



Segment Routing Tree Segment Identifier

Tree Segment Identifier (Tree-SID) is a tree-building solution that uses a Segment Routing Path Computation Element (SR-PCE) using path computation element protocol (PCEP) to calculate the point-to-multipoint (P2MP) tree using SR policies. Tree-SID uses a single MPLS label for building a multicast replication tree in an SR network. Tree-SID does not require multicast control protocols such as RSVP, mLDP, and PIM.

A P2MP SR policy provides an SR-based TE solution for transporting multicast traffic. It works on existing data-plane (MPLS and IP) and supports TE capabilities and single/multi routing domains. At each node of the tree, the forwarding state is represented by the same segment (using a global Tree-SID specified from the SRLB range of labels). P2MP SR policy prevents transient loop and packet loss when updating the path of a P2MP SR policy.

A P2MP SR policy request contains the following:

- Policy name
- SID for the P2MP Tree (Tree-SID)
- Address of the root node
- Addresses of the leaf nodes
- Optimization objectives (TE, IGP, delay metric)
- Constraints (affinity)

Tree SID Policy Types and Behaviors

- Static P2MP Policies—can be configured in the following ways:
 - Tree SID parameters provided via Cisco Crosswork Optimization Engine (COE) UI
 - COE passes the policy configuration to the SR-PCE via REST API (no Tree-SID CLI at PCE). This method allows for SR-PCE High Availability (HA).



Note Refer to the *Traffic Engineering in Crosswork Optimization Engine* chapter in the [Cisco Crosswork Optimization Engine](#) documentation.

- Tree SID parameters configured via Tree-SID CLI at the SR-PCE



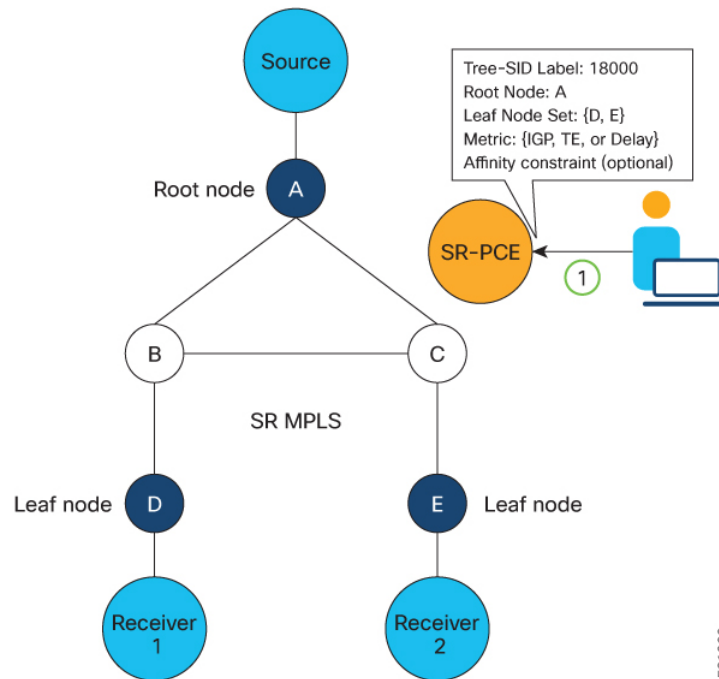
Caution With this method, SR-PCE HA is not supported. For this reason, this configuration method is not recommended.

- Dynamic P2MP Policies—can be configured in the following ways:
 - A BGP mVPN is configured in the network (PE nodes) – service configuration via CLI or Cisco NSO
 - As a result, BGP control plane is used for PE auto-discovery and customer multicast signaling.
 - Tree SID parameters are provided by mVPN PEs via PCEP to the PCE. This method allows for SR-PCE High Availability (HA).

