OpenShift Container Platform 4.19

Network security

Securing network traffic and enforcing network policies in OpenShift Container Platform

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Legal Notice

Abstract

This document covers how to implement and manage network security features, such as network policies and egress firewalls, in OpenShift Container Platform.

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CHAPTER 1. UNDERSTANDING NETWORK POLICY APIS

Network policy is defined using both cluster-scoped and namespace-scoped network policy APIs. By defining network policy across these different levels, you can create sophisticated network security configurations for your clusters, including full multi-tenant isolation.

1.1. NETWORK POLICIES AND THEIR SCOPE

Cluster-scoped network policy

Cluster and network administrators can use the AdminNetworkPolicy to define network policy at the cluster level. The AdminNetworkPolicy feature consists of two APIs: the **AdminNetworkPolicy** API and **BaselineAdminNetworkPolicy** API. These APIs are used to set rules that can be applied to the entire cluster, or delegated to the namespace-scoped **NetworkPolicy**.

Policies defined using the **AdminNetworkPolicy** API take precedence over all other policy types when set to "Allow" or "Deny". However, administrators can also use "Pass" to delegate responsibility for a given policy to the namespace-scoped **NetworkPolicy** to allow application developers and namespace tenants to control specific aspects of network security for their projects.

Policies defined using the **BaselineAdminNetworkPolicy** API apply only when no other network policy overrides them. When you use the **AdminNetworkPolicy** API to delegate an aspect of network policy to the namespace-scoped **NetworkPolicy**, you should also define a sensible minimum restriction in the **BaselineAdminNetworkPolicy**. This ensures a baseline level of network security at the cluster level in case the **NetworkPolicy** for a namespace does not provide sufficient protection.

Namespace-scoped network policy

Application developers and namespace tenants can use the **NetworkPolicy** API to define network policy rules for a specific namespace. Rules in the **NetworkPolicy** for a namespace take precedence over cluster-wide rules configured using the BaselineAdminNetworkPolicy API, or for a cluster-wide rule that has been delegated or "passed" from the cluster-wide **AdminNetworkPolicy** API.

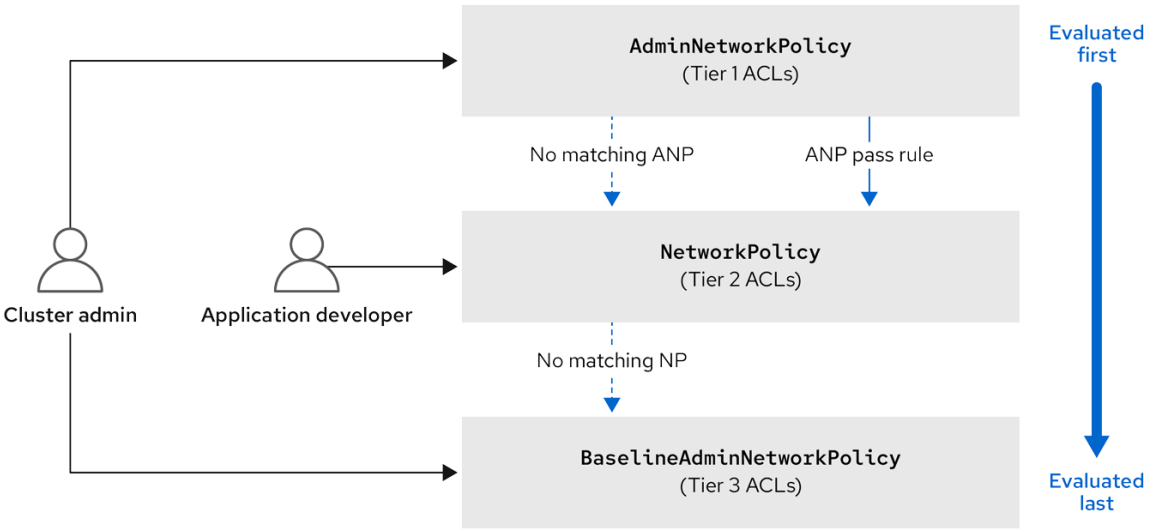
1.2. HOW NETWORK POLICY IS EVALUATED AND APPLIED

When a network connection is established, the network provider (default: OVN-Kubernetes) checks the connection details against network policy rules to determine how to handle the connection.

OVN-Kubernetes evaluates connections against network policy objects in the following order:

1. Check for matches in the AdminNetworkPolicy tier.
    a. If a connection matches an **Allow** or **Deny** rule, follow that rule and stop evaluating.
    b. If a connection matches a **Pass** rule, move to the NetworkPolicy tier.
2. Check for matches in the NetworkPolicy tier.
    a. If a connection matches a rule, follow that rule and stop evaluating.
    b. If no match is found, move to the BaselineAdminNetworkPolicy tier.
3. Follow a matching rule in the BaselineAdminNetworkPolicy tier.

Figure 1.1. Evaluation of network policies by OVN-Kubernetes



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1.3. KEY DIFFERENCES BETWEEN ADMINNETWORKPOLICY AND NETWORKPOLICY CUSTOM RESOURCES

The following table explains key differences between the cluster scoped **AdminNetworkPolicy** API and the namespace scoped **NetworkPolicy** API.

Policy elements	AdminNetworkPolicy	NetworkPolicy
Applicable user	Cluster administrator or equivalent	Namespace owners
Scope	Cluster	Namespace
Drop traffic	Supported with an explicit **Deny** action set as a rule.	Supported via implicit **Deny** isolation at policy creation time.
Delegate traffic	Supported with an **Pass** action set as a rule.	Not applicable.
Allow traffic	Supported with an explicit **Allow** action set as a rule.	The default action for all rules is to allow.
Rule precedence within the policy	Depends on the order in which they appear within an ANP. The higher the rule's position the higher the precedence.	Rules are additive.
Policy precedence	Among ANPs the **priority** field sets the order for evaluation. The lower the priority number higher the policy precedence.	There is no policy ordering between policies.

Policy elements	AdminNetworkPolicy	NetworkPolicy
Feature precedence	Evaluated first via tier 1 ACL and BANP is evaluated last via tier 3 ACL.	Enforced after ANP and before BANP, they are evaluated in tier 2 of the ACL.
Matching pod selection	Can apply different rules across namespaces.	Can apply different rules across pods in single namespace.
Cluster egress traffic	Supported via **nodes** and **networks** peers	Supported through **ipBlock** field along with accepted CIDR syntax.
Cluster ingress traffic	Not supported.	Not supported.
Fully qualified domain names (FQDN) peer support	Not supported.	Not supported.
Namespace selectors	Supports advanced selection of Namespaces with the use of **namespaces.matchLabels** field.	Supports label based namespace selection with the use of **namespaceSelector** field.

CHAPTER 2. ADMIN NETWORK POLICY

2.1. OVN-KUBERNETES ADMINNETWORKPOLICY

2.1.1. AdminNetworkPolicy

An **AdminNetworkPolicy** (ANP) is a cluster-scoped custom resource definition (CRD). As a OpenShift Container Platform administrator, you can use ANP to secure your network by creating network policies before creating namespaces. Additionally, you can create network policies on a cluster-scoped level that is non-overridable by **NetworkPolicy** objects.

The key difference between **AdminNetworkPolicy** and **NetworkPolicy** objects are that the former is for administrators and is cluster scoped while the latter is for tenant owners and is namespace scoped.

An ANP allows administrators to specify the following:

- A **priority** value that determines the order of its evaluation. The lower the value the higher the precedence.
- A set of pods that consists of a set of namespaces or namespace on which the policy is applied.
- A list of ingress rules to be applied for all ingress traffic towards the **subject**.
- A list of egress rules to be applied for all egress traffic from the **subject**.

2.1.1.1. AdminNetworkPolicy example

Example 2.1. Example YAML file for an ANP

```
apiVersion: policy.networking.k8s.io/v1alpha1
kind: AdminNetworkPolicy
metadata:
  name: sample-anp-deny-pass-rules (1)
spec:
  priority: 50 (2)
  subject:
    namespaces:
      matchLabels:
        kubernetes.io/metadata.name: example.name (3)
  ingress: (4)
  - name: "deny-all-ingress-tenant-1" (5)
    action: "Deny"
    from:
    - pods:
        namespaceSelector:
          matchLabels:
            custom-anp: tenant-1
        podSelector:
          matchLabels:
            custom-anp: tenant-1 (6)
  egress:(7)
  - name: "pass-all-egress-to-tenant-1"
    action: "Pass"
```

```
  to:
  - pods:
      namespaceSelector:
        matchLabels:
          custom-anp: tenant-1
      podSelector:
        matchLabels:
          custom-anp: tenant-1
```

1. Specify a name for your ANP.
2. The **spec.priority** field supports a maximum of 100 ANPs in the range of values **0-99** in a cluster. The lower the value, the higher the precedence because the range is read in order from the lowest to highest value. Because there is no guarantee which policy takes precedence when ANPs are created at the same priority, set ANPs at different priorities so that precedence is deliberate.
3. Specify the namespace to apply the ANP resource.
4. ANP have both ingress and egress rules. ANP rules for **spec.ingress** field accepts values of **Pass**, **Deny**, and **Allow** for the **action** field.
5. Specify a name for the **ingress.name**.
6. Specify **podSelector.matchLabels** to select pods within the namespaces selected by **namespaceSelector.matchLabels** as ingress peers.
7. ANPs have both ingress and egress rules. ANP rules for **spec.egress** field accepts values of **Pass**, **Deny**, and **Allow** for the **action** field.

Additional resources

- Network Policy API Working Group

2.1.1.2. AdminNetworkPolicy actions for rules

As an administrator, you can set **Allow**, **Deny**, or **Pass** as the **action** field for your **AdminNetworkPolicy** rules. Because OVN-Kubernetes uses a tiered ACLs to evaluate network traffic rules, ANP allow you to set very strong policy rules that can only be changed by an administrator modifying them, deleting the rule, or overriding them by setting a higher priority rule.

2.1.1.2.1. AdminNetworkPolicy Allow example

The following ANP that is defined at priority 9 ensures all ingress traffic is allowed from the **monitoring** namespace towards any tenant (all other namespaces) in the cluster.

Example 2.2. Example YAML file for a strong Allow ANP

```
apiVersion: policy.networking.k8s.io/v1alpha1
kind: AdminNetworkPolicy
metadata:
  name: allow-monitoring
spec:
```

```
  priority: 9
  subject:
    namespaces: {} # Use the empty selector with caution because it also selects OpenShift
namespaces as well.
  ingress:
  - name: "allow-ingress-from-monitoring"
    action: "Allow"
    from:
    - namespaces:
        matchLabels:
          kubernetes.io/metadata.name: monitoring
# ...
```

This is an example of a strong **Allow** ANP because it is non-overridable by all the parties involved. No tenants can block themselves from being monitored using **NetworkPolicy** objects and the monitoring tenant also has no say in what it can or cannot monitor.

2.1.1.2.2. AdminNetworkPolicy Deny example

The following ANP that is defined at priority 5 ensures all ingress traffic from the **monitoring** namespace is blocked towards restricted tenants (namespaces that have labels **security: restricted**).

Example 2.3. Example YAML file for a strong Deny ANP

```
apiVersion: policy.networking.k8s.io/v1alpha1
kind: AdminNetworkPolicy
metadata:
  name: block-monitoring
spec:
  priority: 5
  subject:
    namespaces:
      matchLabels:
        security: restricted
  ingress:
  - name: "deny-ingress-from-monitoring"
    action: "Deny"
    from:
    - namespaces:
        matchLabels:
          kubernetes.io/metadata.name: monitoring
# ...
```

This is a strong **Deny** ANP that is non-overridable by all the parties involved. The restricted tenant owners cannot authorize themselves to allow monitoring traffic, and the infrastructure's monitoring service cannot scrape anything from these sensitive namespaces.

When combined with the strong **Allow** example, the **block-monitoring** ANP has a lower priority value giving it higher precedence, which ensures restricted tenants are never monitored.

2.1.1.2.3. AdminNetworkPolicy Pass example

The following ANP that is defined at priority 7 ensures all ingress traffic from the **monitoring** namespace towards internal infrastructure tenants (namespaces that have labels **security: internal**) are passed on to tier 2 of the ACLs and evaluated by the namespaces' **NetworkPolicy** objects.

Example 2.4. Example YAML file for a strong Pass ANP

```
apiVersion: policy.networking.k8s.io/v1alpha1
kind: AdminNetworkPolicy
metadata:
  name: pass-monitoring
spec:
  priority: 7
  subject:
    namespaces:
      matchLabels:
        security: internal
  ingress:
  - name: "pass-ingress-from-monitoring"
    action: "Pass"
    from:
    - namespaces:
        matchLabels:
          kubernetes.io/metadata.name: monitoring
# ...
```

This example is a strong **Pass** action ANP because it delegates the decision to **NetworkPolicy** objects defined by tenant owners. This **pass-monitoring** ANP allows all tenant owners grouped at security level **internal** to choose if their metrics should be scraped by the infrastructures' monitoring service using namespace scoped **NetworkPolicy** objects.

2.2. OVN-KUBERNETES BASELINEADMINNETWORKPOLICY

2.2.1. BaselineAdminNetworkPolicy

BaselineAdminNetworkPolicy (BANP) is a cluster-scoped custom resource definition (CRD). As a OpenShift Container Platform administrator, you can use BANP to setup and enforce optional baseline network policy rules that are overridable by users using **NetworkPolicy** objects if need be. Rule actions for BANP are **allow** or **deny**.

The **BaselineAdminNetworkPolicy** resource is a cluster singleton object that can be used as a guardrail policy incase a passed traffic policy does not match any **NetworkPolicy** objects in the cluster. A BANP can also be used as a default security model that provides guardrails that intra-cluster traffic is blocked by default and a user will need to use **NetworkPolicy** objects to allow known traffic. You must use **default** as the name when creating a BANP resource.

A BANP allows administrators to specify:

- A **subject** that consists of a set of namespaces or namespace.
- A list of ingress rules to be applied for all ingress traffic towards the **subject**.
- A list of egress rules to be applied for all egress traffic from the **subject**.

2.2.1.1. BaselineAdminNetworkPolicy example

Example 2.5. Example YAML file for BANP

```
apiVersion: policy.networking.k8s.io/v1alpha1
kind: BaselineAdminNetworkPolicy
metadata:
  name: default (1)
spec:
  subject:
    namespaces:
      matchLabels:
        kubernetes.io/metadata.name: example.name (2)
  ingress: (3)
  - name: "deny-all-ingress-from-tenant-1" (4)
    action: "Deny"
    from:
    - pods:
        namespaceSelector:
          matchLabels:
            custom-banp: tenant-1 (5)
        podSelector:
          matchLabels:
            custom-banp: tenant-1 (6)
  egress:
  - name: "allow-all-egress-to-tenant-1"
    action: "Allow"
    to:
    - pods:
        namespaceSelector:
          matchLabels:
            custom-banp: tenant-1
        podSelector:
          matchLabels:
            custom-banp: tenant-1
```

1. The policy name must be **default** because BANP is a singleton object.
2. Specify the namespace to apply the ANP to.
3. BANP have both ingress and egress rules. BANP rules for **spec.ingress** and **spec.egress** fields accepts values of **Deny** and **Allow** for the **action** field.
4. Specify a name for the **ingress.name**
5. Specify the namespaces to select the pods from to apply the BANP resource.
6. Specify **podSelector.matchLabels** name of the pods to apply the BANP resource.

2.2.1.2. BaselineAdminNetworkPolicy Deny example

The following BANP singleton ensures that the administrator has set up a default deny policy for all

ingress monitoring traffic coming into the tenants at **internal** security level. When combined with the "AdminNetworkPolicy Pass example", this deny policy acts as a guardrail policy for all ingress traffic that is passed by the ANP **pass-monitoring** policy.

Example 2.6. Example YAML file for a guardrail Deny rule

```
apiVersion: policy.networking.k8s.io/v1alpha1
kind: BaselineAdminNetworkPolicy
metadata:
  name: default
spec:
  subject:
    namespaces:
      matchLabels:
        security: internal
  ingress:
  - name: "deny-ingress-from-monitoring"
    action: "Deny"
    from:
    - namespaces:
        matchLabels:
          kubernetes.io/metadata.name: monitoring
# ...
```

You can use an **AdminNetworkPolicy** resource with a **Pass** value for the **action** field in conjunction with the **BaselineAdminNetworkPolicy** resource to create a multi-tenant policy. This multi-tenant policy allows one tenant to collect monitoring data on their application while simultaneously not collecting data from a second tenant.

As an administrator, if you apply both the "AdminNetworkPolicy **Pass** action example" and the "BaselineAdminNetwork Policy **Deny** example", tenants are then left with the ability to choose to create a **NetworkPolicy** resource that will be evaluated before the BANP.

For example, Tenant 1 can set up the following **NetworkPolicy** resource to monitor ingress traffic:

Example 2.7. Example NetworkPolicy

```
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: allow-monitoring
  namespace: tenant 1
spec:
  podSelector:
  policyTypes:
    - Ingress
  ingress:
  - from:
    - namespaceSelector:
        matchLabels:
          kubernetes.io/metadata.name: monitoring
# ...
```

In this scenario, Tenant 1's policy would be evaluated after the "AdminNetworkPolicy **Pass** action example" and before the "BaselineAdminNetwork Policy **Deny** example", which denies all ingress monitoring traffic coming into tenants with **security** level **internal**. With Tenant 1's **NetworkPolicy** object in place, they will be able to collect data on their application. Tenant 2, however, who does not have any **NetworkPolicy** objects in place, will not be able to collect data. As an administrator, you have not by default monitored internal tenants, but instead, you created a BANP that allows tenants to use **NetworkPolicy** objects to override the default behavior of your BANP.

2.3. MONITORING ANP AND BANP

AdminNetworkPolicy and **BaselineAdminNetworkPolicy** resources have metrics that can be used for monitoring and managing your policies. See the following table for more details on the metrics.

2.3.1. Metrics for AdminNetworkPolicy

Name	Description	Explanation
ovnkube_controller_admin_network_policies	Not applicable	The total number of **AdminNetworkPolicy** resources in the cluster.
ovnkube_controller_baseline_admin_network_policies	Not applicable	The total number of **BaselineAdminNetworkPolicy** resources in the cluster. The value should be 0 or 1.
ovnkube_controller_admin_network_policies_rules	• **direction**: specifies either **Ingress** or **Egress**. • **action**: specifies either **Pass**, **Allow**, or **Deny**.	The total number of rules across all ANP policies in the cluster grouped by **direction** and **action**.
ovnkube_controller_baseline_admin_network_policies_rules	• **direction**: specifies either **Ingress** or **Egress**. • **action**: specifies either **Allow** or **Deny**.	The total number of rules across all BANP policies in the cluster grouped by **direction** and **action**.
ovnkube_controller_admin_network_policies_db_objects	**table_name**: specifies either **ACL** or **Address_Set**	The total number of OVN Northbound database (nbdb) objects that are created by all the ANP in the cluster grouped by the **table_name**.

Name	Description	Explanation
ovnkube_controller_baseline_admin_network_policies_db_objects	**table_name**: specifies either **ACL** or **Address_Set**	The total number of OVN Northbound database (nbdb) objects that are created by all the BANP in the cluster grouped by the **table_name**.

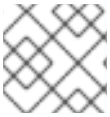
2.4. EGRESS NODES AND NETWORKS PEER FOR ADMINNETWORKPOLICY

This section explains **nodes** and **networks** peers. Administrators can use the examples in this section to design **AdminNetworkPolicy** and **BaselineAdminNetworkPolicy** to control northbound traffic in their cluster.

2.4.1. Northbound traffic controls for AdminNetworkPolicy and BaselineAdminNetworkPolicy

In addition to supporting east-west traffic controls, ANP and BANP also allow administrators to control their northbound traffic leaving the cluster or traffic leaving the node to other nodes in the cluster. End-users can do the following:

- Implement egress traffic control towards cluster nodes using **nodes** egress peer
- Implement egress traffic control towards Kubernetes API servers using **nodes** or **networks** egress peers
- Implement egress traffic control towards external destinations outside the cluster using **networks** peer



NOTE

For ANP and BANP, **nodes** and **networks** peers can be specified for egress rules only.

2.4.1.1. Using nodes peer to control egress traffic to cluster nodes

Using the **nodes** peer administrators can control egress traffic from pods to nodes in the cluster. A benefit of this is that you do not have to change the policy when nodes are added to or deleted from the cluster.

The following example allows egress traffic to the Kubernetes API server on port **6443** by any of the namespaces with a **restricted**, **confidential**, or **internal** level of security using the node selector peer. It also denies traffic to all worker nodes in your cluster from any of the namespaces with a **restricted**, **confidential**, or **internal** level of security.

Example 2.8. Example of ANP Allow egress using nodes peer

```
apiVersion: policy.networking.k8s.io/v1alpha1
kind: AdminNetworkPolicy
metadata:
  name: egress-security-allow
```

```
spec:
  egress:
  - action: Deny
    to:
    - nodes:
        matchExpressions:
        - key: node-role.kubernetes.io/worker
          operator: Exists
  - action: Allow
    name: allow-to-kubernetes-api-server-and-engr-dept-pods
    ports:
    - portNumber:
        port: 6443
        protocol: TCP
    to:
    - nodes: 1
        matchExpressions:
        - key: node-role.kubernetes.io/control-plane
          operator: Exists
    - pods: 2
        namespaceSelector:
          matchLabels:
            dept: engr
        podSelector: {}
  priority: 55
  subject: 3
    namespaces:
      matchExpressions:
      - key: security 4
        operator: In
        values:
        - restricted
        - confidential
        - internal
```

1 Specifies a node or set of nodes in the cluster using the **matchExpressions** field.

2 Specifies all the pods labeled with **dept: engr**.

3 Specifies the subject of the ANP which includes any namespaces that match the labels used by the network policy. The example matches any of the namespaces with **restricted**, **confidential**, or **internal** level of **security**.

4 Specifies key/value pairs for **matchExpressions** field.

2.4.1.2. Using networks peer to control egress traffic towards external destinations

Cluster administrators can use CIDR ranges in **networks** peer and apply a policy to control egress traffic leaving from pods and going to a destination configured at the IP address that is within the CIDR range specified with **networks** field.

The following example uses **networks** peer and combines ANP and BANP policies to restrict egress traffic.

IMPORTANT

Use the empty selector ({}) in the **namespace** field for ANP and BANP with caution. When using an empty selector, it also selects OpenShift namespaces.

If you use values of **0.0.0.0/0** in a ANP or BANP **Deny** rule, you must set a higher priority ANP **Allow** rule to necessary destinations before setting the **Deny** to **0.0.0.0/0**.

