Configure Affinity for OTN using CTC

This chapter describes the CTC procedure for configuring Affinity Support for OTN GMPLS.

Affinity for OTN GMPLS Overview

The Affinity Support for OTN GMPLS feature steers the selection of paths for MPLS TE tunnel, adhering to affinity constraints.

Affinity can be configured through CTC or CLI using following steps :

- Define affinity map, which is a global name-to-value mapping. Here name is a colour and value is a bit value (0-31). This mapping is used to assign colour(s) to TE link.

Note Same bit position should not be used for more than one colour in the map.

- Assign a TE link with one or multiple colours.
- Create attribute-set(affinity profile) that defines affinity constraints. These constraints are used for circuit path calculation.
- Assign attribute set(s) to an OTN tunnel.

Note Affinity mapping bit should be same in all over network.

Configuring Affinity for GMPLS using Cisco IOS XR commands

Procedure

Step 1 Define colours and assign bits to each colour using command : **affinity-map** <*colour*> **bit-position** <*bit position*>

Example:

```
RP/0/RP0:hostname# configure
RP/0/RP0:hostname(config)# mpls traffic-eng
RP/0/RP0:hostname(config-mpls-te)# affinity-map red bit-position 1
RP/0/RP0:hostname(config-mpls-te)# affinity-map green bit-position 0
```

Note Only one colour can be mapped to a particular bit position.

Note Same bit map should defined at all the connected nodes.

Step 2 Assign one or multiple colours to the OTN link using command **affinity-name**<*colour*>

Example:

```
RP/0/RP0:hostname# configure
RP/0/RP0:hostname(config)# mpls traffic-eng
RP/0/RP0:hostname(config-mpls-te)# gmpls optical-nni
RP/0/RP0:hostname(config-te-gmpls-nni)# topology instance ospf abc area 5
RP/0/RP0:hostname(config-te-gmpls-nni-ti)# controller otu4 0/0/0/1
RP/0/RP0:hostname(config-te-gmpls-nni-ti-cntl)# affinity-name red blue green yellow
```

Note Assign colour to all the ports of the connected nodes.

Step 3 Define an attribute set using command **attribute-set path-option**

This will define the affinity constraints.

Example:

```
RP/0/RP0:hostname# configure terminal
RP/0/RP0:hostname(config)# mpls traffic-eng
RP/0/RP0:hostname(config-mpls-te)# attribute-set path-option Affinity1
RP/0/RP0:hostname(config-te-attribute-set)# affinity include red
```

Step 4 Configure **attribute-set** for **path–option** for OTN tunnel.

This will assign affinity constraints to OTN tunnel. Following are the constraint type:

- **include** : The TE link will be eligible for path-calculation if it has all the colours listed in the constraint. The link may have additional colours.
- **include-strict** : The TE link will be eligible for path-calculation only if it has the same set of colours listed in the constraint. The link should not have any additional colour.
- **exclude**: The TE link will be eligible for path-calculation if it does not have all the colours listed in the constraint

- **exclude-all**: This constraint is not associated with any colour.If this constraint is configured for a tunnel, path-calculator will only accept the links that do not have any colour.

  Note In case of exclude-all constraint, other configured constraints for the same tunnel will be ignored.

Example:

```
RP/0/RP0:hostname# configure
RP/0/RP0:hostname(config)# mpls traffic-eng
RP/0/RP0:hostname(config-mpls-te)# gmpls optical-nni
RP/0/RP0:hostname(config-te-gmpls-nni)# controller Odu-Group-Te 7
RP/0/RP0:hostname(config-te-gmpls-tun-0x7)# signalled-bandwidth ODU2
RP/0/RP0:hostname(config-te-gmpls-tun-0x7)# destination ipv4 unicast 192.168.0.3
RP/0/RP0:hostname(config-te-gmpls-tun-0x7)# path-option 1 dynamic attribute-set Affinity1
protected-by 2 restored-from 3 lockdown
RP/0/RP0:hostnam (config-te-gmpls-tun-0x7)# path-option 2 dynamic attribute-set Affinity2
lockdown
```

Step 5 Verify the configurations using show commands.

