



Overview of Dynamic Link Exchange Protocol

The Dynamic Link Exchange Protocol (DLEP) is a radio aware routing (RAR) protocol. DLEP provides a bidirectional, event-driven communication channel between the router and the radio to facilitate communication of changing link characteristics. In large mobile networks, connections to the routing neighbors are interrupted due to distance and radio obstructions. DLEP addresses the challenges faced when merging IP routing and radio frequency (RF) communications.

Benefits of DLEP

DLEP provides capabilities that enable:

- Optimal route selection based on feedback from radios
- Faster convergence when nodes join and leave the network
- Efficient integration of point-to-point, point-to-multipoint and broadcast multi-access radio topologies with multi-hop routing
- Flow-controlled communications between the radio and its partner router using rate-based Quality of Service (QoS) policies
- Dynamic shaping of fluctuating RF bandwidth in near real time to provide optimized use of actual RF bandwidth

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Feature Information for Dynamic Link Exchange Protocol

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Use Cisco Feature Navigator to find information about platform support and Cisco software image support. To access Cisco Feature Navigator, go to www.cisco.com/go/cfn. An account on Cisco.com is not required.

Table 1: Feature Information for Dynamic Link Exchange Protocol

Feature Name	Releases	Feature Information
Dynamic Link Exchange Protocol	Cisco IOS XE Release 17.8.1a	This feature was introduced for the following platforms: • Cisco Catalyst 8000V Edge Software
	Cisco IOS XE Release 17.11.1a	This feature was introduced for the the following platforms: • Cisco Catalyst 8200 Series Edge Platforms • Cisco Catalyst 8300 Series Edge Platforms • Cisco Catalyst 8500 Series Edge Platforms
IPv6 Unicast Support with DLEP	Cisco IOS XE Release 17.12.1a	The IPv6 Unicast Support feature introduces support for IPv6 data plane to RAR DLEP. This feature was introduced for the following platforms: • Cisco Catalyst 8000V Edge Software • Cisco Catalyst 8300 Series Edge Platforms • Cisco Catalyst 8500 and 8500L Series Edge Platforms

DLEP Topology

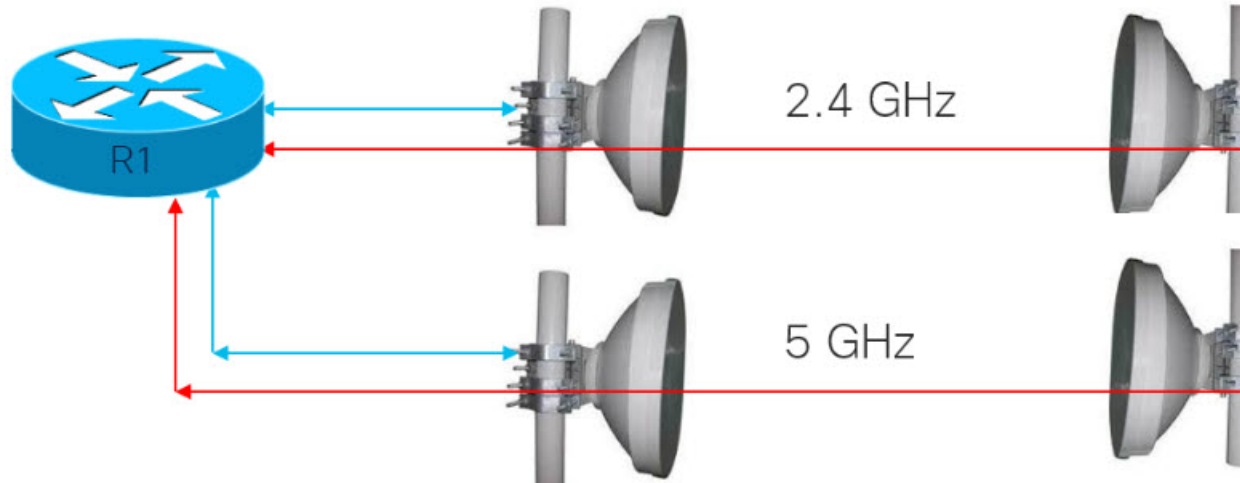
DLEP is a control protocol between a router and a DLEP-enabled radio modem. The DLEP message exchange between the router and radio allows the radio to communicate the router about the link quality. This is analogous to the way the bar icon on your cell phone indicates your Wi-Fi or LTE signal quality.

Figure 1: Network with DLEP



Using DLEP, we can make use of routing distances with equal cost, where metrics are updated in real time, based on the best path.

Figure 2: Network without DLEP



Without DLEP, there are two equal cost paths to any unadjusted routing protocol. With DLEP, routing metrics can be adjusted in real-time to favor the best path.



Note

The final selection of a band is dependent on atmospheric conditions and interference.



-
- Note** in DLEP topology,
- the radio is the DLEP client,
 - the router is the DLEP server, and
 - the remote router is the DLEP neighbor.
-

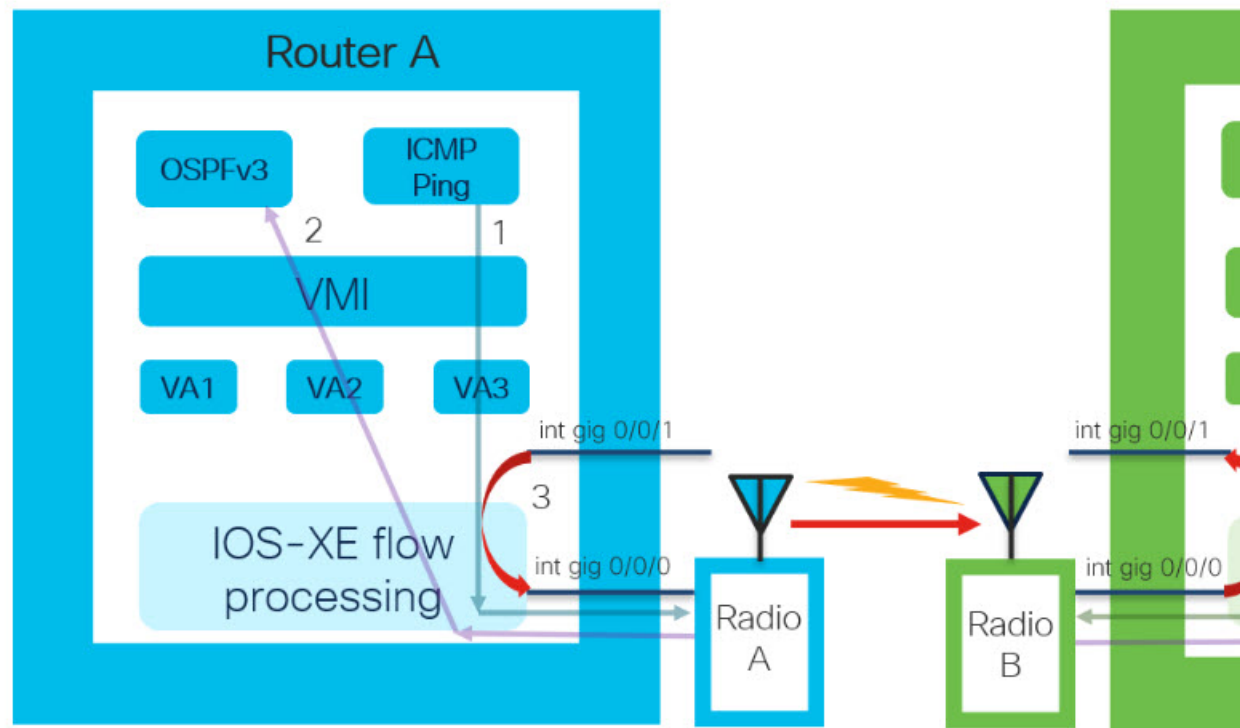
Interfaces in IOS-XE Platforms

- Virtual Multipoint Interface (VMI)
 - The VMI interface acts as an umbrella interface for all virtual access interfaces, per physical interface. VMI is used for routing protocols such as OSPFv3 and EIGRP, which will see a single VMI interface instead of all VA interfaces. This helps reduce routing table size without impacting the integrity of network.
- Virtual Template (VT)
 - Virtual Template serves as the template for every Virtual Access interface.
- Virtual Access (VA) interface
 - One VA is created for each DLEP Neighbor that is discovered on the network.
- Underlying physical Layer 3 WAN interface (Gi 0/0/0 and Gi 0/0/1), or even sub-interface (Gi 0/0/0.2 or Gi0/0/1.2)

Packet Flow Diagram with Flow Types

The following diagram describes the packet flow:

Figure 3: Packet Flow with Flow Types



Item	Description
1	Packet sent from IOS-XE to DLEP neighbor (to Radio): packet with DST MAC of neighbor MAC, neighbor IP sent out from DLEP Physical interface.
2	DLEP Packet (from radio) received thru DLEP Physical interface to IOS-XE: packet needs to be delivered to IOS routing protocol marked as from VMI interface.
3	End to End user data.

Prerequisites for DLEP

- DLEP requires the Network Advantage license.

Restrictions and Limitations

DLEP has the following restrictions and limitations:

- Multicast traffic is not supported with DLEP, but is supported with PPPOE.
- DLEP cannot be deployed with High Availability (HA) configuration.

- You must configure the VMI and Virtual-Template before attaching the Virtual-Template to a physical interface.
- Routers are connected over DLEP radio links, and only 1 radio per interface (VLAN or physical) is supported. The same interface cannot be used for connecting any other router (including remote DLEP peer router).
- You must remove all configurations for the virtual-template individually using the **no** form of the respective configuration commands, before removing the virtual-template using the **no interface virtual-template** command.
- You cannot change the configurations on the virtual-template and VMI interfaces while DLEP is enabled on the physical interface. To make such changes, disable DLEP by removing the DLEP configuration from the physical interface, make the changes, and re-configure DLEP on the physical interface.
- DLEP interface does not support jumbo frames (frames > 1500 bytes in size).
- Routing of internally generated application traffic (e.g. pingv6) with source as DLEP VMI / physical interface is not supported.
- You cannot use the **show ipv6 neighbor** command to view the information about DLEP neighbors.

Configuring DLEP

This section provides the following major sections for initiating, verifying, and managing all aspects of Dynamic Link Exchange Protocol (DLEP) on an interface. DLEP uses following interfaces that need to be configured:

- Physical interface
- VMI interface
- Virtual Templates



Important

You must configure the VMI and Virtual-Template before attaching the Virtual-Template to a physical interface.



Note

Routers are connected over DLEP radio links and only 1 radio per interface (VLAN or physical) is supported. The same interface cannot be used for connecting any other router (including remote DLEP peer router).

