.



NOTE

Because RBAC is designed to prevent escalation, even project administrators are unable to grant access to an SCC. By default, they are not allowed to use the verb **use** on SCC resources, including the **restricted-v2** SCC.

15.6. REFERENCE OF SECURITY CONTEXT CONSTRAINTS COMMANDS

You can manage security context constraints (SCCs) in your instance as normal API objects using the OpenShift CLI (**oc**).



NOTE

You must have **cluster-admin** privileges to manage SCCs.

15.6.1. Listing security context constraints

To get a current list of SCCs:

```
$ oc get scc
```

Example output

```
NAME                PRIV CAPS                SELINUX  RUNASUSER  FSGROUP
SUPGROUP  PRIORITY  READONLYROOTFS  VOLUMES
anyuid                false <no value>          MustRunAs  RunAsAny  RunAsAny
RunAsAny  10       false
["configMap","downwardAPI","emptyDir","persistentVolumeClaim","projected","secret"]
hostaccess            false <no value>          MustRunAs  MustRunAsRange  MustRunAs
RunAsAny  <no value>  false
["configMap","downwardAPI","emptyDir","hostPath","persistentVolumeClaim","projected","secret"]
hostmount-anyuid     false <no value>          MustRunAs  RunAsAny  RunAsAny
RunAsAny  <no value>  false
["configMap","downwardAPI","emptyDir","hostPath","nfs","persistentVolumeClaim","projected","secret"]

hostnetwork          false <no value>          MustRunAs  MustRunAsRange  MustRunAs
MustRunAs  <no value>  false
["configMap","downwardAPI","emptyDir","persistentVolumeClaim","projected","secret"]
hostnetwork-v2       false ["NET_BIND_SERVICE"]  MustRunAs  MustRunAsRange
MustRunAs  MustRunAs  <no value>  false
["configMap","downwardAPI","emptyDir","persistentVolumeClaim","projected","secret"]
node-exporter        true  <no value>          RunAsAny  RunAsAny  RunAsAny
RunAsAny  <no value>  false  ["*"]
nonroot              false <no value>          MustRunAs  MustRunAsNonRoot  RunAsAny
RunAsAny  <no value>  false
["configMap","downwardAPI","emptyDir","persistentVolumeClaim","projected","secret"]
nonroot-v2           false ["NET_BIND_SERVICE"]  MustRunAs  MustRunAsNonRoot
RunAsAny  RunAsAny  <no value>  false
["configMap","downwardAPI","emptyDir","persistentVolumeClaim","projected","secret"]
privileged            true  ["*"]              RunAsAny  RunAsAny  RunAsAny  RunAsAny
<no value>  false  ["*"]
restricted            false <no value>          MustRunAs  MustRunAsRange  MustRunAs
RunAsAny  <no value>  false
["configMap","downwardAPI","emptyDir","persistentVolumeClaim","projected","secret"]
restricted-v2        false ["NET_BIND_SERVICE"]  MustRunAs  MustRunAsRange
MustRunAs  RunAsAny  <no value>  false
["configMap","downwardAPI","emptyDir","persistentVolumeClaim","projected","secret"]
```

15.6.2. Examining security context constraints

You can view information about a particular SCC, including which users, service accounts, and groups the SCC is applied to.

For example, to examine the **restricted** SCC:

```
$ oc describe scc restricted
```

Example output

```
Name:                restricted
Priority:             <none>
```



```

Access:
  Users:                <none> 1
  Groups:               <none> 2
Settings:
  Allow Privileged:     false
  Allow Privilege Escalation: true
  Default Add Capabilities: <none>
  Required Drop Capabilities: KILL,MKNOD,SETUID,SETGID
  Allowed Capabilities: <none>
  Allowed Seccomp Profiles: <none>
  Allowed Volume Types:
configMap,downwardAPI,emptyDir,persistentVolumeClaim,projected,secret
  Allowed Flexvolumes: <all>
  Allowed Unsafe Sysctls: <none>
  Forbidden Sysctls: <none>
  Allow Host Network:   false
  Allow Host Ports:     false
  Allow Host PID:       false
  Allow Host IPC:       false
  Read Only Root Filesystem: false
  Run As User Strategy: MustRunAsRange
  UID:                  <none>
  UID Range Min:        <none>
  UID Range Max:        <none>
  SELinux Context Strategy: MustRunAs
  User:                 <none>
  Role:                 <none>
  Type:                 <none>
  Level:                <none>
  FSGroup Strategy: MustRunAs
  Ranges:               <none>
  Supplemental Groups Strategy: RunAsAny
  Ranges:               <none>

```

- 1** Lists which users and service accounts the SCC is applied to.
- 2** Lists which groups the SCC is applied to.

**NOTE**

To preserve customized SCCs during upgrades, do not edit settings on the default SCCs.

15.6.3. Deleting security context constraints

To delete an SCC:

```
$ oc delete scc <scc_name>
```

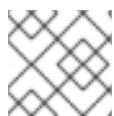
**NOTE**

If you delete a default SCC, it will regenerate when you restart the cluster.

15.6.4. Updating security context constraints

To update an existing SCC:

```
$ oc edit scc <scs_name>
```



NOTE

To preserve customized SCCs during upgrades, do not edit settings on the default SCCs.

15.7. ADDITIONAL RESOURCES

- [Getting support](#)

CHAPTER 16. UNDERSTANDING AND MANAGING POD SECURITY ADMISSION

Pod security admission is an implementation of the [Kubernetes pod security standards](#). Use pod security admission to restrict the behavior of pods.

16.1. POD SECURITY ADMISSION AND SECURITY CONTEXT CONSTRAINTS

Pod security admission standards and security context constraints are reconciled and enforced by two independent controllers. The two controllers work independently using the following processes to enforce security policies:

1. The security context constraint controller may mutate some security context fields per the pod's assigned SCC. For example, if the `seccomp` profile is empty or not set and if the pod's assigned SCC enforces `seccompProfiles` field to be `runtime/default`, the controller sets the default type to `RuntimeDefault`.
2. The security context constraint controller validates the pod's security context against the matching SCC.
3. The pod security admission controller validates the pod's security context against the pod security standard assigned to the namespace.

16.2. SECURITY CONTEXT CONSTRAINT SYNCHRONIZATION WITH POD SECURITY STANDARDS

OpenShift Container Platform includes [Kubernetes pod security admission](#). Globally, the `privileged` profile is enforced, and the `restricted` profile is used for warnings and audits.

In addition to the global pod security admission control configuration, a controller exists that applies pod security admission control `warn` and `audit` labels to namespaces according to the SCC permissions of the service accounts that are in a given namespace.



IMPORTANT

Namespaces that are defined as part of the cluster payload have pod security admission synchronization disabled permanently. You can enable pod security admission synchronization on other namespaces as necessary. If an Operator is installed in a user-created `openshift-*` namespace, synchronization is turned on by default after a cluster service version (CSV) is created in the namespace.

The controller examines `ServiceAccount` object permissions to use security context constraints in each namespace. Security context constraints (SCCs) are mapped to pod security profiles based on their field values; the controller uses these translated profiles. Pod security admission `warn` and `audit` labels are set to the most privileged pod security profile found in the namespace to prevent warnings and audit logging as pods are created.

Namespace labeling is based on consideration of namespace-local service account privileges.

Applying pods directly might use the SCC privileges of the user who runs the pod. However, user privileges are not considered during automatic labeling.

16.3. CONTROLLING POD SECURITY ADMISSION SYNCHRONIZATION

You can enable or disable automatic pod security admission synchronization for most namespaces.

IMPORTANT

Namespaces that are defined as part of the cluster payload have pod security admission synchronization disabled permanently. These namespaces include:

- **default**
- **kube-node-lease**
- **kube-system**
- **kube-public**
- **openshift**
- All system-created namespaces that are prefixed with **openshift-**, except for **openshift-operators**

By default, all namespaces that have an **openshift-** prefix are not synchronized. You can enable synchronization for any user-created **openshift-*** namespaces. You cannot enable synchronization for any system-created **openshift-*** namespaces, except for **openshift-operators**.

If an Operator is installed in a user-created **openshift-*** namespace, synchronization is turned on by default after a cluster service version (CSV) is created in the namespace. The synchronized label inherits the permissions of the service accounts in the namespace.

Procedure

- For each namespace that you want to configure, set a value for the **security.openshift.io/scc.podSecurityLabelSync** label:
 - To disable pod security admission label synchronization in a namespace, set the value of the **security.openshift.io/scc.podSecurityLabelSync** label to **false**.
Run the following command:

```
$ oc label namespace <namespace>
security.openshift.io/scc.podSecurityLabelSync=false
```

- To enable pod security admission label synchronization in a namespace, set the value of the **security.openshift.io/scc.podSecurityLabelSync** label to **true**.
Run the following command:

```
$ oc label namespace <namespace>
security.openshift.io/scc.podSecurityLabelSync=true
```

16.4. ABOUT POD SECURITY ADMISSION ALERTS

A **PodSecurityViolation** alert is triggered when the Kubernetes API server reports that there is a pod denial on the audit level of the pod security admission controller. This alert persists for one day.

View the Kubernetes API server audit logs to investigate alerts that were triggered. As an example, a workload is likely to fail admission if global enforcement is set to the **restricted** pod security level.

For assistance in identifying pod security admission violation audit events, see [Audit annotations](#) in the Kubernetes documentation.

16.4.1. Identifying pod security violations

The **PodSecurityViolation** alert does not provide details on which workloads are causing pod security violations. You can identify the affected workloads by reviewing the Kubernetes API server audit logs. This procedure uses the **must-gather** tool to gather the audit logs and then searches for the **pod-security.kubernetes.io/audit-violations** annotation.

Prerequisites

- You have installed **jq**.
- You have access to the cluster as a user with the **cluster-admin** role.

Procedure

1. To gather the audit logs, enter the following command:

```
$ oc adm must-gather -- /usr/bin/gather_audit_logs
```

2. To output the affected workload details, enter the following command:

```
$ zgrep -h pod-security.kubernetes.io/audit-violations must-gather.local.
<archive_id>/<image_digest_id>/audit_logs/kube-apiserver/*log.gz \
| jq -r 'select((.annotations["pod-security.kubernetes.io/audit-violations"] != null) and
(objectRef.resource=="pods")) | .objectRef.namespace + " " + .objectRef.name' \
| sort | uniq -c
```

Replace **<archive_id>** and **<image_digest_id>** with the actual path names.

Example output

```
1 test-namespace my-pod
```

16.5. ADDITIONAL RESOURCES

- [Viewing audit logs](#)
- [Managing security context constraints](#)

CHAPTER 17. IMPERSONATING THE SYSTEM:ADMIN USER

17.1. API IMPERSONATION

You can configure a request to the OpenShift Container Platform API to act as though it originated from another user. For more information, see [User impersonation](#) in the Kubernetes documentation.

17.2. IMPERSONATING THE SYSTEM:ADMIN USER

You can grant a user permission to impersonate **system:admin**, which grants them cluster administrator permissions.

Procedure

- To grant a user permission to impersonate **system:admin**, run the following command:

```
$ oc create clusterrolebinding <any_valid_name> --clusterrole=sudoer --user=<username>
```

TIP

You can alternatively apply the following YAML to grant permission to impersonate **system:admin**:

```
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRoleBinding
metadata:
  name: <any_valid_name>
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: sudoer
subjects:
- apiGroup: rbac.authorization.k8s.io
  kind: User
  name: <username>
```

17.3. IMPERSONATING THE SYSTEM:ADMIN GROUP

When a **system:admin** user is granted cluster administration permissions through a group, you must include the **--as=<user> --as-group=<group1> --as-group=<group2>** parameters in the command to impersonate the associated groups.

Procedure

- To grant a user permission to impersonate a **system:admin** by impersonating the associated cluster administration groups, run the following command:

```
$ oc create clusterrolebinding <any_valid_name> --clusterrole=sudoer --as=<user> \
--as-group=<group1> --as-group=<group2>
```

CHAPTER 18. SYNCING LDAP GROUPS

As an administrator, you can use groups to manage users, change their permissions, and enhance collaboration. Your organization may have already created user groups and stored them in an LDAP server. OpenShift Container Platform can sync those LDAP records with internal OpenShift Container Platform records, enabling you to manage your groups in one place. OpenShift Container Platform currently supports group sync with LDAP servers using three common schemas for defining group membership: RFC 2307, Active Directory, and augmented Active Directory.

For more information on configuring LDAP, see [Configuring an LDAP identity provider](#).



NOTE

You must have **cluster-admin** privileges to sync groups.

18.1. ABOUT CONFIGURING LDAP SYNC

Before you can run LDAP sync, you need a sync configuration file. This file contains the following LDAP client configuration details:

- Configuration for connecting to your LDAP server.
- Sync configuration options that are dependent on the schema used in your LDAP server.
- An administrator-defined list of name mappings that maps OpenShift Container Platform group names to groups in your LDAP server.

The format of the configuration file depends upon the schema you are using: RFC 2307, Active Directory, or augmented Active Directory.

LDAP client configuration

The LDAP client configuration section of the configuration defines the connections to your LDAP server.

The LDAP client configuration section of the configuration defines the connections to your LDAP server.

LDAP client configuration

```
url: ldap://10.0.0.0:389 1
bindDN: cn=admin,dc=example,dc=com 2
bindPassword: <password> 3
insecure: false 4
ca: my-ldap-ca-bundle.crt 5
```

- 1 The connection protocol, IP address of the LDAP server hosting your database, and the port to connect to, formatted as **scheme://host:port**.
- 2 Optional distinguished name (DN) to use as the Bind DN. OpenShift Container Platform uses this if elevated privilege is required to retrieve entries for the sync operation.
- 3 Optional password to use to bind. OpenShift Container Platform uses this if elevated privilege is necessary to retrieve entries for the sync operation. This value may also be provided in an environment variable, external file, or encrypted file.

- 4 When **false**, secure LDAP (**ldaps://**) URLs connect using TLS, and insecure LDAP (**ldap://**) URLs are upgraded to TLS. When **true**, no TLS connection is made to the server and you cannot use
- 5 The certificate bundle to use for validating server certificates for the configured URL. If empty, OpenShift Container Platform uses system-trusted roots. This only applies if **insecure** is set to **false**.

LDAP query definition

Sync configurations consist of LDAP query definitions for the entries that are required for synchronization. The specific definition of an LDAP query depends on the schema used to store membership information in the LDAP server.

LDAP query definition

```
baseDN: ou=users,dc=example,dc=com 1
scope: sub 2
derefAliases: never 3
timeout: 0 4
filter: (objectClass=person) 5
pageSize: 0 6
```

- 1 The distinguished name (DN) of the branch of the directory where all searches will start from. It is required that you specify the top of your directory tree, but you can also specify a subtree in the directory.
- 2 The scope of the search. Valid values are **base**, **one**, or **sub**. If this is left undefined, then a scope of **sub** is assumed. Descriptions of the scope options can be found in the table below.
- 3 The behavior of the search with respect to aliases in the LDAP tree. Valid values are **never**, **search**, **base**, or **always**. If this is left undefined, then the default is to **always** dereference aliases. Descriptions of the dereferencing behaviors can be found in the table below.
- 4 The time limit allowed for the search by the client, in seconds. A value of **0** imposes no client-side limit.
- 5 A valid LDAP search filter. If this is left undefined, then the default is **(objectClass=*)**.
- 6 The optional maximum size of response pages from the server, measured in LDAP entries. If set to **0**, no size restrictions will be made on pages of responses. Setting paging sizes is necessary when queries return more entries than the client or server allow by default.

Table 18.1. LDAP search scope options

LDAP search scope	Description
base	Only consider the object specified by the base DN given for the query.
one	Consider all of the objects on the same level in the tree as the base DN for the query.
sub	Consider the entire subtree rooted at the base DN given for the query.

Table 18.2. LDAP dereferencing behaviors

Dereferencing behavior	Description
never	Never dereference any aliases found in the LDAP tree.
search	Only dereference aliases found while searching.
base	Only dereference aliases while finding the base object.
always	Always dereference all aliases found in the LDAP tree.

User-defined name mapping

A user-defined name mapping explicitly maps the names of OpenShift Container Platform groups to unique identifiers that find groups on your LDAP server. The mapping uses normal YAML syntax. A user-defined mapping can contain an entry for every group in your LDAP server or only a subset of those groups. If there are groups on the LDAP server that do not have a user-defined name mapping, the default behavior during sync is to use the attribute specified as the OpenShift Container Platform group's name.

User-defined name mapping

```
groupUIDNameMapping:
  "cn=group1,ou=groups,dc=example,dc=com": firstgroup
  "cn=group2,ou=groups,dc=example,dc=com": secondgroup
  "cn=group3,ou=groups,dc=example,dc=com": thirdgroup
```

18.1.1. About the RFC 2307 configuration file

The RFC 2307 schema requires you to provide an LDAP query definition for both user and group entries, as well as the attributes with which to represent them in the internal OpenShift Container Platform records.

For clarity, the group you create in OpenShift Container Platform should use attributes other than the distinguished name whenever possible for user- or administrator-facing fields. For example, identify the users of an OpenShift Container Platform group by their e-mail, and use the name of the group as the common name. The following configuration file creates these relationships:



NOTE

If using user-defined name mappings, your configuration file will differ.

