Security Policy Guide

24.4

This guide describes the Illumio Core Security Policy including the policy objects. It provides guidance on designing a label schema and lists recommended approaches for Illumio's security policy design including creating rulesets and rules.

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Overview of Security Policy

This section describes the security policies, which are configurable sets of rules that protect network assets from threats and disruptions. Illumio Core relies on security policy to secure communications between workloads.

About the Illumio Policy Model

The Illumio security policy for securing workloads differs from traditional network security policies. Traditional security policies use network constructs, such as VLANs, zones, and IP addresses, to tie security to the underlying network infrastructure.

In contrast, the Illumio security policy uses a multidimensional label system to sort and describe the function of workloads. By describing workload functionally, policy statements are unambiguous. Illumio users assign four-dimensional labels to their workloads to identify their roles, applications, environments, and locations. Additionally, users specify labels in the scopes for rulesets and in the providers and consumers components of rules, allowing their organization's workloads to communicate with each other.

Labeling workloads and creating the corresponding rulesets and rules define the security policies for workloads. The PCE converts these label-based security policies into the appropriate rules for the OS-level firewalls of the workloads.

The Illumio Policy Model

Illumio gives you the option to manage your security policies by using either adaptive or static policy. Choosing how to implement security policy is possible because of the Illumio policy model.

About the Illumio Policy Model

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Together, labeling workloads and creating the corresponding rulesets and rules define the security policies for workloads. The PCE converts these label-based security policies into the appropriate rules for the OS-level firewalls of the workloads.

Security Policy Guidelines

The following guidelines are recommendations on how to create your security policy in Illumio Core. Creating a security policy is an iterative process, so following these recommendations will provide a broad initial policy, which can then be incrementally improved until a sufficiently robust policy has been established.

When creating your security policy:

1. Refine your initial policy to strengthen it by narrowing overly broad access.
2. Use the Visibility Only enforcement to verify and enact your policy.

Enforcement States

After creating a ruleset, you can preview the effects in Illumination using the Draft View. This view shows you the changes that will be enacted by your policy when it is enforced.

- **Visibility Only**: After refining your initial policy, most of the traffic lines in Illumination should be green. No traffic will be blocked and you can check your policy's accuracy. Any new traffic will be displayed as a red line.
- **Selective Enforcement**: Enables you to protect applications or processes on workloads while other services and ports function as if the workloads are in the Visibility Only enforcement state. By using selective enforcement, you can gradually expand the enforcement of policy on your workloads. Using the selective enforcement state is useful for temporarily enforcing security for specific ports in case a vulnerability is detected and action must be taken quickly. Using the selective enforcement state enables security enforcement before you are able to create complete allowlists of what traffic is allowed to reach your workloads.
- **Full Enforcement**: It is useful to move workloads to the Full Enforcement state in stages. This action can be done by workload, by application, by environment, or by data center. Start with less critical applications or workloads, stabilize them, then move on to more sensitive systems. This approach minimizes issues to a smaller number of affected workloads.

Understanding Rulesets and Rules

NOTE

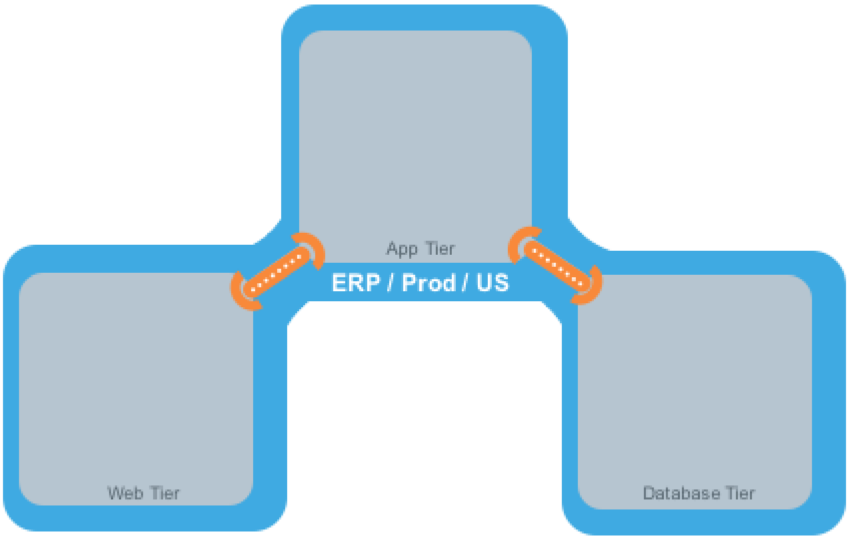
In previous releases, this feature was referred to as “Segmentation Rulesets.” In Illumio Core 21.5.0 and later releases, this feature is now referred to as “Rulesets.”

Rules are an integral component of the Illumio security policy. A set of rules is known as a “ruleset” and it specifies the allowed traffic in your network. Create the rules using labels that identify your workloads. See Labels [18] for more information.

Illumio's Illumio Core allowlist model for security policy uses rules to define the allowed communication for two or more workloads. For example, if you have two workloads that comprise a simple application — a web server and a database server — to allow these two workloads to communicate, you must write a rule that describes this relationship.

NOTE
The order in which the rules are written or any possible overlap between rules does not affect the allowlist model, since each rule permits some traffic between workloads.

For example, in the following diagram:



The relationships between the tiers (or workloads, as they are known in Illumio Core) in this example are:

- The Web workload can initiate communications with the App workload (Web → App).
- The App workload can initiate communications with the Database workload (App → Database).

In Illumio Core, the relationship in the diagram above is expressed as two separate rules:

- The Web workload can initiate communications with the App workload.
- The App workload can initiate communications with the Database workload.

To build your network security policy, create a ruleset for each of your workloads. Use labels to identify your workloads and use scopes to apply the rulesets to multiple workloads at once.

NOTE

Illumio recommends creating no more than 500 rules per ruleset, or the PCE web console will not be able to display all of the rules.

If you want to create a ruleset with more than 500 rules, Illumio recommends splitting the rules across multiple rulesets or using the Illumio Core REST API, where there is no limit on the number of rules you can create per ruleset.

Overview of Policy Objects

The PCE contains the following policy objects that help you write your security policy:

- **Segmentation Templates**: Prepackaged, tested security policies that provide all the rules needed for common enterprise applications.
- Labels and Label Groups [18]: Group similar labels together and use the label groups in rule writing.
- Services: [24] Allow you to define or discover existing services on your workloads. When a workload is paired with the PCE (has a VEN installed), it is scanned for any running processes, which are then displayed in the Services list.
- Virtual Services [32]: Allow you to label processes or services on workloads. Virtual services can either be used directly in rules or the labels applied to virtual services can be used to write rules.
- IP Lists [38]: Create IP lists (allowlists) so you can define IP addresses, IP ranges, and CIDR blocks that should be allowed access to your applications.
- **Load Balancers and Virtual Servers**: Add F5 Load Balancer configurations to the PCE so you can write policy for workloads whose traffic is managed by load balancers.
- **Pairing Profiles**: Configurations that allows you to apply certain properties to workloads as they pair with the PCE, such as applying labels and setting workload enforcement.
- **User Groups**: You can import Active Directory User Groups to write user-based rules for Adaptive User Segmentation [41].

Types of Illumio Policy

This section explains the differences between adaptive and static policy in the Illumio Core.

Adaptive Policy

Without adaptive security, enterprises face an overwhelming number of firewall rules, manual changes required to policies, and the possibility of errors leading to outages or serious vulnerabilities and breaches. Adaptive security automatically accounts for moves, scale, and changes to the applications and infrastructure that are typical of modern datacenters.

Because Illumio bases workload security on a policy model, it enables adaptive security that continuously adjusts to changes in the environment and to changed workload relationships. When a change occurs, the PCE responds dynamically by re-computing the OS-level firewall rules for the impacted workloads. The PCE alerts the VENs of the new OS-level firewall rules. The VENs request the new rules and apply them immediately.

The Illumio Core dynamically adapts and updates security policy when events, such as the following ones, occur in the managed environment.

- Workloads are added to or removed from your environment.
- Workloads change their IP addresses.
- Managed workloads come online and go offline.
- The labels on workloads change.

The PCE does not require Illumio users or automated processes to provision these changes for the PCE to re-compute the OS-level firewall rules for the impacted workloads and transmit them to the VENs.

See the following related topics:

- Pairing in VEN Installation and Upgrade Guide for information about adding workloads to your environment
- IP Lists [38] for information about using them in security policies
- Provisioning [108] for information about provisioning, which is a manual process
- Staged Policy [15] for information about how provisioning differs from adaptive policy

Static Policy

For the large majority of your workloads, adaptive security is the best method for protecting them from the lateral spread of threats. By default, the Illumio Core implements adaptive security for your workloads in all roles, all applications, all environments, and all locations. See Adaptive Policy [10] to learn how Illumio provides adaptive security.

However, in certain scenarios, you might want to control when the VENs apply new or changed OS-level firewall rules to workloads. Using labels, you designate which workloads are impacted by static policy. See Apply Static Policy [14] for the steps to configure static policy using labels.

When you configure the Policy Update Mode for workloads to use static policy, you control when the Illumio VENs running on the workloads apply new OS-level firewall rules that they received from the PCE. The Illumio Core blocks the immediate application of new firewall rules that result from users provisioning policy changes in the PCE and from dynamic updates to firewall rules (adaptive policy) when your environment changes. For example, you add a new rule to a ruleset in the PCE and provision the change, or a change occurs in your environment, such as a workload changes its IP address. In both cases, the VENs for your impacted workloads receive the new OS-level firewall rules from the PCE but they do not apply them until you explicitly select the workloads and click **Apply Policy** in the PCE web console.

See Staged Policy [15] for information about how the Illumio Core uses static policy and stages OS-level firewall updates rather than apply them immediately.

You should view static policy as a Security Setting rather than a type of security policy because configuring workloads to use static policy is a mechanism to control when VENs apply new or updated OS-level firewall rules to affected workloads. You can use the static policy setting to establish an audit trail of which Illumio users apply new OS-level firewall rules to workloads and when they apply them.

Use Cases for Static Policy

By default, the PCE is set to apply security policy updates dynamically through adaptive policy. However, scenarios occur where you want to control when updates to the OS-level firewall rules are applied to workloads.

For example, you might want to control when these updates occur in the following scenarios:

- Corporate policy for business-critical applications requires oversight on when updates to the OS-level firewall rules are applied to workloads.

  For example, a financial institution requires that security updates to its transaction processing application must be explicitly controlled by its security team. The security team authorizes the date and time of the update and applies it in the Illumio PCE.
- The corporate IT team has established policies for applying security updates during disparate maintenance windows.

  The IT team utilizes distributed maintenance windows to lessen the up-time impact on applications; for example, half the application is upgraded during the first maintenance window and the second part during the second maintenance window to keep the application up and running and minimize risk.
- The central security team sets the security policy to static for certain environments and adaptive for others.

  For example, the security policy is adaptive for workloads running in the development environment (using the labels All Applications, Development Environment, and All Locations). However, workloads in the production environment (All Applications, Production Environment, and All Locations) require static policy.

See **Caveats** for guidance on choosing when to configure workloads with static policy.

Example: Static Policy Workflow

The security team for an internet retail application has strict requirements for updating their production environment. They require that all updates to the OS-level firewall rules for their Database tier running in production must be applied during maintenance windows. For their Illumio-managed workloads, they configure a static policy that has the following labels: Role: Database, Applications: All, Environment: Production, Locations: All.

A spike in customer demand occurs and their production environment automatically scales by adding servers to the Web tier. The Illumio PCE detects the web servers connecting to the Database tier workloads and re-computes their security policy to include rules for the web servers. The PCE re-compute the OS-level firewall rules for those workloads and sends them to the VENs running on the Database workloads. The VENs stage the updates locally but they do **not** apply them to OS-level firewalls.

A maintenance window opens and a security team member filters the Database workloads in the PCE to determine which ones have staged security policy. She selects these workloads and applies the staged changes.

The VENs request the latest OS-level firewall rules from the PCE to ensure that all changes are included. The PCE sends the latest OS-level firewall rules to the VENs and they apply them.

Static Policy Prerequisites, Limitations, and Caveats

Before configuring your workloads to use static policy, review the following prerequisites and limitations, and consider the following caveats.

Prerequisites

- You must be a member of the Global Organization Owner role or Global Administrator role to manage Security Settings and add static policy.
- The VENs on affected workloads must be running version 17.2 or later. Earlier versions of VENs cannot stage static policy. They will apply security policy updates immediately to workloads even though you configured them to use static policy.

Limitations

- You should provision label gGroups before adding them to static policy.
- In the following situations, a VEN will apply a security update immediately and will not stage it even though the workload on which the VEN is running is configured to use static policy:
  - When you pair a new workload, the VEN applies the policy it receives from the PCE immediately.
  - When a VEN detects tampering, it requests security updates from the PCE and applies them immediately.
  - A VEN is offline when a user applies changes to their workloads. The VEN comes back online, connects to the PCE, and receives updated OS-level firewall rules. The VEN applies the updated rules to the workload even though it is configured to use static policy.

  > **NOTE**
  > When a VEN goes offline and online, its OS-level firewall rules can become out-of-sync from the rules of other VENs that remained online.
  >
  > See Staged Policy [15] for an explanation of how the VENs stage policy.

  Because of the possibility for a VEN to apply security updates immediately, Illumio recommends that you do not provision security policy updates until the updates are final. Keep the updates in Draft state until you complete them.
- To maximize performance, the PCE transmits 5,000 updated OS-level firewalls to the VENs at a time until all updates are sent.

Caveats

Illumio recommends implementing static policy for special cases and advanced users should oversee the process.

The Illumio Core is designed to ensure that your workloads are protected by the latest versions of your security policy across your environment. Users provision policy changes or the PCE responds dynamically to changes in the environment. In both cases, the PCE re-computes new OS-level firewall rules incorporating the changes, and sends them to the VENs to be applied immediately.

However, when you configure workloads to use static policy, you override this design by controlling when the VENs apply the security update to the workloads. As a result, you can have inconsistent security policy across your managed environment and cause communication disruptions between workloads.

Troubleshooting communication issues is difficult when the workloads within a scope are using different versions of a security policy.

Illumio recommends that you keep the number of workloads in your environment that utilize static policy as low as your business processes allow.

Apply Static Policy

By default, the Illumio Core implements adaptive security for your workloads in all roles, all applications, all environments, and all locations. See Adaptive Policy [10] to learn how Illumio provides adaptive security.

However, you might want to control when updates to OS-level firewall rules are applied to your workloads by adding static policy.

You designate which workloads use static policy by configuring the Policy Update Mode in the Security Settings. To configure the Policy Update Mode, you specify labels for the role, application, environment, and location. Any workloads within the scope of the specified labels will use static policy. You can add multiple scopes. Overlap between the scopes does not affect how workloads use static policy.

Label groups are not supported with static policy currently. To create scopes using multiple labels from the same type, add them as separate scopes. For example, you have four Role labels added to the PCE: Web, Database, API, and Mail. You want to add static policy for the Web and Database roles only so you add two scopes.

See Static Policy Prerequisites, Limitations, and Caveats [13] for information before you complete this task.

To add static policy:

1. From the PCE web console menu, choose **Settings** > **Security**.
2. Choose **Edit** > **Manage Policy Update**.

   The page refreshes with the settings to configure Static as the Policy Update Mode.
3. Click **Add**.

   A dialog box appears in which you set the scope of the static policy.
4. Select labels to select workloads for static policy.
5. Click **OK**.

   The static policy appears in the list.
6. Click **Provision** from the PCE web console toolbar.

Staged Policy

Understanding the distinction between using static policy to stage updates to OS-level firewall rules and provisioning security policy is important because the actions differ in crucial ways.

When you configure workloads to use static policy, the PCE sends the new OS-level firewall rules for Linux iptables or the Windows Filtering Platform (WFP) to the VENs and they stage them locally. The VENs do not apply the new firewall rules immediately. You must select the workloads and explicitly click **Apply Policy** in the Workloads page to activate the staged OS-level firewall rules.

Configuring a set of workloads to use static policy does not eliminate the requirement to provision policy updates for those workloads. Through provisioning, you update the PCE's version of your security policy.

When you provision security policy changes, you trigger the PCE to apply these changes to the workloads. When the workloads are set to use static policy, the VENs on the workloads will stage the changes until you explicitly click **Apply Policy**. However, under certain circumstances, the VENs could apply the latest changes before you explicitly click **Apply Policy**. See Static Policy Prerequisites, Limitations, and Caveats [13] for information.

TIP

The orange badge on the Provision button (top toolbar) indicates the number of changes you need to provision. .

In addition to rulesets and rules, you must provision changes to the Illumio policy objects, such as services, IP lists, and label groups. To make security policies easier to maintain and update, Illumio supports including re-usable policy objects in intra- and extra-scope rules. When you update a policy object, all the rules using the object are updated without you needing to change each rule where the object is included.

When you provision changes to rulesets and policy objects, the PCE saves your security policy as a new version. It recomputes the OS-level firewall rules for all the workloads affected by the change and instructs the VENs on those workloads to download the updated OS-level firewall rules.

See the following topics related to provisioning:

- Overview of Policy Objects [10] for a description of each type of policy item
- Provisioning [108] for the policy items that require provisioning
- Active vs Draft Versions to learn how provisioning establishes the active version of policy

Determine When Workloads Have Staged Policy

Workloads Page

The Workloads page displays each VEN's current state in the Policy Sync column. You can filter your workloads by this column to quickly determine which ones have staged OS-level firewall rules.

- **Active (Syncing):** The PCE is in the process of sending new policy to the VEN. Typically, this process takes only a few seconds.

  > **NOTE**
  >
  > Workloads configured for adaptive policy and static policy can appear in the active (syncing) state while the PCE is sending new policy.

- **Staged:** The VEN has received the latest OS-level firewall rules but has not applied them.
- **Active:** The VEN has received, applied, and confirmed all policies sent from the PCE. (Active workloads have a green dot icon.)

For more information about the VEN Policy Sync states, see "VEN Policy Sync" in VEN Installation and Upgrade Guide.

Workload Details

The Workload details page provides important information about when and how your workloads received staged policy.

- The General section indicates whether the workload is configured to use static policy (Policy Update Mode field) and displays the date and time that the VEN staged the policy (Last Policy Staged field).
- The VEN section includes the Policy Sync state, which can be active (syncing), staged, active, error, warning, and suspended.

  > **NOTE**
  >
  > These fields will not appear in the General or VEN sections when all your workloads are configured to use adaptive policy.

Apply Staged Policy

See Static Policy Prerequisites, Limitations, and Caveats [13] for information before you complete this task.

1. From the PCE web console menu, choose **Workloads**.

   The Workloads page appears.
2. (Optional) Use the Workload property filter in the following ways:
   - To find all your workloads that are configured to use static policy, choose **Policy Update Mode** > **Static Workloads**.
   - To find workloads that have staged policy that needs to be applied, choose **Policy Sync** > **Staged Workloads**.
3. To apply staged policy to specific workloads, select the workloads and choose **Apply Policy** > **Update Selected Workloads**.

NOTE

- Choosing **Update Selected Workloads** only applies staged policy. It does not provision pending policy changes for workloads that are configured to use adaptive policy even when you selected them.
- If you applied policy to a subset of workloads with staged policy, the remaining workloads will continue to use the older policy.
- The **Apply Policy** button is enabled only when you have workloads with staged policy waiting to be applied.

4. To apply policy to all workloads with staged policy, choose **Apply Policy** > **Update All Workloads**.

   NOTE

   If you filtered workloads by label and chose **Update All Workloads**, the PCE applies the staged updates to all the workloads matching that label scope and not just the workloads appearing in the PCE web console page.

   The Apply Policy dialog box appears displaying the number of workloads the staged policy will be applied to.
5. Click **OK**.

   The VEN applies the staged policy and displays the status of the update.

Security Policy Objects

This section describes the policy objects that you can use to write security policies.

Labels and Label Groups

The Illumio Core policy model is a label-based system, which means that the rules you write don't require the use of an IP address or subnet, like traditional firewall solutions. You control the range of your policy by using labels. This helps you categorize your workloads more quickly and makes it easier to set up your policy.

Label Types

Label	Description
Role Database	This label type allows you to describe the “role” (or function) of a workload. In a simple two-tier application consisting of a web server and a database server, there would be two roles: Web and Database. You can use the same role as many times as you want in other rulesets for different applications.
Application	This label type allows you describe the application that a workload supports. When two servers in a two tier application have a relationship with one another because one provides a service (like a database) to another, they likely constitute an application. If an organization has 100 applications, and each application has a separate web role and separate database role, the application role separates each one of the Web and Database role.
Environment Development	This label type allows you to describe a workload based upon its stage in the product development lifecycle, such as QA, staging and production.
Location Amazon	This label type allows you to describe a workload based upon its location. For example, Germany, US, Europe, Asia. Or, Rack #3, Rack #4, Rack #5; or datacenter AWS-east1, AWS-east2, and so on.
Flexible labels	You can define custom label types to reflect additional characteristics of the workloads in your installation. Create any label type that meets your organization's business needs. For example, you might want to label workloads according to their operating systems. The maximum number of labels is 20.

Additional Dimensions

A given workload cannot have more than one label per type. It’s possible to allow a workload that used a service or services or across boundaries to communicate; for example, if a server is playing multiple roles, such as a database server used by two different applications, Illumio recommends that you create different role labels for that workload.

System Default “All” for Labels

When you log into the PCE for the first time as the organization owner, the following default labels are provided:

Label	Description
Role	Web, Database, API, Mail, Single Node App, Load Balancer
Environment	Production, Stage, Dev, Test
Applications	None
Location	None

The built-in (default) Environment, Application, and Location labels are defined as “All,” which enables you to create broad policies to cover All Applications, All Environments, and All Locations.

To avoid confusing policy writers, Illumio recommends not creating labels named “All Applications,” “All Environments,” or “All Locations” (exactly as written in quotes).

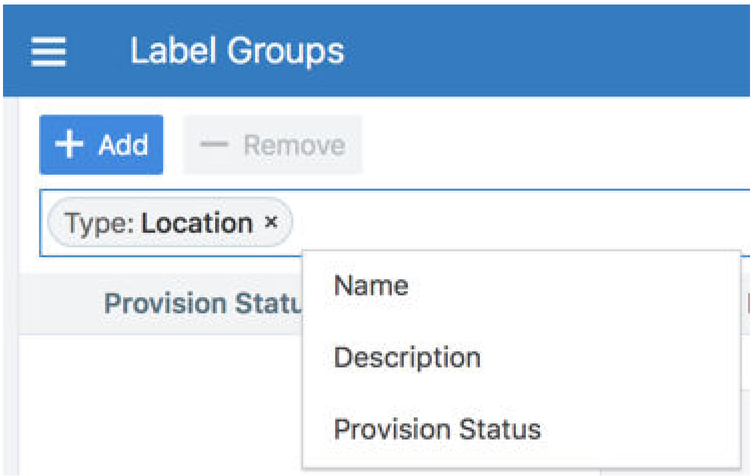
When you attempt to create labels of these types with the exact name as the system defaults, for example “All Applications,” an “HTTP 406 Not Acceptable” error will be displayed.

NOTE
You can modify or delete these default labels at any time.

Filtering Labels and Label Groups

To find the label or labels groups you are looking for, you can use the property filter at the top of the **Policy Objects** > **Labels** or **Label Groups** pages.

On the Labels page, you can filter by label type and exact label name. Similarly, you can filter by label name, description, and provision status on the Label Groups page. For example, if you want to only see Location labels, you can select **Type: Location** in the Label property filter.



Create a Label Type

Illumio Core provides the default label types Role, Application, Environment, and Location. You can define custom label types to reflect additional characteristics of the workloads in your installation. Create any label type that meets your organization's business needs. For example, you might want to label workloads according to their operating systems. The maximum number of labels is 20.

To create a new label type:

1. From the PCE web console menu, choose **Settings** > **Label Settings**.
2. On the Label Settings page, click **Add**.
3. Enter a unique Key. The PCE will use this key to identify the label internally. For example, OS.
4. Enter singular and plural versions of the Display Name (for example, Operating System and Operating Systems).
5. Choose an icon, and enter a one- or two-character unique initial to be displayed with the icon (such as OS).
6. Choose foreground and background colors to be used when the label is displayed.
7. Click **Save**.

The new label type will now appear in the web console UI wherever the default label types would appear, such as in the Type dropdown selector when you are creating a new label.

Create a Label

1. From the PCE web console menu, choose **Policy Objects** > **Labels**.
2. On the Labels page, click **Add**.
3. Enter a label name (such as, Web) and choose a label type (such as, Role).
4. Click **Save**.

You cannot create a label name that already exists, regardless of its alphabetic case. For example, you cannot create a new label named "WINDOWS" if the label name "Windows" already exists.

Label Workloads

You apply labels to workloads to identify their function or purpose in an application (Role label), the application they belong to (Application label), their network environment (Environment label), their location (Location label), and any custom purpose you have defined (flexible labels; for example, OS). After a workload is labeled, you can write rules using the labels you have applied to the workload.

After you Create a Label, you can label a workload in two ways:

- Automatically label the workloads when you pair them by adding labels in the pairing profile. (See "Pairing Profiles and Scripts" in VEN Installation and Upgrade Guide.
- Add labels to the workload on the Workload Summary page. In the PCE web console, select **Workloads and VENs > Workloads** from the left navigation menu. Select a workload, and in the details panel click **Edit** to select any or all of the label types to apply to the workload.

Edit Labels for Multiple Workloads

You can add, modify, or remove labels on multiple workloads. This approach saves time when you want to apply or remove the same label or set of labels to more than one workload at a time. In the Illumio Core 20.1.0 release and higher, if you want to delete a Label and it was in use by a Virtual Server, you can determine whether it was in use or not. On the Labels page, the "In use by" column includes Virtual Servers. The Labels' summary page also displays the "In Use By Virtual Servers Yes/No" field.

NOTE

Keep in mind that label changes do not require provisioning, so mass label changes can potentially have a major impact on your rulesets, rules, and overall security policy.

1. From the PCE web console menu, choose **Workloads and VENs > Workloads**.
2. From the left side of the Workloads list, select the workloads you want to change labels for.
3. From the top of the Workloads list, click **Edit Labels**.

   A dialog box appears asking if you are sure you want to edit labels for multiple workloads.
4. Click **OK**.
5. In the Edit Labels dialog box, you can add or remove labels assigned to the selected workloads. The top of the dialog indicates how many workloads will be affected by the label change. Depending on the assigned labels, you have three general options:
   - When the selected workloads share the exact same label of a specific type (for example, Role), you can change the current label by clicking the little **X** on the label to remove it. Then, you can type or select a new label assignment.
   - When the selected workloads have different labels of the same type, faded text in the Label field indicates that the workloads contain multiple labels of that type. You can click in the Label field and add a new label.
   - When you remove a label assignment, that label is removed from all selected workloads.

6. When you are finished, click **OK**.

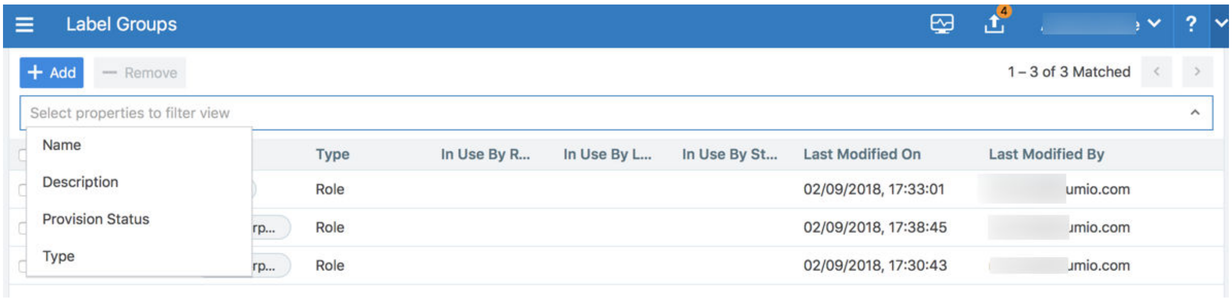
Label Groups

Label groups help you write your security policy more efficiently when you use the same labels repeatedly in rulesets. When you add those labels to a label group, the label group can be used in a rule or scope as a shortcut or an alias for multiple labels. The Label Groups list pages can contain up to 10,000 label groups and the individual Label Groups pages can contain up to 10,000 members. You can use filters to find labels or label groups.

For example, you have workloads residing in datacenters in Dallas, New York, and Washington and you want to apply a rule to all those workloads. Instead of using the labels for Dallas, New York, and Washington in three separate rules, you can define a Location label group named US, add those three location labels to the label group, and use the US label group.

Label groups are displayed as a list that includes the following details:

- Provision status
- Name of the label group
- Type (Role, Application, Environment, Location, or a custom-defined Flexible Label type)
- When it is currently in use by a ruleset, label group, and static policy
- Last modified date and time
- User who last modified the label group



	Type	In Use By R...	In Use By L...	In Use By St...	Last Modified On	Last Modified By
	Role				02/09/2018, 17:33:01	[redacted]umio.com
rp...	Role				02/09/2018, 17:38:45	[redacted]umio.com
rp...	Role				02/09/2018, 17:30:43	[redacted]umio.com

Policy Calculation Using Label Groups

Label groups can be nested, so it is important to understand how label groups can affect policy.

NOTE

You cannot assign a label group to a workload - only individual labels can be applied to workloads. Label groups can only be used in rulesets.

Create a Label Group

Create label groups when you want to combine several labels that share common characteristics into a single label category. After the labels are added to a Label Group, you can use the label group in a rule.

1. From the PCE web console menu, choose **Policy Objects** > **Label Groups**.
2. On the Label Groups page, click **Add**.
3. In the Add Label Group page, choose the label type and enter a name for the label. You cannot create a label group name that already exists, regardless of its alphabetic case. For example, you cannot create a new label group named "WINDOWS" if the label group name "Windows" already exists.
4. Click **Save**.
5. In the Members tab, enter a label name to find labels to add to the group, and then click **Add**. You can add as many labels (or label groups) of the same type to the group as desired.

You cannot create a label group name that already exists, regardless of its alphabetic case. For example, you cannot create a new label group named "WINDOWS" if the label group name "Windows" already exists.

Use a Label Group in a Scope

When you use a label group in a scope, the label group is expanded into multiple scopes. Cross-communication is not allowed.

For example, to create a scope that applies to all environments other than production, first create a Non-Prod label group which consists of the labels for the Dev, QA, and Stage environments. The following ruleset (scope + rule):

Scope:

- App: HRM
- Env: Non-prod
- Loc: US

Rule:

- Providers: DB
- Services: MySQL
- Consumers: DB

This means “workloads in all Non-Prod environments (Dev, QA, and Stage) can communicate within their environments with the DB using MySQL” and would allow the following communication:

- HRM | Dev | US | DB ← HRM | Dev | US | DB

The following communication would not be allowed, since the Environment labels are different and cross-communication is not allowed:

- HRM | Dev | US | DB ← HRM | QA | US | DB
  and
- HRM | Dev | US | DB ← HRM | Stage | US | DB

Use a Label Group in a Rule

When you use a label group in a rule, the label group is expanded into multiple rules. Cross-communication is allowed.

For example, the Non-Prod label group is used again here, but in the rule and not the scope, which allows cross-communication. The following ruleset (scope + rule):

Scope:

- App: HRM
- Env: All
- Loc: US

Rule:

- Providers: Non-prod DB
- Services: MySQL
- Consumers: Non-prod DB

This means “allow MySQL from Non-Prod DB to Non-Prod DB for the HRM application in All environments located in the US" and would allow the following communication:

- HRM | Dev | US | DB ← HRM | Dev | US | DB
- HRM | Dev | US | DB ← HRM | QA | US | DB
- HRM | Dev | US | DB ← HRM | Stage | US | DB
- HRM | QA | US | DB ← HRM | Dev | US | DB
- HRM | QA | US | DB ← HRM | Stage | US | DB

Services

When workloads are paired with the PCE, the VEN discovers all running processes and services on a workload and makes those services available for use when writing rules. You can see those discovered services when you view the Processes tab on the Workload's details page.

However, you can also create your own to services to specify the service type, as well as the ports and protocols the services use to communicate.

> **NOTE**
>
> Service names can be unrestricted, for example, `sc.exe qsidtypemyservice`. You can write rules with unrestricted service IDs (SIDs). When there is a restricted SID, you should write rules without the SID. Including the service with a restricted SID type causes the traffic to be dropped and might cause traffic between the Reported view and Draft view to be reported inaccurately.

Service Types

When you create a service, you can choose one of two general types:

- **All Operating Systems: Port-Based**: This type of service can be used for writing rules for any workloads, and is defined by specifying a port and protocol, a port range, or in some cases, only the protocol. For example: `80 TCP`, `1000-2000 TCP`, `500 UDP`. For GRE or IPIP, you only need to specify the protocol.
- **Windows Inbound: Process/Service-Based**: This type of service can be used for writing rules for Windows Workloads only and is defined by specifying one of the following combinations or scenarios.
  - **Port and/or Protocol, Windows Process, and Windows Service**

    `443 TCP c:\windows\myprocess.exe myservice`
  - **Port and/or Protocol and Windows Process**

    `443 TCP c:\windows\myprocess.exe`
  - **Port and/or Protocol and Windows Service**

    `443 TCP myservice`
  - **Windows Port and/or Protocol**

    `514 UDP`
  - **Windows Process**

    `c:\windows\myprocess.exe`
  - **Windows Service**

    `myservice`

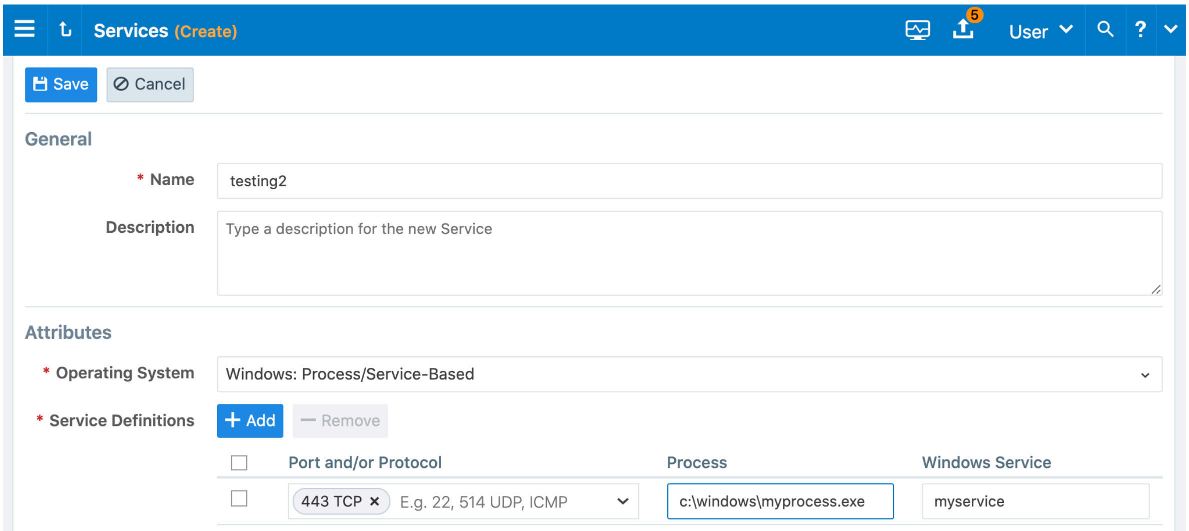
Windows Process-based Rules

Rules to Allow System Created Processes

Rules can be created to allow all system-initiated processes in Windows. This approach allows all traffic related to drivers and other operating system modules. You can create a service of type Windows—process or service-based—with word “system” (case-insensitive) in the Port/Protocol text input field. Once you create this service, you can use it in rules.