Example 2.9. Example of ANP and BANP using networks peers

```
apiVersion: policy.networking.k8s.io/v1alpha1
kind: AdminNetworkPolicy
metadata:
  name: network-as-egress-peer
spec:
  priority: 70
  subject:
    namespaces: {} # Use the empty selector with caution because it also selects OpenShift
namespaces as well.
  egress:
  - name: "deny-egress-to-external-dns-servers"
    action: "Deny"
    to:
    - networks: (1)
      - 8.8.8.8/32
      - 8.8.4.4/32
      - 208.67.222.222/32
    ports:
      - portNumber:
          protocol: UDP
          port: 53
  - name: "allow-all-egress-to-intranet"
    action: "Allow"
    to:
    - networks: (2)
      - 89.246.180.0/22
      - 60.45.72.0/22
  - name: "allow-all-intra-cluster-traffic"
    action: "Allow"
    to:
    - namespaces: {} # Use the empty selector with caution because it also selects OpenShift
namespaces as well.
  - name: "pass-all-egress-to-internet"
    action: "Pass"
    to:
    - networks:
      - 0.0.0.0/0 (3)
---
apiVersion: policy.networking.k8s.io/v1alpha1
kind: BaselineAdminNetworkPolicy
metadata:
  name: default
spec:
  subject:
    namespaces: {} # Use the empty selector with caution because it also selects OpenShift
```

```
    namespaces as well.
  egress:
  - name: "deny-all-egress-to-internet"
    action: "Deny"
    to:
    - networks:
      - 0.0.0.0/0 4
---
```

1 Use **networks** to specify a range of CIDR networks outside of the cluster.

2 Specifies the CIDR ranges for the intra-cluster traffic from your resources.

3 4 Specifies a **Deny** egress to everything by setting **networks** values to **0.0.0.0/0**. Make sure you have a higher priority **Allow** rule to necessary destinations before setting a **Deny** to **0.0.0.0/0** because this will deny all traffic including to Kubernetes API and DNS servers.

Collectively the **network-as-egress-peer** ANP and **default** BANP using **networks** peers enforces the following egress policy:

- All pods cannot talk to external DNS servers at the listed IP addresses.
- All pods can talk to rest of the company's intranet.
- All pods can talk to other pods, nodes, and services.
- All pods cannot talk to the internet. Combining the last ANP **Pass** rule and the strong BANP **Deny** rule a guardrail policy is created that secures traffic in the cluster.

2.4.1.3. Using nodes peer and networks peer together

Cluster administrators can combine **nodes** and **networks** peer in your ANP and BANP policies.

Example 2.10. Example of nodes and networks peer

```
apiVersion: policy.networking.k8s.io/v1alpha1
kind: AdminNetworkPolicy
metadata:
  name: egress-peer-1 1
spec:
  egress: 2
  - action: "Allow"
    name: "allow-egress"
    to:
    - nodes:
        matchExpressions:
        - key: worker-group
          operator: In
          values:
          - workloads # Egress traffic from nodes with label worker-group: workloads is allowed.
    - networks:
      - 104.154.164.170/32
    - pods:
```

```
      namespaceSelector:
        matchLabels:
          apps: external-apps
      podSelector:
        matchLabels:
          app: web # This rule in the policy allows the traffic directed to pods labeled apps: web in
projects with apps: external-apps to leave the cluster.
  - action: "Deny"
    name: "deny-egress"
    to:
    - nodes:
        matchExpressions:
        - key: worker-group
          operator: In
          values:
          - infra # Egress traffic from nodes with label worker-group: infra is denied.
    - networks:
      - 104.154.164.160/32 # Egress traffic to this IP address from cluster is denied.
    - pods:
        namespaceSelector:
          matchLabels:
            apps: internal-apps
        podSelector: {}
  - action: "Pass"
    name: "pass-egress"
    to:
    - nodes:
        matchExpressions:
        - key: node-role.kubernetes.io/worker
          operator: Exists # All other egress traffic is passed to NetworkPolicy or BANP for evaluation.
  priority: 30 (3)
  subject: (4)
    namespaces:
      matchLabels:
        apps: all-apps
```

1. Specifies the name of the policy.
2. For **nodes** and **networks** peers, you can only use northbound traffic controls in ANP as **egress**.
3. Specifies the priority of the ANP, determining the order in which they should be evaluated. Lower priority rules have higher precedence. ANP accepts values of 0-99 with 0 being the highest priority and 99 being the lowest.
4. Specifies the set of pods in the cluster on which the rules of the policy are to be applied. In the example, any pods with the **apps: all-apps** label across all namespaces are the **subject** of the policy.

2.5. TROUBLESHOOTING ADMINNETWORKPOLICY

2.5.1. Checking creation of ANP

To check that your **AdminNetworkPolicy** (ANP) and **BaselineAdminNetworkPolicy** (BANP) are created correctly, check the status outputs of the following commands: **oc describe anp** or **oc describe banp**.

A good status indicates **OVN DB plumbing was successful** and the **SetupSucceeded**.

Example 2.11. Example ANP with a good status

```
...
Conditions:
Last Transition Time:  2024-06-08T20:29:00Z
Message:               Setting up OVN DB plumbing was successful
Reason:                SetupSucceeded
Status:                True
Type:                  Ready-In-Zone-ovn-control-plane Last Transition Time:  2024-06-08T20:29:00Z
Message:               Setting up OVN DB plumbing was successful
Reason:                SetupSucceeded
Status:                True
Type:                  Ready-In-Zone-ovn-worker
Last Transition Time:  2024-06-08T20:29:00Z
Message:               Setting up OVN DB plumbing was successful
Reason:                SetupSucceeded
Status:                True
Type:                  Ready-In-Zone-ovn-worker2
...
```

If plumbing is unsuccessful, an error is reported from the respective zone controller.

Example 2.12. Example of an ANP with a bad status and error message

```
...
Status:
  Conditions:
    Last Transition Time:  2024-06-25T12:47:44Z
    Message:               error attempting to add ANP cluster-control with priority 600 because, OVNK
only supports priority ranges 0-99
    Reason:                SetupFailed
    Status:                False
    Type:                  Ready-In-Zone-example-worker-1.example.example-org.net
    Last Transition Time:  2024-06-25T12:47:45Z
    Message:               error attempting to add ANP cluster-control with priority 600 because, OVNK
only supports priority ranges 0-99
    Reason:                SetupFailed
    Status:                False
    Type:                  Ready-In-Zone-example-worker-0.example.example-org.net
    Last Transition Time:  2024-06-25T12:47:44Z
    Message:               error attempting to add ANP cluster-control with priority 600 because, OVNK
only supports priority ranges 0-99
    Reason:                SetupFailed
    Status:                False
    Type:                  Ready-In-Zone-example-ctlplane-1.example.example-org.net
    Last Transition Time:  2024-06-25T12:47:44Z
    Message:               error attempting to add ANP cluster-control with priority 600 because, OVNK
only supports priority ranges 0-99
```

```
    Reason:               SetupFailed
    Status:               False
    Type:                 Ready-In-Zone-example-ctlplane-2.example.example-org.net
    Last Transition Time:  2024-06-25T12:47:44Z
    Message:              error attempting to add ANP cluster-control with priority 600 because, OVNK
only supports priority ranges 0-99
    Reason:               SetupFailed
    Status:               False
    Type:                 Ready-In-Zone-example-ctlplane-0.example.example-org.net
    ```
```

See the following section for **nbctl** commands to help troubleshoot unsuccessful policies.

#### 2.5.1.1. Using nbctl commands for ANP and BANP

To troubleshoot an unsuccessful setup, start by looking at OVN Northbound database (nbdb) objects including **ACL**, **AdressSet**, and **Port_Group**. To view the nbdb, you need to be inside the pod on that node to view the objects in that node's database.

**Prerequisites**

- Access to the cluster as a user with the **cluster-admin** role.
- The OpenShift CLI (**oc**) installed.

**NOTE**

To run ovn **nbctl** commands in a cluster, you must open a remote shell into the `nbdb`on the relevant node.

The following policy was used to generate outputs.

**Example 2.13. AdminNetworkPolicy used to generate outputs**

```
apiVersion: policy.networking.k8s.io/v1alpha1
kind: AdminNetworkPolicy
metadata:
  name: cluster-control
spec:
  priority: 34
  subject:
    namespaces:
      matchLabels:
        anp: cluster-control-anp # Only namespaces with this label have this ANP
  ingress:
  - name: "allow-from-ingress-router" # rule0
    action: "Allow"
    from:
    - namespaces:
        matchLabels:
          policy-group.network.openshift.io/ingress: ""
  - name: "allow-from-monitoring" # rule1
    action: "Allow"
```
```

```
    from:
    - namespaces:
        matchLabels:
          kubernetes.io/metadata.name: openshift-monitoring
    ports:
    - portNumber:
        protocol: TCP
        port: 7564
    - namedPort: "scrape"
  - name: "allow-from-open-tenants" # rule2
    action: "Allow"
    from:
    - namespaces: # open tenants
        matchLabels:
          tenant: open
  - name: "pass-from-restricted-tenants" # rule3
    action: "Pass"
    from:
    - namespaces: # restricted tenants
        matchLabels:
          tenant: restricted
  - name: "default-deny" # rule4
    action: "Deny"
    from:
    - namespaces: {} # Use the empty selector with caution because it also selects OpenShift
namespaces as well.
  egress:
  - name: "allow-to-dns" # rule0
    action: "Allow"
    to:
    - pods:
        namespaceSelector:
          matchLabels:
            kubernetes.io/metadata.name: openshift-dns
        podSelector:
          matchLabels:
            app: dns
    ports:
    - portNumber:
        protocol: UDP
        port: 5353
  - name: "allow-to-kapi-server" # rule1
    action: "Allow"
    to:
    - nodes:
        matchExpressions:
        - key: node-role.kubernetes.io/control-plane
          operator: Exists
    ports:
    - portNumber:
        protocol: TCP
        port: 6443
  - name: "allow-to-splunk" # rule2
    action: "Allow"
    to:
    - namespaces:
```

```
      matchLabels:
        tenant: splunk
  ports:
  - portNumber:
      protocol: TCP
      port: 8991
  - portNumber:
      protocol: TCP
      port: 8992
- name: "allow-to-open-tenants-and-intranet-and-worker-nodes" # rule3
  action: "Allow"
  to:
  - nodes: # worker-nodes
      matchExpressions:
      - key: node-role.kubernetes.io/worker
        operator: Exists
  - networks: # intranet
    - 172.29.0.0/30
    - 10.0.54.0/19
    - 10.0.56.38/32
    - 10.0.69.0/24
  - namespaces: # open tenants
      matchLabels:
        tenant: open
- name: "pass-to-restricted-tenants" # rule4
  action: "Pass"
  to:
  - namespaces: # restricted tenants
      matchLabels:
        tenant: restricted
- name: "default-deny"
  action: "Deny"
  to:
  - networks:
    - 0.0.0.0/0
```

Procedure

1. List pods with node information by running the following command:

```
$ oc get pods -n openshift-ovn-kubernetes -owide
```

Example output

```
NAME                                  READY   STATUS    RESTARTS   AGE   IP           NODE
NOMINATED NODE   READINESS GATES
ovnkube-control-plane-5c95487779-8k9fd   2/2     Running   0          34m   10.0.0.5     ci-ln-
0tv5gg2-72292-6sjw5-master-0   <none>           <none>
ovnkube-control-plane-5c95487779-v2xn8   2/2     Running   0          34m   10.0.0.3     ci-ln-
0tv5gg2-72292-6sjw5-master-1   <none>           <none>
ovnkube-node-524dt                    8/8     Running   0          33m   10.0.0.4     ci-ln-0tv5gg2-
72292-6sjw5-master-2   <none>           <none>
ovnkube-node-gbwr9                    8/8     Running   0          24m   10.0.128.4   ci-ln-0tv5gg2-
72292-6sjw5-worker-c-s9gqt   <none>           <none>
```

```
ovnkube-node-h4fpx                  8/8     Running   0          33m   10.0.0.5     ci-ln-0tv5gg2-
72292-6sjw5-master-0        <none>          <none>
ovnkube-node-j4hzw                  8/8     Running   0          24m   10.0.128.2   ci-ln-0tv5gg2-
72292-6sjw5-worker-a-hzbh5  <none>          <none>
ovnkube-node-wdhgv                  8/8     Running   0          33m   10.0.0.3     ci-ln-0tv5gg2-
72292-6sjw5-master-1        <none>          <none>
ovnkube-node-wfncn                  8/8     Running   0          24m   10.0.128.3   ci-ln-0tv5gg2-
72292-6sjw5-worker-b-5bb7f  <none>          <none>
```

2. Navigate into a pod to look at the northbound database by running the following command:

```
$ oc rsh -c nbdb -n openshift-ovn-kubernetes ovnkube-node-524dt
```

3. Run the following command to look at the ACLs nbdb:

```
$ ovn-nbctl find ACL 'external_ids{>=}{"k8s.ovn.org/owner-
type"=AdminNetworkPolicy,"k8s.ovn.org/name"=cluster-control}'
```

Where, cluster-control

Specifies the name of the **AdminNetworkPolicy** you are troubleshooting.

AdminNetworkPolicy

Specifies the type: **AdminNetworkPolicy** or **BaselineAdminNetworkPolicy**.

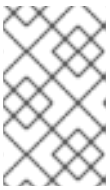
Example 2.14. Example output for ACLs

```
_uuid               : 0d5e4722-b608-4bb1-b625-23c323cc9926
action              : allow-related
direction           : to-lport
external_ids        : {direction=Ingress, gress-index="2", "k8s.ovn.org/id"="default-network-
controller:AdminNetworkPolicy:cluster-control:Ingress:2:None",
"k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-controller"=default-network-
controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy, port-policy-protocol=None}
label               : 0
log                 : false
match               : "outport == @a14645450421485494999 && ((ip4.src ==
$a13730899355151937870))"
meter               : acl-logging
name                : "ANP:cluster-control:Ingress:2"
options             : {}
priority            : 26598
severity            : []
tier                : 1

_uuid               : b7be6472-df67-439c-8c9c-f55929f0a6e0
action              : drop
direction           : from-lport
external_ids        : {direction=Egress, gress-index="5", "k8s.ovn.org/id"="default-network-
controller:AdminNetworkPolicy:cluster-control:Egress:5:None",
"k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-controller"=default-network-
controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy, port-policy-protocol=None}
label               : 0
log                 : false
match               : "inport == @a14645450421485494999 && ((ip4.dst ==
$a11452480169090787059))"
```

```
meter               : acl-logging
name                : "ANP:cluster-control:Egress:5"
options             : {apply-after-lb="true"}
priority            : 26595
severity            : []
tier                : 1

_uuid               : 5a6e5bb4-36eb-4209-b8bc-c611983d4624
action              : pass
direction           : to-lport
external_ids        : {direction=Ingress, gress-index="3", "k8s.ovn.org/id"="default-network-
controller:AdminNetworkPolicy:cluster-control:Ingress:3:None",
"k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-controller"=default-network-
controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy, port-policy-protocol=None}
label               : 0
log                 : false
match               : "outport == @a14645450421485494999 && ((ip4.src ==
$a764182844364804195))"
meter               : acl-logging
name                : "ANP:cluster-control:Ingress:3"
options             : {}
priority            : 26597
severity            : []
tier                : 1

_uuid               : 04f20275-c410-405c-a923-0e677f767889
action              : pass
direction           : from-lport
external_ids        : {direction=Egress, gress-index="4", "k8s.ovn.org/id"="default-network-
controller:AdminNetworkPolicy:cluster-control:Egress:4:None",
"k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-controller"=default-network-
controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy, port-policy-protocol=None}
label               : 0
log                 : false
match               : "inport == @a14645450421485494999 && ((ip4.dst ==
$a5972452606168369118))"
meter               : acl-logging
name                : "ANP:cluster-control:Egress:4"
options             : {apply-after-lb="true"}
priority            : 26596
severity            : []
tier                : 1

_uuid               : 4b5d836a-e0a3-4088-825e-f9f0ca58e538
action              : drop
direction           : to-lport
external_ids        : {direction=Ingress, gress-index="4", "k8s.ovn.org/id"="default-network-
controller:AdminNetworkPolicy:cluster-control:Ingress:4:None",
"k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-controller"=default-network-
controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy, port-policy-protocol=None}
label               : 0
log                 : false
match               : "outport == @a14645450421485494999 && ((ip4.src ==
$a13814616246365836720))"
meter               : acl-logging
name                : "ANP:cluster-control:Ingress:4"
```

```
options             : {}
priority            : 26596
severity            : []
tier                : 1

_uuid               : 5d09957d-d2cc-4f5a-9ddd-b97d9d772023
action              : allow-related
direction           : from-lport
external_ids        : {direction=Egress, gress-index="2", "k8s.ovn.org/id"="default-network-
controller:AdminNetworkPolicy:cluster-control:Egress:2:tcp", "k8s.ovn.org/name"=cluster-
control, "k8s.ovn.org/owner-controller"=default-network-controller, "k8s.ovn.org/owner-
type"=AdminNetworkPolicy, port-policy-protocol=tcp}
label               : 0
log                 : false
match               : "inport == @a14645450421485494999 && ((ip4.dst ==
$a18396736153283155648)) && tcp && tcp.dst=={8991,8992}"
meter               : acl-logging
name                : "ANP:cluster-control:Egress:2"
options             : {apply-after-lb="true"}
priority            : 26598
severity            : []
tier                : 1

_uuid               : 1a68a5ed-e7f9-47d0-b55c-89184d97e81a
action              : allow-related
direction           : from-lport
external_ids        : {direction=Egress, gress-index="1", "k8s.ovn.org/id"="default-network-
controller:AdminNetworkPolicy:cluster-control:Egress:1:tcp", "k8s.ovn.org/name"=cluster-
control, "k8s.ovn.org/owner-controller"=default-network-controller, "k8s.ovn.org/owner-
type"=AdminNetworkPolicy, port-policy-protocol=tcp}
label               : 0
log                 : false
match               : "inport == @a14645450421485494999 && ((ip4.dst ==
$a10706246167277696183)) && tcp && tcp.dst==6443"
meter               : acl-logging
name                : "ANP:cluster-control:Egress:1"
options             : {apply-after-lb="true"}
priority            : 26599
severity            : []
tier                : 1

_uuid               : aa1a224d-7960-4952-bdfb-35246bafbac8
action              : allow-related
direction           : to-lport
external_ids        : {direction=Ingress, gress-index="1", "k8s.ovn.org/id"="default-network-
controller:AdminNetworkPolicy:cluster-control:Ingress:1:tcp", "k8s.ovn.org/name"=cluster-
control, "k8s.ovn.org/owner-controller"=default-network-controller, "k8s.ovn.org/owner-
type"=AdminNetworkPolicy, port-policy-protocol=tcp}
label               : 0
log                 : false
match               : "outport == @a14645450421485494999 && ((ip4.src ==
$a6786643370959569281)) && tcp && tcp.dst==7564"
meter               : acl-logging
name                : "ANP:cluster-control:Ingress:1"
options             : {}
priority            : 26599
```

```
severity            : []
tier                : 1

_uuid               : 1a27d30e-3f96-4915-8ddd-ade7f22c117b
action              : allow-related
direction           : from-lport
external_ids        : {direction=Egress, gress-index="3", "k8s.ovn.org/id"="default-network-
controller:AdminNetworkPolicy:cluster-control:Egress:3:None",
"k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-controller"=default-network-
controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy, port-policy-protocol=None}
label               : 0
log                 : false
match               : "inport == @a14645450421485494999 && ((ip4.dst ==
$a10622494091691694581))"
meter               : acl-logging
name                : "ANP:cluster-control:Egress:3"
options             : {apply-after-lb="true"}
priority            : 26597
severity            : []
tier                : 1

_uuid               : b23a087f-08f8-4225-8c27-4a9a9ee0c407
action              : allow-related
direction           : from-lport
external_ids        : {direction=Egress, gress-index="0", "k8s.ovn.org/id"="default-network-
controller:AdminNetworkPolicy:cluster-control:Egress:0:udp", "k8s.ovn.org/name"=cluster-
control, "k8s.ovn.org/owner-controller"=default-network-controller, "k8s.ovn.org/owner-
type"=AdminNetworkPolicy, port-policy-protocol=udp}
label               : 0
log                 : false
match               : "inport == @a14645450421485494999 && ((ip4.dst ==
$a13517855690389298082)) && udp && udp.dst==5353"
meter               : acl-logging
name                : "ANP:cluster-control:Egress:0"
options             : {apply-after-lb="true"}
priority            : 26600
severity            : []
tier                : 1

_uuid               : d14ed5cf-2e06-496e-8cae-6b76d5dd5ccd
action              : allow-related
direction           : to-lport
external_ids        : {direction=Ingress, gress-index="0", "k8s.ovn.org/id"="default-network-
controller:AdminNetworkPolicy:cluster-control:Ingress:0:None",
"k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-controller"=default-network-
controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy, port-policy-protocol=None}
label               : 0
log                 : false
match               : "outport == @a14645450421485494999 && ((ip4.src ==
$a14545668191619617708))"
meter               : acl-logging
name                : "ANP:cluster-control:Ingress:0"
options             : {}
priority            : 26600
severity            : []
tier                : 1
```



NOTE

The outputs for ingress and egress show you the logic of the policy in the ACL. For example, every time a packet matches the provided **match** the **action** is taken.

a. Examine the specific ACL for the rule by running the following command:

```
$ ovn-nbctl find ACL 'external_ids{>=}{"k8s.ovn.org/owner-
type"=AdminNetworkPolicy,direction=Ingress,"k8s.ovn.org/name"=cluster-control,gress-
index="1"}'
```

Where, cluster-control

Specifies the **name** of your ANP.

Ingress

Specifies the **direction** of traffic either of type **Ingress** or **Egress**.

1

Specifies the rule you want to look at.

For the example ANP named **cluster-control** at **priority 34**, the following is an example output for **Ingress rule** 1:

Example 2.15. Example output

```
_uuid               : aa1a224d-7960-4952-bdfb-35246bafbac8
action              : allow-related
direction           : to-lport
external_ids        : {direction=Ingress, gress-index="1", "k8s.ovn.org/id"="default-
network-controller:AdminNetworkPolicy:cluster-control:Ingress:1:tcp",
"k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-controller"=default-network-
controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy, port-policy-protocol=tcp}
label               : 0
log                 : false
match               : "outport == @a14645450421485494999 && ((ip4.src ==
$a6786643370959569281)) && tcp && tcp.dst==7564"
meter               : acl-logging
name                : "ANP:cluster-control:Ingress:1"
options             : {}
priority            : 26599
severity            : []
tier                : 1
```

4. Run the following command to look at address sets in the nbdb:

```
$ ovn-nbctl find Address_Set 'external_ids{>=}{"k8s.ovn.org/owner-
type"=AdminNetworkPolicy,"k8s.ovn.org/name"=cluster-control}'
```

Example 2.16. Example outputs for Address_Set

