



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, which represents all of the tree segments and devices in it. The SDN controller is highly flexible, as it understands the segmentation and can construct routing paths using any kind of 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 6](#)
- [Modify a Tree-SID Policy, on page 9](#)

Visualize Tree-SID Policies

Crosswork 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 the following nodes:

- Root node—Encapsulates the multicast traffic, replicates it, and forwards it to the transit nodes.
- Transit node—Acts as a leaf (egress) node as well as a mid-point (transit) node toward the downstream sub-tree.
- Leaf node—Decapsulates the multicast traffic and forward it to the multicast receivers.

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

You can visualize the following Tree-SID policies:

- **Static:** A Static Tree-SID policy is configured via SR-PCE, either directly using SR-PCE CLI or from the Crosswork UI. You can refer to the Tree-SID configuration documentation for your specific device to find out 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 a 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 allows you to visualize Tree-SID policies configured in your network.

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

You can drill down on the nodes and the links to see more details about the Tree-SID policy and validate the configuration.

The screenshot displays the Crosswork Traffic Engineering interface. On the left, a topology map shows a network of nodes and links. A purple path highlights a Tree-SID policy starting from a root node (R) and branching to leaf nodes (L). The nodes are labeled with names like xrv9k-26, xrv9k-23, and xrv9k-27. On the right, the 'Tree-SID Policy Details' panel is open, showing two policies: xrv9k-27 and xrv9k-24. Each policy has a table of nodes and egress links.

Tree-SID Policy Details				
Current		History		
Leaf Node Name	Leaf Node IP	Collapse All		
<input checked="" type="checkbox"/> xrv9k-27	192.168.0.27			
Role	Name	IP	Local IP	Remote IP
Root	xrv9k-26	192.168.0.26	10.0.0.30	10.0.0.29
Transit	xrv9k-23	192.168.0.23	10.0.0.41	10.0.0.42
Leaf	xrv9k-27	192.168.0.27	-	-
<input checked="" type="checkbox"/> xrv9k-24	192.168.0.24			
Role	Name	IP	Local IP	Remote IP
Root	xrv9k-26	192.168.0.26	10.0.0.30	10.0.0.29
Transit	xrv9k-23	192.168.0.23	10.0.0.41	10.0.0.42
Bud	xrv9k-27	192.168.0.27	10.0.0.46	10.0.0.45
Leaf	xrv9k-24	192.168.0.24	-	-

