

Tree Segment Identifier (Tree-SID) Multicast Traffic Engineering

Tree-SID is a method of implementing tree-like multicast flows over a segmented routing network. Using Tree-SID, an SDN controller (a device running SR-PCE using PCEP) calculates the tree. Each node (device) in the tree has a specific role in routing the multicast data through the tree. These roles include Ingress for the root or headend node, Transit or Bud for midpoint nodes that are not leaf nodes, and Egress for destination leaf nodes. The tree itself is assigned a single SID label, representing all of the tree segments and devices. The SDN controller is highly flexible, as it understands the segmentation and can construct routing paths using any constraints that network architects can specify.

The most interesting use case for constraint-based Tree-SID use is where routers are configured to deliver two P2MP streams with the same content over different paths. Here, the multicast flow is forwarded twice through the network, each copy following a unique path. The two copies never use the same node or link to reach the destination, reducing packet loss due to network failures on any one of the paths.

For detailed information on Tree-SID, see the Segment Routing Tree-SID configuration documentation for your specific device (for example, Segment Routing Configuration Guide for Cisco NCS 540 Series Routers).

This section contains the following topics.

- Visualize Tree-SID policies, on page 1
- View a point-to-multipoint tree on the Topology Map, on page 2
- Create static Tree-SID policies, on page 5
- Modify a Tree-SID policy, on page 9

Visualize Tree-SID policies

Crosswork Network Controller UI provides the ability to view details of the Tree-SID root, transit, leaf nodes, and bud nodes in the UI and allows you to easily confirm that Tree-SID is implemented correctly in your network (see View a point-to-multipoint tree on the Topology Map, on page 2).

The Tree-SID policy has these nodes:

- **Root**—Encapsulates the multicast traffic, replicates it, and forwards it to the transit nodes.
- **Transit**—Acts as a leaf (egress) node and a mid-point (transit) node toward the downstream sub-tree.
- **Leaf**—Decapsulates the multicast traffic and forwards it to the multicast receivers.
- **Bud**—Has a separate leaf node path and is displayed separately in the topology map.

You can visualize these Tree-SID policy types:

- **Static** —A Static Tree-SID policy is configured via SR-PCE, directly using SR-PCE CLI or from the Crosswork UI. You can refer to the Tree-SID configuration documentation for your specific device for more information and examples of the supported configuration commands. (for example, Segment Routing Configuration Guide for Cisco ASR 9000 Series Routers
- **Dynamic** —A Dynamic Tree-SID policy is not explicitly configured; it is configured as part of an L3VPN/ mVPN service.

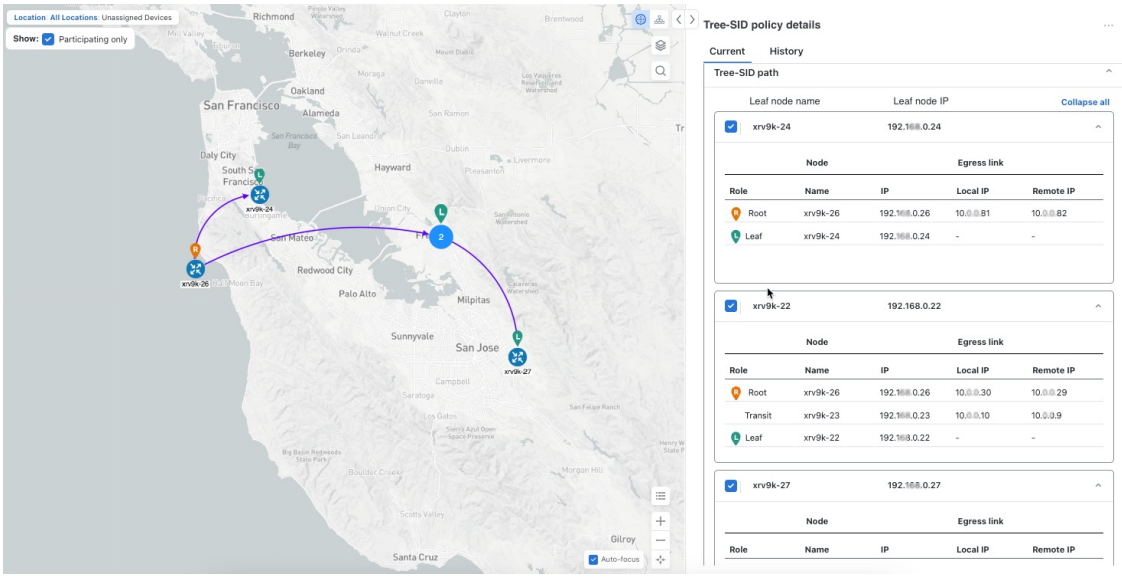
Note Static and Dynamic Tree-SID policies support fast reroute (FRR).