```
_uuid               : 56e89601-5552-4238-9fc3-8833f5494869
addresses           : ["192.168.194.135", "192.168.194.152", "192.168.194.193",
"192.168.194.254"]
external_ids        : {direction=Egress, gress-index="1", ip-family=v4,
"k8s.ovn.org/id"="default-network-controller:AdminNetworkPolicy:cluster-
control:Egress:1:v4", "k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-
controller"=default-network-controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy}
name                : a10706246167277696183

_uuid               : 7df9330d-380b-4bdb-8acd-4eddeda2419c
addresses           : ["10.132.0.10", "10.132.0.11", "10.132.0.12", "10.132.0.13",
"10.132.0.14", "10.132.0.15", "10.132.0.16", "10.132.0.17", "10.132.0.5", "10.132.0.7",
"10.132.0.71", "10.132.0.75", "10.132.0.8", "10.132.0.81", "10.132.0.9", "10.132.2.10",
"10.132.2.11", "10.132.2.12", "10.132.2.14", "10.132.2.15", "10.132.2.3", "10.132.2.4",
"10.132.2.5", "10.132.2.6", "10.132.2.7", "10.132.2.8", "10.132.2.9", "10.132.3.64",
"10.132.3.65", "10.132.3.72", "10.132.3.73", "10.132.3.76", "10.133.0.10", "10.133.0.11",
"10.133.0.12", "10.133.0.13", "10.133.0.14", "10.133.0.15", "10.133.0.16", "10.133.0.17",
"10.133.0.18", "10.133.0.19", "10.133.0.20", "10.133.0.21", "10.133.0.22", "10.133.0.23",
"10.133.0.24", "10.133.0.25", "10.133.0.26", "10.133.0.27", "10.133.0.28", "10.133.0.29",
"10.133.0.30", "10.133.0.31", "10.133.0.32", "10.133.0.33", "10.133.0.34", "10.133.0.35",
"10.133.0.36", "10.133.0.37", "10.133.0.38", "10.133.0.39", "10.133.0.40", "10.133.0.41",
"10.133.0.42", "10.133.0.44", "10.133.0.45", "10.133.0.46", "10.133.0.47", "10.133.0.48",
"10.133.0.5", "10.133.0.6", "10.133.0.7", "10.133.0.8", "10.133.0.9", "10.134.0.10",
"10.134.0.11", "10.134.0.12", "10.134.0.13", "10.134.0.14", "10.134.0.15", "10.134.0.16",
"10.134.0.17", "10.134.0.18", "10.134.0.19", "10.134.0.20", "10.134.0.21", "10.134.0.22",
"10.134.0.23", "10.134.0.24", "10.134.0.25", "10.134.0.26", "10.134.0.27", "10.134.0.28",
"10.134.0.30", "10.134.0.31", "10.134.0.32", "10.134.0.33", "10.134.0.34", "10.134.0.35",
"10.134.0.36", "10.134.0.37", "10.134.0.38", "10.134.0.4", "10.134.0.42", "10.134.0.9",
"10.135.0.10", "10.135.0.11", "10.135.0.12", "10.135.0.13", "10.135.0.14", "10.135.0.15",
"10.135.0.16", "10.135.0.17", "10.135.0.18", "10.135.0.19", "10.135.0.23", "10.135.0.24",
"10.135.0.26", "10.135.0.27", "10.135.0.29", "10.135.0.3", "10.135.0.4", "10.135.0.40",
"10.135.0.41", "10.135.0.42", "10.135.0.43", "10.135.0.44", "10.135.0.5", "10.135.0.6",
"10.135.0.7", "10.135.0.8", "10.135.0.9"]
external_ids        : {direction=Ingress, gress-index="4", ip-family=v4,
"k8s.ovn.org/id"="default-network-controller:AdminNetworkPolicy:cluster-
control:Ingress:4:v4", "k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-
controller"=default-network-controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy}
name                : a13814616246365836720

_uuid               : 84d76f13-ad95-4c00-8329-a0b1d023c289
addresses           : ["10.132.3.76", "10.135.0.44"]
external_ids        : {direction=Egress, gress-index="4", ip-family=v4,
"k8s.ovn.org/id"="default-network-controller:AdminNetworkPolicy:cluster-
control:Egress:4:v4", "k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-
controller"=default-network-controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy}
name                : a5972452606168369118

_uuid               : 0c53e917-f7ee-4256-8f3a-9522c0481e52
addresses           : ["10.132.0.10", "10.132.0.11", "10.132.0.12", "10.132.0.13",
"10.132.0.14", "10.132.0.15", "10.132.0.16", "10.132.0.17", "10.132.0.5", "10.132.0.7",
"10.132.0.71", "10.132.0.75", "10.132.0.8", "10.132.0.81", "10.132.0.9", "10.132.2.10",
"10.132.2.11", "10.132.2.12", "10.132.2.14", "10.132.2.15", "10.132.2.3", "10.132.2.4",
"10.132.2.5", "10.132.2.6", "10.132.2.7", "10.132.2.8", "10.132.2.9", "10.132.3.64",
"10.132.3.65", "10.132.3.72", "10.132.3.73", "10.132.3.76", "10.133.0.10", "10.133.0.11",
"10.133.0.12", "10.133.0.13", "10.133.0.14", "10.133.0.15", "10.133.0.16", "10.133.0.17",
"10.133.0.18", "10.133.0.19", "10.133.0.20", "10.133.0.21", "10.133.0.22", "10.133.0.23",
```

"10.133.0.24", "10.133.0.25", "10.133.0.26", "10.133.0.27", "10.133.0.28", "10.133.0.29",
"10.133.0.30", "10.133.0.31", "10.133.0.32", "10.133.0.33", "10.133.0.34", "10.133.0.35",
"10.133.0.36", "10.133.0.37", "10.133.0.38", "10.133.0.39", "10.133.0.40", "10.133.0.41",
"10.133.0.42", "10.133.0.44", "10.133.0.45", "10.133.0.46", "10.133.0.47", "10.133.0.48",
"10.133.0.5", "10.133.0.6", "10.133.0.7", "10.133.0.8", "10.133.0.9", "10.134.0.10",
"10.134.0.11", "10.134.0.12", "10.134.0.13", "10.134.0.14", "10.134.0.15", "10.134.0.16",
"10.134.0.17", "10.134.0.18", "10.134.0.19", "10.134.0.20", "10.134.0.21", "10.134.0.22",
"10.134.0.23", "10.134.0.24", "10.134.0.25", "10.134.0.26", "10.134.0.27", "10.134.0.28",
"10.134.0.30", "10.134.0.31", "10.134.0.32", "10.134.0.33", "10.134.0.34", "10.134.0.35",
"10.134.0.36", "10.134.0.37", "10.134.0.38", "10.134.0.4", "10.134.0.42", "10.134.0.9",
"10.135.0.10", "10.135.0.11", "10.135.0.12", "10.135.0.13", "10.135.0.14", "10.135.0.15",
"10.135.0.16", "10.135.0.17", "10.135.0.18", "10.135.0.19", "10.135.0.23", "10.135.0.24",
"10.135.0.26", "10.135.0.27", "10.135.0.29", "10.135.0.3", "10.135.0.4", "10.135.0.40",
"10.135.0.41", "10.135.0.42", "10.135.0.43", "10.135.0.44", "10.135.0.5", "10.135.0.6",
"10.135.0.7", "10.135.0.8", "10.135.0.9"]
external_ids : {direction=Egress, gress-index="2", ip-family=v4,
"k8s.ovn.org/id"="default-network-controller:AdminNetworkPolicy:cluster-
control:Egress:2:v4", "k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-
controller"=default-network-controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy}
name : a18396736153283155648

_uuid : 5228bf1b-dfd8-40ec-bfa8-95c5bf9aded9
addresses : []
external_ids : {direction=Ingress, gress-index="0", ip-family=v4,
"k8s.ovn.org/id"="default-network-controller:AdminNetworkPolicy:cluster-
control:Ingress:0:v4", "k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-
controller"=default-network-controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy}
name : a14545668191619617708

_uuid : 46530d69-70da-4558-8c63-884ec9dc4f25
addresses : ["10.132.2.10", "10.132.2.5", "10.132.2.6", "10.132.2.7", "10.132.2.8",
"10.132.2.9", "10.133.0.47", "10.134.0.33", "10.135.0.10", "10.135.0.11", "10.135.0.12",
"10.135.0.19", "10.135.0.24", "10.135.0.7", "10.135.0.8", "10.135.0.9"]
external_ids : {direction=Ingress, gress-index="1", ip-family=v4,
"k8s.ovn.org/id"="default-network-controller:AdminNetworkPolicy:cluster-
control:Ingress:1:v4", "k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-
controller"=default-network-controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy}
name : a6786643370959569281

_uuid : 65fdcdea-0b9f-4318-9884-1b51d231ad1d
addresses : ["10.132.3.72", "10.135.0.42"]
external_ids : {direction=Ingress, gress-index="2", ip-family=v4,
"k8s.ovn.org/id"="default-network-controller:AdminNetworkPolicy:cluster-
control:Ingress:2:v4", "k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-
controller"=default-network-controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy}
name : a13730899355151937870

_uuid : 73eabdb0-36bf-4ca3-b66d-156ac710df4c
addresses : ["10.0.32.0/19", "10.0.56.38/32", "10.0.69.0/24", "10.132.3.72",
"10.135.0.42", "172.29.0.0/30", "192.168.194.103", "192.168.194.2"]
external_ids : {direction=Egress, gress-index="3", ip-family=v4,
"k8s.ovn.org/id"="default-network-controller:AdminNetworkPolicy:cluster-
control:Egress:3:v4", "k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-
controller"=default-network-controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy}
name : a10622494091691694581

```
_uuid               : 50cdbef2-71b5-474b-914c-6fcd1d7712d3
addresses           : ["10.132.0.10", "10.132.0.11", "10.132.0.12", "10.132.0.13",
"10.132.0.14", "10.132.0.15", "10.132.0.16", "10.132.0.17", "10.132.0.5", "10.132.0.7",
"10.132.0.71", "10.132.0.75", "10.132.0.8", "10.132.0.81", "10.132.0.9", "10.132.2.10",
"10.132.2.11", "10.132.2.12", "10.132.2.14", "10.132.2.15", "10.132.2.3", "10.132.2.4",
"10.132.2.5", "10.132.2.6", "10.132.2.7", "10.132.2.8", "10.132.2.9", "10.132.3.64",
"10.132.3.65", "10.132.3.72", "10.132.3.73", "10.132.3.76", "10.133.0.10", "10.133.0.11",
"10.133.0.12", "10.133.0.13", "10.133.0.14", "10.133.0.15", "10.133.0.16", "10.133.0.17",
"10.133.0.18", "10.133.0.19", "10.133.0.20", "10.133.0.21", "10.133.0.22", "10.133.0.23",
"10.133.0.24", "10.133.0.25", "10.133.0.26", "10.133.0.27", "10.133.0.28", "10.133.0.29",
"10.133.0.30", "10.133.0.31", "10.133.0.32", "10.133.0.33", "10.133.0.34", "10.133.0.35",
"10.133.0.36", "10.133.0.37", "10.133.0.38", "10.133.0.39", "10.133.0.40", "10.133.0.41",
"10.133.0.42", "10.133.0.44", "10.133.0.45", "10.133.0.46", "10.133.0.47", "10.133.0.48",
"10.133.0.5", "10.133.0.6", "10.133.0.7", "10.133.0.8", "10.133.0.9", "10.134.0.10",
"10.134.0.11", "10.134.0.12", "10.134.0.13", "10.134.0.14", "10.134.0.15", "10.134.0.16",
"10.134.0.17", "10.134.0.18", "10.134.0.19", "10.134.0.20", "10.134.0.21", "10.134.0.22",
"10.134.0.23", "10.134.0.24", "10.134.0.25", "10.134.0.26", "10.134.0.27", "10.134.0.28",
"10.134.0.30", "10.134.0.31", "10.134.0.32", "10.134.0.33", "10.134.0.34", "10.134.0.35",
"10.134.0.36", "10.134.0.37", "10.134.0.38", "10.134.0.4", "10.134.0.42", "10.134.0.9",
"10.135.0.10", "10.135.0.11", "10.135.0.12", "10.135.0.13", "10.135.0.14", "10.135.0.15",
"10.135.0.16", "10.135.0.17", "10.135.0.18", "10.135.0.19", "10.135.0.23", "10.135.0.24",
"10.135.0.26", "10.135.0.27", "10.135.0.29", "10.135.0.3", "10.135.0.4", "10.135.0.40",
"10.135.0.41", "10.135.0.42", "10.135.0.43", "10.135.0.44", "10.135.0.5", "10.135.0.6",
"10.135.0.7", "10.135.0.8", "10.135.0.9"]
external_ids        : {direction=Egress, gress-index="0", ip-family=v4,
"k8s.ovn.org/id"="default-network-controller:AdminNetworkPolicy:cluster-
control:Egress:0:v4", "k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-
controller"=default-network-controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy}
name                : a13517855690389298082

_uuid               : 32a42f32-2d11-43dd-979d-a56d7ee6aa57
addresses           : ["10.132.3.76", "10.135.0.44"]
external_ids        : {direction=Ingress, gress-index="3", ip-family=v4,
"k8s.ovn.org/id"="default-network-controller:AdminNetworkPolicy:cluster-
control:Ingress:3:v4", "k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-
controller"=default-network-controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy}
name                : a764182844364804195

_uuid               : 8fd3b977-6e1c-47aa-82b7-e3e3136c4a72
addresses           : ["0.0.0.0/0"]
external_ids        : {direction=Egress, gress-index="5", ip-family=v4,
"k8s.ovn.org/id"="default-network-controller:AdminNetworkPolicy:cluster-
control:Egress:5:v4", "k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-
controller"=default-network-controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy}
name                : a11452480169090787059
```

a. Examine the specific address set of the rule by running the following command:

```
$ ovn-nbctl find Address_Set 'external_ids{>=}{"k8s.ovn.org/owner-
type"=AdminNetworkPolicy,direction=Egress,"k8s.ovn.org/name"=cluster-control,gress-
index="5"}'
```

Example 2.17. Example outputs for Address_Set

```
_uuid               : 8fd3b977-6e1c-47aa-82b7-e3e3136c4a72
addresses           : ["0.0.0.0/0"]
external_ids        : {direction=Egress, gress-index="5", ip-family=v4,
"k8s.ovn.org/id"="default-network-controller:AdminNetworkPolicy:cluster-
control:Egress:5:v4", "k8s.ovn.org/name"=cluster-control, "k8s.ovn.org/owner-
controller"=default-network-controller, "k8s.ovn.org/owner-type"=AdminNetworkPolicy}
name                : a11452480169090787059
```

5. Run the following command to look at the port groups in the nbdb:

```
$ ovn-nbctl find Port_Group 'external_ids{>=}{"k8s.ovn.org/owner-
type"=AdminNetworkPolicy,"k8s.ovn.org/name"=cluster-control}'
```

Example 2.18. Example outputs for Port_Group

```
_uuid               : f50acf71-7488-4b9a-b7b8-c8a024e99d21
acls                : [04f20275-c410-405c-a923-0e677f767889, 0d5e4722-b608-4bb1-b625-
23c323cc9926, 1a27d30e-3f96-4915-8ddd-ade7f22c117b, 1a68a5ed-e7f9-47d0-b55c-
89184d97e81a, 4b5d836a-e0a3-4088-825e-f9f0ca58e538, 5a6e5bb4-36eb-4209-b8bc-
c611983d4624, 5d09957d-d2cc-4f5a-9ddd-b97d9d772023, aa1a224d-7960-4952-bdfb-
35246bafbac8, b23a087f-08f8-4225-8c27-4a9a9ee0c407, b7be6472-df67-439c-8c9c-
f55929f0a6e0, d14ed5cf-2e06-496e-8cae-6b76d5dd5ccd]
external_ids        : {"k8s.ovn.org/id"="default-network-
controller:AdminNetworkPolicy:cluster-control", "k8s.ovn.org/name"=cluster-control,
"k8s.ovn.org/owner-controller"=default-network-controller, "k8s.ovn.org/owner-
type"=AdminNetworkPolicy}
name                : a14645450421485494999
ports               : [5e75f289-8273-4f8a-8798-8c10f7318833, de7e1b71-6184-445d-93e7-
b20acadf41ea]
```

2.5.2. Additional resources

- Tracing Openflow with ovnkube-trace
- Troubleshooting OVN-Kubernetes

2.6. BEST PRACTICES FOR ADMINNETWORKPOLICY

This section provides best practices for the **AdminNetworkPolicy** and **BaselineAdminNetworkPolicy** resources.

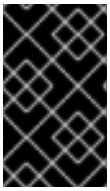
2.6.1. Designing AdminNetworkPolicy

When building **AdminNetworkPolicy** (ANP) resources, you might consider the following when creating your policies:

- You can create ANPs that have the same priority. If you do create two ANPs at the same priority, ensure that they do not apply overlapping rules to the same traffic. Only one rule per value is applied and there is no guarantee which rule is applied when there is more than one at

the same priority value. Because there is no guarantee which policy takes precedence when overlapping ANPs are created, set ANPs at different priorities so that precedence is well defined.

- Administrators must create ANP that apply to user namespaces not system namespaces.



IMPORTANT

Applying ANP and **BaselineAdminNetworkPolicy** (BANP) to system namespaces (**default**, **kube-system**, any namespace whose name starts with **openshift-**, etc) is not supported, and this can leave your cluster unresponsive and in a non-functional state.

- Because **0-100** is the supported priority range, you might design your ANP to use a middle range like **30-70**. This leaves some placeholder for priorities before and after. Even in the middle range, you might want to leave gaps so that as your infrastructure requirements evolve over time, you are able to insert new ANPs when needed at the right priority level. If you pack your ANPs, then you might need to recreate all of them to accommodate any changes in the future.
- When using **0.0.0.0/0** or **::/0** to create a strong **Deny** policy, ensure that you have higher priority **Allow** or **Pass** rules for essential traffic.
- Use **Allow** as your **action** field when you want to ensure that a connection is allowed no matter what. An **Allow** rule in an ANP means that the connection will always be allowed, and **NetworkPolicy** will be ignored.
- Use **Pass** as your **action** field to delegate the policy decision of allowing or denying the connection to the **NetworkPolicy** layer.
- Ensure that the selectors across multiple rules do not overlap so that the same IPs do not appear in multiple policies, which can cause performance and scale limitations.
- Avoid using **namedPorts** in conjunction with **PortNumber** and **PortRange** because this creates 6 ACLs and cause inefficiencies in your cluster.

2.6.1.1. Considerations for using BaselineAdminNetworkPolicy

- You can define only a single **BaselineAdminNetworkPolicy** (BANP) resource within a cluster. The following are supported uses for BANP that administrators might consider in designing their BANP:
  - You can set a default deny policy for cluster-local ingress in user namespaces. This BANP will force developers to have to add **NetworkPolicy** objects to allow the ingress traffic that they want to allow, and if they do not add network policies for ingress it will be denied.
  - You can set a default deny policy for cluster-local egress in user namespaces. This BANP will force developers to have to add **NetworkPolicy** objects to allow the egress traffic that they want to allow, and if they do not add network policies it will be denied.
  - You can set a default allow policy for egress to the in-cluster DNS service. Such a BANP ensures that the namespaced users do not have to set an allow egress **NetworkPolicy** to the in-cluster DNS service.
  - You can set an egress policy that allows internal egress traffic to all pods but denies access to all external endpoints (i.e **0.0.0.0/0** and **::/0**). This BANP allows user workloads to send traffic to other in-cluster endpoints, but not to external endpoints by default.

NetworkPolicy can then be used by developers in order to allow their applications to send traffic to an explicit set of external services.

- Ensure you scope your BANP so that it only denies traffic to user namespaces and not to system namespaces. This is because the system namespaces do not have **NetworkPolicy** objects to override your BANP.

2.6.1.2. Differences to consider between AdminNetworkPolicy and NetworkPolicy

- Unlike **NetworkPolicy** objects, you must use explicit labels to reference your workloads within ANP and BANP rather than using the empty (**{}**) catch all selector to avoid accidental traffic selection.

IMPORTANT

An empty namespace selector applied to a infrastructure namespace can make your cluster unresponsive and in a non-functional state.

- In API semantics for ANP, you have to explicitly define allow or deny rules when you create the policy, unlike **NetworkPolicy** objects which have an implicit deny.

- Unlike **NetworkPolicy** objects, **AdminNetworkPolicy** objects ingress rules are limited to in-cluster pods and namespaces so you cannot, and do not need to, set rules for ingress from the host network.

CHAPTER 3. NETWORK POLICY

3.1. ABOUT NETWORK POLICY

As a developer, you can define network policies that restrict traffic to pods in your cluster.

3.1.1. About network policy

By default, all pods in a project are accessible from other pods and network endpoints. To isolate one or more pods in a project, you can create **NetworkPolicy** objects in that project to indicate the allowed incoming connections. Project administrators can create and delete **NetworkPolicy** objects within their own project.

If a pod is matched by selectors in one or more **NetworkPolicy** objects, then the pod will accept only connections that are allowed by at least one of those **NetworkPolicy** objects. A pod that is not selected by any **NetworkPolicy** objects is fully accessible.

A network policy applies to only the Transmission Control Protocol (TCP), User Datagram Protocol (UDP), Internet Control Message Protocol (ICMP), and Stream Control Transmission Protocol (SCTP) protocols. Other protocols are not affected.

WARNING

- A network policy does not apply to the host network namespace. Pods with host networking enabled are unaffected by network policy rules. However, pods connecting to the host-networked pods might be affected by the network policy rules.
- Using the **namespaceSelector** field without the **podSelector** field set to **{}** will not include **hostNetwork** pods. You must use the **podSelector** set to **{}** with the **namespaceSelector** field in order to target **hostNetwork** pods when creating network policies.
- Network policies cannot block traffic from localhost or from their resident nodes.
- When creating a network policy, do not apply the **network.openshift.io/policy-group: ingress** label to custom namespace or projects. This label is Operator-managed and reserved for OpenShift Container Platform networking functions. It should not be altered on system-created namespaces.
  Using this label can result in intermittent network connectivity drops, unintended application of system **NetworkPolicies** resource, or configuration drift as the operator attempts to reconcile the state. For custom traffic grouping, always use unique, user-defined labels as shown in the following procedure.

The following example **NetworkPolicy** objects demonstrate supporting different scenarios:

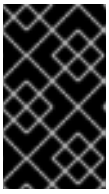
- Deny all traffic:
  To make a project deny by default, add a **NetworkPolicy** object that matches all pods but accepts no traffic:

```
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
metadata:
  name: deny-by-default
spec:
  podSelector: {}
  ingress: []
```

- Only allow connections from the OpenShift Container Platform Ingress Controller:
  To make a project allow only connections from the OpenShift Container Platform Ingress Controller, add the following **NetworkPolicy** object.