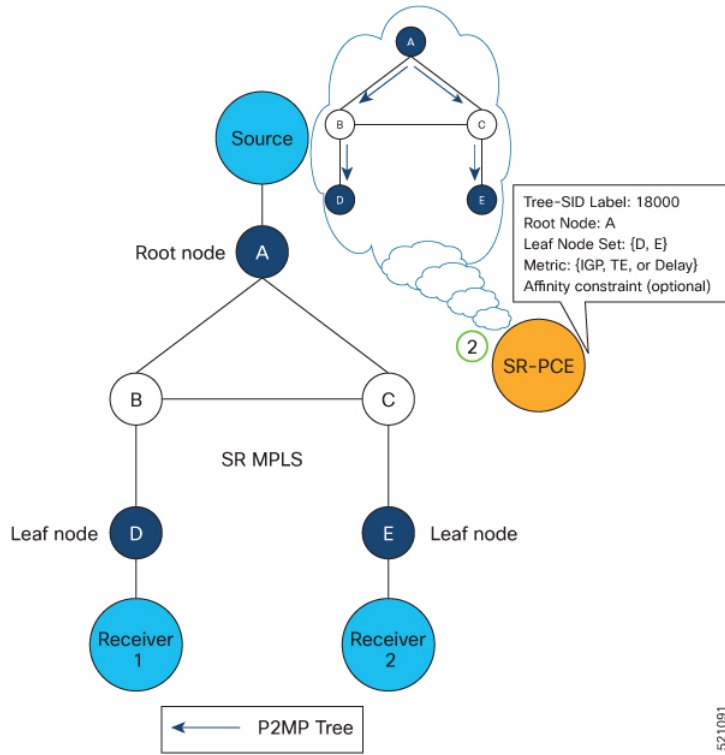
Tree SID Workflow Overview

This sections shows a basic workflow using a static Tree SID policy:

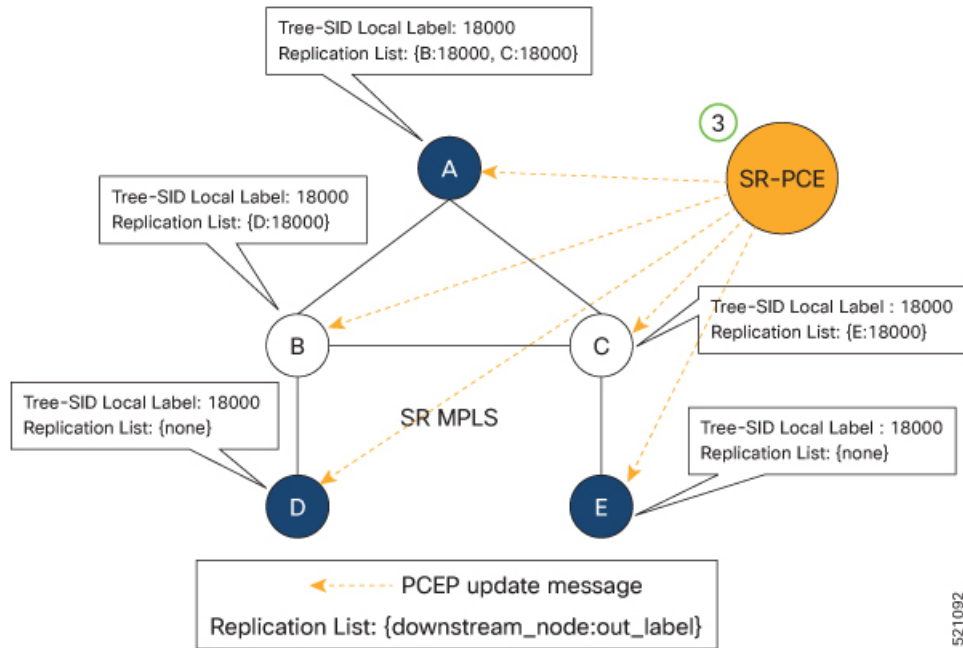
1. User creates a static Tree-SID policy, either via Crosswork Optimization Engine (preferred), or via CLI at the SR-PCE (not recommended).



