Dynamic Path Computation Client

Effective Cisco IOS XE Everest 16.6.1, the Stateful Path Computation Element Protocol (PCEP) enables a router to report and delegate Label Switched Paths (LSPs) that are established using Resource Reservation Protocol (RSVP) protocol to a stateful Path Computation Element (PCE). An LSP delegated to a PCE can be updated by the PCE and a stateful PCE can initiate an LSP on a Path Computation Client (PCC).

RSVP-TE LSPs require link-state routing protocols such as OSPF or IS-IS to distribute and learn traffic engineering topology. A stateful PCE can learn the traffic engineering topology through BGP Link-State (BGP-LS) protocol. The IGP instance running on a router feeds the traffic engineering topology information into BGP which passes that information to stateful PCE.

Note Dynamic PCC is available only on the Cisco RSP2 Module.

Note Path Computation Element is not supported on the Cisco RSP2 Module.

Information About Dynamic PCC

PCEP functions

A PCEP session is a TCP session between a PCC and a PCE with protocol messages. The PCEP functions are verified based on the PCC functions. The configuration and verification show that the request is accepted and path computation is provided based on PCReq message from the client. The passive reporting enables a router to report a tunnel instead of delegating it to a PCE. The PCE is aware of the tunnel even though it cannot modify the tunnel.

PCEP functions are useful when a network has both router-controlled and PCE delegated tunnels. The PCE is aware of both the tunnels and can make an accurate decision on path computation.

Configuring Dynamic PCC Globally

Perform the following task to configure dynamic PCC globally:

```
enable
configure terminal
mpls traffic-eng tunnels
mpls traffic-eng pcc peer 10.0.0.1 ----..(10.0.0.1 is the PCE server address)
mpls traffic-eng pcc report-all
end
```

Configuring Dynamic PCC on an Interface

Perform the following task to configure dynamic PCC on an interface

```
interface Tunnel1
 ip unnumbered Loopback0
 tunnel mode mpls traffic-eng
 tunnel destination 7.7.7.7
 tunnel mpls traffic-eng autoroute announce
 tunnel mpls traffic-eng priority 5 5
 tunnel mpls traffic-eng bandwidth 200
 tunnel mpls traffic-eng path-option 10 dynamic pce segment-routing
end
```

Verifying Dynamic PCC

The following sample output is from the **show pce client peer detail** command.

```
Device# show pce client peer detail
PCC's peer database:
-------------------
Peer address: 10.0.0.1
  State up
  Capabilities: Stateful, Update, Segment-Routing
  PCEP has been up for: 23:44:58
  PCEP session ID: local 1, remote: 0
  Sending KA every 30 seconds
  Minimum acceptable KA interval: 20 seconds
  Peer timeout after 120 seconds
  Statistics:
Keepalive messages: rx   2798 tx    2112
Request messages:  rx      0 tx      32
Reply messages:    rx     32 tx       0
Error messages:    rx      0 tx       0
Open messages:     rx      1 tx       1
Report messages:   rx      0 tx      57
Update messages:   rx     72 tx       0
```

The following sample output is from the **show tunnel** command which shows the LSP details.

```
Device# show tunnel 1
Name: d1_t1                           (Tunnel1) Destination: 7.7.7.7
  Status:
    Admin: up        Oper: up     Path: valid        Signalling: connected
    path option 10, (SEGMENT-ROUTING) (PCE) type dynamic (Basis for Setup, path weight 0)
  Config Parameters:
    Bandwidth: 200       kbps (Global)  Priority: 5  5   Affinity: 0x0/0xFFFF
    Metric Type: TE (default)
    Path Selection:
     Protection: any (default)
    Path-selection Tiebreaker:
      Global: not set   Tunnel Specific: not set   Effective: min-fill (default)
    Hop Limit: disabled
    Cost Limit: disabled
    Path-invalidation timeout: 10000 msec (default), Action: Tear
    AutoRoute: enabled  LockDown: disabled Loadshare: 200 [10000000] bw-based
    auto-bw: disabled
    Fault-OAM: disabled, Wrap-Protection: disabled, Wrap-Capable: No
  Active Path Option Parameters:
    State: dynamic path option 10 is active
    BandwidthOverride: disabled  LockDown: disabled  Verbatim: disabled
  PCEP Info:
    Delegation state: Working: yes    Protect: no
    Current Path Info:
      Request status: processed
      Created via PCRep message from PCE server: 10.0.0.1
    Reported paths:
      Tunnel Name: csr551_t2001
       LSPs:
        LSP[0]:
          source 2.2.2.2, destination 7.7.7.7, tunnel ID 1, LSP ID 5
          State: Admin up, Operation active
          Setup type: SR
          Bandwidth: signaled 0
          LSP object:
            PLSP-ID 0x807D1, flags: D:0 S:0 R:0 A:1 O:2
          Reported path:
            Metric type: TE, Accumulated Metric 0
  History:
    Tunnel:
      Time since created: 34 minutes, 3 seconds
      Time since path change: 1 minutes, 44 seconds
      Number of LSP IDs (Tun_Instances) used: 5
    Current LSP: [ID: 5]
      Uptime: 1 minutes, 44 seconds
    Prior LSP: [ID: 3]
      ID: path option unknown
      Removal Trigger: path verification failed
  Tun_Instance: 5
Segment-Routing Path Info (isis  level-1)
Segment0[Node]: 3.3.3.3, Label: 20270
  Segment1[Node]: 6.6.6.6, Label: 20120
  Segment2[Node]: 7.7.7.7, Label: 20210
```