Configuring the Virtual Multipoint Interface

By default, virtual multipoint interfaces (VMIs) operate in aggregate mode, which means that all the virtual access interfaces created by DLEP sessions are aggregated logically under the configured VMI. Packets sent to the VMI are forwarded to the correct virtual access interface.

To configure the VMI, perform the following procedure:

Procedure

	Command or Action	Purpose
Step 1	enable Example: <pre>Router> enable Router#</pre>	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	configure terminal Example: <pre>Router# configure terminal Enter configuration commands, one per line. End with CNTL/Z. Router(config)#</pre>	Enters global configuration mode.
Step 3	interface vmi number Example: <pre>Router(config)# interface vmi 1 Router(config-if)#</pre>	Creates a VMI and enters interface configuration mode. This example creates VMI1.
Step 4	ip unnumbered interface Example: <pre>Router(config-if)# ip unnumbered gigabitEthernet 0/0/1</pre>	Enables the IP on the VMI and bring it up without assigning a unique IP address to it.
Step 5	physical-interface interface Example: <pre>Router(config-if)# physical-interface gigabitEthernet 0/0/0</pre>	Binds the physical interface to VMI interface, for packet flow.
Step 6	ipv6 enable Example: <pre>Router(config-if)# ipv6 enable</pre>	Enable ipv6 support under VMI interface.
Step 7	Configure routing protocols. Example: <pre>Router(config-if)# ospfv3 1 ipv4 area 0</pre>	Enable VMI interface to participate in OSPFv3 or EIGRP routing.
Step 8	exit Example: <pre>Router(config-if)# exit Router(config)#</pre>	Exits the current mode.

	Command or Action	Purpose
Step 9	router ospfv3 1 Example: Router(config)# router ospfv3 1	Global configuration for OSPFv3
Step 10	address-family ipv4 unicast Example: Router(config-router)# address-family ipv4 unicast Router(config-router-af)#	Adding address family for IPv4 unicast routing under global OSPFv3 configuration.

Configuring the Virtual Template

Configuring DLEP requires a virtual template to be defined. Perform this task to create the DLEP virtual template:

Procedure

	Command or Action	Purpose
Step 1	enable Example: Router> enable Router#	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal Enter configuration commands, one per line. End with CNTL/Z. Router(config)#	Enters global configuration mode.
Step 3	interface Virtual-Template number Example: Router(config)# interface Virtual-Template 1 Router(config-if)#	Creates Virtual-Template interface and enters interface configuration mode. Note You need to use the same virtual-template interface for configuring DLEP on physical interface.
Step 4	ip unnumbered interface Example: Router(config-if)# ip unnumbered gigabitEthernet 0/0/0	Enables the IP on the VMI and bring it up without assigning a unique IP address to it.
Step 5	ipv6 enable Example:	Enables IPv6 support under Virtual-Template interface.

	Command or Action	Purpose
	Router(config-if) # ipv6 enable Router(config) #	
Step 6	exit Example: Router(config-if) # exit Router(config) #	Exits the current mode.

Configuring the Physical Interface

DLEP configuration is currently supported on the WAN interface of routing platforms. As described above, you need to configure both the VMI and Virtual-Template interface before configuring the physical interface. There are various ways that DLEP configuration can be attached to WAN interface:

- DLEP template with well-known ip address [**Recommended**]
- DLEP template with TCP/UDP port based between server (Router) and client (Radio)
- DLEP template with dynamic port on server (Router)
- DLEP template attach in discovery mode

For each of the four modes mentioned above, the user also has the option to enable Generalized TTL Security Mechanism (GTSM).

To configure DLEP on an interface, perform the following procedure:

Procedure

	Command or Action	Purpose
Step 1	enable Example: Router> enable Router#	Enables privileged EXEC mode. • Enter your password if prompted.
Step 2	configure terminal Example: Router# configure terminal Enter configuration commands, one per line. End with CNTL/Z. Router(config) #	Enters global configuration mode.
Step 3	interface gi0/0/0 or gi0/0/1 Example: Router(config) # interface gigabitEthernet 0/0/0 Router(config-if) #	Enters interface configuration mode.

	Command or Action	Purpose
Step 4	ipv6 enable Example: Router(config-if)# ipv6 enable	Enables IPv6 support under interface level.
Step 5	Assigning IP address to physical interface Example: Router(config-if)# ip address 10.0.0.1 255.255.255.0	Assigns physical IP address to the WAN interface.
Step 6	ip dlep vtemplate port number Example: Router(config-if)# ip dlep vtemplate number 1	Attaches DLEP Template to WAN interface, for discovery mode.
Step 7	no shutdown Example: Router(config-if)# no shutdown	Brings up the interface.
Step 8	exit Example: Router(config-if)# exit Router(config)#	Exits the current mode.

Configuring IPv6 with DLEP

From Cisco IOS XE 17.12.1a, DLEP can be configured with IPv6 dataplane.



Note

When you configure DLEP for IPv6 traffic, enable IPv6 on the physical interface using the **ipv6 enable** command before associating the VMI interface with the physical interface using the **physical-interface <interface_name>** command.

Procedure

Step 1 Enable IPv6 unicast routing:

```
Router# configure terminal
Router(config)# ipv6 unicast-routing
Router(config)#end
Router#
```

Step 2 Enable IPv6 on the physical interface:

```
Router#configure terminal
Router(config)# interface GigabitEthernet0/0/0
Router(config-if)# ipv6 enable
Router(config-if)#end
Router#
```

Step 3 Configure the Virtual Template Interface:

```
Router#configure terminal
Router(config)# interface virtual-template1
Router(config-if)# ip unnumbered GigabitEthernet0/0/0
Router(config-if)# ipv6 enable
Router(config-if)# ipv6 nd dad attempts 0
Router(config-if)#end
Router#
```

Step 4 Configure the Virtual Multipoint Interface:

```
Router#configure terminal
Router(config)# interface vmil
Router(config-if)# ip unnumbered GigabitEthernet0/0/0
Router(config-if)# physical-interface GigabitEthernet0/0/0
Router(config-if)# ipv6 enable
Router(config-if)#end
Router#
```

Step 5 Configure the physical interface:

```
Router#configure terminal
Router(config)# interface GigabitEthernet0/0/0
Router(config-if)# ip address 10.1.1.1 255.255.255.0
Router(config-if)# ipv6 address 1000::1/64
Router(config-if)# ip dlep vtemplate 1
Router(config-if)#end
Router#
```

Attaching DLEP Virtual Templates

DLEP virtual templates can be attached in different modes to the WAN or sub-interface of the router.

Configuring DLEP Client/Server Based On Port Number

In this example, you are configuring the DLEP server, and client UDP and TCP ports.

Command or Action	Purpose
<pre>Router(config)#interface gi0/0/0 Router(config-if)# ip address 10.0.0.1 255.255.255.0 Router(config-if)# ipv6 enable Router(config-if)# ip dlep vtemplate 1 port 11113 tcp port 11114 client ip 10.0.0.3 port 11115 Router(config-if)# no shutdown</pre>	DLEP configuration where the server (router) is listening on UDP port 11113 and TCP port 11114, and the client (radio) is listening to TCP port 11115. The UDP port of the client is by default on 854.

Configuring DLEP with Dynamic Port on Server

In this example, you are configuring the DLEP server, and the UDP and TCP ports on the client.

Command or Action	Purpose
<pre>Router(config)#interface gi0/0/0 Router(config-if)# ip address 10.0.0.1 255.255.255.0 Router(config-if)# ipv6 enable Router(config-if)# ip dlep vtemplate 1 client ip 10.0.0.3 port 11115 Router(config-if)# no shutdown</pre>	The DLEP configuration where the server (router) is listening to the default UDP or TCP ports, and the client (radio) is listening to TCP port 11115. The UDP port of the client is by default on 854.

Attaching DLEP Template in Discovery Mode

When in discovery mode, the DLEP server sends out Peer Discovery signals, and waits for a Peer Offer signal from the radio.

Command or Action	Purpose
<pre>Router(config)#interface gi0/0/0 Router(config-if)# ip address 10.0.0.1 255.255.255.0 Router(config-if)# ipv6 enable Router(config-if)# ip dlep vtemplate 1 Router(config-if)# no shutdown</pre>	The DLEP configuration where the server (router) is listening to the default UDP or TCP ports.

Using a DLEP Template with a Well-Known IP Address

DLEP works based on RFC 8175, and uses the well-known IP address 224.0.0.117 on the server to communicate with radios.

Procedure

	Command or Action	Purpose
Step 1	ip multicast-routing distributed Example: <pre>ip multicast-routing distributed</pre>	Enables multicast routing on the router.
Step 2	interface interface Example: <pre>Router(config)# interface gi0/0/0 Router(config-if)# ip address 10.1.2.3 255.255.255.0 Router(config-if)# no shutdown</pre>	Configures IPv4 address of the server.
Step 3	ip pim sparse-dense-mode Example: <pre>Router(config-if)# ip pim sparse-dense-mode</pre>	Enables the PIM to operate in sparse or dense mode, depending on the multicast group.

	Command or Action	Purpose
Step 4	Configure forwarding Example: <pre>Router(config-if)# ip mfib cef in Router(config-if)# ip mfib cef out Router(config-if)# ip mfib forwarding in Router(config-if)# ip mfib forwarding out</pre>	Enables the router to forward multicast traffic.
Step 5	<pre>ip dlep vtemplate <Number> well-known ip <ip-address></pre> Example: <pre>Router(config-if)# ip dlep vtemplate 1 well-known ip 224.0.0.117</pre>	Enable sDLEP vTemplate to listen to multi-cast traffic. Note Under the command show running-configuration the output will display as “ip dlep vtemplate 1” which means “well-known ip 224.0.0.117” is hidden.

DLEP Quality of Service Configuration

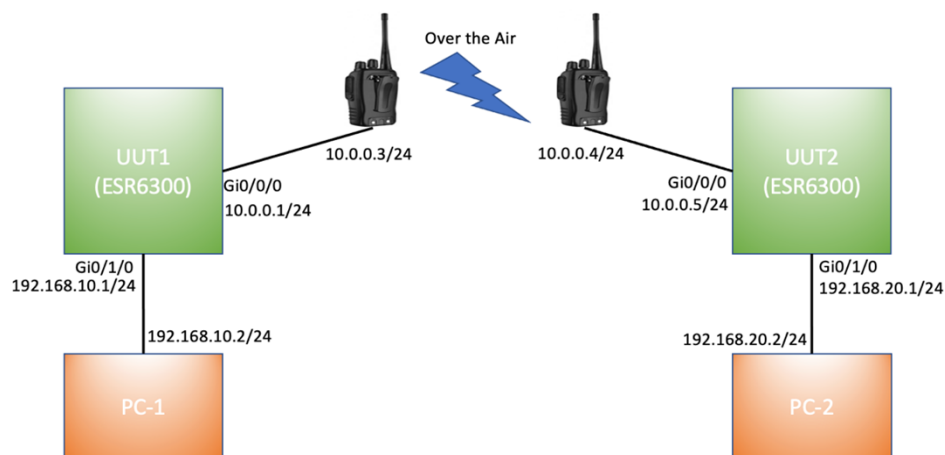
Quality of Service (QoS) for DLEP can be configured on the Virtual-Template which is associated with the physical interface. The data packets for DLEP flow through the Virtual Access interfaces that are created when DLEP neighbors come up.