Example:

```
RP/0/RP0:hostname# show mpls traffic-eng affinity-map

Tue Jun 26 15:12:01.948 IST
                     Affinity Name     Bit-position            Affinity Value
Affinity Table
  ----------------------------------   --------------        ------------------------
----------------
                                red               2           0x::4
Mapping
                             yellow               3           0x::8
Mapping
                               blue              21           0x::20:0
Mapping
                              green              31           0x::8000:0
Mapping

RP/0/RP0:hostname# show mpls traffic-eng link-management optical-nni controller otu2 0/0/0/22

Tue Nov  7 11:52:51.063 IST
System Information::
NNI OTN Links Count: 3 (Maximum NNI OTN Links Supported 300)
Link Name:: OTU20_0_0_22 (Handle:0x00000170, Addr: V4-Unnum 192.168.0.1 [17])
Link Status         : Up
Link Label Type     : G709_ODU
Physical BW         : OTU2 (10.709Gbps)
Max LSP Bandwidth Per Priority(kbps):
  Priority[0] : 7495557
  Priority[1] : 0
  Priority[2] : 0
  Priority[3] : 0
  Priority[4] : 0
  Priority[5] : 0
  Priority[6] : 0
  Priority[7] : 0
Fixed ODU Capabilities:
     Signal Type       Stages            Flags             Resources
                   1   2   3   4   T S 1.25G 2.5G V L Maximum    Unreserved
                   -   -   -   -   - - ----- ---- - - -------    ----------
```

```
   ODU2                          Y Y Y     N    N N 1          0
   ODU0           2              Y Y Y     N    N N 8          6
   ODU1           2              Y Y Y     N    N N 4          3
Flex  ODU Capabilities:
     Signal Type       Stages            Flags               Bandwidth(kbps)
                   1   2   3   4   T S 1.25G 2.5G V L Maximum   Unreserved  Max Lsp
                   -   -   -   -   - - ----- ---- - - --------  ----------  --------
   ODUFlex CBR     2              Y Y Y     N    N N 9995277   7495557     7495557
   ODUFlex GFPFix  2              Y Y Y     N    N N 9995277   7494313     7494313

SRLG Values:1,
TTI Mode            : Section Monitoring
TCM ID              : 0
IGP Neighbor Count  : 1
Flooding Status: (1 area)
IGP Area[1]:: OSPF, ring, 0: Flooded
Remote Link Id:V4-Unnum 192.168.0.2 [16], TE Metric: 1
Delay(Configured/Computed/ToFlood): 0/0/300000 micro-sec
Attributes          :  0x2
Attribute Names     :  red(1)
```

```
RP/0/RP0:hostname# show mpls traffic-eng topology

IGP Id: 192.168.0.4, MPLS TE Id: 192.168.0.4 Router Node  (OSPF ring area 0)
  Link[0]:Point-to-Point, Nbr IGP Id:192.168.0.2, Nbr Node Id:2, gen:28399
      Attribute Flags: 0x2
      Ext Admin Group:
          Length: 256 bits
          Value : 0x::2
     Attribute Names: red(1)
      Intf Id:13 Nbr Intf Id:15 TE Metric:1
      Uni Delay:300000
      SRLGs: 3
      Switching Capability:otn, Encoding:g709-otn
      Physical BW:10709224 (kbps), Max Reservable BW:10709224 (kbps)
      Max LSP Bandwidth Per Priority(kbps):
        Priority[0] : 7495556
        Priority[1] : 0
        Priority[2] : 0
        Priority[3] : 0
        Priority[4] : 0
        Priority[5] : 0
        Priority[6] : 0
        Priority[7] : 0