```
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: allow-from-openshift-ingress
spec:
  ingress:
  - from:
    - namespaceSelector:
        matchLabels:
          policy-group.network.openshift.io/ingress: ""
  podSelector: {}
  policyTypes:
  - Ingress
```

- Only accept connections from pods within a project:



IMPORTANT

To allow ingress connections from **hostNetwork** pods in the same namespace, you need to apply the **allow-from-hostnetwork** policy together with the **allow-same-namespace** policy.

  To make pods accept connections from other pods in the same project, but reject all other connections from pods in other projects, add the following **NetworkPolicy** object:

```
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
metadata:
  name: allow-same-namespace
spec:
  podSelector: {}
  ingress:
  - from:
    - podSelector: {}
```

- Only allow HTTP and HTTPS traffic based on pod labels:

To enable only HTTP and HTTPS access to the pods with a specific label (**role=frontend** in following example), add a **NetworkPolicy** object similar to the following:

```
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
metadata:
  name: allow-http-and-https
spec:
  podSelector:
    matchLabels:
      role: frontend
  ingress:
  - ports:
    - protocol: TCP
      port: 80
    - protocol: TCP
      port: 443
```

- Accept connections by using both namespace and pod selectors:
  To match network traffic by combining namespace and pod selectors, you can use a **NetworkPolicy** object similar to the following:

```
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
metadata:
  name: allow-pod-and-namespace-both
spec:
  podSelector:
    matchLabels:
      name: test-pods
  ingress:
    - from:
      - namespaceSelector:
          matchLabels:
            project: project_name
        podSelector:
          matchLabels:
            name: test-pods
```

NetworkPolicy objects are additive, which means you can combine multiple **NetworkPolicy** objects together to satisfy complex network requirements.

For example, for the **NetworkPolicy** objects defined in previous samples, you can define both **allow-same-namespace** and **allow-http-and-https** policies within the same project. Thus allowing the pods with the label **role=frontend**, to accept any connection allowed by each policy. That is, connections on any port from pods in the same namespace, and connections on ports **80** and **443** from pods in any namespace.

3.1.1.1. Using the allow-from-router network policy

Use the following **NetworkPolicy** to allow external traffic regardless of the router configuration:

```
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
```

```
metadata:
  name: allow-from-router
spec:
  ingress:
  - from:
    - namespaceSelector:
        matchLabels:
          policy-group.network.openshift.io/ingress: "" (1)
  podSelector: {}
  policyTypes:
  - Ingress
```

(1) **policy-group.network.openshift.io/ingress:""** label supports OVN-Kubernetes.

3.1.1.2. Using the allow-from-hostnetwork network policy

Add the following **allow-from-hostnetwork NetworkPolicy** object to direct traffic from the host network pods.

```
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: allow-from-hostnetwork
spec:
  ingress:
  - from:
    - namespaceSelector:
        matchLabels:
          policy-group.network.openshift.io/host-network: ""
  podSelector: {}
  policyTypes:
  - Ingress
```

3.1.2. Optimizations for network policy with OVN-Kubernetes network plugin

Learn how to optimize OVN-Kubernetes network policies to reduce flow count and ensure external IP traffic is allowed when needed.

When designing your network policy, refer to the following guidelines:

- For network policies with the same **spec.podSelector** spec, it is more efficient to use one network policy with multiple **ingress** or **egress** rules, than multiple network policies with subsets of **ingress** or **egress** rules.
- Every **ingress** or **egress** rule based on the **podSelector** or **namespaceSelector** spec generates the number of OVS flows proportional to **number of pods selected by network policy + number of pods selected by ingress or egress rule**. Therefore, it is preferable to use the **podSelector** or **namespaceSelector** spec that can select as many pods as you need in one rule, instead of creating individual rules for every pod.
  For example, the following policy contains two rules:

  ```
  apiVersion: networking.k8s.io/v1
  kind: NetworkPolicy
  ```

```
metadata:
  name: test-network-policy
spec:
  podSelector: {}
  ingress:
  - from:
    - podSelector:
        matchLabels:
          role: frontend
  - from:
    - podSelector:
        matchLabels:
          role: backend
```

The following policy expresses those same two rules as one:

```
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: test-network-policy
spec:
  podSelector: {}
  ingress:
  - from:
    - podSelector:
        matchExpressions:
        - {key: role, operator: In, values: [frontend, backend]}
```

The same guideline applies to the **spec.podSelector** spec. If you have the same **ingress** or **egress** rules for different network policies, it might be more efficient to create one network policy with a common **spec.podSelector** spec. For example, the following two policies have different rules:

```
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: policy1
spec:
  podSelector:
    matchLabels:
      role: db
  ingress:
  - from:
    - podSelector:
        matchLabels:
          role: frontend
---
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: policy2
spec:
  podSelector:
    matchLabels:
      role: client
```

```
  ingress:
  - from:
    - podSelector:
        matchLabels:
          role: frontend
```

The following network policy expresses those same two rules as one:

```
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: policy3
spec:
  podSelector:
    matchExpressions:
    - {key: role, operator: In, values: [db, client]}
  ingress:
  - from:
    - podSelector:
        matchLabels:
          role: frontend
```

You can apply this optimization when only multiple selectors are expressed as one. In cases where selectors are based on different labels, it may not be possible to apply this optimization. In those cases, consider applying some new labels for network policy optimization specifically.

3.1.2.1. NetworkPolicy CR and external IPs in OVN-Kubernetes

In OVN-Kubernetes, the **NetworkPolicy** custom resource (CR) enforces strict isolation rules. If a service is exposed using an external IP, a network policy can block access from other namespaces unless explicitly configured to allow traffic.

To allow access to external IPs across namespaces, create a **NetworkPolicy** CR that explicitly permits ingress from the required namespaces and ensures traffic is allowed to the designated service ports. Without allowing traffic to the required ports, access might still be restricted.

Example output

```
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  annotations:
  name: <policy_name>
  namespace: openshift-ingress
spec:
  ingress:
  - ports:
    - port: 80
      protocol: TCP
  - ports:
    - port: 443
      protocol: TCP
  - from:
    - namespaceSelector:
        matchLabels:
```

```
        kubernetes.io/metadata.name: <my_namespace>
  podSelector: {}
  policyTypes:
  - Ingress
```

where:

<policy_name>

Specifies your name for the policy.

<my_namespace>

Specifies the name of the namespace where the policy is deployed.

For more details, see "About network policy".

3.1.3. Next steps

- Creating a network policy
- Optional: Defining a default network policy for projects

3.1.4. Additional resources

- Projects and namespaces
- Configuring multitenant isolation with network policy
- NetworkPolicy API

3.2. CREATING A NETWORK POLICY

As a cluster administrator, you can create a network policy for a namespace.

3.2.1. Example NetworkPolicy object

The following configuration annotates an example NetworkPolicy object:

```
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
metadata:
  name: allow-27107
spec:
  podSelector:
    matchLabels:
      app: mongodb
  ingress:
  - from:
    - podSelector:
        matchLabels:
          app: app
    ports:
    - protocol: TCP
      port: 27017
```

where:

name

The name of the NetworkPolicy object.

spec.podSelector

A selector that describes the pods to which the policy applies. The policy object can only select pods in the project that defines the NetworkPolicy object.

ingress.from.podSelector

A selector that matches the pods from which the policy object allows ingress traffic. The selector matches pods in the same namespace as the NetworkPolicy.

ingress.ports

A list of one or more destination ports on which to accept traffic.

3.2.2. Creating a network policy using the CLI

To define granular rules describing ingress or egress network traffic allowed for namespaces in your cluster, you can create a network policy.

NOTE

If you log in with a user with the **cluster-admin** role, then you can create a network policy in any namespace in the cluster.

Prerequisites

- Your cluster uses a network plugin that supports **NetworkPolicy** objects, such as the OVN-Kubernetes network plugin, with **mode: NetworkPolicy** set.
- You installed the OpenShift CLI (**oc**).
- You logged in to the cluster with a user with **admin** privileges.
- You are working in the namespace that the network policy applies to.

Procedure

1. Create a policy rule.
   a. Create a **<policy_name>.yaml** file:

   ```
   $ touch <policy_name>.yaml
   ```

   where:

   <policy_name>

   Specifies the network policy file name.

   b. Define a network policy in the created file. The following example denies ingress traffic from all pods in all namespaces. This is a fundamental policy, blocking all cross-pod networking other than cross-pod traffic allowed by the configuration of other Network Policies.

   ```
   kind: NetworkPolicy
   ```

```
apiVersion: networking.k8s.io/v1
spec:
  podSelector: {}
  policyTypes:
  - Ingress
  ingress: []
```

The following example configuration allows ingress traffic from all pods in the same namespace:

```
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
metadata:
  name: allow-same-namespace
spec:
  podSelector:
  ingress:
  - from:
    - podSelector: {}
# ...
```

The following example allows ingress traffic to one pod from a particular namespace. This policy allows traffic to pods that have the **pod-a** label from pods running in **namespace-y**.

```
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
metadata:
  name: allow-traffic-pod
spec:
  podSelector:
   matchLabels:
      pod: pod-a
  policyTypes:
  - Ingress
  ingress:
  - from:
    - namespaceSelector:
        matchLabels:
          kubernetes.io/metadata.name: namespace-y
# ...
```

The following example configuration restricts traffic to a service. This policy when applied ensures every pod with both labels **app=bookstore** and **role=api** can only be accessed by pods with label **app=bookstore**. In this example the application could be a REST API server, marked with labels **app=bookstore** and **role=api**.

This example configuration addresses the following use cases:

- Restricting the traffic to a service to only the other microservices that need to use it.
- Restricting the connections to a database to only permit the application using it.

```
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
metadata:
```

```
  name: api-allow
spec:
  podSelector:
    matchLabels:
      app: bookstore
      role: api
  ingress:
  - from:
      - podSelector:
          matchLabels:
            app: bookstore
# ...
```

2. To create the network policy object, enter the following command. Successful output lists the name of the policy object and the **created** status.

```
$ oc apply -f <policy_name>.yaml -n <namespace>
```

where:

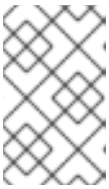
<policy_name>

Specifies the network policy file name.

<namespace>

Optional parameter. If you defined the object in a different namespace than the current namespace, the parameter specifices the namespace.

Successful output lists the name of the policy object and the **created** status.



NOTE

If you log in to the web console with **cluster-admin** privileges, you have a choice of creating a network policy in any namespace in the cluster directly in YAML or from a form in the web console.

3.2.3. Creating a default deny all network policy

The default deny all network policy blocks all cross-pod networking other than network traffic allowed by the configuration of other deployed network policies and traffic between host-networked pods. This procedure enforces a strong deny policy by applying a **deny-by-default** policy in the **my-project** namespace.

WARNING

Without configuring a **NetworkPolicy** custom resource (CR) that allows traffic communication, the following policy might cause communication problems across your cluster.

Prerequisites

- Your cluster uses a network plugin that supports **NetworkPolicy** objects, such as the OVN-Kubernetes network plugin, with **mode: NetworkPolicy** set.
- You installed the OpenShift CLI (**oc**).
- You logged in to the cluster with a user with **admin** privileges.
- You are working in the namespace that the network policy applies to.

Procedure

1. Create the following YAML that defines a **deny-by-default** policy to deny ingress from all pods in all namespaces. Save the YAML in the **deny-by-default.yaml** file:

```
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
metadata:
  name: deny-by-default
  namespace: my-project
spec:
  podSelector: {}
  ingress: []
```

   where:

   namespace

   Specifies the namespace in which to deploy the policy. For example, the **my-project** namespace.

   podSelector

   If this field is empty, the configuration matches all the pods. Therefore, the policy applies to all pods in the **my-project** namespace.

   ingress

   Where **[]** indicates that no **ingress** rules are specified. This causes incoming traffic to be dropped to all pods.

2. Apply the policy by entering the following command. Successful output lists the name of the policy object and the **created** status.

```
$ oc apply -f deny-by-default.yaml
```

3.2.4. Creating a network policy to allow traffic from external clients

With the **deny-by-default** policy in place you can proceed to configure a policy that allows traffic from external clients to a pod with the label **app=web**.

NOTE

If you log in with a user with the **cluster-admin** role, then you can create a network policy in any namespace in the cluster.

Follow this procedure to configure a policy that allows external service from the public Internet directly or by using a Load Balancer to access the pod. Traffic is only allowed to a pod with the label **app=web**.

Prerequisites

- Your cluster uses a network plugin that supports **NetworkPolicy** objects, such as the OVN-Kubernetes network plugin, with **mode: NetworkPolicy** set.
- You installed the OpenShift CLI (**oc**).
- You logged in to the cluster with a user with **admin** privileges.
- You are working in the namespace that the network policy applies to.

Procedure

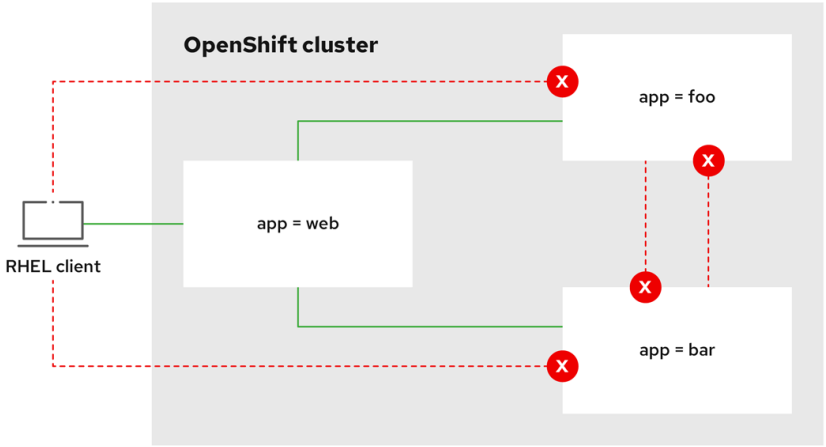
1. Create a policy that allows traffic from the public Internet directly or by using a load balancer to access the pod. Save the YAML in the **web-allow-external.yaml** file:

```
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
spec:
  policyTypes:
  - Ingress
  podSelector:
    matchLabels:
      app: web
  ingress:
    - {}
```

2. Apply the policy by entering the following command. Successful output lists the name of the policy object and the **created** status.

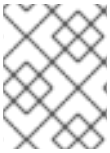
```
$ oc apply -f web-allow-external.yaml
```

This policy allows traffic from all resources, including external traffic as illustrated in the following diagram:



3.2.5. Creating a network policy allowing traffic to an application from all namespaces

You can configure a policy that allows traffic from all pods in all namespaces to a particular application.



NOTE

If you log in with a user with the **cluster-admin** role, then you can create a network policy in any namespace in the cluster.

Prerequisites

- Your cluster uses a network plugin that supports **NetworkPolicy** objects, such as the OVN-Kubernetes network plugin, with **mode: NetworkPolicy** set.
- You installed the OpenShift CLI (**oc**).
- You logged in to the cluster with a user with **admin** privileges.
- You are working in the namespace that the network policy applies to.

Procedure

1. Create a policy that allows traffic from all pods in all namespaces to a particular application. Save the YAML in the **web-allow-all-namespaces.yaml** file:

```
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: web-allow-all-namespaces
  namespace: default
spec:
  podSelector:
    matchLabels:
      app: web
  policyTypes:
  - Ingress
  ingress:
  - from:
    - namespaceSelector: {}
```

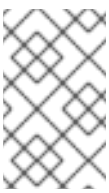
where:

app

Applies the policy only to **app:web** pods in default namespace.

namespaceSelector

Selects all pods in all namespaces.



NOTE

By default, if you do not specify a **namespaceSelector** parameter in the policy object, no namespaces get selected. This means the policy allows traffic only from the namespace where the network policy deployes.

2. Apply the policy by entering the following command. Successful output lists the name of the policy object and the **created** status.

```
$ oc apply -f web-allow-all-namespaces.yaml
```

Verification

1. Start a web service in the **default** namespace by entering the following command:

```
$ oc run web --namespace=default --image=nginx --labels="app=web" --expose --port=80
```

2. Run the following command to deploy an **alpine** image in the **secondary** namespace and to start a shell:

```
$ oc run test-$RANDOM --namespace=secondary --rm -i -t --image=alpine -- sh
```

3. Run the following command in the shell and observe that the service allows the request:

```
# wget -qO- --timeout=2 http://web.default
```

```
<!DOCTYPE html>
<html>
<head>
<title>Welcome to nginx!</title>
<style>
html { color-scheme: light dark; }
body { width: 35em; margin: 0 auto;
font-family: Tahoma, Verdana, Arial, sans-serif; }
</style>
</head>
<body>
<h1>Welcome to nginx!</h1>
<p>If you see this page, the nginx web server is successfully installed and
working. Further configuration is required.</p>

<p>For online documentation and support please refer to
<a href="http://nginx.org/">nginx.org</a>.<br/>
Commercial support is available at
<a href="http://nginx.com/">nginx.com</a>.</p>

<p><em>Thank you for using nginx.</em></p>
</body>
</html>
```

3.2.6. Creating a network policy allowing traffic to an application from a namespace

You can configure a policy that allows traffic to a pod with the label **app=web** from a particular namespace. This configuration is useful in the following use cases:

- Restrict traffic to a production database only to namespaces that have production workloads deployed.

- Enable monitoring tools deployed to a particular namespace to scrape metrics from the current namespace.

NOTE

If you log in with a user with the **cluster-admin** role, then you can create a network policy in any namespace in the cluster.

Prerequisites

- Your cluster uses a network plugin that supports **NetworkPolicy** objects, such as the OVN-Kubernetes network plugin, with **mode: NetworkPolicy** set.
- You installed the OpenShift CLI (**oc**).
- You logged in to the cluster with a user with **admin** privileges.
- You are working in the namespace that the network policy applies to.

WARNING

Do not apply the **network.openshift.io/policy-group: ingress** label to custom namespace or projects. This label is Operator-managed and reserved for OpenShift Container Platform networking functions. It should not be altered on system-created namespaces.

Using this label can result in intermittent network connectivity drops, unintended application of system **NetworkPolicies** resource, or configuration drift as the operator attempts to reconcile the state. For custom traffic grouping, always use unique, user-defined labels as shown in the following procedure.

Procedure

1. Create a policy that allows traffic from all pods in a particular namespaces with a label **purpose=production**. Save the YAML in the **web-allow-prod.yaml** file:

```
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
metadata:
  name: web-allow-prod
  namespace: default
spec:
  podSelector:
    matchLabels:
      app: web
  policyTypes:
  - Ingress
  ingress:
  - from:
```

```
    - namespaceSelector:
        matchLabels:
          purpose: production
```

where:

app

Applies the policy only to **app:web** pods in the default namespace.

purpose

Restricts traffic to only pods in namespaces that have the label **purpose=production**.

2. Apply the policy by entering the following command. Successful output lists the name of the policy object and the **created** status.

```
$ oc apply -f web-allow-prod.yaml
```

Verification

1. Start a web service in the **default** namespace by entering the following command:

```
$ oc run web --namespace=default --image=nginx --labels="app=web" --expose --port=80
```

2. Run the following command to create the **prod** namespace:

```
$ oc create namespace prod
```

3. Run the following command to label the **prod** namespace:

```
$ oc label namespace/prod purpose=production
```

4. Run the following command to create the **dev** namespace:

```
$ oc create namespace dev
```

5. Run the following command to label the **dev** namespace:

```
$ oc label namespace/dev purpose=testing
```

6. Run the following command to deploy an **alpine** image in the **dev** namespace and to start a shell:

```
$ oc run test-$RANDOM --namespace=dev --rm -i -t --image=alpine -- sh
```

7. Run the following command in the shell and observe the reason for the blocked request. For example, expected output states **wget: download timed out**.

```
# wget -qO- --timeout=2 http://web.default
```

8. Run the following command to deploy an **alpine** image in the **prod** namespace and start a shell:

```
$ oc run test-$RANDOM --namespace=prod --rm -i -t --image=alpine -- sh
```

9. Run the following command in the shell and observe that the request is allowed:

```
# wget -qO- --timeout=2 http://web.default
```

```
<!DOCTYPE html>
<html>
<head>
<title>Welcome to nginx!</title>
<style>
html { color-scheme: light dark; }
body { width: 35em; margin: 0 auto;
font-family: Tahoma, Verdana, Arial, sans-serif; }
</style>
</head>
<body>
<h1>Welcome to nginx!</h1>
<p>If you see this page, the nginx web server is successfully installed and
working. Further configuration is required.</p>

<p>For online documentation and support please refer to
<a href="http://nginx.org/">nginx.org</a>.<br/>
Commercial support is available at
<a href="http://nginx.com/">nginx.com</a>.</p>

<p><em>Thank you for using nginx.</em></p>
</body>
</html>
```

3.2.7. Additional resources

- Accessing the web console
- Logging for egress firewall and network policy rules

3.3. VIEWING A NETWORK POLICY

As a cluster administrator, you can view a network policy for a namespace.

3.3.1. Example NetworkPolicy object

The following configuration annotates an example NetworkPolicy object:

```
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
metadata:
  name: allow-27107
spec:
  podSelector:
    matchLabels:
      app: mongodb
  ingress:
  - from:
```

```
- podSelector:
    matchLabels:
      app: app
ports:
- protocol: TCP
  port: 27017
```

where:

name

The name of the NetworkPolicy object.

spec.podSelector

A selector that describes the pods to which the policy applies. The policy object can only select pods in the project that defines the NetworkPolicy object.

ingress.from.podSelector

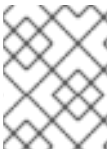
A selector that matches the pods from which the policy object allows ingress traffic. The selector matches pods in the same namespace as the NetworkPolicy.

ingress.ports

A list of one or more destination ports on which to accept traffic.

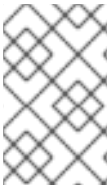
3.3.2. Viewing network policies using the CLI

You can examine the network policies in a namespace.



NOTE

If you log in with **cluster-admin** privileges, you can edit network policies in any namespace in the cluster.



NOTE

If you log in with **cluster-admin** privileges, you can edit network policies in any namespace in the cluster. In the web console, you can edit policies directly in YAML or by using the **Actions** menu.

Prerequisites

- You installed the OpenShift CLI (**oc**).
- You are logged in to the cluster with a user with **admin** privileges.
- You are working in the namespace where the network policy exists.

Procedure

1. List network policies in a namespace.
   a. To view network policy objects defined in a namespace enter the following command:

      ```
      $ oc get networkpolicy
      ```

   b. Optional: To examine a specific network policy enter the following command:

```
$ oc describe networkpolicy <policy_name> -n <namespace>
```

where:

<policy_name>

Specifies the name of the network policy to inspect.

<namespace>

Optional: Specifies the namespace if the object is defined in a different namespace than the current namespace.