Before proceeding, it is recommended to familiarize yourself with the [Quality of Service \(QoS\) Configuration Guide for IOS-XE](#).

DLEP QoS Topology

The following figure shows a sample topology for DLEP with QoS.

Figure 4: QoS for DLEP



Based on above figure, the QoS policy is applied to egress of Virtual-Template attached to WAN interface Gi0/0/0.

Sample Configuration

```

Router# show running-config
Building configuration...

Current configuration : 7773 bytes
!
!
version 17.8
service timestamps debug datetime msec
service timestamps log datetime msec
service call-home
platform qfp utilization monitor load 80
platform punt-keepalive disable-kernel-core
!
hostname UUT1
!
boot-start-marker
boot system bootflash:/c6300-universalk9.SSA.bin
!
ipv6 unicast-routing
!
class-map match-any CMAP_VIDEO
  match dscp 33
  match dscp 35
  match dscp 37
  match dscp 39
  match dscp af41
class-map match-any CMAP_VOICE
  match dscp 41
  match dscp 43
  match dscp 45
  match dscp 47
  match dscp 49
class-map match-any CMAP_DATA
  match dscp 9
  match dscp 11
  match dscp 13
  match dscp 15
  match dscp af11
!
policy-map Queue_Map
  class CMAP_VOICE
    bandwidth percent 40
    set dscp af11
  class CMAP_VIDEO
    bandwidth percent 50
  class CMAP_DATA
    bandwidth percent 10
    set dscp af23
!
interface Loopback1
  ip address 1.1.1.1 255.255.255.255
  ipv6 enable
  ospfv3 1 ipv4 area 0
!
interface GigabitEthernet0/0/0
  ip address 10.0.0.1 255.255.255.0
  ip dlep vtemplate 1 port 11113 tcp port 11114 client ip 10.0.0.3 port 11115
  negotiation auto
  ipv6 address 1000::1/64
  ipv6 enable
!
interface GigabitEthernet0/0/1

```

```

no ip address
shutdown
negotiation auto
!
interface GigabitEthernet0/1/0
  switchport access vlan 30
!
interface GigabitEthernet0/1/1
!
interface GigabitEthernet0/1/2
!
interface GigabitEthernet0/1/3
!
interface Virtual-Template1
  ip unnumbered GigabitEthernet0/0/0
  ipv6 enable
  service-policy output Queue_Map
!
interface Vlan1
  no ip address
!
interface Vlan30
  ip address 192.168.10.1 255.255.255.0
  ipv6 address 1010::1/64
  ipv6 enable
  ospfv3 1 ipv6 area 0
!
interface Async0/2/0
  no ip address
  encapsulation scada
!
interface vmil
  ip unnumbered GigabitEthernet0/0/0
  ipv6 address FE80::7E31:EFF:FE85:1E78 link-local
  ipv6 enable
  ospfv3 1 ipv4 area 0
  physical-interface GigabitEthernet0/0/0
!
router ospfv3 1
!
  router-id 1.1.1.1
  address-family ipv4 unicast
  exit-address-family
!
end
Router#

```

Edit the Virtual-Template

Before you begin

To edit the Virtual-Template, you need to remove the configuration for **ip dlep vtemplate** on the WAN interface.

Procedure

	Command or Action	Purpose
Step 1	enable Example: <pre>Router> enable Router#</pre>	Enables privileged EXEC mode.
Step 2	configure terminal Example: <pre>Router# configure terminal Router(config)#</pre>	Enters global configuration mode.
Step 3	interface Virtual-Template <i>number</i> Example: <pre>Router(config)# interface Virtual-Template 1 Router(config-if)#</pre>	Creates VMI interface and enters interface configuration mode.
Step 4	Service-policy [input output] <policy-map> Example: <pre>Router(config-if)# service-policy output Queue_Map</pre>	Applies the policy-map to egress and ingress interfaces of the Virtual-Template.

Configuring DLEP on a Sub-Interface

DLEP can also be configured on a sub-interface. The following is an example:

Procedure

	Command or Action	Purpose
Step 1	enable Example: <pre>Router> enable Router#</pre>	Enables privileged EXEC mode.
Step 2	configure terminal Example: <pre>Router# configure terminal Router(config)#</pre>	Enters global configuration mode.
Step 3	interface <i>interface</i> Example: <pre>Router(config)# interface gi0/0/0 Router(config-int)# no shut</pre>	Specifies an interface to configure. Note WAN interface must be in active state.

	Command or Action	Purpose
Step 4	interface <i>sub-interface</i> Example: Router(config-if) # interface gi0/0/0.2	Creates sub-interface gi0/0/0.2
Step 5	Encapsulation dot1q <VLAN> native Example: Router(config-subif) # encapsulation dot1q 2 native	Configures encapsulation dot1q over VLAN 2, and makes it native.
Step 6	ip address <IP> <SUBNET> Example: Router(config-subif) # ip address 10.0.0.1 255.255.255.0	Adds the IPv4 address for sub-interface.
Step 7	ipv6 enable Example: Router(config-subif) # ipv6 enable	Adds the IPv6 address for sub-interface. OSPFv3 IPv4 needs to have ipv6 support enabled on the interface level.
Step 8	interface vmi <i>number</i> Example: Router(config-subif) # interface vmi 1 Router(config-if) #	Creates VMI interface and enters interface configuration mode.
Step 9	ip unnumbered <i>interface</i> Example: Router(config-if) # ip unnumbered gigabitEthernet 0/0/0.2	Specifies VMI interface to use physical interface IP address.
Step 10	physical-interface <i>interface</i> Example: Router(config-if) # physical-interface gigabitEthernet 0/0/0.2	Binds the physical interface to VMI interface, for packet flow.
Step 11	ipv6 enable Example: Router(config-if) # ipv6 enable	Enables IPv6 support under VMI interface.
Step 12	interface <i>sub-interface</i> Example: Router(config-if) # interface gi0/0/0.2	Configures the sub-interface for the DLEP template.
Step 13	ip dlep vtemplate <number> [<i>gtsm</i>] client { <i>ipv4</i> <i>ipv6</i> } < <i>ip-address</i> > port <i>port</i> Example: Router(config-subif) # ip dlep vtemplate 1 gtsm client 10.0.0	Attaches the DLEP Template to the sub-interface Note DLEP can be configured either in auto-discovery mode or manual configuration mode. Use the first example to configure DLEP in auto-discovery mode, or the second example to configure DLEP in manual mode.

	Command or Action	Purpose
	OR Router(config-subif)# ip dlep vtemplate 1 port 11113 tcp port 11114 gtsm client ip 10.0.0.3 port	
Step 14	exit Example: Router(config-if)# exit Router(config)#	Exits the current mode.
Step 15	router eigrp <AS-NO> Example: Router(config)# router eigrp 1 Router(config-router)# router-id 1.1.1.1 Router(config-router)# network 10.0.0.0 0.0.0.255	Enables global configuration for EIGRP.

Configuring DLEP with OSPFv3

This section describes configuring DLEP with OSPFv3.



- Note** By default, OSPFv3 considers only the following DLEP metrics in route cost calculation:
- CDR
 - RLQ
 - MDR
 - Resource

Procedure

- Step 1** Configure DLEP with IPv6:
See section [Configuring IPv6 with DLEP](#).
- Step 2** Configure the OSPF router:
- ```
Router#configure terminal
Router(config)#router ospfv3 1
Router(config-router)#router-id 200.200.200.200
Router(config-router)#address-family ipv4 unicast
Router(config-router-af)#end
Router#
```
- Step 3** Configure OSPF on the VMI:
- ```
Router#configure terminal
Router(config)#interface vm11
```

```
Router(config-if)#ospfv3 1 ipv4 area 0
Router(config-if)#ospfv3 1 ipv4 cost dynamic
Router(config-if)#ospfv3 1 ipv4 network manet
Router(config-if)#end
Router#
```

Configuring OSPFv3 for DLEP IPv6 unicast

From Cisco IOS XE 17.12.1, OSPFv3 for DLEP can be configured with IPv6 unicast.

Procedure

Step 1 Configure DLEP with IPv6:

See section [Configuring IPv6 with DLEP, on page 10](#).

Step 2 Configure the OSPF router:

```
Router#configure terminal
Router(config)# router ospfv3 1
Router(config-router)# router-id 200.200.200.200
Router(config-router)# address-family ipv6 unicast
Router(config-router-af)#end
Router#
```

Step 3 Configure OSPF on the VMI:

```
Router#configure terminal
Router(config)# interface vmil
Router(config-if)# ospfv3 1 ipv6 area 0
Router(config-if)# ospfv3 1 ipv6 cost dynamic          -> enables dynamic route cost.
Router(config-if)# ospfv3 1 ipv6 network manet         -> sets OSPF network type to MANET.
Router(config-if)#end
Router#
```

Configuring DLEP EIGRP

This section describes configuring DLEP with EIGRP.



Note By default, EIGRP considers only the following DLEP metrics in route cost calculation:

- CDR
 - RLQ
 - MDR
-

Procedure

	Command or Action	Purpose
Step 1	enable Example: Router> enable Router#	Enables privileged EXEC mode.
Step 2	configure terminal Example: Router# configure terminal Router(config)#	Enters global configuration mode.
Step 3	interface vmi number Example: Router(config)# interface vmi 1 Router(config-if)#	Creates VMI interface and enters interface configuration mode.
Step 4	ip unnumbered interface Example: Router(config-if)# ip unnumbered gigabitEthernet 0/0/0	Attaches the VMI interface with the physical interface IP address.
Step 5	physical-interface interface Example: Router(config-if)# physical-interface gigabitEthernet 0/0/0	Binds the physical interface to the VMI interface, for packet flow.
Step 6	ipv6 enable Example: Router(config-if)# ipv6 enable	Enables IPv6 support under VMI interface.
Step 7	no ip split-horizon eigrp number Example: Router(config-if)# no ip split-horizon eigrp 1	Disables split-horizon mechanism.
Step 8	exit Example: Router(config-if)# exit Router(config)#	Exits the current mode.
Step 9	router eigrp autonomous-system-number Example: Router(config)# router eigrp 1 Router(config-router)# router-id 1.1.1.1 Router(config-router)# network 10.0.0.0 0.0.0.255	Enables EIGRP configuration with autonomous system number that identifies the services to the other EIGRP address-family routers.