      Fixed ODU Capabilities:
           Signal Type       Stages            Flags             Resources
                         1   2   3   4   T S 1.25G 2.5G V L Maximum    Unreserved
                         -   -   -   -   - - ----- ---- - - -------    ----------
         ODU2                              Y Y Y     N    N N 1          0
         ODU0           2                  Y Y Y     N    N N 8          6
         ODU1           2                  Y Y Y     N    N N 4          3
      Flex  ODU Capabilities:
           Signal Type       Stages            Flags               Bandwidth(kbps)

                         1   2   3   4   T S 1.25G 2.5G V L Maximum   Unreserved  Max Lsp

                         -   -   -   -   - - ----- ---- - - --------  ----------  --------

         ODUFlex CBR     2                  Y Y Y     N    N N 9995277   7495556     7495556

         ODUFlex GFPFix  2                  Y Y Y     N    N N 9995277   7494312     7494312
```

```
RP/0/RP0:hostname# show mpls traffic-eng attribute-set path-option test2

Thu Dec 21 14:12:43.364 IST
Attribute Set Name: test2 (Type: path option)
  Bandwidth: 0 kbps (CT0) (Default)
  Number of affinity constraints: 3
     Include bit map          : 0x2
     Include ext bit map      :
         Length: 256 bits
         Value : 0x::2
     Include affinity name    : red(1)
     Include bit map          : 0x4
     Include ext bit map      :
         Length: 256 bits
         Value : 0x::4
     Include affinity name    : blue(2)
     Include bit map          : 0x8
     Include ext bit map      :
         Length: 256 bits
         Value : 0x::8
     Include affinity name    : yellow(3)
  Exclude List Name:  none (Default)
  List of tunnel IDs (count 0)
```

```
RP/0/RP0:hostname# show mpls traffic-eng tunnels 7 detail

Tue Nov  7 11:19:28.610 IST
Name: Odu-Group-Te7  Destination: 192.168.0.4  Ifhandle:0xd0
  Signalled-Name: rtrA_otn7
  Status:
    Admin:    up Oper:   up   Path:  valid   Signalling: connected
    path option 1, (LOCKDOWN) type dynamic  (Basis for Current, path weight 2)
      Protected-by PO index: none
      Path-option attribute: test_red
        Number of affinity constraints: 1
          Include bit map          : 0x2
           Include ext bit map      :
               Length: 256 bits
               Value : 0x::2
           Include affinity name    : red(1)
        Reroute pending (DROP)
    path option 2, (LOCKDOWN) type dynamic
      Path-option attribute: test_red
        Number of affinity constraints: 1
           Include bit map          : 0x2
           Include ext bit map      :
               Length: 256 bits
               Value : 0x::2
           Include affinity name    : red(1)

    Last PCALC Error [Standby]: Mon Nov  6 16:52:34 2017
      Info: No diverse path found
    Bandwidth Requested: 2498775 kbps  CT0
    Creation Time: Mon Nov  6 15:36:06 2017 (19:43:22 ago)
  Config Parameters:
    Bandwidth: ODU1
    Priority: 24  0 Affinity: 0x0/0xffff
    Metric Type: TE (default)
    Path Selection:
      Tiebreaker: Min-fill (default)
    Hop-limit: disabled
    Cost-limit: disabled
```

```
  Delay-limit: disabled