View a point-to-multipoint tree on the Topology Map

Crosswork Network Controller allows you to visualize Tree-SID policies configured in your network.

The following example shows a representation of a Tree-SID policy in the topology map. The root node (R) and leaf nodes (L) are marked, and the arrows denote the path through the transit nodes from the root to the leaf nodes.

Figure 1: Create a new Tree-SID Policy (static)



Before you begin

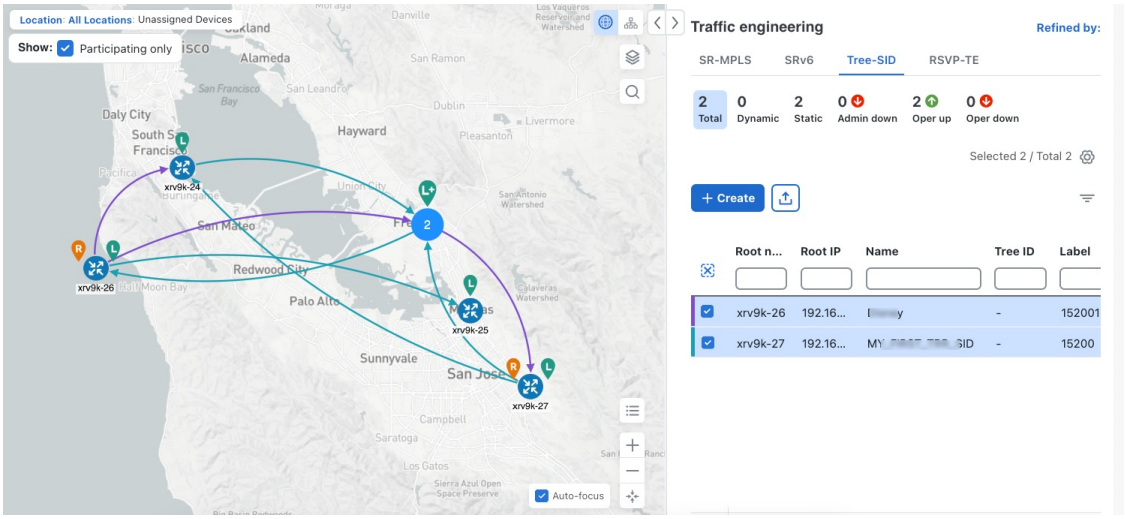
To visualize a multicast tree in the topology map, Tree-SID policies must be configured in your network. For more information, see the SR Tree-SID configuration documentation for your specific device (for example, Segment Routing Configuration Guide for Cisco NCS 540 Series Routers).

Procedure

Step 1 From the main menu, select **Services & Traffic Engineering** > **Traffic Engineering** > **Tree-SID**.

Step 2 Select the Tree-SID policies you want to view on the topology map. You can view a maximum of two policies on the topology map at the same time.

Figure 2: Tree-SID Policies (static) on the Topology Map



Note
Any change in end-points is captured as an event in the historical data tab. For information on Tree-SID Historical Data, see View TE event and utilization history

Step 3 To view Tree-SID details, from the **Actions** column, click ··· > **View details** for one of the Tree-SID policies. You will see a summary and Tree-SID path information.