LDAP sync configuration that uses RFC 2307 schema: `rfc2307_config.yaml`

```
kind: LDAPSyncConfig
apiVersion: v1
url: ldap://LDAP_SERVICE_IP:389 1
insecure: false 2
rfc2307:
  groupsQuery:
```

```

baseDN: "ou=groups,dc=example,dc=com"
scope: sub
derefAliases: never
pageSize: 0
groupUIDAttribute: dn 3
groupNameAttributes: [ cn ] 4
groupMembershipAttributes: [ member ] 5
usersQuery:
  baseDN: "ou=users,dc=example,dc=com"
  scope: sub
  derefAliases: never
  pageSize: 0
userUIDAttribute: dn 6
userNameAttributes: [ mail ] 7
tolerateMemberNotFoundErrors: false
tolerateMemberOutOfScopeErrors: false

```

- 1 The IP address and host of the LDAP server where this group's record is stored.
- 2 When **false**, secure LDAP (**ldaps://**) URLs connect using TLS, and insecure LDAP (**ldap://**) URLs are upgraded to TLS. When **true**, no TLS connection is made to the server and you cannot use **ldaps://** URL schemes.
- 3 The attribute that uniquely identifies a group on the LDAP server. You cannot specify **groupsQuery** filters when using DN for **groupUIDAttribute**. For fine-grained filtering, use the whitelist / blacklist method.
- 4 The attribute to use as the name of the group.
- 5 The attribute on the group that stores the membership information.
- 6 The attribute that uniquely identifies a user on the LDAP server. You cannot specify **usersQuery** filters when using DN for userUIDAttribute. For fine-grained filtering, use the whitelist / blacklist method.
- 7 The attribute to use as the name of the user in the OpenShift Container Platform group record.

18.1.2. About the Active Directory configuration file

The Active Directory schema requires you to provide an LDAP query definition for user entries, as well as the attributes to represent them with in the internal OpenShift Container Platform group records.

For clarity, the group you create in OpenShift Container Platform should use attributes other than the distinguished name whenever possible for user- or administrator-facing fields. For example, identify the users of an OpenShift Container Platform group by their e-mail, but define the name of the group by the name of the group on the LDAP server. The following configuration file creates these relationships:

LDAP sync configuration that uses Active Directory schema: `active_directory_config.yaml`

```

kind: LDAPSyncConfig
apiVersion: v1
url: ldap://LDAP_SERVICE_IP:389
activeDirectory:
  usersQuery:

```

```

baseDN: "ou=users,dc=example,dc=com"
scope: sub
derefAliases: never
filter: (objectclass=person)
pageSize: 0
userNameAttributes: [ mail ] ❶
groupMembershipAttributes: [ memberOf ] ❷

```

- ❶ The attribute to use as the name of the user in the OpenShift Container Platform group record.
- ❷ The attribute on the user that stores the membership information.

18.1.3. About the augmented Active Directory configuration file

The augmented Active Directory schema requires you to provide an LDAP query definition for both user entries and group entries, as well as the attributes with which to represent them in the internal OpenShift Container Platform group records.

For clarity, the group you create in OpenShift Container Platform should use attributes other than the distinguished name whenever possible for user- or administrator-facing fields. For example, identify the users of an OpenShift Container Platform group by their e-mail, and use the name of the group as the common name. The following configuration file creates these relationships.

LDAP sync configuration that uses augmented Active Directory schema: augmented_active_directory_config.yaml

```

kind: LDAPSyncConfig
apiVersion: v1
url: ldap://LDAP_SERVICE_IP:389
augmentedActiveDirectory:
  groupsQuery:
    baseDN: "ou=groups,dc=example,dc=com"
    scope: sub
    derefAliases: never
    pageSize: 0
  groupUIDAttribute: dn ❶
  groupNameAttributes: [ cn ] ❷
  usersQuery:
    baseDN: "ou=users,dc=example,dc=com"
    scope: sub
    derefAliases: never
    filter: (objectclass=person)
    pageSize: 0
  userNameAttributes: [ mail ] ❸
  groupMembershipAttributes: [ memberOf ] ❹

```

- ❶ The attribute that uniquely identifies a group on the LDAP server. You cannot specify **groupsQuery** filters when using DN for groupUIDAttribute. For fine-grained filtering, use the whitelist / blacklist method.
- ❷ The attribute to use as the name of the group.
- ❸ The attribute to use as the name of the user in the OpenShift Container Platform group record.

- 4 The attribute on the user that stores the membership information.

18.2. RUNNING LDAP SYNC

Once you have created a sync configuration file, you can begin to sync. OpenShift Container Platform allows administrators to perform a number of different sync types with the same server.

18.2.1. Syncing the LDAP server with OpenShift Container Platform

You can sync all groups from the LDAP server with OpenShift Container Platform.

Prerequisites

- Create a sync configuration file.

Procedure

- To sync all groups from the LDAP server with OpenShift Container Platform:

```
$ oc adm groups sync --sync-config=config.yaml --confirm
```



NOTE

By default, all group synchronization operations are dry-run, so you must set the **-confirm** flag on the **oc adm groups sync** command to make changes to OpenShift Container Platform group records.

18.2.2. Syncing OpenShift Container Platform groups with the LDAP server

You can sync all groups already in OpenShift Container Platform that correspond to groups in the LDAP server specified in the configuration file.

Prerequisites

- Create a sync configuration file.

Procedure

- To sync OpenShift Container Platform groups with the LDAP server:

```
$ oc adm groups sync --type=openshift --sync-config=config.yaml --confirm
```



NOTE

By default, all group synchronization operations are dry-run, so you must set the **-confirm** flag on the **oc adm groups sync** command to make changes to OpenShift Container Platform group records.

18.2.3. Syncing subgroups from the LDAP server with OpenShift Container Platform

You can sync a subset of LDAP groups with OpenShift Container Platform using whitelist files, blacklist files, or both.



NOTE

You can use any combination of blacklist files, whitelist files, or whitelist literals. Whitelist and blacklist files must contain one unique group identifier per line, and you can include whitelist literals directly in the command itself. These guidelines apply to groups found on LDAP servers as well as groups already present in OpenShift Container Platform.

Prerequisites

- Create a sync configuration file.

Procedure

- To sync a subset of LDAP groups with OpenShift Container Platform, use any the following commands:

```
$ oc adm groups sync --whitelist=<whitelist_file> \
    --sync-config=config.yaml \
    --confirm
```

```
$ oc adm groups sync --blacklist=<blacklist_file> \
    --sync-config=config.yaml \
    --confirm
```

```
$ oc adm groups sync <group_unique_identifier> \
    --sync-config=config.yaml \
    --confirm
```

```
$ oc adm groups sync <group_unique_identifier> \
    --whitelist=<whitelist_file> \
    --blacklist=<blacklist_file> \
    --sync-config=config.yaml \
    --confirm
```

```
$ oc adm groups sync --type=openshift \
    --whitelist=<whitelist_file> \
    --sync-config=config.yaml \
    --confirm
```



NOTE

By default, all group synchronization operations are dry-run, so you must set the **-confirm** flag on the **oc adm groups sync** command to make changes to OpenShift Container Platform group records.

18.3. RUNNING A GROUP PRUNING JOB

An administrator can also choose to remove groups from OpenShift Container Platform records if the records on the LDAP server that created them are no longer present. The prune job will accept the same sync configuration file and whitelists or blacklists as used for the sync job.

For example:

```
$ oc adm prune groups --sync-config=/path/to/ldap-sync-config.yaml --confirm
```

```
$ oc adm prune groups --whitelist=/path/to/whitelist.txt --sync-config=/path/to/ldap-sync-config.yaml --confirm
```

```
$ oc adm prune groups --blacklist=/path/to/blacklist.txt --sync-config=/path/to/ldap-sync-config.yaml --confirm
```

18.4. AUTOMATICALLY SYNCING LDAP GROUPS

You can automatically sync LDAP groups on a periodic basis by configuring a cron job.

Prerequisites

- You have access to the cluster as a user with the **cluster-admin** role.
- You have configured an LDAP identity provider (IDP).
This procedure assumes that you created an LDAP secret named **ldap-secret** and a config map named **ca-config-map**.

Procedure

1. Create a project where the cron job will run:

```
$ oc new-project ldap-sync 1
```

1 This procedure uses a project called **ldap-sync**.

2. Locate the secret and config map that you created when configuring the LDAP identity provider and copy them to this new project.
The secret and config map exist in the **openshift-config** project and must be copied to the new **ldap-sync** project.

3. Define a service account:

Example **ldap-sync-service-account.yaml**

```
kind: ServiceAccount
apiVersion: v1
metadata:
  name: ldap-group-syncer
  namespace: ldap-sync
```

4. Create the service account:

```
$ oc create -f ldap-sync-service-account.yaml
```

- 5. Define a cluster role:

Example `ldap-sync-cluster-role.yaml`

```
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRole
metadata:
  name: ldap-group-syncer
rules:
  - apiGroups:
    - ""
    - user.openshift.io
  resources:
    - groups
  verbs:
    - get
    - list
    - create
    - update
```

- 6. Create the cluster role:

```
$ oc create -f ldap-sync-cluster-role.yaml
```

- 7. Define a cluster role binding to bind the cluster role to the service account:

Example `ldap-sync-cluster-role-binding.yaml`

```
kind: ClusterRoleBinding
apiVersion: rbac.authorization.k8s.io/v1
metadata:
  name: ldap-group-syncer
subjects:
  - kind: ServiceAccount
    name: ldap-group-syncer 1
    namespace: ldap-sync
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: ldap-group-syncer 2
```

1 Reference to the service account created earlier in this procedure.

2 Reference to the cluster role created earlier in this procedure.

- 8. Create the cluster role binding:

```
$ oc create -f ldap-sync-cluster-role-binding.yaml
```

- 9. Define a config map that specifies the sync configuration file:

Example `ldap-sync-config-map.yaml`

```

kind: ConfigMap
apiVersion: v1
metadata:
  name: ldap-group-syncer
  namespace: ldap-sync
data:
  sync.yaml: |
    kind: LDAPSyncConfig
    apiVersion: v1
    url: ldaps://10.0.0.0:389
    insecure: false
    bindDN: cn=admin,dc=example,dc=com
    bindPassword:
      file: "/etc/secrets/bindPassword"
    ca: /etc/ldap-ca/ca.crt
    rfc2307:
      groupsQuery:
        baseDN: "ou=groups,dc=example,dc=com"
        scope: sub
        filter: "(objectClass=groupOfMembers)"
        derefAliases: never
        pageSize: 0
      groupUIDAttribute: dn
      groupNameAttributes: [ cn ]
      groupMembershipAttributes: [ member ]
      usersQuery:
        baseDN: "ou=users,dc=example,dc=com"
        scope: sub
        derefAliases: never
        pageSize: 0
      userUIDAttribute: dn
      userNameAttributes: [ uid ]
      tolerateMemberNotFoundErrors: false
      tolerateMemberOutOfScopeErrors: false

```

- 1 Define the sync configuration file.
- 2 Specify the URL.
- 3 Specify the **bindDN**.
- 4 This example uses the RFC2307 schema; adjust values as necessary. You can also use a different schema.
- 5 Specify the **baseDN** for **groupsQuery**.
- 6 Specify the **baseDN** for **usersQuery**.

10. Create the config map:

```
$ oc create -f ldap-sync-config-map.yaml
```

11. Define a cron job:

```
- . . . . .
```


Example `ldap-sync-cron-job.yaml`

```

kind: CronJob
apiVersion: batch/v1
metadata:
  name: ldap-group-syncer
  namespace: ldap-sync
spec:
  schedule: "*/30 * * * *"
  concurrencyPolicy: Forbid
  jobTemplate:
    spec:
      backoffLimit: 0
      ttlSecondsAfterFinished: 1800
      template:
        spec:
          containers:
            - name: ldap-group-sync
              image: "registry.redhat.io/openshift4/ose-cli:latest"
              command:
                - "/bin/bash"
                - "-c"
                - "oc adm groups sync --sync-config=/etc/config/sync.yaml --confirm"
              volumeMounts:
                - mountPath: "/etc/config"
                  name: "ldap-sync-volume"
                - mountPath: "/etc/secrets"
                  name: "ldap-bind-password"
                - mountPath: "/etc/ldap-ca"
                  name: "ldap-ca"
          volumes:
            - name: "ldap-sync-volume"
              configMap:
                name: "ldap-group-syncer"
            - name: "ldap-bind-password"
              secret:
                secretName: "ldap-secret"
            - name: "ldap-ca"
              configMap:
                name: "ca-config-map"
          restartPolicy: "Never"
          terminationGracePeriodSeconds: 30
          activeDeadlineSeconds: 500
          dnsPolicy: "ClusterFirst"
          serviceAccountName: "ldap-group-syncer"

```

- 1 Configure the settings for the cron job. See "Creating cron jobs" for more information on cron job settings.
- 2 The schedule for the job specified in [cron format](#). This example cron job runs every 30 minutes. Adjust the frequency as necessary, making sure to take into account how long the sync takes to run.
- 3 How long, in seconds, to keep finished jobs. This should match the period of the job schedule in order to clean old failed jobs and prevent unnecessary alerts. For more information, see [TTI -after-finished Controller](#) in the Kubernetes documentation.

information, see [LDAP Entry Finished Controller](#) in the Kubernetes documentation.

- 4 The LDAP sync command for the cron job to run. Passes in the sync configuration file that was defined in the config map.
- 5 This secret was created when the LDAP IDP was configured.
- 6 This config map was created when the LDAP IDP was configured.

12. Create the cron job:

```
$ oc create -f ldap-sync-cron-job.yaml
```

Additional resources

- [Configuring an LDAP identity provider](#)
- [Creating cron jobs](#)

18.5. LDAP GROUP SYNC EXAMPLES

This section contains examples for the RFC 2307, Active Directory, and augmented Active Directory schemas.



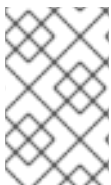
NOTE

These examples assume that all users are direct members of their respective groups. Specifically, no groups have other groups as members. See the Nested Membership Sync Example for information on how to sync nested groups.

18.5.1. Syncing groups using the RFC 2307 schema

For the RFC 2307 schema, the following examples synchronize a group named **admins** that has two members: **Jane** and **Jim**. The examples explain:

- How the group and users are added to the LDAP server.
- What the resulting group record in OpenShift Container Platform will be after synchronization.



NOTE

These examples assume that all users are direct members of their respective groups. Specifically, no groups have other groups as members. See the Nested Membership Sync Example for information on how to sync nested groups.

In the RFC 2307 schema, both users (Jane and Jim) and groups exist on the LDAP server as first-class entries, and group membership is stored in attributes on the group. The following snippet of **ldif** defines the users and group for this schema:

LDAP entries that use RFC 2307 schema: **rfc2307.ldif**

```
dn: ou=users,dc=example,dc=com
objectClass: organizationalUnit
```

```

ou: users
dn: cn=Jane,ou=users,dc=example,dc=com
objectClass: person
objectClass: organizationalPerson
objectClass: inetOrgPerson
cn: Jane
sn: Smith
displayName: Jane Smith
mail: jane.smith@example.com
dn: cn=Jim,ou=users,dc=example,dc=com
objectClass: person
objectClass: organizationalPerson
objectClass: inetOrgPerson
cn: Jim
sn: Adams
displayName: Jim Adams
mail: jim.adams@example.com
dn: ou=groups,dc=example,dc=com
objectClass: organizationalUnit
ou: groups
dn: cn=admins,ou=groups,dc=example,dc=com 1
objectClass: groupOfNames
cn: admins
owner: cn=admin,dc=example,dc=com
description: System Administrators
member: cn=Jane,ou=users,dc=example,dc=com 2
member: cn=Jim,ou=users,dc=example,dc=com

```

- 1 The group is a first-class entry in the LDAP server.
- 2 Members of a group are listed with an identifying reference as attributes on the group.

Prerequisites

- Create the configuration file.

Procedure

- Run the sync with the **rfc2307_config.yaml** file:

```
$ oc adm groups sync --sync-config=rfc2307_config.yaml --confirm
```

OpenShift Container Platform creates the following group record as a result of the above sync operation:

OpenShift Container Platform group created by using the **rfc2307_config.yaml** file

```

apiVersion: user.openshift.io/v1
kind: Group
metadata:
  annotations:
    openshift.io/ldap.sync-time: 2015-10-13T10:08:38-0400 1
    openshift.io/ldap.uid: cn=admins,ou=groups,dc=example,dc=com 2

```

```

openshift.io/ldap.url: LDAP_SERVER_IP:389 3
creationTimestamp:
name: admins 4
users: 5
- jane.smith@example.com
- jim.adams@example.com

```

- 1 The last time this OpenShift Container Platform group was synchronized with the LDAP server, in ISO 6801 format.
- 2 The unique identifier for the group on the LDAP server.
- 3 The IP address and host of the LDAP server where this group's record is stored.
- 4 The name of the group as specified by the sync file.
- 5 The users that are members of the group, named as specified by the sync file.

18.5.2. Syncing groups using the RFC2307 schema with user-defined name mappings

When syncing groups with user-defined name mappings, the configuration file changes to contain these mappings as shown below.

LDAP sync configuration that uses RFC 2307 schema with user-defined name mappings:
rfc2307_config_user_defined.yaml

```

kind: LDAPSyncConfig
apiVersion: v1
groupUIDNameMapping:
  "cn=admins,ou=groups,dc=example,dc=com": Administrators 1
rfc2307:
  groupsQuery:
    baseDN: "ou=groups,dc=example,dc=com"
    scope: sub
    derefAliases: never
    pageSize: 0
  groupUIDAttribute: dn 2
  groupNameAttributes: [ cn ] 3
  groupMembershipAttributes: [ member ]
  usersQuery:
    baseDN: "ou=users,dc=example,dc=com"
    scope: sub
    derefAliases: never
    pageSize: 0
  userUIDAttribute: dn 4
  userNameAttributes: [ mail ]
  tolerateMemberNotFoundErrors: false
  tolerateMemberOutOfScopeErrors: false

```

- 1 The user-defined name mapping.
- 2 The unique identifier attribute that is used for the keys in the user-defined name mapping. You cannot specify **groupsQuery** filters when using DN for groupUIDAttribute. For fine-grained

cannot specify **groupsQuery** filters when using DN for groupOIDAttribute. For fine-grained filtering, use the whitelist / blacklist method.

- 3 The attribute to name OpenShift Container Platform groups with if their unique identifier is not in the user-defined name mapping.
- 4 The attribute that uniquely identifies a user on the LDAP server. You cannot specify **usersQuery** filters when using DN for userUIDAttribute. For fine-grained filtering, use the whitelist / blacklist method.