	Command or Action	Purpose
	Router(config-router)# passive-interface GigabitEthernet0/0/0	

Configuring EIGRP for DLEP IPv6 unicast

From Cisco IOS XE 17.12.1a, EIGRP for DLEP can be configured with IPv6 unicast.

Procedure

Step 1 Configure the EIGRP router:

```
Router#configure terminal
Router(config)# ipv6 router eigrp 2
Router(config-rtr)# eigrp router-id 2.2.2.2
Router(config-rtr)#end
Router#
```

Step 2 Configure EIGRPv6 on VMI:

```
Router#configure terminal
Router(config)# interface vmil
Router(config-if)# ipv6 eigrp 2
Router(config-if)# no ipv6 split-horizon eigrp 2
Router(config-if)#end
Router#
```

Optional Configurations for DLEP

There are a set of optional commands that are available to configure DLEP with a WAN or sub-interface. Using these commands, you can define the set of timeout intervals between peers, neighbors, and the heart-beat intervals for radios.

Command	Purpose
ip dlep set heartbeat-threshold ? <2-8> Threshold of missed heartbeat messages	Sets the heartbeat-threshold, between Server and Client.
ip dlep set peer-description ? LINE Peer Description Name	Defines the description with Peer.
ip dlep set peer-heartbeat-interval ? <1-60> Peer Heartbeat Interval timer duration in seconds	Sets the heartbeat interval between Server and client.
ip dlep set peer-discovery-interval ? <1-60> Peer Discovery Interval timer duration in seconds	Sets the peer discovery interval timer.

Removing the DLEP Configuration

Before you begin

You must remove all configurations for the virtual-template individually using the **no** form of the respective configuration commands, before removing the virtual-template using the **no interface virtual-template** command.

Procedure

	Command or Action	Purpose
Step 1	enable Example: <pre>Router> enable Router#</pre>	Enables privileged EXEC mode.
Step 2	configure terminal Example: <pre>Router# configure terminal Router(config)#</pre>	Enters global configuration mode.
Step 3	interface interface Example: <pre>Router(config)# interface gi0/0/0</pre>	Specifies the interface.
Step 4	no ip dlep vtemplate 1 Example: <pre>Router(config-if)# no ip dlep vtemplate 1</pre>	Clears the DLEP configuration. Note Disabling DLEP on the physical interface also removes all optional DLEP configurations indicated in section Optional Configurations for DLEP .
Step 5	no int vmi <number> Example: <pre>Router(config-if)# no int vmi 1</pre>	Removes the VMI interface on the router.
Step 6	no int Virtual-Template <number> Example: <pre>Router(config-if)# no ip unnumbered gigabitEthernet 0/0/0 Router(config-if)# no ipv6 enable Router(config-if)# no int Virtual-Template 1</pre>	Removing Virtual template on Router.

With the above configuration, DLEP will be removed from router. However, Virtual-Access interfaces that are created while bringing up DLEP neighbors, will still show up in the output of the **show ip interface brief** command until the system is rebooted.

Clearing DLEP Clients and Neighbors

This section describes how to clear DLEP configuration, using the **clear dlep client** <interface> <peer id> command, and possible ramifications.

The **clear dlep client** command clears the peer session.

The following shows an example:



Note First obtain the Peer ID from the output of the **show dlep client** command. Then, use that as the input to the **clear dlep client** command.

```
Router#show dlep client gi0/0/1

DLEP Clients for Interface GigabitEthernet0/0/1
DLEP Local IP=15.0.0.10:55555 Sock=0

DLEP Local Radio IP=15.0.0.2:856 TCP Socket fd=1
Peer ID=20, Virtual template=2
Description: DLEP_Radio_2042
Peer Timers (all values in milliseconds):
  Heartbeat=60000, Dead Interval=120000, Terminate ACK=240000
Neighbor Timers (all values in seconds):
  Activity timeout=0, Neighbor Down ACK=10

Supported Metrics:
  Link RLQ RX Metric : 100
  Link RLQ TX Metric : 100
  Link Resources Metric : 100
  Link MTU Metric : 100
  Link Latency Metric : 250 microseconds
  Link CDR RX Metric : 100000000 bps
  Link CDR TX Metric : 100000000 bps
  Link MDR RX Metric : 100000000 bps
  Link MDR TX Metric : 100000000 bps
Router#
```

```
Router#clear dlep client gi0/0/1 20
DLEP: Clear Client (peer) peer_id=20 from 15.0.0.10
```

There is another command that can be used to clear DLEP configuration. The **clear dlep neighbor** <interface> <session id> command clears DLEP neighbors. The session ID can be obtained using the **show dlep neighbor** command.

```
Router#clear dlep neighbor gi0/0/1 2215
DLEP: Clear neighbor sid=2215 from 195.0.0.2
```

DLEP Validation Commands

This section contains examples of how to verify the DLEP configuration on the router.

DLEP Configuration

Command	Information
Router# show dlep config ? GigabitEthernet GigabitEthernet IEEE 802.3z Output modifiers <cr> <cr>	DLEP configuration is supported only on WAN or sub-interface.

```
Router# show dlep config g0/0/1
DLEP Configuration for GigabitEthernet0/0/1
```

```
DLEP Peer Description -
DLEP Version = RFC 8175
DLEP Server IP=10.0.0.1:11117
DLEPv27 TCP Port = 11118
Virtual template=2
Timers (all values are in seconds):
Missed heartbeat threshold=2, Peer Terminate ACK timeout=10
Dlepv27 Applicable configs(in seconds):
Heartbeat interval=5, Discovery interval =5, Session Ack timeout=10
Neighbor activity timeout=0, Neighbor Down ACK timeout=10
```

DLEP Clients

Command	Information
Router# show dlep clients ? GigabitEthernet GigabitEthernet IEEE 802.3z Output modifiers <cr> <cr>	DLEP clients is supported only on WAN or sub-interface.

```
Router# show dlep clients
DLEP Clients for all interfaces:
```

```
DLEP Clients for Interface GigabitEthernet0/0/1
DLEP Server IP=10.0.0.1:11117 Sock=0 --> Local Router IP address
```

```
DLEP Client IP=10.0.0.2:859 TCP Socket fd=1 --> Directly connected Radio to the router
Peer ID=2, Virtual template=2
Description: DLEP_RadioSIM2
Peer Timers (all values in milliseconds):
Heartbeat=5000, Dead Interval=10000, Terminate ACK=20000
Neighbor Timers (all values in seconds):
Activity timeout=0, Neighbor Down ACK=10
```

```
Supported Metrics:
Link RLQ RX Metric : 100
Link RLQ TX Metric : 100
Link Resources Metric : 100
Link MTU Metric : 100
Link Latency Metric : 250 microseconds
Link CDR RX Metric : 100000000 bps
Link CDR TX Metric : 100000000 bps
Link MDR RX Metric : 100000000 bps
```



```
Link MDR TX Metric : 100000000 bps
Router#
```

DLEP Neighbor

Command	Information
Router# show dlep neighbor ? GigabitEthernet GigabitEthernet IEEE 802.3z Output modifiers <cr> <cr>	DLEP neighbors is supported only on WAN or sub-interface.

```
Router# show dlep neighbor
```

```
DLEP Neighbors for all interfaces:
```

```
DLEP Neighbors for Interface GigabitEthernet0/0/1
```

```
DLEP Server IP=10.0.0.1:11117 Sock=0    ---> Local Router IP address
```

```
SID=2151    MAC_Address=a453.0e94.f861
```

```
Addresses:
```

```
IPv4 : 16.0.0.1                      ---> Mac-Address and IPv4 address of neighbor's end-point device
```

```
Supported Metrics:
```

```
RLQ RX Metric : 100
```

```
RLQ TX Metric : 100
```

```
Resources Metric : 100
```

```
MTU Metric : 1500
```

```
Latency Metric : 250 microseconds
```

```
CDR RX Metric : 100000000 bps
```

```
CDR TX Metric : 100000000 bps
```

```
MDR RX Metric : 100000000 bps
```

```
MDR TX Metric : 100000000 bps
```

DLEP Counters

Command	Information
Router# show dlep counters ? GigabitEthernet GigabitEthernet IEEE 802.3z Output modifiers <cr> <cr>	DLEP Counters is supported only on WAN or sub-interface, which will summarize port information, counters for peer, and neighbors.

```
UUT1# show dlep counters
```

```
DLEP Counters for GigabitEthernet0/0/1
```

```
Last Clear Time =
```

```
DLEP Version = RFC 8175
```

```
DLEP Server IP=10.0.0.1:11117
```

```
DLEPv5 TCP Port = 11118
```

```
Peer Counters:
```

```

RX Peer Discovery      0      TX Peer Offer      0
RX Peer Offer         0      TX Peer Discovery  0
RX Peer Init          0      TX Peer Init Ack   0
RX Peer Init Ack      1      TX Peer Init       1
RX Heartbeat         41      TX Heartbeat       41
RX Peer Terminate     0      TX Peer Terminate Ack 0
RX Peer Terminate Ack 0      TX Peer Terminate  0
```

```

Neighbor Counters:
RX Neighbor Up          1      TX Neighbor Up Ack      1
RX Metric               0
RX Neighbor Down        0      TX Neighbor Down Ack    0
RX Neighbor Down Ack    0      TX Neighbor Down       1

Exception Counters:
RX Invalid Message      0      RX Unknown Message      0
Pre-Existing Neighbor  0      Neighbor Resource Error  1
Neighbor Not Found      0      Neighbor Msg Peer Not Up 0

Timer Counters:
Peer Heartbeat Timer     41
Peer Terminate Ack Timer 0
Neighbor Terminate Ack Timer 0
Neighbor Activity Timer  0
Radio Connect Timer      5

Single Timer Wheel "Manet Infra Wheel"
Granularity      = 250 msec
Wheel size       = 4096
Spoke index      = 3730
Tick count       = 3423890
Flags            = 0x00
Active timers    = 1
High water mark  = 1
Started timers   = 171177
Restarted timers = 2
Cancelled timers = 5
Expired timers   = 171169
Long timers      = 0
Long timer revs  = 0
Timer suspends   = 0

```

Verifying DLEP Configuration

Use the following show commands to verify DLEP configuration.