```
$ oc describe networkpolicy allow-same-namespace
```

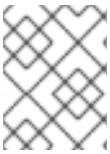
```
Name:         allow-same-namespace
Namespace:    ns1
Created on:   2021-05-24 22:28:56 -0400 EDT
Labels:       <none>
Annotations:  <none>
Spec:
  PodSelector:     <none> (Allowing the specific traffic to all pods in this namespace)
  Allowing ingress traffic:
    To Port: <any> (traffic allowed to all ports)
    From:
      PodSelector: <none>
  Not affecting egress traffic
  Policy Types: Ingress
```

3.4. EDITING A NETWORK POLICY

As a cluster administrator, you can edit an existing network policy for a namespace.

3.4.1. Editing a network policy

To modify existing policy configurations, you can edit a network policy in a namespace. Edit policies by modifying the policy file and applying it with **oc apply**, or by using the **oc edit** command directly.



NOTE

If you log in with **cluster-admin** privileges, you can edit network policies in any namespace in the cluster.

NOTE

If you log in with **cluster-admin** privileges, you can edit network policies in any namespace in the cluster. In the web console, you can edit policies directly in YAML or by using the **Actions** menu.

Prerequisites

- Your cluster uses a network plugin that supports **NetworkPolicy** objects, such as the OVN-Kubernetes network plugin, with **mode: NetworkPolicy** set.

- You installed the OpenShift CLI (**oc**).
- You are logged in to the cluster with a user with **admin** privileges.
- You are working in the namespace where the network policy exists.

Procedure

1. Optional: To list the network policy objects in a namespace, enter the following command:

```
$ oc get network policy -n <namespace>
```

   where:

   <namespace>

   Optional: Specifies the namespace if the object is defined in a different namespace than the current namespace.

2. Edit the network policy object.

   a. If you saved the network policy definition in a file, edit the file and make any necessary changes, and then enter the following command.

```
$ oc apply -n <namespace> -f <policy_file>.yaml
```

      where:

      <namespace>

      Optional: Specifies the namespace if the object is defined in a different namespace than the current namespace.

      <policy_file>

      Specifies the name of the file containing the network policy.

   b. If you need to update the network policy object directly, enter the following command:

```
$ oc edit network policy <policy_name> -n <namespace>
```

      where:

      <policy_name>

      Specifies the name of the network policy.

      <namespace>

      Optional: Specifies the namespace if the object is defined in a different namespace than the current namespace.

3. Confirm that the network policy object is updated.

```
$ oc describe networkpolicy <policy_name> -n <namespace>
```

   where:

   <policy_name>

Specifies the name of the network policy.

<namespace>

Optional: Specifies the namespace if the object is defined in a different namespace than the current namespace.

3.4.2. Example NetworkPolicy object

The following configuration annotates an example NetworkPolicy object:

```
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
metadata:
  name: allow-27107
spec:
  podSelector:
    matchLabels:
      app: mongodb
  ingress:
  - from:
    - podSelector:
        matchLabels:
          app: app
    ports:
    - protocol: TCP
      port: 27017
```

where:

name

The name of the NetworkPolicy object.

spec.podSelector

A selector that describes the pods to which the policy applies. The policy object can only select pods in the project that defines the NetworkPolicy object.

ingress.from.podSelector

A selector that matches the pods from which the policy object allows ingress traffic. The selector matches pods in the same namespace as the NetworkPolicy.

ingress.ports

A list of one or more destination ports on which to accept traffic.

3.4.3. Additional resources

- Creating a network policy

3.5. DELETING A NETWORK POLICY

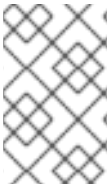
As a cluster administrator, you can delete a network policy from a namespace.

3.5.1. Deleting a network policy using the CLI

You can delete a network policy in a namespace.

NOTE

If you log in with **cluster-admin** privileges, you can delete network policies in any namespace in the cluster.



NOTE

If you log in with **cluster-admin** privileges, you can delete network policies in any namespace in the cluster. In the web console, you can delete policies directly in YAML or by using the **Actions** menu.

Prerequisites

- Your cluster uses a network plugin that supports **NetworkPolicy** objects, such as the OVN-Kubernetes network plugin, with **mode: NetworkPolicy** set.
- You installed the OpenShift CLI (**oc**).
- You logged in to the cluster with a user with **admin** privileges.
- You are working in the namespace where the network policy exists.

Procedure

- To delete a network policy object, enter the following command. Successful output lists the name of the policy object and the **deleted** status.

```
$ oc delete networkpolicy <policy_name> -n <namespace>
```

where:

<policy_name>

Specifies the name of the network policy.

<namespace>

Optional parameter. If you defined the object in a different namespace than the current namespace, the parameter specifices the namespace.

3.6. DEFINING A DEFAULT NETWORK POLICY FOR PROJECTS

As a cluster administrator, you can modify the new project template to automatically include network policies when you create a new project. If you do not yet have a customized template for new projects, you must first create one.

3.6.1. Modifying the template for new projects

As a cluster administrator, you can modify the default project template so that new projects are created using your custom requirements.

To create your own custom project template:

Prerequisites

- You have access to an OpenShift Container Platform cluster using an account with **cluster-admin** permissions.

Procedure

1. Log in as a user with **cluster-admin** privileges.
2. Generate the default project template:

```
$ oc adm create-bootstrap-project-template -o yaml > template.yaml
```

3. Use a text editor to modify the generated **template.yaml** file by adding objects or modifying existing objects.
4. The project template must be created in the **openshift-config** namespace. Load your modified template:

```
$ oc create -f template.yaml -n openshift-config
```

5. Edit the project configuration resource using the web console or CLI.
   - Using the web console:
     i. Navigate to the **Administration → Cluster Settings** page.
     ii. Click **Configuration** to view all configuration resources.
     iii. Find the entry for **Project** and click **Edit YAML**.
   - Using the CLI:
     i. Edit the **project.config.openshift.io/cluster** resource:

```
$ oc edit project.config.openshift.io/cluster
```

6. Update the **spec** section to include the **projectRequestTemplate** and **name** parameters, and set the name of your uploaded project template. The default name is **project-request**.

Project configuration resource with custom project template

```
apiVersion: config.openshift.io/v1
kind: Project
metadata:
# ...
spec:
  projectRequestTemplate:
    name: <template_name>
# ...
```

7. After you save your changes, create a new project to verify that your changes were successfully applied.

3.6.2. Adding network policies to the new project template

As a cluster administrator, you can add network policies to the default template for new projects. OpenShift Container Platform will automatically create all the **NetworkPolicy** objects specified in the template in the project.

Prerequisites

- Your cluster uses a default container network interface (CNI) network plugin that supports **NetworkPolicy** objects, such as the OVN-Kubernetes.
- You installed the OpenShift CLI (**oc**).
- You must log in to the cluster with a user with **cluster-admin** privileges.
- You must have created a custom default project template for new projects.

Procedure

1. Edit the default template for a new project by running the following command:

```
$ oc edit template <project_template> -n openshift-config
```

   Replace **<project_template>** with the name of the default template that you configured for your cluster. The default template name is **project-request**.

2. In the template, add each **NetworkPolicy** object as an element to the **objects** parameter. The **objects** parameter accepts a collection of one or more objects.
   In the following example, the **objects** parameter collection includes several **NetworkPolicy** objects.

```
objects:
- apiVersion: networking.k8s.io/v1
  kind: NetworkPolicy
  metadata:
    name: allow-from-same-namespace
  spec:
    podSelector: {}
    ingress:
    - from:
      - podSelector: {}
- apiVersion: networking.k8s.io/v1
  kind: NetworkPolicy
  metadata:
    name: allow-from-openshift-ingress
  spec:
    ingress:
    - from:
      - namespaceSelector:
          matchLabels:
            policy-group.network.openshift.io/ingress:
    podSelector: {}
    policyTypes:
    - Ingress
- apiVersion: networking.k8s.io/v1
  kind: NetworkPolicy
  metadata:
```

```
    name: allow-from-kube-apiserver-operator
  spec:
    ingress:
    - from:
      - namespaceSelector:
          matchLabels:
            kubernetes.io/metadata.name: openshift-kube-apiserver-operator
        podSelector:
          matchLabels:
            app: kube-apiserver-operator
    policyTypes:
    - Ingress
...
```

3. Optional: Create a new project and confirm the successful creation of your network policy objects.

   a. Create a new project:

   ```
   $ oc new-project <project> 1
   ```

   1 Replace **<project>** with the name for the project you are creating.

   b. Confirm that the network policy objects in the new project template exist in the new project:

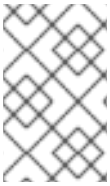
   ```
   $ oc get networkpolicy
   ```

   Expected output:

   ```
   NAME                           POD-SELECTOR   AGE
   allow-from-openshift-ingress   <none>         7s
   allow-from-same-namespace      <none>         7s
   ```

3.7. CONFIGURING MULTITENANT ISOLATION WITH NETWORK POLICY

As a cluster administrator, you can configure your network policies to provide multitenant network isolation.



NOTE

Configuring network policies as described in this section provides network isolation similar to the multitenant mode of OpenShift SDN in previous versions of OpenShift Container Platform.

3.7.1. Configuring multitenant isolation by using network policy

You can configure your project to isolate it from pods and services in other project namespaces.

Prerequisites

- Your cluster uses a network plugin that supports **NetworkPolicy** objects, such as the OVN-Kubernetes network plugin, with **mode: NetworkPolicy** set.
- You installed the OpenShift CLI (**oc**).
- You are logged in to the cluster with a user with **admin** privileges.

Procedure

1. Create the following **NetworkPolicy** objects:

   a. A policy named **allow-from-openshift-ingress**.

```
$ cat << EOF| oc create -f -
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: allow-from-openshift-ingress
spec:
  ingress:
  - from:
    - namespaceSelector:
        matchLabels:
          policy-group.network.openshift.io/ingress: ""
  podSelector: {}
  policyTypes:
  - Ingress
EOF
```

NOTE

policy-group.network.openshift.io/ingress: "" is the preferred namespace selector label for OVN-Kubernetes.

   b. A policy named **allow-from-openshift-monitoring**:

```
$ cat << EOF| oc create -f -
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: allow-from-openshift-monitoring
spec:
  ingress:
  - from:
    - namespaceSelector:
        matchLabels:
          network.openshift.io/policy-group: monitoring
  podSelector: {}
  policyTypes:
  - Ingress
EOF
```

   c. A policy named **allow-same-namespace**:

```
$ cat << EOF| oc create -f -
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
metadata:
  name: allow-same-namespace
spec:
  podSelector:
  ingress:
  - from:
    - podSelector: {}
EOF
```

d. A policy named **allow-from-kube-apiserver-operator**:

```
$ cat << EOF| oc create -f -
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: allow-from-kube-apiserver-operator
spec:
  ingress:
  - from:
    - namespaceSelector:
        matchLabels:
          kubernetes.io/metadata.name: openshift-kube-apiserver-operator
      podSelector:
        matchLabels:
          app: kube-apiserver-operator
  policyTypes:
  - Ingress
EOF
```

For more details, see New **kube-apiserver-operator** webhook controller validating health of webhook.

2. Optional: To confirm that the network policies exist in your current project, enter the following command:

```
$ oc describe networkpolicy
```

Example output

```
Name:         allow-from-openshift-ingress
Namespace:    example1
Created on:   2020-06-09 00:28:17 -0400 EDT
Labels:       <none>
Annotations:  <none>
Spec:
  PodSelector:     <none> (Allowing the specific traffic to all pods in this namespace)
  Allowing ingress traffic:
    To Port: <any> (traffic allowed to all ports)
    From:
      NamespaceSelector: policy-group.network.openshift.io/ingress:
  Not affecting egress traffic
  Policy Types: Ingress
```

```
Name:         allow-from-openshift-monitoring
Namespace:    example1
Created on:   2020-06-09 00:29:57 -0400 EDT
Labels:       <none>
Annotations:  <none>
Spec:
  PodSelector:     <none> (Allowing the specific traffic to all pods in this namespace)
  Allowing ingress traffic:
    To Port: <any> (traffic allowed to all ports)
    From:
      NamespaceSelector: network.openshift.io/policy-group: monitoring
  Not affecting egress traffic
  Policy Types: Ingress
```

3.7.2. Next steps

- Defining a default network policy for a project

CHAPTER 4. AUDIT LOGGING FOR NETWORK SECURITY

The OVN-Kubernetes network plugin uses Open Virtual Network (OVN) access control lists (ACLs) to manage **AdminNetworkPolicy**, **BaselineAdminNetworkPolicy**, **NetworkPolicy**, and **EgressFirewall** objects. Audit logging exposes **allow** and **deny** ACL events for **NetworkPolicy**, **EgressFirewall** and **BaselineAdminNetworkPolicy** custom resources (CR). Logging also exposes **allow**, **deny**, and **pass** ACL events for **AdminNetworkPolicy** (ANP) CR.

NOTE

Audit logging is available for only the OVN-Kubernetes network plugin.

4.1. AUDIT CONFIGURATION

The configuration for audit logging is specified as part of the OVN-Kubernetes cluster network provider configuration. The following YAML illustrates the default values for the audit logging:

Audit logging configuration

```
apiVersion: operator.openshift.io/v1
kind: Network
metadata:
  name: cluster
spec:
  defaultNetwork:
    ovnKubernetesConfig:
      policyAuditConfig:
        destination: "null"
        maxFileSize: 50
        rateLimit: 20
        syslogFacility: local0
```

The following table describes the configuration fields for audit logging.

Table 4.1. policyAuditConfig object

Field	Type	Description
rateLimit	integer	The maximum number of messages to generate every second per node. The default value is **20** messages per second.
maxFileSize	integer	The maximum size for the audit log in bytes. The default value is **50000000** or 50 MB.
maxLogFiles	integer	The maximum number of log files that are retained.

Field	Type	Description
destination	string	One of the following additional audit log targets: **libc** The libc **syslog()** function of the journald process on the host. **udp:<host>:<port>** A syslog server. Replace **<host>:<port>** with the host and port of the syslog server. **unix:<file>** A Unix Domain Socket file specified by **<file>**. **null** Do not send the audit logs to any additional target.
syslogFacility	string	The syslog facility, such as **kern**, as defined by RFC5424. The default value is **local0**.

4.2. AUDIT LOGGING

You can configure the destination for audit logs, such as a syslog server or a UNIX domain socket. Regardless of any additional configuration, an audit log is always saved to **/var/log/ovn/acl-audit-log.log** on each OVN-Kubernetes pod in the cluster.

You can enable audit logging for each namespace by annotating each namespace configuration with a **k8s.ovn.org/acl-logging** section. In the **k8s.ovn.org/acl-logging** section, you must specify **allow**, **deny**, or both values to enable audit logging for a namespace.

NOTE

A network policy does not support setting the **Pass** action set as a rule.

The ACL-logging implementation logs access control list (ACL) events for a network. You can view these logs to analyze any potential security issues.

Example namespace annotation

```
kind: Namespace
apiVersion: v1
metadata:
  name: example1
  annotations:
    k8s.ovn.org/acl-logging: |-
      {
        "deny": "info",
        "allow": "info"
      }
```

To view the default ACL logging configuration values, see the **policyAuditConfig** object in the **cluster-network-03-config.yml** file. If required, you can change the ACL logging configuration values for log file parameters in this file.

The logging message format is compatible with syslog as defined by RFC5424. The syslog facility is configurable and defaults to **local0**. The following example shows key parameters and their values outputted in a log message:

Example logging message that outputs parameters and their values

```
<timestamp>|<message_serial>|acl_log(ovn_pinctrl0)|<severity>|name="<acl_name>", verdict="
<verdict>", severity="<severity>", direction="<direction>": <flow>
```

Where:

- **<timestamp>** states the time and date for the creation of a log message.
- **<message_serial>** lists the serial number for a log message.
- **acl_log(ovn_pinctrl0)** is a literal string that prints the location of the log message in the OVN-Kubernetes plugin.
- **<severity>** sets the severity level for a log message. If you enable audit logging that supports **allow** and **deny** tasks then two severity levels show in the log message output.
- **<name>** states the name of the ACL-logging implementation in the OVN Network Bridging Database (**nbdb**) that was created by the network policy.
- **<verdict>** can be either **allow** or **drop**.
- **<direction>** can be either **to-lport** or **from-lport** to indicate that the policy was applied to traffic going to or away from a pod.
- **<flow>** shows packet information in a format equivalent to the **OpenFlow** protocol. This parameter comprises Open vSwitch (OVS) fields.

The following example shows OVS fields that the **flow** parameter uses to extract packet information from system memory:

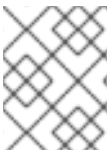
Example of OVS fields used by the flow parameter to extract packet information

```
<proto>,vlan_tci=0x0000,dl_src=<src_mac>,dl_dst=<source_mac>,nw_src=<source_ip>,nw_dst=
<target_ip>,nw_tos=<tos_dscp>,nw_ecn=<tos_ecn>,nw_ttl=<ip_ttl>,nw_frag=<fragment>,tp_src=
<tcp_src_port>,tp_dst=<tcp_dst_port>,tcp_flags=<tcp_flags>
```

Where:

- **<proto>** states the protocol. Valid values are **tcp** and **udp**.
- **vlan_tci=0x0000** states the VLAN header as **0** because a VLAN ID is not set for internal pod network traffic.
- **<src_mac>** specifies the source for the Media Access Control (MAC) address.
- **<source_mac>** specifies the destination for the MAC address.

- **<source_ip>** lists the source IP address
- **<target_ip>** lists the target IP address.
- **<tos_dscp>** states Differentiated Services Code Point (DSCP) values to classify and prioritize certain network traffic over other traffic.
- **<tos_ecn>** states Explicit Congestion Notification (ECN) values that indicate any congested traffic in your network.
- **<ip_ttl>** states the Time To Live (TTP) information for an packet.
- **<fragment>** specifies what type of IP fragments or IP non-fragments to match.
- **<tcp_src_port>** shows the source for the port for TCP and UDP protocols.
- **<tcp_dst_port>** lists the destination port for TCP and UDP protocols.
- **<tcp_flags>** supports numerous flags such as **SYN**, **ACK**, **PSH** and so on. If you need to set multiple values then each value is separated by a vertical bar (|). The UDP protocol does not support this parameter.



NOTE

For more information about the previous field descriptions, go to the OVS manual page for **ovs-fields**.

Example ACL deny log entry for a network policy

```
2023-11-02T16:28:54.139Z|00004|acl_log(ovn_pinctrl0)|INFO|name="NP:verify-audit-
logging:Ingress", verdict=drop, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:81:02:01,dl_dst=0a:58:0a:81:02:23,nw_src=10.131.0.39,nw_dst=1
0.129.2.35,nw_tos=0,nw_ecn=0,nw_ttl=62,nw_frag=no,tp_src=58496,tp_dst=8080,tcp_flags=syn
2023-11-02T16:28:55.187Z|00005|acl_log(ovn_pinctrl0)|INFO|name="NP:verify-audit-
logging:Ingress", verdict=drop, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:81:02:01,dl_dst=0a:58:0a:81:02:23,nw_src=10.131.0.39,nw_dst=1
0.129.2.35,nw_tos=0,nw_ecn=0,nw_ttl=62,nw_frag=no,tp_src=58496,tp_dst=8080,tcp_flags=syn
2023-11-02T16:28:57.235Z|00006|acl_log(ovn_pinctrl0)|INFO|name="NP:verify-audit-
logging:Ingress", verdict=drop, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:81:02:01,dl_dst=0a:58:0a:81:02:23,nw_src=10.131.0.39,nw_dst=1
0.129.2.35,nw_tos=0,nw_ecn=0,nw_ttl=62,nw_frag=no,tp_src=58496,tp_dst=8080,tcp_flags=syn
```

The following table describes namespace annotation values:

Table 4.2. Audit logging namespace annotation for k8s.ovn.org/acl-logging

Field	Description
deny	Blocks namespace access to any traffic that matches an ACL rule with the **deny** action. The field supports **alert**, **warning**, **notice**, **info**, or **debug** values.

Field	Description
allow	Permits namespace access to any traffic that matches an ACL rule with the **allow** action. The field supports **alert**, **warning**, **notice**, **info**, or **debug** values.
pass	A **pass** action applies to an admin network policy's ACL rule. A **pass** action allows either the network policy in the namespace or the baseline admin network policy rule to evaluate all incoming and outgoing traffic. A network policy does not support a **pass** action.

Additional resources

- Understanding network policy APIs

4.3. ADMINNETWORKPOLICY AUDIT LOGGING

Audit logging is enabled per **AdminNetworkPolicy** CR by annotating an ANP policy with the **k8s.ovn.org/acl-logging** key such as in the following example:

Example 4.1. Example of annotation for AdminNetworkPolicy CR

```
apiVersion: policy.networking.k8s.io/v1alpha1
kind: AdminNetworkPolicy
metadata:
  annotations:
    k8s.ovn.org/acl-logging: '{ "deny": "alert", "allow": "alert", "pass" : "warning" }'
  name: anp-tenant-log
spec:
  priority: 5
  subject:
    namespaces:
      matchLabels:
        tenant: backend-storage # Selects all pods owned by storage tenant.
  ingress:
    - name: "allow-all-ingress-product-development-and-customer" # Product development and customer tenant ingress to backend storage.
      action: "Allow"
      from:
      - pods:
          namespaceSelector:
            matchExpressions:
            - key: tenant
              operator: In
              values:
              - product-development
              - customer
          podSelector: {}
    - name: "pass-all-ingress-product-security"
```

```
    action: "Pass"
    from:
    - namespaces:
        matchLabels:
          tenant: product-security
  - name: "deny-all-ingress" # Ingress to backend from all other pods in the cluster.
    action: "Deny"
    from:
    - namespaces: {}
egress:
  - name: "allow-all-egress-product-development"
    action: "Allow"
    to:
    - pods:
        namespaceSelector:
          matchLabels:
            tenant: product-development
        podSelector: {}
  - name: "pass-egress-product-security"
    action: "Pass"
    to:
    - namespaces:
        matchLabels:
          tenant: product-security
  - name: "deny-all-egress" # Egress from backend denied to all other pods.
    action: "Deny"
    to:
    - namespaces: {}
```

Logs are generated whenever a specific OVN ACL is hit and meets the action criteria set in your logging annotation. For example, an event in which any of the namespaces with the label **tenant: product-development** accesses the namespaces with the label **tenant: backend-storage**, a log is generated.

NOTE

ACL logging is limited to 60 characters. If your ANP **name** field is long, the rest of the log will be truncated.

The following is a direction index for the examples log entries that follow:

Direction	Rule
Ingress	**Rule0** Allow from tenant **product-development** and **customer** to tenant **backend-storage**; Ingress0: **Allow** **Rule1** Pass from **product-security`to tenant `backend-storage**; Ingress1: **Pass** **Rule2** Deny ingress from all pods; Ingress2: **Deny**

Direction	Rule
Egress	**Rule0** Allow to **product-development**; Egress0: **Allow** **Rule1** Pass to **product-security**; Egress1: **Pass** **Rule2** Deny egress to all other pods; Egress2: **Deny**

Example 4.2. Example ACL log entry for Allow action of the AdminNetworkPolicy named anp-tenant-log with Ingress:0 and Egress:0