Prerequisites

- Create the configuration file.

Procedure

- Run the sync with the **rfc2307_config_user_defined.yaml** file:

```
$ oc adm groups sync --sync-config=rfc2307_config_user_defined.yaml --confirm
```

OpenShift Container Platform creates the following group record as a result of the above sync operation:

OpenShift Container Platform group created by using the **rfc2307_config_user_defined.yaml** file

```
apiVersion: user.openshift.io/v1
kind: Group
metadata:
  annotations:
    openshift.io/ldap.sync-time: 2015-10-13T10:08:38-0400
    openshift.io/ldap.uid: cn=admins,ou=groups,dc=example,dc=com
    openshift.io/ldap.url: LDAP_SERVER_IP:389
  creationTimestamp:
    name: Administrators 1
  users:
  - jane.smith@example.com
  - jim.adams@example.com
```

- 1 The name of the group as specified by the user-defined name mapping.

18.5.3. Syncing groups using RFC 2307 with user-defined error tolerances

By default, if the groups being synced contain members whose entries are outside of the scope defined in the member query, the group sync fails with an error:

```
Error determining LDAP group membership for "<group>": membership lookup for user "<user>" in group "<group>" failed because of "search for entry with dn="<user-dn>" would search outside of the base dn specified (dn="<base-dn>")".
```

This often indicates a misconfigured **baseDN** in the **usersQuery** field. However, in cases where the **baseDN** intentionally does not contain some of the members of the group, setting **tolerateMemberOutOfScopeErrors: true** allows the group sync to continue. Out of scope members

will be ignored.

Similarly, when the group sync process fails to locate a member for a group, it fails outright with errors:

```
Error determining LDAP group membership for "<group>": membership lookup for user "<user>" in
group "<group>" failed because of "search for entry with base dn="<user-dn>" refers to a non-
existent entry".
```

```
Error determining LDAP group membership for "<group>": membership lookup for user "<user>" in
group "<group>" failed because of "search for entry with base dn="<user-dn>" and filter "<filter>" did
not return any results".
```

This often indicates a misconfigured **usersQuery** field. However, in cases where the group contains member entries that are known to be missing, setting **tolerateMemberNotFoundErrors: true** allows the group sync to continue. Problematic members will be ignored.



WARNING

Enabling error tolerances for the LDAP group sync causes the sync process to ignore problematic member entries. If the LDAP group sync is not configured correctly, this could result in synced OpenShift Container Platform groups missing members.

LDAP entries that use RFC 2307 schema with problematic group membership: `rfc2307_problematic_users.ldif`

```
dn: ou=users,dc=example,dc=com
objectClass: organizationalUnit
ou: users
dn: cn=Jane,ou=users,dc=example,dc=com
objectClass: person
objectClass: organizationalPerson
objectClass: inetOrgPerson
cn: Jane
sn: Smith
displayName: Jane Smith
mail: jane.smith@example.com
dn: cn=Jim,ou=users,dc=example,dc=com
objectClass: person
objectClass: organizationalPerson
objectClass: inetOrgPerson
cn: Jim
sn: Adams
displayName: Jim Adams
mail: jim.adams@example.com
dn: ou=groups,dc=example,dc=com
objectClass: organizationalUnit
ou: groups
dn: cn=admins,ou=groups,dc=example,dc=com
objectClass: groupOfNames
cn: admins
```

```
owner: cn=admin,dc=example,dc=com
description: System Administrators
member: cn=Jane,ou=users,dc=example,dc=com
member: cn=Jim,ou=users,dc=example,dc=com
member: cn=INVALID,ou=users,dc=example,dc=com ❶
member: cn=Jim,ou=OUTOFSCOPE,dc=example,dc=com ❷
```

- ❶ A member that does not exist on the LDAP server.
- ❷ A member that may exist, but is not under the **baseDN** in the user query for the sync job.

To tolerate the errors in the above example, the following additions to your sync configuration file must be made:

LDAP sync configuration that uses RFC 2307 schema tolerating errors:

rfc2307_config_tolerating.yaml

```
kind: LDAPSyncConfig
apiVersion: v1
url: ldap://LDAP_SERVICE_IP:389
rfc2307:
  groupsQuery:
    baseDN: "ou=groups,dc=example,dc=com"
    scope: sub
    derefAliases: never
  groupUIDAttribute: dn
  groupNameAttributes: [ cn ]
  groupMembershipAttributes: [ member ]
  usersQuery:
    baseDN: "ou=users,dc=example,dc=com"
    scope: sub
    derefAliases: never
  userUIDAttribute: dn ❶
  userNameAttributes: [ mail ]
  tolerateMemberNotFoundErrors: true ❷
  tolerateMemberOutOfScopeErrors: true ❸
```

- ❶ The attribute that uniquely identifies a user on the LDAP server. You cannot specify **usersQuery** filters when using DN for userUIDAttribute. For fine-grained filtering, use the whitelist / blacklist method.
- ❷ When **true**, the sync job tolerates groups for which some members were not found, and members whose LDAP entries are not found are ignored. The default behavior for the sync job is to fail if a member of a group is not found.
- ❸ When **true**, the sync job tolerates groups for which some members are outside the user scope given in the **usersQuery** base DN, and members outside the member query scope are ignored. The default behavior for the sync job is to fail if a member of a group is out of scope.

Prerequisites

- Create the configuration file.

Procedure

- Run the sync with the **rfc2307_config_tolerating.yaml** file:

```
$ oc adm groups sync --sync-config=rfc2307_config_tolerating.yaml --confirm
```

OpenShift Container Platform creates the following group record as a result of the above sync operation:

OpenShift Container Platform group created by using the **rfc2307_config.yaml** file

```
apiVersion: user.openshift.io/v1
kind: Group
metadata:
  annotations:
    openshift.io/ldap.sync-time: 2015-10-13T10:08:38-0400
    openshift.io/ldap.uid: cn=admins,ou=groups,dc=example,dc=com
    openshift.io/ldap.url: LDAP_SERVER_IP:389
  creationTimestamp:
    name: admins
  users: 1
  - jane.smith@example.com
  - jim.adams@example.com
```

- 1** The users that are members of the group, as specified by the sync file. Members for which lookup encountered tolerated errors are absent.

18.5.4. Syncing groups using the Active Directory schema

In the Active Directory schema, both users (Jane and Jim) exist in the LDAP server as first-class entries, and group membership is stored in attributes on the user. The following snippet of **ldif** defines the users and group for this schema:

LDAP entries that use Active Directory schema: **active_directory.ldif**

```
dn: ou=users,dc=example,dc=com
objectClass: organizationalUnit
ou: users

dn: cn=Jane,ou=users,dc=example,dc=com
objectClass: person
objectClass: organizationalPerson
objectClass: inetOrgPerson
objectClass: testPerson
cn: Jane
sn: Smith
displayName: Jane Smith
mail: jane.smith@example.com
memberOf: admins 1

dn: cn=Jim,ou=users,dc=example,dc=com
objectClass: person
objectClass: organizationalPerson
```



```
objectClass: inetOrgPerson
objectClass: testPerson
cn: Jim
sn: Adams
displayName: Jim Adams
mail: jim.adams@example.com
memberOf: admins
```

- 1 The user's group memberships are listed as attributes on the user, and the group does not exist as an entry on the server. The **memberOf** attribute does not have to be a literal attribute on the user; in some LDAP servers, it is created during search and returned to the client, but not committed to the database.

Prerequisites

- Create the configuration file.

Procedure

- Run the sync with the **active_directory_config.yaml** file:

```
$ oc adm groups sync --sync-config=active_directory_config.yaml --confirm
```

OpenShift Container Platform creates the following group record as a result of the above sync operation:

OpenShift Container Platform group created by using the **active_directory_config.yaml** file

```
apiVersion: user.openshift.io/v1
kind: Group
metadata:
  annotations:
    openshift.io/ldap.sync-time: 2015-10-13T10:08:38-0400 1
    openshift.io/ldap.uid: admins 2
    openshift.io/ldap.url: LDAP_SERVER_IP:389 3
  creationTimestamp:
    name: admins 4
  users: 5
- jane.smith@example.com
- jim.adams@example.com
```

- 1 The last time this OpenShift Container Platform group was synchronized with the LDAP server, in ISO 6801 format.
- 2 The unique identifier for the group on the LDAP server.
- 3 The IP address and host of the LDAP server where this group's record is stored.
- 4 The name of the group as listed in the LDAP server.
- 5 The users that are members of the group, named as specified by the sync file.

18.5.5. Syncing groups using the augmented Active Directory schema

In the augmented Active Directory schema, both users (Jane and Jim) and groups exist in the LDAP server as first-class entries, and group membership is stored in attributes on the user. The following snippet of **ldif** defines the users and group for this schema:

LDAP entries that use augmented Active Directory schema: `augmented_active_directory.ldif`

```
dn: ou=users,dc=example,dc=com
objectClass: organizationalUnit
ou: users

dn: cn=Jane,ou=users,dc=example,dc=com
objectClass: person
objectClass: organizationalPerson
objectClass: inetOrgPerson
objectClass: testPerson
cn: Jane
sn: Smith
displayName: Jane Smith
mail: jane.smith@example.com
memberOf: cn=admins,ou=groups,dc=example,dc=com 1

dn: cn=Jim,ou=users,dc=example,dc=com
objectClass: person
objectClass: organizationalPerson
objectClass: inetOrgPerson
objectClass: testPerson
cn: Jim
sn: Adams
displayName: Jim Adams
mail: jim.adams@example.com
memberOf: cn=admins,ou=groups,dc=example,dc=com

dn: ou=groups,dc=example,dc=com
objectClass: organizationalUnit
ou: groups

dn: cn=admins,ou=groups,dc=example,dc=com 2
objectClass: groupOfNames
cn: admins
owner: cn=admin,dc=example,dc=com
description: System Administrators
member: cn=Jane,ou=users,dc=example,dc=com
member: cn=Jim,ou=users,dc=example,dc=com
```

- 1 The user's group memberships are listed as attributes on the user.
- 2 The group is a first-class entry on the LDAP server.

Prerequisites

- Create the configuration file.

Procedure

- Run the sync with the **augmented_active_directory_config.yaml** file:

```
$ oc adm groups sync --sync-config=augmented_active_directory_config.yaml --confirm
```

OpenShift Container Platform creates the following group record as a result of the above sync operation:

OpenShift Container Platform group created by using the **augmented_active_directory_config.yaml** file

```
apiVersion: user.openshift.io/v1
kind: Group
metadata:
  annotations:
    openshift.io/ldap.sync-time: 2015-10-13T10:08:38-0400 ①
    openshift.io/ldap.uid: cn=admins,ou=groups,dc=example,dc=com ②
    openshift.io/ldap.url: LDAP_SERVER_IP:389 ③
  creationTimestamp:
    name: admins ④
  users: ⑤
  - jane.smith@example.com
  - jim.adams@example.com
```

- ① The last time this OpenShift Container Platform group was synchronized with the LDAP server, in ISO 6801 format.
- ② The unique identifier for the group on the LDAP server.
- ③ The IP address and host of the LDAP server where this group's record is stored.
- ④ The name of the group as specified by the sync file.
- ⑤ The users that are members of the group, named as specified by the sync file.

18.5.5.1. LDAP nested membership sync example

Groups in OpenShift Container Platform do not nest. The LDAP server must flatten group membership before the data can be consumed. Microsoft's Active Directory Server supports this feature via the **LDAP_MATCHING_RULE_IN_CHAIN** rule, which has the OID **1.2.840.113556.1.4.1941**. Furthermore, only explicitly whitelisted groups can be synced when using this matching rule.

This section has an example for the augmented Active Directory schema, which synchronizes a group named **admins** that has one user **Jane** and one group **otheradmins** as members. The **otheradmins** group has one user member: **Jim**. This example explains:

- How the group and users are added to the LDAP server.
- What the LDAP sync configuration file looks like.
- What the resulting group record in OpenShift Container Platform will be after synchronization.

In the augmented Active Directory schema, both users (**Jane** and **Jim**) and groups exist in the LDAP server as first-class entries, and group membership is stored in attributes on the user or the group. The following snippet of **ldif** defines the users and groups for this schema:

LDAP entries that use augmented Active Directory schema with nested members: **augmented_active_directory_nested.ldif**

```
dn: ou=users,dc=example,dc=com
objectClass: organizationalUnit
ou: users

dn: cn=Jane,ou=users,dc=example,dc=com
objectClass: person
objectClass: organizationalPerson
objectClass: inetOrgPerson
objectClass: testPerson
cn: Jane
sn: Smith
displayName: Jane Smith
mail: jane.smith@example.com
memberOf: cn=admins,ou=groups,dc=example,dc=com 1

dn: cn=Jim,ou=users,dc=example,dc=com
objectClass: person
objectClass: organizationalPerson
objectClass: inetOrgPerson
objectClass: testPerson
cn: Jim
sn: Adams
displayName: Jim Adams
mail: jim.adams@example.com
memberOf: cn=otheradmins,ou=groups,dc=example,dc=com 2

dn: ou=groups,dc=example,dc=com
objectClass: organizationalUnit
ou: groups

dn: cn=admins,ou=groups,dc=example,dc=com 3
objectClass: group
cn: admins
owner: cn=admin,dc=example,dc=com
description: System Administrators
member: cn=Jane,ou=users,dc=example,dc=com
member: cn=otheradmins,ou=groups,dc=example,dc=com

dn: cn=otheradmins,ou=groups,dc=example,dc=com 4
objectClass: group
cn: otheradmins
owner: cn=admin,dc=example,dc=com
description: Other System Administrators
memberOf: cn=admins,ou=groups,dc=example,dc=com 5 6
member: cn=Jim,ou=users,dc=example,dc=com
```

1 2 5 The user's and group's memberships are listed as attributes on the object.

3 **4** The groups are first-class entries on the LDAP server.

6 The **otheradmins** group is a member of the **admins** group.

When syncing nested groups with Active Directory, you must provide an LDAP query definition for both user entries and group entries, as well as the attributes with which to represent them in the internal OpenShift Container Platform group records. Furthermore, certain changes are required in this configuration:

- The **oc adm groups sync** command must explicitly whitelist groups.
- The user's **groupMembershipAttributes** must include **"memberOf:1.2.840.113556.1.4.1941:"** to comply with the **LDAP_MATCHING_RULE_IN_CHAIN** rule.
- The **groupUIDAttribute** must be set to **dn**.
- The **groupsQuery**:
 - Must not set **filter**.
 - Must set a valid **derefAliases**.
 - Should not set **baseDN** as that value is ignored.
 - Should not set **scope** as that value is ignored.

For clarity, the group you create in OpenShift Container Platform should use attributes other than the distinguished name whenever possible for user- or administrator-facing fields. For example, identify the users of an OpenShift Container Platform group by their e-mail, and use the name of the group as the common name. The following configuration file creates these relationships:

LDAP sync configuration that uses augmented Active Directory schema with nested members: `augmented_active_directory_config_nested.yaml`

```
kind: LDAPSyncConfig
apiVersion: v1
url: ldap://LDAP_SERVICE_IP:389
augmentedActiveDirectory:
  groupsQuery: 1
    derefAliases: never
    pageSize: 0
  groupUIDAttribute: dn 2
  groupNameAttributes: [ cn ] 3
  usersQuery:
    baseDN: "ou=users,dc=example,dc=com"
    scope: sub
    derefAliases: never
    filter: (objectclass=person)
    pageSize: 0
  userNameAttributes: [ mail ] 4
  groupMembershipAttributes: [ "memberOf:1.2.840.113556.1.4.1941:" ] 5
```

1 **groupsQuery** filters cannot be specified. The **groupsQuery** base DN and scope values are ignored. **groupsQuery** must set a valid **derefAliases**.

- 2 The attribute that uniquely identifies a group on the LDAP server. It must be set to **dn**.
- 3 The attribute to use as the name of the group.
- 4 The attribute to use as the name of the user in the OpenShift Container Platform group record. **mail** or **sAMAccountName** are preferred choices in most installations.
- 5 The attribute on the user that stores the membership information. Note the use of **LDAP_MATCHING_RULE_IN_CHAIN**.

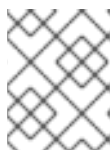
Prerequisites

- Create the configuration file.

Procedure

- Run the sync with the **augmented_active_directory_config_nested.yaml** file:

```
$ oc adm groups sync \
  'cn=admins,ou=groups,dc=example,dc=com' \
  --sync-config=augmented_active_directory_config_nested.yaml \
  --confirm
```



NOTE

You must explicitly whitelist the **cn=admins,ou=groups,dc=example,dc=com** group.

OpenShift Container Platform creates the following group record as a result of the above sync operation:

OpenShift Container Platform group created by using the **augmented_active_directory_config_nested.yaml** file

```
apiVersion: user.openshift.io/v1
kind: Group
metadata:
  annotations:
    openshift.io/ldap.sync-time: 2015-10-13T10:08:38-0400 1
    openshift.io/ldap.uid: cn=admins,ou=groups,dc=example,dc=com 2
    openshift.io/ldap.url: LDAP_SERVER_IP:389 3
  creationTimestamp:
    name: admins 4
  users: 5
  - jane.smith@example.com
  - jim.adams@example.com
```

- 1 The last time this OpenShift Container Platform group was synchronized with the LDAP server, in ISO 6801 format.
- 2 The unique identifier for the group on the LDAP server.

- 3 The IP address and host of the LDAP server where this group's record is stored.
- 4 The name of the group as specified by the sync file.
- 5 The users that are members of the group, named as specified by the sync file. Note that members of nested groups are included since the group membership was flattened by the Microsoft Active Directory Server.

18.6. LDAP SYNC CONFIGURATION SPECIFICATION

The object specification for the configuration file is below. Note that the different schema objects have different fields. For example, `v1.ActiveDirectoryConfig` has no **groupsQuery** field whereas `v1.RFC2307Config` and `v1.AugmentedActiveDirectoryConfig` both do.