Use the **show dlep clients** command to verify the DLEP client configuration based on port number:

```

Router# show dlep clients
DLEP Clients for all interfaces:

DLEP Clients for Interface GigabitEthernet0/0/0
DLEP Server IP=10.0.0.1:11113 Sock=0

DLEP Client IP=10.0.0.3:11115 TCP Socket fd=1
Peer ID=1, Virtual template=1
Description: DLEP-Radiol-Path-1
Peer Timers (all values in milliseconds):
Heartbeat=5000, Dead Interval=10000, Terminate ACK=20000
Neighbor Timers (all values in seconds):
Activity timeout=0, Neighbor Down ACK=10

Supported Metrics:
Link RLQ RX Metric : 100
Link RLQ TX Metric : 100
Link Resources Metric : 100
Link MTU Metric : 100
Link Latency Metric : 250 microseconds
Link CDR RX Metric : 100000000 bps
Link CDR TX Metric : 100000000 bps

```

```
Link MDR RX Metric : 100000000 bps
Link MDR TX Metric : 100000000 bps
```

Use the **show dlep clients** and **show dlep counters** commands to verify DLEP configuration with dynamic port on server:

```
Router# show dlep clients
DLEP Clients for all interfaces:

DLEP Clients for Interface GigabitEthernet0/0/0
DLEP Server IP=10.0.0.1:55555 Sock=0

DLEP Client IP=10.0.0.3:11115 TCP Socket fd=1
Peer ID=1, Virtual template=1
Description: DLEP-Radiol-Path-1
Peer Timers (all values in milliseconds):
  Heartbeat=5000, Dead Interval=10000, Terminate ACK=20000
Neighbor Timers (all values in seconds):
  Activity timeout=0, Neighbor Down ACK=10

Supported Metrics:
Link RLQ RX Metric : 100
Link RLQ TX Metric : 100
Link Resources Metric : 100
Link MTU Metric : 100
Link Latency Metric : 250 microseconds
Link CDR RX Metric : 100000000 bps
Link CDR TX Metric : 100000000 bps
Link MDR RX Metric : 100000000 bps
Link MDR TX Metric : 100000000 bps

Router# show dlep counters
DLEP Counters for GigabitEthernet0/0/0

Last Clear Time =

DLEP Version = RFC 8175
DLEP Server IP=10.0.0.1:55555
DLEPv5 TCP Port = 55556

Peer Counters:
RX Peer Discovery      0      TX Peer Offer          0
RX Peer Offer         0      TX Peer Discovery      0
RX Peer Init          0      TX Peer Init Ack      0
RX Peer Init Ack      1      TX Peer Init          1
RX Heartbeat         58      TX Heartbeat          58
RX Peer Terminate     0      TX Peer Terminate Ack 0
RX Peer Terminate Ack 0      TX Peer Terminate     0

Neighbor Counters:
RX Neighbor Up        0      TX Neighbor Up Ack    0
RX Metric             0
RX Neighbor Down      0      TX Neighbor Down Ack  0
RX Neighbor Down Ack  0      TX Neighbor Down      0

Exception Counters:
RX Invalid Message    0      RX Unknown Message    0
Pre-Existing Neighbor 0      Neighbor Resource Error 0
Neighbor Not Found    0      Neighbor Msg Peer Not Up 0

Timer Counters:
Peer Heartbeat Timer   58
Peer Terminate Ack Timer 0
Neighbor Terminate Ack Timer 0
Neighbor Activity Timer 0
```

```

Radio Connect Timer          5

Single Timer Wheel "Manet Infra Wheel"
  Granularity      = 250 msec
  Wheel size       = 4096
  Spoke index      = 3592
  Tick count       = 3592
  Flags            = 0x00
  Active timers    = 1
  High water mark  = 2
  Started timers   = 164
  Restarted timers = 2
  Cancelled timers = 3
  Expired timers   = 158
  Long timers      = 0
  Long timer revs  = 0
  Timer suspends   = 0

```

Use the **show dlep clients** and **show dlep counters** commands to verify DLEP template attached in discovery mode:

```

Router# show dlep clients
DLEP Clients for all interfaces:

DLEP Clients for Interface GigabitEthernet0/0/0
DLEP Server IP=10.0.0.1:55555 Sock=0

DLEP Client IP=10.0.0.3:11115 TCP Socket fd=1
Peer ID=1, Virtual template=1
Description: DLEP-Radiol-Path-1
Peer Timers (all values in milliseconds):
Heartbeat=5000, Dead Interval=10000, Terminate ACK=20000
Neighbor Timers (all values in seconds):
Activity timeout=0, Neighbor Down ACK=10

Supported Metrics:
Link RLQ RX Metric : 100
Link RLQ TX Metric : 100
Link Resources Metric : 100
Link MTU Metric : 100
Link Latency Metric : 250 microseconds
Link CDR RX Metric : 100000000 bps
Link CDR TX Metric : 100000000 bps
Link MDR RX Metric : 100000000 bps
Link MDR TX Metric : 100000000 bps

Router# show dlep counters
DLEP Counters for GigabitEthernet0/0/0

Last Clear Time =

DLEP Version = RFC 8175
DLEP Server IP=10.0.0.1:55555
DLEPv5 TCP Port = 55556

Peer Counters:
RX Peer Discovery      0      TX Peer Offer      0
RX Peer Offer          3      TX Peer Discovery  194
RX Peer Init           0      TX Peer Init Ack   0
RX Peer Init Ack       3      TX Peer Init       3
RX Heartbeat           710     TX Heartbeat       707
RX Peer Terminate      0      TX Peer Terminate Ack 0
RX Peer Terminate Ack  0      TX Peer Terminate  2

Neighbor Counters:

```

```

RX Neighbor Up          0      TX Neighbor Up Ack      0
RX Metric               0
RX Neighbor Down        0      TX Neighbor Down Ack    0
RX Neighbor Down Ack    0      TX Neighbor Down        0

Exception Counters:
RX Invalid Message      0      RX Unknown Message      0
Pre-Existing Neighbor   0      Neighbor Resource Error  0
Neighbor Not Found      0      Neighbor Msg Peer Not Up 0

Timer Counters:
Peer Heartbeat Timer    709
Peer Terminate Ack Timer 2
Neighbor Terminate Ack Timer 0
Neighbor Activity Timer 0
Radio Connect Timer     3

Single Timer Wheel "Manet Infra Wheel"
Granularity      = 250 msec
Wheel size       = 4096
Spoke index      = 8
Tick count       = 24584
Flags            = 0x00
Active timers    = 1
High water mark  = 2
Started timers   = 1209
Restarted timers = 4
Cancelled timers = 14
Expired timers   = 1190
Long timers      = 0
Long timer revs  = 0
Timer suspends   = 0

```

Use the **show dlep clients** command to verify DLEP template configuration with well-known IP address:

```

Router# show dlep clients
DLEP Clients for all interfaces:
DLEP Clients for Interface GigabitEthernet0/0/0
DLEP Server IP=10.1.2.3:55555 Sock=2

DLEP Client IP=10.1.2.4:854 TCP Socket fd=3
Peer ID=1, Virtual template=1
Description: OONF DLEP Radio
Peer Timers (all values in milliseconds):
  Heartbeat=5000, Dead Interval=10000, Terminate ACK=20000
Neighbor Timers (all values in seconds):
  Activity timeout=0, Neighbor Down ACK=10

Supported Metrics:
Link RLQ RX Metric : 100
Link RLQ TX Metric : 100
Link Resources Metric : 100
Link Latency Metric : 1000 microseconds
Link CDR RX Metric : 104857600 bps
Link CDR TX Metric : 104857600 bps
Link MDR RX Metric : 104857600 bps
Link MDR TX Metric : 104857600 bps

```

Use the **show policy-map interface Virtual-Access** command to verify QoS policy. In the following example, QoS policy is applied to Virtual-Template1, and data packets are flowing through Virtual-Access2 interface which is created when DLEP neighbors came up:

```

Router#show policy-map interface Virtual-Access 2
Virtual-Access2

```

```

Service-policy output: Queue_Map

Class-map: CMAP_VOICE (match-any)
  0 packets, 0 bytes
  5 minute offered rate 0000 bps, drop rate 0000 bps
  Match: dscp 41
  Match: dscp 43
  Match: dscp 45
  Match: dscp 47
  Match: dscp 49
  Queueing
  queue limit 208 packets
  (queue depth/total drops/no-buffer drops) 0/0/0
  (pkts output/bytes output) 0/0
  bandwidth 40% (400000 kbps)
  QoS Set
    dscp af11
    Marker statistics: Disabled

Class-map: CMAP_VIDEO (match-any)
  0 packets, 0 bytes
  5 minute offered rate 0000 bps, drop rate 0000 bps
  Match: dscp 33
  Match: dscp 35
  Match: dscp 37
  Match: dscp 39
  Match: dscp af41 (34)
  Queueing
  queue limit 208 packets
  (queue depth/total drops/no-buffer drops) 0/0/0
  (pkts output/bytes output) 0/0
  bandwidth 50% (500000 kbps)

Class-map: CMAP_DATA (match-any)
  0 packets, 0 bytes
  5 minute offered rate 0000 bps, drop rate 0000 bps
  Match: dscp 9
  Match: dscp 11
  Match: dscp 13
  Match: dscp 15
  Match: dscp af11 (10)
  Queueing
  queue limit 208 packets
  (queue depth/total drops/no-buffer drops) 0/0/0
  (pkts output/bytes output) 1024337/34827458
  bandwidth 10% (100000 kbps)
  QoS Set
    dscp af23
    Marker statistics: Disabled

Class-map: class-default (match-any)
  0 packets, 0 bytes
  5 minute offered rate 0000 bps, drop rate 0000 bps
  Match: any

  queue limit 208 packets
  (queue depth/total drops/no-buffer drops) 0/0/0
  (pkts output/bytes output) 0/0

```

Use the **show running-config** command to verify DLEP configuration on a sub-interface:

```

Router# show running-config
Building configuration...
Current configuration : 7726 bytes
!