```
2024-06-10T16:27:45.194Z|00052|acl_log(ovn_pinctrl0)|INFO|name="ANP:anp-tenant-
log:Ingress:0", verdict=allow, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:80:02:1a,dl_dst=0a:58:0a:80:02:19,nw_src=10.128.2.26,nw_ds
t=10.128.2.25,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=57814,tp_dst=8080,tcp_flags=syn

2024-06-10T16:28:23.130Z|00059|acl_log(ovn_pinctrl0)|INFO|name="ANP:anp-tenant-
log:Ingress:0", verdict=allow, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:80:02:18,dl_dst=0a:58:0a:80:02:19,nw_src=10.128.2.24,nw_ds
t=10.128.2.25,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=38620,tp_dst=8080,tcp_flags=ack

2024-06-10T16:28:38.293Z|00069|acl_log(ovn_pinctrl0)|INFO|name="ANP:anp-tenant-
log:Egress:0", verdict=allow, severity=alert, direction=from-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:80:02:19,dl_dst=0a:58:0a:80:02:1a,nw_src=10.128.2.25,nw_ds
t=10.128.2.26,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=47566,tp_dst=8080,tcp_flags=fin|a
ck=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=55704,tp_dst=8080,tcp_flags=ack
```

Example 4.3. Example ACL log entry for Pass action of the AdminNetworkPolicy named anp-tenant-log with Ingress:1 and Egress:1

```
2024-06-10T16:33:12.019Z|00075|acl_log(ovn_pinctrl0)|INFO|name="ANP:anp-tenant-
log:Ingress:1", verdict=pass, severity=warning, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:80:02:1b,dl_dst=0a:58:0a:80:02:19,nw_src=10.128.2.27,nw_ds
t=10.128.2.25,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=37394,tp_dst=8080,tcp_flags=ack

2024-06-10T16:35:04.209Z|00081|acl_log(ovn_pinctrl0)|INFO|name="ANP:anp-tenant-
log:Egress:1", verdict=pass, severity=warning, direction=from-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:80:02:19,dl_dst=0a:58:0a:80:02:1b,nw_src=10.128.2.25,nw_ds
t=10.128.2.27,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=34018,tp_dst=8080,tcp_flags=ack
```

Example 4.4. Example ACL log entry for Deny action of the AdminNetworkPolicy named anp-tenant-log with Egress:2 and Ingress2

```
2024-06-10T16:43:05.287Z|00087|acl_log(ovn_pinctrl0)|INFO|name="ANP:anp-tenant-
log:Egress:2", verdict=drop, severity=alert, direction=from-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:80:02:19,dl_dst=0a:58:0a:80:02:18,nw_src=10.128.2.25,nw_ds
```

```
t=10.128.2.24,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=51598,tp_dst=8080,tcp_flags=syn

2024-06-10T16:44:43.591Z|00090|acl_log(ovn_pinctrl0)|INFO|name="ANP:anp-tenant-
log:Ingress:2", verdict=drop, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:80:02:1c,dl_dst=0a:58:0a:80:02:19,nw_src=10.128.2.28,nw_ds
=10.128.2.25,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=33774,tp_dst=8080,tcp_flags=syn
```

The following table describes ANP annotation:

Table 4.3. Audit logging AdminNetworkPolicy annotation

Annotation	Value
k8s.ovn.org/acl-logging	You must specify at least one of **Allow**, **Deny**, or **Pass** to enable audit logging for a namespace. **Deny** Optional: Specify **alert**, **warning**, **notice**, **info**, or **debug**. **Allow** Optional: Specify **alert**, **warning**, **notice**, **info**, or **debug**. **Pass** Optional: Specify **alert**, **warning**, **notice**, **info**, or **debug**.

4.4. BASELINEADMINNETWORKPOLICY AUDIT LOGGING

Audit logging is enabled in the **BaselineAdminNetworkPolicy** CR by annotating an BANP policy with the **k8s.ovn.org/acl-logging** key such as in the following example:

Example 4.5. Example of annotation for BaselineAdminNetworkPolicy CR

```yaml
apiVersion: policy.networking.k8s.io/v1alpha1
kind: BaselineAdminNetworkPolicy
metadata:
  annotations:
    k8s.ovn.org/acl-logging: '{ "deny": "alert", "allow": "alert"}'
  name: default
spec:
  subject:
    namespaces:
      matchLabels:
        tenant: workloads # Selects all workload pods in the cluster.
  ingress:
  - name: "default-allow-dns" # This rule allows ingress from dns tenant to all workloads.
    action: "Allow"
    from:
    - namespaces:
        matchLabels:
          tenant: dns
  - name: "default-deny-dns" # This rule denies all ingress from all pods to workloads.
    action: "Deny"
    from:
```

```
    - namespaces: {} # Use the empty selector with caution because it also selects OpenShift
namespaces as well.
  egress:
  - name: "default-deny-dns" # This rule denies all egress from workloads. It will be applied when
no ANP or network policy matches.
    action: "Deny"
    to:
    - namespaces: {} # Use the empty selector with caution because it also selects OpenShift
namespaces as well.
```

In the example, an event in which any of the namespaces with the label **tenant: dns** accesses the namespaces with the label **tenant: workloads**, a log is generated.

The following is a direction index for the examples log entries that follow:

Direction	Rule
Ingress	**Rule0** Allow from tenant **dns** to tenant **workloads**; Ingress0: **Allow** **Rule1** Deny to tenant **workloads** from all pods; Ingress1:**Deny**
Egress	**Rule0** Deny to all pods; Egress0: **Deny**

Example 4.6. Example ACL allow log entry for Allow action of default BANP with Ingress:0

```
2024-06-10T18:11:58.263Z|00022|acl_log(ovn_pinctrl0)|INFO|name="BANP:default:Ingress:0",
verdict=allow, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:82:02:57,dl_dst=0a:58:0a:82:02:56,nw_src=10.130.2.87,nw_ds
t=10.130.2.86,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=60510,tp_dst=8080,tcp_flags=syn

2024-06-10T18:11:58.264Z|00023|acl_log(ovn_pinctrl0)|INFO|name="BANP:default:Ingress:0",
verdict=allow, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:82:02:57,dl_dst=0a:58:0a:82:02:56,nw_src=10.130.2.87,nw_ds
t=10.130.2.86,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=60510,tp_dst=8080,tcp_flags=psh|
ack
2024-06-10T18:11:58.264Z|00024|acl_log(ovn_pinctrl0)|INFO|name="BANP:default:Ingress:0",
verdict=allow, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:82:02:57,dl_dst=0a:58:0a:82:02:56,nw_src=10.130.2.87,nw_ds
t=10.130.2.86,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=60510,tp_dst=8080,tcp_flags=ack

2024-06-10T18:11:58.264Z|00025|acl_log(ovn_pinctrl0)|INFO|name="BANP:default:Ingress:0",
verdict=allow, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:82:02:57,dl_dst=0a:58:0a:82:02:56,nw_src=10.130.2.87,nw_ds
t=10.130.2.86,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=60510,tp_dst=8080,tcp_flags=ack

2024-06-10T18:11:58.264Z|00026|acl_log(ovn_pinctrl0)|INFO|name="BANP:default:Ingress:0",
```

```
verdict=allow, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:82:02:57,dl_dst=0a:58:0a:82:02:56,nw_src=10.130.2.87,nw_ds
t=10.130.2.86,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=60510,tp_dst=8080,tcp_flags=fin|a
ck
2024-06-10T18:11:58.264Z|00027|acl_log(ovn_pinctrl0)|INFO|name="BANP:default:Ingress:0",
verdict=allow, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:82:02:57,dl_dst=0a:58:0a:82:02:56,nw_src=10.130.2.87,nw_ds
t=10.130.2.86,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=60510,tp_dst=8080,tcp_flags=ack
```

Example 4.7. Example ACL allow log entry for Allow action of default BANP with Egress:0 and Ingress:1

```
2024-06-10T18:09:57.774Z|00016|acl_log(ovn_pinctrl0)|INFO|name="BANP:default:Egress:0",
verdict=drop, severity=alert, direction=from-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:82:02:56,dl_dst=0a:58:0a:82:02:57,nw_src=10.130.2.86,nw_ds
t=10.130.2.87,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=45614,tp_dst=8080,tcp_flags=syn

2024-06-10T18:09:58.809Z|00017|acl_log(ovn_pinctrl0)|INFO|name="BANP:default:Egress:0",
verdict=drop, severity=alert, direction=from-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:82:02:56,dl_dst=0a:58:0a:82:02:57,nw_src=10.130.2.86,nw_ds
t=10.130.2.87,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=45614,tp_dst=8080,tcp_flags=syn

2024-06-10T18:10:00.857Z|00018|acl_log(ovn_pinctrl0)|INFO|name="BANP:default:Egress:0",
verdict=drop, severity=alert, direction=from-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:82:02:56,dl_dst=0a:58:0a:82:02:57,nw_src=10.130.2.86,nw_ds
t=10.130.2.87,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=45614,tp_dst=8080,tcp_flags=syn

2024-06-10T18:10:25.414Z|00019|acl_log(ovn_pinctrl0)|INFO|name="BANP:default:Ingress:1",
verdict=drop, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:82:02:58,dl_dst=0a:58:0a:82:02:56,nw_src=10.130.2.88,nw_ds
t=10.130.2.86,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=40630,tp_dst=8080,tcp_flags=syn

2024-06-10T18:10:26.457Z|00020|acl_log(ovn_pinctrl0)|INFO|name="BANP:default:Ingress:1",
verdict=drop, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:82:02:58,dl_dst=0a:58:0a:82:02:56,nw_src=10.130.2.88,nw_ds
t=10.130.2.86,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=40630,tp_dst=8080,tcp_flags=syn

2024-06-10T18:10:28.505Z|00021|acl_log(ovn_pinctrl0)|INFO|name="BANP:default:Ingress:1",
verdict=drop, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:82:02:58,dl_dst=0a:58:0a:82:02:56,nw_src=10.130.2.88,nw_ds
t=10.130.2.86,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,tp_src=40630,tp_dst=8080,tcp_flags=syn
```

The following table describes BANP annotation:

Table 4.4. Audit logging BaselineAdminNetworkPolicy annotation

Annotation	Value

Annotation	Value
k8s.ovn.org/acl-logging	You must specify at least one of **Allow** or **Deny** to enable audit logging for a namespace. **Deny** Optional: Specify **alert**, **warning**, **notice**, **info**, or **debug**. **Allow** Optional: Specify **alert**, **warning**, **notice**, **info**, or **debug**.

4.5. CONFIGURING EGRESS FIREWALL AND NETWORK POLICY AUDITING FOR A CLUSTER

As a cluster administrator, you can customize audit logging for your cluster.

Prerequisites

- Install the OpenShift CLI (**oc**).
- Log in to the cluster with a user with **cluster-admin** privileges.

Procedure

- To customize the audit logging configuration, enter the following command:

```
$ oc edit network.operator.openshift.io/cluster
```

TIP

You can also customize and apply the following YAML to configure audit logging:

```
apiVersion: operator.openshift.io/v1
kind: Network
metadata:
  name: cluster
spec:
  defaultNetwork:
    ovnKubernetesConfig:
      policyAuditConfig:
        destination: "null"
        maxFileSize: 50
        rateLimit: 20
        syslogFacility: local0
```

Verification

1. To create a namespace with network policies complete the following steps:
   a. Create a namespace for verification:

```
$ cat <<EOF| oc create -f -
kind: Namespace
apiVersion: v1
metadata:
  name: verify-audit-logging
  annotations:
    k8s.ovn.org/acl-logging: '{ "deny": "alert", "allow": "alert" }'
EOF
```

Successful output lists the namespace with the network policy and the **created** status.

b. Create network policies for the namespace:

```
$ cat <<EOF| oc create -n verify-audit-logging -f -
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: deny-all
spec:
  podSelector:
    matchLabels:
  policyTypes:
  - Ingress
  - Egress
---
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: allow-from-same-namespace
  namespace: verify-audit-logging
spec:
  podSelector: {}
  policyTypes:
   - Ingress
   - Egress
  ingress:
    - from:
        - podSelector: {}
  egress:
    - to:
       - namespaceSelector:
          matchLabels:
            kubernetes.io/metadata.name: verify-audit-logging
EOF
```

Example output

```
networkpolicy.networking.k8s.io/deny-all created
networkpolicy.networking.k8s.io/allow-from-same-namespace created
```

2. Create a pod for source traffic in the **default** namespace:

```
$ cat <<EOF| oc create -n default -f -
apiVersion: v1
kind: Pod
```

```
metadata:
  name: client
spec:
  containers:
    - name: client
      image: registry.access.redhat.com/rhel7/rhel-tools
      command: ["/bin/sh", "-c"]
      args:
        ["sleep inf"]
EOF
```

3. Create two pods in the **verify-audit-logging** namespace:

```
$ for name in client server; do
cat <<EOF| oc create -n verify-audit-logging -f -
apiVersion: v1
kind: Pod
metadata:
  name: ${name}
spec:
  containers:
    - name: ${name}
      image: registry.access.redhat.com/rhel7/rhel-tools
      command: ["/bin/sh", "-c"]
      args:
        ["sleep inf"]
EOF
done
```

Successful output lists the two pods, such as **pod/client** and **pod/server**, and the **created** status.

4. To generate traffic and produce network policy audit log entries, complete the following steps:

   a. Obtain the IP address for pod named **server** in the **verify-audit-logging** namespace:

   ```
   $ POD_IP=$(oc get pods server -n verify-audit-logging -o jsonpath='{.status.podIP}')
   ```

   b. Ping the IP address from an earlier command from the pod named **client** in the **default** namespace and confirm the all packets are dropped:

   ```
   $ oc exec -it client -n default -- /bin/ping -c 2 $POD_IP
   ```

   Example output

   ```
   PING 10.128.2.55 (10.128.2.55) 56(84) bytes of data.

   --- 10.128.2.55 ping statistics ---
   2 packets transmitted, 0 received, 100% packet loss, time 2041ms
   ```

   c. From the client pod in the **verify-audit-logging** namespace, ping the IP address stored in the **POD_IP shell** environment variable and confirm the system allows all packets.

   ```
   $ oc exec -it client -n verify-audit-logging -- /bin/ping -c 2 $POD_IP
   ```

-

Example output

```
PING 10.128.0.86 (10.128.0.86) 56(84) bytes of data.
64 bytes from 10.128.0.86: icmp_seq=1 ttl=64 time=2.21 ms
64 bytes from 10.128.0.86: icmp_seq=2 ttl=64 time=0.440 ms

--- 10.128.0.86 ping statistics ---
2 packets transmitted, 2 received, 0% packet loss, time 1001ms
rtt min/avg/max/mdev = 0.440/1.329/2.219/0.890 ms
```

5. Display the latest entries in the network policy audit log:

```
$ for pod in $(oc get pods -n openshift-ovn-kubernetes -l app=ovnkube-node --no-
headers=true | awk '{ print $1 }') ; do
   oc exec -it $pod -n openshift-ovn-kubernetes -- tail -4 /var/log/ovn/acl-audit-log.log
 done
```

Example output

```
2023-11-02T16:28:54.139Z|00004|acl_log(ovn_pinctrl0)|INFO|name="NP:verify-audit-
logging:Ingress", verdict=drop, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:81:02:01,dl_dst=0a:58:0a:81:02:23,nw_src=10.131.0.39,n
w_dst=10.129.2.35,nw_tos=0,nw_ecn=0,nw_ttl=62,nw_frag=no,tp_src=58496,tp_dst=8080,tcp
_flags=syn
2023-11-02T16:28:55.187Z|00005|acl_log(ovn_pinctrl0)|INFO|name="NP:verify-audit-
logging:Ingress", verdict=drop, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:81:02:01,dl_dst=0a:58:0a:81:02:23,nw_src=10.131.0.39,n
w_dst=10.129.2.35,nw_tos=0,nw_ecn=0,nw_ttl=62,nw_frag=no,tp_src=58496,tp_dst=8080,tcp
_flags=syn
2023-11-02T16:28:57.235Z|00006|acl_log(ovn_pinctrl0)|INFO|name="NP:verify-audit-
logging:Ingress", verdict=drop, severity=alert, direction=to-lport:
tcp,vlan_tci=0x0000,dl_src=0a:58:0a:81:02:01,dl_dst=0a:58:0a:81:02:23,nw_src=10.131.0.39,n
w_dst=10.129.2.35,nw_tos=0,nw_ecn=0,nw_ttl=62,nw_frag=no,tp_src=58496,tp_dst=8080,tcp
_flags=syn
2023-11-02T16:49:57.909Z|00028|acl_log(ovn_pinctrl0)|INFO|name="NP:verify-audit-
logging:allow-from-same-namespace:Egress:0", verdict=allow, severity=alert, direction=from-
lport:
icmp,vlan_tci=0x0000,dl_src=0a:58:0a:81:02:22,dl_dst=0a:58:0a:81:02:23,nw_src=10.129.2.34,
nw_dst=10.129.2.35,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,icmp_type=8,icmp_code=0
2023-11-02T16:49:57.909Z|00029|acl_log(ovn_pinctrl0)|INFO|name="NP:verify-audit-
logging:allow-from-same-namespace:Ingress:0", verdict=allow, severity=alert, direction=to-
lport:
icmp,vlan_tci=0x0000,dl_src=0a:58:0a:81:02:22,dl_dst=0a:58:0a:81:02:23,nw_src=10.129.2.34,
nw_dst=10.129.2.35,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,icmp_type=8,icmp_code=0
2023-11-02T16:49:58.932Z|00030|acl_log(ovn_pinctrl0)|INFO|name="NP:verify-audit-
logging:allow-from-same-namespace:Egress:0", verdict=allow, severity=alert, direction=from-
lport:
icmp,vlan_tci=0x0000,dl_src=0a:58:0a:81:02:22,dl_dst=0a:58:0a:81:02:23,nw_src=10.129.2.34,
nw_dst=10.129.2.35,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,icmp_type=8,icmp_code=0
2023-11-02T16:49:58.932Z|00031|acl_log(ovn_pinctrl0)|INFO|name="NP:verify-audit-
logging:allow-from-same-namespace:Ingress:0", verdict=allow, severity=alert, direction=to-
lport:
icmp,vlan_tci=0x0000,dl_src=0a:58:0a:81:02:22,dl_dst=0a:58:0a:81:02:23,nw_src=10.129.2.34,
nw_dst=10.129.2.35,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,icmp_type=8,icmp_code=0
```

-

4.6. ENABLING EGRESS FIREWALL AND NETWORK POLICY AUDIT LOGGING FOR A NAMESPACE

As a cluster administrator, you can enable audit logging for a namespace.

Prerequisites

- Install the OpenShift CLI (**oc**).
- Log in to the cluster with a user with **cluster-admin** privileges.

Procedure

- To enable audit logging for a namespace, enter the following command:

```
$ oc annotate namespace <namespace> \
  k8s.ovn.org/acl-logging='{ "deny": "alert", "allow": "notice" }'
```

where:

<namespace>

Specifies the name of the namespace.

TIP

You can also apply the following YAML to enable audit logging:

```
kind: Namespace
apiVersion: v1
metadata:
  name: <namespace>
  annotations:
    k8s.ovn.org/acl-logging: |-
      {
        "deny": "alert",
        "allow": "notice"
      }
```

Successful output lists the audit logging name and the **annotated** status.

Verification

- Display the latest entries in the audit log:

```
$ for pod in $(oc get pods -n openshift-ovn-kubernetes -l app=ovnkube-node --no-
headers=true | awk '{ print $1 }') ; do
    oc exec -it $pod -n openshift-ovn-kubernetes -- tail -4 /var/log/ovn/acl-audit-log.log
  done
```

Example output

```
2023-11-02T16:49:57.909Z|00028|acl_log(ovn_pinctrl0)|INFO|name="NP:verify-audit-
logging:allow-from-same-namespace:Egress:0", verdict=allow, severity=alert, direction=from-
lport:
icmp,vlan_tci=0x0000,dl_src=0a:58:0a:81:02:22,dl_dst=0a:58:0a:81:02:23,nw_src=10.129.2.34,
nw_dst=10.129.2.35,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,icmp_type=8,icmp_code=0
2023-11-02T16:49:57.909Z|00029|acl_log(ovn_pinctrl0)|INFO|name="NP:verify-audit-
logging:allow-from-same-namespace:Ingress:0", verdict=allow, severity=alert, direction=to-
lport:
icmp,vlan_tci=0x0000,dl_src=0a:58:0a:81:02:22,dl_dst=0a:58:0a:81:02:23,nw_src=10.129.2.34,
nw_dst=10.129.2.35,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,icmp_type=8,icmp_code=0
2023-11-02T16:49:58.932Z|00030|acl_log(ovn_pinctrl0)|INFO|name="NP:verify-audit-
logging:allow-from-same-namespace:Egress:0", verdict=allow, severity=alert, direction=from-
lport:
icmp,vlan_tci=0x0000,dl_src=0a:58:0a:81:02:22,dl_dst=0a:58:0a:81:02:23,nw_src=10.129.2.34,
nw_dst=10.129.2.35,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,icmp_type=8,icmp_code=0
2023-11-02T16:49:58.932Z|00031|acl_log(ovn_pinctrl0)|INFO|name="NP:verify-audit-
logging:allow-from-same-namespace:Ingress:0", verdict=allow, severity=alert, direction=to-
lport:
icmp,vlan_tci=0x0000,dl_src=0a:58:0a:81:02:22,dl_dst=0a:58:0a:81:02:23,nw_src=10.129.2.34,
nw_dst=10.129.2.35,nw_tos=0,nw_ecn=0,nw_ttl=64,nw_frag=no,icmp_type=8,icmp_code=0
```

4.7. DISABLING EGRESS FIREWALL AND NETWORK POLICY AUDIT LOGGING FOR A NAMESPACE

As a cluster administrator, you can disable audit logging for a namespace.

Prerequisites

- Install the OpenShift CLI (**oc**).
- Log in to the cluster with a user with **cluster-admin** privileges.

Procedure

- To disable audit logging for a namespace, enter the following command:

```
$ oc annotate --overwrite namespace <namespace> k8s.ovn.org/acl-logging-
```

where:

<namespace>

Specifies the name of the namespace.

TIP

You can also apply the following YAML to disable audit logging:

```
kind: Namespace
apiVersion: v1
metadata:
  name: <namespace>
  annotations:
    k8s.ovn.org/acl-logging: null
```

Successful output lists the audit logging name and the **annotated** status.

4.8. ADDITIONAL RESOURCES

- About network policy
- Configuring an egress firewall for a project

CHAPTER 5. EGRESS FIREWALL

5.1. VIEWING AN EGRESS FIREWALL FOR A PROJECT

As a cluster administrator, you can list the names of any existing egress firewalls and view the traffic rules for a specific egress firewall.

5.1.1. Viewing an EgressFirewall custom resource (CR)

You can view an **EgressFirewall** CR in your cluster.

Prerequisites

- A cluster using the OVN-Kubernetes network plugin.
- Install the OpenShift Command-line Interface (CLI), commonly known as **oc**.
- You must log in to the cluster.

Procedure

1. Optional: To view the names of the **EgressFirewall** CR defined in your cluster, enter the following command:

```
$ oc get egressfirewall --all-namespaces
```

2. To inspect a policy, enter the following command. Replace **<policy_name>** with the name of the policy to inspect.