To create a service that allows all system-initiated processes:

1. From the PCE web console menu, choose **Policy Objects** > **Services**.



General

* Name: testing2

Description: Type a description for the new Service

Attributes

* Operating System: Windows: Process/Service-Based

* Service Definitions

□	Port and/or Protocol	Process	Windows Service
□	443 TCP × E.g. 22, 514 UDP, ICMP	c:\windows\myprocess.exe	myservice

2. Click **Add**.
3. Enter a name and definition for the service you are adding.
   - To add a service definition, from the Operating System drop-down, select either **All Operating Systems: Port Based** or **Windows Inbound: Process/Service-Based**:
     - If you select **All Operating Systems: Port-Based**, you can only indicate a port, a protocol, or both, separating the port and protocol with a space. For example, port `512 TCP`.
     - If you select **Windows Inbound: Process/Service-Based**, from the Port and/or Protocol drop-down, specify a port/protocol, a process or service, or a port/protocol with a process or service, separating the port and protocol with a space. For example, port `512 TCP`, process `C:\windows\myprocess.exe`, and Windows service, `myprocess`.
   - To remove a service definition, from the Operating System drop-down, select either **All Operating Systems: Port-Based** or **Windows Inbound: Process/Service-Based**:
     a. Click the check box next to the Port and/or Protocol. You may select a single or multiple entries.
     b. Click **Remove**.
4. Click **Save**.

Service Using Windows Environmental Variables

The Windows environmental variable can be used to specify the full path. This can be done by creating a Service of type Windows: Process or Service based with the environment variables in the Port Protocol text input field

NOTE

Currently, only the Windows System variable is supported for use in the process path. For example `%systemroot%\myprocess.exe`

Rules can be created to allow all system-initiated processes in Windows. This will allow all traffic related to drivers and other operating system modules. This can be done by placing the word **system** (case-insensitive) in the text input field.

To create a service that uses Windows environmental variables:

1. From the PCE web console menu, choose **Policy Objects** > **Services**.
2. Click **Add**.
3. In the Name field, enter `system` (case-insensitive).
4. From the Operating System drop-down list, select **Windows Inbound: Process/Service-Based**.
5. In Port and/or Protocol, specify the port/protocol, separating the port and protocol with a space. For example:

   ```
   %systemroot%\myprocess.exe
   ```
6. Click **Save**.

IGMP Services

IGMP can be added as a service and used in rules to write granular inbound or outbound policy for IGMP, which is typically used for multicast. No range is required for IGMP.

You can export IGMP traffic in JSON, CEF, or LEEF format.

You can also create and update services that use the IGMP protocol by using the Illumio Core REST API. See "Services" in REST API Developer Guide for information about using the REST API to create services.

Caveats

- When IGMP service is used in a rule, all IGMP types are allowed; however, granular control and specific multicast addresses are not supported.
- IGMP is not supported in the Illumination map.

ICMP Services

ICMP can be added as a service and used in rules to write granular inbound or outbound policy for ICMP. ICMP is usually used for traceroute and path MTU discovery.

You can export ICMP traffic in JSON, CEF, or LEEF format.

NOTE

When these services are blocked, they do not appear in the Blocked Traffic list and the connection is dropped silently.

ICMP types/codes (such as 0 ICMP or 3/2 ICMP) are supported. The ICMP range is from 0 to 255.

The following table describes the correct format for each type of supported ICMP rule:

Example	Format	Meaning in Rule
ICMP (on a new line)	Protocol name only	Allow all ICMP traffic
3 ICMP	Type = 3 Protocol name = ICMP	All ICMP traffic of type 3 (Destination Unreachable) is allowed regardless of the code used in the rule.

3/6 ICMP	Type = 3
	Code = 6
	Protocol name = ICMP
		Only type 3 and code 6 ICMP traffic is allowed.

3 ICMP, 6 ICMP	Type 3 of ICMP, Type 6 of ICMP	Only type 3 and type 6 ICMP traffic is allowed regardless of the code used in the rule.
	TIP Use this format to add as many types as you need.	

ICMP traffic is displayed in Explorer, similar to TCP/UDP traffic. From the 19.1.0 release on, you can see ICMP traffic flows in Illumination and the App Groups Map. You can choose to conceal them by using the filter in Illumination.

You can also create and update services that use the ICMP protocol using the Illumio Core REST API.

Caveats

- ICMP is not supported for virtual services.
- When an ICMP service is used in a rule, all ICMP types are allowed; however, granular control and specific multicast addresses are not supported.
- When you enable IPv6 on Windows VENs, IPv6 systems rules are not propagated to those VENs. You need to write security rules to ensure robust IPv6 functionality. The ICMPv6 types that are required in those rules are as follows:

ICMPv6 Message	ICMPv6 Type
Router Solicitation Message	133
Router Advertisement Message	134
Neighbor Solicitation Message	135
Neighbor Advertisement Message	136

Upgrading from Illumio Core Version 17.1

If the ICMP Echo option was allowed in your PCE prior to upgrade, the PCE automatically adds and provisions a rule during the upgrade to allow ICMP Echo on all workloads. During the upgrade, the PCE checks the current organization settings and takes the following actions:

1. Creates a new service named “ICMP.”
2. Creates a new rule in the default ruleset to allow outbound ICMP for all workloads.
3. When the ICMP Echo setting was enabled, creates a new service named “ICMP ECHO” to allow echo requests and a new rule to allow all “ICMP ECHO” on all workloads.
4. Adds the rules to the active version of the policy.

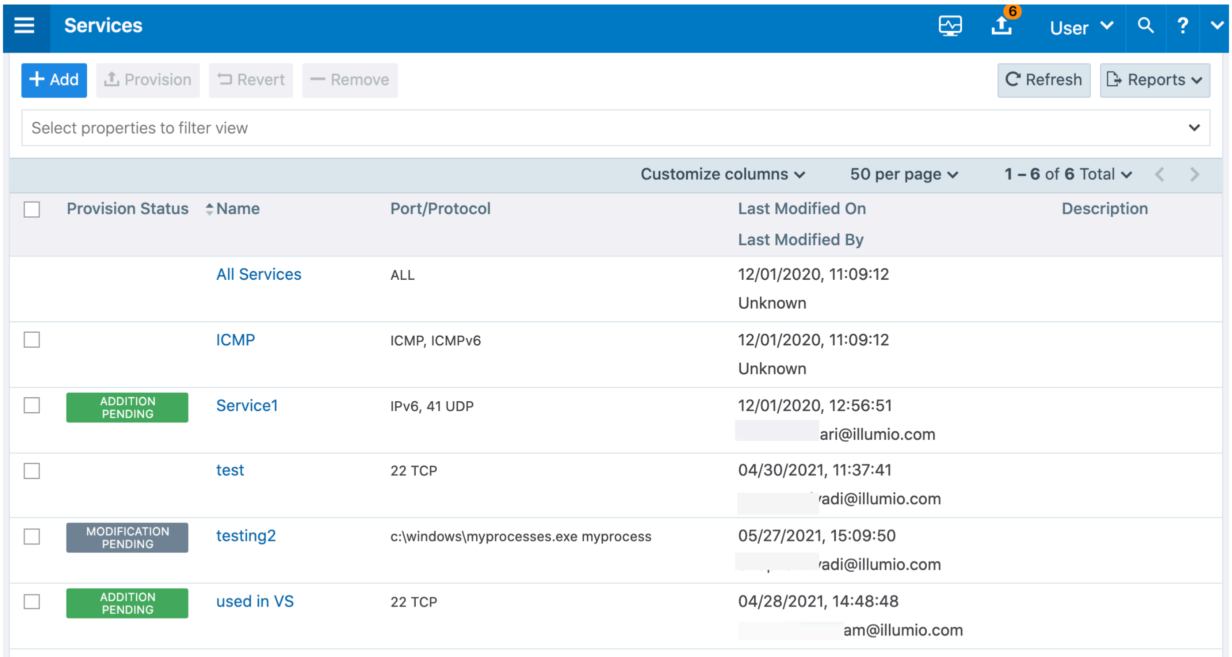
View or Edit a Service

To view or edit an existing service:

1. From the PCE web console menu, choose **Policy Objects** > **Services**.
2. Click the name of the desired service. You can filter the list by various attributes. See Filter the Services List [29] for details.
3. On the details page for the service, you can view information about the service, including its general data, attributes , and, if appropriate, the external data for the service and ransomware protection details.
4. Click **Edit** to change selected portions of the service definition. Some portions might not be editable.
   - To remove a service definition, from the Operating System drop-down, select either **All Operating Systems: Port-Based** or **Windows Inbound: Process/Service-Based**.
   - To remove a specific service definition, click the check box next to the Port and/or Protocol. You may select a single or multiple entries.
5. Click **Remove**.

Filter the Services List

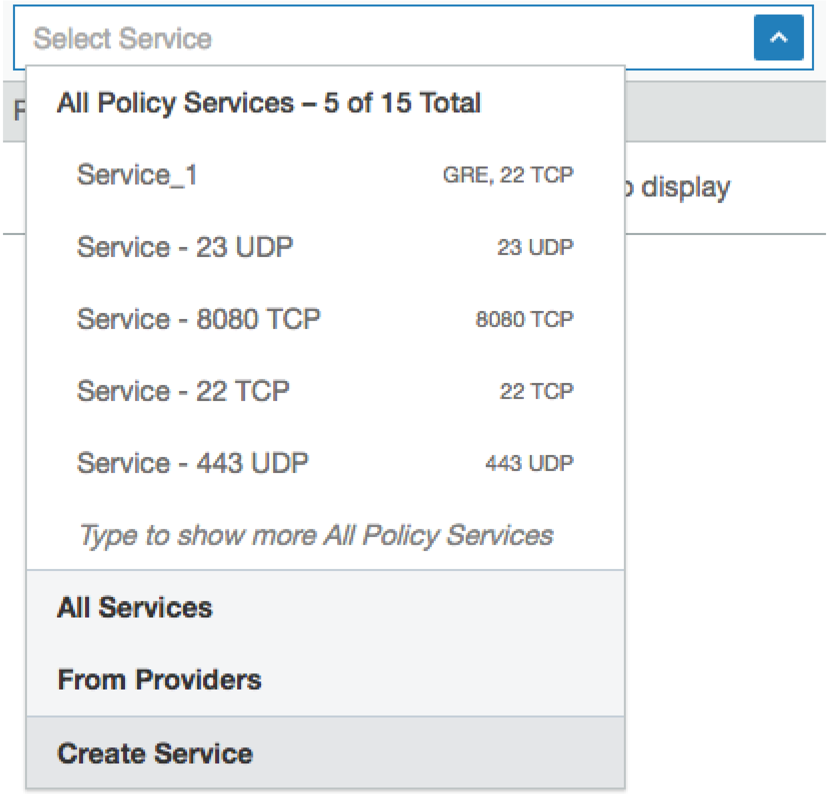
You can filter the Services list using the property filter at the top of the list. You can filter the list by entering a service name, description, port, protocol, and provision status (draft or active).



□	Provision Status	Name	Port/Protocol	Last Modified On Last Modified By	Description
		All Services	ALL	12/01/2020, 11:09:12 Unknown	
□		ICMP	ICMP, ICMPv6	12/01/2020, 11:09:12 Unknown	
□	ADDITION PENDING	Service1	IPv6, 41 UDP	12/01/2020, 12:56:51 [redacted]ari@illumio.com	
□		test	22 TCP	04/30/2021, 11:37:41 [redacted]adi@illumio.com	
□	MODIFICATION PENDING	testing2	c:\windows\myprocesses.exe myprocess	05/27/2021, 15:09:50 [redacted]adi@illumio.com	
□	ADDITION PENDING	used in VS	22 TCP	04/28/2021, 14:48:48 [redacted]am@illumio.com	

Services in a Rule

When you create a rule, you can select a service to indicate the allowed communication between workloads and other entities.



Create a Service

When you create a service, that service becomes available to use in a rule.

For a list of the types of services you can create, see Service Types [25].

To create a service from the Services page:

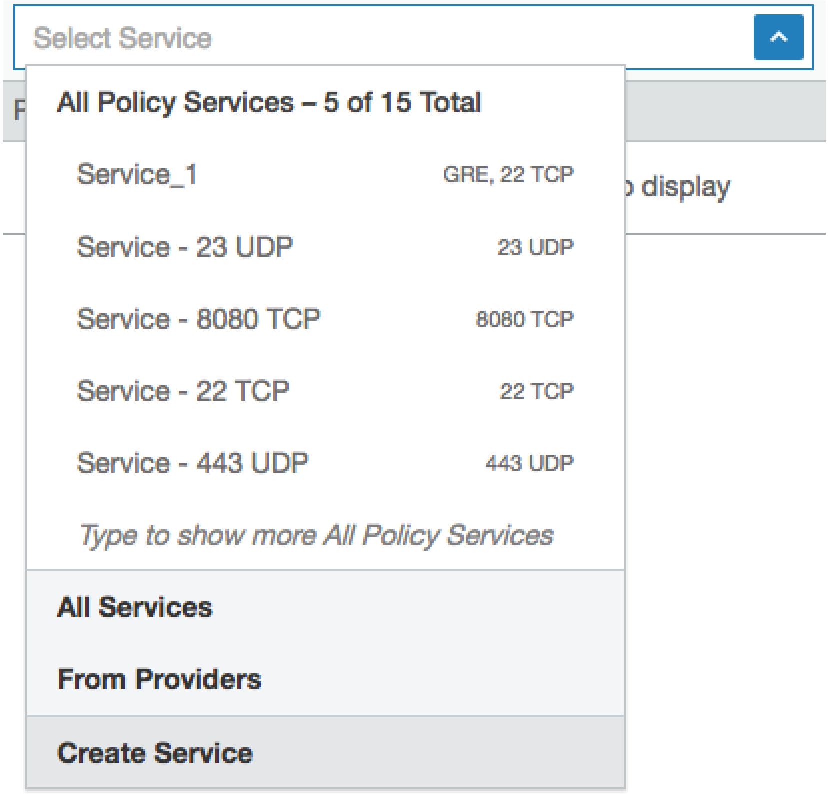
1. From the PCE web console menu, choose **Policy Objects** > **Services**.
2. Click **Add**.
3. Enter the service a name and description (optional).
4. Under Attributes, choose whether you want to create a port-based or Windows service-based service.
5. In the Port and/or Protocol section, click **Add** and enter the ports, using a space to separate them from the protocol. If you want to enter a range, separate the port numbers by a hyphen. You can also copy and paste lists of services here from another source.
6. When the service uses any UDP ports, enter them as well.
7. Click **Save**.

To create a service from the Ruleset page:

To make rule writing easier, you can create a new service in a ruleset as you are writing rules.

NOTE
The service is not associated with the ruleset.

1. Create an extra-scope or an intra-scope rule.
2. In the Select Service field, choose **Create Service** at the end of the list.



Virtual Services

Virtual services (previously known as bound services) allow you to label processes or services on workloads. Virtual services can either be used directly in rules or the labels applied to virtual services can be used to write rules.

Overview of Virtual Services

A virtual service can be used in the following scenarios:

- **Apply rules to a single service:** Represents a service or process on a workload using a name or label. This approach allows you to write policy to allow other entities to communicate only with that service. The policy does not need to change when the service is moved to a different workload or a new set of workloads. Only the workload bindings on the virtual service need to be changed. The PCE dynamically calculates the required rules on the updated workloads to allow this service.
- **Apply rules to multiple services (on same workload):** Represents each service or process running on a workload with a different set of labels. You can write rules to allow other entities to communicate only with that service. The policy does not need to change when this service is moved to a different workload or a new set of workloads. Only the workload bindings on the virtual service need to be changed. The PCE dynamically calculates the required rules on the updated workloads to allow the service.

From the 18.3.1 release on, Illumination, Policy Generator, and Explorer support virtual services. You have to assign labels to a virtual service in order to write label-based rules. A virtual service does not have an enforcement, so you need to refer to the enforcement of its bound workloads.

Virtual services are provisionable objects, which means they must be created and provisioned before they can be applied to workloads. However, the bindings are not provisionable objects, so the bindings can be changed without having to provision the changes. Additionally, port overrides have been moved from the virtual service to the workload binding. See Provisioning [108] and Bind a Virtual Service to a Workload [37]for more information.

How Virtual Services Work

For example, if a single workload is running both an Apache Tomcat and Apache HTTP server, supporting an HRM and ERP application respectively, you can create a virtual service for each service and then label one service as belonging to an HRM application and one belonging to an ERP application. You can then write a set of label-based rules that apply only to the Apache Tomcat process serving the HRM application, effectively isolating it from the ERP application.

In the following example, two different virtual services are created: one for an HRM database and one for an ERP database. The following configurations would allow the web to communicate with the database for each application (HRM or ERP) in the specified environment (Prod or QA) in the specified location (US or EU):

Virtual Service - HRM

- **Name:** HRM-DB
- **Labels:** DB | HRM | Prod | US
- **Service:** MySQL
- **Bound to:** Workload - Database 1, Port Override: 3308
- **Scope:** HRM | Prod | US
- **Rule:** DB ← From Providers ← Web

Virtual Service - ERP

- **Name:** ERP-DB
- **Labels:** DB | ERP | QA | EU
- **Service:** MySQL
- **Bound to:** Workload - Database 1, Port Override: 3309
- **Scope:** ERP | QA | EU
- **Rule:** DB ← From Providers ← Web

Virtual Services in Rule Writing

When you create rules for virtual services using the Policy Generator or from Illumination, you need to add the “Uses Virtual Services only” option or “Uses Virtual Services and Workloads” option in the Providers or Consumers field of the generated rules. You can configure virtual services using port or port range.

NOTE

Custom iptables rules and SecureConnect are not supported with virtual services.

When you write a rule in a ruleset, you need to specify the following values:

- A service
- Providers of the service
- Consumers of the service

For example:

Web provides Apache Tomcat service to All Workloads

When you write rules using virtual services, you do not need to select a service in the rule, because the virtual service is both the service and the provider of the service.

For example:

Virtual Service Apache Tomcat is provided to All Workloads

When you want to treat the providers as a virtual service, select “Uses Virtual Services” or “Uses Virtual Services and Workloads” from the Providers drop-down list as the service.

When you want to write a rule applicable for all virtual services labeled “Database,” you would write it the same way and select “Uses Virtual Services” or “Uses Virtual Services and Workloads” as the providing service.

NOTE

Workloads labeled “Database" are not be impacted by the above rule. To include them, you need an additional rule listing the specific service applicable.

When you want to use a virtual service as a provider, select “Uses Virtual Services” or “Uses Virtual Services and Workloads” from the Provider drop-down list.

When you select a specific service, then the rule applies only to workloads that have the selected label.

For example, for the following virtual service rule:

- DB | MySQL | Web

The rule is only applied to workloads that use the DB label.

However, when the virtual service rule is the following type of rule:

- DB | Uses virtual services or uses virtual services and workloads | Web

The inbound side of rule is applied to all workloads bound to the virtual service using the DB label.

Advanced Configuration for Virtual Services

You have two advanced configuration options to consider when configuring a virtual service:

- **Apply To: Host Network or Internal Bridge Network:** This optional setting allows you to determine if the rules associated with the virtual service are applied over an internal bridged network or the host network. If you choose Internal Bridge Network, the rules associated with the virtual service are programmed into the FORWARD chain on Linux iptables (rules to internal bridge are ignored by Windows in this current implementation). Or, you can specify that a virtual service's rules are applied over the host network, programmed into the INPUT/OUTPUT chains in Linux iptables. Stateless rules are not supported when associated with FORWARD chain; instead, stateful rules are programmed.
- **Optional Configuration: IP Overrides:** Allows you to specify IP addresses or ranges (CIDR blocks) to be used for programming the rules associated with the virtual service instead of using the IP address of the bound workload. When IP overrides are specified on a virtual service and the virtual service is used in a rule, the IP addresses programmed on other hosts communicating with the virtual service are the IP addresses and subnets specified in the IP overrides rather than the IP addresses of the workloads bound to the virtual service.

A combination of stateless rules and forwarding rules on the same host, port, and consumer is not supported. For example, when a workload has a service running on a port with stateless rules, a forwarding rule to allow traffic to a container running on the same host using the same port does not work when the consumer is the same.

Host-Only Network

Example of a virtual service rule using host network (default):

Providers	Services	Consumers
Virtual Service X	From Providers	Workload B
Virtual Service X is bound to workload A, with service 80 TCP		Workload B has IP address 192.168.0.200
Workload A has IP address 192.168.0.100		

This rule programs the following security policy:

- An inbound rule on workload A for 80 TCP with source address 192.168.0.200
- An outbound rule on workload B for 80 TCP with destination address 192.168.0.100

When you add an IP override, the subnet 172.16.0.0/16 on the BPS, this rule programs the following security policy:

- An inbound rule on workload A for 80 TCP with source address 192.168.0.200
- An outbound rule on workload B for 80 TCP with destination subnet 172.16.0.0/16

The IP override dictates that for device that is allowed to communicate with this virtual service, use the addresses/subnets specified in the IP overrides.

Internal Bridge Network

When you remove the IP override and change to Internal Bridge Network, this rules programs the following security policy:

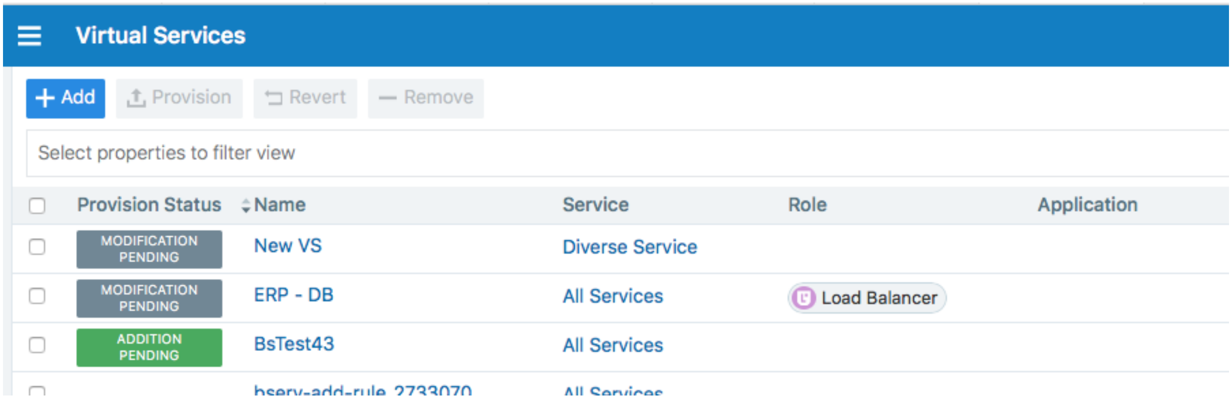
- An inbound rule on workload A for 80 TCP with source address 192.168.0.200 on the FORWARD chain of the firewall

  This means that the rule applies to traffic destined for somewhere other than the host network namespace that hits the host firewall.
- An outbound rule on workload B for 80 TCP with destination address 192.168.0.100.

Filter the Virtual Services List

You can filter the Virtual Services list by using the properties filter at the top of the list. For example, you can filter and search by label. In the case of DNS-based rules, you can also filter and search by the following objects:

- Service or port
- IP entry or DNS entry (for example, search for *.google.com)



□	Provision Status	Name	Service	Role	Application
□	MODIFICATION PENDING	New VS	Diverse Service		
□	MODIFICATION PENDING	ERP - DB	All Services	Load Balancer	
□	ADDITION PENDING	BsTest43	All Services		
□		bserv-add-rule 2733070	All Services		

Add a Virtual Service

When adding a virtual service, you need to give it a name, select the service, and apply labels to it.

Then, you need to bind it to the workload where the service is running. This binding instructs the PCE where to enforce the rules for this virtual service.

When you configure two rules with the same service ports and one of the rules is stateless and the other stateful, the stateless rule takes precedence.

NOTE

A virtual service must be provisioned before binding it to a workload. See Provisioning [108] for more information.

1. From the PCE web console menu, choose **Policy Objects** > **Virtual Services**.
2. Click **Add**.

   The Add Virtual Service page appears.
3. Enter a name for the service.
4. From the Service drop-down list, select the service or enter a service name.
5. Select a Role, Application, Environment, and Location label.
6. (Optional) Choose whether you want the rules associated with the virtual service to be applied over an internal bridged network instead of a host network (default behavior).
   - **Internal Bridge Network:** The rules associated with the virtual service are programmed into the FORWARD chain on Linux iptables.
   - **Host only network:** The rules associated with the virtual service are applied over the host network, programmed into the INPUT/OUTPUT chains in Linux iptables.
7. (Optional) In the IP addresses field, you can override the IP address of the workload bound to the virtual service and specify different IP addresses or CIDR block that will be used for programming the virtual service rules.
8. Click **Save**.

   The virtual service is created and labeled; next, provision it and bind it to a workload. See Provisioning [108] for more information.

NOTE

SecureConnect [125] is not supported for virtual services.

Bind a Virtual Service to a Workload

When you bind a virtual service to a workload, it enables the PCE to program rules to the VEN on the workload the virtual service is bound to.

If the workload binding ever changes, the rules of your ruleset are dynamically recalculated for the new binding.

NOTE

Before binding a virtual service to a workload, the virtual service must be provisioned. See Provisioning [108] for more information.

1. From the PCE web console menu, choose **Policy Objects**, > **Virtual Services**.
2. Select the virtual service you want to bind to a workload.

The Virtual Services details page appears.

3. Click the **Workloads** tab.
4. Click **Bind**.
5. In the Workloads drop-down list, select the workload to which you want to bind this virtual service.
6. To allow this virtual service to use a different port than the one specified, select the Override ports checkbox.

   > **NOTE**
   > When you select **All Services** as the service for the virtual service, you cannot enable port overrides on the workload bindings.

7. In the Ports/Protocols section, enter the TCP and UDP ports for this virtual service to use.
8. Click **Save**.

IP Lists

IP lists allow you to define allowlists of trusted IP address, IP address ranges, or CIDR blocks that you want to allow into your datacenter and to be able to access workloads and applications in your network.

Overview of IP Lists

After you define an IP list, you can use it in rulesets to create rules for workload traffic flows. When you provision the rulesets, the workload only allows IP addresses in the IP list to access workload services.

The default IP list “Any” represents all IPv6 addresses as well as all IPv4 addresses. Rules that use IP lists are programmed on one side of the connection only. IP lists can be used as a provider or a consumer.

> **NOTE**
> To allow outbound access to IP lists, Illumio recommends using an intra-scope rule to prevent application of the rule to a broader set of workloads than intended.

Example of IP List Usage

For example, the following ruleset (scope + rules):

	App	Env	Loc
Scope	**HRM**	**Prod**	**US**
	Providers	**Services**	**Consumers**
Rule	DB	SSH	Corp-HQ

Means “allow SSH from Corp-HQ to the database.”

This ruleset:

	App	Env	Loc
Scope	**All**	**Prod**	**All**
	Providers	**Services**	**Consumers**
Rule	Corp-HQ	SSH	DB

Means “allow SSH from the database to Corp-HQ.”

This ruleset:

	App	Env	Loc
Scope	**All**	**Prod**	**All**
	Providers	**Services**	**Consumers**
Rule	Any	Any	Any

Means “do not apply Any IP list to anything.”

Create an IP List

1. From the PCE web console menu, choose **Policy Objects** > **IP Lists**.
2. Click **Add**.
3. Enter a name for the IP list.
4. Add IP addresses, IP address ranges, or CIDR blocks to define the list.

> **TIP**
>
> You can copy and paste lists of IP addresses from other sources.

5. Click **Save**.

IP List Exclusions

In IP lists, you can exclude certain IP addresses or subnets from a broader IP subnet.

For example, you might want to exclude a list of IP addresses within an IP range that should not access certain workloads. Or, you might want to open up a set of workloads to any IP address (0.0.0.0/0 and ::/0), but exclude a set of IP addresses that keep attempting unauthorized access to your workloads.

> **NOTE**
> Any (0.0.0.0/0) refers to IP addresses not associated with workloads while "All workloads" refers to workloads within a scope.

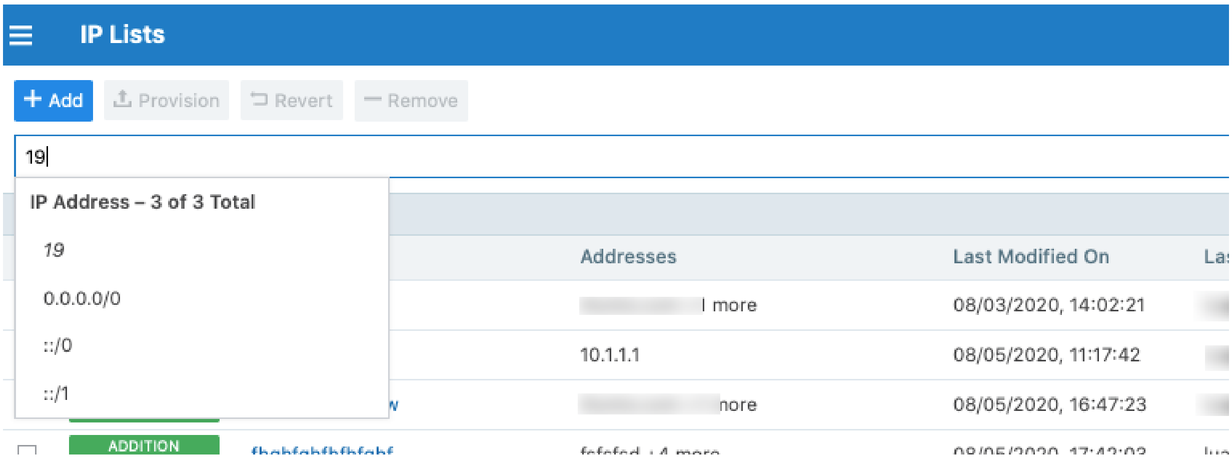
When you use an IP list with exclusions in a rule, any IP addresses that are marked as exclusions are not allowed, while all the others in the IP list are allowed.

To create IP list exclusions:

- To add an IP address or subnet exclusion, use an exclamation point followed by the IP address, CIDR block or IP range. The excluded IP addresses must be within the included IP range.
  For example, you added 192.16.0.0/12 as an allowed IP address and you want to exclude an IP address from this CIDR block, enter the following value:
  `!192.31.43.0-192.31.43.100`
- To add a CIDR block but exclude a portion of the CIDR block, enter the following values:
  `10.0.0.0/8 !10.1.0.0/24`
  In this example, the first block would be included and the second block would be excluded.

Filter IP Lists

You can filter the IP list page using the property filter at the top of the list. You can filter list by entering an IP list name, description, IP address, FQDN, and provision status (draft or active).



Adaptive User Segmentation

Illumio's Adaptive User Segmentation (AUS) allows you to leverage Microsoft Active Directory User Groups to control access to computing resources in your organization. With this feature, you can create user groups in the PCE that map directly to your Active Directory Groups.

Overview of Adaptive User Segmentation

You can then write rules with these groups so that you can control outbound access on specific workloads—such as a VDI desktop—based on the group membership of the user logged in to that workload.

For example, you might want to allow only employees in the Sales user group to access the ERP application, but not users in HR. You might want to allow HR users to only access HR applications, but not all internal resources.

If you have a Windows workload that controls access to other resources in your network, such as a VDI desktop that has the VEN installed on it, you can add both the VDI desktop workload and Active Directory User Groups to the rule. Writing this type of rule allows user access only to the resources that are explicitly allowed by the rules.

This type of rule is represented by an icon, where the VDI desktop and AD User Group are added as the consumers of a ruleset, and entities that these user groups are allowed to access are added as providers.

Add Active Directory User Groups

IMPORTANT

Adaptive User Segmentation rules are only supported for Active Directory (Windows domain) user accounts.

1. From the PCE web console menu, choose **Policy Objects** > **User Groups**.
2. In the User Groups page, click **Add**.
3. In the Add User Group page, enter a name, system identifier (SID), and description for the Active Directory Group.
4. Click **Save**.

   The new Active Directory Group appears in the User Groups list. You can now use the user group in a ruleset to control access to specific workloads.

NOTE

A maximum of 100 User Groups can be displayed.

User Group-Based Rules for AUS

1. From the PCE web console menu, choose **Rulesets and Rules > Rulesets**.
2. In the Rulesets list, click **Add**.
3. Enter a name for the ruleset.
4. Select an Application, Environment, and Location label to define the ruleset scope.
5. Click **Save**.

   In the Rules section, you can start writing identity-based rules.
6. If necessary, expand the *Intra-Scope Rule* section.
7. In the Consumers drop-down list, select the user group that you want to provide access to the other workload.
8. From the Providers drop-down list, select the workloads or labels that you want to provide access to by a user group.
9. In the Services drop-down list, select the service that you want the user groups to be able to access on the providing workloads.
10. Click the **Save** icon at the end of the row.
11. To add additional rules to the ruleset, Click the **Add** (+) icon.

To enact these changes on the workloads this ruleset affects, provision your changes.

Export Reports

Using the Export Reports feature, you can download PCE objects in JSON and CSV formats. These reports are very useful when you want to share the data with application owners, managers, executives, or auditors who do not have access to the PCE.

Overview of Export Reports

CSV is the most common and popular format because you can import it into other tools like CMDBs. You can export the following objects into an export report:

- Workloads
- Rulesets
- IP lists
- Pairing profiles
- Services
- Labels
- Label groups
- Virtual services
- Virtual servers

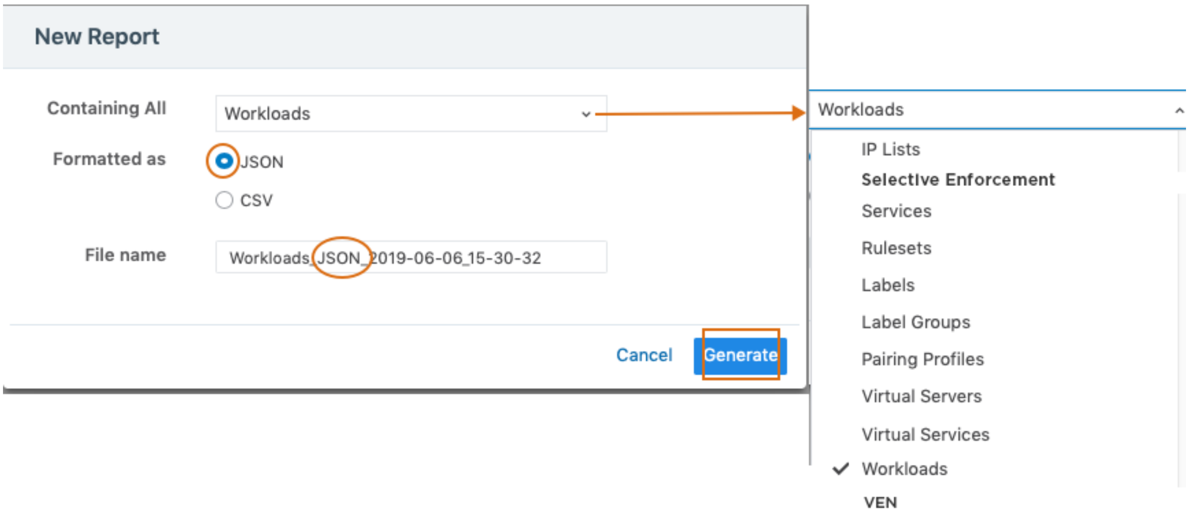
Generate an Export Report

1. From the PCE web console menu, choose **Troubleshooting** > **Export Reports**.
2. Click **New Report**.
3. From the Containing All drop-down list, select the object for which you want to generate the report.