2. SR-PCE computes the P2MP Tree.

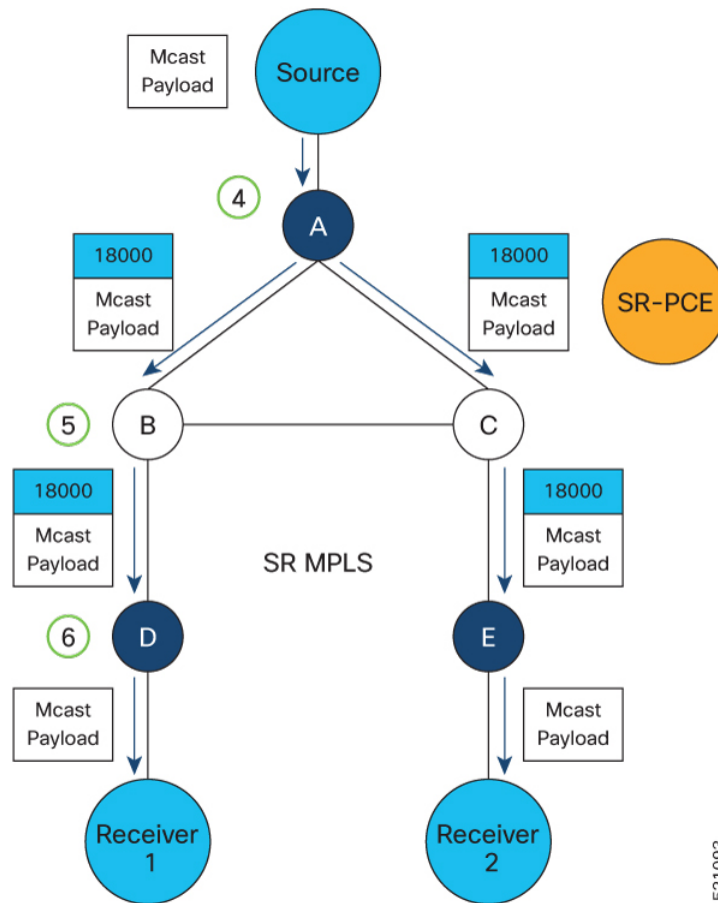


3. SR-PCE instantiates the Tree-SID state at each node in the tree.



4. The Root node encapsulates the multicast traffic, replicates it, and forwards it to the Transit nodes.

5. The Transit nodes replicate the multicast traffic and forward it to the Leaf nodes.
6. The Leaf nodes decapsulate the multicast traffic and forward it to the multicast receivers.



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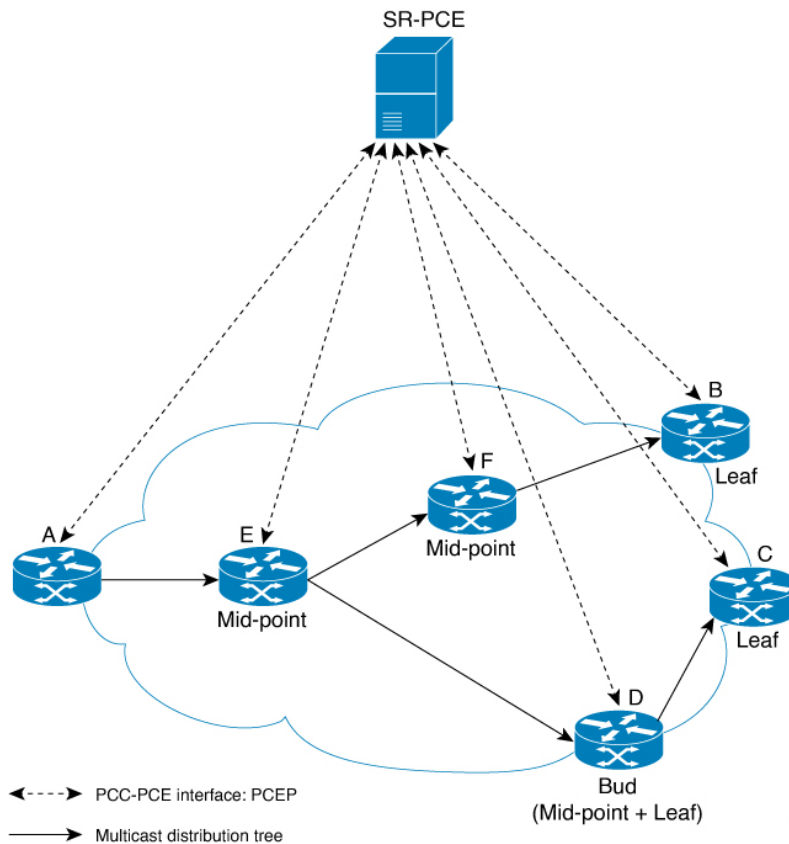
Usage Guidelines and Limitations

- SR-PCE High Availability (HA) is supported for dynamic P2MP policies and for static P2MP policies configured via Cisco Crosswork Optimization Engine (COE) UI.
- SR-PCE HA is not supported for static Tree-SID policy configured via Tree-SID CLI at the SR-PCE. Tree-SID can only be controlled by a single PCE. Configure only one PCE on each PCC in the Tree-SID path.

Bud Node Support

In a multicast distribution tree, a Bud node is a node that acts as a leaf (egress) node as well as a mid-point (transit) node toward the downstream sub-tree.

In the below multicast distribution tree topology with Root node {A} and Leaf nodes set {B, C, D}, node D is a Bud node. Similarly, if node E is later added to the Leaf set, it would also become a Bud node.



The tree computation algorithm on SR-PCE has been enhanced to detect a Bud node based on knowledge of the Leaf set, and to handle Leaf/Transit node transitions to Bud node. The role of the Bud node is also explicitly signaled in PCEP.

Configure Static Segment Routing Tree-SID via CLI at SR-PCE



Caution With this configuration method, SR-PCE HA is not supported. For this reason, this configuration method is not recommended.