```
$ oc describe egressfirewall <policy_name>
```

Example output

```
Name:  default
Namespace: project1
Created: 20 minutes ago
Labels:  <none>
Annotations: <none>
Rule:  Allow to 1.2.3.0/24
Rule:  Allow to www.example.com
Rule:  Deny to 0.0.0.0/0
```

5.2. EDITING AN EGRESS FIREWALL FOR A PROJECT

As a cluster administrator, you can modify network traffic rules for an existing egress firewall.

5.2.1. Editing an EgressFirewall custom resource (CR)

As a cluster administrator, you can update the egress firewall for a project.

Prerequisites

- A cluster using the OVN-Kubernetes network plugin.
- Install the OpenShift CLI (**oc**).
- You must log in to the cluster as a cluster administrator.

Procedure

1. Find the name of the **EgressFirewall** CR for the project. Replace **<project>** with the name of the project.

```
$ oc get -n <project> egressfirewall
```

2. Optional: If you did not save a copy of the **EgressFirewall** object when you created the egress network firewall, enter the following command to create a copy.

```
$ oc get -n <project> egressfirewall <name> -o yaml > <filename>.yaml
```

   Replace **<project>** with the name of the project. Replace **<name>** with the name of the object. Replace **<filename>** with the name of the file to save the YAML to.

3. After making changes to the policy rules, enter the following command to replace the **EgressFirewall** CR. Replace **<filename>** with the name of the file containing the updated **EgressFirewall** CR.

```
$ oc replace -f <filename>.yaml
```

5.3. REMOVING AN EGRESS FIREWALL FROM A PROJECT

As a cluster administrator, you can remove an egress firewall from a project to remove all restrictions on network traffic from the project that leaves the OpenShift Container Platform cluster.

5.3.1. Removing an EgressFirewall CR

As a cluster administrator, you can remove an egress firewall from a project.

Prerequisites

- A cluster using the OVN-Kubernetes network plugin.
- Install the OpenShift CLI (**oc**).
- You must log in to the cluster as a cluster administrator.

Procedure

1. Find the name of the **EgressFirewall** CR for the project. Replace **<project>** with the name of the project.

```
$ oc get egressfirewall -n <project>
```

2. Delete the **EgressFirewall** CR by entering the following command. Replace **<project>** with the name of the project and **<name>** with the name of the object.

```
$ oc delete -n <project> egressfirewall <name>
```

5.4. CONFIGURING AN EGRESS FIREWALL FOR A PROJECT

As a cluster administrator, you can create an egress firewall for a project that restricts egress traffic leaving your OpenShift Container Platform cluster.

5.4.1. How an egress firewall works in a project

As a cluster administrator, you can use an *egress firewall* to limit the external hosts that some or all pods can access from within the cluster. An egress firewall supports the following scenarios:

- A pod can only connect to internal hosts and cannot initiate connections to the public internet.
- A pod can only connect to the public internet and cannot initiate connections to internal hosts that are outside the OpenShift Container Platform cluster.
- A pod cannot reach specified internal subnets or hosts outside the OpenShift Container Platform cluster.
- A pod can only connect to specific external hosts.

For example, you can allow one project access to a specified IP range but deny the same access to a different project. Or, you can restrict application developers from updating from Python pip mirrors, and force updates to come only from approved sources.

You configure an egress firewall policy by creating an **EgressFirewall** custom resource (CR). The egress firewall matches network traffic that meets any of the following criteria:

- An IP address range in CIDR format
- A DNS name that resolves to an IP address
- A port number
- A protocol that is one of the following protocols: TCP, UDP, and SCTP

5.4.1.1. Limitations of an egress firewall

An egress firewall has the following limitations:

- No project can have more than one **EgressFirewall** CR.
- Egress firewall rules do not apply to traffic that goes through routers. Any user with permission to create a **Route** CR object can bypass egress firewall policy rules by creating a route that points to a forbidden destination.
- Egress firewall does not apply to the host network namespace. Pods with host networking enabled are unaffected by egress firewall rules.
- If your egress firewall includes a deny rule for **0.0.0.0/0**, access to your OpenShift Container Platform API servers is blocked. You must either add allow rules for each IP address or use the **nodeSelector** type allow rule in your egress policy rules to connect to API servers.
  The following example illustrates the order of the egress firewall rules necessary to ensure API server access:

```
apiVersion: k8s.ovn.org/v1
kind: EgressFirewall
metadata:
  name: default
  namespace: <namespace>
spec:
  egress:
  - to:
      cidrSelector: <api_server_address_range> 1
    type: Allow
# ...
  - to:
      cidrSelector: 0.0.0.0/0 2
    type: Deny
```

where:

<namespace>

Specifies the namespace for the egress firewall.

<api_server_address_range>

Specifies the IP address range that includes your OpenShift Container Platform API servers.

<cidrSelector>

Specifies a value of **0.0.0.0/0** to set a global deny rule that prevents access to the OpenShift Container Platform API servers.
To find the IP address for your API servers, run **oc get ep kubernetes -n default**.

For more information, see BZ#1988324.

- A maximum of one **EgressFirewall** object with a maximum of 8,000 rules can be defined per project.
- If you are using the OVN-Kubernetes network plugin with shared gateway mode in Red Hat OpenShift Networking, return ingress replies are affected by egress firewall rules. If the egress firewall rules drop the ingress reply destination IP, the traffic is dropped.
- In general, using Domain Name Server (DNS) names in your egress firewall policy does not affect local DNS resolution through CoreDNS. However, if your egress firewall policy uses domain names and an external DNS server handles DNS resolution for an affected pod, you must include egress firewall rules that permit access to the IP addresses of your DNS server.

Violating any of these restrictions results in a broken egress firewall for the project. Consequently, all external network traffic is dropped, which can cause security risks for your organization.

An **EgressFirewall** resource is created in the **kube-node-lease**, **kube-public**, **kube-system**, **openshift** and **openshift-** projects.

5.4.1.2. Matching order for egress firewall policy rules

OVN-Kubernetes evaluates egress firewall policy rules in the order they are defined in, from first to last. The first rule that matches an egress connection from a pod applies. Any subsequent rules are ignored for that connection.

5.4.1.3. How Domain Name Server (DNS) resolution works

If you use DNS names in any of your egress firewall policy rules, proper resolution of the domain names is subject to the following restrictions:

- Domain name updates are polled based on a time-to-live (TTL) duration. By default, the duration is 30 minutes. When the egress firewall controller queries the local name servers for a domain name, if the response includes a TTL and the TTL is less than 30 minutes, the controller sets the duration for that DNS name to the returned value. Each DNS name is queried after the TTL for the DNS record expires.
- The pod must resolve the domain from the same local name servers when necessary. Otherwise the IP addresses for the domain known by the egress firewall controller and the pod can be different. If the IP addresses for a hostname differ, the egress firewall might not be enforced consistently.
- Because the egress firewall controller and pods asynchronously poll the same local name server, the pod might obtain the updated IP address before the egress controller does, which causes a race condition. Due to this current limitation, domain name usage in **EgressFirewall** objects is only recommended for domains with infrequent IP address changes.

5.4.1.3.1. Improved DNS resolution and resolving wildcard domain names

There might be situations where the IP addresses associated with a DNS record change frequently, or you might want to specify wildcard domain names in your egress firewall policy rules.

In this situation, the OVN-Kubernetes cluster manager creates a **DNSNameResolver** custom resource object for each unique DNS name used in your egress firewall policy rules. This custom resource stores the following information:

IMPORTANT

Improved DNS resolution for egress firewall rules 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 .

Example DNSNameResolver CR definition

```
apiVersion: networking.openshift.io/v1alpha1
kind: DNSNameResolver
spec:
  name: www.example.com.
status:
  resolvedNames:
  - dnsName: www.example.com.
    resolvedAddress:
    - ip: "1.2.3.4"
      ttlSeconds: 60
      lastLookupTime: "2023-08-08T15:07:04Z"
```

where:

<name>

Specifies the DNS name. This can be either a standard DNS name or a wildcard DNS name. For a wildcard DNS name, the DNS name resolution information contains all of the DNS names that match the wildcard DNS name.

<dnsName>

Specifies the resolved DNS name matching the **spec.name** field. If the **spec.name** field contains a wildcard DNS name, then multiple **dnsName** entries are created that contain the standard DNS names that match the wildcard DNS name when resolved. If the wildcard DNS name can also be successfully resolved, then this field also stores the wildcard DNS name. <ip> Specifies the current IP addresses associated with the DNS name.

<ttlSeconds>

Specifies the last time-to-live (TTL) duration.

<lastLookupTime>

Specifies the last lookup time.

If during DNS resolution the DNS name in the query matches any name defined in a **DNSNameResolver** CR, then the previous information is updated accordingly in the CR **status** field. For unsuccessful DNS wildcard name lookups, the request is retried after a default TTL of 30 minutes.

The OVN-Kubernetes cluster manager watches for updates to an **EgressFirewall** custom resource object, and creates, modifies, or deletes **DNSNameResolver** CRs associated with those egress firewall policies when that update occurs.

WARNING

Do not modify **DNSNameResolver** custom resources directly. This can lead to unwanted behavior of your egress firewall.

5.4.2. EgressFirewall custom resource (CR)

You can define one or more rules for an egress firewall. A rule is either an **Allow** rule or a **Deny** rule, with a specification for the traffic that the rule applies to.

The following YAML describes an **EgressFirewall** CR:

EgressFirewall object

```
apiVersion: k8s.ovn.org/v1
kind: EgressFirewall
metadata:
  name: <ovn>
spec:
  egress: <egress_rules>
    ...
```

where:

<ovn>

The name for the object must be **default**.

<egress_rules>

Specifies a collection of one or more egress network policy rules as described in the following section.

5.4.2.1. EgressFirewall rules

The following YAML describes the rules for an **EgressFirewall** resource. The user can select either an IP address range in CIDR format, a domain name, or use the **nodeSelector** field to allow or deny egress traffic. The **egress** stanza expects an array of one or more objects.

Egress policy rule stanza

```
egress:
- type: <type>
  to:
    cidrSelector: <cidr_range>
    dnsName: <dns_name>
    nodeSelector: <label_name>: <label_value>
  ports: <optional_port>
      ...
```

where:

<type>

Specifies the type of rule. The value must be either **Allow** or **Deny**.

<to>

Specifies a stanza describing an egress traffic match rule that specifies the **cidrSelector** field or the **dnsName** field. You cannot use both fields in the same rule.

<cidr_range>

Specifies an IP address range in CIDR format.

<dns_name>

Specifies a DNS domain name.

<nodeSelector>

Specifies labels which are key and value pairs that the user defines. Labels are attached to objects, such as pods. The **nodeSelector** allows for one or more node labels to be selected and attached to pods.

<ports>

Specifies an optional field that describes a collection of network ports and protocols for the rule.

Ports stanza

```
ports:
- port:
  protocol:
```

where:

<port>

Specifies a network port, such as **80** or **443**. If you specify a value for this field, you must also specify a value for the **protocol** field.

<protocol>

Specifies a network protocol. The value must be either **TCP**, **UDP**, or **SCTP**.

5.4.2.2. Example EgressFirewall CR

The following example defines several egress firewall policy rules:

```
apiVersion: k8s.ovn.org/v1
kind: EgressFirewall
metadata:
  name: default
spec:
  egress: 1
  - type: Allow
    to:
      cidrSelector: 1.2.3.0/24
  - type: Deny
    to:
      cidrSelector: 0.0.0.0/0
```

where:

<egress>

Specifies a collection of egress firewall policy rule objects.

The following example defines a policy rule that denies traffic to the host at the **172.16.1.1/32** IP address, if the traffic is using either the TCP protocol and destination port **80** or any protocol and destination port **443**.

```
apiVersion: k8s.ovn.org/v1
kind: EgressFirewall
metadata:
  name: default
spec:
  egress:
  - type: Deny
    to:
      cidrSelector: 172.16.1.1/32
    ports:
    - port: 80
      protocol: TCP
    - port: 443
```

5.4.2.3. Example EgressFirewall CR using nodeSelector

As a cluster administrator, you can allow or deny egress traffic to nodes in your cluster by specifying a label using **nodeSelector** field. Labels can be applied to one or more nodes. Labels can be helpful because instead of adding manual rules per node IP address, you can use node selectors to create a label that allows pods behind an egress firewall to access host network pods. The following is an example with the **region=east** label:

```
apiVersion: k8s.ovn.org/v1
kind: EgressFirewall
metadata:
  name: default
spec:
    egress:
    - to:
        nodeSelector:
          matchLabels:
            region: east
      type: Allow
```

5.4.3. Creating an EgressFirewall custom resource (CR)

As a cluster administrator, you can create an egress firewall policy object for a project.

IMPORTANT

If the project already has an **EgressFirewall** resource, you must edit the existing policy to make changes to egress firewall rules.

Prerequisites

- A cluster that uses the OVN-Kubernetes network plugin.
- Install the OpenShift CLI (**oc**).
- You must log in to the cluster as a cluster administrator.

Procedure

1. Create a policy rule:
   a. Create a **<policy_name>.yaml** file where **<policy_name>** describes the egress policy rules.
   b. Define the **EgressFirewall** object in the file.
2. Create the policy object by entering the following command. Replace **<policy_name>** with the name of the policy and **<project>** with the project that the rule applies to.

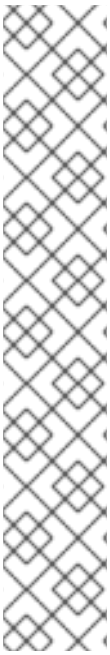
   ```
   $ oc create -f <policy_name>.yaml -n <project>
   ```

   Successful output lists the **egressfirewall.k8s.ovn.org/v1** name and the **created** status.
3. Optional: Save the **<policy_name>.yaml** file so that you can make changes later.

CHAPTER 6. CONFIGURING IPSEC ENCRYPTION

By enabling IPsec, you can encrypt both internal pod-to-pod cluster traffic between nodes and external traffic between pods and IPsec endpoints external to your cluster. All pod-to-pod network traffic between nodes on the OVN-Kubernetes cluster network is encrypted with IPsec in *Transport mode*.

IPsec is disabled by default. You can enable IPsec either during or after installing the cluster. For information about cluster installation, see OpenShift Container Platform installation overview .



NOTE

Upgrading your cluster to OpenShift Container Platform 4.19 when the **libreswan** and **NetworkManager-libreswan** packages have different OpenShift Container Platform versions causes two consecutive compute node reboot operations. For the first reboot, the Cluster Network Operator (CNO) applies the IPsec configuration to compute nodes. For the second reboot, the Machine Config Operator (MCO) applies the latest machine configs to the cluster.

To combine the CNO and MCO updates into a single node reboot, complete the following tasks:

- Before upgrading your cluster, set the **paused** parameter to **true** in the **MachineConfigPools** custom resource (CR) that groups compute nodes.
- After you upgrade your cluster, set the parameter to **false**.

For more information, see Performing a Control Plane Only update .

The following support limitations exist for IPsec on a OpenShift Container Platform cluster:

- On IBM Cloud®, IPsec supports only network address translation-traversal (NAT-T). Encapsulating Security Payload (ESP) is not supported on this platform.
- If your cluster uses hosted control planes for Red Hat OpenShift Container Platform, IPsec is not supported for IPsec encryption of either pod-to-pod or traffic to external hosts.
- Using ESP hardware offloading on any network interface is not supported if one or more of those interfaces is attached to Open vSwitch (OVS). Enabling IPsec for your cluster triggers the use of IPsec with interfaces attached to OVS. By default, OpenShift Container Platform disables ESP hardware offloading on any interfaces attached to OVS.
- If you enabled IPsec for network interfaces that are not attached to OVS, a cluster administrator must manually disable ESP hardware offloading on each interface that is not attached to OVS.

The following list outlines key tasks in the IPsec documentation:

- Enable and disable IPsec after cluster installation.
- Configure IPsec encryption for traffic between the cluster and external hosts.
- Verify that IPsec encrypts traffic between pods on different nodes.

6.1. MODES OF OPERATION

When using IPsec on your OpenShift Container Platform cluster, you can choose from the following operating modes:

Table 6.1. IPsec modes of operation

Mode	Description	Default
Disabled	No traffic is encrypted. This is the cluster default.	Yes
Full	Pod-to-pod traffic is encrypted as described in "Types of network traffic flows encrypted by pod-to-pod IPsec". Traffic to external nodes may be encrypted after you complete the required configuration steps for IPsec.	No
External	Traffic to external nodes may be encrypted after you complete the required configuration steps for IPsec.	No

6.2. PREREQUISITES

For IPsec support for encrypting traffic to external hosts, ensure that you meet the following prerequisites:

- Set **routingViaHost=true** in the **ovnKubernetesConfig.gatewayConfig** specification of the OVN-Kubernetes network plugin.
- Install the NMState Operator. This Operator is required for specifying the IPsec configuration. For more information, see Kubernetes NMState Operator.

NOTE

The NMState Operator is supported on Google Cloud only for configuring IPsec.

- The Butane tool (**butane**) is installed. To install Butane, see Installing Butane.

These prerequisites are required to add certificates into the host NSS database and to configure IPsec to communicate with external hosts.

6.3. NETWORK CONNECTIVITY REQUIREMENTS WHEN IPSEC IS ENABLED

You must configure the network connectivity between machines to allow OpenShift Container Platform cluster components to communicate. Each machine must be able to resolve the hostnames of all other machines in the cluster.

Table 6.2. Ports used for all-machine to all-machine communications

Protocol	Port	Description
UDP	**500**	IPsec IKE packets
	4500	IPsec NAT-T packets

Protocol	Port	Description
ESP	N/A	IPsec Encapsulating Security Payload (ESP)

6.4. IPSEC ENCRYPTION FOR POD-TO-POD TRAFFIC

For IPsec encryption of pod-to-pod traffic, the following sections describe which specific pod-to-pod traffic is encrypted, what kind of encryption protocol is used, and how X.509 certificates are handled. These sections do not apply to IPsec encryption between the cluster and external hosts, which you must configure manually for your specific external network infrastructure.

6.4.1. Types of network traffic flows encrypted by pod-to-pod IPsec

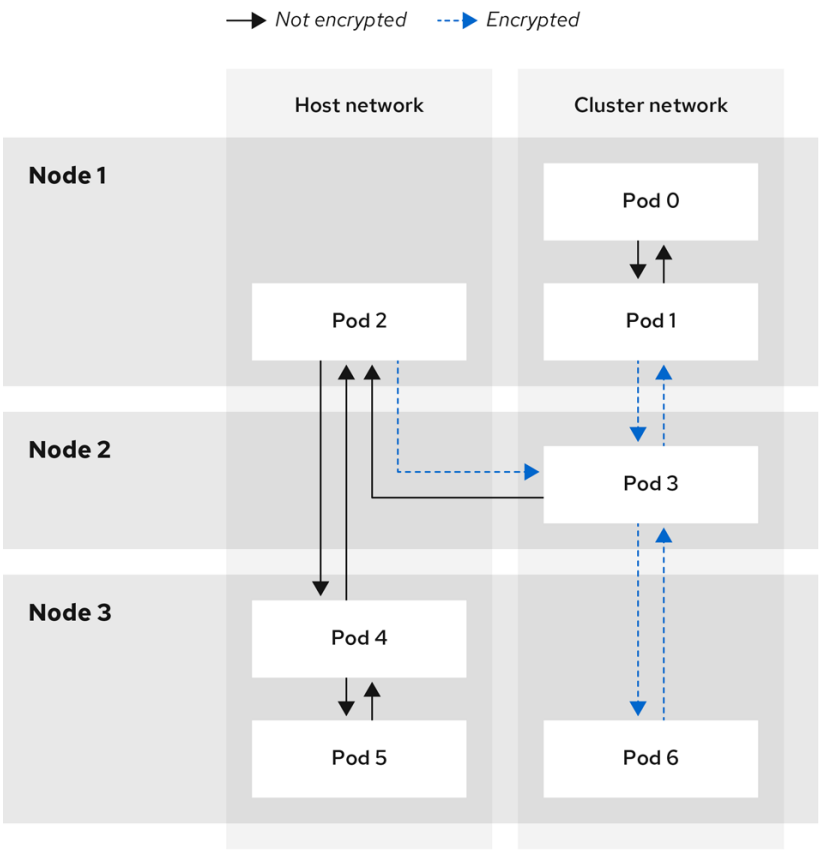
With IPsec enabled, only the following network traffic flows between pods are encrypted:

- Traffic between pods on different nodes on the cluster network
- Traffic from a pod on the host network to a pod on the cluster network

The following traffic flows are not encrypted:

- Traffic between pods on the same node on the cluster network
- Traffic between pods on the host network
- Traffic from a pod on the cluster network to a pod on the host network

The encrypted and unencrypted flows are illustrated in the following diagram:



6.4.2. Encryption protocol and IPsec mode

The encrypt cipher used is **AES-GCM-16-256**. The integrity check value (ICV) is **16** bytes. The key length is **256** bits.

The IPsec mode used is *Transport mode*, a mode that encrypts end-to-end communication by adding an Encapsulated Security Payload (ESP) header to the IP header of the original packet and encrypts the packet data. OpenShift Container Platform does not currently use or support IPsec *Tunnel mode* for pod-to-pod communication.

6.4.3. Security certificate generation and rotation

The Cluster Network Operator (CNO) generates a self-signed X.509 certificate authority (CA) that is used by IPsec for encryption. Certificate signing requests (CSRs) from each node are automatically fulfilled by the CNO.

The CA is valid for 10 years. The individual node certificates are valid for 5 years and are automatically rotated after 4 1/2 years elapse.

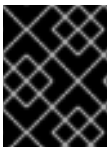
6.5. IPSEC ENCRYPTION FOR EXTERNAL TRAFFIC

OpenShift Container Platform supports the use of IPsec to encrypt traffic destined for external hosts, ensuring confidentiality and integrity of data in transit. This feature relies on X.509 certificates that you must supply.

6.5.1. Supported platforms

This feature is supported on the following platforms:

- Bare metal
- Google Cloud
- Red Hat OpenStack Platform (RHOSP)
- VMware vSphere



IMPORTANT

If you have Red Hat Enterprise Linux (RHEL) compute nodes, these do not support IPsec encryption for external traffic.

If your cluster uses hosted control planes for Red Hat OpenShift Container Platform, configuring IPsec for encrypting traffic to external hosts is not supported.

6.5.2. Limitations

Ensure that the following prohibitions are observed:

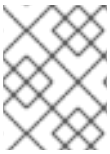
- IPv6 configuration is not currently supported by the NMState Operator when configuring IPsec for external traffic.
- Certificate common names (CN) in the provided certificate bundle must not begin with the **ovs_** prefix, because this naming can conflict with pod-to-pod IPsec CN names in the Network Security Services (NSS) database of each node.

6.6. ENABLING IPSEC ENCRYPTION

As a cluster administrator you can enable pod-to-pod IPsec encryption between the cluster and external IPsec endpoints.

You can configure IPsec in either of the following modes:

- **Full**: Encryption for pod-to-pod and external traffic
- **External**: Encryption for external traffic



NOTE

If you configure IPsec in **Full** mode, you must also complete the "Configuring IPsec encryption for external traffic" procedure.

If you enabled IPsec in **Full** mode, as a cluster administrator you can configure options for the mode by adding the **full** schema to **networks.operator.openshift.io**. The **full** schema supports the **encapsulation** parameter. You can use this parameter to configure network address translation-traversal (NAT-T) encapsulation for IPsec traffic. The **encapsulation** parameter supports the following values:

- **Auto** is the default value and enables UDP encapsulation when **libreswan** detects network address translation (NAT) packets in traffic within a node.
- **Always** enables UDP encapsulation for all traffic types available in a node. This option does not rely upon **libreswan** to detect NAT packets in a node.

Prerequisites

- Install the OpenShift CLI (**oc**).
- You are logged in to the cluster as a user with **cluster-admin** privileges.
- You have reduced the size of your cluster MTU by **46** bytes to allow for the overhead of the IPsec ESP header.

Procedure

1. To enable IPsec encryption, enter the following command:

```
$ oc patch networks.operator.openshift.io cluster --type=merge -p \
  '{
  "spec":{
    "defaultNetwork":{
      "ovnKubernetesConfig":{
        "ipsecConfig":{
          "mode":"<mode> (1)
        }}}}}'
```

(1) Specify **External** to encrypt traffic to external hosts or specify **Full** to encrypt pod-to-pod traffic and, optionally, traffic to external hosts. By default, IPsec is disabled.

Example configuration that has IPsec enabled in Full mode and encapsulation set to Always

```
$ oc patch networks.operator.openshift.io cluster --type=merge -p \
  '{
  "spec":{
    "defaultNetwork":{
      "ovnKubernetesConfig":{
        "ipsecConfig":{
          "mode":"Full",
          "full":{
            "encapsulation": "Always"
          }}}}}}'
```

2. Encrypt external traffic with IPsec by completing the "Configuring IPsec encryption for external traffic" procedure.

Verification

1. To find the names of the OVN-Kubernetes data plane pods, enter the following command:

```
$ oc get pods -n openshift-ovn-kubernetes -l=app=ovnkube-node
```

Example output

```
ovnkube-node-5xqbf                  8/8     Running   0          28m
ovnkube-node-6mwcx                  8/8     Running   0          29m
ovnkube-node-ck5fr                  8/8     Running   0          31m
```

```
ovnkube-node-fr4ld                  8/8     Running   0          26m
ovnkube-node-wgs4l                   8/8     Running   0           33m
ovnkube-node-zfvcl                  8/8     Running   0          34m
...
```

2. Verify that you enabled IPsec on your cluster by running the following command:

NOTE

As a cluster administrator, you can verify that you enabled IPsec between pods on your cluster when you configured IPsec in **Full** mode. This step does not verify whether IPsec is working between your cluster and external hosts.

```
$ oc -n openshift-ovn-kubernetes rsh ovnkube-node-<XXXXX> ovn-nbctl --no-leader-only get nb_global . ipsec 1
```

where: **<XXXXX>** specifies the random sequence of letters for a pod from an earlier step.

Successful output from the command shows the status as **true**.

6.7. CONFIGURING IPSEC ENCRYPTION FOR EXTERNAL TRAFFIC

As a cluster administrator, to encrypt external traffic with IPsec you must configure IPsec for your network infrastructure, including providing PKCS#12 certificates. Because this procedure uses Butane to create machine configs, you must have the **butane** tool installed.

NOTE

After you apply the machine config, the Machine Config Operator (MCO) reboots affected nodes in your cluster to rollout the new machine config.

Prerequisites

- Install the OpenShift CLI (**oc**).
- You have installed the **butane** tool on your local computer.
- You have installed the NMState Operator on the cluster.
- You logged in to the cluster as a user with **cluster-admin** privileges.
- You have an existing PKCS#12 certificate for the IPsec endpoint and a CA cert in Privacy Enhanced Mail (PEM) format.
- You enabled IPsec in either **Full** or **External** mode on your cluster.
- You must set the **routingViaHost** parameter to **true** in the **ovnKubernetesConfig.gatewayConfig** specification of the OVN-Kubernetes network plugin.

Procedure

1. Create an IPsec configuration with an NMState Operator node network configuration policy. For more information, see Configuring an IPsec based VPN connection by using nmstatectl .

a. To identify the IP address of the cluster node that is the IPsec endpoint, enter the following command:

```
$ oc get nodes
```

b. Create a file named **ipsec-config.yaml** that has a node network configuration policy for the NMState Operator, such as in the following examples. For an overview about **NodeNetworkConfigurationPolicy** objects, see The Kubernetes NMState project .

Example NMState IPsec transport configuration

```
apiVersion: nmstate.io/v1
kind: NodeNetworkConfigurationPolicy
metadata:
  name: ipsec-config
spec:
  nodeSelector:
    kubernetes.io/hostname: "<hostname>"
  desiredState:
    interfaces:
    - name: <interface_name>
      type: ipsec
      libreswan:
        left: <cluster_node>
        leftid: '%fromcert'
        leftrsasigkey: '%cert'
        leftcert: left_server
        leftmodecfgclient: false
        right: <external_host>
        rightid: '%fromcert'
        rightrsasigkey: '%cert'
        rightsubnet: <external_address>/32
        ikev2: insist
        type: transport
```

where:

kubernetes.io/hostname

Specifies the hostname to apply the policy to. This host serves as the left side host in the IPsec configuration.

name

Specifies the name of the interface to create on the host.

left

Specifies the hostname of the cluster node that terminates the IPsec tunnel on the cluster side. The name must match the SAN **[Subject Alternate Name]** from your supplied PKCS#12 certificates.

right

Specifies the external hostname, such as **host.example.com**. The name should match the SAN **[Subject Alternate Name]** from your supplied PKCS#12 certificates.

rightsubnet

Specifies the IP address of the external host, such as **10.1.2.3/32**.

Example NMState IPsec tunnel configuration

```
apiVersion: nmstate.io/v1
kind: NodeNetworkConfigurationPolicy
metadata:
  name: ipsec-config
spec:
  nodeSelector:
    kubernetes.io/hostname: "<hostname>"
  desiredState:
    interfaces:
    - name: <interface_name>
      type: ipsec
      libreswan:
        left: <cluster_node>
        leftid: '%fromcert'
        leftmodecfgclient: false
        leftrsasigkey: '%cert'
        leftcert: left_server
        right: <external_host>
        rightid: '%fromcert'
        rightrsasigkey: '%cert'
        rightsubnet: <external_address>/32
        ikev2: insist
        type: tunnel
```

c. To configure the IPsec interface, enter the following command:

```
$ oc create -f ipsec-config.yaml
```

2. Give the following certificate files to add to the Network Security Services (NSS) database on each host. These files are imported as part of the Butane configuration in the next steps.

   - **left_server.p12**: The certificate bundle for the IPsec endpoints
   - **ca.pem**: The certificate authority that you signed your certificates with

3. Create a machine config to add your certificates to the cluster.

4. Read the password from a mounted secret file:

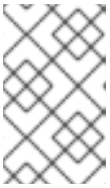
```
$ password=$(cat run/secrets/<left_server_password>)
```

   - **left_server_password**:: The name of the file that contains the password. This file exists in the mounted secret.

5. Use the **pk12util** tool, which comes prepackaged with Red Hat Enterprise Linux (RHEL), to specify a password that protects **PKCS#12** files by entering the following command. Ensure that you replace the **<password>** value with your password.

```
$ pk12util -W "<password>" -i /etc/pki/certs/left_server.p12 -d /var/lib/ipsec/nss/
```

6. To create Butane config files for the control plane and compute nodes, enter the following command:



NOTE

The Butane version you specify in the config file should match the OpenShift Container Platform version and always ends in **0**. For example, **4.19.0**. See "Creating machine configs with Butane" for information about Butane.

```
$ for role in master worker; do
  cat >> "99-ipsec-${role}-endpoint-config.bu" <<-EOF
  variant: openshift
  version: 4.19.0
  metadata:
    name: 99-${role}-import-certs
    labels:
      machineconfiguration.openshift.io/role: $role
  systemd:
    units:
    - name: ipsec-import.service
      enabled: true
      contents: |
        [Unit]
        Description=Import external certs into ipsec NSS
        Before=ipsec.service

        [Service]
        Type=oneshot
        ExecStart=/usr/local/bin/ipsec-addcert.sh
        RemainAfterExit=false
        StandardOutput=journal

        [Install]
        WantedBy=multi-user.target
  storage:
    files:
    - path: /etc/pki/certs/ca.pem
      mode: 0400
      overwrite: true
      contents:
        local: ca.pem
    - path: /etc/pki/certs/left_server.p12
      mode: 0400
      overwrite: true
      contents:
        local: left_server.p12
    - path: /usr/local/bin/ipsec-addcert.sh
      mode: 0740
      overwrite: true
      contents:
        inline: |
          #!/bin/bash -e
          echo "importing cert to NSS"
          certutil -A -n "CA" -t "CT,C,C" -d /var/lib/ipsec/nss/ -i /etc/pki/certs/ca.pem
          pk12util -W "" -i /etc/pki/certs/left_server.p12 -d /var/lib/ipsec/nss/
```

```
        certutil -M -n "left_server" -t "u,u,u" -d /var/lib/ipsec/nss/
EOF
done
```

7. To transform the Butane files that you created in the earlier step into machine configs, enter the following command:

```
$ for role in master worker; do
  butane -d . 99-ipsec-${role}-endpoint-config.bu -o ./99-ipsec-$role-endpoint-config.yaml
done
```

8. To apply the machine configs to your cluster, enter the following command:

```
$ for role in master worker; do
  oc apply -f 99-ipsec-${role}-endpoint-config.yaml
done
```

IMPORTANT

As the Machine Config Operator (MCO) updates machines in each machine config pool, it reboots each node one by one. You must wait for all the nodes to update before external IPsec connectivity is available.

Verification

1. Check the machine config pool status by entering the following command:

```
$ oc get mcp
```

A successfully updated node has the following status: **UPDATED=true**, **UPDATING=false**, **DEGRADED=false**.

NOTE

By default, the MCO updates one machine per pool at a time, causing the total time the migration takes to increase with the size of the cluster.

2. To confirm that IPsec machine configs rolled out successfully, enter the following commands:

   a. Confirm the creation of the IPsec machine configs:

```
$ oc get mc | grep ipsec
```

Example output

```
80-ipsec-master-extensions      3.2.0      6d15h
80-ipsec-worker-extensions      3.2.0      6d15h
```

   b. Confirm you have applied the IPsec extension to control plane nodes:

```
$ oc get mcp master -o yaml | grep 80-ipsec-master-extensions -c
```

c. Confirm the application of the IPsec extension to compute nodes. Example output would show **2**.

```
$ oc get mcp worker -o yaml | grep 80-ipsec-worker-extensions -c
```

6.8. ADDITIONAL RESOURCES

- IPsec Encryption

6.9. DISABLING IPSEC ENCRYPTION FOR AN EXTERNAL IPSEC ENDPOINT

As a cluster administrator, you can remove an existing IPsec tunnel to an external host.

Prerequisites

- Install the OpenShift CLI (**oc**).
- You are logged in to the cluster as a user with **cluster-admin** privileges.
- You enabled IPsec in either **Full** or **External** mode on your cluster.

Procedure

1. Create a file named **remove-ipsec-tunnel.yaml** with the following YAML:

```
kind: NodeNetworkConfigurationPolicy
apiVersion: nmstate.io/v1
metadata:
  name: <name>
spec:
  nodeSelector:
    kubernetes.io/hostname: <node_name>
  desiredState:
    interfaces:
    - name: <tunnel_name>
      type: ipsec
      state: absent
```

where:

name

Specifies a name for the node network configuration policy.

node_name

Specifies the name of the node where the IPsec tunnel that you want to remove exists.

tunnel_name

Specifies the interface name for the existing IPsec tunnel.

2. To remove the IPsec tunnel, enter the following command:

```
$ oc apply -f remove-ipsec-tunnel.yaml
```

6.10. DISABLING IPSEC ENCRYPTION

As a cluster administrator, you can disable IPsec encryption.

Prerequisites

- You installed the OpenShift CLI (**oc**).
- You logged in to the cluster with a user with **cluster-admin** privileges.

Procedure

1. Choose one of the following options to disable IPsec encryption:
   a. Where the **ipsecConfig.mode** parameter is set to either **External** or **Full** and the **ipsecConfig.full** schema is not added to **networks.operator.openshift.io**, enter the following command:

```
$ oc patch networks.operator.openshift.io cluster --type=merge -p \
  '{
  "spec":{
    "defaultNetwork":{
      "ovnKubernetesConfig":{
        "ipsecConfig":{
          "mode":"Disabled"
        }}}}}'
```

   b. Where the **ipsecConfig.mode** parameter is set to **Full** and the **ipsecConfig.full** configuration is added to **networks.operator.openshift.io**, enter the following command:

```
$ oc patch networks.operator.openshift.io cluster --type='json' -p \
      '[{"op": "remove", "path":
"/spec/defaultNetwork/ovnKubernetesConfig/ipsecConfig/full"},
      {"op": "replace", "path":
"/spec/defaultNetwork/ovnKubernetesConfig/ipsecConfig/mode", "value": "Disabled"}]'
```

2. Optional: You can increase the size of your cluster MTU by **46** bytes because there is no longer any overhead from the IPsec Encapsulating Security Payload (ESP) header in IP packets.

6.11. ADDITIONAL RESOURCES

- Configuring a VPN with IPsec
- Installing Butane
- About the OVN-Kubernetes Container Network Interface (CNI) network plugin
- Changing the MTU for the cluster network
- Network [operator.openshift.io/v1] API

CHAPTER 7. ZERO TRUST NETWORKING

Zero trust is an approach to designing security architectures based on the premise that every interaction begins in an untrusted state. This contrasts with traditional architectures, which might determine trustworthiness based on whether communication starts inside a firewall. More specifically, zero trust attempts to close gaps in security architectures that rely on implicit trust models and one-time authentication.

OpenShift Container Platform can add some zero trust networking capabilities to containers running on the platform without requiring changes to the containers or the software running in them. There are also several products that Red Hat offers that can further augment the zero trust networking capabilities of containers. If you have the ability to change the software running in the containers, then there are other projects that Red Hat supports that can add further capabilities.

Explore the following targeted capabilities of zero trust networking.

7.1. ROOT OF TRUST

Public certificates and private keys are critical to zero trust networking. These are used to identify components to one another, authenticate, and to secure traffic. The certificates are signed by other certificates, and there is a chain of trust to a root certificate authority (CA). Everything participating in the network needs to ultimately have the public key for a root CA so that it can validate the chain of trust. For public-facing things, these are usually the set of root CAs that are globally known, and whose keys are distributed with operating systems, web browsers, and so on. However, it is possible to run a private CA for a cluster or a corporation if the certificate of the private CA is distributed to all parties.

Leverage:

- OpenShift Container Platform: OpenShift creates a cluster CA at installation that is used to secure the cluster resources. However, OpenShift Container Platform can also create and sign certificates for services in the cluster, and can inject the cluster CA bundle into a pod if requested. Service certificates created and signed by OpenShift Container Platform have a 26-month time to live (TTL) and are rotated automatically at 13 months. They can also be rotated manually if necessary.

- OpenShift cert-manager Operator: cert-manager allows you to request keys that are signed by an external root of trust. There are many configurable issuers to integrate with external issuers, along with ways to run with a delegated signing certificate. The cert-manager API can be used by other software in zero trust networking to request the necessary certificates (for example, Red Hat OpenShift Service Mesh), or can be used directly by customer software.

7.2. TRAFFIC AUTHENTICATION AND ENCRYPTION

Ensure that all traffic on the wire is encrypted and the endpoints are identifiable. An example of this is Mutual TLS, or mTLS, which is a method for mutual authentication.

Leverage:

- OpenShift Container Platform: With transparent pod-to-pod IPsec, the source and destination of the traffic can be identified by the IP address. There is the capability for egress traffic to be encrypted using IPsec. By using the egress IP feature, the source IP address of the traffic can be used to identify the source of the traffic inside the cluster.

- Red Hat OpenShift Service Mesh: Provides powerful mTLS capabilities that can transparently augment traffic leaving a pod to provide authentication and encryption.

- OpenShift cert-manager Operator: Use custom resource definitions (CRDs) to request certificates that can be mounted for your programs to use for SSL/TLS protocols.

7.3. IDENTIFICATION AND AUTHENTICATION

After you have the ability to mint certificates using a CA, you can use it to establish trust relationships by verification of the identity of the other end of a connection – either a user or a client machine. This also requires management of certificate lifecycles to limit use if compromised.

Leverage:

- OpenShift Container Platform: Cluster-signed service certificates to ensure that a client is talking to a trusted endpoint. This requires that the service uses SSL/TLS and that the client uses the cluster CA. The client identity must be provided using some other means.
- Red Hat Single Sign-On : Provides request authentication integration with enterprise user directories or third-party identity providers.
- Red Hat OpenShift Service Mesh: Transparent upgrade of connections to mTLS, auto-rotation, custom certificate expiration, and request authentication with JSON web token (JWT).
- OpenShift cert-manager Operator: Creation and management of certificates for use by your application. Certificates can be controlled by CRDs and mounted as secrets, or your application can be changed to interact directly with the cert-manager API.

7.4. INTER-SERVICE AUTHORIZATION

It is critical to be able to control access to services based on the identity of the requester. This is done by the platform and does not require each application to implement it. That allows better auditing and inspection of the policies.

Leverage:

- OpenShift Container Platform: Can enforce isolation in the networking layer of the platform using the Kubernetes **NetworkPolicy** and **AdminNetworkPolicy** objects.
- Red Hat OpenShift Service Mesh: Sophisticated L4 and L7 control of traffic using standard Istio objects and using mTLS to identify the source and destination of traffic and then apply policies based on that information.

7.5. TRANSACTION-LEVEL VERIFICATION

In addition to the ability to identify and authenticate connections, it is also useful to control access to individual transactions. This can include rate-limiting by source, observability, and semantic validation that a transaction is well formed.

Leverage:

- Red Hat OpenShift Service Mesh: Perform L7 inspection of requests, rejecting malformed HTTP requests, transaction-level observability and reporting. Service Mesh can also provide request-based authentication using JWT.

7.6. RISK ASSESSMENT

As the number of security policies in a cluster increase, visualization of what the policies allow and deny becomes increasingly important. These tools make it easier to create, visualize, and manage cluster security policies.

Leverage:

- Red Hat OpenShift Service Mesh: Create and visualize Kubernetes **NetworkPolicy** and **AdminNetworkPolicy**, and OpenShift Networking **EgressFirewall** objects using the OpenShift web console.
- Red Hat Advanced Cluster Security for Kubernetes : Advanced visualization of objects.

7.7. SITE-WIDE POLICY ENFORCEMENT AND DISTRIBUTION

After deploying applications on a cluster, it becomes challenging to manage all of the objects that make up the security rules. It becomes critical to be able to apply site-wide policies and audit the deployed objects for compliance with the policies. This should allow for delegation of some permissions to users and cluster administrators within defined bounds, and should allow for exceptions to the policies if necessary.

Leverage:

- Red Hat OpenShift Service Mesh: RBAC to control policy objects and delegate control.
- Red Hat Advanced Cluster Security for Kubernetes : Policy enforcement engine.
- Red Hat Advanced Cluster Management (RHACM) for Kubernetes : Centralized policy control.

7.8. OBSERVABILITY FOR CONSTANT, AND RETROSPECTIVE, EVALUATION

After you have a running cluster, you want to be able to observe the traffic and verify that the traffic comports with the defined rules. This is important for intrusion detection, forensics, and is helpful for operational load management.

Leverage:

- Network Observability Operator: Allows for inspection, monitoring, and alerting on network connections to pods and nodes in the cluster.
- Red Hat Advanced Cluster Management (RHACM) for Kubernetes : Monitors, collects, and evaluates system-level events such as process execution, network connections and flows, and privilege escalation. It can determine a baseline for a cluster, and then detect anomalous activity and alert you about it.
- Red Hat OpenShift Service Mesh: Can monitor traffic entering and leaving a pod.
- Red Hat OpenShift Distributed Tracing Platform: For suitably instrumented applications, you can see all traffic associated with a particular action as it splits into sub-requests to microservices. This allows you to identify bottlenecks within a distributed application.

7.9. ENDPOINT SECURITY

It is important to be able to trust that the software running the services in your cluster has not been compromised. For example, you might need to ensure that certified images are run on trusted hardware, and have policies to only allow connections to or from an endpoint based on endpoint characteristics.

Leverage:

- OpenShift Container Platform: Secureboot can ensure that the nodes in the cluster are running trusted software, so the platform itself (including the container runtime) have not been tampered with. You can configure OpenShift Container Platform to only run images that have been signed by certain signatures.
- Red Hat Trusted Artifact Signer: This can be used in a trusted build chain and produce signed container images.

7.10. EXTENDING TRUST OUTSIDE OF THE CLUSTER

You might want to extend trust outside of the cluster by allowing a cluster to mint CAs for a subdomain. Alternatively, you might want to attest to workload identity in the cluster to a remote endpoint.

Leverage:

- OpenShift cert-manager Operator: You can use cert-manager to manage delegated CAs so that you can distribute trust across different clusters, or through your organization.
- Red Hat OpenShift Service Mesh: Can use SPIFFE to provide remote attestation of workloads to endpoints running in remote or local clusters.