NOTE

Starting from Release 23.4, when you export services to a CSV file, it contains three new columns for ransomware data: ransomware_category, ransomware_severity, and ransomware_os_platform.

4. Select the format, JSON or CSV.



New Report

Containing All: Workloads

Formatted as: ● JSON ○ CSV

File name: Workloads_JSON_2019-06-06_15-30-32

5. Click **Generate**.

Workloads

This section describes workload attributes, it's enforcements, and how to create managed and unmanaged workloads.

Workloads have the following attributes:

- Workload enforcement and visibility state
- Connectivity and policy sync state
- Workload labels
- Attributes

Workloads in the PCE

This section describes how to manage workload by using the Workload pages in the PCE web console.

Overview of Workload Attributes

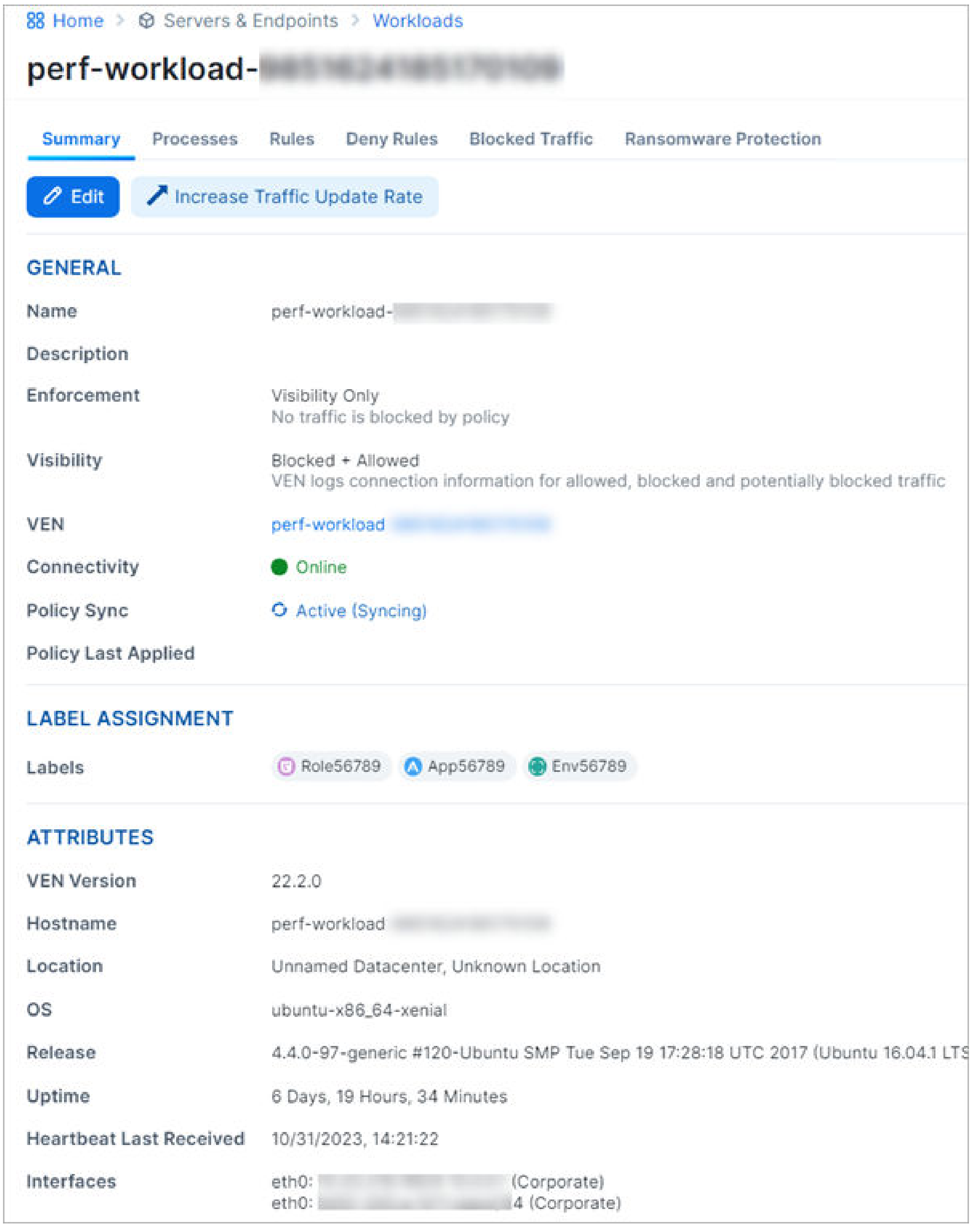
Workloads have the following attributes:

- Workload enforcement and visibility state
- Connectivity and policy sync state
- Workload labels
- Attributes

Workload Summary

The workload summary displays information about the workload, including the user-specified attributes at the time of pairing and information that the Illumio Core has automatically detected about the workload, specifically:

- The name of the workload
- A description (if provided)
- The Workload Enforcement States [118]
- The visibility the VEN uses
- The dates when the policy was revised and last applied
- The workload's VEN connectivity status; see "VEN-to-PCE Communication" in VEN Administration Guide.
- The workload's VEN policy sync status; see "VEN Policy Sync" in VEN Administration Guide
- Any labels applied to the workload
- Workload system attributes (such as VEN version number, hostname, and uptime)



perf-workload-[redacted]

GENERAL

Name	perf-workload-[redacted]
Description	
Enforcement	Visibility Only No traffic is blocked by policy
Visibility	Blocked + Allowed VEN logs connection information for allowed, blocked and potentially blocked traffic
VEN	perf-workload [redacted]
Connectivity	● Online
Policy Sync	Active (Syncing)
Policy Last Applied	

LABEL ASSIGNMENT

Labels	Role56789 App56789 Env56789

ATTRIBUTES

VEN Version	22.2.0
Hostname	perf-workload [redacted]
Location	Unnamed Datacenter, Unknown Location
OS	ubuntu-x86_64-xenial
Release	4.4.0-97-generic #120-Ubuntu SMP Tue Sep 19 17:28:18 UTC 2017 (Ubuntu 16.04.1 LTS
Uptime	6 Days, 19 Hours, 34 Minutes
Heartbeat Last Received	10/31/2023, 14:21:22
Interfaces	eth0: [redacted] (Corporate) eth0: [redacted]4 (Corporate)

Workload Enforcement States

Policy state determines how the rules affect a workload's network communication. The Illumio Core includes four policy states for workloads. The Policy State column is not displayed on the workload list page if a workload is unmanaged.

NOTE

The PCE representation of the enforcement state is the desired state to be applied on the next policy update. If there is an issue applying the enforcement state, a Policy Sync error will be shown for the workload.

Idle

The Idle state is used to install and activate VENs on workloads without changing the workload's firewalls. In the Idle state, the VEN on the workload does not take control of the workload’s host firewall but uses workload network analysis to provide the PCE relevant details about the workload, such as the workload's network interface, operating system, and traffic flows. This information is captured in the following ways and intervals:

- Traffic flows: a snapshot is taken every 10 minutes.
- Operating system: included in the Compatibility Report every four hours.
- Workload network interface: reported to the PCE anytime it changes.

A pairing profile can be used to pair workloads in the idle state.

NOTE

SecureConnect (IPv6 compatibility) is not supported on workloads in the Idle state. When you activate SecureConnect for a rule that applies to workloads in both Idle and Non-idle policy states, the traffic between these workloads can be impacted.

Visibility Only

In the Visibility Only state, the VEN inspects all open ports on a workload and reports traffic flow between it and other workloads to the PCE. In this state, the PCE displays the traffic flow to and from the workload, providing insight into the data center and its applications. No traffic is blocked in this state. This state is useful when firewall policies are not yet known. This state can be used to discover the application traffic flows in the organization and then generate a security policy that governs required communication.

Selective Enforcement

Segmentation rules are enforced only for selected inbound services when a workload is within the scope of a Selective Enforcement Rule.

Full Enforcement

Segmentation Rules are enforced for all inbound and outbound services. Traffic that is not allowed by a Segmentation Rule is blocked.

Visibility Level

You can choose from three levels of visibility for workloads. These modes allow you to specify how much data the VEN collects from a workload when in the Full Enforcement state:

- **Off:** The VEN does not collect any information about traffic connections. This option provides no Illumination detail and demands the least amount of system resources from a workload.

This property is only available for workloads that are in the Full Enforcement state.

- **Blocked:** The VEN only collects the blocked connection details (source IP, destination IP, protocol and source port and destination port), including all packets that were dropped. This option provides less Illumination detail but also demands fewer system resources from a workload than high detail.
- **Blocked + Allowed:** The VEN collects connection details (source IP, destination IP, protocol and source port and destination port). This applies to both allowed and blocked connections. This option provides rich Illumination detail but requires some system resources from a workload.

Workload Processes

The Processes tab of the Workload detail page shows the processes currently running on the workload. For each process running on the workload, the following information is listed:

- V-E Score
- Process name
- Process path
- Ports used by the process
- Protocol (for example, TCP or UDP)

NOTE

On the Workload Processes tab, when you delete the binary for that process while the process is running, the PCE appends the process name with "(deleted)."

The UDP - PCE UI processes tab shows both server and client UDP processes and ports.

On the Services tab for a workload, both UDP client and server processes show up along with their port numbers. For TCP, only listening ports/processes are presented.

For UDP, only listening ports/processes should be presented. The information is coming from service reports sent by VEN once every 24 hours.

Customers depend on this information to understand the provider processes in their data center and write policies to allow traffic from needed workloads.

Workload Rules

The Illumio Core has two types of rules:

- **Inbound Rules:** Show all the services on the workload and the interface endpoints that are allowed to communicate with these services.
- **Outbound Rules:** Show all the interface endpoints that the services on that workload are allowed to communicate with.

To apply rules to a workload, create a ruleset and then make sure that the ruleset and workloads share the same labels.

NOTE

The workload rules are listed against individual IP addresses in an ipset. The PCE places a limit on the size of the returned data. The PCE web console displays an error message whenever the PCE exceeds a certain number of rules and that count is the number of peer-to-peer rules calculated for that workload.

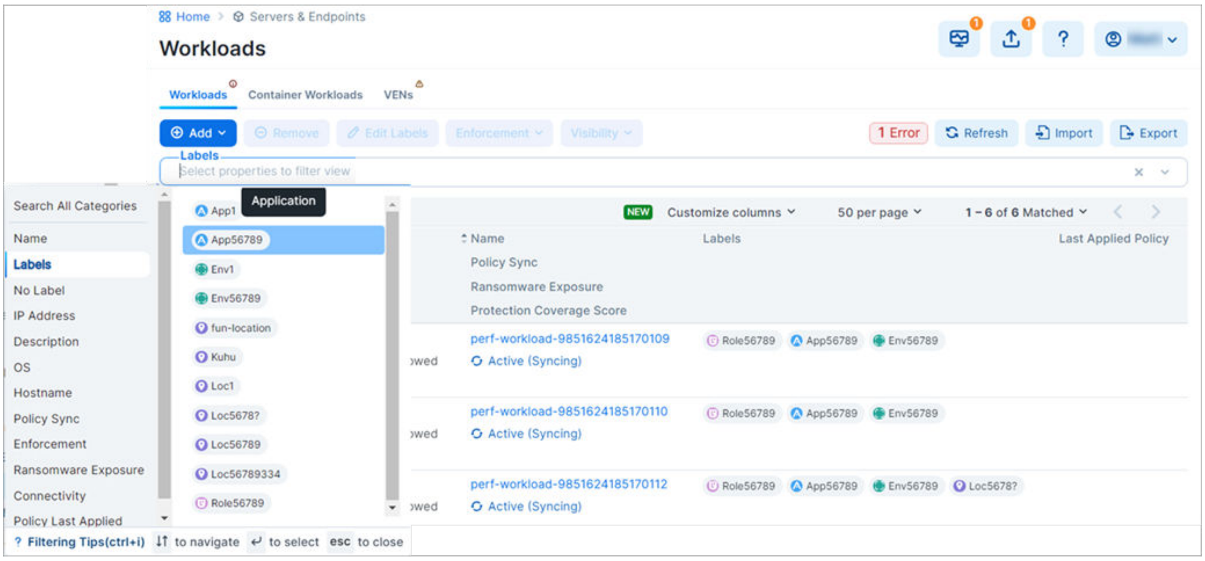
Workloads Blocked Traffic

The Blocked Traffic tab shows you all traffic that attempted to communicate with your workload but was blocked due to policy. For information, see Blocked Traffic [64].

Filter the Workloads List

You can filter by one or any combination of workload labels and properties.

- Use the filter at the top of the Workloads and VENs page to perform a label-based search. For example, you can filter the list to view all workloads with the Application label "App56789."



Name	Labels
perf-workload-9851624185170109 Active (Syncing)	Role56789 App56789 Env56789
perf-workload-9851624185170110 Active (Syncing)	Role56789 App56789 Env56789
perf-workload-9851624185170112 Active (Syncing)	Role56789 App56789 Env56789 Loc5678?

- You can filter workloads based on their properties, such as workload name, IP address, description, hostname, OS family, VEN connectivity, when a policy was last applied to or received by the workload, and when the last heartbeat was received.

Click the **Refresh** button to refresh the content of the page with the latest information without clearing the filters or the results.

Use a Wildcard to Filter Workloads

The Workloads filter supports a wildcard character for the Name and Hostname properties to help sort and organize large numbers of workloads.

To filter the list of workloads on the Workloads page, select either the Name or Hostname property from the drop-down list and enter the search terms using the asterisk (*) character as a wildcard. The asterisk can represent any number of characters.

For example, you can enter “db-*auto” using the Name property to find workloads with names that include “db,” “-auto,” and any number of characters in between (for example, “db-prod-auto,” “db-dev-auto,” or “db-12-auto”).

At least one non-wildcard character must be included before or after the wildcard character. An error message is displayed when you include only the wildcard character in the search field.

NOTE

The auto-complete feature is disabled when the wildcard character is used.

Use Clone Alerts to Filter Workloads

You can filter workloads according to whether a clone has been detected. Workloads in the detected state of the clone are identifiable by a red banner (similar to workloads in suspension) at the top of the workload list page.

The VEN communicates with the PCE using HTTPS over Transport Layer Security (TLS). Additionally, a clone token is generated. When an agent token is mistakenly or maliciously reused on another workload, the clone token detects the condition and disambiguates the hosts. The clone token is periodically rotated, while the agent token is never rotated.

To filter by clone alerts:

1. On the left navigation, go to **Servers & Endpoints > Workloads**.
2. Look for an alert banner indicating some workloads are in a "clone detected" state. This banner will appear only if you pair one or more VENs and then clone the VEN(s).
3. Click the filter link on the banner. The list now shows only the "clone detected" workloads.
4. Click on one of the "clone detected" workloads. An alert for that workload is displayed on the detail page.
5. If you stop, unpair, or repair the cloned VEN, you can come back and see that the messages and alerts are removed from the Workloads List page.

Enforce a Workload Policy State

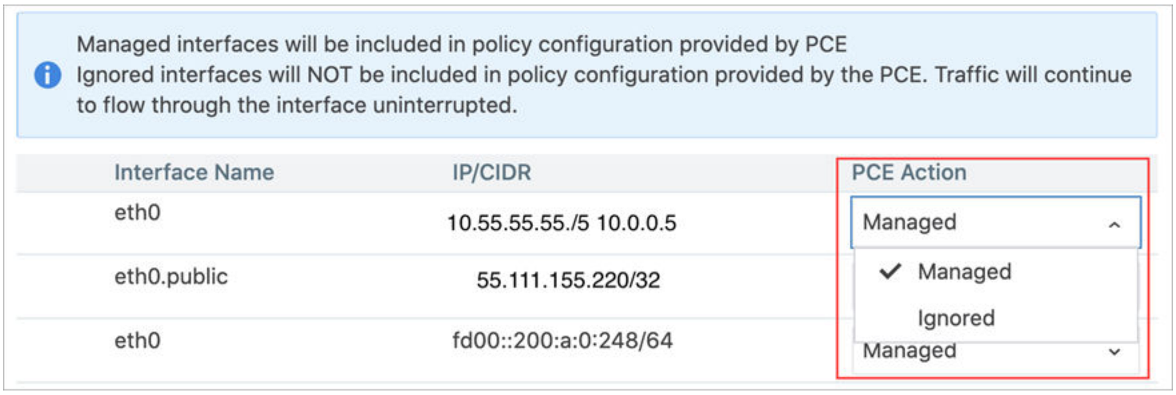
1. On the left navigation, go to **Servers & Endpoints > Workloads**.
2. Click the link for a workload for which you want to change the Enforcement state.

3. Click **Edit**.
4. From the Enforcement drop-down list, select **Idle**, **Visibility Only**, **Selective**, or **Full** depending on how you want to allow or block traffic connections.
5. Click **Save**.

Set Workload Interfaces to Ignored

You can set interfaces from being Managed to Ignored in the PCE web console. You can use this option when you want the workload to ignore visibility and enforcement on the interconnected interfaces of database clusters such as, Oracle RAC. During pairing, you can set one or more interfaces to Ignored, which causes the first downloaded firewall to ignore those interfaces. After you set an interface to Ignored, that interface is not be included in the policy configuration and traffic flows uninterrupted through it without any change in latency. You can see which interfaces are marked as Ignored on the Workloads' Summary page.

1. On the left navigation, go to **Servers & Endpoints > Workloads**.
2. Click a workload to open the details.
3. Click **Edit**.
4. In the Network Interfaces section, change interfaces from Managed to Ignored using the PCE Action drop-down list.



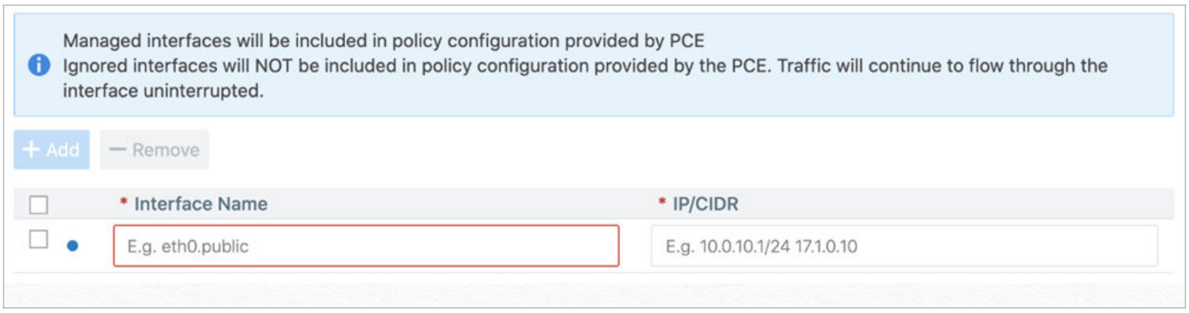
Managed interfaces will be included in policy configuration provided by PCE
Ignored interfaces will NOT be included in policy configuration provided by the PCE. Traffic will continue to flow through the interface uninterrupted.

Interface Name	IP/CIDR	PCE Action
eth0	10.55.55.55./5 10.0.0.5	Managed
eth0.public	55.111.155.220/32	
eth0	fd00::200:a:0:248/64	Managed

WARNING

DO NOT ignore PCE-generated interfaces such as `eth123.public` for cloud workloads.

In case you are editing an unmanaged workload, you will not have the option to ignore the workload using the PCE Action drop-down. That drop-down menu does not exist for unmanaged workloads. You can still provide information on the Interface Name and the IP/CIDR address.



Managed interfaces will be included in policy configuration provided by PCE
Ignored interfaces will NOT be included in policy configuration provided by the PCE. Traffic will continue to flow through the interface uninterrupted.

□		* Interface Name	* IP/CIDR
□	●	E.g. eth0.public	E.g. 10.0.10.1/24 17.1.0.10

5. Click **Save**.

Update Workload Labels in Bulk

This section describes how to perform bulk operations on labels using the Import / Export feature available in the Workloads List Page. With this feature, you can:

- Export a CSV or JSON file containing information about the Illumio labels assigned to your workloads. There's also an option to export other information about your workloads.
- Import changes to your workload labels using either the CSV file that you exported from the PCE or a CSV file of your own. You can use the Import feature to do the following:
  - Create new labels of existing label types and assign them to workloads. (Labels you create using **Import** are assigned to the workloads you specify in the CSV file. You can't use **Import** to create an unassigned label.)
  - Change a label assigned to a workload
  - Un-assign a label from a workload

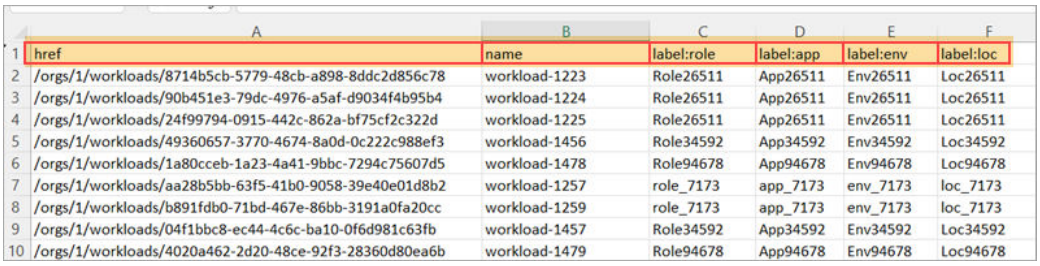
About the Export File

File format

You can export the file in these formats:

- **CSV**: This format is convenient if you use the same file to import label updates to the PCE. Only CSV files can be imported to the PCE.
- **JSON**: This option simply exports workload data in a JSON file. It can't be imported to the PCE.

Columns



	A	B	C	D	E	F
1	href	name	label:role	label:app	label:env	label:loc
2	/orgs/1/workloads/8714b5cb-5779-48cb-a898-8ddc2d856c78	workload-1223	Role26511	App26511	Env26511	Loc26511
3	/orgs/1/workloads/90b451e3-79dc-4976-a5af-d9034f4b95b4	workload-1224	Role26511	App26511	Env26511	Loc26511
4	/orgs/1/workloads/24f99794-0915-442c-862a-bf75cf2c322d	workload-1225	Role26511	App26511	Env26511	Loc26511
5	/orgs/1/workloads/49360657-3770-4674-8a0d-0c222c988ef3	workload-1456	Role34592	App34592	Env34592	Loc34592
6	/orgs/1/workloads/1a80cceb-1a23-4a41-9bbc-7294c75607d5	workload-1478	Role94678	App94678	Env94678	Loc94678
7	/orgs/1/workloads/aa28b5bb-63f5-41b0-9058-39e40e01d8b2	workload-1257	role_7173	app_7173	env_7173	loc_7173
8	/orgs/1/workloads/b891fdb0-71bd-467e-86bb-3191a0fa20cc	workload-1259	role_7173	app_7173	env_7173	loc_7173
9	/orgs/1/workloads/04f1bbc8-ec44-4c6c-ba10-0f6d981c63fb	workload-1457	Role34592	App34592	Env34592	Loc34592
10	/orgs/1/workloads/4020a462-2d20-48ce-92f3-28360d80ea6b	workload-1479	Role94678	App94678	Env94678	Loc94678

NOTE

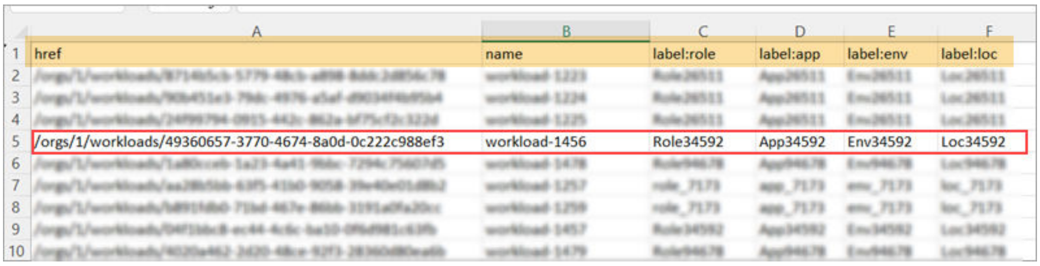
The `href` and `hostname` columns must occupy the first and second columns from the left, respectively, and column headers should not be changed. Label column headers should not be changed but the columns can be in any order.

By default, the exported CSV file has the following columns:

- First column: `href`
- Second column: `hostname`
- label: `role`
- label: `app`
- label: `env`
- label: `loc`

Rows

With the exception of the header row, each row in the import file corresponds to a workload on the PCE.



	A	B	C	D	E	F
1	href	name	label:role	label:app	label:env	label:loc
2	[illegible]	workload-1223	Role26511	App26511	Env26511	Loc26511
3	[illegible]	workload-1224	Role26511	App26511	Env26511	Loc26511
4	[illegible]	workload-1225	Role26511	App26511	Env26511	Loc26511
5	/orgs/1/workloads/49360657-3770-4674-8a0d-0c222c988ef3	workload-1456	Role34592	App34592	Env34592	Loc34592
6	[illegible]	workload-1478	Role94678	App94678	Env94678	Loc94678
7	[illegible]	workload-1257	role_7173	app_7173	env_7173	loc_7173
8	[illegible]	workload-1259	role_7173	app_7173	env_7173	loc_7173
9	[illegible]	workload-1457	Role34592	App34592	Env34592	Loc34592
10	[illegible]	workload-1479	Role94678	App94678	Env94678	Loc94678

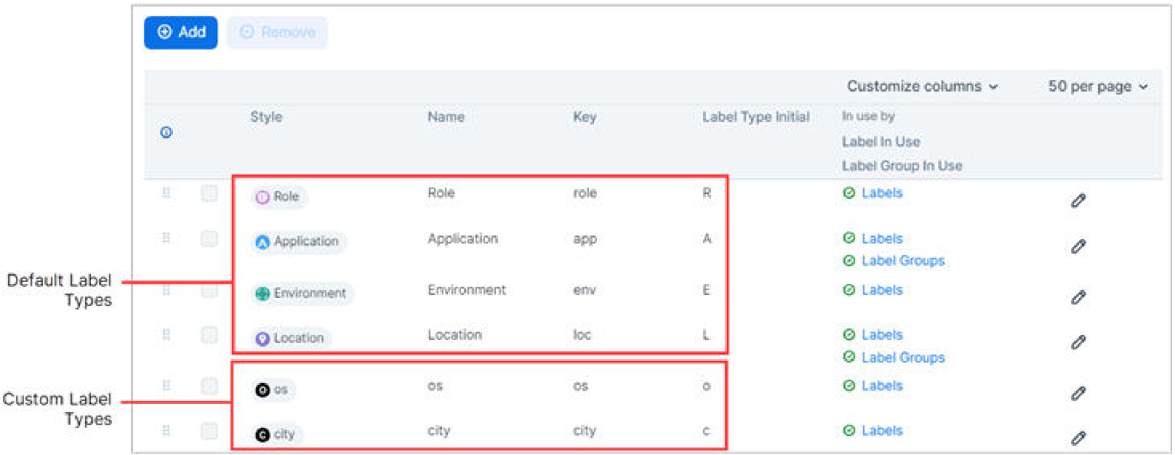
CSV file requirements

Whether you're using a file exported from the PCE or your own *.csv file, the file you intend to import to the PCE must meet the following requirements:

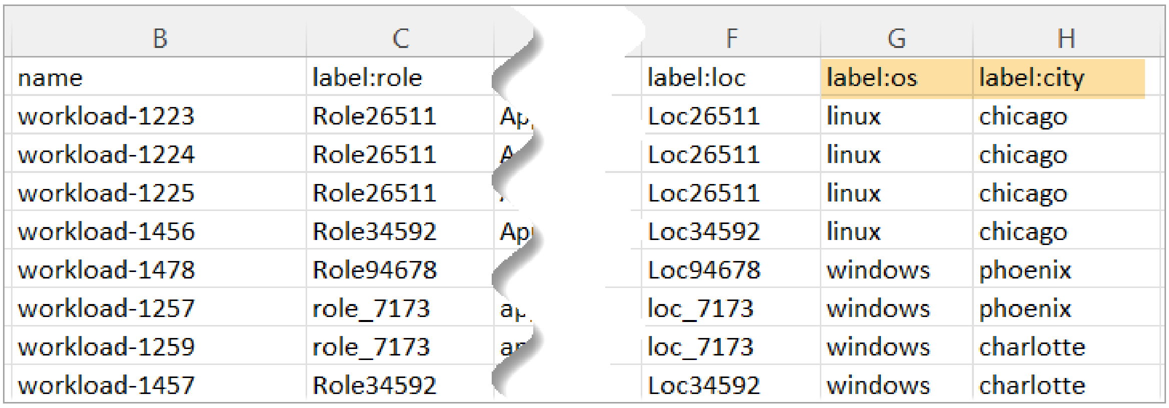
- The file must be a `*.csv` format.
- The first column header must be href
- The second column header must be hostname
- The file doesn't need to include a label column for every label type defined in the PCE Label Settings (**Settings > Label Settings**).
- If you're attempting to create new labels, ensure that they don't already exist in your Illumio instance. If the label already exists, an error occurs and an error message displays.
- You can include label types other than Role, Application, Environment, and Location if they are already defined in the PCE Label Settings.
- Blank cells in the import file are ignored.
- Up to 1000 import rows per CSV is supported.

Customizing the file

If custom label types are defined in **Settings > Label Settings** on the PCE, the exported file will include columns corresponding to those Label Types. For example, if your organization defined custom label types for **os** and **city**, the exported file will include corresponding columns.



Style	Name	Key	Label Type Initial	In use by Label In Use Label Group In Use
Role	Role	role	R	Labels
Application	Application	app	A	Labels Label Groups
Environment	Environment	env	E	Labels
Location	Location	loc	L	Labels Label Groups
os	os	os	o	Labels
city	city	city	c	Labels



B	C		F	G	H
name	label:role		label:loc	label:os	label:city
workload-1223	Role26511	Ap	Loc26511	linux	chicago
workload-1224	Role26511	A	Loc26511	linux	chicago
workload-1225	Role26511	'	Loc26511	linux	chicago
workload-1456	Role34592	Ap	Loc34592	linux	chicago
workload-1478	Role94678		Loc94678	windows	phoenix
workload-1257	role_7173	ap	loc_7173	windows	phoenix
workload-1259	role_7173	ar	loc_7173	windows	charlotte
workload-1457	Role34592		Loc34592	windows	charlotte

Here's how to prepare the CSV file to create, assign, update, and unassign labels during the import step.

STEP 1: Export Workload Information

TIP

You can skip the Export step if you plan to prepare your own CSV file for importation to the PCE. See STEP 2: Prepare the CSV File for Import [54].

You can use the Export feature to create and download a file to your local computer for one or both of the following reasons:

- **Prepare for importing bulk updates**. In the exported file, you'll specify the updates that you want to make to Workload labels as described in STEP 2: Prepare the CSV file for import [54]. You'll import the file to the PCE as described in STEP 3: Update Workload Labels Using Import [54].
- **Capture workload information**. Export data about your workloads in a text file for informational purposes.

1. In the left navigation, click **Servers & Endpoints > Workload**s.
2. On the Workload list page, click **Export** in the upper right corner.
3. In the Export Workloads dialog box, configure settings:
   - **Export**:
     - **All Workloads**: Select if you want the exported file to include all Workloads. If no filters are applied, only this option is available.
     - **Filtered Workloads**: This option is available only if one or more filters are applied to the list of workloads. Select if you want the exported file to include only the filtered list of Workloads. Otherwise, select **All Workloads**.
   - **Columns**:
     - **All Columns**: Select if you want the exported file to include all columns in the Workload List Page, including hidden columns. Note: While the exported file includes all columns, only updates that you make to data in the label columns will take effect when you import the file to the PCE. Changes to data in other columns, if any, are ignored.
     - **Labeling Columns**: Select if you want the exported file to include only the label columns in the Workload List Page.

- **File Format**:
  - **CSV**: Select CSV if you plan to use this file to import label updates to the PCE. Only CSV files can be imported to the PCE.
  - **JSON**: Not used for updating labels. This option simply exports workload data in a JSON file. JSON files can't be imported to the PCE.

4. Click **Export**. The file is sent to your Downloads folder.

STEP 2: Prepare the CSV File for Import

Here's how to prepare the CSV file to create, assign, update, and unassign labels during the import step.

1. Open the CSV file located in your Downloads folder and modify it in any of the following ways:
   - **Assign a new or change an existing label**

     In the appropriate label column and workload row, enter a label name or change an existing label name for each workload that you want to have the new or a changed label.
   - **Unassign labels**

     In the appropriate label column and workload row, replace the name of the label you want to unassign with any combination of alphanumeric or special characters. Later, in STEP 3: Update Workload Labels Using Import [54], you'll enter the same string in the option Remove existing label if the imported label matches the string listed below. Also, unassigning a label from a given workload doesn't delete the label for use with other workloads in the PCE.

     NOTE

     Simply deleting the label name from the CSV file and then importing the file to the PCE does not unassign the label from the workload. As described in the above step, you must replace the label name in the CSV file with a string that you'll also enter in the **Import a CSV to edit workload labels** dialog box as described in STEP 3: Update Workload Labels Using Import [54]. If the strings don't match when you perform the import, an error occurs and the label isn't unassigned.
2. Save the CSV file.

STEP 3: Update Workload Labels Using Import

The Import feature sends a CSV file to the PCE to update workload labels on your PCE. You can upload a CSV exported from the PCE (STEP 1: Export Workload Information [53]) or prepare and upload your own CSV file.

1. Prepare the CSV file for import (STEP 2 [54] above).
2. If you are not already, log in to the PCE.
3. In the left navigation, go to **Servers & Endpoints > Workloads**.
4. On the Workload list page, click **Import** in the upper right corner.
5. In the **Import a CSV to edit workload labels** dialog box, click **Choose File** and then select the CSV file you want to import to the PCE.
6. Select one or both of the following options:
   - **Create labels if they don't already exist**

     This option allows you to create new labels of an existing label type and assign them to workloads you specified in the CSV file. Available label types are defined in **Settings > Label Settings**.