IMPORTANT

There is no support for binary attributes. All attribute data coming from the LDAP server must be in the format of a UTF-8 encoded string. For example, never use a binary attribute, such as **objectGUID**, as an ID attribute. You must use string attributes, such as **sAMAccountName** or **userPrincipalName**, instead.

18.6.1. v1.LDAPSyncConfig

LDAPSyncConfig holds the necessary configuration options to define an LDAP group sync.

Name	Description	Schema
kind	String value representing the REST resource this object represents. Servers may infer this from the endpoint the client submits requests to. Cannot be updated. In CamelCase. More info: https://github.com/kubernetes/community/blob/master/contributors/devel/sig-architecture/api-conventions.md#types-kinds	string
apiVersion	Defines the versioned schema of this representation of an object. Servers should convert recognized schemas to the latest internal value, and may reject unrecognized values. More info: https://github.com/kubernetes/community/blob/master/contributors/devel/sig-architecture/api-conventions.md#resources	string

Name	Description	Schema
url	Host is the scheme, host and port of the LDAP server to connect to: scheme://host:port	string
bindDN	Optional DN to bind to the LDAP server with.	string
bindPassword	Optional password to bind with during the search phase.	v1.StringSource
insecure	If true , indicates the connection should not use TLS. If false , ldaps:// URLs connect using TLS, and ldap:// URLs are upgraded to a TLS connection using StartTLS as specified in https://tools.ietf.org/html/rfc2830 . If you set insecure to true , you cannot use ldaps:// URL schemes.	boolean
ca	Optional trusted certificate authority bundle to use when making requests to the server. If empty, the default system roots are used.	string
groupUIDNameMapping	Optional direct mapping of LDAP group UIDs to OpenShift Container Platform group names.	object
rfc2307	Holds the configuration for extracting data from an LDAP server set up in a fashion similar to RFC2307: first-class group and user entries, with group membership determined by a multi-valued attribute on the group entry listing its members.	v1.RFC2307Config
activeDirectory	Holds the configuration for extracting data from an LDAP server set up in a fashion similar to that used in Active Directory: first-class user entries, with group membership determined by a multi-valued attribute on members listing groups they are a member of.	v1.ActiveDirectoryConfig

Name	Description	Schema
augmentedActiveDirectory	Holds the configuration for extracting data from an LDAP server set up in a fashion similar to that used in Active Directory as described above, with one addition: first-class group entries exist and are used to hold metadata but not group membership.	v1.AugmentedActiveDirectoryConfig

18.6.2. v1.StringSource

StringSource allows specifying a string inline, or externally via environment variable or file. When it contains only a string value, it marshals to a simple JSON string.

Name	Description	Schema
value	Specifies the cleartext value, or an encrypted value if keyFile is specified.	string
env	Specifies an environment variable containing the cleartext value, or an encrypted value if the keyFile is specified.	string
file	References a file containing the cleartext value, or an encrypted value if a keyFile is specified.	string
keyFile	References a file containing the key to use to decrypt the value.	string

18.6.3. v1.LDAPQuery

LDAPQuery holds the options necessary to build an LDAP query.

Name	Description	Schema
baseDN	DN of the branch of the directory where all searches should start from.	string

Name	Description	Schema
scope	The optional scope of the search. Can be base : only the base object, one : all objects on the base level, sub : the entire subtree. Defaults to sub if not set.	string
derefAliases	The optional behavior of the search with regards to aliases. Can be never : never dereference aliases, search : only dereference in searching, base : only dereference in finding the base object, always : always dereference. Defaults to always if not set.	string
timeout	Holds the limit of time in seconds that any request to the server can remain outstanding before the wait for a response is given up. If this is 0 , no client-side limit is imposed.	integer
filter	A valid LDAP search filter that retrieves all relevant entries from the LDAP server with the base DN.	string
pageSize	Maximum preferred page size, measured in LDAP entries. A page size of 0 means no paging will be done.	integer

18.6.4. v1.RFC2307Config

RFC2307Config holds the necessary configuration options to define how an LDAP group sync interacts with an LDAP server using the RFC2307 schema.

Name	Description	Schema
groupsQuery	Holds the template for an LDAP query that returns group entries.	v1.LDAPQuery
groupUIDAttribute	Defines which attribute on an LDAP group entry will be interpreted as its unique identifier. (IdapGroupUID)	string

Name	Description	Schema
groupNameAttributes	Defines which attributes on an LDAP group entry will be interpreted as its name to use for an OpenShift Container Platform group.	string array
groupMembershipAttributes	Defines which attributes on an LDAP group entry will be interpreted as its members. The values contained in those attributes must be queryable by your UserUIDAttribute .	string array
usersQuery	Holds the template for an LDAP query that returns user entries.	v1.LDAPQuery
userUIDAttribute	Defines which attribute on an LDAP user entry will be interpreted as its unique identifier. It must correspond to values that will be found from the GroupMembershipAttributes .	string
userNameAttributes	Defines which attributes on an LDAP user entry will be used, in order, as its OpenShift Container Platform user name. The first attribute with a non-empty value is used. This should match your PreferredUsername setting for your LDAPPasswordIdentityProvider . The attribute to use as the name of the user in the OpenShift Container Platform group record. mail or SAMAccountName are preferred choices in most installations.	string array

Name	Description	Schema
tolerateMemberNotFoundErrors	Determines the behavior of the LDAP sync job when missing user entries are encountered. If true , an LDAP query for users that does not find any will be tolerated and an only and error will be logged. If false , the LDAP sync job will fail if a query for users doesn't find any. The default value is false . Misconfigured LDAP sync jobs with this flag set to true can cause group membership to be removed, so it is recommended to use this flag with caution.	boolean
tolerateMemberOutOfScopeErrors	Determines the behavior of the LDAP sync job when out-of-scope user entries are encountered. If true , an LDAP query for a user that falls outside of the base DN given for the all user query will be tolerated and only an error will be logged. If false , the LDAP sync job will fail if a user query would search outside of the base DN specified by the all user query. Misconfigured LDAP sync jobs with this flag set to true can result in groups missing users, so it is recommended to use this flag with caution.	boolean

18.6.5. v1.ActiveDirectoryConfig

ActiveDirectoryConfig holds the necessary configuration options to define how an LDAP group sync interacts with an LDAP server using the Active Directory schema.

Name	Description	Schema
usersQuery	Holds the template for an LDAP query that returns user entries.	v1.LDAPQuery

Name	Description	Schema
userNameAttributes	Defines which attributes on an LDAP user entry will be interpreted as its OpenShift Container Platform user name. The attribute to use as the name of the user in the OpenShift Container Platform group record. mail or sAMAccountName are preferred choices in most installations.	string array
groupMembershipAttributes	Defines which attributes on an LDAP user entry will be interpreted as the groups it is a member of.	string array

18.6.6. v1.AugmentedActiveDirectoryConfig

AugmentedActiveDirectoryConfig holds the necessary configuration options to define how an LDAP group sync interacts with an LDAP server using the augmented Active Directory schema.

Name	Description	Schema
usersQuery	Holds the template for an LDAP query that returns user entries.	v1.LDAPQuery
userNameAttributes	Defines which attributes on an LDAP user entry will be interpreted as its OpenShift Container Platform user name. The attribute to use as the name of the user in the OpenShift Container Platform group record. mail or sAMAccountName are preferred choices in most installations.	string array
groupMembershipAttributes	Defines which attributes on an LDAP user entry will be interpreted as the groups it is a member of.	string array
groupsQuery	Holds the template for an LDAP query that returns group entries.	v1.LDAPQuery

Name	Description	Schema
groupUIDAttribute	Defines which attribute on an LDAP group entry will be interpreted as its unique identifier. (IdapGroupUID)	string
groupNameAttributes	Defines which attributes on an LDAP group entry will be interpreted as its name to use for an OpenShift Container Platform group.	string array

CHAPTER 19. MANAGING CLOUD PROVIDER CREDENTIALS

19.1. ABOUT THE CLOUD CREDENTIAL OPERATOR

The Cloud Credential Operator (CCO) manages cloud provider credentials as custom resource definitions (CRDs). The CCO syncs on **CredentialsRequest** custom resources (CRs) to allow OpenShift Container Platform components to request cloud provider credentials with the specific permissions that are required for the cluster to run.

By setting different values for the **credentialsMode** parameter in the **install-config.yaml** file, the CCO can be configured to operate in several different modes. If no mode is specified, or the **credentialsMode** parameter is set to an empty string (""), the CCO operates in its default mode.

19.1.1. Modes

By setting different values for the **credentialsMode** parameter in the **install-config.yaml** file, the CCO can be configured to operate in *mint*, *passthrough*, or *manual* mode. These options provide transparency and flexibility in how the CCO uses cloud credentials to process **CredentialsRequest** CRs in the cluster, and allow the CCO to be configured to suit the security requirements of your organization. Not all CCO modes are supported for all cloud providers.

- **Mint**: In mint mode, the CCO uses the provided admin-level cloud credential to create new credentials for components in the cluster with only the specific permissions that are required.
- **Passthrough**: In passthrough mode, the CCO passes the provided cloud credential to the components that request cloud credentials.
- **Manual**: In manual mode, a user manages cloud credentials instead of the CCO.
 - **Manual with AWS Security Token Service** In manual mode, you can configure an AWS cluster to use Amazon Web Services Security Token Service (AWS STS). With this configuration, the CCO uses temporary credentials for different components.
 - **Manual with GCP Workload Identity** In manual mode, you can configure a GCP cluster to use GCP Workload Identity. With this configuration, the CCO uses temporary credentials for different components.

Table 19.1. CCO mode support matrix

Cloud provider	Mint	Passthrough	Manual
Alibaba Cloud			X
Amazon Web Services (AWS)	X	X	X
Microsoft Azure		X [1]	X
Google Cloud Platform (GCP)	X	X	X
IBM Cloud			X
Nutanix			X

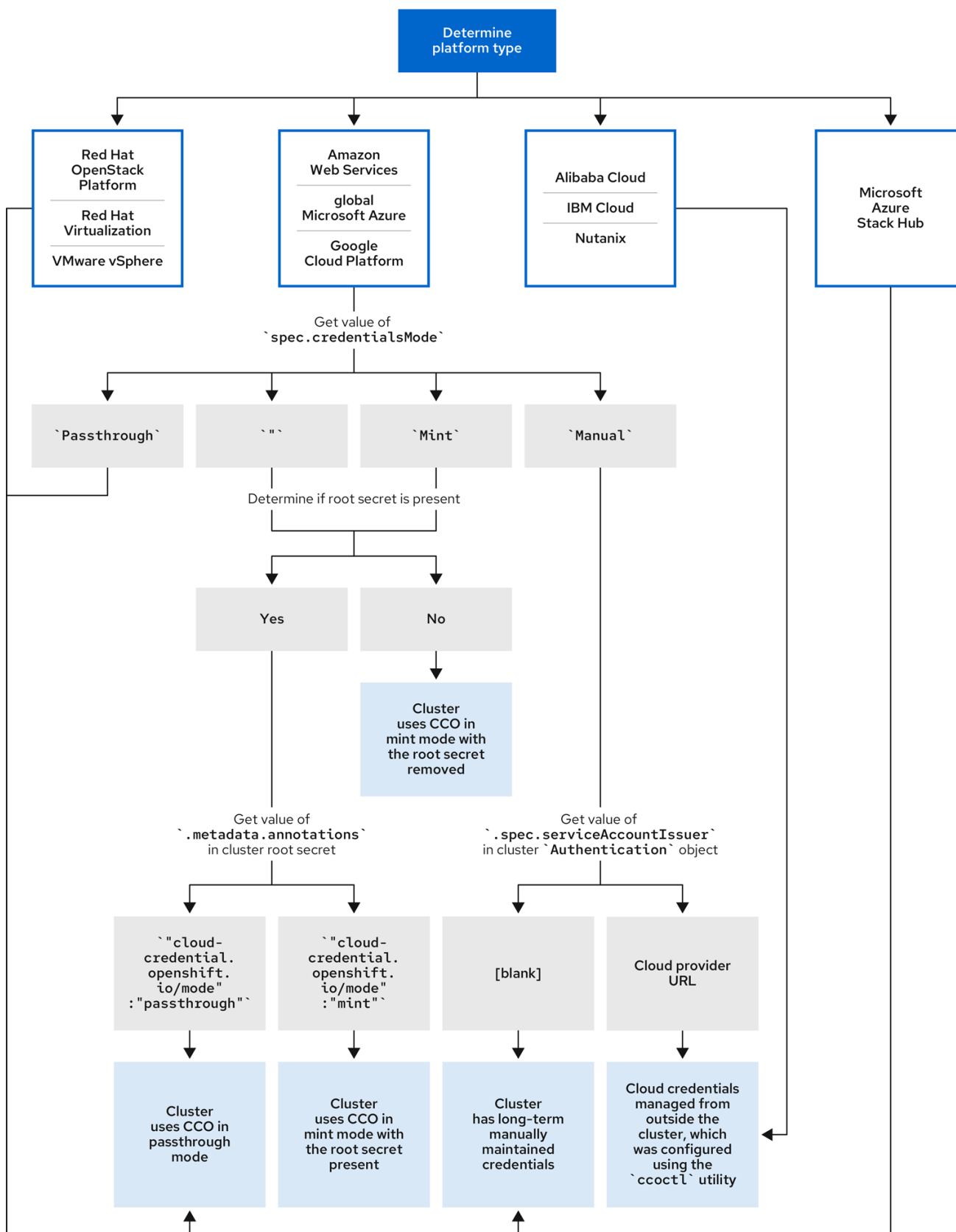
Cloud provider	Mint	Passthrough	Manual
Red Hat OpenStack Platform (RHOSP)		X	
Red Hat Virtualization (RHV)		X	
VMware vSphere		X	

1. Manual mode is the only supported CCO configuration for Microsoft Azure Stack Hub.

19.1.2. Determining the Cloud Credential Operator mode

For platforms that support using the CCO in multiple modes, you can determine what mode the CCO is configured to use by using the web console or the CLI.

Figure 19.1. Determining the CCO configuration



334_OpenShift_0923

19.1.2.1. Determining the Cloud Credential Operator mode by using the web console

You can determine what mode the Cloud Credential Operator (CCO) is configured to use by using the web console.

**NOTE**

Only Amazon Web Services (AWS), global Microsoft Azure, and Google Cloud Platform (GCP) clusters support multiple CCO modes.

Prerequisites

- You have access to an OpenShift Container Platform account with cluster administrator permissions.

Procedure

1. Log in to the OpenShift Container Platform web console as a user with the **cluster-admin** role.
2. Navigate to **Administration** → **Cluster Settings**.
3. On the **Cluster Settings** page, select the **Configuration** tab.
4. Under **Configuration resource**, select **CloudCredential**.
5. On the **CloudCredential details** page, select the **YAML** tab.
6. In the YAML block, check the value of **spec.credentialsMode**. The following values are possible, though not all are supported on all platforms:
 - **"**: The CCO is operating in the default mode. In this configuration, the CCO operates in mint or passthrough mode, depending on the credentials provided during installation.
 - **Mint**: The CCO is operating in mint mode.
 - **Passthrough**: The CCO is operating in passthrough mode.
 - **Manual**: The CCO is operating in manual mode.

**IMPORTANT**

To determine the specific configuration of an AWS or GCP cluster that has a **spec.credentialsMode** of **"**, **Mint**, or **Manual**, you must investigate further.

AWS and GCP clusters support using mint mode with the root secret deleted.

An AWS or GCP cluster that uses manual mode might be configured to create and manage cloud credentials from outside of the cluster using the AWS Security Token Service (STS) or GCP Workload Identity. You can determine whether your cluster uses this strategy by examining the cluster **Authentication** object.

7. AWS or GCP clusters that use the default (**"**) only: To determine whether the cluster is operating in mint or passthrough mode, inspect the annotations on the cluster root secret:
 - a. Navigate to **Workloads** → **Secrets** and look for the root secret for your cloud provider.

**NOTE**

Ensure that the **Project** dropdown is set to **All Projects**.

Platform	Secret name
AWS	aws-creds
GCP	gcp-credentials

b. To view the CCO mode that the cluster is using, click **1 annotation** under **Annotations**, and check the value field. The following values are possible:

- **Mint:** The CCO is operating in mint mode.
- **Passthrough:** The CCO is operating in passthrough mode.

If your cluster uses mint mode, you can also determine whether the cluster is operating without the root secret.

8. AWS or GCP clusters that use mint mode only: To determine whether the cluster is operating without the root secret, navigate to **Workloads** → **Secrets** and look for the root secret for your cloud provider.



NOTE

Ensure that the **Project** dropdown is set to **All Projects**.

Platform	Secret name
AWS	aws-creds
GCP	gcp-credentials

- If you see one of these values, your cluster is using mint or passthrough mode with the root secret present.
- If you do not see these values, your cluster is using the CCO in mint mode with the root secret removed.

9. AWS or GCP clusters that use manual mode only: To determine whether the cluster is configured to create and manage cloud credentials from outside of the cluster, you must check the cluster **Authentication** object YAML values.

a. Navigate to **Administration** → **Cluster Settings**.

b. On the **Cluster Settings** page, select the **Configuration** tab.

c. Under **Configuration resource**, select **Authentication**.

d. On the **Authentication details** page, select the **YAML** tab.

e. In the YAML block, check the value of the **.spec.serviceAccountIssuer** parameter.

- A value that contains a URL that is associated with your cloud provider indicates that the CCO is using manual mode with AWS STS or GCP Workload Identity to create and

manage cloud credentials from outside of the cluster. These clusters are configured using the **ccoctl** utility.

- An empty value (") indicates that the cluster is using the CCO in manual mode but was not configured using the **ccoctl** utility.

19.1.2.2. Determining the Cloud Credential Operator mode by using the CLI

You can determine what mode the Cloud Credential Operator (CCO) is configured to use by using the CLI.



NOTE

Only Amazon Web Services (AWS), global Microsoft Azure, and Google Cloud Platform (GCP) clusters support multiple CCO modes.