```

```

!
version 17.8
hostname Router
!
boot-start-marker
boot system bootflash:/c6300-universalk9.SSA.bin
boot-end-marker
!
ipv6 unicast-routing
subscriber templating
!
license udi pid ESR-6300-CON-K9 sn FOC234304H3
license boot level network-advantage
!
interface Loopback1
 ip address 1.1.1.1 255.255.255.255
 ipv6 enable
 ospfv3 1 ipv4 area 0
!
interface GigabitEthernet0/0/0
 no ip address
 negotiation auto
!
interface GigabitEthernet0/0/0.10
 encapsulation dot1Q 10
 ip address 10.0.0.1 255.255.255.0
 ip dlep vtemplate 1 port 11113 tcp port 11114 client ip 10.0.0.2 port 11115
 ipv6 enable
!
interface Virtual-Template1
 ip unnumbered GigabitEthernet0/0/0.10
!
interface vmil
 ip unnumbered GigabitEthernet0/0/0.10
 ipv6 address FE80::7E31:EFF:FE85:1E78 link-local
 ipv6 enable
 ospfv3 1 network manet
 ospfv3 1 ipv4 area 0
 physical-interface GigabitEthernet0/0/0.10
!
router ospfv3 1
!
 address-family ipv4 unicast
 exit-address-family
!
 address-family ipv6 unicast
 exit-address-family
!
end

Router#

```

Use the **show dlep neighbors** command to verify IPv6 configuration with DLEP:

```

router# show dlep neighbors

DLEP Neighbors for all interfaces:
  DLEP Neighbors for Interface GigabitEthernet0/0/0.10
  DLEP Local IP=10.0.0.12:55555 Sock=0

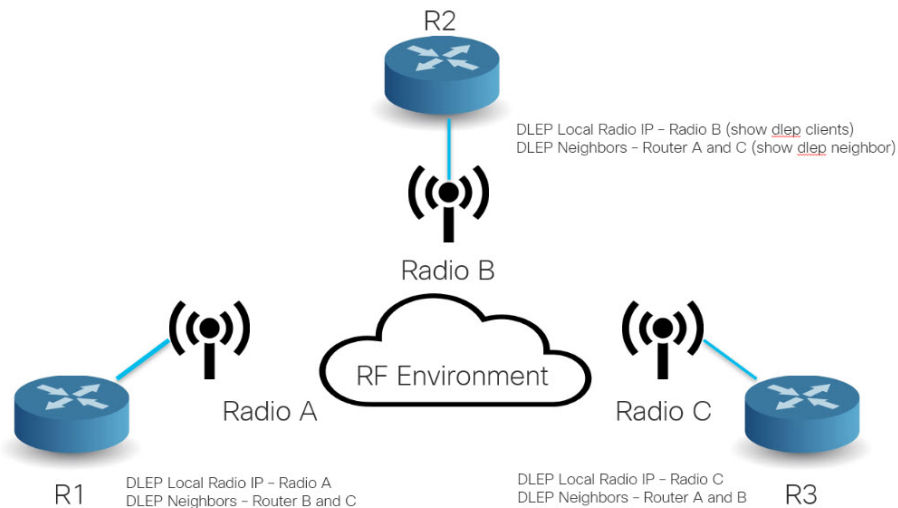
SID=3323 Remote End-point MAC_Address=d478.9b5d.3800
Addresses:
  DLEP Remote IP : 10.0.0.2
  DLEP Remote IPv6 LL : FE80::D678:9BFF:FE5D:3800

```

Troubleshooting DLEP Configuration with show Commands

The following figure illustrates the sample topography that the various show commands in this section use.

Figure 5: Sample Installation



show DLEP Configuration

```
Router# show dlep config Te0/0/0
DLEP Configuration for TenGigabitEthernet0/0/0

DLEP Peer Description -
DLEP Version = RFC 8175
DLEP Local IP=19.19.19.151:55113----> Local Router IP address
DLEPv27 TCP Port = 55114
Virtual template=1
Timers (all values are in seconds):
Missed heartbeat threshold=2, Peer Terminate ACK timeout=10
Dlepv27 Applicable configs(in seconds):
Heartbeat interval=5, Discovery interval =5, Session Ack timeout=10
Neighbor activity timeout=0, Neighbor Down ACK timeout=10
```

show DLEP Clients

```
Router# show dlep clients

DLEP Clients for all interfaces:

DLEP Clients for Interface TenGigabitEthernet0/0/0
DLEP Local IP=19.19.19.151:55113 Sock=2----> Local Router IP address

DLEP Local Radio IP=19.19.19.121:9121 TCP Socket fd=3----> Directly connected Radio IP
address
Peer ID=42, Virtual template=1 ----> Attached virtual template for directly connected Radio
from the router
Description: radio_9
Peer Timers (all values in milliseconds):
Heartbeat=5000, Dead Interval=10000, Terminate ACK=20000
Neighbor Timers (all values in seconds):
```


Activity timeout=0, Neighbor Down ACK=10

Supported Metrics:----> Metrics from directly connected radio

Link RLQ RX Metric : 100
 Link RLQ TX Metric : 100
 Link Resources Metric : 100
 Link MTU Metric : 100
 Link Latency Metric : 250 microseconds
 Link CDR RX Metric : 100000000 bps
 Link CDR TX Metric : 100000000 bps
 Link MDR RX Metric : 100000000 bps
 Link MDR TX Metric : 100000000 bps

DLEP Clients for Interface TenGigabitEthernet0/0/1
 DLEP Local IP=18.18.18.111:21115 Sock=0

DLEP Local Radio IP=18.18.18.112:8111 TCP Socket fd=1
 Peer ID=43, Virtual template=2
 Description: radio_7_8nw
 Peer Timers (all values in milliseconds):
 Heartbeat=5000, Dead Interval=10000, Terminate ACK=20000
 Neighbor Timers (all values in seconds):
 Activity timeout=0, Neighbor Down ACK=10

Supported Metrics:
 Link RLQ RX Metric : 100
 Link RLQ TX Metric : 100
 Link Resources Metric : 100
 Link MTU Metric : 100
 Link Latency Metric : 250 microseconds
 Link CDR RX Metric : 100000000 bps
 Link CDR TX Metric : 100000000 bps
 Link MDR RX Metric : 100000000 bps
 Link MDR TX Metric : 100000000 bps

=====

show DLEP Neighbors

Router# **show dlep neighbors**

DLEP Neighbors for all interfaces:

DLEP Neighbors for Interface TenGigabitEthernet0/0/0
DLEP Local IP=19.19.19.151:55113 Sock=2----> Local Router IP address

SID=2187 Remote End-point MAC_Address=000c.2915.d4f8 ----> MAC address of end-point router interface

Addresses:

DLEP Remote IP : 19.19.19.161 DLEP Remote IPv6 LL : FE80::20C:29FF:FE15:D4F8

Associated virtual access interface : Virtual-Access4----> DLEP Remote address and link-local of end-point router

Supported Metrics:----> Supported Metrics to reach end point router directly connected radio, based on the routing distance metrics will update appropriately

RLQ RX Metric : 100
 RLQ TX Metric : 100
 Resources Metric : 100
 MTU Metric : 1500
 Latency Metric : 250 microseconds
 CDR RX Metric : 100000000 bps
 CDR TX Metric : 100000000 bps

```
MDR RX Metric : 100000000 bps
MDR TX Metric : 100000000 bps
```

```
DLEP Neighbors for Interface TenGigabitEthernet0/0/1
DLEP Local IP=18.18.18.111:21115 Sock=0
```

```
SID=2188 Remote End-point MAC_Address=000c.2915.d402
Addresses:
DLEP Remote IP : 18.18.18.119 DLEP Remote IPv6 LL : FE80::20C:29FF:FE15:D402
Associated virtual access interface : Virtual-Access3
Supported Metrics:
RLQ RX Metric : 100
RLQ TX Metric : 100
Resources Metric : 100
MTU Metric : 1500
Latency Metric : 250 microseconds
CDR RX Metric : 100000000 bps
CDR TX Metric : 100000000 bps
MDR RX Metric : 100000000 bps
MDR TX Metric : 100000000 bps
```

show DLEP Counters

```
Router# show dlep counters
```

```
DLEP Counters for TenGigabitEthernet0/0/0
```

```
Last Clear Time =
```

```
DLEP Version = RFC 8175
```

```
DLEP Local IP=19.19.19.151:55113----> Local Router IP address
```

```
DLEPv5 TCP Port = 55114
```

Peer Counters:

RX Peer Discovery	0	TX Peer Offer	0
RX Peer Offer	0	TX Peer Discovery	0
RX Peer Init	0	TX Peer Init Ack	0
RX Peer Init Ack	1	TX Peer Init	1
RX Heartbeat	23	TX Heartbeat	23
RX Peer Terminate	0	TX Peer Terminate Ack	0
RX Peer Terminate Ack	0	TX Peer Terminate	0

Neighbor Counters:

RX Neighbor Up	1	TX Neighbor Up Ack	1
RX Metric	0		
RX Neighbor Down	0	TX Neighbor Down Ack	0
RX Neighbor Down Ack	0	TX Neighbor Down	0

Exception Counters:

RX Invalid Message	0	RX Unknown Message	0
Pre-Existing Neighbor	0	Neighbor Resource Error	0
Neighbor Not Found	0	Neighbor Msg Peer Not Up	0

Timer Counters:

Peer Heartbeat Timer	23
Peer Terminate Ack Timer	0
Neighbor Terminate Ack Timer	0
Neighbor Activity Timer	0
Radio Connect Timer	0

```
DLEP Counters for TenGigabitEthernet0/0/1
```

```
Last Clear Time =
```

```

DLEP Version = RFC 8175
DLEP Local IP=18.18.18.111:21115
DLEPv5 TCP Port = 21116

Peer Counters:
RX Peer Discovery      0      TX Peer Offer      0
RX Peer Offer         0      TX Peer Discovery  0
RX Peer Init          0      TX Peer Init Ack   0
RX Peer Init Ack      1      TX Peer Init       1
RX Heartbeat         16      TX Heartbeat       16
RX Peer Terminate     0      TX Peer Terminate Ack 0
RX Peer Terminate Ack 0      TX Peer Terminate  0

Neighbor Counters:
RX Neighbor Up        1      TX Neighbor Up Ack  1
RX Metric             0
RX Neighbor Down      0      TX Neighbor Down Ack 0
RX Neighbor Down Ack  0      TX Neighbor Down    0

Exception Counters:
RX Invalid Message    0      RX Unknown Message  0
Pre-Existing Neighbor 0      Neighbor Resource Error 0
Neighbor Not Found    0      Neighbor Msg Peer Not Up 0

Timer Counters:
Peer Heartbeat Timer   16
Peer Terminate Ack Timer 0
Neighbor Terminate Ack Timer 0
Neighbor Activity Timer 0
Radio Connect Timer    0

Single Timer Wheel "Manet Infra Wheel"
Granularity      = 250 msec
Wheel size       = 4096
Spoke index      = 3078
Tick count       = 470022
Flags            = 0x00
Active timers    = 2
High water mark  = 3
Started timers   = 4900
Restarted timers = 10
Cancelled timers = 105
Expired timers   = 4783
Long timers      = 0
Long timer revs  = 0
Timer suspends  = 0

```

Troubleshooting DLEP Configuration with debug Commands

This section shows two different troubleshooting scenarios.



Note It is recommended to use debug commands only under the guidance of Cisco TAC.

Scenario 1 : DLEP client is not reachable

In this scenario, the router is not running in discovery mode, and the client/radio attributes have been explicitly configured.