- **Remove existing label if the imported label matches the string listed below**

  This option allows you to unassign a label from workloads you specified in the CSV file in STEP 2: Prepare the CSV File for Import [54]. Enter the same string in this field that you entered in the CSV file as described in STEP 2. If the strings don't match when you perform the import, an error occurs and the label isn't unassigned.

  > **NOTE**
  >
  > Simply entering a string in this field and then importing the CSV file to the PCE does not unassign the label from the workload. You must enter the same string in this field that you entered in the CSV file. If the strings don't match when you perform the import, an error occurs and the label isn't unassigned. Also, unassigning a label from a given workload doesn't delete the label for use with other workloads in the PCE.

7. Click **Preview Changes**.
8. Review the proposed changes in the **Preview Changes** message.
9. Optional. Click **Review** if you want to see the impact of your changes before you complete the import process. Any new labels you created appear in the New Labels list. A copy button allows you to copy the details into your buffer. Click **Back** to return to the **Preview Changes** message.
10. Click **Save**. The file is imported to the PCE.
11. Click **Refresh** to see the label changes reflected in the workloads list.
12. If you entered a string in the CSV file for removing an existing label, delete the string from the file and then save the file. Otherwise, if you import the file again, the PCE will interpret the string as a label you want to add to a workload.

Compare Workload App Group V-E Scores by Enforcement Type

The **Show Vulnerability Exposure (V-E) Score** tool lets you see how the security of your workloads app groups would change if you were to change their current enforcement mode. Columns in the Workload App Group list and details pages provide a side-by-side comparison of the effect different enforcement modes would have on Vulnerability and Exposure (V-E) scores. A toggle allows you to simulate the switch between Full Enforcement and Visibility Only enforcement modes.

> **NOTE**
>
> This option allows you to simulate the switch between Full Enforcement and Visibility Only modes. It doesn't change the actual enforcement mode of your workloadsapp groups.

How it works

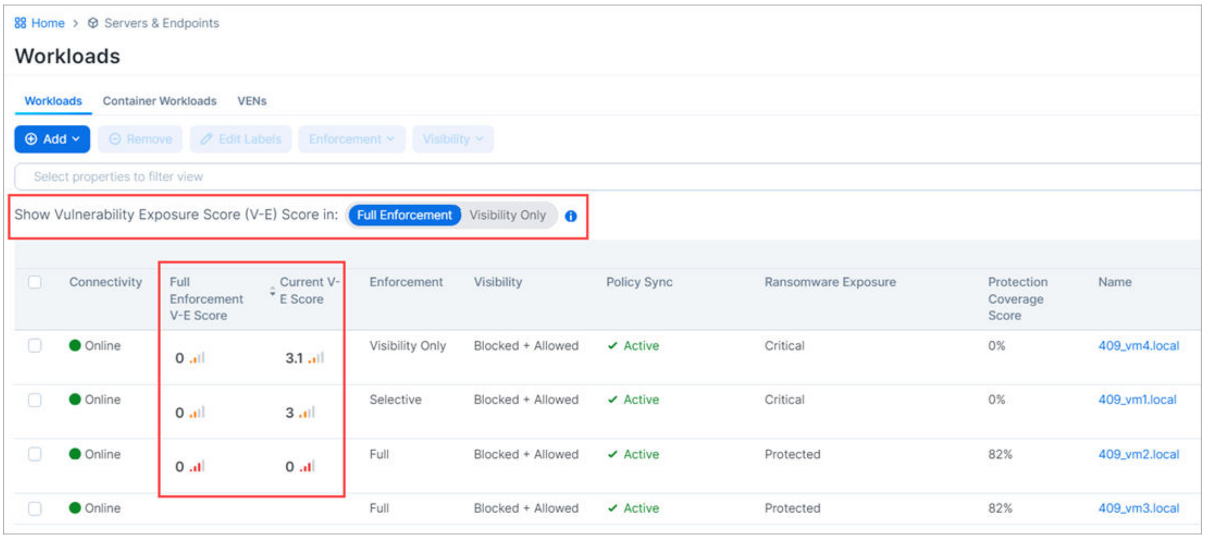
- The PCE displays V-E scores in the UI based on ransomware and vulnerability statistics it previously calculated and stored in a database.
- If the stored data is stale (4 hours or older), the PCE recalculates the statistics and updates the V-E scores in the UI.

- Toggling the Full Enforcement/Visibility Only options provides a side-by-side comparison of the effect of the different enforcement modes.
- Because the PCE calculates and re-checks for new data periodically, the information in the UI may not immediately reflect the current V-E score.
- API responses include the complete vulnerability data set for the different enforcement modes. V-E data for all modes is pre-processed and stored in a database to eliminate the performance impact that would result from frequent recalculation.
- A V-E score is the calculated value based on the Vulnerability Score and Exposure Score = ∑ f (VS, ES). It can be shown for an individual vulnerability on a port for a single workload app group or as a summation of all the V-E Scores for an App Group, role, or workload.

Workload App Group List pages

On Workload App Group list pages, two adjacent columns show the following:

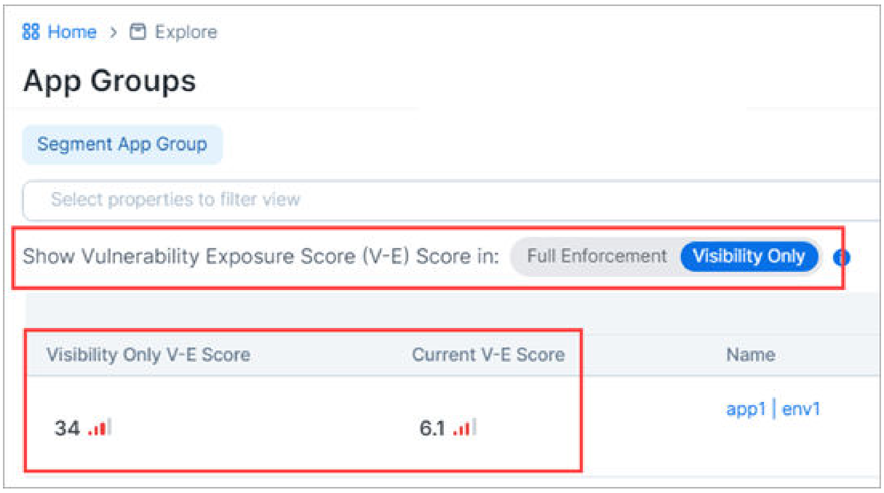
- Full Enforcement / Visibility Only V-E Score: Depending on the item's current enforcement mode, this column matches the Current V-E Score column or changes to show a different V-E score obtainable if the actual enforcement mode were changed.
- Current V-E Score: The most recently calculated V-E score of the workload.



Workloads

Show Vulnerability Exposure Score (V-E) Score in: [✓ Full Enforcement] Visibility Only

□	Connectivity	Full Enforcement V-E Score	Current V-E Score	Enforcement	Visibility	Policy Sync	Ransomware Exposure	Protection Coverage Score	Name
□	● Online	0	3.1	Visibility Only	Blocked + Allowed	✓ Active	Critical	0%	409_vm4.local
□	● Online	0	3	Selective	Blocked + Allowed	✓ Active	Critical	0%	409_vm1.local
□	● Online	0	0	Full	Blocked + Allowed	✓ Active	Protected	82%	409_vm2.local
□	● Online			Full	Blocked + Allowed	✓ Active	Protected	82%	409_vm3.local



App Groups

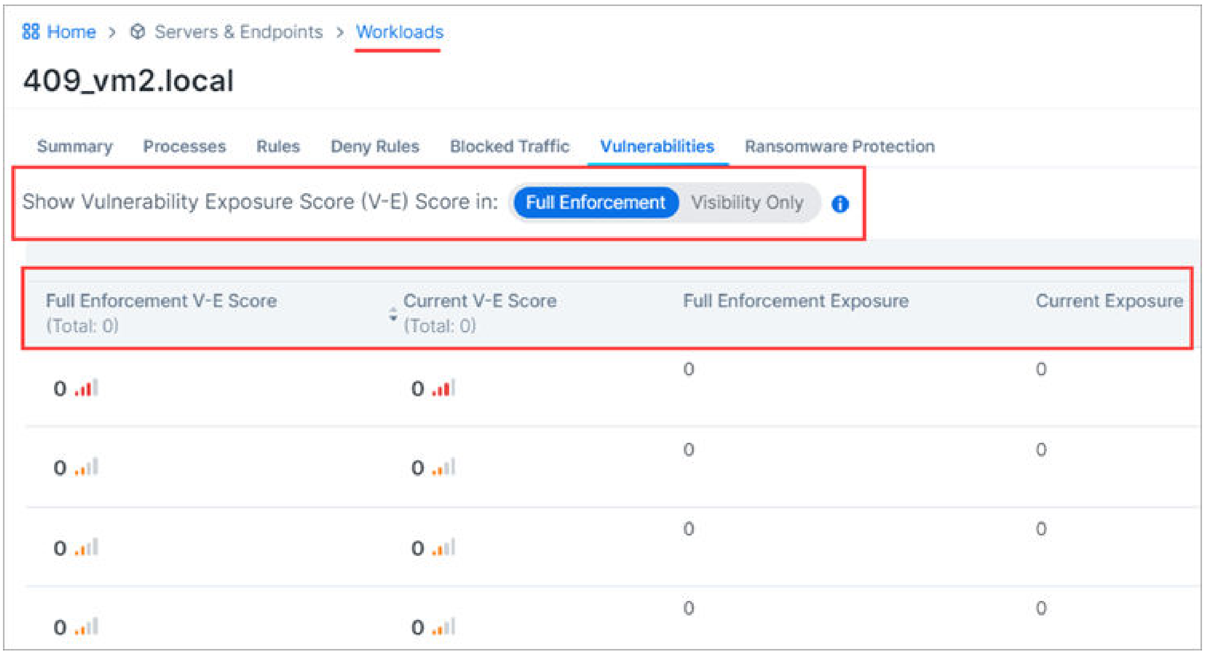
Show Vulnerability Exposure Score (V-E) Score in: Full Enforcement [✓ Visibility Only]

Visibility Only V-E Score	Current V-E Score	Name
34	6.1	app1 | env1

Workload App Group Details pages

On the Vulnerabilities tab of Workload App Group details pages, four adjacent columns show the following:

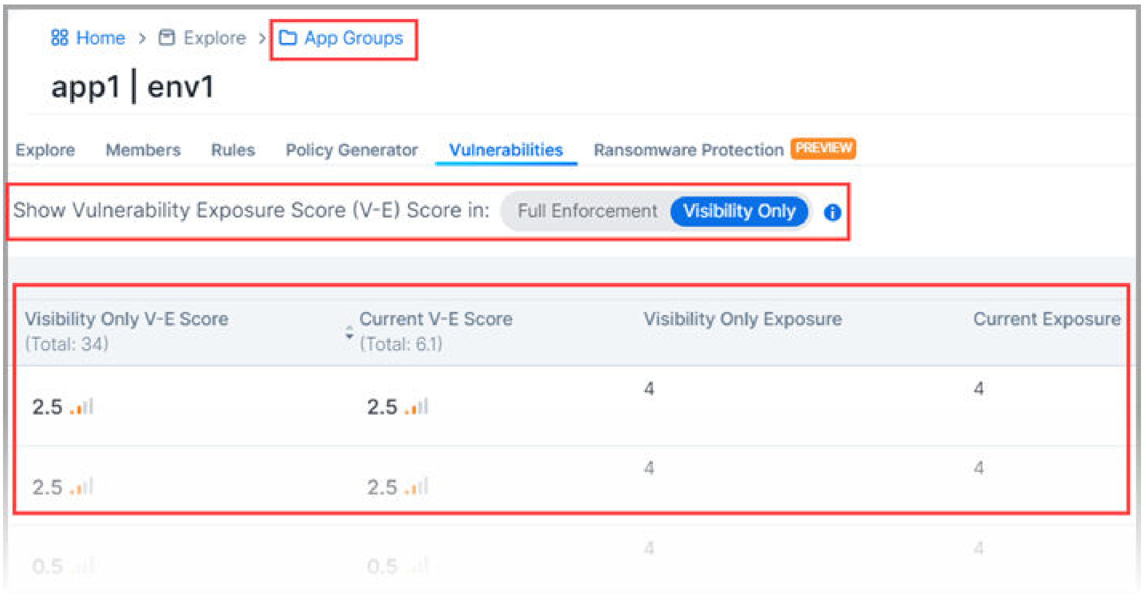
- **Full Enforcement / Visibility Only V-E Score:** Depending on the item's current enforcement mode, this column matches the Current V-E Score column or changes to show a different V-E score obtainable if the actual enforcement mode were changed.
- **Current V-E Score:** The most recently calculated V-E score of the workloadapp group.
- **Full Enforcement Exposure:** Depending on the item's current enforcement mode, this column either matches the Current Exposure column or changes to show a different exposure score obtainable if the actual enforcement mode was changed.
- **Current Exposure:** The current exposure score of the workloadapp group.



409_vm2.local

Show Vulnerability Exposure Score (V-E) Score in: Full Enforcement | Visibility Only

Full Enforcement V-E Score (Total: 0)	Current V-E Score (Total: 0)	Full Enforcement Exposure	Current Exposure
0	0	0	0
0	0	0	0
0	0	0	0
0	0	0	0



app1 | env1

Show Vulnerability Exposure Score (V-E) Score in: Full Enforcement | Visibility Only

Visibility Only V-E Score (Total: 34)	Current V-E Score (Total: 6.1)	Visibility Only Exposure	Current Exposure
2.5	2.5	4	4
2.5	2.5	4	4
0.5	0.5	4	4

Workloads and VENs

The Workloads navigation menu includes Workloads, Container Workloads, and VENs. You can see all your workloads, container workloads, and VENs on separate tabs. You can view their configuration, do workload or VEN-specific actions, and find the related VENs and workloads.

An idle workload does not program a firewall, therefore the Rules page of an idle workload does not show its rules.

The VENs are listed in a new page separate from workloads. The VEN-related actions are not available under the Workloads tab.

Manage Workloads and VENs

NOTE
Users with the Workload Manager role can manage workloads and VENs.

You can select VENs to unpair, refresh, and generate support reports. Container workloads (if any) are displayed under the Container Workloads tab.

Click the **Unpair** button to unpair a VEN.

On the Unpair VEN page, select the appropriate radio button to define the Final Firewall Status:

Firewall Status	Description
Remove Illumio Policy	This is the default option. Linux: Removes Illumio policy and retains the coexistent firewall rules AIX/Solaris: Removes Illumio policy and reverts firewall rules to the pre-pairing state Windows: Removes firewall WFP filters and activates Windows firewall
Open all ports	All OS system: leaves all ports open
Close all ports except remote management	Linux/AIX/Solaris: temporarily allows only SSH/22 until the system is rebooted Windows: allows only RDP/3389 and WinRM/5985, 5986

Proceed with unpairing as follows:

Pairing Method	Policy Mode	Unpair Action
Pairing Key	Visibility only/ Enforced	• Uninstalls the selected VEN(s). • Removes policy for the associated workloads. • Policies are configured in to the host firewall based on options selected in "Select final firewall status".

Pairing Method	Policy Mode	Unpair Action
Pairing Key	Idle	• Uninstalls the selected VEN(s). • Removes policy for the associated workloads. • No changes to the host firewall.
PKI Certificate or Kerberos	Visibility only/ Enforced	• Uninstalls the selected VEN(s). • Associated workloads become unmanaged but retain labels and IP addresses. • Policies are configured in to the host firewall based on options selected in "Select final firewall status".
PKI Certificate or Kerberos	Idle	• Uninstalls the selected VEN(s). • Associated workloads become unmanaged but retain labels and IP addresses. • No changes to the host firewall.

Delete a workload from the PCE

You cannot directly delete workloads from the PCE, as the workload represents an entity that the PCE does not control. You can unpair the VEN on that workload from the VENs tab on the Servers & Endpoints/Workloads menu, which will remove the workload from the workloads table.

Enhanced Data Collection

The Enhanced Data Collection optional feature on the PCE is now fully available starting in the 22.5.10 release, after being a preview feature available with the 20.2.0 release. When enabled, the PCE reports the amount of data transferred in to and out of workloads and applications in a data center. The number of bytes sent by and received by the provider of an application are provided separately. These values can be seen in traffic flow summaries streamed out of the PCE. This capability can be enabled on a per-workload basis in the Workload page. It can also be enabled in the pairing profile so that workloads are directly paired into this mode.

To enable Enhanced Data Collection you need a License file. For information about obtaining the license, please contact Illumio Customer Support.

Once licensed, enable Enhanced Data Collection for a workload with the Visibility button.

- On the Workloads an VENs -Workloads page, select **Visibility > Enhanced Data Collection**.

  You can also enable Enhanced Data Collection as a Visibility option in the Pairing Profile page by selecting the radio button "Enhanced Data Collection".

After the VEN's visibility level is set to Enhanced Data Collection, it starts reporting the number of bytes transferred over the connections. The PCE collects this data, adds relevant information, such as labels, and sends the traffic flow summaries out of the PCE.

The direction reported in flow summary is from the viewpoint of the provider of the flow.

- Destination Total Bytes Out (dst_tbo): Number of bytes transferred out of provider (Connection Responder)
- Destination Total Bytes In (dst_tbi): Number of bytes transferred in to provider (Connection Responder)

The number of bytes includes:

- L3 and L4 header sizes of each packet (IP Header and TCP Header)
- Sizes of multiple headers that may be included in communication (when SecureConnect is enabled)
- Retransmitted packets.

  The bytes transferred in the packets of a connection are included in measurement. This is similar to various networking products such as firewalls, span-port measurement tools, and other network traffic measurement tools that measure network traffic.

Term	Description
dst_tbi	**Destination Total Bytes In** In Total bytes received till now by the destination over the flows included in this flow-summary in the latest sampled interval. This is the same as bytes sent by the source. Present in 'A', 'C', and 'T' flow-summaries. source = client = connection initiator, destination = server = connection responder.
dst_tbo	**Destination Total Bytes Out** Out Total bytes sent till now by the destination over the flows included in this flow-summary in the latest sampled interval. This is the same as bytes received by the source. Present in 'A', 'C', and 'T' flow-summaries. source = client = connection initiator, destination = server = connection responder.
dst_dbi	**Destination Delta Bytes In** In Number of bytes received by the destination in the latest sampled interval, over the flows included in this flow-summary. This is the same as bytes sent by the source. Present in 'A', 'C', and 'T' flow-summaries. source = client = connection initiator, destination = server = connection responder.
dst_dbo	**Destination Delta Bytes Out** Out Number of bytes sent by the destination in the latest sampled interval, over the flows included in this flow-summary. This is the same as bytes received by the source. Present in 'A', 'C', and 'T' flow-summaries. source = client = connection initiator, destination = server = connection responder.
interval_sec T	**Time Interval in Seconds** Duration of latest sampled interval over which the above metrics are valid.

Connection State	Description
A	**Active:** The connection is still active at the time the record was posted. Typically observed with long-lived flows on source and destination side of communication.
T	**Timed Out:** Flow does not exist any more. It has timed out. Typically observed on destination side of communication.

Connection State	Description
C	**Closed:** Flow does not exist any more. It has been closed. Typically observed on source side of communication.
S	**Snapshot:** Connection was active at the time VEN sampled the flow. Typically observed when the VEN is in Idle state.

Container Workloads

The Container Workloads page lists the containers that exist on the PCE.

The page contains this information:

Column	Description
Summary	**General** Information about the container's Name, namespace/project, policy state, and so on. **Labels** Information such as Role, Application, Environment, Location **Attributes** Information about Interfaces and Workloads
Containers	Information about a specific container.
Rules	Information about rules.

Workload Setup Using PCE Web Console

After you pair workloads, you can view details by clicking a single workload. From the Workload Summary page, you can name the workload, write a description, and change the workload's policy state.

About Creating Managed Workloads by Installing VENs

When you install a VEN on a workload and pair it to the PCE, it becomes a managed workload because it can be managed using the PCE. For more information, see "VEN Installation Using VEN Library in PCE" in VEN Installation and Upgrade Guide.

Unmanaged Workloads

Unmanaged workloads extend rule-writing capabilities to network entities that are not paired with the PCE and do not have an installed VEN. Adding unmanaged workloads to the PCE allows you to write rules so that workloads that are paired with the PCE can communicate with those other entities. The policy between workloads with a VEN and unmanaged workloads is enforced using the outbound rules on the workloads where the VEN is running. For unmanaged workloads, enforcement is displayed blank.

For example, when you want to ensure that a network file server belonging to an HRM application is only accessible from the database workloads of the HRM application, you can add unmanaged workloads for the file servers and use label-based rules to enforce the policy. The PCE uses the outbound rules on the database workloads running the VEN to ensure that only the databases labeled HRM are allowed to make outbound connections to the network file servers.

Add an Unmanaged Workload

You can add unmanaged workloads from the Workloads list. After assigning labels, write label-based Rules [85] that apply to unmanaged workloads.

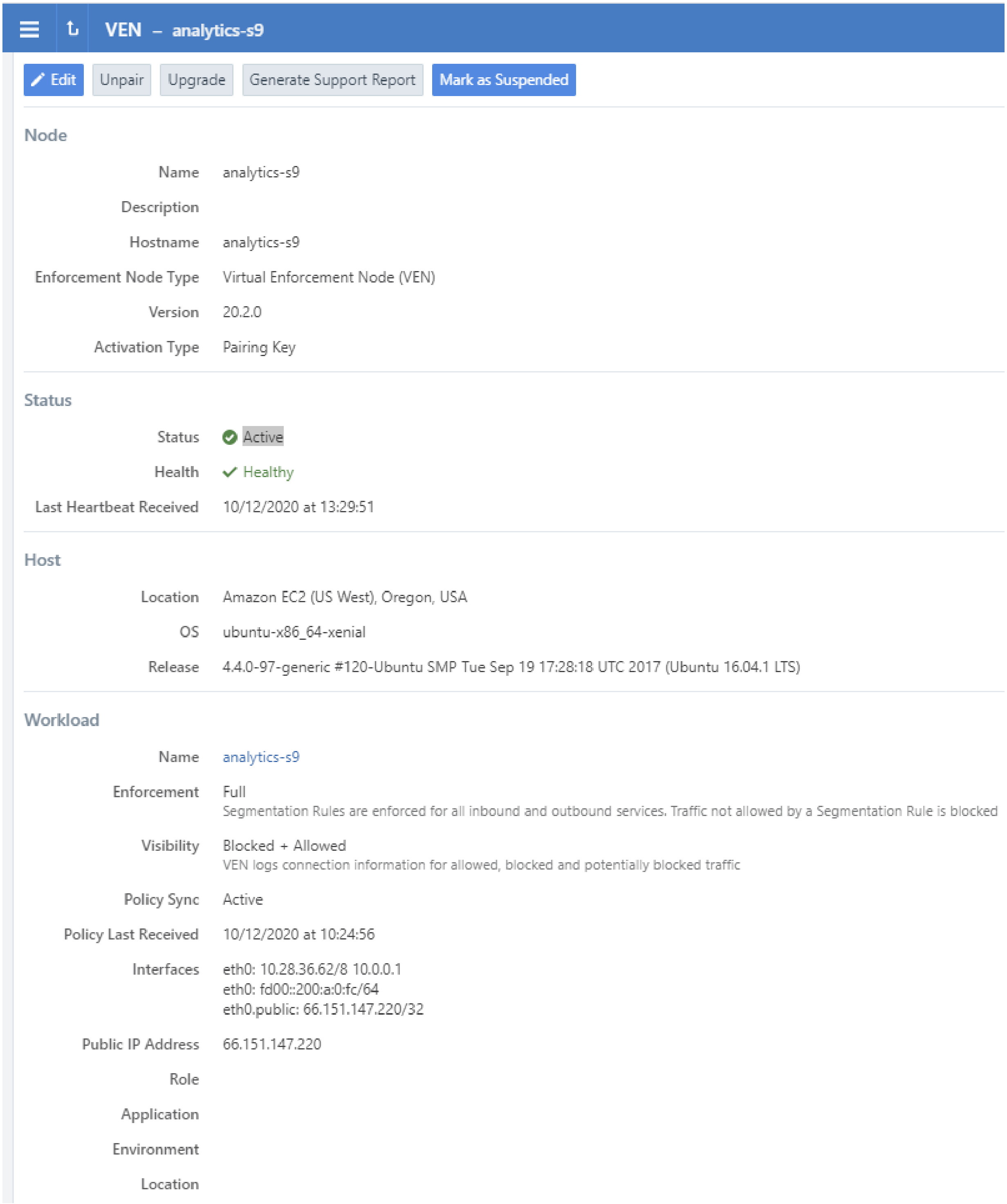
> **TIP**
>
> You can also create an unmanaged Workload from a blocked traffic IP address. See Create Unmanaged Workload from Blocked Traffic [67] for information.

1. From left navigation Servers & Endpoints category, click **Workloads**.
2. Click **Add** > **Add Unmanaged Workload**.
3. In the Add Unmanaged Workload details page, enter a name and description for the unmanaged workload.
4. In the Label Assignment section, select the labels you want to be applied to the unmanaged workload.
5. In the Host Attributes section, enter all the relevant information about the unmanaged workload, such as its hostname, IP addresses, location, and OS.
6.
7. (Optional) In the Machine Authentication ID field, enter all or part of the DN string from the Issuer field of the end entity certificate (CA Subject Name). Complete this field when you plan to use this unmanaged workload with the AdminConnect feature because the unmanaged workload is a laptop running Windows or Linux. See Secure Laptops with AdminConnect [129] for information.
8. Click **Save**.

VEN Administration on Workloads

The connectivity, policy sync, and health status of the VEN can be monitored from the PCE web console. To view VEN health status, see the VEN list page for your managed environment. From the PCE web console menu, choose Workloads and VENs > VENs. The VEN list page appears.

VEN Details for a Workload



Node

Name	analytics-s9
Description	
Hostname	analytics-s9
Enforcement Node Type	Virtual Enforcement Node (VEN)
Version	20.2.0
Activation Type	Pairing Key

Status

Status	● Active
Health	✓ Healthy
Last Heartbeat Received	10/12/2020 at 13:29:51

Host

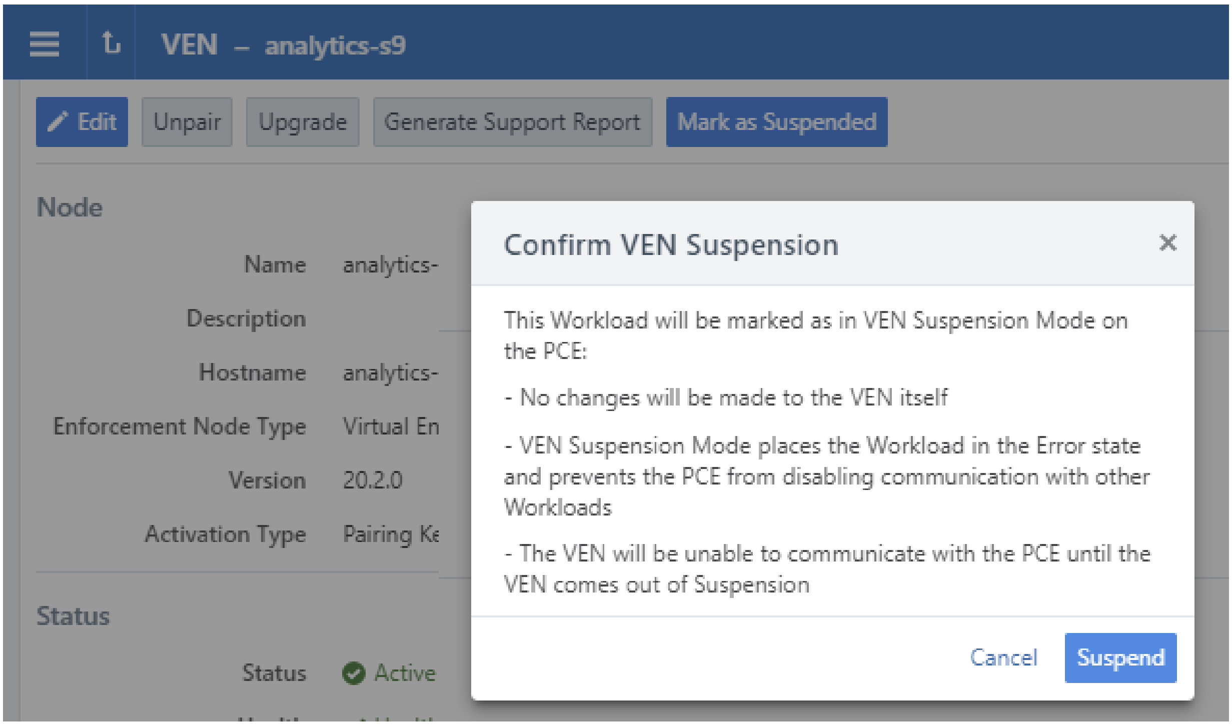
Location	Amazon EC2 (US West), Oregon, USA
OS	ubuntu-x86_64-xenial
Release	4.4.0-97-generic #120-Ubuntu SMP Tue Sep 19 17:28:18 UTC 2017 (Ubuntu 16.04.1 LTS)

Workload

Name	analytics-s9
Enforcement	Full Segmentation Rules are enforced for all inbound and outbound services. Traffic not allowed by a Segmentation Rule is blocked
Visibility	Blocked + Allowed VEN logs connection information for allowed, blocked and potentially blocked traffic
Policy Sync	Active
Policy Last Received	10/12/2020 at 10:24:56
Interfaces	eth0: 10.28.36.62/8 10.0.0.1 eth0: fd00::200:a:0:fc/64 eth0.public: 66.151.147.220/32
Public IP Address	66.151.147.220
Role	
Application	
Environment	
Location	

VEN Suspension

You can mark a workload as suspended by using the PCE web console. To suspend a VEN, choose **Workloads and VENs** > **VENs** from the PCE web console menu. Select your VEN to open its details page and click **Mark as Suspended**.



Confirm VEN Suspension

This Workload will be marked as in VEN Suspension Mode on the PCE:

- No changes will be made to the VEN itself

- VEN Suspension Mode places the Workload in the Error state and prevents the PCE from disabling communication with other Workloads

- The VEN will be unable to communicate with the PCE until the VEN comes out of Suspension

Loopback Interfaces

(Works with Linux VENs) VENs can report loopback interfaces and enforce policy on them.

The VEN reports all interfaces, including loopback interfaces. If the VEN detects an interface that is a loopback interface, but is not in the standard defined IP block that is meant for loopback interfaces (127.0.0.0/8), the VEN reports this as a loopback interface to the PCE. If the workload is in the scope where loopback interfaces are to participate in policy enforcement, the workload distributes the IP address to peers and enforces policy on that interface.

The scope where loopback interfaces are to participate in policy enforcement is defined through the PCE web console.

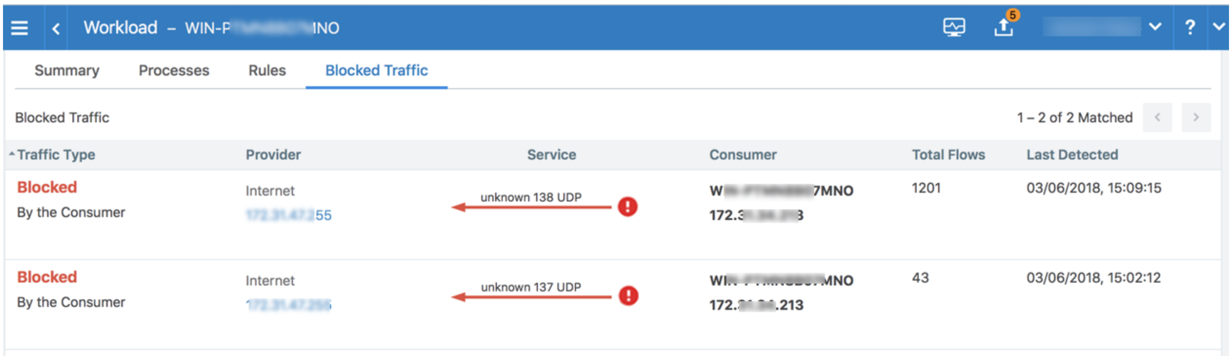
1. Log in to the web console as a Global Ruleset Provisioner or a Global Org Owner.
2. Choose **Settings** > **Security**.
3. Click the Loopback Interfaces tab.
4. Choose labels to define the scope.

Blocked Traffic

Blocked traffic identifies blocked and potentially blocked traffic among workloads and other entities managed by the PCE.

Overview of Blocked Traffic

To view the Blocked Traffic page, choose **Troubleshooting** > **Blocked Traffic** from the PCE web console menu. The Blocked Traffic tab shows you all traffic that attempted to communicate with your workload but was blocked due to policy. Blocked traffic alerts provide information such as the port and protocol of the service, as well the IP address of the consumer, the total number of flows, and the time last detected.



Blocked Traffic

1 – 2 of 2 Matched

Traffic Type	Provider	Service	Consumer	Total Flows	Last Detected
Blocked By the Consumer	Internet [redacted]255	unknown 138 UDP	W[redacted]7MNO 172.3[redacted]3	1201	03/06/2018, 15:09:15
Blocked By the Consumer	Internet [redacted]	unknown 137 UDP	WI[redacted]MNO 172.[redacted].213	43	03/06/2018, 15:02:12

Under the following conditions, traffic is marked as potentially blocked or blocked based on the active policy at the PCE when the latest flow was recorded:

- Traffic is blocked when a workload is in the enforced state and the PCE doesn't have rules in the active policy to allow that traffic.
- Traffic is potentially blocked when a workload is in a Visibility Only state and the PCE doesn't have rules in the active policy to allow that traffic.

Traffic that is blocked in the following ways is reported as blocked traffic in the Illumination map, regardless of the workload enforcement:

- Firewalls on the workload not managed by Illumio Core
- WFP policies not managed by Illumio Core

Existing connections are reported as static connections during pairing. These connections display as blocked or potentially blocked until new traffic for the connections is detected.

When you select the blocked connection, the Detail view provides more information on when the connection was last reported (when available).

The Blocked Traffic page allows you to verify that only unauthorized traffic is blocked and permitted communication between workloads is not unintentionally blocked before moving workloads to the enforced state.

You can use the page buttons in the upper left to navigate the listings. You can also use the **Refresh** button to refresh the content of the page with the latest information without clearing the filters or the results.

NOTE
Only the latest 500 blocked traffic entries are displayed.

For each traffic record, the following information is displayed:

- **Traffic Type:** Specifies whether the traffic is blocked or potentially blocked and whether it is blocked by the consumer or by the provider.
- **Provider:** Displays the workload name and IP address of the provider.
- **Provider Labels:** Displays labels assigned to the provider.
- **Service:** Displays the process name, port, and protocol information of the traffic that was reported along with an indication of whether the record was reported by the consumer or the provider.

  NOTE
  For optimal scale and performance, when the PCE has two connections with the same source workload, destination workload, destination port, and protocol but the process or service names are different, the two connections are combined in the Illumination map. The process or service name that was part of the most recently reported connection is displayed.

- **Consumer:** Displays the workload name and IP address of the consumer.
- **Consumer Labels:** Displays labels assigned to the consumer.
- **Total Flows:** Displays the total number of traffic flows for that connection.
- **Last Detected:** Displays a timestamp for the most recent recorded connection.