Prerequisites

- You have access to an OpenShift Container Platform account with cluster administrator permissions.
- You have installed the OpenShift CLI (**oc**).

Procedure

1. Log in to **oc** on the cluster as a user with the **cluster-admin** role.
2. To determine the mode that the CCO is configured to use, enter the following command:

```
$ oc get cloudcredentials cluster \
  -o=jsonpath={.spec.credentialsMode}
```

The following output values are possible, though not all are supported on all platforms:

- "": The CCO is operating in the default mode. In this configuration, the CCO operates in mint or passthrough mode, depending on the credentials provided during installation.
- **Mint**: The CCO is operating in mint mode.
- **Passthrough**: The CCO is operating in passthrough mode.
- **Manual**: The CCO is operating in manual mode.



IMPORTANT

To determine the specific configuration of an AWS or GCP cluster that has a **spec.credentialsMode** of "", **Mint**, or **Manual**, you must investigate further.

AWS and GCP clusters support using mint mode with the root secret deleted.

An AWS or GCP cluster that uses manual mode might be configured to create and manage cloud credentials from outside of the cluster using the AWS Security Token Service (STS) or GCP Workload Identity. You can determine whether your cluster uses this strategy by examining the cluster **Authentication** object.

3. AWS or GCP clusters that use the default ("") only: To determine whether the cluster is operating in mint or passthrough mode, run the following command:

```
$ oc get secret <secret_name> \
  -n kube-system \
  -o jsonpath \
  --template '{ .metadata.annotations }'
```

where **<secret_name>** is **aws-creds** for AWS or **gcp-credentials** for GCP.

This command displays the value of the **.metadata.annotations** parameter in the cluster root secret object. The following output values are possible:

- **Mint:** The CCO is operating in mint mode.
- **Passthrough:** The CCO is operating in passthrough mode.

If your cluster uses mint mode, you can also determine whether the cluster is operating without the root secret.

4. AWS or GCP clusters that use mint mode only: To determine whether the cluster is operating without the root secret, run the following command:

```
$ oc get secret <secret_name> \
  -n=kube-system
```

where **<secret_name>** is **aws-creds** for AWS or **gcp-credentials** for GCP.

If the root secret is present, the output of this command returns information about the secret. An error indicates that the root secret is not present on the cluster.

5. AWS or GCP clusters that use manual mode only: To determine whether the cluster is configured to create and manage cloud credentials from outside of the cluster, run the following command:

```
$ oc get authentication cluster \
  -o jsonpath \
  --template='{ .spec.serviceAccountIssuer }'
```

This command displays the value of the **.spec.serviceAccountIssuer** parameter in the cluster **Authentication** object.

- An output of a URL that is associated with your cloud provider indicates that the CCO is using manual mode with AWS STS or GCP Workload Identity to create and manage cloud credentials from outside of the cluster. These clusters are configured using the **ccoctl** utility.
- An empty output indicates that the cluster is using the CCO in manual mode but was not configured using the **ccoctl** utility.

19.1.3. Default behavior

For platforms on which multiple modes are supported (AWS, Azure, and GCP), when the CCO operates in its default mode, it checks the provided credentials dynamically to determine for which mode they are sufficient to process **CredentialsRequest** CRs.

By default, the CCO determines whether the credentials are sufficient for mint mode, which is the preferred mode of operation, and uses those credentials to create appropriate credentials for components in the cluster. If the credentials are not sufficient for mint mode, it determines whether they are sufficient for passthrough mode. If the credentials are not sufficient for passthrough mode, the CCO cannot adequately process **CredentialsRequest** CRs.

If the provided credentials are determined to be insufficient during installation, the installation fails. For AWS, the installer fails early in the process and indicates which required permissions are missing. Other providers might not provide specific information about the cause of the error until errors are encountered.

If the credentials are changed after a successful installation and the CCO determines that the new credentials are insufficient, the CCO puts conditions on any new **CredentialsRequest** CRs to indicate that it cannot process them because of the insufficient credentials.

To resolve insufficient credentials issues, provide a credential with sufficient permissions. If an error occurred during installation, try installing again. For issues with new **CredentialsRequest** CRs, wait for the CCO to try to process the CR again. As an alternative, you can manually create IAM for [AWS](#), [Azure](#), and [GCP](#).

19.1.4. Additional resources

- [Cluster Operators reference page for the Cloud Credential Operator](#)

19.2. USING MINT MODE

Mint mode is supported for Amazon Web Services (AWS) and Google Cloud Platform (GCP).

Mint mode is the default mode on the platforms for which it is supported. In this mode, the Cloud Credential Operator (CCO) uses the provided administrator-level cloud credential to create new credentials for components in the cluster with only the specific permissions that are required.

If the credential is not removed after installation, it is stored and used by the CCO to process **CredentialsRequest** CRs for components in the cluster and create new credentials for each with only the specific permissions that are required. The continuous reconciliation of cloud credentials in mint mode allows actions that require additional credentials or permissions, such as upgrading, to proceed.

Mint mode stores the administrator-level credential in the cluster **kube-system** namespace. If this approach does not meet the security requirements of your organization, see *Alternatives to storing administrator-level secrets in the kube-system project* for [AWS](#) or [GCP](#).

19.2.1. Mint mode permissions requirements

When using the CCO in mint mode, ensure that the credential you provide meets the requirements of the cloud on which you are running or installing OpenShift Container Platform. If the provided credentials are not sufficient for mint mode, the CCO cannot create an IAM user.

19.2.1.1. Amazon Web Services (AWS) permissions

The credential you provide for mint mode in AWS must have the following permissions:

- **iam:CreateAccessKey**
- **iam:CreateUser**

- `iam:DeleteAccessKey`
- `iam:DeleteUser`
- `iam:DeleteUserPolicy`
- `iam:GetUser`
- `iam:GetUserPolicy`
- `iam:ListAccessKeys`
- `iam:PutUserPolicy`
- `iam:TagUser`
- `iam:SimulatePrincipalPolicy`

19.2.1.2. Google Cloud Platform (GCP) permissions

The credential you provide for mint mode in GCP must have the following permissions:

- `resourcemanager.projects.get`
- `serviceusage.services.list`
- `iam.serviceAccountKeys.create`
- `iam.serviceAccountKeys.delete`
- `iam.serviceAccounts.create`
- `iam.serviceAccounts.delete`
- `iam.serviceAccounts.get`
- `iam.roles.get`
- `resourcemanager.projects.getIamPolicy`
- `resourcemanager.projects.setIamPolicy`

19.2.2. Admin credentials root secret format

Each cloud provider uses a credentials root secret in the **kube-system** namespace by convention, which is then used to satisfy all credentials requests and create their respective secrets. This is done either by minting new credentials with *mint mode*, or by copying the credentials root secret with *passthrough mode*.

The format for the secret varies by cloud, and is also used for each **CredentialsRequest** secret.

Amazon Web Services (AWS) secret format

```
apiVersion: v1
kind: Secret
metadata:
  namespace: kube-system
```

```

name: aws-creds
stringData:
  aws_access_key_id: <base64-encoded_access_key_id>
  aws_secret_access_key: <base64-encoded_secret_access_key>

```

Google Cloud Platform (GCP) secret format

```

apiVersion: v1
kind: Secret
metadata:
  namespace: kube-system
  name: gcp-credentials
stringData:
  service_account.json: <base64-encoded_service_account>

```

19.2.3. Mint mode with removal or rotation of the administrator-level credential

Currently, this mode is only supported on AWS and GCP.

In this mode, a user installs OpenShift Container Platform with an administrator-level credential just like the normal mint mode. However, this process removes the administrator-level credential secret from the cluster post-installation.

The administrator can have the Cloud Credential Operator make its own request for a read-only credential that allows it to verify if all **CredentialsRequest** objects have their required permissions, thus the administrator-level credential is not required unless something needs to be changed. After the associated credential is removed, it can be deleted or deactivated on the underlying cloud, if desired.



NOTE

Prior to a non z-stream upgrade, you must reinstate the credential secret with the administrator-level credential. If the credential is not present, the upgrade might be blocked.

The administrator-level credential is not stored in the cluster permanently.

Following these steps still requires the administrator-level credential in the cluster for brief periods of time. It also requires manually re-instating the secret with administrator-level credentials for each upgrade.

19.2.3.1. Rotating cloud provider credentials manually

If your cloud provider credentials are changed for any reason, you must manually update the secret that the Cloud Credential Operator (CCO) uses to manage cloud provider credentials.

The process for rotating cloud credentials depends on the mode that the CCO is configured to use. After you rotate credentials for a cluster that is using mint mode, you must manually remove the component credentials that were created by the removed credential.

Prerequisites


- Your cluster is installed on a platform that supports rotating cloud credentials manually with the CCO mode that you are using:

- For mint mode, Amazon Web Services (AWS) and Google Cloud Platform (GCP) are supported.
- You have changed the credentials that are used to interface with your cloud provider.
- The new credentials have sufficient permissions for the mode CCO is configured to use in your cluster.

Procedure

1. In the **Administrator** perspective of the web console, navigate to **Workloads → Secrets**.
2. In the table on the **Secrets** page, find the root secret for your cloud provider.

Platform	Secret name
AWS	aws-creds
GCP	gcp-credentials

3. Click the **Options** menu  in the same row as the secret and select **Edit Secret**.
4. Record the contents of the **Value** field or fields. You can use this information to verify that the value is different after updating the credentials.
5. Update the text in the **Value** field or fields with the new authentication information for your cloud provider, and then click **Save**.
6. Delete each component secret that is referenced by the individual **CredentialsRequest** objects.
 - a. Log in to the OpenShift Container Platform CLI as a user with the **cluster-admin** role.
 - b. Get the names and namespaces of all referenced component secrets:

```
$ oc -n openshift-cloud-credential-operator get CredentialsRequest \
  -o json | jq -r '.items[] | select (.spec.providerSpec.kind=="<provider_spec>") |
  .spec.secretRef'
```

where **<provider_spec>** is the corresponding value for your cloud provider:

- AWS: **AWSProviderSpec**
- GCP: **GCPProviderSpec**

Partial example output for AWS

```
{
  "name": "ebs-cloud-credentials",
  "namespace": "openshift-cluster-csi-drivers"
}
```

```
"name": "cloud-credential-operator-iam-ro-creds",
"namespace": "openshift-cloud-credential-operator"
}
```

- c. Delete each of the referenced component secrets:

```
$ oc delete secret <secret_name> \ 1
-n <secret_namespace> 2
```

- 1** Specify the name of a secret.
- 2** Specify the namespace that contains the secret.

Example deletion of an AWS secret

```
$ oc delete secret ebs-cloud-credentials -n openshift-cluster-csi-drivers
```

You do not need to manually delete the credentials from your provider console. Deleting the referenced component secrets will cause the CCO to delete the existing credentials from the platform and create new ones.

Verification

To verify that the credentials have changed:

1. In the **Administrator** perspective of the web console, navigate to **Workloads → Secrets**.
2. Verify that the contents of the **Value** field or fields have changed.

19.2.3.2. Removing cloud provider credentials

After installing an OpenShift Container Platform cluster with the Cloud Credential Operator (CCO) in mint mode, you can remove the administrator-level credential secret from the **kube-system** namespace in the cluster. The administrator-level credential is required only during changes that require its elevated permissions, such as upgrades.



NOTE

Prior to a non z-stream upgrade, you must reinstate the credential secret with the administrator-level credential. If the credential is not present, the upgrade might be blocked.

Prerequisites

- Your cluster is installed on a platform that supports removing cloud credentials from the CCO. Supported platforms are AWS and GCP.

Procedure

1. In the **Administrator** perspective of the web console, navigate to **Workloads → Secrets**.
2. In the table on the **Secrets** page, find the root secret for your cloud provider.

Platform	Secret name
AWS	aws-creds
GCP	gcp-credentials

3. Click the **Options** menu  in the same row as the secret and select **Delete Secret**.

19.2.4. Additional resources

- [Alternatives to storing administrator-level secrets in the kube-system project](#) for AWS
- [Alternatives to storing administrator-level secrets in the kube-system project](#) for GCP

19.3. USING PASSTHROUGH MODE

Passthrough mode is supported for Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform (GCP), Red Hat OpenStack Platform (RHOSP), Red Hat Virtualization (RHV), and VMware vSphere.

In passthrough mode, the Cloud Credential Operator (CCO) passes the provided cloud credential to the components that request cloud credentials. The credential must have permissions to perform the installation and complete the operations that are required by components in the cluster, but does not need to be able to create new credentials. The CCO does not attempt to create additional limited-scoped credentials in passthrough mode.



NOTE

[Manual mode](#) is the only supported CCO configuration for Microsoft Azure Stack Hub.

19.3.1. Passthrough mode permissions requirements

When using the CCO in passthrough mode, ensure that the credential you provide meets the requirements of the cloud on which you are running or installing OpenShift Container Platform. If the provided credentials the CCO passes to a component that creates a **CredentialsRequest** CR are not sufficient, that component will report an error when it tries to call an API that it does not have permissions for.

19.3.1.1. Amazon Web Services (AWS) permissions

The credential you provide for passthrough mode in AWS must have all the requested permissions for all **CredentialsRequest** CRs that are required by the version of OpenShift Container Platform you are running or installing.

To locate the **CredentialsRequest** CRs that are required, see [Manually creating IAM for AWS](#).

19.3.1.2. Microsoft Azure permissions

The credential you provide for passthrough mode in Azure must have all the requested permissions for all **CredentialsRequest** CRs that are required by the version of OpenShift Container Platform you are running or installing.

To locate the **CredentialsRequest** CRs that are required, see [Manually creating IAM for Azure](#).

19.3.1.3. Google Cloud Platform (GCP) permissions

The credential you provide for passthrough mode in GCP must have all the requested permissions for all **CredentialsRequest** CRs that are required by the version of OpenShift Container Platform you are running or installing.

To locate the **CredentialsRequest** CRs that are required, see [Manually creating IAM for GCP](#).

19.3.1.4. Red Hat OpenStack Platform (RHOSP) permissions

To install an OpenShift Container Platform cluster on RHOSP, the CCO requires a credential with the permissions of a **member** user role.

19.3.1.5. Red Hat Virtualization (RHV) permissions

To install an OpenShift Container Platform cluster on RHV, the CCO requires a credential with the following privileges:

- **DiskOperator**
- **DiskCreator**
- **UserTemplateBasedVm**
- **TemplateOwner**
- **TemplateCreator**
- **ClusterAdmin** on the specific cluster that is targeted for OpenShift Container Platform deployment

19.3.1.6. VMware vSphere permissions

To install an OpenShift Container Platform cluster on VMware vSphere, the CCO requires a credential with the following vSphere privileges:

Table 19.2. Required vSphere privileges

Category	Privileges
Datastore	<i>Allocate space</i>
Folder	<i>Create folder, Delete folder</i>
vSphere Tagging	All privileges
Network	<i>Assign network</i>

Category	Privileges
Resource	Assign virtual machine to resource pool
Profile-driven storage	All privileges
vApp	All privileges
Virtual machine	All privileges

19.3.2. Admin credentials root secret format

Each cloud provider uses a credentials root secret in the **kube-system** namespace by convention, which is then used to satisfy all credentials requests and create their respective secrets. This is done either by minting new credentials with *mint mode*, or by copying the credentials root secret with *passthrough mode*.

The format for the secret varies by cloud, and is also used for each **CredentialsRequest** secret.

Amazon Web Services (AWS) secret format

```
apiVersion: v1
kind: Secret
metadata:
  namespace: kube-system
  name: aws-creds
stringData:
  aws_access_key_id: <base64-encoded_access_key_id>
  aws_secret_access_key: <base64-encoded_secret_access_key>
```

Microsoft Azure secret format

```
apiVersion: v1
kind: Secret
metadata:
  namespace: kube-system
  name: azure-credentials
stringData:
  azure_subscription_id: <base64-encoded_subscription_id>
  azure_client_id: <base64-encoded_client_id>
  azure_client_secret: <base64-encoded_client_secret>
  azure_tenant_id: <base64-encoded_tenant_id>
  azure_resource_prefix: <base64-encoded_resource_prefix>
  azure_resourcegroup: <base64-encoded_resource_group>
  azure_region: <base64-encoded_region>
```

On Microsoft Azure, the credentials secret format includes two properties that must contain the cluster's infrastructure ID, generated randomly for each cluster installation. This value can be found after running create manifests:

```
$ cat .openshift_install_state.json | jq '.*installconfig.ClusterID'.InfraID' -r
```

Example output

```
mycluster-2mpcn
```

This value would be used in the secret data as follows:

```
azure_resource_prefix: mycluster-2mpcn
azure_resourcegroup: mycluster-2mpcn-rg
```

Google Cloud Platform (GCP) secret format

```
apiVersion: v1
kind: Secret
metadata:
  namespace: kube-system
  name: gcp-credentials
stringData:
  service_account.json: <base64-encoded_service_account>
```

Red Hat OpenStack Platform (RHOSP) secret format

```
apiVersion: v1
kind: Secret
metadata:
  namespace: kube-system
  name: openstack-credentials
data:
  clouds.yaml: <base64-encoded_cloud_creds>
  clouds.conf: <base64-encoded_cloud_creds_init>
```

Red Hat Virtualization (RHV) secret format

```
apiVersion: v1
kind: Secret
metadata:
  namespace: kube-system
  name: ovirt-credentials
data:
  ovirt_url: <base64-encoded_url>
  ovirt_username: <base64-encoded_username>
  ovirt_password: <base64-encoded_password>
  ovirt_insecure: <base64-encoded_insecure>
  ovirt_ca_bundle: <base64-encoded_ca_bundle>
```

VMware vSphere secret format

```
apiVersion: v1
kind: Secret
metadata:
  namespace: kube-system
  name: vsphere-creds
```

```
data:
  vsphere.openshift.example.com.username: <base64-encoded_username>
  vsphere.openshift.example.com.password: <base64-encoded_password>
```

19.3.3. Passthrough mode credential maintenance

If **CredentialsRequest** CRs change over time as the cluster is upgraded, you must manually update the passthrough mode credential to meet the requirements. To avoid credentials issues during an upgrade, check the **CredentialsRequest** CRs in the release image for the new version of OpenShift Container Platform before upgrading. To locate the **CredentialsRequest** CRs that are required for your cloud provider, see *Manually creating IAM* for [AWS](#), [Azure](#), or [GCP](#).