  Path-invalidation timeout: 10000 msec (default), Action: Tear (default)
  AutoRoute: disabled  LockDown:  enabled  Policy class: not set
  Forward class: 0 (not enabled)
  Forwarding-Adjacency: disabled
  Autoroute Destinations: 0
  Loadshare:          0 equal loadshares
  Auto-bw: disabled
  Fast Reroute: Disabled, Protection Desired: None
  BFD Fast Detection: Disabled
  Reoptimization after affinity failure: Enabled
  Soft Preemption: Disabled
SNMP Index: 13
Binding SID: None
Path Protection Info:
  SNC Mode:SNC-N , TCM id: Not used , Type:Bi-directional APS, Non-revertive
  Restoration style: keep-failed-lsp
  Path Protection Profile Type: 1+0
  Timers WTR: 300000 milliseconds, HoldOff: 0 milliseconds
  Active Lsp: WORKING LSP, Standby Diversity Type: None
Restoration Info:
  Non-revertive
  Diverse Lsp for UNKNOWN, Diversity Type: None
Revert Schedule: Not Configured
Static-uni Info:
  Locally Client Port:   Client Ifhandle: 0x0
  Client ODU:   Client ODU Ifhandle: 0x0
    XC Id: 0
    State: Not Connected
    Uptime: Thu Jan  1 05:30:00 1970
Working Homepath ERO:
  Status: Down
  Explicit Route:
Diversity Info:
  Dependent Tunnel List:
     8

Current LSP Info:
  Instance: 2108, Signaling Area: OSPF ring area 0
  Uptime: 18:27:10 (since Mon Nov 06 16:52:18 IST 2017), Signaling State: Up, Oper State:
Up
  G-PID: None (0)
    XC Id: 0
    State: Connected
    Uptime: Mon Nov  6 16:52:18 2017
    Egress Interface: OTU20/0/0/22 (State:Up  Ifhandle:0x170)
    Egress Controller: ODU20_0_0_22 (State:Up Ifhandle:0x190)
    Egress Sub Controller: ODU10_0_0_22_41 (State:Up, Ifhandle:0x3d0)
    Path Ingress  label: TPN: 4 BitMap Len: 8 BitMap: 7:8
    Resv Egress  label: TPN: 4 BitMap Len: 8 BitMap: 7:8
  Router-IDs: local      192.168.0.1
              downstream 192.168.0.2
  Soft Preemption: None
  SRLGs: not collected
  Path Info:
    Outgoing:
      Explicit Route:
        Strict, 192.168.0.2(16)
        Strict, 192.168.0.4(13)
        Strict, 192.168.0.4

    Record Route: Empty
    Tspec: signal_type ODU1 Bitrate 0kbps NVC 0 MT 1
```

```
      Session Attributes: Local Prot: Not Set, Node Prot: Not Set, BW Prot: Not Set
                          Soft Preemption Desired: Not Set
    Path Protection Info:
      SNC Mode:SNC-N TCM id:Not used Type:Bi-directional APS
      Path Protection Profile Type: 1+0
      Bits S:0 P:0 N:0 O:0
      Timeout WTR:0 milliseconds HoldOff:0 milliseconds
    Resv Info:
      Record Route:
        IPv4 192.168.0.2, flags 0x20 (Node-ID)
        Label         Label TPN: 4 BitMap Len: 8 BitMap: 7:8 , flags 0x1

        Unnumbered 192.168.0.2 (16), flags 0x0
        Label         Label TPN: 4 BitMap Len: 8 BitMap: 7:8 , flags 0x1
        IPv4 192.168.0.4, flags 0x20 (Node-ID)
        Label         Label TPN: 4 BitMap Len: 8 BitMap: 7:8 , flags 0x1

        Unnumbered 192.168.0.4 (13), flags 0x0
        Label         Label TPN: 4 BitMap Len: 8 BitMap: 7:8 , flags 0x1
      Fspec: signal_type ODU1 Bitrate 0kbps NVC 0 MT 1

  Persistent Forwarding Statistics:
    Out Bytes: 0
    Out Packets: 0
Displayed 1 (of 2) heads, 0 (of 0) midpoints, 0 (of 0) tails
Displayed 1 up, 0 down, 0 recovering, 0 recovered heads
```