Step 1: The output of **show dlep clients** indicates that there is no active client:

```
Router# show dlep clients
```

DLEP Clients for all interfaces:

```
DLEP Clients for Interface GigabitEthernet0/0/1
DLEP Server IP=14.0.0.3:11117 Sock=-1
```

Step 2: Check the DLEP configuration:

```
Router#show dlep config
```

DLEP Configuration for GigabitEthernet0/0/1

```
DLEP Peer Description -
DLEP Version = RFC 8175
DLEP Server IP=14.0.0.3:11117
DLEPv27 TCP Port = 11118
Virtual template=2
Timers (all values are in seconds):
Missed heartbeat threshold=2, Peer Terminate ACK timeout=10
Dlepv27 Applicable configs(in seconds):
Heartbeat interval=60, Discovery interval =5, Session Ack timeout=10
Neighbor activity timeout=0, Neighbor Down ACK timeout=10
```

```
Router#show run int g0/0/1
```

Building configuration...

Current configuration : 245 bytes

```
!
interface GigabitEthernet0/0/1
 ip address 14.0.0.3 255.255.255.0
 ip dlep set peer-heartbeat-interval 60
 ip dlep vtemplate 2 port 11117 tcp port 11118 client ip 14.0.0.6 port 859
 negotiation auto
 ipv6 address 1111::1/120
 ipv6 enable
end
```

Step 3: Verify that the configuration on the radio (client) matches the configuration on the router (server) and that the router can reach the radio.

```
Router#show ip arp
```

Protocol	Address	Age (min)	Hardware Addr	Type	Interface
Internet	10.199.184.2	9	0013.5f22.0b4a	ARPA	GigabitEthernet0/0/0
Internet	10.199.184.3	8	0018.7414.4e80	ARPA	GigabitEthernet0/0/0
Internet	10.199.184.19	-	a453.0e94.f638	ARPA	GigabitEthernet0/0/0
Internet	14.0.0.2	4	000c.297a.6b3d	ARPA	GigabitEthernet0/0/1
Internet	14.0.0.3	-	a453.0e94.f639	ARPA	GigabitEthernet0/0/1
Internet	14.0.0.6	0	Incomplete	ARPA	

```
Router#ping 14.0.0.6
```

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 14.0.0.6, timeout is 2 seconds:

...

Success rate is 0 percent (0/3)

Step 4: The client '14.0.0.6' cannot be pinged. A quick check of the radio configuration revealed that the client IP address was actually 14.0.0.2.

```
Router#show run int g0/0/1
```

Building configuration...

Current configuration : 245 bytes

```

!
interface GigabitEthernet0/0/1
 ip address 14.0.0.3 255.255.255.0
 ip dlep set peer-heartbeat-interval 60
 ip dlep vtemplate 2 port 11117 tcp port 11118 client ip 14.0.0.6 port 859
 negotiation auto
 ipv6 address 1111::1/120
 ipv6 enable
end

```

Step 5: Correct the client IP address.

```

Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int g0/0/1
Router(config-if)#no ip dlep vtemplate 2 port 11117 tcp port 11118 client ip 14.0.0.6 port
859
Router(config-if)# ip dlep set peer-heartbeat-interval 60
Router(config-if)#ip dlep vtemplate 2 port 11117 tcp port 11118 client ip 14.0.0.6 port 859
Router(config-if)#^Z
Router#
*Feb 18 19:43:48.951: %SYS-5-CONFIG_I: Configured from console by console

```

Step 6: Verify the fix.

```

Router#show dlep counters
DLEP Counters for GigabitEthernet0/0/1

Last Clear Time =

DLEP Version = RFC 8175
DLEP Server IP=14.0.0.3:11117
DLEPv5 TCP Port = 11118

Peer Counters:
RX Peer Discovery      0      TX Peer Offer      0
RX Peer Offer          0      TX Peer Discovery  0
RX Peer Init           0      TX Peer Init Ack   0
RX Peer Init Ack       1      TX Peer Init       1
RX Heartbeat           0      TX Heartbeat       0
RX Peer Terminate      0      TX Peer Terminate  0
RX Peer Terminate Ack  0      TX Peer Terminate  0

Neighbor Counters:
RX Neighbor Up         0      TX Neighbor Up Ack  0
RX Metric              0
RX Neighbor Down       0      TX Neighbor Down Ack 0
RX Neighbor Down Ack   0      TX Neighbor Down    0

Exception Counters:
RX Invalid Message     0      RX Unknown Message  0
Pre-Existing Neighbor  0      Neighbor Resource Error 0
Neighbor Not Found     0      Neighbor Msg Peer Not Up 0

Timer Counters:
Peer Heartbeat Timer   0
Peer Terminate Ack Timer 0
Neighbor Terminate Ack Timer 0
Neighbor Activity Timer 0
Radio Connect Timer    1

Single Timer Wheel "Manet Infra Wheel"
Granularity      = 250 msec
Wheel size       = 4096
Spoke index      = 1710

```

```

Tick count      = 9902
Flags           = 0x00
Active timers   = 1
High water mark = 1
Started timers  = 95
Restarted timers = 4
Cancelled timers = 4
Expired timers  = 86
Long timers     = 0
Long timer revs = 0
Timer suspends  = 0

```

Router#

Router#**show dlep clients**

DLEP Clients for all interfaces:

DLEP Clients for Interface GigabitEthernet0/0/1
DLEP Server IP=14.0.0.3:11117 Sock=0

DLEP Client IP=14.0.0.2:859 TCP Socket fd=1
Peer ID=3, Virtual template=2
Description: DLEP_RadioSIM2
Peer Timers (all values in milliseconds):
Heartbeat=60000, Dead Interval=120000, Terminate ACK=240000
Neighbor Timers (all values in seconds):
Activity timeout=0, Neighbor Down ACK=10

Supported Metrics:

```

Link RLQ RX Metric : 100
Link RLQ TX Metric : 100
Link Resources Metric : 100
Link MTU Metric : 100
Link Latency Metric : 250 microseconds
Link CDR RX Metric : 100000000 bps
Link CDR TX Metric : 100000000 bps
Link MDR RX Metric : 100000000 bps
Link MDR TX Metric : 100000000 bps

```

Scenario 2: DLEP session keeps timing out

In this scenario, the router is running in discovery mode.

Step 1: The DLEP session keeps flapping as indicated by the output of **show dlep client** sometimes shows an active client and sometimes it does not. Also, the VMI and virtual-access interfaces keep going up and down.

Router#**show dlep clients**

DLEP Clients for all interfaces:

DLEP Clients for Interface GigabitEthernet0/0/1
DLEP Server IP=14.0.0.3:55555 Sock=0

DLEP Client IP=14.0.0.2:859 TCP Socket fd=1
Peer ID=13, Virtual template=2
Description: DLEP_RadioSIM2
Peer Timers (all values in milliseconds):
Heartbeat=5000, Dead Interval=10000, Terminate ACK=20000
Neighbor Timers (all values in seconds):

```

Activity timeout=0, Neighbor Down ACK=10

Supported Metrics:
Link RLQ RX Metric : 100
Link RLQ TX Metric : 100
Link Resources Metric : 100
Link MTU Metric : 100
Link Latency Metric : 250 microseconds
Link CDR RX Metric : 100000000 bps
Link CDR TX Metric : 100000000 bps
Link MDR RX Metric : 100000000 bps
Link MDR TX Metric : 100000000 bps
Router#

*Feb 18 20:01:32.577: %SYS-5-CONFIG_P: Configured programmatically by process Manet Infra
Background from console as console
*Feb 18 20:01:32.580: %LINEPROTO-5-UPDOWN: Line protocol on Interface Virtual-Access3,
changed state to up
*Feb 18 20:01:32.584: %LINK-3-UPDOWN: Interface Virtual-Access3, changed state to up
*Feb 18 20:01:32.625: %LINEPROTO-5-UPDOWN: Line protocol on Interface vmi2, changed state
to up
Router#
Router#
*Feb 18 20:01:44.864: %LINEPROTO-5-UPDOWN: Line protocol on Interface vmi2, changed state
to down
*Feb 18 20:01:44.873: %LINEPROTO-5-UPDOWN: Line protocol on Interface Virtual-Access3,
changed state to down
*Feb 18 20:01:44.878: %LINK-3-UPDOWN: Interface Virtual-Access3, changed state to down
*Feb 18 20:01:44.889: %SYS-5-CONFIG_P: Configured programmatically by process VTEMPLATE
Background Mgr from console as console

```

Step 2: Turn on the following debug commands to troubleshoot:

```

debug dlep server
debug dlep timer detail
debug dlep client error
debug dlep client infra
debug dlep client packet detail
debug dlep client state

```

Step 3: The debug logs indicate that the router/server sent a peer discovery signal and received a peer offer in return.

```

*Feb 18 20:14:59.553: dlepv27_encoder_signal_packet_start DLEP_SIGNAL_PEER_DISCOVERY(1)
*Feb 18 20:14:59.553: dlepv27_encoder_signal_packet_end tlv block size=0 packet length=8
*Feb 18 20:15:04.609: dlepv27_encoder_signal_packet_start DLEP_SIGNAL_PEER_DISCOVERY(1)
*Feb 18 20:15:04.609: dlepv27_encoder_signal_packet_end tlv block size=0 packet length=8
*Feb 18 20:15:04.611: dlepv27_decoder_signal_packet DLEP_SIGNAL_PEER_OFFER(2) data length
30
*Feb 18 20:15:04.611: dlepv27_decoder_peer_type_tlv DLEP_TLV_PEER_TYPE flag - 0
dlepv27_decoder_parse_tlv_block last tlv 4; current block_len 11; next tlv 2
IPv4 Addr 14.0.0.2 dlepv27_decoder_ipv4_conn_point_tlv DLEP_TLV_IPv4_CONN_POINT
dlepv27_decoder_parse_tlv_block last tlv 2; current block_len 0;
*Feb 18 20:15:04.611:
*Feb 18 20:15:04.611: dlepv27_decoder_packet rc(RC_DLEP_OK-0) state 0 signal 1 packet_len
38
*Feb 18 20:15:09.648: %DLEP_MSG-4-CONNECT_ERROR: TCP connect to Radio 14.0.0.2 failed via
Gi0/0/1. Error code: Resource temporarily unavailable

```

Step 4: The router/server sends a session initialization message, and receives an acknowledgement in return. The acknowledgement also carries the attributes of the radio/client. An examination of those attributes reveals that the heartbeat interval on the radio is set to 60 seconds.

```

*Feb 18 20:15:09.648: dlepv27_encoder_msg_packet_start DLEP_MSG_SESSION_INITIALIZATION(1)
*Feb 18 20:15:09.648: dlepv27_encoder_msg_packet_end tlv block size=13 packet length=17