Example:

Note

- A (Compute) label, next to the SR-PCE field, details the SR-PCE used to create the policies.
- If a source node is unavailable, a warning icon and message appear next to the Oper Status field (hover your mouse over the warning icon), detailing where the connection issue resides.

Figure 3: Tree-SID Details Summary

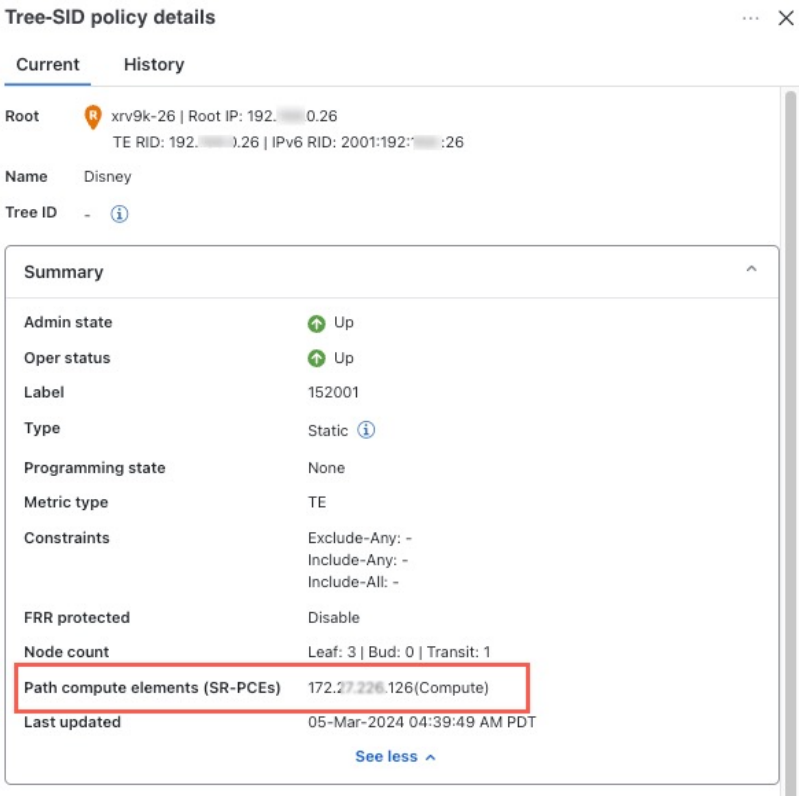
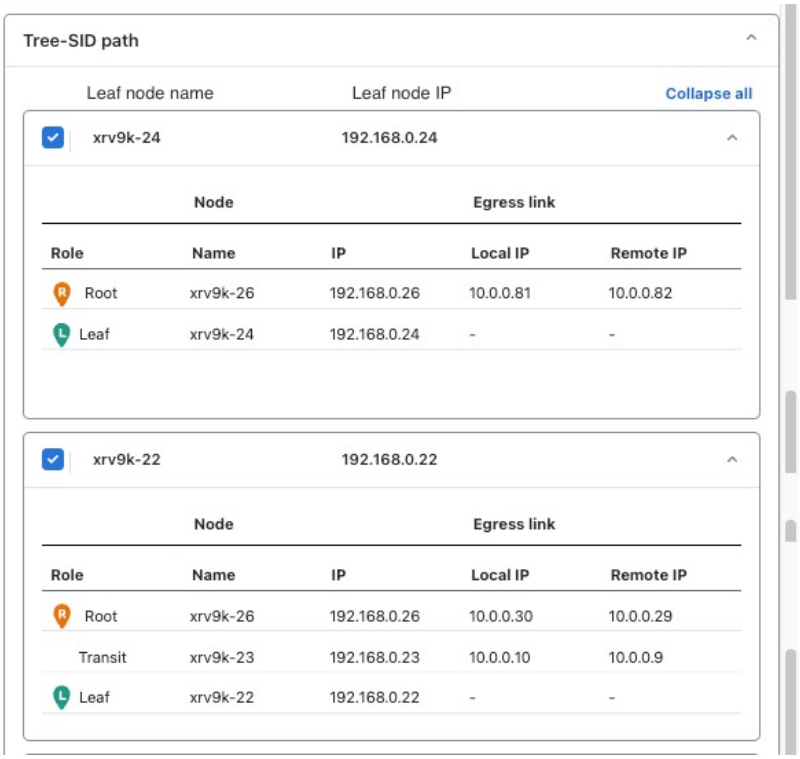