19.3.3.1. Rotating cloud provider credentials manually

If your cloud provider credentials are changed for any reason, you must manually update the secret that the Cloud Credential Operator (CCO) uses to manage cloud provider credentials.

The process for rotating cloud credentials depends on the mode that the CCO is configured to use. After you rotate credentials for a cluster that is using mint mode, you must manually remove the component credentials that were created by the removed credential.

Prerequisites


- Your cluster is installed on a platform that supports rotating cloud credentials manually with the CCO mode that you are using:
 - For passthrough mode, Amazon Web Services (AWS), Microsoft Azure, Google Cloud Platform (GCP), Red Hat OpenStack Platform (RHOSP), Red Hat Virtualization (RHV), and VMware vSphere are supported.
- You have changed the credentials that are used to interface with your cloud provider.
- The new credentials have sufficient permissions for the mode CCO is configured to use in your cluster.

Procedure

1. In the **Administrator** perspective of the web console, navigate to **Workloads → Secrets**.
2. In the table on the **Secrets** page, find the root secret for your cloud provider.

Platform	Secret name
AWS	aws-creds
Azure	azure-credentials
GCP	gcp-credentials
RHOSP	openstack-credentials
RHV	ovirt-credentials

Platform	Secret name
VMware vSphere	vsphere-creds

- Click the **Options** menu  in the same row as the secret and select **Edit Secret**.
- Record the contents of the **Value** field or fields. You can use this information to verify that the value is different after updating the credentials.
- Update the text in the **Value** field or fields with the new authentication information for your cloud provider, and then click **Save**.
- If you are updating the credentials for a vSphere cluster that does not have the vSphere CSI Driver Operator enabled, you must force a rollout of the Kubernetes controller manager to apply the updated credentials.

**NOTE**

If the vSphere CSI Driver Operator is enabled, this step is not required.

To apply the updated vSphere credentials, log in to the OpenShift Container Platform CLI as a user with the **cluster-admin** role and run the following command:

```
$ oc patch kubecontrollermanager cluster \
  -p='{"spec": {"forceRedeploymentReason": "recovery-"'$( date )'"}}' \
  --type=merge
```

While the credentials are rolling out, the status of the Kubernetes Controller Manager Operator reports **Progressing=true**. To view the status, run the following command:

```
$ oc get co kube-controller-manager
```

Verification

To verify that the credentials have changed:

- In the **Administrator** perspective of the web console, navigate to **Workloads → Secrets**.
- Verify that the contents of the **Value** field or fields have changed.

Additional resources

- [vSphere CSI Driver Operator](#)

19.3.4. Reducing permissions after installation

When using passthrough mode, each component has the same permissions used by all other components. If you do not reduce the permissions after installing, all components have the broad permissions that are required to run the installer.

After installation, you can reduce the permissions on your credential to only those that are required to run the cluster, as defined by the **CredentialsRequest** CRs in the release image for the version of OpenShift Container Platform that you are using.

To locate the **CredentialsRequest** CRs that are required for AWS, Azure, or GCP and learn how to change the permissions the CCO uses, see *Manually creating IAM* for [AWS](#), [Azure](#), or [GCP](#).

19.3.5. Additional resources

- [Manually creating IAM for AWS](#)
- [Manually creating IAM for Azure](#)
- [Manually creating IAM for GCP](#)

19.4. USING MANUAL MODE

Manual mode is supported for Alibaba Cloud, Amazon Web Services (AWS), Microsoft Azure, IBM Cloud, and Google Cloud Platform (GCP).

In manual mode, a user manages cloud credentials instead of the Cloud Credential Operator (CCO). To use this mode, you must examine the **CredentialsRequest** CRs in the release image for the version of OpenShift Container Platform that you are running or installing, create corresponding credentials in the underlying cloud provider, and create Kubernetes Secrets in the correct namespaces to satisfy all **CredentialsRequest** CRs for the cluster's cloud provider.

Using manual mode allows each cluster component to have only the permissions it requires, without storing an administrator-level credential in the cluster. This mode also does not require connectivity to the AWS public IAM endpoint. However, you must manually reconcile permissions with new release images for every upgrade.

For information about configuring your cloud provider to use manual mode, see the manual credentials management options for your cloud provider:

- [Manually creating RAM resources for Alibaba Cloud](#)
- [Manually creating IAM for AWS](#)
- [Manually creating IAM for Azure](#)
- [Manually creating IAM for GCP](#)
- [Configuring IAM for IBM Cloud](#)
- [Configuring IAM for Nutanix](#)

19.4.1. Manual mode with cloud credentials created and managed outside of the cluster

An AWS or GCP cluster that uses manual mode might be configured to create and manage cloud credentials from outside of the cluster using the AWS Security Token Service (STS) or GCP Workload Identity. With this configuration, the CCO uses temporary credentials for different components.

For more information, see [Using manual mode with Amazon Web Services Security Token Service](#) or [Using manual mode with GCP Workload Identity](#).

19.4.2. Updating cloud provider resources with manually maintained credentials

Before upgrading a cluster with manually maintained credentials, you must create any new credentials for the release image that you are upgrading to. You must also review the required permissions for existing credentials and accommodate any new permissions requirements in the new release for those components.

Procedure

1. Extract and examine the **CredentialsRequest** custom resource for the new release. The "Manually creating IAM" section of the installation content for your cloud provider explains how to obtain and use the credentials required for your cloud.
2. Update the manually maintained credentials on your cluster:
 - Create new secrets for any **CredentialsRequest** custom resources that are added by the new release image.
 - If the **CredentialsRequest** custom resources for any existing credentials that are stored in secrets have changed permissions requirements, update the permissions as required.
3. If your cluster uses cluster capabilities to disable one or more optional components, delete the **CredentialsRequest** custom resources for any disabled components.

Example credrequests directory contents for OpenShift Container Platform 4.12 on AWS

```
0000_30_machine-api-operator_00_credentials-request.yaml 1
0000_50_cloud-credential-operator_05-iam-ro-credentialsrequest.yaml 2
0000_50_cluster-image-registry-operator_01-registry-credentials-request.yaml 3
0000_50_cluster-ingress-operator_00-ingress-credentials-request.yaml 4
0000_50_cluster-network-operator_02-cncc-credentials.yaml 5
0000_50_cluster-storage-operator_03_credentials_request_aws.yaml 6
```

- 1 The Machine API Operator CR is required.
- 2 The Cloud Credential Operator CR is required.
- 3 The Image Registry Operator CR is required.
- 4 The Ingress Operator CR is required.
- 5 The Network Operator CR is required.
- 6 The Storage Operator CR is an optional component and might be disabled in your cluster.

Example credrequests directory contents for OpenShift Container Platform 4.12 on GCP

```
0000_26_cloud-controller-manager-operator_16_credentialsrequest-gcp.yaml 1
0000_30_machine-api-operator_00_credentials-request.yaml 2
0000_50_cloud-credential-operator_05-gcp-ro-credentialsrequest.yaml 3
0000_50_cluster-image-registry-operator_01-registry-credentials-request-gcs.yaml 4
```

```
0000_50_cluster-ingress-operator_00-ingress-credentials-request.yaml 5
0000_50_cluster-network-operator_02-cncc-credentials.yaml 6
0000_50_cluster-storage-operator_03_credentials_request_gcp.yaml 7
```

- 1** The Cloud Controller Manager Operator CR is required.
- 2** The Machine API Operator CR is required.
- 3** The Cloud Credential Operator CR is required.
- 4** The Image Registry Operator CR is required.
- 5** The Ingress Operator CR is required.
- 6** The Network Operator CR is required.
- 7** The Storage Operator CR is an optional component and might be disabled in your cluster.

Next steps

- Update the **upgradeable-to** annotation to indicate that the cluster is ready to upgrade.

19.4.2.1. Indicating that the cluster is ready to upgrade

The Cloud Credential Operator (CCO) **Upgradeable** status for a cluster with manually maintained credentials is **False** by default.

Prerequisites

- For the release image that you are upgrading to, you have processed any new credentials manually or by using the Cloud Credential Operator utility (**ccoctl**).
- You have installed the OpenShift CLI (**oc**).

Procedure

1. Log in to **oc** on the cluster as a user with the **cluster-admin** role.
2. Edit the **CloudCredential** resource to add an **upgradeable-to** annotation within the **metadata** field by running the following command:

```
$ oc edit cloudcredential cluster
```

Text to add

```
...
  metadata:
    annotations:
      cloudcredential.openshift.io/upgradeable-to: <version_number>
...
```

Where **<version_number>** is the version that you are upgrading to, in the format **x.y.z**. For example, use **4.12.2** for OpenShift Container Platform 4.12.2.

It may take several minutes after adding the annotation for the upgradeable status to change.

Verification

1. In the **Administrator** perspective of the web console, navigate to **Administration** → **Cluster Settings**.
2. To view the CCO status details, click **cloud-credential** in the **Cluster Operators** list.
 - If the **Upgradeable** status in the **Conditions** section is **False**, verify that the **upgradeable-to** annotation is free of typographical errors.
3. When the **Upgradeable** status in the **Conditions** section is **True**, begin the OpenShift Container Platform upgrade.

19.4.3. Additional resources

- [Manually creating RAM resources for Alibaba Cloud](#)
- [Manually creating IAM for AWS](#)
- [Using manual mode with Amazon Web Services Security Token Service](#)
- [Manually creating IAM for Azure](#)
- [Manually creating IAM for GCP](#)
- [Using manual mode with GCP Workload Identity](#)
- [Configuring IAM for IBM Cloud](#)
- [Configuring IAM for Nutanix](#)

19.5. USING MANUAL MODE WITH AMAZON WEB SERVICES SECURITY TOKEN SERVICE

Manual mode with STS is supported for Amazon Web Services (AWS).



NOTE

This credentials strategy is supported for only new OpenShift Container Platform clusters and must be configured during installation. You cannot reconfigure an existing cluster that uses a different credentials strategy to use this feature.

19.5.1. About manual mode with AWS Security Token Service

In manual mode with STS, the individual OpenShift Container Platform cluster components use AWS Security Token Service (STS) to assign components IAM roles that provide short-term, limited-privilege security credentials. These credentials are associated with IAM roles that are specific to each component that makes AWS API calls.

19.5.1.1. AWS Security Token Service authentication process

The AWS Security Token Service (STS) and the [AssumeRole](#) API action allow pods to retrieve access keys that are defined by an IAM role policy.

The OpenShift Container Platform cluster includes a Kubernetes service account signing service. This service uses a private key to sign service account JSON web tokens (JWT). A pod that requires a service account token requests one through the pod specification. When the pod is created and assigned to a node, the node retrieves a signed service account from the service account signing service and mounts it onto the pod.

Clusters that use STS contain an IAM role ID in their Kubernetes configuration secrets. Workloads assume the identity of this IAM role ID. The signed service account token issued to the workload aligns with the configuration in AWS, which allows AWS STS to grant access keys for the specified IAM role to the workload.

AWS STS grants access keys only for requests that include service account tokens that meet the following conditions:

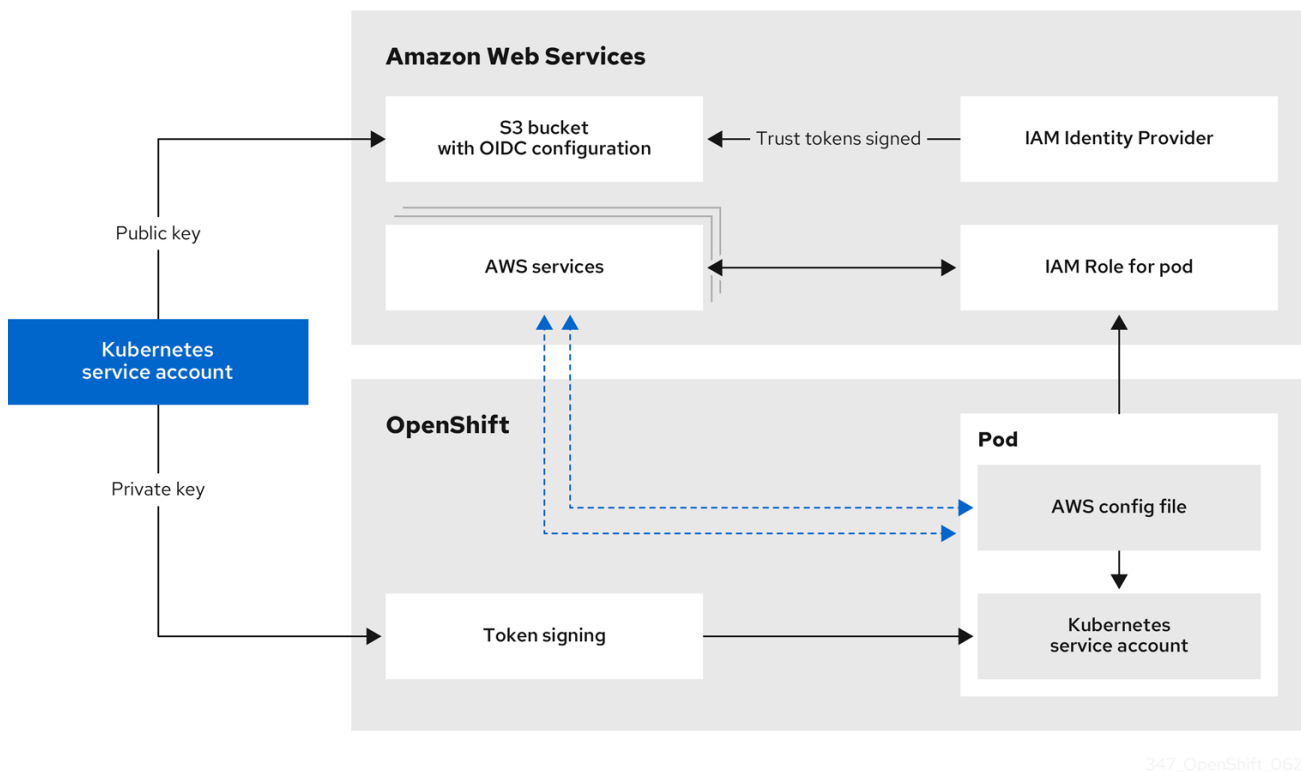
- The token name and namespace match the service account name and namespace.
- The token is signed by a key that matches the public key. The public key pair for the service account signing key used by the cluster is stored in an AWS S3 bucket. AWS STS federation validates that the service account token signature aligns with the public key stored in the S3 bucket.

19.5.1.2. Authentication flow for AWS STS

The following diagram illustrates the authentication flow between AWS and the OpenShift Container Platform cluster when using AWS STS.

- *Token signing* is the Kubernetes service account signing service on the OpenShift Container Platform cluster.
- The *Kubernetes service account* in the pod is the signed service account token.

Figure 19.2. AWS Security Token Service authentication flow



Requests for new and refreshed credentials are automated by using an appropriately configured AWS IAM OpenID Connect (OIDC) identity provider combined with AWS IAM roles. Service account tokens that are trusted by AWS IAM are signed by OpenShift Container Platform and can be projected into a pod and used for authentication.

19.5.1.3. Token refreshing for AWS STS

The signed service account token that a pod uses expires after a period of time. For clusters that use AWS STS, this time period is 3600 seconds, or one hour.

The kubelet on the node that the pod is assigned to ensures that the token is refreshed. The kubelet attempts to rotate a token when it is older than 80 percent of its time to live.

19.5.1.4. OpenID Connect requirements for AWS STS

You can store the public portion of the encryption keys for your OIDC configuration in a public or private S3 bucket.

The OIDC spec requires the use of HTTPS. AWS services require a public endpoint to expose the OIDC documents in the form of JSON web key set (JWKS) public keys. This allows AWS services to validate the bound tokens signed by Kubernetes and determine whether to trust certificates. As a result, both S3 bucket options require a public HTTPS endpoint and private endpoints are not supported.

To use AWS STS, the public AWS backbone for the AWS STS service must be able to communicate with a public S3 bucket or a private S3 bucket with a public CloudFront endpoint. You can choose which type of bucket to use when you process **CredentialsRequest** objects during installation:

- By default, the CCO utility (**ccoctl**) stores the OIDC configuration files in a public S3 bucket and uses the S3 URL as the public OIDC endpoint.

- As an alternative, you can have the **ccoctl** utility store the OIDC configuration in a private S3 bucket that is accessed by the IAM identity provider through a public CloudFront distribution URL.

19.5.1.5. AWS component secret formats

Using manual mode with STS changes the content of the AWS credentials that are provided to individual OpenShift Container Platform components. Compare the following secret formats:

AWS secret format using long-lived credentials

```
apiVersion: v1
kind: Secret
metadata:
  namespace: <target-namespace> 1
  name: <target-secret-name> 2
data:
  aws_access_key_id: <base64-encoded-access-key-id>
  aws_secret_access_key: <base64-encoded-secret-access-key>
```

1 The namespace for the component.

2 The name of the component secret.

AWS secret format with STS

```
apiVersion: v1
kind: Secret
metadata:
  namespace: <target-namespace> 1
  name: <target-secret-name> 2
stringData:
  credentials: |-
    [default]
    sts_regional_endpoints = regional
    role_name: <operator-role-name> 3
    web_identity_token_file: <path-to-token> 4
```

1 The namespace for the component.

2 The name of the component secret.

3 The IAM role for the component.

4 The path to the service account token inside the pod. By convention, this is **/var/run/secrets/openshift/serviceaccount/token** for OpenShift Container Platform components.

