Tree Segment Identifier Multicast Traffic Engineering

Tree Segment Identifier

A Tree-SID is a method for implementing tree-like multicast flows over a segmented routing network that:

- assigns a single SID label to represent all segments and devices within a multicast tree,
- uses an SDN controller (such as a device running SR-PCE with PCEP) to calculate the tree structure, and
- designates a specific role to each node within the tree for forwarding multicast data.

The SDN controller constructs routing paths using any constraints defined by network architects.

A key use case for constraint-based Tree-SID is when routers are configured to deliver two point-to-multipoint (P2MP) streams carrying the same content over different paths. In this scenario, the multicast flow is forwarded twice, with each copy following a unique path through the network. The two copies use different nodes and links to reach the destination. This approach reduces packet loss because a network failure on one path does not impact the delivery of the multicast stream on the other path.

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).

Tree-SID node roles

Crosswork Network Controller provides the ability to view the details of Tree-SID root, transit, leaf, and bud nodes in the UI, allowing you to easily confirm proper Tree-SID implementation in your network (see View point-to-multipoint trees on the topology map, on page 2).

Tree-SID policies define four distinct node roles, each of which serves a specific function in multicast data forwarding:

- **Root**: The ingress or head-end node. Encapsulates 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 downstream sub-tree.

- **Leaf**: The egress or the destination node. Decapsulates multicast traffic and forwards it to multicast receivers.

- **Bud**: Has a separate leaf node path and is displayed separately in the topology map.

Tree-SID policy types

Crosswork Network Controller allows you to visualize these Tree-SID policy types.

- **Static**: Configured via SR-PCE, either directly using SR-PCE CLI or through the Crosswork Network Controller UI. For more information and supported configuration commands, for your specific device, refer to the Tree-SID configuration documentation (for example, Segment Routing Configuration Guide for Cisco ASR 9000 Series Routers.

- **Dynamic**: Not explicitly configured. It is configured as part of an L3VPN or multicast VPN (mVPN) service.

> **Note** You can use either static or dynamic Tree-SID policies to enable fast reroute (FRR) capabilities in your multicast network.

# View point-to-multipoint trees on the topology map

Before you begin

To visualize multicast trees 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).

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

The 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 indicate the path through the transit nodes from the root to the leaf nodes.

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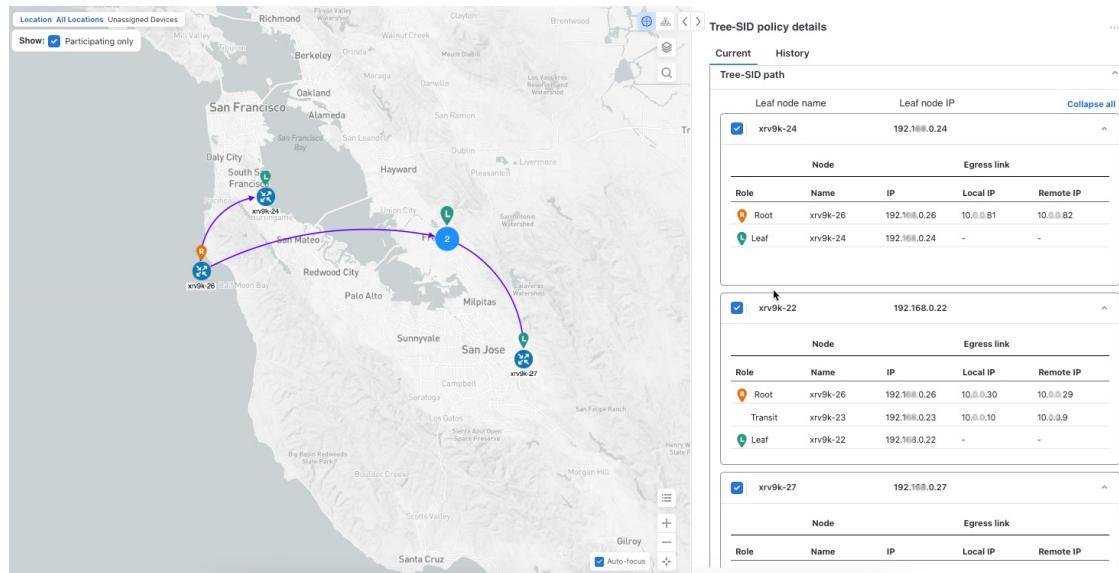
Procedure

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. Only two policies can be displayed on the topology map at a time.

Figure 2: Tree-SID policies (static) on the topology map
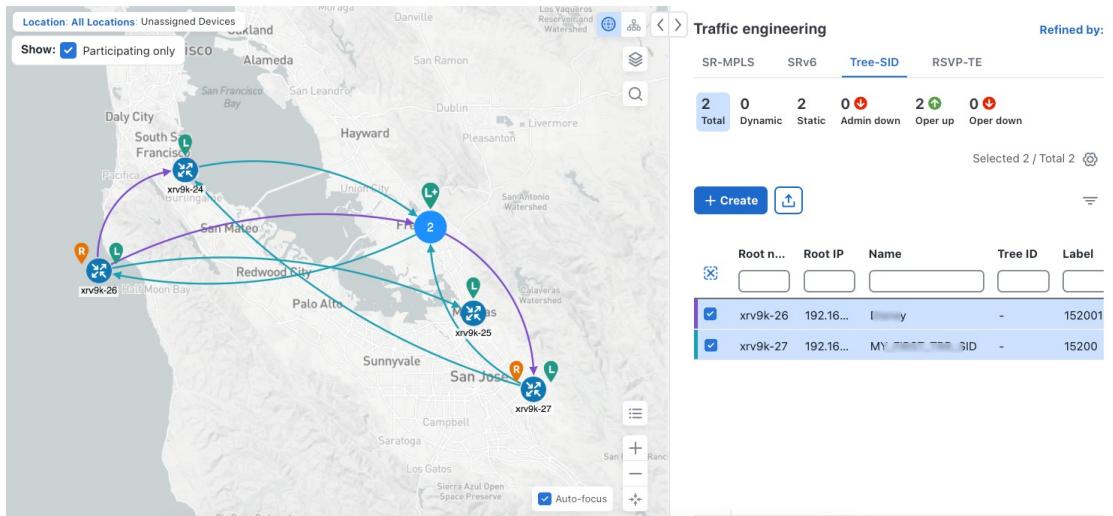
Note