Figure 4: Tree-SID Path Details



Create static Tree-SID policies

Follow these steps to create a static Tree-SID policy, each representing a leaf or a root node.

Before you begin

If you plan to use affinities, collect affinity information from your devices and map them in Cisco Crosswork before creating a static Tree-SID policy. For more information, see Configure TE link affinities in Crosswork Network Controller.

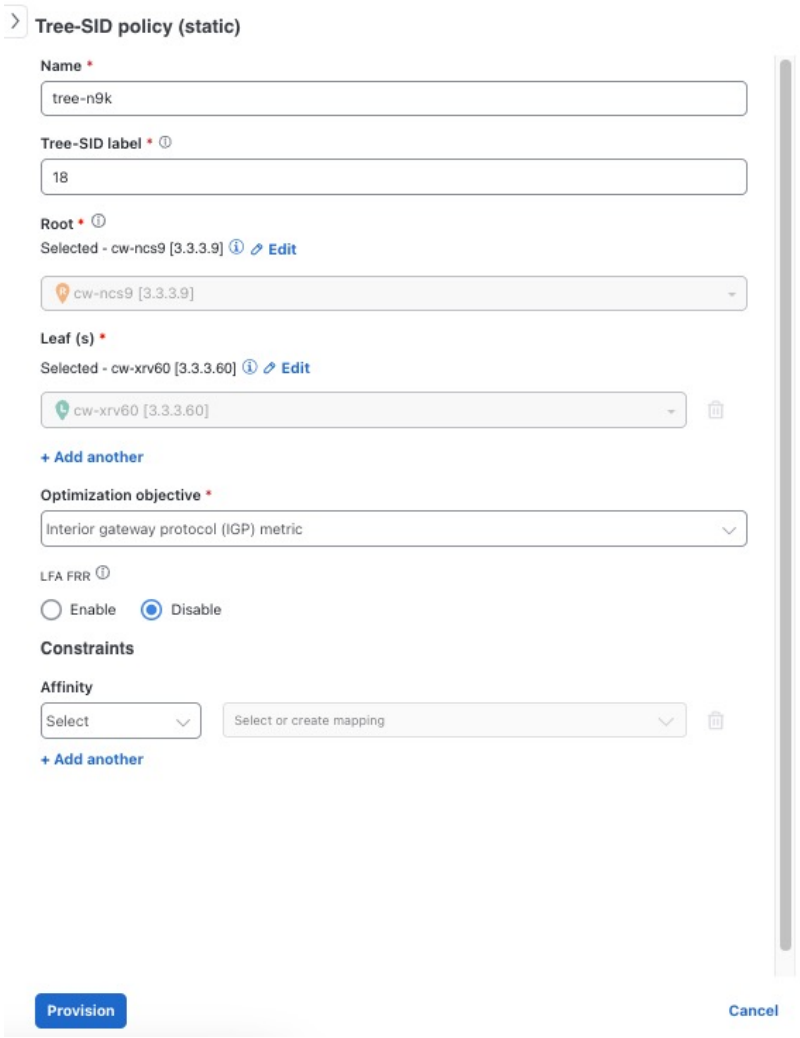
Procedure

Step 1 From the main menu, choose **Services & Traffic Engineering** > **Traffic Engineering** > **Tree-SID** and click **Create**.