NOTE
When the provider reports the record, the information in the consumer column is grayed out. When the consumer reports the record, the information in the provider column is grayed out.

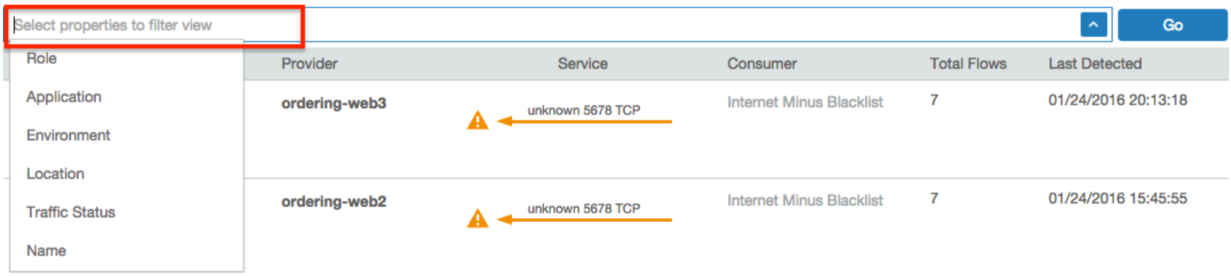
From the 18.3.1 release on, the traffic entries displayed on the blocked traffic page cannot be removed via the PCE web console.

Filter Blocked Traffic

The Blocked Traffic page displays the 500 most recent entries from all workloads managed by the PCE. When you are monitoring or writing rules for a specific set of workloads, use Blocked Traffic filters to display up to 500 of the most relevant entries based on the 10,000 entries in the PCE.

The PCE web console allows you to use filters to display only the blocked traffic entries of interest. You can filter based on workload name, label, traffic type (blocked or potentially blocked), or any combination of these attributes. When you apply the filter by clicking **Go**, the 500 most recent entries that match the search criteria are displayed.

To filter blocked traffic, type the keywords for the filter in the Select properties to filter view field at the top of the Blocked Traffic page.



Provider	Service	Consumer	Total Flows	Last Detected
ordering-web3	unknown 5678 TCP	Internet Minus Blacklist	7	01/24/2016 20:13:18
ordering-web2	unknown 5678 TCP	Internet Minus Blacklist	7	01/24/2016 15:45:55

NOTE

You can filter blocked traffic using multiple properties at the same time. Only entries that match all the entered criteria are displayed.

To specify the type of results, click the arrow at the end of the text entry field and select one or more of the available properties:

- Role
- Application
- Environment
- Location
- Traffic status
- Workload name

After entering your keywords, click **Go** to the right of the text entry field. The results display below the text entry field. The following information is included:

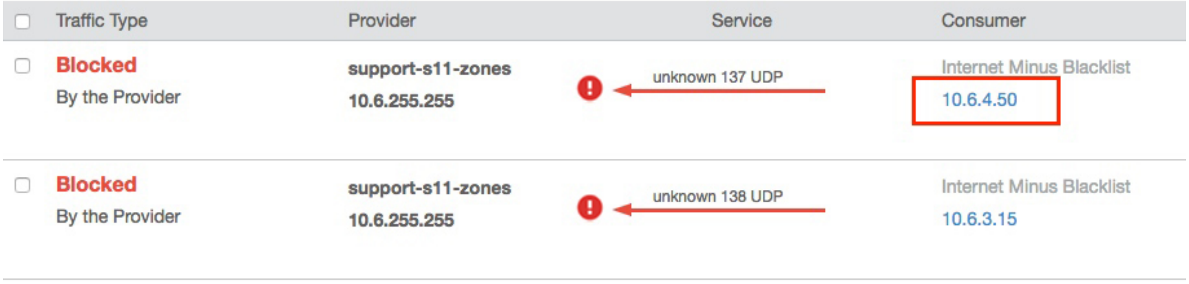
- **Traffic Type:** A link to additional information about that entry
- **Provider:** The provider of the service
- **Service:** The service type
- **Consumer:** The consumer of the service
- **Total Flows:** The total number of times this blocked traffic flow occurred
- **Last Detected:** A timestamp (in hh:mm:ss format) of the last time this flow occurred

Create Unmanaged Workload from Blocked Traffic

In some cases, your policy might be blocked from the IP address of a host that you want to allow to communicate with one of your managed workloads. You can do this by converting the IP address to an unmanaged workload, which enables the PCE to permit it to be used in policy.

Click the IP address in the blocked traffic event and fill out the Unmanaged Workload page. Once you have converted the IP address into an unmanaged workload, you can use it in rulesets to allow other managed workloads to communicate with it, or you can later convert it into a managed workload by pairing it. For more information about unmanaged workloads, see Unmanaged Workloads [61].

1. From the PCE web console menu, choose **Troubleshooting** > **Blocked Traffic**.
2. From the list of blocked traffic events, under the Consumer column, click any of the linked IP addresses.



☐	Traffic Type	Provider	Service	Consumer
☐	Blocked By the Provider	support-s11-zones 10.6.255.255	❗ unknown 137 UDP	Internet Minus Blacklist 10.6.4.50
☐	Blocked By the Provider	support-s11-zones 10.6.255.255	❗ unknown 138 UDP	Internet Minus Blacklist 10.6.3.15

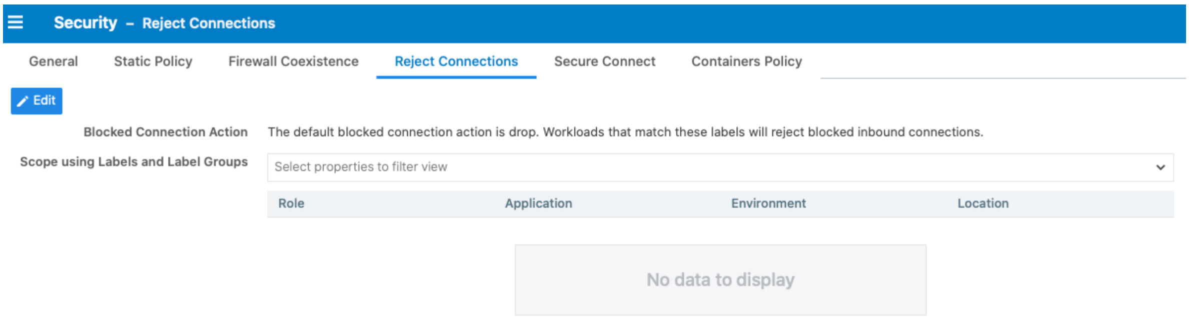
The Unmanaged Workload page appears.

3. Complete all the fields and click **Save**.

You can now use the unmanaged workload in your policy. For example, you can configure rules to allow incoming traffic from this unmanaged workload to other managed workloads.

Reject Connections

You can configure Workloads to reject traffic that does not meet the required policy, instead of blocking it in the *Enforced* state. You can edit *Reject Connections* from the **Settings > Security** menu option.



Blocked Connection Action: The default blocked connection action is drop. Workloads that match these labels will reject blocked inbound connections.

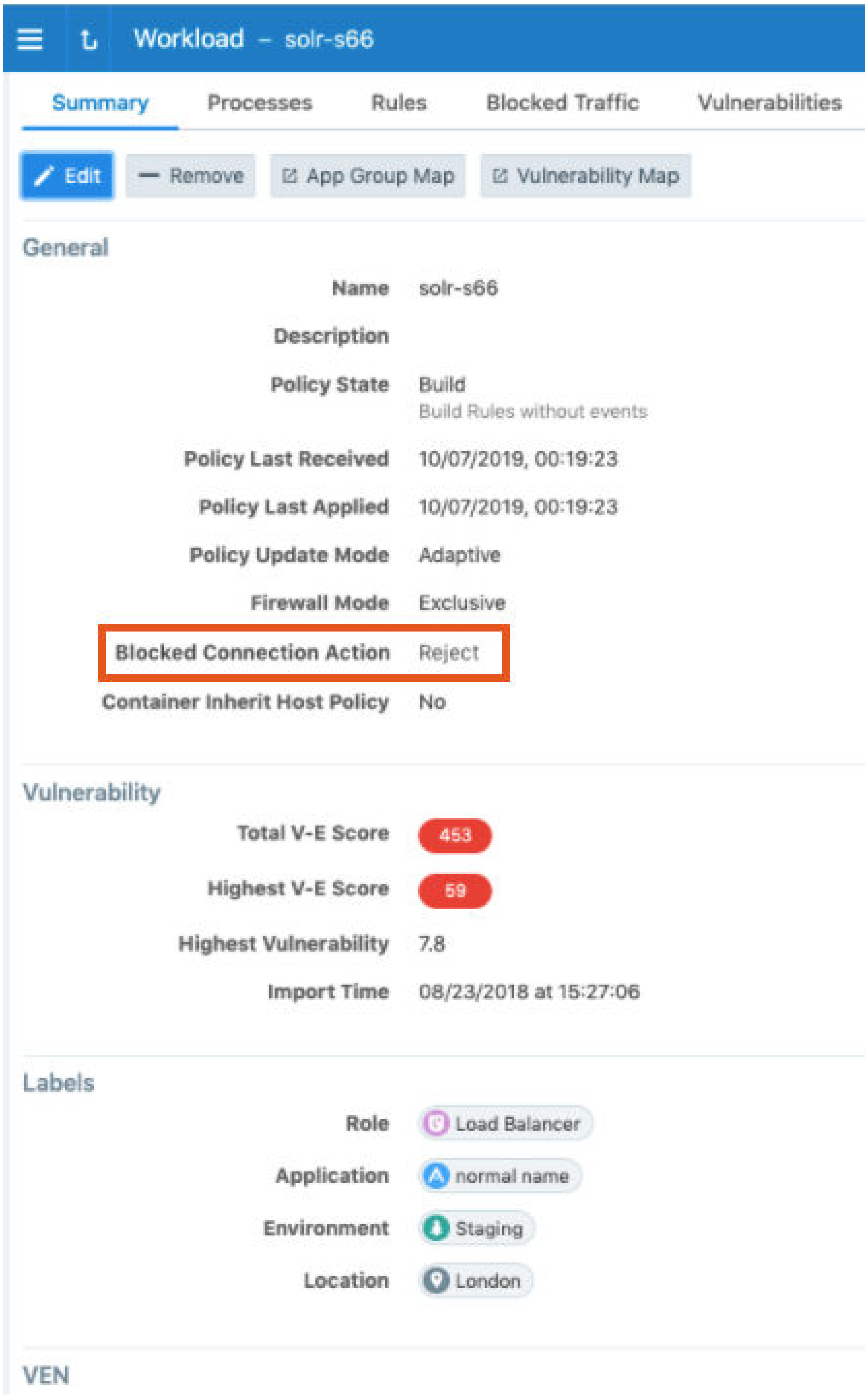
Scope using Labels and Label Groups: Select properties to filter view

Role	Application	Environment	Location

No data to display

A new firewall security setting provides two options:

- Reject blocked inbound traffic: When this setting is applied, the firewall is configured to send:
  - TCP RST for TCP connections
  - ICMP port unreachable for UDP connections
  - ICMP protocol unreachable for other connections
- Drop disallowed traffic (default).
- The setting acts at the VEN level and not at the interface level. It is selected by a Label set.
- It is visible on the Workload detail page.



General

Name	solr-s66
Description	
Policy State	Build Build Rules without events
Policy Last Received	10/07/2019, 00:19:23
Policy Last Applied	10/07/2019, 00:19:23
Policy Update Mode	Adaptive
Firewall Mode	Exclusive
Blocked Connection Action	Reject
Container Inherit Host Policy	No

Vulnerability

Total V-E Score	453
Highest V-E Score	59
Highest Vulnerability	7.8
Import Time	08/23/2018 at 15:27:06

Labels

Role	Load Balancer
Application	normal name
Environment	Staging
Location	London

VEN

Create Security Policy

This section describes how to create a security policy in the Illumio Core. Creating a security policy is an iterative process. Illumio recommends creating a broad initial policy, which you can incrementally improve until you establish a sufficiently robust policy.

Core Services Detector

Core services (such as DNS, Domain Controller, NTP, and LDAP) are essential to your computing environment and run on one or multiple workloads. The Core Service Detector feature helps you identify these core services and suggests an appropriate label for them. The Illumio PCE can detect 51 core services. Identifying and labeling these workloads is important because they are centrally connected, and other applications depend on them.

Application owners sometimes don’t know enough about the core services or how to identify them. In addition, different teams could be managing core services, and application owners must coordinate with these teams to secure their applications. When you use the Core Services Detector to label and write policies for core services, you can save time on application policies and progress to policy enforcement faster.

NOTE

In a Supercluster, the Core Services Detector is available only on the leader PCE.

For information about using the REST API to manage core services, see the REST API for managing Core Services in REST API Developer Guide.

Enabling Core Services Detection

The Core Services Detector is not enabled by default because it is an optional feature. Organizations that have already done extensive work with labeling their core services might not be interested in this feature.

IMPORTANT

To enable Core Services detection, you must be an Illumio Org Administrator.

To enabled this feature, follow these steps:

1. To obtain access to the Core Services feature in the PCE, update the value for the following parameter in the PCE `runtime_env.yml` file: `core_services_enabled: true.`

2. Log into the PCE web console and choose **Settings** > **Core Services.** The setting for the Core Services feature appears.
3. Select **Enabled**.

   The **Core Services** menu option will now appear in the PCE web console main menu under **Infrastructure** and you can use the Illumio REST API to manage Core Services.

Workflow for Managing Core Services

Core Services Detector uses a three-step process to identify and manage core services:

1. **Detect**: The detection tool runs in the backend to recommend potential core services (workloads running core services).
2. **Review**: Review recommendations provided by the detection tool and accept or reject them.
3. **Label**: Label accepted recommendations for core services.

Detection Methods

The PCE uses three methods to detect core services:

- **Port Matching**: Rule-based model based on connections to specific ports.
- **Port-based ML**: Machine learning model based on connections to specific ports.
- **Process-based ML**: Machine learning model based on processes running on the server.

NOTE

- The method that the PCE uses to detect a core service is not configurable.
- All three algorithms run all the time.
- The core services detection for Microsoft Active Directory uses the machine learning (ML) model.

Detection methods can be such as:Port-based ML, 93% confidence

Identify and Review a Core Service

1. From the PCE web console main menu, choose **Infrastructure** > **Core Services.**

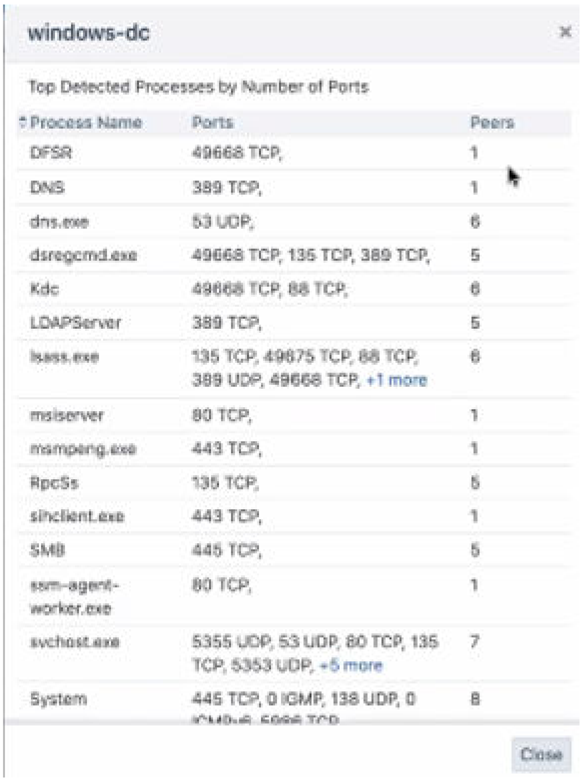
   The landing page for core services shows all services detected by the detection tool during the last run.

   It also tabulates the workloads that are recommended as running that particular core service along with the ones previously accepted or rejected for that service.
2. Click the link for any of the listed core services. The page refreshes and displays detailed status for that service.

   The details page for a core service provides the following information:
   - **Status**: Shows whether the recommendation is new.

- **Detection Model**: Indicates with method the PCE used to detect the service.
- **Server**: Displays the IP addresses and workloads recommended for that particular core service. The column includes either a defined workload or an unknown IP address.
- **Labels**: For a defined workload, displays the existing labels.

To see the following details about the service in a pop-up dialog box, click either the detection method or the value in the **Server** column.



windows-dc

Top Detected Processes by Number of Ports

Process Name	Ports	Peers
DFSR	49668 TCP,	1
DNS	389 TCP,	1
dns.exe	53 UDP,	6
dsregcmd.exe	49668 TCP, 135 TCP, 389 TCP,	5
Kdc	49668 TCP, 88 TCP,	6
LDAPServer	389 TCP,	5
lsass.exe	135 TCP, 49675 TCP, 88 TCP, 389 UDP, 49668 TCP, +1 more	6
msiserver	80 TCP,	1
msmpeng.exe	443 TCP,	1
RpcSs	135 TCP,	5
slnclient.exe	443 TCP,	1
SMB	445 TCP,	5
ssm-agent-worker.exe	80 TCP,	1
svchost.exe	5355 UDP, 53 UDP, 80 TCP, 135 TCP, 5353 UDP, +5 more	7
System	445 TCP, 0 IGMP, 138 UDP, 0 ICMPv6, 5986 TCP	8

3. Accept or reject the core service by clicking the buttons on the right.

   Accept: If the core service is from an unknown IP address, clicking **Accept** creates an unmanaged workload such as 35.251.68.112.

   > **NOTE**
   >
   > Illumio encourages customers to create unmanaged workloads, install VENs on the unmanaged workloads so that they become managed, and then label them to allow enforcement.

   Reject: When you reject the recommendation, that IP address is no longer recommended as a Destination of the detected core service.

   Follow Up: If you are unsure whether to accept the recommendation, leave a note about your reasons to help in later decision-making.

Label the Detected Core Services

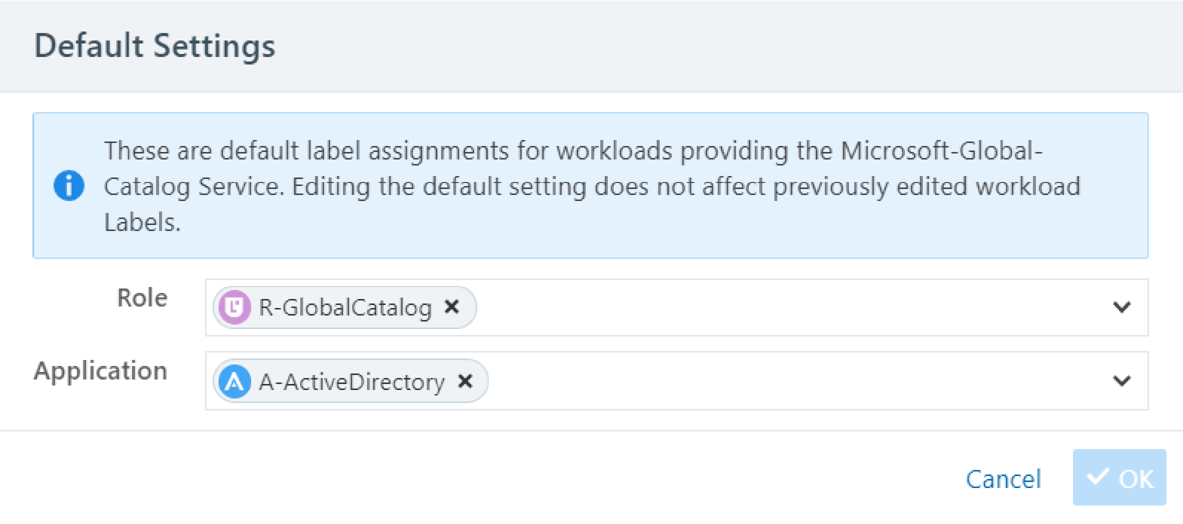
1. Once you have accepted a recommendation to label a service, select the **Accepted** tab the Core Services page.

   Each service type has its own recommended label.
2. Click **Edit Labels** to see what the current labels are. The **Edit Labels** screen shows the current labels on the left and the recommended label on the right. The types of labels shown include Role, Application, Environment, Location, and any custom label types you have defined using flexible labels.

3. Click **OK** to accept the recommended labeling.

   The page refreshes and displays the labels added for the core service.
4. When required for your network environment, change the default labels by selecting the **Edit Default Settings** button and modifying the labels as necessary.

IMPORTANT
To change the default label assignments, you must be an Illumio Org Administrator.



Default Settings

These are default label assignments for workloads providing the Microsoft-Global-Catalog Service. Editing the default setting does not affect previously edited workload Labels.

Role: R-GlobalCatalog

Application: A-ActiveDirectory

NOTE
Changing the default label assignment does not change any of the previously edited workload labels.

Scanner Detection

Scanners running in a network can be automatically detected, much as services are detected.

IMPORTANT
Scanner detection by default is not enabled. You must manually enable scanner detection at the Core Services page. After being enabled, scanner detection runs every 24 hours to detect scanner traffic.

After a scanner is detected, the `src_port` can be used to create a collector-side traffic filter, so that traffic originating from that `src_port` will be dropped and not stored in the PCE.

Rulesets

You can use rulesets to write policy so the workloads in your application can communicate with each other. A ruleset consists of rules and scopes:

- Rules define which workloads are allowed to communicate.
- Scopes define which workloads the rules are applied to.

NOTE
In previous releases, this feature was referred to as “Segmentation Rulesets.” In Illumio Core 21.5.0 and later releases, this feature is referred to as “Rulesets.” Some images might still display the previous feature name.

Basic versus Scoped Rulesets

You have the option to create basic or scoped rulesets. You can choose whether you want to include scopes when creating new rulesets. The **Scope** field appears in the **Add Ruleset** dialog box only when the PCE is configured to display scopes in rulesets. When the PCE is configured to create scopeless rulesets, you create simple rules that do not apply to specific environments, locations, applications, or other categories you may have defined using flexible label types. These rules are scopeless rules because they do not belong to a ruleset that uses scopes.

You might want to create these basic rules when you are new to using Illumio Core and you are creating your first security policy rules. For example, you might want to create a simple rule to control SSH traffic for all your workloads. As you become more familiar with Illumio Core or you need to create more complicated rules, you can choose to create scoped rules; namely intra-scope, extra-scope, and custom iptables rules. Creating scoped rules allows you to create rulesets and rules that are defined for specific environments, locations, applications (typically larger environments), or other categories you define in flexible label types.

When the PCE is configured to create scopeless rulesets, you can still add a scope to a ruleset after saving the ruleset. From the **Ruleset Actions** menu at the top right corner of the **Ruleset** page, select **Add Scope**.

NOTE
The ability to create scoped rules is only enabled when the PCE is configured to display scopes.

Behavior of Scopeless Rulesets in PCE Web Console

The following details apply to scopeless rulesets in the PCE web console:

- A option in the Policy Settings page determines whether new rulesets are created with or without scopes. However, the permission every Illumio Core user has to create rulesets is always based on the scopes they have access to even when the PCE is configured to create scopeless rulesets. Stated another way, disabling scopes in rulesets does not invalidate the Ruleset Manager or Ruleset Provisioner roles used for user authentication (also known as role-based access control).
- When the PCE is configured to create scopeless rules, the Ruleset details page for a ruleset displays a single **Rules** tab where you add basic rules, including container hosts as consumers.
- When you add a scope to a scopeless ruleset after creating the ruleset, the page refreshes and displays **Intra-scope Rules** and **Extra-scope Rules** tabs. If any rules include container hosts for consumers, those rules are moved to the **Extra-scope Rules** tab.
- Adding custom iptables rules is not available for scopeless rulesets. To create custom iptables rules, you must add a scope to the ruleset.
- When you remove all scopes from a ruleset, the PCE merges the rules in the **Intra-scope Rules** and **Extra-scope Rules** tabs into a single **Rules** tab. However, any custom iptables rules created in the ruleset remain in the **Custom iptable Rules** tab.

Ruleset Scope

NOTE

The Scope field only appears when the PCE is configured to display it.

The scope of a ruleset determines which workloads receive the ruleset's rules and enables the rules in a ruleset to apply to workloads in a group (one scope).

When workloads share the same set of labels defined in a ruleset's scope, those workloads receive all the rules from the ruleset. When you add a second scope, all the workloads within both scopes receive the rules from the ruleset.

A single scope is defined by using labels that identify the workload:

- **Application:** To what application (for example, ERP or HRM) do these workloads belong?
- **Environment:** Which type of environment (for example, development, production, or testing) describes these workloads?
- **Location:** Where are these workloads located—either physically (for example, rack server or AWS) or geographically (for example, US, EU, or CA)?
- **Flexible labels:** If you have defined custom label types, you can use them to define a scope.

NOTE

The Role label should not be used in the scope.

For example, a scope (or collection of workloads that the rules are applied to) is defined as ERP | Prod | US, which means that the rules apply to any workload that meets the following three requirements:

- Workloads in the ERP application
- Workloads in the Prod (Production) environment
- Workloads in the US location

That example is relatively simple, but combining rules and scopes can be used to create complex security policies.

For example, the following ruleset (scope + rules):

Scope		
App	**Environment**	**Location**
HRM	Prod	US
Rules		
Source	**Destination**	**Service**
Processing	DB	MySQL
Web	Processing	Tomcat
Corp-HQ	Web	Apache

Allows the following communication:

- Processing | HRM | Prod | US → DB | HRM | Prod | US
- Web | HRM | Prod | US → Processing | HRM | Pod | US
- Corp-HQ | HRM | Prod | US → Web | HRM | Prod | US

Single Ruleset Scopes

Using a single scope in a ruleset narrows the list of workloads that the rules apply to and allows workload cross-communication.

When you are defining rules, you have the option of using the “All” label in the scope. The “All” label applies to all instances of that label type (Application, Environment, Location, or a flexible label type that you have defined). For example, creating a rule with a scope of “All | All | All” means that the rule applies to all workloads.

When you create a rule with a scope of “HRM | All | US,” this rule applies only to workloads using the HRM and US labels, regardless of Environment (“All”). For example, the following ruleset:

Scope		
App	**Environment**	**Location**
HRM	(unspecified)	US
Rule		
Source	**Destination**	**Service**
Processing	DB	MySQL

Means “The HRM application in the US can initiate communications between Processing and DB in any environment” and allows the following communication:

NOTE

(1) Assume below that “Dev” and “Prod” are types of Environment labels.

(2) When no label is specified in the scope for a given dimension, any label for that dimension is within the scope.

- Processing | HRM | (Env label unspecified) | US | → DB | HRM | Anything | US

- or -

- Processing | HRM | Dev | US | → DB | HRM | Dev | US
- Processing | HRM | Prod | US | → DB | HRM | Dev | US
- Processing | HRM | Dev | US | → DB | HRM | Prod | US
- Processing | HRM | Prod | US | → DB | HRM | Prod | US

Multiple Ruleset Scopes

NOTE

The Scope field only appears when the PCE is configured to display it.

Using multiple scopes in a ruleset applies the rules to each scope in isolation and does not allow workload cross-communication.

For example, consider the following ruleset:

Scope		
App	**Environment**	**Location**
HRM	Prod	US
HRM	DEV	US
Rule		
Source	**Destination**	**Service**
Processing	DB	MySQL

This rule and scope state:

“Workloads using the HRM application in the Prod environment in the US can initiate communications between Processing and the DB."

And

"Workloads using the HRM application in the Dev environment in the US can initiate communications between the Processing and the DB.”

The rule and scope **do not** state:

“Workloads using the HRM application in the Prod and Dev environments in the US can initiate communications between the Processing and the DB.”

This example **does** allow the following communication:

- Processing | HRM | Prod | US → DB | HRM | Prod | US

And

- Processing | HRM | Dev | US → DB |HRM | Dev | US

But **not**

- Processing | HRM | Prod | US → DB |HRM | Dev | US

Combine Labels in Scopes and Rules

NOTE

The Scope field only appears when the PCE is configured to display it.

When the same type of label is used multiple times in a rule, they are expanded as multiple rules with one label for each rule.

The following examples further demonstrate how scopes work with rules.

The following ruleset:

Scope		
App	**Environment**	**Location**
HRM	(unspecified)	US
Rules		
Source	**Destination**	**Service**
Dev	Prod	MySQL
DB	DB	MySQL

IMPORTANT

When no label is specified in the scope for a given dimension, any label for that dimension is within the scope.

Means:

“Allow the database used by the HRM application in the Dev environment to communicate with the database used by the HRM application in the Prod environment”

and allows the following communication:

DB | HRM | Dev | US → DB | HRM | Prod| US

The following ruleset:

Scope		
App	**Environment**	**Location**
(unspecified)	(unspecified)	US
Rules		
Source	**Destination**	**Service**
ERP	HRM	MySQL
Dev	Prod	MySQL
DB	DB	MySQL

IMPORTANT
When no label is specified in the scope for a given dimension, any label for that dimension is within the scope.

Means:

“Allow the database used by the ERP application in the Dev environment located in the US to communicate with the database used by the HRM application in the Dev environment located in the US”

And allows the following communication:

DB | ERP | Dev | US → DB | HRM | Dev | US

The following ruleset:

Scope		
App	**Environment**	**Location**
(unspecified)	Dev	US
(unspecified)	Prod	EU
Rules		
Source	**Destination**	**Service**
ERP	HRM	MySQL
DB	DB	MySQL

IMPORTANT

When no label is specified in the scope for a given dimension, any label for that dimension is within the scope.

Allows the following communication:

- ERP | (App label unspecified) | Dev | US → HRM | All | Dev | US
- ERP | (App label unspecified) | Prod | US → HRM | All | Prod | US
- DB | (App label unspecified) | Dev | US → DB | All | Dev | US
- DB | (App label unspecified) | Prod | US → DB | All | Prod | US

NOTE

When the service in a rule is DNS, the consumer must be an IP List.

Enable or Disable Scopes for Rulesets

In Illumio Core 22.2.0 and later releases, you can control whether rulesets use a scope.

The *Scope* field appears in the **Add Ruleset** dialog box only when the PCE is configured to display scopes in rulesets.

IMPORTANT

You must have Global Administrator access to the PCE to manage PCE settings and configuration.

To globally enable or disable scopes in the PCE:

1. From the PCE web console main menu, choose **Settings** > **Policy Settings**.
2. Click **Edit**.
3. In the *Scopes in Rulesets* section, toggle between **Yes** and **No** for the Display Scopes in Rulesets value depending on whether you want to enable scoped rulesets in the PCE.
4. Click **Save**.

Ruleset Status

You can view the ruleset status on the Rulesets page. The current status of each ruleset (enabled or disabled) is displayed in the Status column. When you change a ruleset but have not yet provisioned the change, the type of change (addition, deletion, or modification) appears in the Provision Status column with the word “Pending” to indicate that these changes must be provisioned to be applied.

Filter the Rulesets List

You can filter the rulesets list using the label and property filter at the top of the list. You can filter the list by entering a label type to show only those rulesets that use the selected labels. You can further filter the list by selecting specific properties of the rulesets. For example, you can filter the list by provision status, such as rulesets that are in draft state and have not yet been provisioned.

Create a Ruleset

NOTE

This procedure provides the steps to create a ruleset when scoped rulesets are enabled for the PCE. If scoped rulesets are disabled for the PCE, you can always add a scope after creating the ruleset.

You can create a ruleset to write rules that define the allowed communication between workloads in a single group or multiple groups. See "Groups in Illumination" in the Visualization Guide for information.

When you write a rule for a Windows workload, you can add a Windows service name without specifying a port or protocol and the rule will allow communication for that service over *any* port and protocol.

The following task creates a single scope, which means the rules in the ruleset apply to a single group. To apply the rules to another group, add a second scope, which is indicated by the group's labels.

To create a ruleset:

1. From the PCE web console menu, choose **Policy > Rulesets & Rules**.
2. Click **Add**.
3. Enter a name for the ruleset.
4. In Scope, select the labels for the ruleset: Application, Environment, Location, or any custom label types you have defined using Flexible Labels.

   These labels define the scope for your ruleset, which is the range or boundary of your ruleset. The scope defines the workloads affected by this ruleset, which is all workloads that share the same labels in the scope.

   NOTE

   The Scope field only appears when the PCE is configured to display it.
5. Click **Save**.

Now that the ruleset is created, you can add rules to define your security policy. See Rules [85] for information about the types of rules you can add.

NOTE

Illumio recommends creating no more than 500 rules per ruleset, or the PCE web console will not be able to display all of the rules.

If you want to create a ruleset with more than 500 rules, Illumio recommends splitting the rules across multiple rulesets or using the Illumio Core REST API, where there is no limit on the number of rules you can create per ruleset.

Add a Scope to a Scopeless Ruleset

When the PCE is configured to create scopeless rulesets, you can still add a scope to an existing ruleset.

1. Click the name of a ruleset to display the Ruleset details page.
2. Select **Add Scope** from the **Ruleset Actions** menu at the top right corner of the page.

   The page refreshes and displays a dropdown list to select an existing scope.
3. Open the **Select Scope** list and select the labels you want to include for the ruleset scope.
4. When done selecting labels, exit the dropdown list and click the **Save** icon.

   The page refreshes and the new scope appears at the top of the page.

Create a Ruleset with Multiple Scopes

> **NOTE**
>
> The Scope field only appears when the PCE is configured to display it.

You can create rulesets with multiple scopes to define the allowed communication between workloads in one or more groups.

See "Groups in Illumination" in the Visualization Guide for information.

How you define the scope in a ruleset enables you to write rules for workloads in multiple groups (two or more scopes). Each scope corresponds to one group. The scope defines the boundaries of the rules in the ruleset.

To create a multi-scope ruleset:

1. From the PCE web console menu, choose **Policy > Rulesets & Rules**.

   The Rulesets list page appears.
2. Click **Add**.
3. Enter a name for the ruleset.
4. In the Scope section, set the labels that define the scope by selecting them from the drop-down lists. You can use Application, Environment, Location, or any custom label types you have defined using flexible labels.
5. After you select the labels, click **Save**.

   The page refreshes and the Scopes and Rules tab appears.

   > **NOTE**
   >
   > To edit the Scope, click the Edit icon ✎.
6. To add another scope, click the Add Scope icon (+).

   A new field with a dropdown list appears in the Scopes section.
7. Set the labels for the new scope and click the Save icon at the end of the row.

This addition is pending, so you need to provision the new ruleset in order for the rule to take effect. See Provisioning [108] for more information.

> **NOTE**
>
> This task contains the steps to define multiple scopes in the ruleset. For information about rules to the ruleset, see Rules.

Duplicate a Ruleset

When you have a ruleset that you want to use to create other new rulesets, you can duplicate an existing ruleset.

1. From the PCE web console menu, choose **Policy > Rulesets & Rules**.
   The Ruleset list page appears.
2. Click the ruleset, then **Ruleset Actions > Duplicate Ruleset**.
   The Duplicate Ruleset dialog appears.
3. Rename the copy of the ruleset.

   > **NOTE**
   > The default name is “Copy of [Ruleset Name]” (where [Ruleset Name] is the name of the original Ruleset).