```

```

*Feb 18 20:15:09.649: Adding Peer for address 14.0.0.2(859), peer_id=22
*Feb 18 20:15:09.649: MANET_Infra: insert s=FFFF771137A8, type=2 (client insert)
*Feb 18 20:15:09.650: MANET_Infra: Insert=FFFF745209B0 successful (client insert)
*Feb 18 20:15:09.650: MANET_Infra: insert s=FFFF771137A8, type=1 (client insert)
*Feb 18 20:15:09.650: MANET_Infra: Insert=FFFF64C3CEE8 successful (client insert)
*Feb 18 20:15:09.650: -0 Allocated peer context at 0xFFFF771137A8
*Feb 18 20:15:09.650: dlepv27_decoder_msg_packet DLEP_MSG_SESSION_INITIALIZATION_ACK(2)
data length 132
dlepv27_decoder_status_tlv DLEP_TLV_STATUS status_code=0 desc ()
dlepv27_decoder_parse_tlv_block last tlv 1; current block_len 127; next tlv 4

*Feb 18 20:15:09.650: dlepv27_decoder_peer_type_tlv DLEP_TLV_PEER_TYPE flag - 0
dlepv27_decoder_parse_tlv_block last tlv 4; current block_len 108; next tlv 5
dlepv27_decoder_heartbeat_interval_tlv DLEP_TLV_HEARTBEAT_INTERVAL heartbeat=60000
dlepv27_decoder_parse_tlv_block last tlv 5; current block_len 100; next tlv 12

*Feb 18 20:15:09.650: dlepv27_decoder_latency_data_rate_value DLEP_TLV_LINK_MDR_METRIC_RX
value=100000000
dlepv27_decoder_parse_tlv_block last tlv 12; current block_len 88; next tlv 13

*Feb 18 20:15:09.650: dlepv27_decoder_latency_data_rate_value DLEP_TLV_LINK_MDR_METRIC_TX
value=100000000
dlepv27_decoder_parse_tlv_block last tlv 13; current block_len 76; next tlv 14

*Feb 18 20:15:09.650: dlepv27_decoder_latency_data_rate_value DLEP_TLV_LINK_CDR_METRIC_RX
value=100000000
dlepv27_decoder_parse_tlv_block last tlv 14; current block_len 64; next tlv 15

*Feb 18 20:15:09.650: dlepv27_decoder_latency_data_rate_value DLEP_TLV_LINK_CDR_METRIC_TX
value=100000000
dlepv27_decoder_parse_tlv_block last tlv 15; current block_len 52; next tlv 16

*Feb 18 20:15:09.650: dlepv27_decoder_latency_data_rate_value DLEP_TLV_LINK_LATENCY_METRIC
value=250
dlepv27_decoder_parse_tlv_block last tlv 16; current block_len 40; next tlv 18
dlepv27_decoder_rlq_resource_value DLEP_TLV_LINK_RLQ_METRIC_RX value=100
dlepv27_decoder_parse_tlv_block last tlv 18; current block_len 35; next tlv 19
dlepv27_decoder_rlq_resource_value DLEP_TLV_LINK_RLQ_METRIC_TX value=100
dlepv27_decoder_parse_tlv_block last tlv 19; current block_len 30; next tlv 17
dlepv27_decoder_rlq_resource_value DLEP_TLV_LINK_RESOURCES value=100
dlepv27_decoder_parse_tlv_block last tlv 17; current block_len 25; next tlv 20
dlepv27_decoder_mtu_tlv DLEP_TLV_LINK_MTU mtu=100
dlepv27_decoder_parse_tlv_block last tlv 20; current block_len 19; next tlv 8
IPv4 Addr 14.0.0.2dlepv27_decoder_ipv4_address_tlv DLEP_TLV_IPV4_ADDRESS operation=1
dlepv27_decoder_parse_tlv_block last tlv 8; current block_len 10; next tlv 10
IPv4 Subnet Addr 255.255.255.0dlepv27_decoder_ipv4_address_subnet_tlv
DLEP_TLV_IPV4_ATTACHED_SUBNET operation=1 mask=24
dlepv27_decoder_parse_tlv_block last tlv 10; current block_len 0;
*Feb 18 20:15:09.651:
*Feb 18 20:15:09.651: dlepv27_decoder_packet rc(RC_DLEP_OK-0) state 1 signal 0 packet_len
136
Router#

```

Step 5: The router appears to be sending heartbeats 5 seconds apart:

```

*Feb 18 20:15:14.569: dlepv27_decoder_msg_packet DLEP_MSG_PEER_HEARTBEAT(16) data length 0

*Feb 18 20:15:14.569: -curr_state Dlep In-Session State normalized_event=Dlep Peer Heartbeat
Event p2peer=0xFFFF771137A8 peer_id=22 p2neighbor=0x0
*Feb 18 20:15:14.569: dlepv27_decoder_packet rc(RC_DLEP_OK-0) state 2 signal 0 packet_len
4
Router#
*Feb 18 20:15:19.569: dlepv27_decoder_msg_packet DLEP_MSG_PEER_HEARTBEAT(16) data length 0

```



```
*Feb 18 20:15:19.569: -curr_state Dlep In-Session State normalized_event=Dlep Peer Heartbeat
Event p2peer=0xFFFF771137A8 peer_id=22 p2neighbor=0x0
*Feb 18 20:15:19.569: dlepv27_decoder_packet rc(RC_DLEP_OK-0) state 2 signal 0 packet_len
4
Router#
```

Step6: The router is terminating the session, and receiving an acknowledgement of the same:

```
*Feb 18 20:15:24.569: dlepv27_decoder_msg_packet DLEP_MSG_SESSION_TERM(5) data length 5
dlepv27_decoder_status_tlv DLEP_TLV_STATUS status_code=0 desc ()
dlepv27_decoder_parse_tlv_block last tlv 1; current block_len 0;
*Feb 18 20:15:24.569:
*Feb 18 20:15:24.569: -curr_state Dlep In-Session State normalized_event=Dlep Peer Term
Event p2peer=0xFFFF771137A8 peer_id=22 p2neighbor=0x0
*Feb 18 20:15:24.569: -curr_state Dlep Terminating State normalized_event=Dlep Peer Term
ACK Event p2peer=0xFFFF771137A8 peer_id=22 p2neighbor=0x0
*Feb 18 20:15:24.569: dlepv27_encoder_msg_packet_start DLEP_MSG_SESSION_TERM_ACK(6)
*Feb 18 20:15:24.569: dlepv27_encoder_msg_packet_end tlv block size=12 packet length=16
*Feb 18 20:15:24.570: -curr_state Dlep Session Reset State normalized_event=Dlep Peer
sessoin reset Event p2peer=0xFFFF771137A8 peer_id=22 p2neighbor=0x0
*Feb 18 20:15:24.570: -0 Restart all peers on IDB GigabitEthernet0/0/1
*Feb 18 20:15:24.570: dlepv27_decoder_packet rc(RC_DLEP_OK-0) state 2 signal 0 packet_len
9
```

Step 7: An examination of the DLEP config reveals that the heartbeat on the router is set to 5 seconds:

```
Router#show dlep config
DLEP Configuration for GigabitEthernet0/0/1

DLEP Peer Description -
DLEP Version = RFC 8175
DLEP Server IP=14.0.0.3:55555
DLEPv27 TCP Port = 55556
Virtual template=2
Timers (all values are in seconds):
Missed heartbeat threshold=2, Peer Terminate ACK timeout=10
Dlepv27 Applicable configs(in seconds):
Heartbeat interval=5, Discovery interval =5, Session Ack timeout=10
Neighbor activity timeout=0, Neighbor Down ACK timeout=10
```

Step 8: Change the heartbeat to 60 seconds:

```
Router#conf t
Enter configuration commands, one per line. End with CNTL/Z.
Router(config)#int g0/0/1
Router(config-if)#no ip dlep
Router(config-if)#no ip dlep vtemplate
Router(config-if)#no ip dlep vtemplate 2
Router(config-if)#ip dlep set peer-heartbeat-interval 60
Router(config-if)# ip dlep vtemplate 2
Router(config-if)#^Z
```

Step 9: Verify the change fixed the problem:

```
Router#show dlep clients

DLEP Clients for all interfaces:

DLEP Clients for Interface GigabitEthernet0/0/1
DLEP Server IP=14.0.0.3:55555 Sock=0

DLEP Client IP=14.0.0.2:859 TCP Socket fd=1
Peer ID=51, Virtual template=2
```

```

Description: DLEP_RadioSIM2
Peer Timers (all values in milliseconds):
Heartbeat=60000, Dead Interval=120000, Terminate ACK=240000
Neighbor Timers (all values in seconds):
Activity timeout=0, Neighbor Down ACK=10

Supported Metrics:
Link RLQ RX Metric : 100
Link RLQ TX Metric : 100
Link Resources Metric : 100
Link MTU Metric : 100
Link Latency Metric : 250 microseconds
Link CDR RX Metric : 100000000 bps
Link CDR TX Metric : 100000000 bps
Link MDR RX Metric : 100000000 bps
Link MDR TX Metric : 100000000 bps

Router#
*Feb 18 20:38:03.708: %SYS-5-CONFIG_P: Configured programmatically by process Manet Infra
Background from console as console
*Feb 18 20:38:03.712: %LINEPROTO-5-UPDOWN: Line protocol on Interface Virtual-Access3,
changed state to up
*Feb 18 20:38:03.716: %LINK-3-UPDOWN: Interface Virtual-Access3, changed state to up
*Feb 18 20:38:03.722: %LINEPROTO-5-UPDOWN: Line protocol on Interface vmi2, changed state
to up

```

Additional Debug Commands



Note It is recommended to use debug commands only under the guidance of Cisco TAC.

The following commands are available.

DLEP

```

debug dlep server detail
debug dlep timer detail
debug dlep neighbor error
debug dlep neighbor infrastructure detail
debug dlep neighbor infrastructure error
debug dlep neighbor metrics
debug dlep neighbor state
debug dlep neighbor all
debug dlep client error
debug dlep client infrastructure
debug dlep client packet dump
debug dlep client packet detail
debug dlep client state

```

VMI

```

debug vmi bma
debug vmi packet
debug vmi error
debug vmi multicast
debug vmi neighbor
debug vmi registries

```

Virtual Template

```
debug vtemplate cloning
debug vtemplate error
debug vtemplate event
debug vtemplate subinterface
```

PPPOE

```
debug pppoe errors
debug pppoe events
debug pppoe packets
debug pppoe data
```

SSS

```
debug sss error
debug sss event
```

Related Documentation

Additional information can be found in the following resources:

Radio Aware Routing is discussed in this [Cisco white paper](#).

[Internet Engineering Task Force \(IETF\) RFC 8175](#)