Configuring Affinity Using CTC

Purpose	This procedure enables you to configure an OTN tunnel with path adhering to affinity constraints, using CTC.
Tools/Equipment	None
Prerequisite Procedures	"Login to CTC" in *System Setup and Software Installation Guide for Cisco NCS 4000 Series.*
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 To define affinity map, complete Define Affinity Map Using CTC, on page 8

Step 2 To assign OTN link with one or multiple colours, complete Assign Affinity Name(s) to TE Link Using CTC, on page 8

Step 3 To create affinity profile defining affinity constraints, complete Define Affinity Profile Using CTC, on page 9

Step 4 To assign affinity profile(constraints) to OTN tunnel, complete Configure an OTN Circuit Using CTC.

Stop. You have completed this procedure.

Define Affinity Map Using CTC

Purpose	This procedure enables you to define affinity names(colours) and assign bits to each affinity name, using CTC.
Tools/Equipment	None
Prerequisite Procedures	"Login to CTC" in *System Setup and Software Installation Guide for Cisco NCS 4000 Series.*
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 In the **Network View**, click the OTN > Affinity > Affinity Mapping tabs.

Step 2 Click the **Add Mapping** button.

Step 3 In the Add Mapping dialog box, enter the following :

- Affinity Name - Enter the colour.
- Bit Value - Select the bit value corresponding to the affinity name(colour).

Step 4 Select an affinity mapping and click **Store** button.

Step 5 In the Affinity Mapping Storing dialog box, select the node to save the affinity mapping.

Step 6 Click **ok** to save the selected affinity mapping on the selected node in the network .

You can use the **Load** button to verify if the affinity map is sucessfully saved.

Step 7 Return to your originating procedure.

Assign Affinity Name(s) to TE Link Using CTC

Purpose	This procedure enables you to assign an OTN link with one or multiple affinity names(colours), using CTC.
Tools/Equipment	None
Prerequisite Procedures	"Login to CTC" in *System Setup and Software Installation Guide for Cisco NCS 4000 Series.*
Required/As Needed	As needed

Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 In the **Node View**, click the Provisioning > Network > MPLS-TE tabs.

Step 2 In the Controllers section, select a line card and expand the corresponding section to see the list of controllers.

Step 3 To update the affinity name for the controller, double click the **Affinity Name** column.

Step 4 In the dialog box, select one or multiple affinity names(colours) and click **Ok**.

This will assign affinity name(s) to the selected controller(TE link).

Note A TE link can be assigned maximum of 32 colours.

Note Assign same affinity name(colour) for the controlleres on both source and destination end of the TE link.

Step 5 Return to your originating procedure.

Define Affinity Profile Using CTC

Purpose	This procedure enables you to define affinity constraints to be used for circuit path calculation.
Tools/Equipment	None
Prerequisite Procedures	"Login to CTC" in *System Setup and Software Installation Guide for Cisco NCS 4000 Series.*
Required/As Needed	As needed
Onsite/Remote	Onsite or remote
Security Level	Provisioning or higher

Procedure

Step 1 In the **Network View**, click the OTN > Affinity > Affinity Profile tabs.

Step 2 Click the **Create** button.

Step 3 In the Create Affinity Profile dialog box:

- Name - Enter name of Affinity Profile(Affinity Constraint).
- Node Name - Select the node on which you want to save the profile.
- Constraint Type - Select the constarint type from the drop down list.

Following are the constraint types:

- **include** : The TE link will be eligible for path-calculation if it has all the colours listed in the constraint. The link may have additional colours.
- **include-strict** : The TE link will be eligible for path-calculation only if it has the same set of colours listed in the constraint. The link should not have any additional colour.
- **exclude**: The TE link will be eligible for path-calculation if it does not have all the colours listed in the constraint
- **exclude-all**: This constraint is not associated with any colour.If this constraint is configured for a tunnel, path-calculator will only accept the links that do not have any colour.

  Note In case of exclude-all constraint, other configured constraints for the same tunnel will be ignored.

- Affinity Names - Select one or multiple affinity names(colours).

  Note Each constraint can have maximum 10 colours.

- Add Constarint - Click **Add Constraint** button, to add the constraint to the affinity profile.

Step 4 Click **Apply** button, to save the affinity profile.

Step 5 Return to your originating procedure.