4. Click **Save**.

After saving the new duplicate ruleset, make any needed scope or rule changes and then provision to apply them. See Provisioning [108] for more information.

Rules

Rules allow communication between multiple applications or entities in different scopes or the same scope. To write a rule, you need to define three things: A service, a Source, and a Destination for the service. You also need to select the type of rule:

- **Intra-scope rule:** Allow communication within a group. The ruleset scope applies to both Sources and Destinations.
- **Extra-scope rules:** Allow communication between groups.
- **Custom iptables rules:** Allows custom iptables configurations in a ruleset. These rules are managed by the PCE and applied on each managed Linux workload VEN that matches the labels for the scope and receivers.

About Rules

Illumio supports the delegation of rule writing using role-based access control (RBAC). Application administrators can only edit rules where the scope of the ruleset matches the scopes where they have administrator privileges. They cannot create or manage rulesets if the scope includes “All.”

Rule types allow the application administrator to write rules allowing other applications to communicate with the applicationsthey manage without requiring global administrator privileges. This feature allows users to group rules required for inter-application and intra-application communication for a specific application into one ruleset.

You can combine multiple types of rules (intra-scope, extra-scope, and custom iptables) in a single ruleset.

You can use multiple services or ports and protocols in a rule. This approach helps reduce the number of rules in your PCEs, which helps improve the PCE performance.

NOTE

You cannot provision drop actions from the PCE in a NAT table for custom IP tables. Doing so results in a firewall generation failure.

Intra-scope Rules

NOTE

The ability to create intra-scope rules is only enabled when the PCE is configured to display it.

Intra-scope rules allow authorized users to write rules that allow communication between providers and consumers within a specific scope. This rule type is typically used to allow communication between workloads that belong to the same application. For intra-scope rules, the labels used in the scope must match those used for both the provider and the consumer. If you don't specify a Label, "All" is used by default.

For example, you can create a rule where all Database workloads with the labels HRM | US | Dev can accept MySQL connections from all Web workloads with the HRM | US | Dev.

Extra-scope Rules

NOTE

The ability to create extra-scope rules is only enabled when the PCE is configured to display it.

Extra-scope rules allow authorized users to write rules that allow communication between applications. Specifically, you can write rules that allow providers within a scope to be accessed by consumers that can be in or outside the specified scope. For extra-scope rules, the labels used in the scope must match the labels used by the provider. If you don't specify a label, "All" is used by default.

For example, you can create a rule where all Database workloads with the labels HRM | US | Dev can accept connections on MySQL from all workloads with the label Web, irrespective of other labels.

MySQL might not belong to the HRM application (for example, the consumers are "Global" and are not restricted by the labels in the scope).

NOTE

If the RBAC user's scope coverage type is "Sources and Destinations," the user cannot select an IP list as the consumer. To select an IP list as a consumer in a rule, the scope coverage type must be "Sources Only."

Custom iptables Rules

NOTE

The ability to create iptables rules is only enabled when the PCE is configured to display it.

You might have configured iptables directly on your Linux workloads as needed for your application workloads as part of your host configuration. However, when you pair a workload and put a policy into the Visibility Only or Full enforcement mode, the VEN assumes control of the iptables to enact the policy and does not apply any pre-programmed iptables to the policy.

Custom iptables rules in Illumio Core provide the ability for you to program the custom iptables rules needed for your applications as part of the rules managed by the PCE. Custom iptables rules help preserve any configured iptables from native Linux host configurations by allowing you to include them with the rules for your policy.

To clarify:

- **iptables** refer to a Linux host configuration before the VEN is installed.
- **Rules** refer to statements written by the PCE to determine permitted traffic, typically by assuming control of iptables and programming the new rules.
- **iptables rules** refer to iptables that are inserted as rules onto the VENs and managed by the PCE.

Custom rules follow the iptables `-A` (append) command pattern:

`-t`*<table>*`-A`*<chain> <rule>*

Example:

```
-t filter -A INPUT -p tcp -s 10.10.10.10 --sport 8888 -j ACCEPT
```

Custom iptables rules consist of a list of iptables statements and the entities that receive the rules. Each rule can consist of a list of iptables rules, which allows users to group a sequence of rules for a specific function. The custom iptables rules are programmed after the Illumio PCE generates the iptables rules, but prior to the last default rule.

Before they is sent to the VEN, the custom iptables rules are checked for any unsupported tokens (such as names of firewall chains already in use by Illumio, matches against IP sets, and semicolons). If an unsupported token is included, the rule cannot be saved or provisioned.

If the VEN fails to apply a custom iptables rule because of a missing package or an incorrectly formatted rule:

- The error is reported to the PCE and is logged in the organization's events
- The error is displayed in the VEN policy sync status
- The new policy is not use,d and the last known successful policy is used instead

For policy distribution and enforcement, the VEN creates a custom chain that contains the rules for each table or chain in the iptables. Each custom chain is appended to the end of its corresponding chain in the correct table. When the VEN requests the policy, the iptables command is sent, including the chain where it should be placed.

For security reasons, custom iptables rules only support rules in the `mangle`, `nat`, and `filter` tables.

The following table describes the permitted actions for each iptables type:

Table Name	Chain Names	Custom Rules Support
`raw`	prerouting, output	No
`mangle`	prerouting, input, output, forward, postrouting	Yes
`nat`	prerouting, output, postrouting	Yes
`filter`	input, output, forward	Yes
`security`	input, output, forward	No

NOTE

If the RBAC user's scope coverage type is “Sources and Destinations,” the user cannot manage custom iptables rules. To allow access to custom iptables rules, the scope coverage type must be “Sources Only.”

Permitted Rule Writing Combinations

The following table explains the valid rule combinations between providers and consumers.

If Provider is	And Service is	Consumer can be
Workload, All workloads, label, label group	Any service	Workload , IP list (including Any (0.0.0.0/0 and ::/0), label, label group, user groups, All workloads
IP list	Any service	Workload, label, label group, user groups, All workloads
Uses virtual services	Not applicable (the service is derived from the virtual service)	Workload, label, label group, IP lists, All workloads, uses virtual service, uses virtual services and workloads
Uses virtual services and workloads	Any service	Workload, label, label group, IP lists, All workloads, uses virtual service, uses virtual services and workloads
Workload, All workloads, label, or label groups	Any service	User groups and one or more of the following: workload, All workloads, label, label groups

Stateless Rules

By default, all rules you write in the PCE are stateful, which means that the host's firewall keeps track of a connection for the entire duration of the session.

For workloads, you can specify stateless packet filtering for a rule (“stateless”: true). This means that the VEN instructs the host's firewall to *not* maintain persistent connections for all sessions. You can create this type of a stateless rule for datacenter core services, such as DNS and NTP.

Caveats

In a stateless rule, you can add the following policy objects as consumers:

- An individual workload
- A label (one each of a specific type, up to four total)
- Any IP list plus All workloads

Be aware also of the following when enabling stateless rules:

- Linux traffic does not get logged in the PCE
- Windows traffic gets logged in the PCE if connections are established
- Traffic is allowed in the opposite direction

If you attempt to add any other consumers, you receive an error.

The Illumio Core limits the number of stateless rules to 100, to ensure that both stateful and stateless rules coexist on the host in a way that optimizes system and network performance. If you need more than 100 stateless rules in your Illumio policy, contact your Illumio Professional Services Representative for more information.

WARNING

Existing active connections on workloads allowed by a stateless rule (for example, an SSH session) are terminated when workloads receive new rules from the PCE. Those connections need to be reestablished by the clients. For this reason, Illumio recommends that you use stateless rules for services that use high-frequency short-lived connections, such as DNS and SNMP.

Rule Search

When you have a large number of rules organized in rulesets, you can't easily search for rules across rulesets. Segmentation rule search solves this issue by making it simple to search for specific rules.

For example, when you want to know how many rules there are for SNMP (UDP 161) and you have around 200,000 rules organized across 700 rulesets, it is time-consuming to narrow down that search without using this feature.

You can search for and analyze rules that allow communication over a specific port and protocol.

- Segmentation Rule Search allows you to quickly find rules that apply to a set of providers and consumers.
- Providers and consumers can be represented by a workload, an IP address, or a set of labels.
- Using this feature helps you identify rules that are getting applied to your workloads due to unnecessarily broadly applicable rulesets or human errors.

To search for rules:

1. From the PCE web console menu, choose **Policy > Rulesets & Rules**.
   The Rulesets and Rules page appears.
2. Choose the **Rule Search** tab.
3. Search for Active or Draft rules.
4. Perform a Basic or Advanced search of your rules:
   - Basic: Searches all attributes
   - Advanced: Searches by source, destination, or both.

   NOTE

   When you perform an advanced search by workload name, the search results do not display the IP list rules when the iplist contains workload IP addresses because the Illumio Core does not resolve CIDRs and ranges within an IP list.
5. From the Results drop-down list, choose to either have the exact match of the selected search filters to be displayed or a match to any of the selected filters (All Results).
6. Click the Customize columns drop-down list to select the attributes you want to be displayed in the search results.

7. Filter options to further narrow your search.
8. Click **Run**.
9. In the Ruleset column, you can click a ruleset name and make changes to the rules.
10. Click **Download** to download the results of your search in JSON format.

Rules for Application Policies

Illumio allows or denies traffic between applications using policies that you write. To write application policies, you must create rules for the policy.

Illumio has the following types of rules for application policies:

Override Deny Rules

- This rule type is typically used to deny communication between sources and destinations that might inadvertently be given to allow rules by another administrator. Override Deny rules take precedence over all other types of rules.

Allow Rules

- You can write rules that allow communication between sources and destinations.

Deny Rules

- You can write rules that deny communication between sources and destinations.

Custom IPtables Rules

- You can write rules for Linux workloads.

Policy Check

The Policy Check feature allows you to determine if a rule allowing communication between workloads or between a workload and another IP address already exists. On the Policy Check page, you select two workloads or IP addresses to determine if a rule exists to allow communication between them. Policy check can use a network profile to account for rules affecting outbound traffic to non-corporate interfaces on endpoints. Servers cannot have non-corporate interfaces.

NOTE

You can do a policy check between two workloads, or between a single workload and a single IP address.

For example, you have created several rulesets for your workloads and applications, and you want to know whether your organization has an existing rule for that traffic before you start writing new rules that duplicate those existing rules.

To perform a policy check:

1. From the PCE web console menu, choose **Troubleshoot** > **Policy Check**.
2. In the *Source* field, type or select a workload or IP address.
3. In the Destination field, type or select a workload or IP address.
4. In the Destination Port and Protocol field, enter a port and protocol when the connection is running over TCP or UDP, or just a protocol when the connection is running over GRE or IPIP.
5. In the Network Profile field, choose either Corporate, Non-Corporate Networks (Endpoints Only), or Any.

   If an IP address is specified in both Consumer and Provider fields, the Network Profile value must by Corporate -- that is, searching within the internal corporate network only.
6. Click **Check Rules**.

   If a connection is allowed between the selected two workloads or IP addresses, the page will display at least one rule that allows the connection.

   When a rule does not exists, the page displays “No Rules exist to allow that connection.”

Rule Writing

This section explains how to write various rules.

Permitted Rule Writing Combinations

The following table explains the valid rule combinations between sources and destinations.

If Source is	And Service is	Destination can be
Workload, All workloads, label, label group	Any service	Workload , IP list (including Any (0.0.0.0/0 and ::/0), label, label group, user groups, All workloads
IP list	Any service	Workload, label, label group, user groups, All workloads
Uses virtual services	Not applicable (the service is derived from the virtual service)	Workload, label, label group, IP lists, All workloads, uses virtual service, uses virtual services and workloads
Uses virtual services and workloads	Any service	Workload, label, label group, IP lists, All workloads, uses virtual service, uses virtual services and workloads
Workload, All workloads, label, or label groups	Any service	User groups and one or more of the following: workload, All workloads, label, label groups

Stateless Rules

By default, all rules you write in the PCE are stateful, meaning the host's firewall keeps track of a connection for the entire session duration.

For workloads, you can specify stateless packet filtering for a rule (“stateless”: true). This means that the VEN instructs the host's firewall to *not* maintain persistent connections for all sessions. You can create this type of stateless rule for data center core services, such as DNS and NTP.

Caveats

In a stateless rule, you can add the following policy objects as Destinations:

- An individual workload
- A label (one each of a specific type, up to four total)
- Any IP list plus All workloads

Be aware also of the following when enabling stateless rules:

- Linux traffic does not get logged in the PCE
- Windows traffic gets logged in the PCE if connections are established
- Traffic is allowed in the opposite direction

If you attempt to add any other Destinations, you receive an error.

The Illumio Core limits the number of stateless rules to 100 to ensure that both stateful and stateless rules coexist on the host in a way that optimizes system and network performance. If you need more than 100 stateless rules in your Illumio policy, contact your Illumio Professional Services Representative for more information.

⚠ **WARNING**

Existing active connections on workloads allowed by a stateless rule (for example, an SSH session) are terminated when workloads receive new rules from the PCE. Those connections need to be reestablished by the clients. For this reason, Illumio recommends using stateless rules for services that use high-frequency short-lived connections, such as DNS and SNMP.

Rule-Based Labeling

Rule-based labeling allows you to assign labels to one or more workloads when their attributes match the conditions you specify in easily-configurable rules. This simplifies the task of labeling multiple workloads.

Before you begin

- Label assignment:
  - You can assign system default and user-defined labels to matching workloads.
  - You can assign only one label of a given type to a workload.
  - Rule-Based Labeling assigns labels to workloads but doesn't replace existing labels already assigned to workloads. For example, if a matching workload has an existing Location label of New York and your labeling rule specifies a Location label of London, the existing New York Location label is preserved and the London Location label is bypassed.
- Depending on how many workloads match labeling rules, it may take a few minutes for the labels to be assigned to all of them. You can navigate to other areas of the PCE UI while the load process continues in the background. When matching and loading has finished, a notification appears wherever you are in the PCE user interface.

- An event is created when a rule-based label is assigned to a workload. The name format of the event differs depending on how the label is assigned:
  - When assigned from the PCE UI: `label_mapping_rules_run.assign_labels`
  - When assigned from a system job: `system_task.automatic_label_application_for_new_vens`
- It's not possible to remove a label from the list of labels (**Policy Objects > Labels**) if it's used in a labeling rule.

Typical Labeling Rule Workflow

Here is a typical workflow for adding rules, launching a search for matching workloads, and assigning labels.

Step 1: Add a Labeling Rule

Labeling rules work by identifying workloads in your environment that match certain conditions you specify and then assigning one or more labels to those workloads. See Add a Labeling Rule [94].

Step 2: Find and review matching workloads

After adding labeling rules, let the Rule Labeling feature search your environment for workloads that match the rule conditions, and then review the generated list of workloads. See Find and Review Matching Workloads [95].

Step 3: Assign labels to matching workloads

Once the feature finds matching workloads, you can assign the labels you specified in Step 1: Add a Labeling Rule. See Assign labels to matching workloads [95].

Work with Labeling Rules

This section describes how to add, remove, reorder, edit, and enable/disable labeling rules. It also includes procedures for finding and matching workloads and exporting a list of labeling rules to a CSV file.

Add a Labeling Rule

Labeling rules work by identifying workloads in your environment that match conditions you specify and then assigning one or more labels to those workloads.

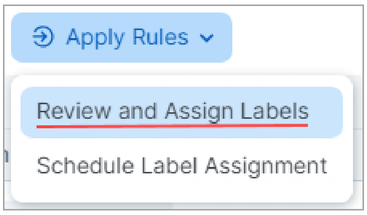
1. Identify the workloads you want to label by examining the workloads on the Workloads page and then take note of the attributes you'll need to specify in later steps.
2. Go to **Policy Objects > Labels**.
3. Click the **Labeling Rules** tab.
4. Click **Add**.
5. Specify the matching condition. (For terminology and matching logic, see How Label Matching Works [100].)
   - Add an attribute.
   - Add an operator.
   - Add one or more values.

6. Select one or more labels in the **Label** field.
7. Click **Save**.

Find and Review Matching Workloads

This procedure describes how to search your environment for workloads that match the rule conditions.

1. Go to **Policy Objects > Labels**.
2. Click **Apply Rules** and then choose **Review and Assign Labels**.



   The Workloads that match criteria side panel opens showing the workloads in your environment that match your rules (if any).

   > **NOTE**
   >
   > Depending on the number of workloads that match labeling rules, it may take several minutes for the PCE to load the workloads that match your rules. You can close the **Workloads that match criteria** side panel while the load process continues in the background. A progress message appears on the main page while the operation is underway. When matching and loading has finished, a notification appears wherever you are in the PCE user interface.

3. Review the list to ensure it includes the workloads you want your rules to match. If the list doesn't include the workloads you intended, click **Close**, recheck the condition(s) you specified in the rule(s), and then modify the rules if necessary. You may need to return to the Workloads page and re-examine the workloads to make sure you've specified the correct workload attributes in your rule(s).
4. If the list of matching workloads meets your expectations, assign the specified labels [95].

Assign labels to matching workloads

This procedure describes the different ways to assign labels to the workloads that match your labeling rules.

1. Go to **Policy Objects > Labels**.
2. Make sure the **Workloads that match criteria** side panel is open (see Find and Review Matching Workloads [95]).
3. Choose how you want to assign labels to matching workloads.
   - Immediately: From the **Workloads that match criteria** side panel, click **Assign** if you want to assign labels immediately. The message **Labels have been assigned to _ workloads** appears.
   - At specific times and intervals. See Schedule Label Assignment [95].
   - When VENs are activated. See Schedule Label Assignment [95].

Schedule Label Assignment

If you aren't assigning labels immediately in the Assign labels to matching workloads [95] procedure, perform these steps to specify when you want them to be assigned.

1. From the **Apply Rules** drop-down list, click **Schedule Label Assignment**.
2. In the **Recurring Rule Application** dialog box, select one or both of the following options:
   - Apply rules when triggered. Select if you want to automatically assign the specified label(s) to the matching workload(s) whenever a VEN is activated. (For details, see VEN Administration Guide "Pairing and Activating the VEN").
   - Apply rules regularly. Select if you want the specified label(s) to be applied automatically according to a schedule that you configure.
3. Click **Done**.

Edit a Labeling Rule

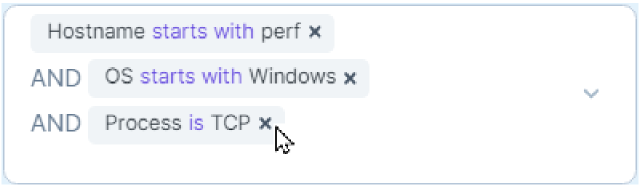
You can edit a rule's condition and label(s). To learn more about rule components, see Terminology [100].

To add a statement to an existing rule

1. Go to **Policy Objects > Labels**.
2. Click the **Labeling Rules** tab.
3. Click the Edit icon for the rule you want to edit.
4. Click the down arrow to activate the Condition selectors.
5. Specify the statement you want to add.
6. If needed, add or remove label(s) in the **Label** field.
7. Click **Save**.

To delete a value from an existing rule

1. Go to **Policy Objects > Labels**.
2. Click the **Labeling Rules** tab.
3. Click the **Edit** icon for the rule you want to edit.
4. On the condition you want to delete, click the **X** to delete it.



5. If needed, edit label(s) in the **Label** field.
6. Click **Save**.

To edit a value in an existing condition

> **NOTE**
>
> To change a value in an existing condition, you must delete the original condition and then re-add it, specifying the value you want. You can't directly edit a value in an existing condition and preserve it.
>
> For example, if you want to change the IP range
>
> ```
> 10.13.0.26-10.13.8.26
> ```
>
> to . . .
>
> ```
> 10.13.0.26-10.92.8.26
> ```
>
> . . . you must add the new range as a new condition and also delete the original condition.

1. Click the **Edit** icon for the rule you want to edit.
2. Click the down arrow to activate the Condition selectors.
3. Add the new statement [96].
4. Delete the original value [96].
5. If needed, edit label(s) in the **Label** field.
6. Click **Save**.

Enable/Disable Labeling Rules

The Enabe/Disable options allow you to generate different matching results by excluding or including one or more labeling rules from the workload matching process.

1. Go to **Policy Objects > Labels**.
2. Click the **Labeling Rules** tab.
3. Select one or more labeling rules in the list of rules.
4. Click **Enable** or **Disable**.
5. To see the effect of the enable/disable option you selected, re-run the workload matching process.

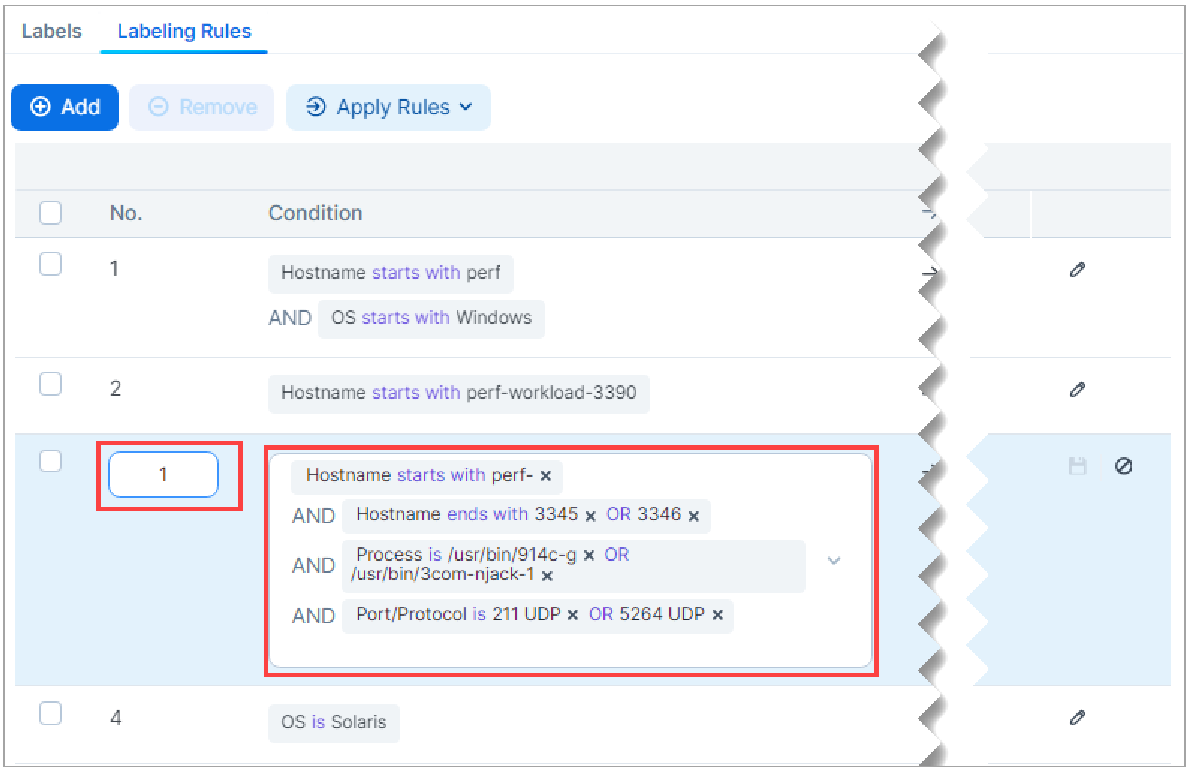
Reorder Labeling Rules

When labeling rules are applied, evaluation begins from the top of the list in ascending order (Rule 1, then Rule 2, etc), with Rule 1 having the highest precedence.

To change the precedence of a rule, change its rule number in the list of rules. Note that this will also reorder other rules in the list and change their precedence accordingly.

1. Go to **Policy Objects > Labels**.
2. Click the **Labeling Rules** tab.

3. Click the **Edit** icon for the rule you want to move. The rule number becomes an editable field.
4. Enter the new rule number in the field.
5. Click **Save**.

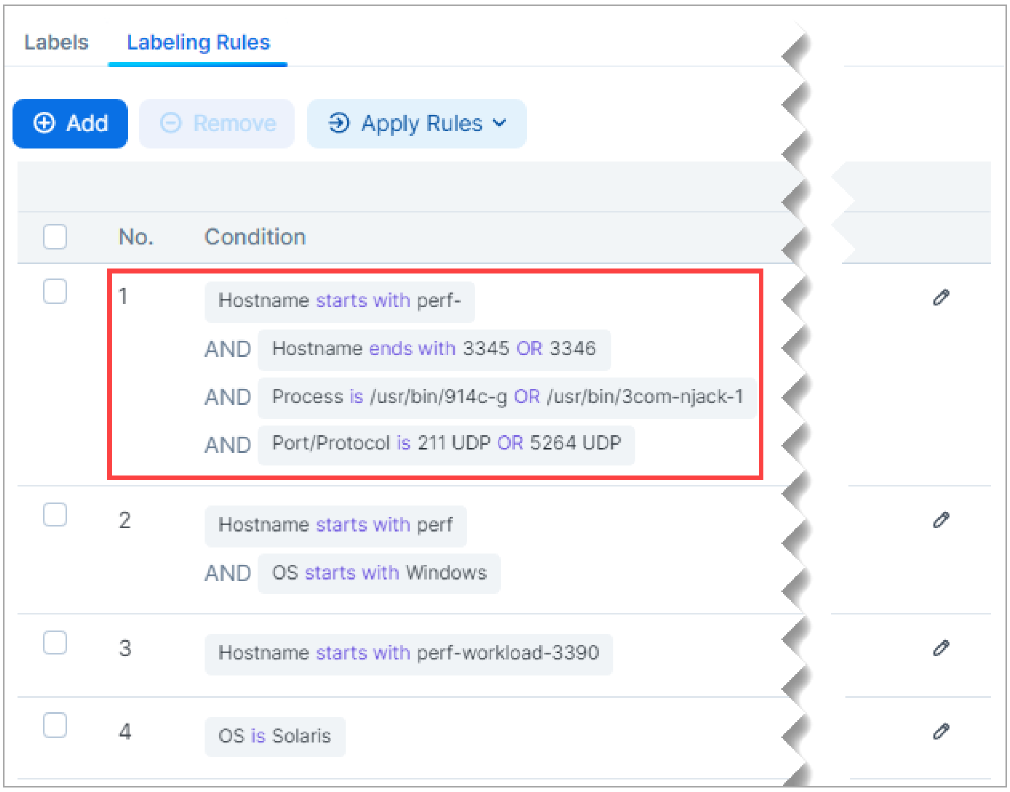


	No.	Condition
□	1	Hostname starts with perf AND OS starts with Windows
□	2	Hostname starts with perf-workload-3390
□	1	Hostname starts with perf- × AND Hostname ends with 3345 × OR 3346 × AND Process is /usr/bin/914c-g × OR /usr/bin/3com-njack-1 × AND Port/Protocol is 211 UDP × OR 5264 UDP ×
□	4	OS is Solaris

NOTE

Note that reordering rules changes the precedence of other rules.

- The former Rule 3 becomes Rule 1 with the highest precedence.
- The former Rule 1 moves to become Rule 2.
- The former Rule 2 moves to become Rule 3.



☐	No.	Condition
☐	1	Hostname starts with perf- AND Hostname ends with 3345 OR 3346 AND Process is /usr/bin/914c-g OR /usr/bin/3com-njack-1 AND Port/Protocol is 211 UDP OR 5264 UDP
☐	2	Hostname starts with perf AND OS starts with Windows
☐	3	Hostname starts with perf-workload-3390
☐	4	OS is Solaris

Remove Labeling Rules

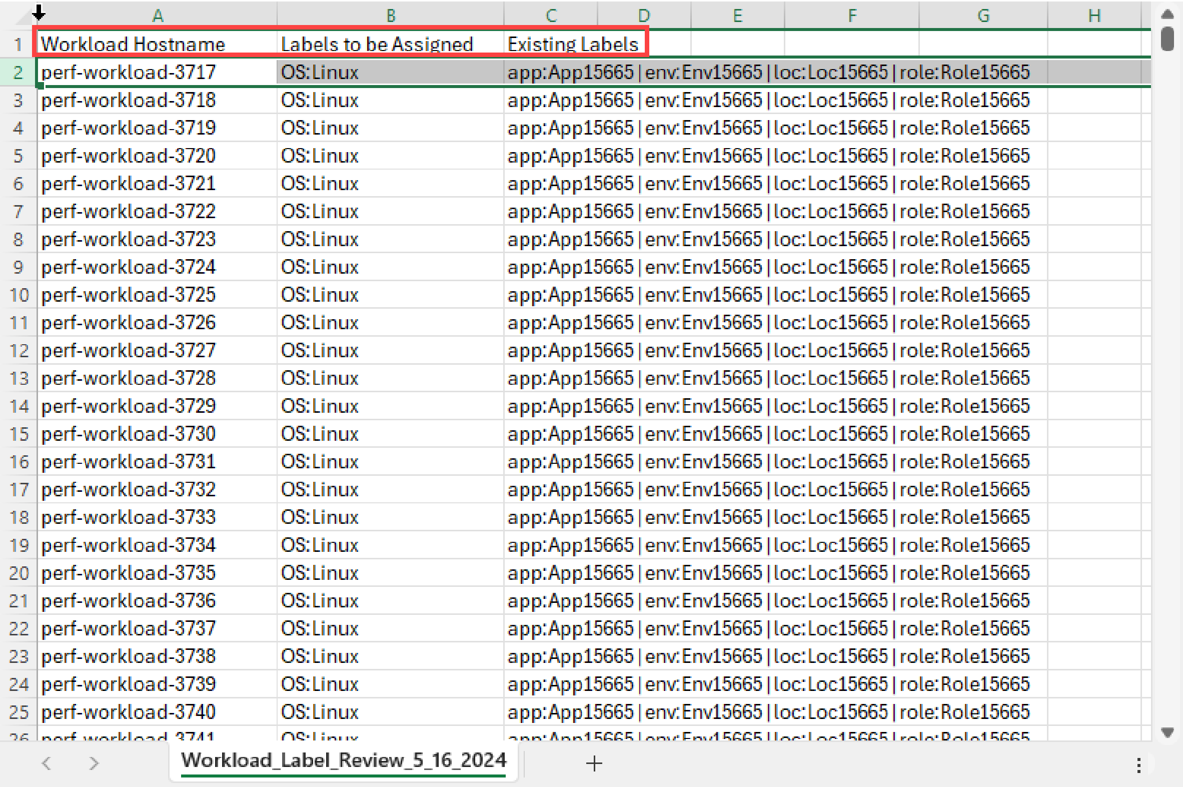
1. Go to **Policy Objects > Labels**.
2. Click the **Labeling Rules** tab.
3. Select one or more labeling rules in the list of rules.
4. Click **Remove**.

Export a Workload-Label-Review List

You can export a CSV file showing the workloads that match your rules and the label(s) that will be assigned to those workloads. This is helpful when you have a large number of rules and workloads.

1. Go to **Policy Objects > Labels**.
2. Click the **Labeling Rules** tab.
3. Click **Apply Rules** and then click **Review and Assign Labels**.
4. On the **Workloads** that match criteria side panel, click **Export**.

   The generated CSV file is downloaded to your Downloads folder with a filename similar to `Workload_Label_Review_(month_day_year)`.
5. Open and review the CSV file.



	A	B	C	D	E	F	G	H
1	Workload Hostname	Labels to be Assigned	Existing Labels					
2	perf-workload-3717	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
3	perf-workload-3718	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
4	perf-workload-3719	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
5	perf-workload-3720	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
6	perf-workload-3721	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
7	perf-workload-3722	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
8	perf-workload-3723	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
9	perf-workload-3724	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
10	perf-workload-3725	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
11	perf-workload-3726	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
12	perf-workload-3727	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
13	perf-workload-3728	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
14	perf-workload-3729	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
15	perf-workload-3730	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
16	perf-workload-3731	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
17	perf-workload-3732	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
18	perf-workload-3733	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
19	perf-workload-3734	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
20	perf-workload-3735	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
21	perf-workload-3736	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
22	perf-workload-3737	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
23	perf-workload-3738	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
24	perf-workload-3739	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
25	perf-workload-3740	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					
26	perf-workload-3741	OS:Linux	app:App15665 | env:Env15665 | loc:Loc15665 | role:Role15665					

How Label Matching Works

This section provides a detailed example of the Rule-Based Labeling feature's label matching logic. It also presents a brief list of terms used throughout this document.

When you click Review and Assign Labels to generate a list of workloads that match your labeling rules, workloads are evaluated against the conditions defined in the rules.

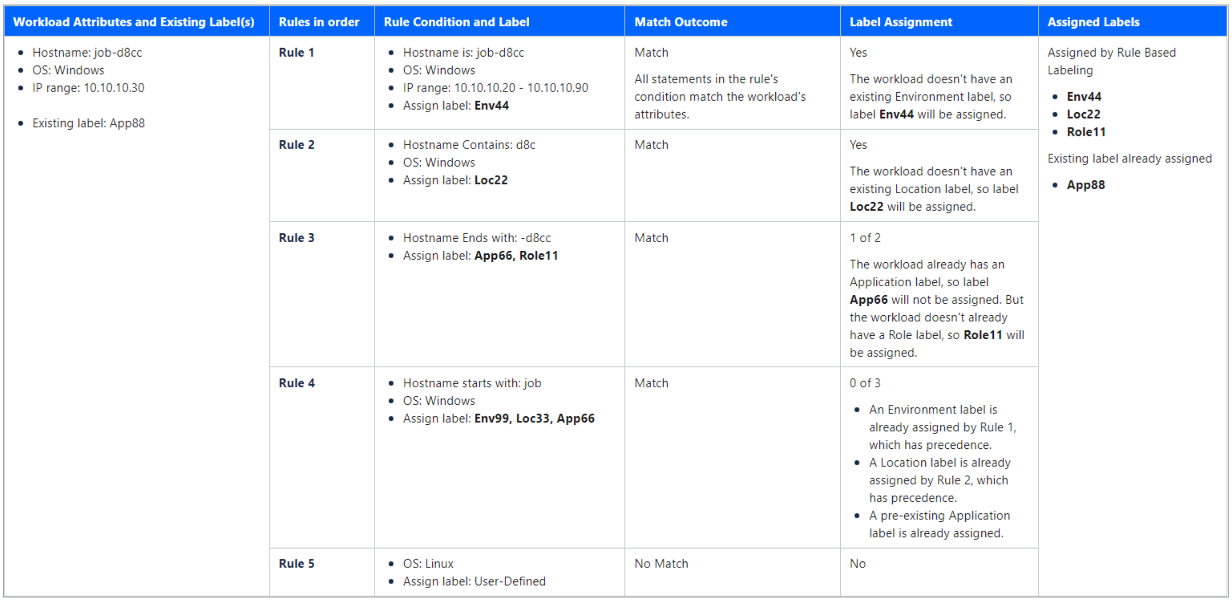
A match occurs if all of the statements in a rule's condition match a workload's attributes.