19.5.2. Installing an OpenShift Container Platform cluster configured for manual mode with STS

To install a cluster that is configured to use the Cloud Credential Operator (CCO) in manual mode with STS:

1. [Configure the Cloud Credential Operator utility.](#)
2. Create the required AWS resources [individually](#), or [with a single command](#).
3. [Run the OpenShift Container Platform installer.](#)
4. [Verify that the cluster is using short-lived credentials.](#)

**NOTE**

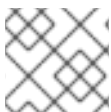
Because the cluster is operating in manual mode when using STS, it is not able to create new credentials for components with the permissions that they require. When upgrading to a different minor version of OpenShift Container Platform, there are often new AWS permission requirements. Before upgrading a cluster that is using STS, the cluster administrator must manually ensure that the AWS permissions are sufficient for existing components and available to any new components.

Additional resources

- [Configuring the Cloud Credential Operator utility for a cluster update](#)

19.5.2.1. Configuring the Cloud Credential Operator utility

To create and manage cloud credentials from outside of the cluster when the Cloud Credential Operator (CCO) is operating in manual mode, extract and prepare the CCO utility (**ccoctl**) binary.

**NOTE**

The **ccoctl** utility is a Linux binary that must run in a Linux environment.

Prerequisites

- You have access to an OpenShift Container Platform account with cluster administrator access.
- You have installed the OpenShift CLI (**oc**).
- You have created an AWS account for the **ccoctl** utility to use with the following permissions:

Table 19.3. Required AWS permissions

Permission type	Required permissions
-----------------	----------------------

Permission type	Required permissions
iam permissions	<ul style="list-style-type: none">○ iam:CreateOpenIDConnectProvider○ iam:CreateRole○ iam>DeleteOpenIDConnectProvider○ iam>DeleteRole○ iam>DeleteRolePolicy○ iam:GetOpenIDConnectProvider○ iam:GetRole○ iam:GetUser○ iam:ListOpenIDConnectProviders○ iam:ListRolePolicies○ iam:ListRoles○ iam:PutRolePolicy○ iam:TagOpenIDConnectProvider○ iam:TagRole

Permission type	Required permissions
s3 permissions	<ul style="list-style-type: none"> ○ s3:CreateBucket ○ s3>DeleteBucket ○ s3>DeleteObject ○ s3:GetBucketAcl ○ s3:GetBucketTagging ○ s3:GetObject ○ s3:GetObjectAcl ○ s3:GetObjectTagging ○ s3:ListBucket ○ s3:PutBucketAcl ○ s3:PutBucketPolicy ○ s3:PutBucketPublicAccessBlock ○ s3:PutBucketTagging ○ s3:PutObject ○ s3:PutObjectAcl ○ s3:PutObjectTagging
cloudfront permissions	<ul style="list-style-type: none"> ○ cloudfront:ListCloudFrontOriginAccessIdentities ○ cloudfront:ListDistributions ○ cloudfront:ListTagsForResource

If you plan to store the OIDC configuration in a private S3 bucket that is accessed by the IAM identity provider through a public CloudFront distribution URL, the AWS account that runs the **ccctl** utility requires the following additional permissions:

- **cloudfront:CreateCloudFrontOriginAccessIdentity**
- **cloudfront:CreateDistribution**
- **cloudfront>DeleteCloudFrontOriginAccessIdentity**
- **cloudfront>DeleteDistribution**
- **cloudfront:GetCloudFrontOriginAccessIdentity**
- **cloudfront:GetCloudFrontOriginAccessIdentityConfig**

- **cloudfront:GetDistribution**
- **cloudfront:TagResource**
- **cloudfront:UpdateDistribution**

**NOTE**

These additional permissions support the use of the **--create-private-s3-bucket** option when processing credentials requests with the **ccoctl aws create-all** command.

Procedure

1. Obtain the OpenShift Container Platform release image by running the following command:

```
$ RELEASE_IMAGE=$(./openshift-install version | awk '/release image/ {print $3}')
```

2. Obtain the CCO container image from the OpenShift Container Platform release image by running the following command:

```
$ CCO_IMAGE=$(oc adm release info --image-for='cloud-credential-operator'
$RELEASE_IMAGE -a ~/.pull-secret)
```

**NOTE**

Ensure that the architecture of the **\$RELEASE_IMAGE** matches the architecture of the environment in which you will use the **ccoctl** tool.

3. Extract the **ccoctl** binary from the CCO container image within the OpenShift Container Platform release image by running the following command:

```
$ oc image extract $CCO_IMAGE --file="/usr/bin/ccoctl" -a ~/.pull-secret
```

4. Change the permissions to make **ccoctl** executable by running the following command:

```
$ chmod 775 ccoctl
```

Verification

- To verify that **ccoctl** is ready to use, display the help file by running the following command:

```
$ ccoctl --help
```

Output of ccoctl --help

```
OpenShift credentials provisioning tool
```

```
Usage:
ccoctl [command]
```

```
Available Commands:
```

```

alibabacloud Manage credentials objects for alibaba cloud
aws          Manage credentials objects for AWS cloud
gcp          Manage credentials objects for Google cloud
help         Help about any command
ibmcloud     Manage credentials objects for IBM Cloud
nutanix      Manage credentials objects for Nutanix

```

Flags:

```
-h, --help help for ccoctl
```

Use "ccoctl [command] --help" for more information about a command.

19.5.2.2. Creating AWS resources with the Cloud Credential Operator utility

You can use the CCO utility (**ccoctl**) to create the required AWS resources [individually](#), or [with a single command](#).

19.5.2.2.1. Creating AWS resources individually

If you need to review the JSON files that the **ccoctl** tool creates before modifying AWS resources, or if the process the **ccoctl** tool uses to create AWS resources automatically does not meet the requirements of your organization, you can create the AWS resources individually. For example, this option might be useful for an organization that shares the responsibility for creating these resources among different users or departments.

Otherwise, you can use the **ccoctl aws create-all** command to create the AWS resources automatically.



NOTE

By default, **ccoctl** creates objects in the directory in which the commands are run. To create the objects in a different directory, use the **--output-dir** flag. This procedure uses **<path_to_ccoctl_output_dir>** to refer to this directory.

Some **ccoctl** commands make AWS API calls to create or modify AWS resources. You can use the **--dry-run** flag to avoid making API calls. Using this flag creates JSON files on the local file system instead. You can review and modify the JSON files and then apply them with the AWS CLI tool using the **--cli-input-json** parameters.

Prerequisites

- Extract and prepare the **ccoctl** binary.

Procedure

1. Generate the public and private RSA key files that are used to set up the OpenID Connect provider for the cluster:

```
$ ccoctl aws create-key-pair
```

Example output:

```

2021/04/13 11:01:02 Generating RSA keypair
2021/04/13 11:01:03 Writing private key to /<path_to_ccoctl_output_dir>/serviceaccount-
signer.private

```

```
2021/04/13 11:01:03 Writing public key to /<path_to_ccoctl_output_dir>/serviceaccount-
signer.public
2021/04/13 11:01:03 Copying signing key for use by installer
```

where **serviceaccount-signer.private** and **serviceaccount-signer.public** are the generated key files.

This command also creates a private key that the cluster requires during installation in **/<path_to_ccoctl_output_dir>/tls/bound-service-account-signing-key.key**.

2. Create an OpenID Connect identity provider and S3 bucket on AWS:

```
$ ccoctl aws create-identity-provider \
  --name=<name> \
  --region=<aws_region> \
  --public-key-file=<path_to_ccoctl_output_dir>/serviceaccount-signer.public
```

where:

- **<name>** is the name used to tag any cloud resources that are created for tracking.
- **<aws-region>** is the AWS region in which cloud resources will be created.
- **<path_to_ccoctl_output_dir>** is the path to the public key file that the **ccoctl aws create-key-pair** command generated.

Example output:

```
2021/04/13 11:16:09 Bucket <name>-oidc created
2021/04/13 11:16:10 OpenID Connect discovery document in the S3 bucket <name>-oidc at
.well-known/openid-configuration updated
2021/04/13 11:16:10 Reading public key
2021/04/13 11:16:10 JSON web key set (JWKS) in the S3 bucket <name>-oidc at keys.json
updated
2021/04/13 11:16:18 Identity Provider created with ARN: arn:aws:iam::
<aws_account_id>:oidc-provider/<name>-oidc.s3.<aws_region>.amazonaws.com
```

where **openid-configuration** is a discovery document and **keys.json** is a JSON web key set file.

This command also creates a YAML configuration file in **/<path_to_ccoctl_output_dir>/manifests/cluster-authentication-02-config.yaml**. This file sets the issuer URL field for the service account tokens that the cluster generates, so that the AWS IAM identity provider trusts the tokens.

3. Create IAM roles for each component in the cluster.
 - a. Extract the list of **CredentialsRequest** objects from the OpenShift Container Platform release image:

```
$ oc adm release extract \
  --from=$RELEASE_IMAGE \
  --credentials-requests \
  --cloud=aws \
  --to=<path_to_directory_with_list_of_credentials_requests>/credrequests 1
```

- 1 **credrequests** is the directory where the list of **CredentialsRequest** objects is stored. This command creates the directory if it does not exist.
- b. If your cluster uses cluster capabilities to disable one or more optional components, delete the **CredentialsRequest** custom resources for any disabled components.

Example **credrequests** directory contents for OpenShift Container Platform 4.13 on AWS

```
0000_30_cluster-api_00_credentials-request.yaml 1
0000_30_machine-api-operator_00_credentials-request.yaml 2
0000_50_cloud-credential-operator_05-iam-ro-credentialsrequest.yaml 3
0000_50_cluster-image-registry-operator_01-registry-credentials-request.yaml 4
0000_50_cluster-ingress-operator_00-ingress-credentials-request.yaml 5
0000_50_cluster-network-operator_02-cncc-credentials.yaml 6
0000_50_cluster-storage-operator_03_credentials_request_aws.yaml 7
```

- 1 For clusters that use the **TechPreviewNoUpgrade** feature set, the Cluster API Operator CR is required.
 - 2 The Machine API Operator CR is required.
 - 3 The Cloud Credential Operator CR is required.
 - 4 The Image Registry Operator CR is required.
 - 5 The Ingress Operator CR is required.
 - 6 The Network Operator CR is required.
 - 7 The Storage Operator CR is an optional component and might be disabled in your cluster.
- c. Use the **ccoctl** tool to process all **CredentialsRequest** objects in the **credrequests** directory:

```
$ ccoctl aws create-iam-roles \
  --name=<name> \
  --region=<aws_region> \
  --credentials-requests-dir=
<path_to_directory_with_list_of_credentials_requests>/credrequests \
  --identity-provider-arn=arn:aws:iam::<aws_account_id>:oidc-provider/<name>-oidc.s3.
<aws_region>.amazonaws.com
```



NOTE

For AWS environments that use alternative IAM API endpoints, such as GovCloud, you must also specify your region with the **--region** parameter.

If your cluster uses Technology Preview features that are enabled by the **TechPreviewNoUpgrade** feature set, you must include the **--enable-tech-preview** parameter.

For each **CredentialsRequest** object, **ccoctl** creates an IAM role with a trust policy that is tied to the specified OIDC identity provider, and a permissions policy as defined in each **CredentialsRequest** object from the OpenShift Container Platform release image.

Verification

- To verify that the OpenShift Container Platform secrets are created, list the files in the `<path_to_ccoctl_output_dir>/manifests` directory:

```
$ ls <path_to_ccoctl_output_dir>/manifests
```

Example output:

```
cluster-authentication-02-config.yaml
openshift-cloud-credential-operator-cloud-credential-operator-iam-ro-creds-credentials.yaml
openshift-cloud-network-config-controller-cloud-credentials-credentials.yaml
openshift-cluster-api-capamanager-bootstrap-credentials-credentials.yaml
openshift-cluster-csi-drivers-ebs-cloud-credentials-credentials.yaml
openshift-image-registry-installer-cloud-credentials-credentials.yaml
openshift-ingress-operator-cloud-credentials-credentials.yaml
openshift-machine-api-aws-cloud-credentials-credentials.yaml
```

You can verify that the IAM roles are created by querying AWS. For more information, refer to AWS documentation on listing IAM roles.

19.5.2.2.2. Creating AWS resources with a single command

If you do not need to review the JSON files that the **ccoctl** tool creates before modifying AWS resources, and if the process the **ccoctl** tool uses to create AWS resources automatically meets the requirements of your organization, you can use the **ccoctl aws create-all** command to automate the creation of AWS resources.

Otherwise, you can create the AWS resources individually.



NOTE

By default, **ccoctl** creates objects in the directory in which the commands are run. To create the objects in a different directory, use the **--output-dir** flag. This procedure uses `<path_to_ccoctl_output_dir>` to refer to this directory.

Prerequisites

You must have:

- Extracted and prepared the **ccoctl** binary.

Procedure

1. Set the **\$RELEASE_IMAGE** variable by running the following command:

```
$ RELEASE_IMAGE=$(./openshift-install version | awk 'release image/ {print $3}')
```

2. Extract the list of **CredentialsRequest** objects from the OpenShift Container Platform release image by running the following command:

```
$ oc adm release extract \
  --from=$RELEASE_IMAGE \
  --credentials-requests \
  --cloud=aws \
  --to=<path_to_directory_with_list_of_credentials_requests>/credrequests 1
```

- 1** **credrequests** is the directory where the list of **CredentialsRequest** objects is stored. This command creates the directory if it does not exist.



NOTE

This command can take a few moments to run.

3. If your cluster uses cluster capabilities to disable one or more optional components, delete the **CredentialsRequest** custom resources for any disabled components.

Example **credrequests** directory contents for OpenShift Container Platform 4.13 on AWS

```
0000_30_cluster-api_00_credentials-request.yaml 1
0000_30_machine-api-operator_00_credentials-request.yaml 2
0000_50_cloud-credential-operator_05-iam-ro-credentialsrequest.yaml 3
0000_50_cluster-image-registry-operator_01-registry-credentials-request.yaml 4
0000_50_cluster-ingress-operator_00-ingress-credentials-request.yaml 5
0000_50_cluster-network-operator_02-cncc-credentials.yaml 6
0000_50_cluster-storage-operator_03_credentials_request_aws.yaml 7
```

- 1** For clusters that use the **TechPreviewNoUpgrade** feature set, the Cluster API Operator CR is required.
- 2** The Machine API Operator CR is required.
- 3** The Cloud Credential Operator CR is required.
- 4** The Image Registry Operator CR is required.
- 5** The Ingress Operator CR is required.
- 6** The Network Operator CR is required.
- 7** The Storage Operator CR is an optional component and might be disabled in your cluster.

4. Use the **ccoctl** tool to process all **CredentialsRequest** objects in the **credrequests** directory:

```
$ ccoctl aws create-all \
  --name=<name> 1
  --region=<aws_region> 2
  --credentials-requests-dir=
  <path_to_directory_with_list_of_credentials_requests>/credrequests 3
  --output-dir=<path_to_ccoctl_output_dir> 4
  --create-private-s3-bucket 5
```


- 1 Specify the name used to tag any cloud resources that are created for tracking.
- 2 Specify the AWS region in which cloud resources will be created.
- 3 Specify the directory containing the files for the component **CredentialsRequest** objects.
- 4 Optional: Specify the directory in which you want the **ccoctl** utility to create objects. By default, the utility creates objects in the directory in which the commands are run.
- 5 Optional: By default, the **ccoctl** utility stores the OpenID Connect (OIDC) configuration files in a public S3 bucket and uses the S3 URL as the public OIDC endpoint. To store the OIDC configuration in a private S3 bucket that is accessed by the IAM identity provider through a public CloudFront distribution URL instead, use the **--create-private-s3-bucket** parameter.



NOTE

If your cluster uses Technology Preview features that are enabled by the **TechPreviewNoUpgrade** feature set, you must include the **--enable-tech-preview** parameter.

Verification

- To verify that the OpenShift Container Platform secrets are created, list the files in the **<path_to_ccoctl_output_dir>/manifests** directory:

```
$ ls <path_to_ccoctl_output_dir>/manifests
```

Example output:

```
cluster-authentication-02-config.yaml
openshift-cloud-credential-operator-cloud-credential-operator-iam-ro-creds-credentials.yaml
openshift-cloud-network-config-controller-cloud-credentials-credentials.yaml
openshift-cluster-api-capamanager-bootstrap-credentials-credentials.yaml
openshift-cluster-csi-drivers-ebs-cloud-credentials-credentials.yaml
openshift-image-registry-installer-cloud-credentials-credentials.yaml
openshift-ingress-operator-cloud-credentials-credentials.yaml
openshift-machine-api-aws-cloud-credentials-credentials.yaml
```

You can verify that the IAM roles are created by querying AWS. For more information, refer to AWS documentation on listing IAM roles.

19.5.2.3. Running the installer

Prerequisites

- Configure an account with the cloud platform that hosts your cluster.
- Obtain the OpenShift Container Platform release image.

Procedure

1. Set the **CCOCTL_OUTPUT_DIR** environment variable to the directory in which you want to store the manifests:

1. Change to the directory that contains the installation program and create the **install-config.yaml** file:

```
$ openshift-install create install-config --dir <installation_directory>
```

where **<installation_directory>** is the directory in which the installation program creates files.

2. Edit the **install-config.yaml** configuration file so that it contains the **credentialsMode** parameter set to **Manual**.

Example **install-config.yaml** configuration file

```
apiVersion: v1
baseDomain: cluster1.example.com
credentialsMode: Manual 1
compute:
- architecture: amd64
  hyperthreading: Enabled
```

- 1** This line is added to set the **credentialsMode** parameter to **Manual**.