Step 2 Enter or select the required Tree-SID policy values. Hover the mouse pointer over ⓘ to view a description of the field.

Note
You can only add PCC nodes with a PCEP session to PCE as root nodes.

Figure 5: Create Static Tree-SID Policy



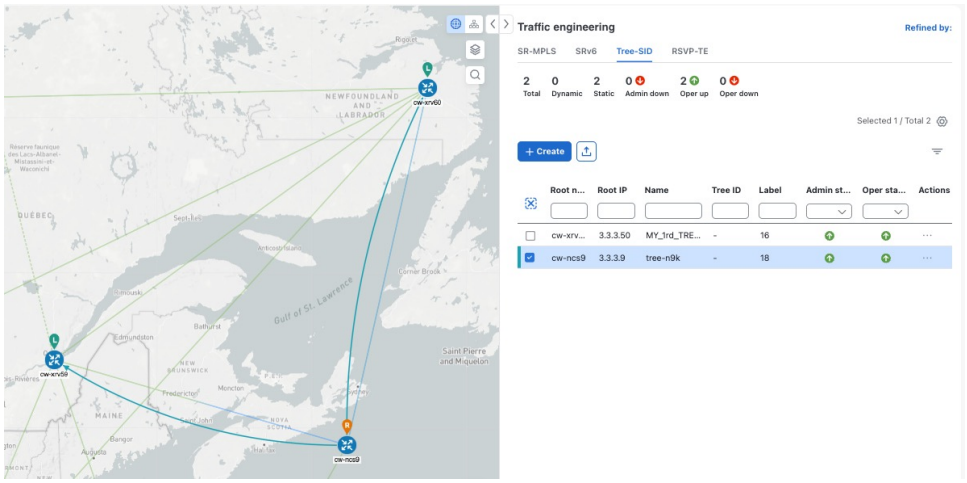
Step 3 To commit the policy, click **Provision**.

Step 4 Validate the Tree-SID policy creation.

a. Confirm that the new Tree-SID policy appears in the **Traffic engineering** table. You can also click the check box next to the policy to see it highlighted in the map.

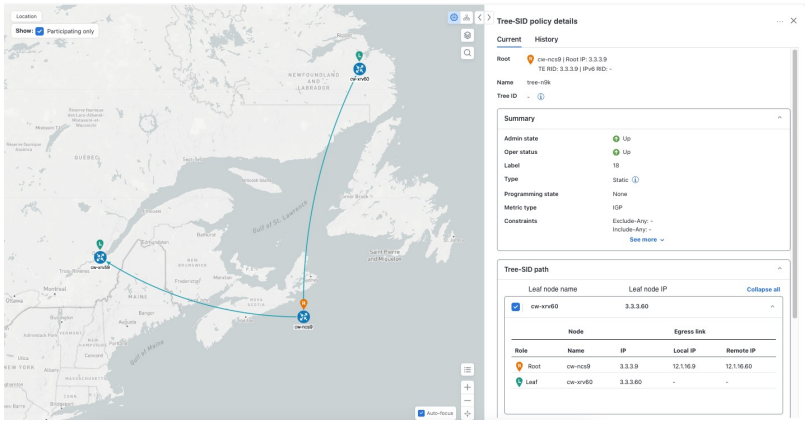
Note
The newly provisioned Tree-SID policy may take some time to appear in the **Traffic engineering** table, depending on the network size and performance. The **Traffic engineering** table is refreshed every 30 seconds.

Figure 6: Newly Added Tree-SID Policy on Topology Map



b. View and confirm the new Tree-SID policy details. From the Actions column, click ··· and select **View details**.