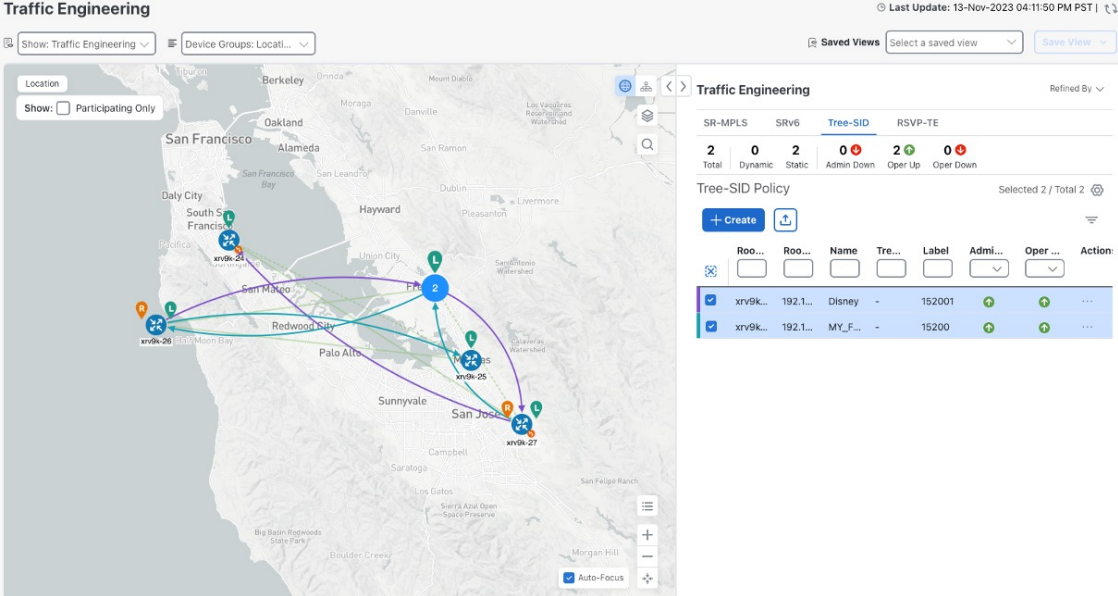
Before you begin

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](#)).

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

Step 2 Select the Tree-SID policies you want to view on the topology map.

Note You can view a maximum of two policies on the topology map at the same time.



The screenshot displays the Traffic Engineering interface. On the left, a map shows a network topology with nodes and connections. On the right, a panel titled 'Traffic Engineering' shows a summary of policies and a table of selected policies.


Traffic Engineering Summary:

SR-MPLS	SRV6	Tree-SID	RSVP-TE
2	0	2	0
Total	Dynamic	Static	Admin Down
		Oper Up	Oper Down

Tree-SID Policy Table:

Roos...	Roos...	Name	Tre...	Label	Admi...	Oper ...	Action
<input checked="" type="checkbox"/>	xrv9K...	192.1...	Disney	-	152001	+	+
<input checked="" type="checkbox"/>	xrv9K...	192.1...	MY_F...	-	15200	+	+

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 the Tree-SID Details, from the **Actions** column, click  > **View Details** for one of the Tree-SID policies.


View a Point-to-Multipoint Tree on the Topology Map

Traffic Engineering Last Update: 13-Nov-2023 04:13:51 PM PST | ↕


Show: Traffic Engineering | Device Groups: Locat... | Saved Views | Select a saved view | Save View

Tree-SID Policy Details




Current | History

Root  xrv9k-26 | Root IP: 192.168.0.26
TE RID: 192.168.0.26 | IPv6 RID: 2001:192:168::26

Name: Disney

Tree ID: 




Summary

Admin State  Up
Oper Status  Up
Label: 152001
Type: Static 

Programming State: None
Metric Type: TE
Constraints: Exclude-Any: -
Include-Any: -
Include-All: -
FRR Protected: Disable

[See more](#) ↓

Tree-SID path

Leaf Node Name	Leaf Node IP			
<input checked="" type="checkbox"/> xrv9k-27	192.168.0.27	Collapse All		
Node				
Egress Link				
Role	Name	IP	Local IP	Remote IP
 Root	xrv9k-26	192.168.0.26	10.0.0.30	10.0.0.29
 Transit	xrv9k-23	192.168.0.23	10.0.0.41	10.0.0.42
 Leaf	xrv9k-27	192.168.0.27	-	-

xrv9k-24 | 192.168.0.24

Step 4 You can view the Tree-SID details and verify the path and node details to ensure that Tree-SID is correctly configured.

Note When viewing Tree-SID Policy Details, if a Source Node is not available, 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.

The screenshot displays the 'Tree-SID Policy Details' interface. At the top, there are tabs for 'Current' and 'History'. Below the tabs, the 'Root' is identified as 'xrv9k-12' with a Root IP of 192.168.0.2, and TE RID: 192.168.0.2 | IPv6 RID: 2001:192:168::2. The 'Name' is 'Test-TS2' and the 'Tree ID' is '-'. The 'Summary' section lists the following details:

- Admin State: Up (green arrow)
- Oper Status: Down (red arrow) - A tooltip points to this field, stating: 'source node 192.168.0.2 not connected via PCEP'
- Label: 9999
- Type: Static (info icon)
- Programming State: None
- Metric Type: TE
- Constraints: Exclude-Any: -, Include-Any: -, Include-All: -
- FRR Protected: Disable

A 'See more' link is located at the bottom of the summary section.

Note A (Compute) label, next to the SR-PCE field, details the SR-PCE used to create the policies.