3. Create the required OpenShift Container Platform installation manifests:

```
$ openshift-install create manifests
```

4. Copy the manifests that **ccoctl** generated to the manifests directory that the installation program created:

```
$ cp /<path_to_ccoctl_output_dir>/manifests/* ./manifests/
```

5. Copy the private key that the **ccoctl** generated in the **tls** directory to the installation directory:

```
$ cp -a /<path_to_ccoctl_output_dir>/tls .
```

6. Run the OpenShift Container Platform installer:

```
$ ./openshift-install create cluster
```

19.5.2.4. Verifying the installation

1. Connect to the OpenShift Container Platform cluster.
2. Verify that the cluster does not have **root** credentials:

```
$ oc get secrets -n kube-system aws-creds
```

The output should look similar to:

```
Error from server (NotFound): secrets "aws-creds" not found
```

3. Verify that the components are assuming the IAM roles that are specified in the secret manifests, instead of using credentials that are created by the CCO:

Example command with the Image Registry Operator

```
$ oc get secrets -n openshift-image-registry installer-cloud-credentials -o json | jq -r
.data.credentials | base64 --decode
```

The output should show the role and web identity token that are used by the component and look similar to:

Example output with the Image Registry Operator

```
[default]
role_arn = arn:aws:iam::123456789:role/openshift-image-registry-installer-cloud-credentials
web_identity_token_file = /var/run/secrets/openshift/serviceaccount/token
```

19.5.3. Additional resources

- [Preparing to update a cluster with manually maintained credentials](#)

19.6. USING MANUAL MODE WITH GCP WORKLOAD IDENTITY

Manual mode with GCP Workload Identity is supported for Google Cloud Platform (GCP).



NOTE

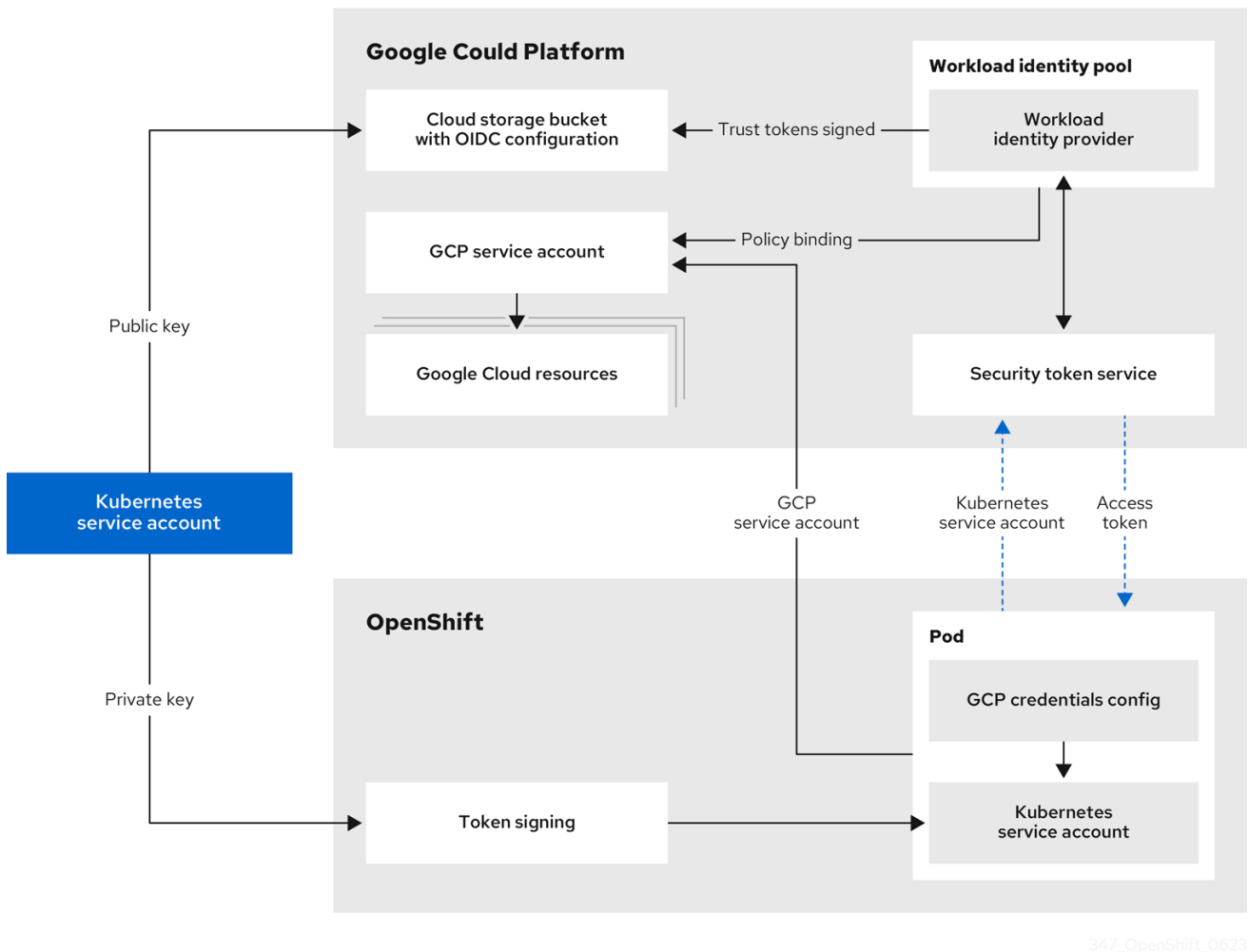
This credentials strategy is supported for only new OpenShift Container Platform clusters and must be configured during installation. You cannot reconfigure an existing cluster that uses a different credentials strategy to use this feature.

19.6.1. About manual mode with GCP Workload Identity

In manual mode with GCP Workload Identity, the individual OpenShift Container Platform cluster components can impersonate IAM service accounts using short-term, limited-privilege credentials.

Requests for new and refreshed credentials are automated by using an appropriately configured OpenID Connect (OIDC) identity provider combined with IAM service accounts. Service account tokens that are trusted by GCP are signed by OpenShift Container Platform and can be projected into a pod and used for authentication. Tokens are refreshed after one hour.

Figure 19.3. Workload Identity authentication flow



Using manual mode with GCP Workload Identity changes the content of the GCP credentials that are provided to individual OpenShift Container Platform components.

GCP secret format

```

apiVersion: v1
kind: Secret
metadata:
  namespace: <target_namespace> 1
  name: <target_secret_name> 2
data:
  service_account.json: <service_account> 3

```

- 1 The namespace for the component.
- 2 The name of the component secret.
- 3 The Base64 encoded service account.

Content of the Base64 encoded `service_account.json` file using long-lived credentials

```
{
```

```

"type": "service_account", ❶
"project_id": "<project_id>",
"private_key_id": "<private_key_id>",
"private_key": "<private_key>", ❷
"client_email": "<client_email_address>",
"client_id": "<client_id>",
"auth_uri": "https://accounts.google.com/o/oauth2/auth",
"token_uri": "https://oauth2.googleapis.com/token",
"auth_provider_x509_cert_url": "https://www.googleapis.com/oauth2/v1/certs",
"client_x509_cert_url":
"https://www.googleapis.com/robot/v1/metadata/x509/<client_email_address>"
}

```

- ❶ The credential type is **service_account**.
- ❷ The private RSA key that is used to authenticate to GCP. This key must be kept secure and is not rotated.

Content of the Base64 encoded `service_account.json` file using GCP Workload Identity

```

{
  "type": "external_account", ❶
  "audience": "///iam.googleapis.com/projects/123456789/locations/global/workloadIdentityPools/test-
pool/providers/test-provider", ❷
  "subject_token_type": "urn:ietf:params:oauth:token-type:jwt",
  "token_url": "https://sts.googleapis.com/v1/token",
  "service_account_impersonation_url": "https://iamcredentials.googleapis.com/v1/projects/-
/serviceAccounts/<client_email_address>:generateAccessToken", ❸
  "credential_source": {
    "file": "<path_to_token>", ❹
    "format": {
      "type": "text"
    }
  }
}

```

- ❶ The credential type is **external_account**.
- ❷ The target audience is the GCP Workload Identity provider.
- ❸ The resource URL of the service account that can be impersonated with these credentials.
- ❹ The path to the service account token inside the pod. By convention, this is `/var/run/secrets/openshift/serviceaccount/token` for OpenShift Container Platform components.

19.6.2. Installing an OpenShift Container Platform cluster configured for manual mode with GCP Workload Identity

To install a cluster that is configured to use the Cloud Credential Operator (CCO) in manual mode with GCP Workload Identity:

1. [Configure the Cloud Credential Operator utility.](#)

2. [Create the required GCP resources.](#)
3. [Run the OpenShift Container Platform installer.](#)
4. [Verify that the cluster is using short-lived credentials.](#)



NOTE

Because the cluster is operating in manual mode when using GCP Workload Identity, it is not able to create new credentials for components with the permissions that they require. When upgrading to a different minor version of OpenShift Container Platform, there are often new GCP permission requirements. Before upgrading a cluster that is using GCP Workload Identity, the cluster administrator must manually ensure that the GCP permissions are sufficient for existing components and available to any new components.

Additional resources

- [Configuring the Cloud Credential Operator utility for a cluster update](#)

19.6.2.1. Configuring the Cloud Credential Operator utility

To create and manage cloud credentials from outside of the cluster when the Cloud Credential Operator (CCO) is operating in manual mode, extract and prepare the CCO utility (**ccoctl**) binary.



NOTE

The **ccoctl** utility is a Linux binary that must run in a Linux environment.

Prerequisites

- You have access to an OpenShift Container Platform account with cluster administrator access.
- You have installed the OpenShift CLI (**oc**).

Procedure

1. Obtain the OpenShift Container Platform release image by running the following command:

```
$ RELEASE_IMAGE=$(./openshift-install version | awk 'release image/ {print $3}')
```

2. Obtain the CCO container image from the OpenShift Container Platform release image by running the following command:

```
$ CCO_IMAGE=$(oc adm release info --image-for='cloud-credential-operator'
$RELEASE_IMAGE -a ~/.pull-secret)
```



NOTE

Ensure that the architecture of the **\$RELEASE_IMAGE** matches the architecture of the environment in which you will use the **ccoctl** tool.

3. Extract the **ccoctl** binary from the CCO container image within the OpenShift Container Platform release image by running the following command:

```
$ oc image extract $CCO_IMAGE --file="/usr/bin/ccoctl" -a ~/.pull-secret
```

4. Change the permissions to make **ccoctl** executable by running the following command:

```
$ chmod 775 ccoctl
```

Verification

- To verify that **ccoctl** is ready to use, display the help file by running the following command:

```
$ ccoctl --help
```

Output of **ccoctl --help**

```
OpenShift credentials provisioning tool
```

```
Usage:
```

```
ccoctl [command]
```

```
Available Commands:
```

```
alibabacloud Manage credentials objects for alibaba cloud
```

```
aws          Manage credentials objects for AWS cloud
```

```
gcp         Manage credentials objects for Google cloud
```

```
help       Help about any command
```

```
ibmcloud   Manage credentials objects for IBM Cloud
```

```
nutanix    Manage credentials objects for Nutanix
```

```
Flags:
```

```
-h, --help  help for ccoctl
```

```
Use "ccoctl [command] --help" for more information about a command.
```

19.6.2.2. Creating GCP resources with the Cloud Credential Operator utility

You can use the **ccoctl gcp create-all** command to automate the creation of GCP resources.



NOTE

By default, **ccoctl** creates objects in the directory in which the commands are run. To create the objects in a different directory, use the **--output-dir** flag. This procedure uses **<path_to_ccoctl_output_dir>** to refer to this directory.

Prerequisites

You must have:

- Extracted and prepared the **ccoctl** binary.

Procedure

1. Set the **\$RELEASE_IMAGE** variable by running the following command:

```
$ RELEASE_IMAGE=$(./openshift-install version | awk '/release image/ {print $3}')
```

- 2. Extract the list of **CredentialsRequest** objects from the OpenShift Container Platform release image by running the following command:

```
$ oc adm release extract \
  --from=$RELEASE_IMAGE \
  --credentials-requests \
  --cloud=gcp \
  --to=<path_to_directory_with_list_of_credentials_requests>/credrequests 1
```

- 1** **credrequests** is the directory where the list of **CredentialsRequest** objects is stored. This command creates the directory if it does not exist.



NOTE

This command can take a few moments to run.

- 3. If your cluster uses cluster capabilities to disable one or more optional components, delete the **CredentialsRequest** custom resources for any disabled components.

Example **credrequests** directory contents for OpenShift Container Platform 4.13 on GCP

```
0000_26_cloud-controller-manager-operator_16_credentialsrequest-gcp.yaml 1
0000_30_cluster-api_00_credentials-request.yaml 2
0000_30_machine-api-operator_00_credentials-request.yaml 3
0000_50_cloud-credential-operator_05-gcp-ro-credentialsrequest.yaml 4
0000_50_cluster-image-registry-operator_01-registry-credentials-request-gcs.yaml 5
0000_50_cluster-ingress-operator_00-ingress-credentials-request.yaml 6
0000_50_cluster-network-operator_02-cncc-credentials.yaml 7
0000_50_cluster-storage-operator_03_credentials_request_gcp.yaml 8
```

- 1** The Cloud Controller Manager Operator CR is required.
- 2** For clusters that use the **TechPreviewNoUpgrade** feature set, the Cluster API Operator CR is required.
- 3** The Machine API Operator CR is required.
- 4** The Cloud Credential Operator CR is required.
- 5** The Image Registry Operator CR is required.
- 6** The Ingress Operator CR is required.
- 7** The Network Operator CR is required.
- 8** The Storage Operator CR is an optional component and might be disabled in your cluster.

- 4. Use the **ccoctl** tool to process all **CredentialsRequest** objects in the **credrequests** directory:

```
$ ccoctl gcp create-all \
```



```
--name=<name> \
--region=<gcp_region> \
--project=<gcp_project_id> \
--credentials-requests-dir=
<path_to_directory_with_list_of_credentials_requests>/credrequests
```

where:

- **<name>** is the user-defined name for all created GCP resources used for tracking.
- **<gcp_region>** is the GCP region in which cloud resources will be created.
- **<gcp_project_id>** is the GCP project ID in which cloud resources will be created.
- **<path_to_directory_with_list_of_credentials_requests>/credrequests** is the directory containing the files of **CredentialsRequest** manifests to create GCP service accounts.



NOTE

If your cluster uses Technology Preview features that are enabled by the **TechPreviewNoUpgrade** feature set, you must include the **--enable-tech-preview** parameter.

Verification

- To verify that the OpenShift Container Platform secrets are created, list the files in the **<path_to_ccoctl_output_dir>/manifests** directory:

```
$ ls <path_to_ccoctl_output_dir>/manifests
```

Example output:

```
cluster-authentication-02-config.yaml
openshift-cloud-controller-manager-gcp-ccm-cloud-credentials-credentials.yaml
openshift-cloud-credential-operator-cloud-credential-operator-gcp-ro-creds-credentials.yaml
openshift-cloud-network-config-controller-cloud-credentials-credentials.yaml
openshift-cluster-api-capg-manager-bootstrap-credentials-credentials.yaml
openshift-cluster-csi-drivers-gcp-pd-cloud-credentials-credentials.yaml
openshift-image-registry-installer-cloud-credentials-credentials.yaml
openshift-ingress-operator-cloud-credentials-credentials.yaml
openshift-machine-api-gcp-cloud-credentials-credentials.yaml
```

You can verify that the IAM service accounts are created by querying GCP. For more information, refer to GCP documentation on listing IAM service accounts.

19.6.2.3. Running the installer

Prerequisites

- Configure an account with the cloud platform that hosts your cluster.
- Obtain the OpenShift Container Platform release image.

Procedure

1. Change to the directory that contains the installation program and create the **install-config.yaml** file:

```
$ openshift-install create install-config --dir <installation_directory>
```

where **<installation_directory>** is the directory in which the installation program creates files.

2. Edit the **install-config.yaml** configuration file so that it contains the **credentialsMode** parameter set to **Manual**.

Example **install-config.yaml** configuration file

```
apiVersion: v1
baseDomain: cluster1.example.com
credentialsMode: Manual 1
compute:
- architecture: amd64
  hyperthreading: Enabled
```

- 1** This line is added to set the **credentialsMode** parameter to **Manual**.

3. Create the required OpenShift Container Platform installation manifests:

```
$ openshift-install create manifests
```

4. Copy the manifests that **ccoctl** generated to the manifests directory that the installation program created:

```
$ cp /<path_to_ccoctl_output_dir>/manifests/* ./manifests/
```

5. Copy the private key that the **ccoctl** generated in the **tls** directory to the installation directory:

```
$ cp -a /<path_to_ccoctl_output_dir>/tls .
```

6. Run the OpenShift Container Platform installer:

```
$ ./openshift-install create cluster
```

19.6.2.4. Verifying the installation

1. Connect to the OpenShift Container Platform cluster.
2. Verify that the cluster does not have **root** credentials:

```
$ oc get secrets -n kube-system gcp-credentials
```

The output should look similar to:

```
Error from server (NotFound): secrets "gcp-credentials" not found
```

3. Verify that the components are assuming the service accounts that are specified in the secret manifests, instead of using credentials that are created by the CCO:

Example command with the Image Registry Operator

```
$ oc get secrets -n openshift-image-registry installer-cloud-credentials -o json | jq -r
'.data."service_account.json"' | base64 -d
```

The output should show the role and web identity token that are used by the component and look similar to:

Example output with the Image Registry Operator

```
{
  "type": "external_account", 1
  "audience":
  "//iam.googleapis.com/projects/123456789/locations/global/workloadIdentityPools/test-
  pool/providers/test-provider",
  "subject_token_type": "urn:ietf:params:oauth:token-type:jwt",
  "token_url": "https://sts.googleapis.com/v1/token",
  "service_account_impersonation_url": "https://iamcredentials.googleapis.com/v1/projects/-
  /serviceAccounts/<client-email-address>:generateAccessToken", 2
  "credential_source": {
    "file": "/var/run/secrets/openshift/serviceaccount/token",
    "format": {
      "type": "text"
    }
  }
}
```

- 1** The credential type is **external_account**.
- 2** The resource URL of the service account used by the Image Registry Operator.

19.6.3. Additional resources

- [Preparing to update a cluster with manually maintained credentials](#)