To configure static Segment Routing Tree-SID for Point-to-Multipoint (P2MP) SR policies, complete the following configurations:

1. Configure Path Computation Element Protocol (PCEP) Path Computation Client (PCC) on all nodes involved in the Tree-SID path (root, mid-point, leaf)
2. Configure Affinity Maps on the SR-PCE
3. Configure P2MP SR Policy on SR-PCE
4. Configure Multicast on the Root and Leaf Nodes

Configure PCEP PCC on All Nodes in Tree-SID Path

Configure all nodes involved in the Tree-SID path (root, mid-point, leaf) as PCEP PCC. For detailed PCEP PCC configuration information, see [Configure the Head-End Router as PCEP PCC](#).

Configure Affinity Maps on the SR-PCE

Use the **affinity bit-map** *COLOR bit-position* command in PCE SR-TE sub-mode to define affinity maps. The bit-position range is from 0 to 255.

```
Router# configure
Router(config)# pce
Router(config-pce)# segment-routing traffic-eng
Router(config-pce-sr-te)# affinity bit-map RED 23
Router(config-pce-sr-te)# affinity bit-map BLUE 24
Router(config-pce-sr-te)# affinity bit-map CROSS 25
Router(config-pce-sr-te)#
```

Configure P2MP SR Policy on SR-PCE

Configure the end-point name and addresses, Tree-SID label, and constraints for the P2MP policy.

Use the **endpoint-set** *NAME* command in SR-PCE P2MP sub-mode to enter the name of the end-point set and to define the set of end-point addresses.

```
Router(config-pce-sr-te)# p2mp
Router(config-pce-sr-te-p2mp)# endpoint-set BAR
Router(config-pce-p2mp-ep-set)# ipv4 10.1.1.2
Router(config-pce-p2mp-ep-set)# ipv4 10.1.1.3
Router(config-pce-p2mp-ep-set)# ipv4 10.1.1.4
Router(config-pce-p2mp-ep-set)# exit
Router(config-pce-sr-te-p2mp)#
```

Use the **policy** *policy* command to configure the P2MP policy name and enter P2MP Policy sub-mode. Configure the source address, endpoint-set color, Tree-SID label, affinity constraints, and metric type.

```
Router(config-pce-sr-te-p2mp)# policy FOO
Router(config-pce-p2mp-policy)# source ipv4 10.1.1.6
Router(config-pce-p2mp-policy)# color 10 endpoint-set BAR
Router(config-pce-p2mp-policy)# treesid mpls 15200
Router(config-pce-p2mp-policy)# candidate-paths
Router(config-pce-p2mp-policy-path)# constraints
Router(config-pce-p2mp-path-const)# affinity
Router(config-pce-p2mp-path-affinity)# exclude BLUE
Router(config-pce-p2mp-path-affinity)# exit
Router(config-pce-p2mp-path-const)# exit
Router(config-pce-p2mp-policy-path)# preference 100
Router(config-pce-p2mp-policy-path-preference)# dynamic
Router(config-pce-p2mp-path-info)# metric type te
```

```
Router(config-pce-p2mp-path-info)# root
Router(config)#
```

Configure Multicast on the Root and Leaf Nodes

On the root node of the SR P2MP segment, use the **router pim** command to enter Protocol Independent Multicast (PIM) configuration mode to statically steer multicast flows into an SR P2MP policy.



Note Enter this configuration only on an SR P2MP segment. Multicast traffic cannot be steered into a P2P policy.

```
Router(config)# router pim
Router(config-pim)# vrf name
Router(config-pim-name)# address-family ipv4
Router(config-pim-name-ipv4)# sr-p2mp-policy FOO
Router(config-pim-name-ipv4-srp2mp)# static-group 235.1.1.5 10.1.1.6
Router(config-pim-name-ipv4-srp2mp)# root
Router(config)#
```

On the root and leaf nodes of the SR P2MP tree, use the **mdt static segment-routing** command to configure the multicast distribution tree (MDT) core as Tree-SID from the multicast VRF configuration submode.

```
Router(config)# multicast-routing
Router(config-mcast)# vrf TEST
Router(config-mcast-TEST)# address-family ipv4
Router(config-mcast-TEST-ipv4)# mdt static segment-routing
```

On the leaf nodes of an SR P2MP segment, use the **static sr-policy p2mp-policy** command to configure the static SR P2MP Policy from the multicast VRF configuration submode to statically decapsulate multicast flows.

```
Router(config)# multicast-routing
Router(config-mcast)# vrf TEST
Router(config-mcast-TEST)# address-family ipv4
Router(config-mcast-TEST-ipv4)# static sr-policy FOO
```

Running Config

The following example shows how to configure the end point addresses and P2MP SR policy with affinity constraints on SR-PCE.

```
pce
segment-routing
traffic-eng
affinity bit-map
RED 23
BLUE 24
CROSS 25
!
p2mp
endpoint-set BAR
ipv4 10.1.1.2
ipv4 10.1.1.3
ipv4 10.1.1.4
!
```