The following sample output is from the **show pce client lsp detail** command.

```
Device# show pce client lsp detail
PCC's tunnel database:
---------------------
Tunnel Name: d1_t1
 LSPs:
  LSP[0]:
```

```
    source 2.2.2.2, destination 7.7.7.7, tunnel ID 1, LSP ID 5
    State: Admin up, Operation active
    Setup type: SR
    Bandwidth: signaled 0
    LSP object:
      PLSP-ID 0x807D1, flags: D:0 S:0 R:0 A:1 O:2
    Reported path:
      Metric type: TE, Accumulated Metric 0
```

The following sample output is from the **show pce lsp detail** command which shows the tunnel is delegated.

```
Device# show pce lsp detail
Thu Jul  7 10:24:30.836 EDT
PCE's tunnel database:
----------------------
PCC 102.103.2.1:
Tunnel Name: d1_t1
 LSPs:
  LSP[0]:
    source 2.2.2.2, destination 7.7.7.7, tunnel ID 1, LSP ID 5
    State: Admin up, Operation active
    Binding SID: 0
    PCEP information:
      plsp-id 526289, flags: D:1 S:0 R:0 A:1 O:2
    Reported path:
      Metric type: TE, Accumulated Metric 0
        SID[0]: Node, Label 20270, Address 3.3.3.3
        SID[1]: Node, Label 20120, Address 6.6.6.6
        SID[2]: Node, Label 20210, Address 7.7.7.7
    Computed path:
      Metric type: TE, Accumulated Metric 30
        SID[0]: Node, Label 20270, Address 3.3.3.3
        SID[1]: Node, Label 20120, Address 6.6.6.6
        SID[2]: Node, Label 20210, Address 7.7.7.7
    Recorded path:
      None
```

The following sample output is from the **show pce client lsp detail** command for reported tunnel.

```
Device# show pce client lsp detail
PCC's tunnel database:
----------------------
Tunnel Name: d1_t2
 LSPs:
  LSP[0]:
    source 2.2.2.2, destination 7.7.7.7, tunnel ID 2, LSP ID 1
    State: Admin up, Operation active
    Setup type: SR
    Bandwidth: signaled 0
    LSP object:
      PLSP-ID 0x807D2, flags: D:0 S:0 R:0 A:1 O:2
    Reported path:
Metric type: TE, Accumulated Metric 30
```

The following sample output is from the **show pce lsp detail** command which shows the tunnel is not delegated.

```
Device# show pce lsp detail
Thu Jul  7 10:29:48.754 EDT
PCE's tunnel database:
----------------------
```

```
PCC 10.0.0.1:
Tunnel Name: d1_t2
 LSPs:
  LSP[0]:
    source 2.2.2.2, destination 7.7.7.7, tunnel ID 2, LSP ID 1
    State: Admin up, Operation active
    Binding SID: 0
    PCEP information:
      plsp-id 526290, flags: D:0 S:0 R:0 A:1 O:2
    Reported path:
      Metric type: TE, Accumulated Metric 30
        SID[0]: Adj, Label 74, Address: local 172.16.0.1 remote 172.16.0.2
        SID[1]: Adj, Label 63, Address: local 173.17.0.1 remote 173.17.0.2
        SID[2]: Adj, Label 67, Address: local 174.18.0.1 remote 174.18.0.2
        SID[3]: Node, Label unknownAddress 7.7.7.7
    Computed path:
      None
    Recorded path:
      None
```