Figure 7: Tree-SID Policy Details



Static Tree-SID policy configuration example

The output below shows the static Tree-SID policy, configured from Crosswork UI, on the compute SR-PCE.

```
RP/0/RP0/CPU0:cw-xrv56#sh pce lsp p2mp


Tree: 50-52-54, Root: 3.3.3.50
 PCC: 3.3.3.50
 Label:   505254
 Operational: up  Admin: up  Compute: Yes
 Local LFA FRR: Disabled
 Metric Type: IGP
 Transition count: 1
 Uptime: 00:01:45 (since Thu Apr 27 10:54:49 PDT 2023)
 Destinations: 3.3.3.52, 3.3.3.54
```

```
 Nodes:
  Node[0]: 3.3.3.50 (cw-xrv50)
   Delegation: PCC
   PLSP-ID: 205
   Role: Ingress
   Hops:
    Incoming: 505254 CC-ID: 1
    Outgoing: 505254 CC-ID: 1 (11.1.28.54) [cw-xrv54]
    Outgoing: 505254 CC-ID: 1 (11.1.1.51) [cw-xrv51]
  Node[1]: 3.3.3.54 (cw-xrv54)
   Delegation: PCC
   PLSP-ID: 148
   Role: Egress
   Hops:
    Incoming: 505254 CC-ID: 2
  Node[2]: 3.3.3.51 (cw-xrv51)
   Delegation: PCC
   PLSP-ID: 187
   Role: Transit
   Hops:
    Incoming: 505254 CC-ID: 3
    Outgoing: 505254 CC-ID: 3 (11.1.2.52) [cw-xrv52]
  Node[3]: 3.3.3.52 (cw-xrv52)
   Delegation: PCC
   PLSP-ID: 247
   Role: Egress
   Hops:
    Incoming: 505254 CC-ID: 4
```

The output below shows the same static Tree-SID policy on the High Availability (HA) peer SR-PCE.

```
RP/0/RP0/CPU0:cw-xrv63#sh pce lsp p2mp

Tree: 50-52-54, Root: 3.3.3.50
 PCC: 3.3.3.50
 Label:   505254
 Operational: standby  Admin: up  Compute: No
 Local LFA FRR: Disabled
 Metric Type: IGP
 Transition count: 0
 Destinations: 3.3.3.52, 3.3.3.54
 Nodes:
  Node[0]: 3.3.3.54 (cw-xrv54)
   Delegation: PCE (3.3.3.56)
   PLSP-ID: 148
   Role: Egress
   Hops:
    Incoming: 505254 CC-ID: 2
  Node[1]: 3.3.3.52 (cw-xrv52)
   Delegation: PCE (3.3.3.56)
   PLSP-ID: 247
   Role: Egress
   Hops:
    Incoming: 505254 CC-ID: 4
  Node[2]: 3.3.3.51 (cw-xrv51)
   Delegation: PCE (3.3.3.56)
   PLSP-ID: 187
   Role: Transit
   Hops:
    Incoming: 505254 CC-ID: 3
    Outgoing: 505254 CC-ID: 3 (11.1.2.52)
  Node[3]: 3.3.3.50 (cw-xrv50)
   Delegation: PCE (3.3.3.56)
   PLSP-ID: 205
```

```
Role: Ingress
Hops:
 Incoming: 505254 CC-ID: 1
 Outgoing: 505254 CC-ID: 1 (11.1.28.54)
 Outgoing: 505254 CC-ID: 1 (11.1.1.51)
```

Modify a Tree-SID policy

Tree SID modification considerations

- You cannot modify the name, label and root of a Tree-SID policy.
- You can only modify or delete a static Tree-SID policy that is created using the Crosswork Network Controller UI or API as opposed to one created using SR-PCE CLI.

Follow these steps to modify a Tree-SID policy.

Procedure

Step 1 Choose **Services & Traffic Engineering** > **Traffic Engineering** > **Tree-SID** .

Step 2 Locate the Tree-SID policy you are interested in and click ⋯.

Step 3 Choose **Edit/Delete**. After updating the Tree-SID policy details, you can preview the changes on the map before saving it.