Terminology

- **Rule:** Rules consist of a condition and one or more label(s). If a workload matches the rule's condition, it is assigned the corresponding label(s), provided the workload has not already been assigned a label of the same type.
- **Condition:** Conditions are the user-defined criteria that workloads must match to be eligible for label assignment. A condition consists of one or more statements connected by AND, ensuring that workloads must satisfy all statements of the condition to match the rule.
- **Statement:** Statements define the specific workload attributes, operators, and values that are evaluated. Multiple values within a statement are considered using OR, allowing you to specify match criteria flexibly.
- **Precedence:** Rules are numbered, with Rule 1 having the highest precedence. A workload is evaluated against the rules in order, ensuring that rules with the labeling criteria most important to you are considered first.

Matching Logic

Example: Workload and Rule Evaluation



Workload Attributes and Existing Label(s)	Rules in order	Rule Condition and Label	Match Outcome	Label Assignment	Assigned Labels
• Hostname: job-d8cc • OS: Windows • IP range: 10.10.10.30 • Existing label: App88	**Rule 1**	• Hostname is: job-d8cc • OS: Windows • IP range: 10.10.10.20 - 10.10.10.90 • Assign label: **Env44**	Match All statements in the rule's condition match the workload's attributes.	Yes The workload doesn't have an existing Environment label, so label **Env44** will be assigned.	Assigned by Rule Based Labeling • **Env44** • **Loc22** • **Role11** Existing label already assigned • **App88**
	Rule 2	• Hostname Contains: d8c • OS: Windows • Assign label: **Loc22**	Match	Yes The workload doesn't have an existing Location label, so label **Loc22** will be assigned.	
	Rule 3	• Hostname Ends with: -d8cc • Assign label: **App66, Role11**	Match	1 of 2 The workload already has an Application label, so label **App66** will not be assigned. But the workload doesn't already have a Role label, so **Role11** will be assigned.	
	Rule 4	• Hostname starts with: job • OS: Windows • Assign label: **Env99, Loc33, App66**	Match	0 of 3 • An Environment label is already assigned by Rule 1, which has precedence. • A Location label is already assigned by Rule 2, which has precedence. • A pre-existing Application label is already assigned.	
	Rule 5	• OS: Linux • Assign label: User-Defined	No Match	No	

Labeling Rule Examples

This section provides several detailed examples of adding labeling rules.

Keep in mind the following as you add labels:

- The **operator** you select and the particular values you enter in the **Values** field allow you to control the granularity of the labeling rule.
- When you include multiple statements in a condition, Rule-Based Labeling automatically inserts an AND between the statements.
- When you specify multiple values in a statement, Rule-Based Labeling automatically inserts an OR between the values.

Example 1. Hostname Rule to match workloads that contain part of a specified host name

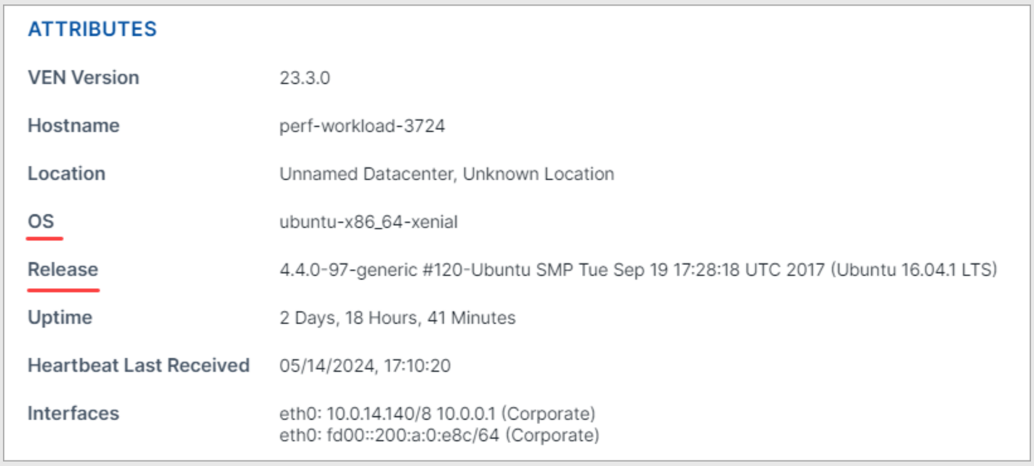
1. Select **Hostname** in the **Attribute** field.
2. Select contains in the **Operator** field.
3. Enter **AWS** in the **Values** field.
4. Click **Close**.
5. Select one or more labels in the **Label** field.
6. Click **Save**.

Example 2. OS Rule to match workloads running a specific operating system

NOTE

Match on OS version or release

You can configure OS labeling rules to match all or part of the workload's OS version or release by selecting the **Starts with**, **Contains**, or **Ends** with operator and entering the details. To find details, go to **Servers & Endpoints > Workloads** and click the workload. On the **Summary** tab, go to the **Attributes** section of the workload's details page.



ATTRIBUTES

VEN Version	23.3.0
Hostname	perf-workload-3724
Location	Unnamed Datacenter, Unknown Location
OS	ubuntu-x86_64-xenial
Release	4.4.0-97-generic #120-Ubuntu SMP Tue Sep 19 17:28:18 UTC 2017 (Ubuntu 16.04.1 LTS)
Uptime	2 Days, 18 Hours, 41 Minutes
Heartbeat Last Received	05/14/2024, 17:10:20
Interfaces	eth0: 10.0.14.140/8 10.0.0.1 (Corporate) eth0: fd00::200:a:0:e8c/64 (Corporate)

1. Select **OS** in the **Attribute** field.
2. Select an **Operator**.
3. Select **Linux** in the **Value** field.
4. Click **Close**.
5. Select one or more labels in the **Label** field.
6. Click **Save**.

Example 3. IP Address Rule to match workloads within a specific IP address range:

1. Select IP Address in the **Attribute** field.
2. Select is in in the **Operator** field.
3. In the **Value** field, enter a narrow range such as `10.2.0.0 - 10.2.200.0`.
4. Click **Close**.
5. Select one or more labels in the **Label** field.
6. Click **Save**.

Example 4. CIDR Block Rule to match workloads within a specific CIDR block:

1. Select IP Address in the **Attribute** field.

2. Select is in in the **Operator** field.
3. In the **Value** field, enter a CIDR block. For example: `10.2.20.0/24`
4. Click **Close**.
5. Select one or more labels in the **Label** field.
6. Click **Save**.

Example 5. Rule with multiple attributes, each with a single value:

1. Specify a hostname:
   - Select **Hostname** in the **Attribute** field.
   - Select contains in the **Operator** field.
   - Enter details in the **Values** field.
2. Specify an operating system:
   - Select **OS** in the **Attribute** field.
   - Select contains in the **Operator** field.
   - Select an operating system in the **Values** field.
3. Specify an IP address:
   - Select **IP Address** in the **Attribute** field.
   - Select **is** in in the **Operator** field.
   - In the **Values**, field enter an IP range or CIDR block.
4. Specify a listening port and/or protocol:
   - Select **Port/Protocol** in the **Attribute** field.
   - In the **Operator** field, select is for a specific port/protocol; select is in to specify a range.
   - In the **Values** field, enter either a specific port/protocol or a range as appropriate.
5. Specify a process path:
   - Select **Process** in the **Attribute** field.
   - In the **Operator** field, select an appropriate operator.
   - In the **Values** field, enter all or part of a process path according to your selected operator.
6. Click **Close**.
7. Select one or more labels in the **Label** field.
8. Click **Save**.

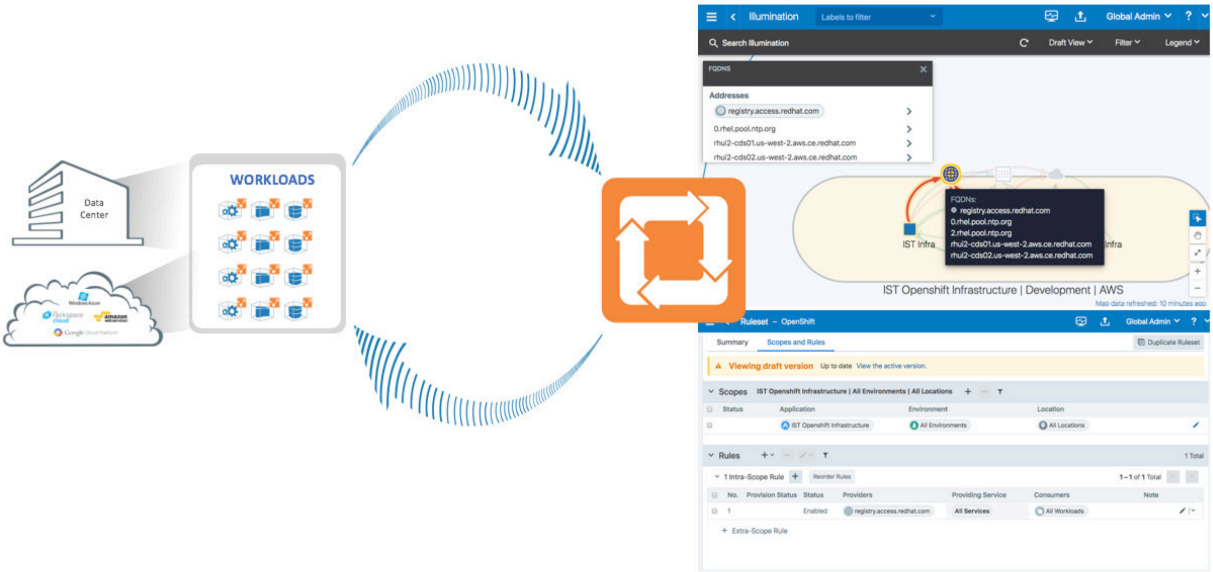
FQDN-Based Rules

Applications across datacenters and cloud environments are responsible for a vast amount of east-west traffic. This traffic is the result of communication between workloads, including bare-metal, virtual machines, and containers. However, many applications might need to communicate with services, such as SaaS, PaaS or external registries. These services are coupled with an IP address but that address might be unknown or the services might only be reachable by a URL because their IP addresses are frequently changing. This situation introduces a challenge to security teams because security policies are based on IP addresses or subnets. Administrators can allow outbound communication to any workload or to a broad range of IP addresses to overcome this challenge; however, this approach opens a security gap. To resolve this challenge, Illumio has added FQDN-based visibility and enforcement to its Illumio Core.

Benefits of FQDN-Based Rules

Implementing FQDN-based rules in the Illumio Core has the following benefits:

- **Deeper visibility:** Delivers visibility into communications from workloads to any workload reachable via a URL. For example, when a workload needs to pull an image from an unmanaged repository or use Amazon RDS for database services, Illumio provides visibility to those FQDNs and not just to the IP addresses behind them.
- **Natural language policy:** Automatically generate or write allowlist policies that allow workloads to consume services from FQDNs rather than IP addresses or subnets.
- **Adaptive security:** Using distributed DNS snooping at the workload, the Illumio Core dynamically conforms policy to any changes, such as a domain name resolving to a new IP address.
- **Lock-down outbound communications and reduce risk:** With FQDN-based enforcement, you decide which outbound services should be allow-listed for your application rather than allowing all outbound communications. This ability mitigates the risk of applications potentially communicating with a malicious IP address or domain name.
- **Wildcard support:** Enables you to write FQDN-based policy using wildcards, such as *.redhat.com.



FQDNS

Addresses
registry.access.redhat.com
0.rhel.pool.ntp.org
rhui2-cds01.us-west-2.aws.ce.redhat.com
rhui2-cds02.us-west-2.aws.ce.redhat.com

FQDNs:
registry.access.redhat.com
0.rhel.pool.ntp.org
2.rhel.pool.ntp.org
rhui2-cds01.us-west-2.aws.ce.redhat.com
rhui2-cds02.us-west-2.aws.ce.redhat.com

IST Openshift Infrastructure | Development | AWS

Viewing draft version Up to date View the active version.

Scopes IST Openshift Infrastructure | All Environments | All Locations

Status	Application	Environment	Location
	IST Openshift Infrastructure	All Environments	All Locations

Rules 1 Total

1 Intra-Scope Rule 1 – 1 of 1 Total

No.	Provision Status	Status	Providers	Providing Service	Consumers	Note
1		Enabled	registry.access.redhat.com	All Services	All Workloads	

Features of FQDN-Based Rules

Distributed DNS Snooping

The VEN performs DNS snooping for both visibility and enforcement purposes. Each time a workload sends out a DNS request, the VEN snoops for a DNS response for that request. The VEN collects data from the DNS response including the CNAMEs, and records and programs it into a DNS cache created by the VEN. The VEN does not generate control plane traffic, for example DNS requests. Additionally, the VEN does DNS-request tracking, which means when the workload receives a DNS response for an FQDN it did not send a request for, the VEN will not add the DNS response data into its cache.

DNS Visibility

One of the core elements of the Illumio Core is visibility into communications between workloads. The VEN periodically reports flow data to the PCE including IP addresses, ports, and protocols. With FQDN-based visibility, the VEN can report outbound communications to

FQDNs in addition to IP addresses, ports, and protocols. As the VEN writes flows to its local traffic database, it also checks the VEN DNS cache and maps FQDNs with outbound flow data. When there is a match between the destination IP address in the flow logs and a record in the DNS cache, the VEN adds the FQDN to the outbound flow records. Once the VEN reports flow data to the PCE, the PCE presents the outbound DNS-based traffic flows in Illumination in near real-time as well as in Explorer for historical data retention.

DNS Enforcement

The Illumio Core allows security teams to write allowlist policies that allow communications across workloads or between workloads and IP addresses. FQDN-based enforcement allows users to control which DNS hostnames or FQDNs that each managed workload can communicate to without the user needing to understand the IP addresses tied to that FQDN. Once an FQDN gets allow-listed by the policy, the PCE sends firewall instructions to the VEN and the VEN creates an FQDN policy table. This policy table tracks the allow-listed FQDN as well as which ports and protocols the workload is allowed to use for outbound communication to the FQDN. The VEN also checks the local DNS cache table for IP listings.

Wildcards

The FQDN-based rules support wildcards such as *.google.com, s3*.aws.amazon.com, and proc1.azure*.com. Wildcards are expanded to zero or more of the characters in [a-z|A-Z|0-9|-]. Wildcards are allowed at the end of the FQDN, for example www.google.*.

Illumio recommends the use of wildcards for the same patterns. This will help reduce rather than increase the number of FQDN-based rules with the same patterns. For better performance, when you write FQDN-based rules, limit the number of rules to around a 100 entries.

FQDN-Based Rule Requirements and Limitations

FQDN-based visibility and enforcement is subject to the following requirements and limitations:

- Requires Illumio Core 19.1.0 or later and VEN 19.1.0 or later.
- Supported for any Linux OS that is supported with the Illumio VEN 19.1.0 release.
- Supported for any Windows OS that is supported with the Illumio VEN 19.1.0 release.
- Supported for any Mac OS that is supported with the Illumio endpoint VEN 23.2.0 release.
- Solaris and AIX workloads are not supported.
- Visibility and enforcement for DNS-based traffic when the source is a DNS hostname are not supported.
- FQDNs can be described in IP lists or virtual services, but not in an unmanaged workload interface.
- Only one FQDN (wildcard supported) can be specified when using virtual services. IP lists can support a list or a group of FQDNs.
- A mix of virtual services and IP lists are supported.
- A period character is not supported in a wildcard. For example, **www.server*.mycorp.com** matches **www.server1.mycorp.com** but not **www.server1.farm2.mycorp.com**.
- A wildcard-only entry (specifying only "*") is not allowed.

IMPORTANT

A wildcard will not cover subdomains. For example, ***.mycorp.com** will not match **host1.downloads.mycorp.com**

FQDN Visibility

Illumio requires no new configuration to gain visibility into outbound traffic towards FQDNs. However, you can create Illumio policy objects representing an FQDN or a list of FQDNs. In the following example, Illumination presents outbound FQDN flows when no policy objects have been created. A web server is fetching updates from us-west-1.ec2.archive.ubuntu.com.

You can create an Illumio policy object, such as an IP list or a virtual service representing the FQDN.

Create Policy Objects for FQDNs

IP List

By default, you can leverage IP lists to describe IP ranges, groups, and subnets. From the 19.1.0 release on, you can use IP lists to describe FQDNs.

You can use the previous example (us-west-1.ec2.archive.ubuntu.com) to create an IP list for FQDNs:

1. From the PCE web console menu, choose **Policy Objects** > **IP Lists**.
2. Click **Add**.
3. Enter a name (can be a custom name).
4. In the IP Addresses and FQDNs field, enter one or multiple FQDNs (wildcards are supported).
5. Click **Save**.
6. Provision the changes.

IMPORTANT

The provided checkbox can be selected to "Disable validation of IP addresses and FQDNs". For performance reasons, it is recommended to disable real-time IP Addresses and FQDN validation when working with large sets of IP Addresses and FQDNs.

The following methods of describing the specific FQDN are supported:

Supported examples

- us-west-1.ec2.archive.ubuntu.com
- *.ec2.archive.ubuntu.com
- *.*.archive.ubuntu.com
- *.*.*.ubuntu,com

You can use a wildcard in the IP list, such as ***.ec2.archive.ubuntu.com**.

Virtual Service

When you have created an IP list to describe the FQDN, you do not need to create a virtual service to describe the same FQDN.

You should only create a virtual service for an FQDN when you do not want to create an IP list:

1. From the PCE web console menu, choose **Policy Objects** > **Virtual Services**.
2. Click **Add**.
   - Enter a name.
   - Enter a service or port.
   - Enter your R-A-E-L labels for the FQDN.
   - Click **Add FQDN** and enter an FQDN.
3. Click **Save**.
4. Provision the changes.

Based on the example above, these methods of describing the specific FQDN are supported or unsupported.

Supported

- us-west-1.ec2.archive.ubuntu.com
- us-west-1.ec2.*.ubuntu.com
- *.ec2.*.ubuntu.com
- us-*.ec2.archive.ubuntu.com

The syntax below is supported; however, it does not describe the FQDN in the example.

- ubuntu.com
- *.ubuntu.com

Write Policies to Allowlist FQDNs

IP List

The syntax and ruleset structure for IP list policies does not change for FQDNs.

Ruleset Scope Example

Application	Environment	Location
HRM	Production	All Locations

Intra-Scope Rule Example			
Destination	Providing Service	Source	Note
*.ec2.archive.ubuntu.com (IP List object)	All Services	Web	You an use 80 TCP as the providing service

Virtual Service

Writing a policy against a virtual service for an FQDN is the same as writing a policy for an IP-based virtual service.

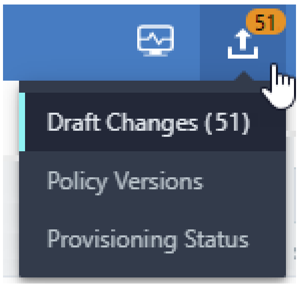
See the following example that uses the Ubuntu Repo (*.ec2.archive.ubuntu.com):

Ruleset Scope Example			
Application	Environment	Location	
HRM	Production	All Locations	
Intra-Scope Rule Example			
Destination	Providing Service	Source	Note
Ubuntu repo (Virtual Service role label for *.ec2.archive.ubuntu.com + Uses Virtual Services Only	Derived from Destination Virtual Service	Web	There are two objects selected in theiDestination column; one is for the Role label and the other is called "Uses Virtual Services Only"

Provisioning

When you provision updates, the PCE recalculates any changes made to rulesets, IP lists, services, label groups, and security settings, and then transmits those changes to all VENs installed on your workloads.

When your PCE has changes that need to be provisioned, the orange badge on the Provision button indicates the number of changes that need to be provisioned.



Items that Require Provisioning

The following security policy items must be provisioned before they can take effect:

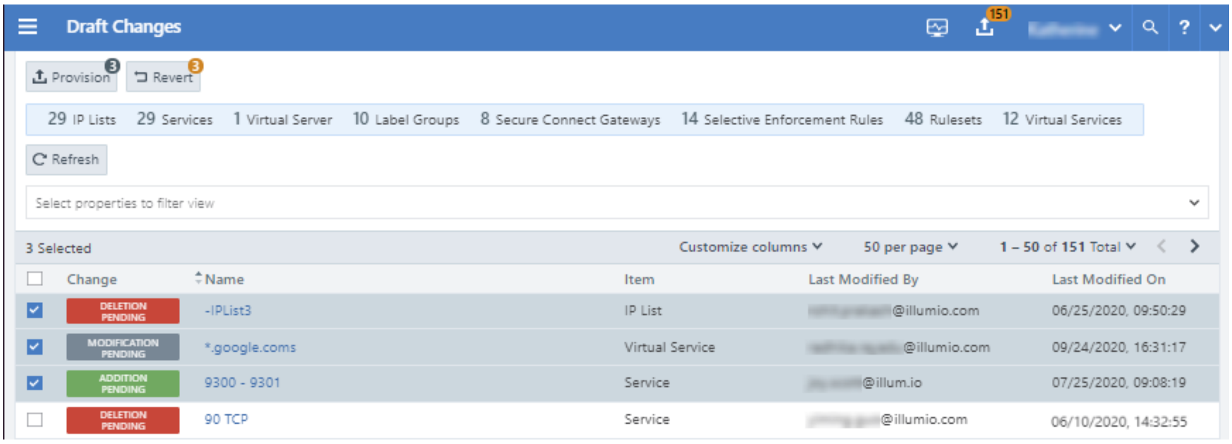
- Rulesets
- Rule notes
- IP lists
- Services
- Label groups
- Security settings
- Virtual services
- Virtual servers

Provision All or Selected Items

When you create or change security policy items (such as rulesets, IP lists, services, label groups, and security settings), you can provision the item immediately from the item page after you save the change.

You can click **Provision** button on the top PCE web console toolbar, which allows you to see all of the security policy changes that require provisioning. The list shows any items that have been modified (gray) or deleted (red), or added (green).

In the list of changes requiring provisioning, you can select all items, or select items individually to provision.



□	Change	Name	Item	Last Modified By	Last Modified On
☑	DELETION PENDING	-IPList3	IP List	[redacted]@illumio.com	06/25/2020, 09:50:29
☑	MODIFICATION PENDING	*.google.coms	Virtual Service	[redacted]@illumio.com	09/24/2020, 16:31:17
☑	ADDITION PENDING	9300 - 9301	Service	[redacted]@illum.io	07/25/2020, 09:08:19
□	DELETION PENDING	90 TCP	Service	[redacted]@illumio.com	06/10/2020, 14:32:55

Dependencies for Partial Provisioning

When you select only some items to provision (rather than provisioning all policy item changes), some of those items might have dependencies that are also provisioned. Before you commit to the provision, the PCE shows you the items that are dependent and will also be provisioned.

NOTE

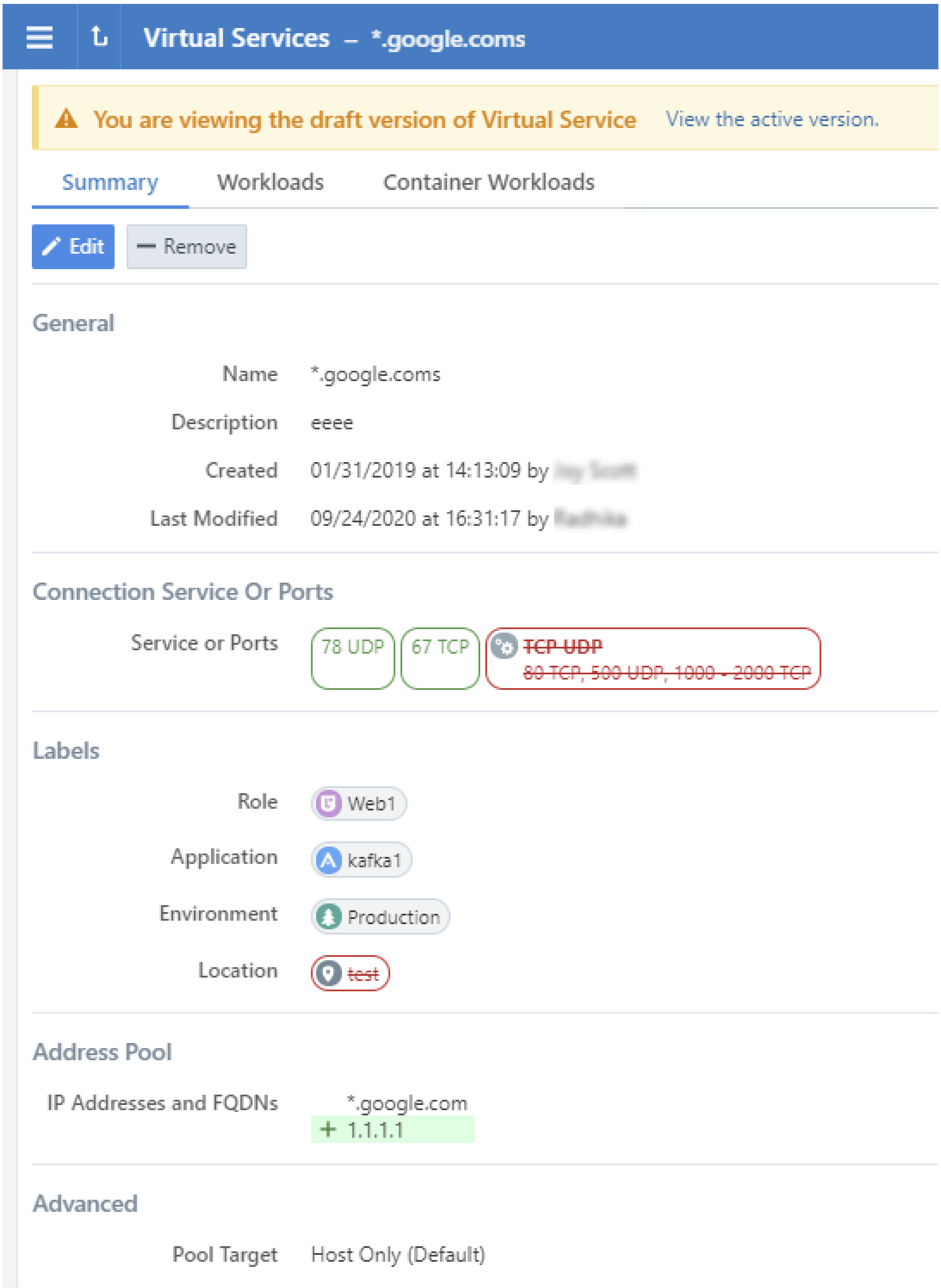
You cannot partially provision resources with more than 500 dependencies. All changes must be provisioned at the same time.

Active vs Draft Versions

Any changes you make to security items, such as rulesets, services, IP lists, label groups, and security settings, need to be provisioned. All the changes you make to those items are considered to be in a “draft” state (non-versioned) until you provision them. After you provision your changes, those changes become the “active” version.

When you edit a security item that has been published at least once, and new changes have occurred since the last provisioning, you see a note at the top of the page that indicates the item is currently in draft state.

If you want to view the active version, click the **View the active version** link.



⚠ You are viewing the draft version of Virtual Service View the active version.

General

Name	*.google.coms
Description	eeee
Created	01/31/2019 at 14:13:09 by [redacted]
Last Modified	09/24/2020 at 16:31:17 by [redacted]

Connection Service Or Ports

Service or Ports	78 UDP 67 TCP ~~TCP-UDP~~ ~~80 TCP, 500 UDP, 1000 - 2000 TCP~~

Labels

Role	Web1
Application	kafka1
Environment	Production
Location	~~test~~

Address Pool

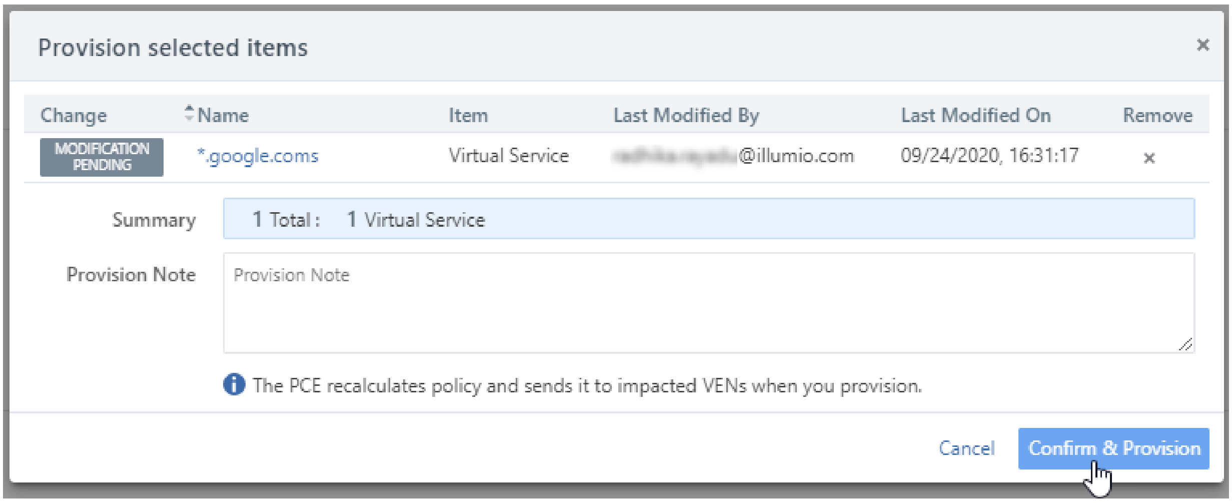
IP Addresses and FQDNs	*.google.com + 1.1.1.1

Advanced

Pool Target	Host Only (Default)

Provisioning Progress Indicator

When you confirm provisioning by clicking **Confirm & Provision**, the Provisioning progress indicator displays the number of workloads that need to be synchronized with the latest provisioned policy changes and the progress for applying the policy changes to those workloads.



Provision selected items

Change	Name	Item	Last Modified By	Last Modified On	Remove
MODIFICATION PENDING	*.google.coms	Virtual Service	[redacted]@illumio.com	09/24/2020, 16:31:17	×

Summary: 1 Total : 1 Virtual Service

Provision Note: Provision Note

The PCE recalculates policy and sends it to impacted VENs when you provision.

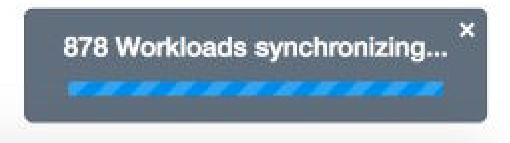
On the Provisioning page, you can:

- View the previous policy change by clicking **View the last commit**
- View a list of provisioned changes by clicking **View Provision History**

NOTE

If multiple subsequent policy changes have been provisioned, the number is the total number of workloads that have not yet received all provisioned policy changes, not just the most recently provisioned changes.

During this process, if you navigate to another page, the policy synchronization will continue and a window in the lower-right displays the number of workloads pending synchronization with the latest policy.



878 Workloads synchronizing...

To return to the Provisioning page, click the window in the lower right corner or select **Provisioning** from the drop-down Provisioning list.

When the provisioning completes successfully, a confirmation message displays.

NOTE

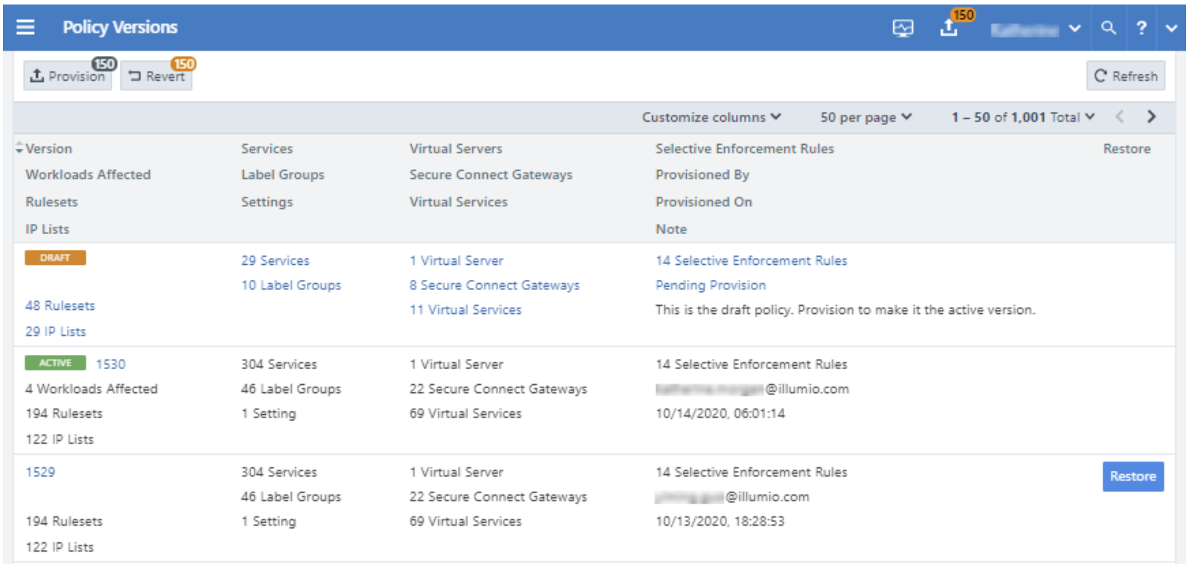
If multiple users simultaneously provision changes, the Provisioning progress indicator is updated to show the new changes, so all users will see the same Provisioning progress indicator.

Policy Versions

Each time you provision changes to policy items (such as rulesets, services, IP lists, label groups, and security settings), the entire set of changes you provisioned receives a version number. You can view the history of your policies and view their differences.

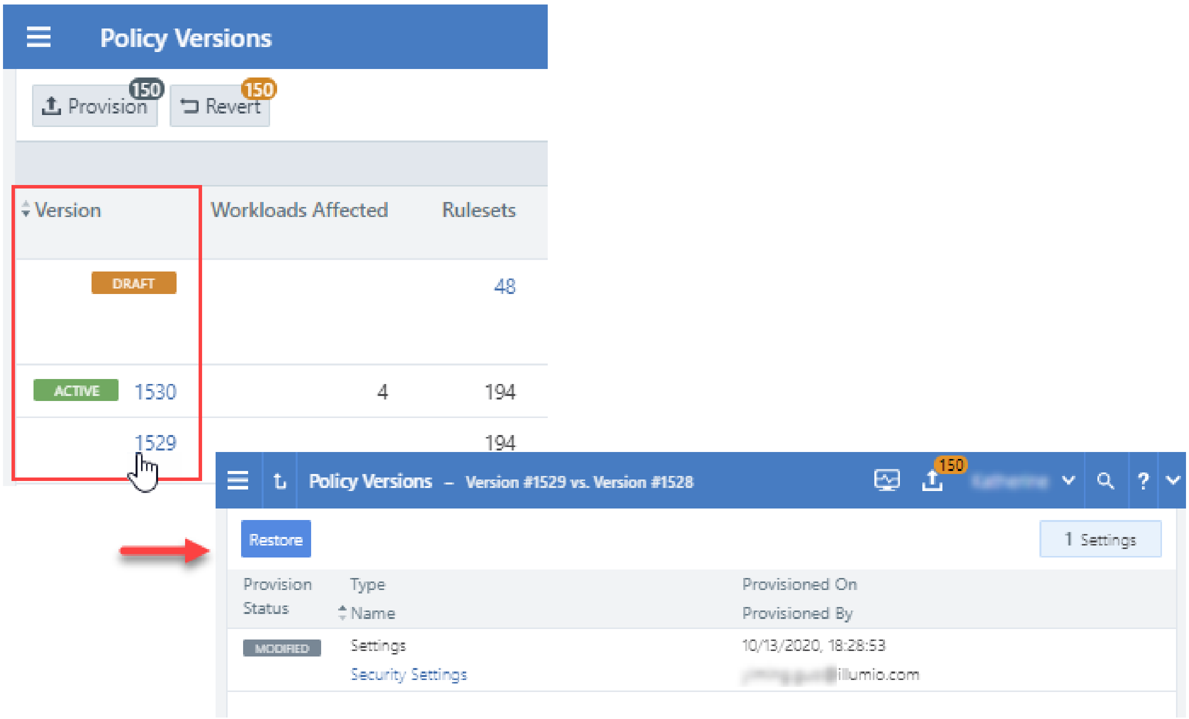
You can select a previous version to see information about that specific version. By default, the PCE retains only the last 1000 versions of the policy and automatically removes the older versions for improved performance. When a new change is provisioned, the oldest version of the policy is removed.