Any change in end-points is recorded as an event in the historical data tab. For information about 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:

Figure 3: Tree-SID details summary

Note
- A (Compute) label, next to the SR-PCE field identifies 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 the mouse over the warning icon to see where the connection issue is located.

Figure 4: Tree-SID path details

Create static Tree-SID policies

Before you begin

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

To create a static Tree-SID policy that represents a leaf or a root node, complete these steps:

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. To view a description of a field, hover the mouse pointer over the ⓘ icon.

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. To highlight the policy on the map, select the check box next to the policy.

Note

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

Figure 6: Newly added tree-SID policy on topology map
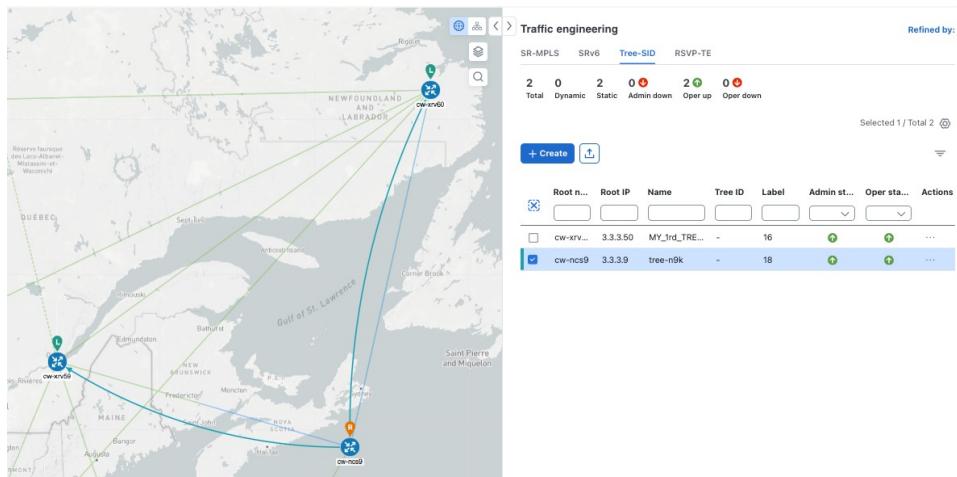
b. View and confirm the new Tree-SID policy details. From the Actions column, click ⋯ and select **View details**.

Figure 7: Tree-SID policy details
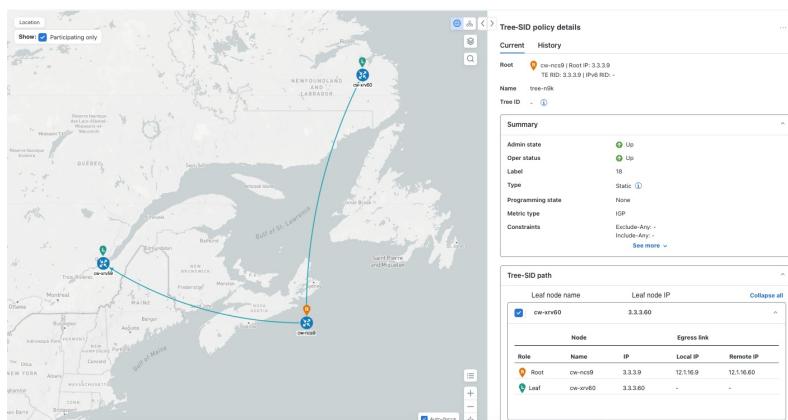
Static Tree-SID policy configuration

The following output shows a static Tree-SID policy configured from the Crosswork Network Controller 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 below output shows the same static Tree-SID policy as viewed 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

Before you begin

Tree SID modification considerations

- You cannot modify the name, label, or root of a Tree-SID policy.

- You can modify or delete only a static Tree-SID policy created using the Crosswork Network Controller UI or API. You cannot modify or delete static Tree-SID policies created using SR-PCE CLI.

To view, modify, or delete a Tree-SID policy, complete these steps:

Procedure

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

Step 2   Locate the Tree-SID policy you want to modify, and click ⊡.

Step 3   Choose **View details** or **Edit/Delete**. After you update the Tree-SID policy details, preview the changes on the map, and save them.

Tree-SID important considerations

Limitations

Working with Tree-SID policies has these 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 you use a single instance of SR-PCE, note that all static Tree-SID policies configured from the UI are deleted if the SR-PCE restarts.

- IPv4 unnumbered interfaces are not supported.

Visualization of Tree-SID paths with missing nodes

If a node on a Tree-SID policy path is not added to the Crosswork device inventory, it will not appear in the Crosswork Network Controller topology information. As a result, one or more root-to-leaf paths may look broken in the topology map, even though the right panel will still display the full Tree-SID policy path.

Figure 8: Tree-SID path visualization