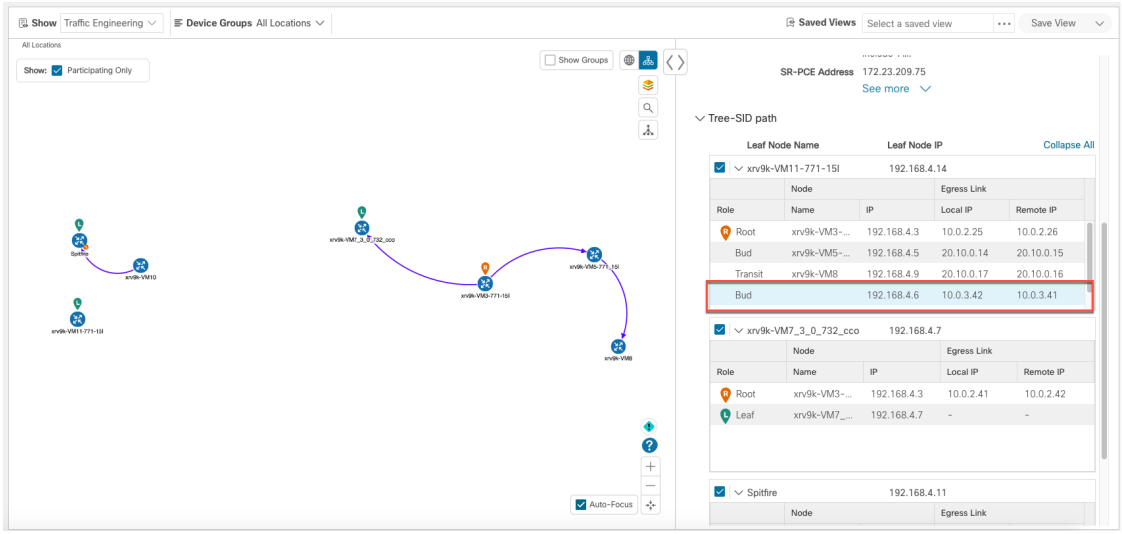
Tree-SID important considerations

Limitations

- Tree-SID policies are only supported on devices running Cisco IOS XR software.
- PCE high-availability (HA) is supported for static Tree-SID policies configured via the UI, but is not supported if configured directly on the SR-PCE CLI.
- Tree-SID policy details based on SRv6 are not supported.
- If a single instance of SR-PCE is used, and the SR-PCE restarts, all static Tree-SID policies that were configured from the UI are deleted.
- IPV4 unnumbered interfaces are not supported.

Visualization of Tree-SID paths with missing nodes

There may be instances where a node on a Tree-SID policy path is not available in the Crosswork topology information. This could happen if the node is not added to the Crosswork device inventory. This affects the display of the Tree-SID policy path on the topology map, causing one or more root-to-leaf paths to appear broken. However, the path details in the right panel will still show the full path.


Show
Traffic Engineering
Device Groups
All Locations
Saved Views
Select a saved view
Save View
Show:
Participating Only
Show Groups
SR-PCE Address
172.23.209.75
See more
Tree-SID path
Leaf Node Name
Leaf Node IP
Collapse All
xrv9k-VM11-771-15I
192.168.4.14
Node
Egress Link
Role
Name
IP
Local IP
Remote IP
Root
xrv9k-VM3-...
192.168.4.3
10.0.2.25
10.0.2.26
Bud
xrv9k-VM5-...
192.168.4.5
20.10.0.14
20.10.0.15
Transit
xrv9k-VM8
192.168.4.9
20.10.0.17
20.10.0.16
Bud
192.168.4.6
10.0.3.42
10.0.3.41
xrv9k-VM7_3_0_732_cco
192.168.4.7
Root
xrv9k-VM3-...
192.168.4.3
10.0.2.41
10.0.2.42
Leaf
xrv9k-VM7_...
192.168.4.7
Spitfire
192.168.4.11
Auto-Focus