1. From the PCE web console toolbar, click the **Provision** button and choose **Policy Versions**.
   The Provision History page appears, which displays the history of the last provisions in your organization.



Version Workloads Affected Rulesets IP Lists	Services Label Groups Settings	Virtual Servers Secure Connect Gateways Virtual Services	Selective Enforcement Rules Provisioned By Provisioned On Note	Restore
DRAFT 48 Rulesets 29 IP Lists	29 Services 10 Label Groups	1 Virtual Server 8 Secure Connect Gateways 11 Virtual Services	14 Selective Enforcement Rules Pending Provision This is the draft policy. Provision to make it the active version.	
ACTIVE 1530 4 Workloads Affected 194 Rulesets 122 IP Lists	304 Services 46 Label Groups 1 Setting	1 Virtual Server 22 Secure Connect Gateways 69 Virtual Services	14 Selective Enforcement Rules [redacted]@illumio.com 10/14/2020, 06:01:14	
1529 194 Rulesets 122 IP Lists	304 Services 46 Label Groups 1 Setting	1 Virtual Server 22 Secure Connect Gateways 69 Virtual Services	14 Selective Enforcement Rules [redacted]@illumio.com 10/13/2020, 18:28:53	Restore

2. To view details about the changes, click one of the items. For the selected item, you can see the changes that were provisioned in this version.



Version	Workloads Affected	Rulesets
DRAFT		48
ACTIVE 1530	4	194
1529		194

Provision Status	Type Name	Provisioned On Provisioned By
MODIFIED	Settings Security Settings	10/13/2020, 18:28:53 [redacted]@illumio.com

Provision Changes

If you have made any changes to provisionable objects, such as rulesets, IP lists, services, label groups, and security settings, you need to provision those changes before they can take effect.

1. From the PCE web console toolbar, click the **Provision** button > **Draft Changes**.
   The Draft Changes page appears, which displays a list of all policy items that have been added, modified, or removed. The top of the page shows a summary of changes based on item type.
2. Select one, several, or all the items you want to provision.
3. Click **Provision** to see a preview of the changes that will occur when you provision them.

> **NOTE**
> When you selectively choose items to provision, some of those items might have dependencies that are also published. Any object dependencies are also be provisioned.

4. You can add a note to the provision. If a note is mandatory, the **Confirm & Provision** button is grayed out until you enter text in the field. After you enter appropriate text in the field the button is enabled.
5. Click **Confirm & Provision** to push all the policy changes to workloads.

Revert Provisionable Changes

Any changes you make to policy configuration items (rulesets, IP lists, label groups, services, or security settings) appear as pending provisioning. You can revert those changes before you provision them.

1. From the PCE web console toolbar, click the **Provision** button > **Draft Changes**.
   The Draft Changes page appears, which lists all security policy items have been added, modified, or removed. You also see a summary of changes based on item type.
2. Select individual items to revert or you can revert all changes.
3. Click **Revert**.

Restore Policy

With the policy restore feature, you can revert to an older version of the policy when the newly provisioned policy did not work as expected.

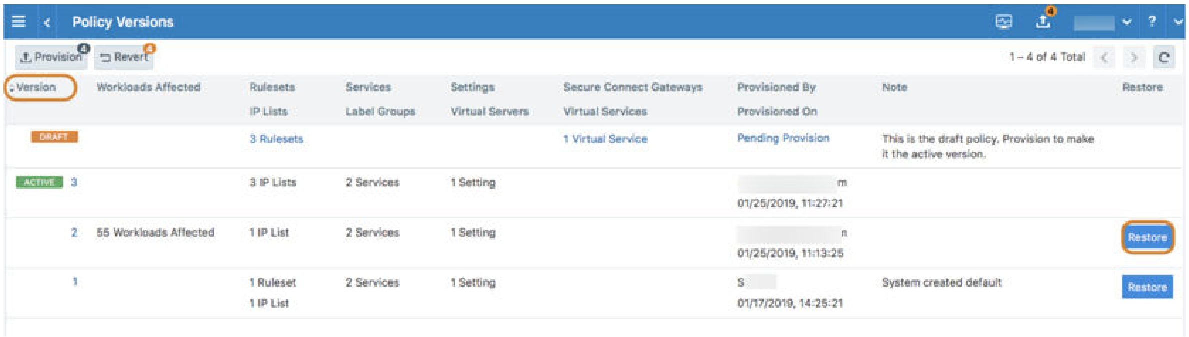
> **NOTE**
> You need to be a Global Administrator or Global Organization Owner to use this feature.

The older version of the policy is copied to the current working draft version. You can immediately provision it to replace the version that is not working.

When there are pending changes, you cannot restore to a previous version. If you try to restore to this version, it will result in references to deleted non-versioned objects such as labels and workloads, the restore will fail, and an error message will be displayed.

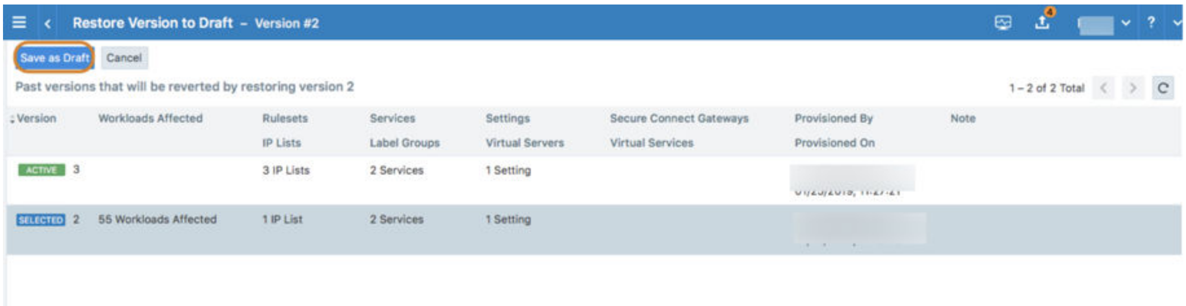
To revert to an older policy version:

1. Choose **Provision** > **Policy Versions** from the PCE web console menu or from the top-right provision menu.
   The policy versions are displayed under the **Version** column.
2. Click **Restore** for the policy version that you want to revert to.



Version	Workloads Affected	Rulesets IP Lists	Services Label Groups	Settings Virtual Servers	Secure Connect Gateways Virtual Services	Provisioned By Provisioned On	Note	Restore
DRAFT		3 Rulesets			1 Virtual Service	Pending Provision	This is the draft policy. Provision to make it the active version.	
ACTIVE 3		3 IP Lists	2 Services	1 Setting		[redacted] 01/25/2019, 11:27:21		
2	55 Workloads Affected	1 IP List	2 Services	1 Setting		[redacted] 01/25/2019, 11:13:25		Restore
1		1 Ruleset 1 IP List	2 Services	1 Setting		[redacted] 01/17/2019, 14:25:21	System created default	Restore

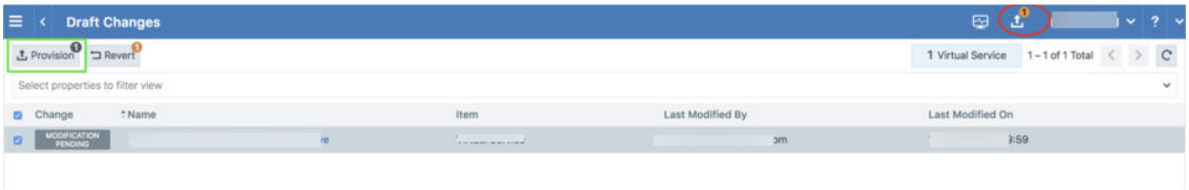
3. Click **Save as Draft** to restore the policy to the selected version.



Past versions that will be reverted by restoring version 2

Version	Workloads Affected	Rulesets IP Lists	Services Label Groups	Settings Virtual Servers	Secure Connect Gateways Virtual Services	Provisioned By Provisioned On	Note
ACTIVE 3		3 IP Lists	2 Services	1 Setting		[redacted]	
SELECTED 2	55 Workloads Affected	1 IP List	2 Services	1 Setting		[redacted]	

4. Review the draft changes and click **Provision** to restore the policy to the selected version or click **Revert** to return to the Policy page.



Draft Changes

☑	Change	Name	Item	Last Modified By	Last Modified On
☑	MODIFICATION PENDING	re		om	:59

Provisioning Note Setting

You can make a provision note mandatory before you provision rules. It is disabled by default, but you can enable it to make it mandatory. This feature supports the need to describe context before provisioning and can support your organization's internal workflow. When enabled, you must populate the note field before provisioning changes.

You might want your users to populate the Provision Note field with a link to your internal bug tracking system or project number for tracking and the error message they see when they leave the field empty will remind them to do so. Illumio Core does not validate the content entered in the Provision Note field.

You cannot provision updates when enabled until you enter text in the Provision Note field. The **Confirm & Provision** button is grayed out. After you enter the appropriate text in the field, the **Confirm & Provision** button is enabled.

NOTE

You must have the correct role and permissions to access this feature. If necessary, contact your Illumio administrator for assistance.

To make the provision note mandatory:

1. From the PCE web console menu, choose **Settings** > **Policy Settings**.
   The Policy Settings page appears. By default, this option is set to No.
2. Click **Edit**.
3. Change the Require Provision Note option to Yes.
4. Click **Confirm**.
5. Click **Save**.

Policy Enforcement

This section describes the ways that you can enforce security policy for your managed workloads. This section assumes that you have already created the policy objects necessary for your security policy approach, created rulesets and rules, and installed VENs on your workloads.

See the following topics and sections for information about those tasks.

- Security Policy Objects [18]
- Create Security Policy [70]
- Workload Setup Using PCE Web Console [61]

Ways to Enforce Policy

Illumio provides several ways to enforce policy on your managed workloads. For information about creating a managed workload, see "Workload Setup Using PCE Web Console".

For information about creating security policy by defining rulesets and rules, see Rulesets and Rules.

Enforcement States for Rules

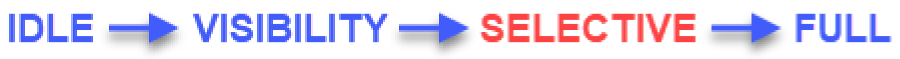
The Illumio policy model follows an allowlist model whereby all communication between workloads is denied unless explicitly allowed by Illumio security policy. Users create rules to allow traffic between their workloads.

This method of controlling traffic ensures secure communication between your workloads. However, as you work toward applying the allowlist model for security policy, you might choose a more targeted approach to applying security policy. In addition to creating rules for your workloads, you can control the enforcement state for your workloads.

A workload's enforcement state operates alongside the rules that govern it. By choosing an enforcement mode, you can separate policy enforcement and visibility states per workload. Applying selective enforcement to a workload is based on one or more labels or label groups.

Using selective enforcement mode, you can protect a subset of your services and ports on your managed workloads. The other ports on the workload remain in visibility-only state and function as if the entire workload is in visibility-only mode. In addition to gradually expanding your policy enforcement envelope, selective enforcement is useful for temporarily enforcing policy on specific ports in case a vulnerability is detected and you need to take action quickly.

Another way to think of selective enforcement of security policy is as an intermediate enforcement state on the workload:



In this intermediate enforcement mode, label-based rules designate the workloads and the services/ports that need to be enforced; while other services and ports are in visibility-only mode. Policy enforcement is applied only on the provider side (ingress traffic) of the rules.

For more information about visibility modes, see Workload Enforcement States [118] and Visibility Level [119] in this guide and "Set Group Enforcement" in Visualization Guide.

Limitations for Applying Selective Enforcement State

- Selective enforcement state is directional. If you want to manage traffic between both ends of a connection, create both provider-centric and consumer-centric policy to apply to inbound and outbound connections.
- Selective enforcement state only applies to managed workloads; it is not supported for NEN-controlled or other unmanaged workloads.
- Virtual Services are enforced at the workload level. As a result, selective enforcement state does not affect virtual services directly; instead, selective enforcement state affects the workloads they are comprised of.

Workload Enforcement States

Policy mode determines how the rules affect a workload's network communication. Illumio Core includes four policy modes for workloads. If a workload is unmanaged, the Enforcement column is not displayed on the workload list page.

NOTE

The PCE representation of the enforcement state is the desired state to be applied on the next policy update. If there is an issue applying the enforcement state, a Policy Sync error will be shown for the workload

Idle

The Idle state is used to install and activate VENs on workloads without changing the workload's firewalls. In the Idle state, the VEN on the workload does not take control of the workload’s host firewall but uses workload network analysis to provide the PCE relevant details about the workload, such as the workload's network interface, operating system, and traffic flows. This information is captured in the following ways and intervals:

- Traffic flows: a snapshot is taken every 10 minutes.
- Operating system: included in the Compatibility Report every four hours.
- Workload network interface: reported to the PCE anytime it changes.

A pairing profile can be used to pair workloads in the idle state.

NOTE

SecureConnect (IPv6 compatibility) is not supported on workloads in the Idle state. When you activate SecureConnect for a rule that applies to workloads that are in both Idle and Non-idle enforcement states, it can impact the traffic between these workloads.

Visibility Only

In the Visibility Only state, the VEN inspects all open ports on a workload and reports the flow of traffic between it and other workloads to the PCE. In this state, the PCE displays the flow of traffic to and from the workload, providing insight into the datacenter and the applications running in it. This state is useful when firewall policies are not yet known. This state can be used for discovering the application traffic flows in the organization and then generating a security policy that governs required communication.

⚠ **WARNING**

Visibility can disrupt Docker and other applications that rely on NATing and ip-forwarding.

Selective Enforcement

Rules are enforced directionally for selected services when a workload is within the scope of an Enforcement Boundary.

Full Enforcement

Rules are enforced for all inbound and outbound services. Traffic that is not allowed by a rule is blocked.

Visibility Level

You can choose from three levels of visibility for workloads. These modes allow you to specify how much data the VEN collects from a workload when in the Full Enforcement state:

- **Off:** The VEN does not collect any information about traffic connections. This option provides no Illumination detail and demands the least amount of system resources from a workload.

  This property is only available for workloads that are in the Full Enforcement state.
- **Blocked:** The VEN only collects the blocked connection details (source IP, destination IP, protocol and source port and destination port), including all packets that were dropped. This option provides less Illumination detail but also demands fewer system resources from a workload than high detail.

- **Blocked + Allowed:** The VEN collects connection details (source IP, destination IP, protocol and source port and destination port). This applies to both allowed and blocked connections. This option provides rich Illumination detail but requires some system resources from a workload.

Policy Exclusions

In Illumio Core 22.2.0 and later releases, the PCE supports including policy exclusions in ruleset scopes and rules. This topic explains what they are, how they are supported in Illumio Core, and how to add them to your security policy.

Policy Exclusions Described

Using policy exclusions in your Illumio Core policy can greatly simplify the rule writing process. Specifically, using a policy exclusion in a ruleset scope or in rules allows you to replace the inclusion of a large number of required labels with the exclusion of a small number of unwanted labels. Security policy written with policy exclusions can be easier to read and definitely easier to maintain.

Using a policy exclusions gives you a way to state in your security policy that you want a ruleset or rule to apply to “all except *X*,” where *X* can be both labels and label groups. To state this another way, “all except *X*” means ”All labeled workloads except X” or “All label group objects of a dimension except X.”

You can include policy exclusions in ruleset scopes and in rules actors, namely consumers and providers.

Use Cases

The following examples demonstrate a few common use cases for using policy exclusions:

- All environments except Production should be able to pull updates directly from RedHat
- The standard jump boxes should be able to connect to all environments except PCI
- All applications except Quarantine should be able to connect to Core Services

Support for Policy Exclusions

Policy exclusions are supported by Illumio Core features and in the PCE web console in the following ways:

Illumio Core Feature	Details
Ruleset scopes and rules	In rulesets and rules, excluding a label creates an “all-but” rule or boundary that applies to all workloads that don't have that excluded label but do have another label of the same label type as the excluded label. For example, your data center supports three environments: Production, QA, and Development. Adding an exclusion for “All environments except Production” means that the rules apply to all workloads with Environment labels minus the Production label. It does not translate to “All workloads except those with the Production label,” which would include workloads that don't have an Environment label. When you create a rule that applies to “All environments but Production,” this rule achieves the same affect as creating a rule that applies to the QA and Development environments only.
Labels	Fully supports except for the restrictions below. See Requirements and Restrictions [122].
Label Groups	Label groups are supported for policy exclusions in the same way as labels. For example, you want to create a boundary between Finance applications and all other applications. You create a label group named “Finance Apps” and use it as a policy exclusion. Using label group exclusions is not supported with individual workloads, virtual services, virtual servers, “All Workloads,” the “Uses virtual service only” option, the “Uses virtual service and workloads” option, and container hosts. Additionally, you cannot specify exclusions out of label groups. For example, you have created a label group for the environment “Non-production.” You want to use the label group except you don’t want it to apply to the “Development” environment. You want to create a policy exclusion for the “Development” environment label from the “Non-production” label group. This action is not supported. Selecting to exclude a label group excludes all labels within that group.
Rule Search and filters	You cannot search by policy exclusions; however, any rules that contain policy exclusions appear in the results of your rule search. In label filters and rule search, entering a label name displays both included and excluded labels with that name.
App Groups	**App Groups** > **App Groups List** > select a group > **Rules** tab Rules with policy exclusions appear in the **Rules** tab.
Policy Check	Rules with policy exclusions appear in the **Policy Check** page.
Policy Generator	The PCE does not propose policy exclusions when using Policy Generator to create policy. When using Policy Generator to calculate V-E scores for vulnerabilities (you have the Vulnerability maps feature enabled), Policy Generator won’t work for rules that contain policy exclusions because they aren’t supported in Policy Generator.
Access Management	Access management (also know as Role-based Access Control or RBAC) detects policy exclusions when determining user access in the PCE. However, you cannot add a policy exclusion to an RBAC role. Policy exclusions are only supported in rulesets and rules. If a ruleset scope includes a policy exclusion based on labels outside the scopes you have permission for, you cannot view or manage those rulesets and rules. For example, a ruleset includes a policy exclusion of “All environments except Production” and you have permission for the Production environment but do not have permission for the Staging environment, you could not view or manage that ruleset.

Illumio Core Feature	Details
Explorer	When writing rules using Explorer, you can choose rulesets containing policy exclusions. You can edit the rules in the ruleset that have exclusions. You can add new proposed rules taking the exclusion scopes into account. However, you cannot add a new policy exclusion to an existing proposed rule or add an exclusion to a new proposed rule.
PCE web console maps	Policy exclusions are applicable to rules; they are not properties of the traffic links (the lines between the workloads) in the Illumio maps (Illumination Map, App Group Map, and Vulnerability Map). When you click **View Rule** for any traffic link, you can view the policy exclusions in the **View Rule** panel.
Enforcement Boundaries	Policy exclusions are not supported in Enforcement Boundaries. However, you can view policy exclusion rules in the **Rules** tab of an **Enforcement Boundary** details page.

Requirements and Restrictions

Requirements

When specifying a policy exclusion, it must be the same label type as the group it's being excluded from; the following examples are allowed:

- All Locations except the New Jersey location
- All Applications except Billing

However, this example is not allowed because it specifies different label types – Location vs Environment:

- All Locations except those with Development systems

Restrictions

- For each label dimension, you can specify an included or excluded label, but not both. The following examples show valid combinations:
  App: Swift
  App: All but Swift
  Env: Prod, App: All but Swift
  Loc: EU, Env: All but Prod
- You cannot specify both included and excluded labels within the same label type. The following examples are invalid combinations:
  Env: Prod, Env: Dev, Env: All but UAT
  Env: Prod, App: HRM, App: CRM, App: All but Swift
  App: HRM + App: CRM - App:Swift
  Loc: EU - Loc: Switzerland

- You cannot use policy exclusions with the following objects in the PCE:
  - Individual (named) workloads
  - Virtual servers
  - Virtual services
  - Container hosts

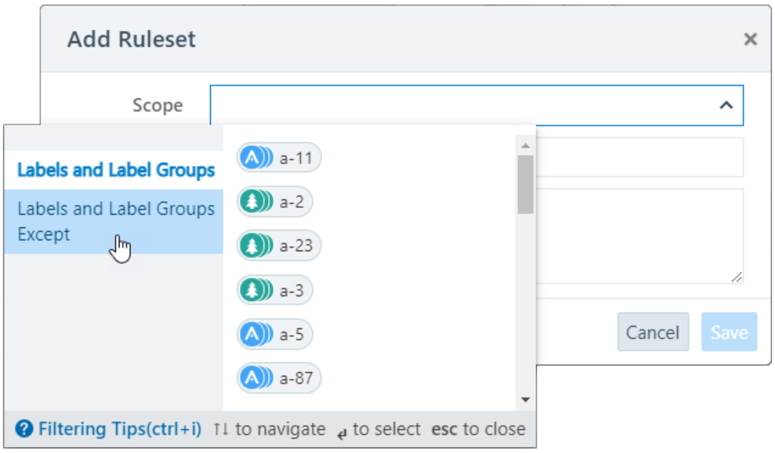
Create a Policy Exclusion

You can add policy exclusions to the scope of a new ruleset and new rules, or edit existing ruleset scopes and rules. This procedure provides the steps to add policy exclusions to the scope of a new ruleset and in new rules.

1. From the PCE web console main menu, choose **Rulesets and Rules** > **Rulesets**.
   The Rulesets page appears.
2. Click **Add**.
   The Add Ruleset dialog box appears.

   > **NOTE**
   > The *Scope* field appears in the **Add Ruleset** dialog box only when the PCE is configured to display scopes in rulesets.
   >
   > If the PCE is configured not to display scopes in rulesets, you can still add a scope with an exclusion after saving the ruleset. From the **Ruleset Actions** menu at the top right corner of the page, select **Add Scope**.

3. To add a policy exclusion to the scope of ruleset, open the Scope drop-down list and select **Labels and Label Groups Except**; then, select labels from the list. When done, click **Save**.

   
   Add Ruleset
   ×
   Scope
   Labels and Label Groups
   Labels and Label Groups Except
   a-11
   a-2
   a-23
   a-3
   a-5
   a-87
   Cancel
   Save
   Filtering Tips(ctrl+i) ↑↓ to navigate ↵ to select esc to close

   The page refreshes and displays the new ruleset and displays Intra-Scope Rules and Extra-Scope Rules tabs below the scope.
4. Select **Add** > **Add Intra-Scope Rule** or **Add** > **Extra-Scope Rule** depending on the type of rule needed.
   An empty row for the new rule appears in the page.
5. Configure the values for the row.
   To add a policy exclusion for either the Consumer or Provider, or both:
   a. From the *Select...* drop-down list, select the **Advanced Options** checkbox.
      A second panel opens displaying your options for adding exclusions.

b. Select Labels and Label Groups Except and then select labels to exclude from the right-hand list.

c. When done configuring the rule, click the **Save** icon at the end of the rule row.

IMPORTANT

If you unintentionally create a rule that has conflicting elements between added labels or label groups and excluded labels or label groups, the PCE web console will display a warning that the security policy as configured might not apply. Specifically, the rule won't have an actual effect on workloads because the rule conflicts with the ruleset scope or the union of the two is will not have an impactful effect on workloads.

For example, you create a ruleset that has the scope “all but the Production environment” and then you create a rule in the ruleset that specifies the Production environment. This rule ends up having no effect because the rule conflicts with the ruleset scope and the union of the two is nothing.

Secure Workload Connections

This section describes SecureConnect and AdminConnect, which are Illumio provided encryption options.

SecureConnect was developed for host-to-host traffic encryption between paired workloads. AdminConnect was developed to get control access to network resources based on Public Key Infrastructure (PKI) certificates.

SecureConnect

Enterprises have requirements to encrypt in transit data in many environments, particularly in PCI and other regulated environments. Encrypting in transit data is straightforward for an enterprise when the data is moving between data centers. An enterprise can deploy dedicated security appliances (such as VPN concentrators) to implement IPsec-based communication across open untrusted networks.

However, what if an enterprise needs to encrypt in transit data within a VLAN, data center, or PCI environment, or from a cloud location to an enterprise data center? Deploying a dedicated security appliance to protect every workload is no longer feasible, especially in public cloud environments. Additionally, configuring and managing IPsec connections becomes more difficult as the number of hosts increases.

Our Solution

SecureConnect leverages the built-in encryption libraries of host operating systems. On Windows hosts, SecureConnect utilizes Windows IPsec. On Linux hosts, SecureConnect utilizes StrongSwan and Linux kernel IPsec for traffic encryption.

With SecureConnect, Illumio delivers a feature that configures the Security Associations (SAs) necessary to enable traffic encryption between workloads. Once authenticated, encryption and cryptographic suites provide confidentiality and data integrity to network traffic flowing between workloads.

The PCE centrally manages all traffic encryption for workloads so that it can be policy driven. For example, a customer can require that all traffic between their web servers and database servers is encrypted. Selecting the SecureConnect option for these workloads allows the PCE to apply the requisite security policy to your organization to make that happen. SecureConnect reduces the complexity of configuring IPsec encryption and auto-scales per your policy definitions.

Use Cases

Employing SecureConnect is especially beneficial in these common scenarios:

- Facilitate PCI compliance by ensuring that confidential data is encrypted over the network.

- Secure off-site backup and recovery of data across geographically distributed datacenters.
- Secure communications across applications and application tiers for regulatory compliance and tighter security.
- Enable secure data migration across different public cloud providers.

Features of SecureConnect

SecureConnect has the following key features.

Platforms Supported by SecureConnect

SecureConnect works for connections between Linux workloads, between Windows workloads, and between Linux and Windows workloads.

IPsec Implementation

SecureConnect implements a subset of the IPsec protocol called Encapsulating Security Payload (ESP), which provides confidentiality, data-origin authentication, connectionless integrity, an anti-replay service, and limited traffic-flow confidentiality.

In its implementation of ESP, SecureConnect uses IPsec transport mode. Using transport mode, only the original payload is encrypted between the workloads. The original IP header information is unchanged so all network routing remains the same. However, the protocol being used will be changed to reflect the transport mode (ESP).

Making this change causes no underlying interfaces to change or be created or any other underlying networking infrastructure changes. Using this approach simply obfuscates the data between endpoint workloads by encrypting the data between them.

If SecureConnect is unable to secure traffic between two workloads with IPsec, it will block unencrypted traffic when the policy was configured to encrypt that traffic.

IKE Versions Used for SecureConnect

SecureConnect connections between workloads use the following versions of Internet Key Exchange (IKE) based on workload operating system:

- Linux ↔ Linux: IKEv2
- Windows ↔ Windows: IKEv1
- Windows ↔ Linux: IKEv1

For a list of supported operating systems for managed workloads, see the VEN OS Support and Package Dependencies on the Illumio Support portal (login required).

Using SecureConnect

To learn how to use SecureConnect with pre-shared keys and PKI certificates, see SecureConnect Setup in the PCE Administration Guide.

AdminConnect

Relationship-based access control rules often use IP addresses to convey identity. This authentication method can be effective. However, in certain environments, using IP addresses to establish identity is not advisable.

Overview of AdminConnect

When you enforce policy on servers for clients that change their IP addresses frequently, the policy enforcement points (PEPs) continuously need to update security rules for IP address changes. These frequent changes can cause performance and scale challenges, and the ipsets of protected workloads to churn.

Additionally, using IP addresses for authentication is vulnerable to IP address spoofing. For example, server A can connect to server B because the PEP uses IP addresses in packets to determine when connections originate from server A. However, in some environments, bad actors can spoof IP addresses and impact the PEP at server B so that it mistakes a connection as coming from server A.

Illumio designed its AdminConnect (Machine Authentication) feature with these types of environments in mind. Using AdminConnect, you can control access to network resources based on Public Key Infrastructure (PKI) certificates. Because the feature bases identity on cryptographic identity associated with the certificates and not IP addresses, mapping users to IP addresses (common for firewall configuration) is not required.

With AdminConnect, a workload can use the certificates-based identity of a client to verify its authenticity before allowing it to connect.

Features of AdminConnect

Cross Platform

Microsoft Windows provides strong support for access control based on PKI certificates assigned to Windows machines. Modern datacenters, however, must support heterogeneous environments. Consequently, Illumio designed AdminConnect to support Windows and Linux servers and Windows laptop clients.

AdminConnect and Data Encryption

When only AdminConnect is enabled, data traffic does not use ESP encryption. This ensures that data is in cleartext even though it is encapsulated in an ESP packet.

When AdminConnect and SecureConnect are enabled for a rule, the ESP packets are encrypted.

Ease of Deployment

Enabling AdminConnect for identity-based authentication is easy because it is a software solution and it does not require deploying any network choke points such as firewalls. It also does not require you to deploy expensive solutions such as Virtual Desktop Infrastructure (VDI) or bastion hosts to control access to critical systems in your datacenters.

AdminConnect Prerequisites and Limitations

Prerequisites

You must meet the following prerequisites to use AdminConnect:

- You must configure SecureConnect to use certificate-based authentication because both features rely on the same PKI certificate infrastructure. See the following topics for more information:
  - Configure SecureConnect to Use Certificates. For information, see PCE Administration Guide.
  - Configure certificates for AdminConnect. For information, see PCE Administration Guide.
- AdminConnect must be used with VEN version 17.3 and later.
- AdminConnect supports Linux/Windows IKE v1 (client only) with unmanaged workloads.

Limitations

You cannot enable AdminConnect for the following types of rules:

- Rules that use All services
- Rules with virtual services in providers or consumers
- Rules with IP lists as providers or consumers
- Stateless rules

AdminConnect is not supported in these situations:

- AdminConnect does not support “TCP -1” (TCP all ports) and “UDP -1” (UDP all ports) services.
- You cannot use Windows Server 2008 R2 or earlier versions as an AdminConnect server.
- Windows Server does not support more than four IKE/IPsec security associations (SAs) concurrently from the same Linux peer (IP addresses).

Enable AdminConnect for a Rule

AdminConnect is supported on workloads in the Visibility Only and Full enforcement . See AdminConnect Prerequisites and Limitations [128] for the list of rule types that do not support AdminConnect.

1. From the PCE web console menu, choose **Rulesets and Rules > Rulesets**.
   The Rulesets page appears.
2. Create a new ruleset or open an existing one.
3. In the ruleset, select the **Scopes and Rules** tab.
4. If necessary create an intra-scope or an extra-scope rule. To edit an existing rule, click the edit icon at the end of the row.
5. To enable AdminConnect for the rule, select **Machine Authentication** from the *Providing Service* drop-down list.

   NOTE
   AdminConnect is displayed as Machine Authentication in the services drop-down lists.

6. Click the **Save** icon 💾 at the end of the row.
   The page refreshes and the Providing Service column indicates that AdminConnect is enabled for that Rule.
7. To apply the changes to the applicable workloads, provision the changes.

Secure Laptops with AdminConnect

You can use Illumio to authenticate laptops and grant them access to managed workloads. To manage a laptop with AdminConnect, complete the following tasks:

1. Deploy a PKI certificate on the laptop. See “Certificates for AdminConnect” in PCE Administration Guide.
2. Add the laptop to the PCE by creating an unmanaged workload and assign the appropriate labels to it to be used for rule writing
3. Create rules using those labels to grant access to the managed workloads. See Enable AdminConnect for a Rule [128] for information.
4. Configure IPsec on a laptop.

To add a laptop to the PCE by creating an unmanaged workload:

To manage a laptop with AdminConnect, add the laptop to the PCE as an unmanaged workload.

1. From the PCE web console menu, choose **Workloads** > **Add** > **Add Unmanaged Workload**.
   The Workloads – Add Unmanaged Workload page appears.
2. Complete the fields in the General, Labels, Attributes, and Processes sections. See Workload Setup Using PCE Web Console [61].
3. In the Machine Authentication ID field, enter all or part of the DN string from the Issuer field of the end entity certificate (CA Subject Name). For example:
   CN=win2k12, O=Illumio, OU=Portal, ST=CA, C=US, L=Sunnyvale

   TIP
   Enter the exact string that you get from the `openssl` command output.

4. Click **Save**.

To configure IPsec on a laptop:

To use the AdminConnect feature with laptops in your organization, you must configure IPsec for these clients.

See the Microsoft Technet article Netsh Commands for Internet Protocol Security (IPsec) for information about using netsh to configure IPsec.

See also the following examples for information about the IPsec settings required to manage laptops with the AdminConnect feature.

```
PS C:\WINDOWS\system32> netsh advfirewall show global

Global Settings:
----------------------------------------------------------------------
IPsec:
StrongCRLCheck                        0:Disabled
SAIdleTimeMin                         5min
DefaultExemptions                     NeighborDiscovery,DHCP
IPsecThroughNAT                       Server and client behind NAT
AuthzUserGrp                          None
AuthzComputerGrp                      None
AuthzUserGrpTransport                 None
AuthzComputerGrpTransport             None

StatefulFTP                           Enable
StatefulPPTP                          Enable

Main Mode:
KeyLifetime                           60min,0sess
SecMethods                            ECDHP384-AES256-SHA384
ForceDH                               Yes

Categories:
BootTimeRuleCategory                  Windows Firewall
FirewallRuleCategory                  Windows Firewall
StealthRuleCategory                   Windows Firewall
ConSecRuleCategory                    Windows Firewall

Ok.


PS C:\WINDOWS\system32> netsh advfirewall consec show  rule name=all

Rule Name:                            telnet
----------------------------------------------------------------------
Enabled:                              Yes
Profiles:                             Domain,Private,Public
Type:                                 Static
Mode:                                 Transport
Endpoint1:                            Any
Endpoint2:
```

```
10.6.3.189/32,10.6.4.35/32,192.168.41.163/32
Port1:                                Any
Port2:                                23
Protocol:                             TCP
Action:                               RequireInRequireOut
Auth1:                                ComputerKerb,ComputerCert
Auth1CAName:                          CN=MACA, O=Company, OU=engineering,
S=CA, C=US, L=Sunnyvale, E=user@sample.com
Auth1CertMapping:                     No
Auth1ExcludeCAName:                   No
Auth1CertType:                        Intermediate
Auth1HealthCert:                      No
MainModeSecMethods:                   ECDHP384-AES256-SHA384
QuickModeSecMethods:                  ESP:SHA1-AES256+60min+100256kb
ApplyAuthorization:                   No
Ok.
```