Tree-SID Policy Details

Current History

Summary

Admin State ↑ Up

Oper Status ↓ Down ⚠

Label 9999

Type Static i

Programming State None

Metric Type TE

Constraints Exclude-Any: -
Include-Any: -
Include-All: -

FRR Protected Disable

Node Count Leaf: 3 | Bud: 0 | Transit: 0

Path Compute Elements (SR-PCEs) 172.27.226.118(Compute)

Last Update 01-Aug-2023 07:23:41 PM CDT

[See less](#) ^

Create Static Tree-SID Policies

This task will explain how to create a static Tree-SID policy each representing a leaf or a root node.



Tip If you plan to use affinities, collect affinity information from your devices and then map them in Cisco Crosswork before creating a static Tree-SID policy. For more information, see [Configure TE Link Affinities](#).

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

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

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

Step 3 Add leaf nodes that will be part of the Tree-SID policy.

Step 4 Under **Affinity**, define any applicable affinities. For more information on Affinities, see [Configure TE Link Affinities](#)

Step 5 To commit the policy, click **Provision**.

Step 6 Validate the Tree-SID policy creation:

- a. Confirm that the new Tree-SID policy appears in the Tree-SID 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 Tree-SID table, depending on the network size and performance. The **Tree-SID** table is refreshed every 30 seconds.

- b. View and confirm the new Tree-SID policy details. From the topology map click **Tree-SID**, click ⋮ and select **View**.

Static Tree-SID Policy Configuration Example through Crosswork UI

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
    Outgoing: 505254 CC-ID: 3 (11.1.2.52)
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
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 (11.1.1.28.54)
  Outgoing: 505254 CC-ID: 1 (11.1.1.1.51)

```

Modify a Tree-SID Policy


To modify a Tree-SID policy, do the following:



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

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

Step 2 From the **Traffic Engineering** window, click the **Tree-SID** tab.

Step 3 Locate the Tree-SID policy you are interested in and click .

Step 4 Choose **Edit**.

- Note**
- You can only modify or delete a static Tree-SID policy that is created using the Crosswork UI or API as opposed to one created using SR-PCE CLI
 - After updating the Tree-SID policy details, you can preview the changes on the map before saving it.

Tree-SID Important Notes

Limitation

- 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 Cisco Crosswork UI, but 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 Crosswork UI are deleted.
- IPV4 unnumbered interfaces are not supported.

Visualization of Tree-SID Paths with Missing Nodes

Missing Tree-SID nodes can cause the following to happen:

A node on a Tree-SID policy path may not be available in the Crosswork topology information for various reasons. For example, the node is not added to the Crosswork device inventory. This affects how the Tree-SID policy path is displayed on the topology map. The unavailable node will cause one or more root-to-leaf paths to look broken on the map, as shown in the figure below. However, the path details in the right panel will still show the full path.

The screenshot displays a network management interface with a central diagram of a Tree-SID path. The path consists of several nodes connected by links, including nodes like 'xrv9k-VM11-771-15I', 'xrv9k-VM7-771-15I', and 'xrv9k-VM8'. The interface includes a 'Show' dropdown set to 'Traffic Engineering', a 'Device Groups' dropdown set to 'All Locations', and a 'Saved Views' section.

On the right side, a detailed view of the 'Tree-SID path' is shown, including a table of nodes and links. The table is organized into sections for different leaf nodes.

Leaf Node Name		Leaf Node IP		Collapse All	
<input checked="" type="checkbox"/>	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	xrv9k-VM7-...	192.168.4.6	10.0.3.42	10.0.3.41	
<input checked="" type="checkbox"/>	xrv9k-VM7_3_0_732_cco	192.168.4.7			
	Node	Egress Link			
Role	Name	IP	Local IP	Remote IP	
Root	xrv9k-VM3-...	192.168.4.3	10.0.2.41	10.0.2.42	
Leaf	xrv9k-VM7_...	192.168.4.7	-	-	
<input checked="" type="checkbox"/>	Spitfire	192.168.4.11			
	Node	Egress Link			