



# Radio-Aware Routing with Cisco ESR6300

Reference Design Guide

December 2023

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# Radio-Aware Routing with Cisco ESR6300

## Introduction

Reliable, secure connectivity is critical in today's industrial networks. The most challenging environments in the world require specialized hardware with robust software capabilities to meet these connectivity needs. This Cisco Reference Design document describes how Cisco's embedded Industrial IoT portfolio, specifically the ESR6300, with its support for Dynamic Link Exchange Protocol (DLEP), can be used in a variety of applications from defense to search and rescue. Focus is paid to how the ESR6300 unique support for DLEP can help maintain connectivity in dynamic, harsh environments, even while on the move.

## Industry Requirements

The Cisco industrial IoT portfolio is designed to work in a broad range of conditions. Embedded routers and switches rely on system integrators to build the enclosures and supporting components to meet the specific requirements of each use case. Requirements can include resistance to dust and water, extreme temperatures, humidity, shock, and vibration. Often these systems also must meet specific requirements for their packaging to fit in small spaces, work with available power, and meet budget constraints.

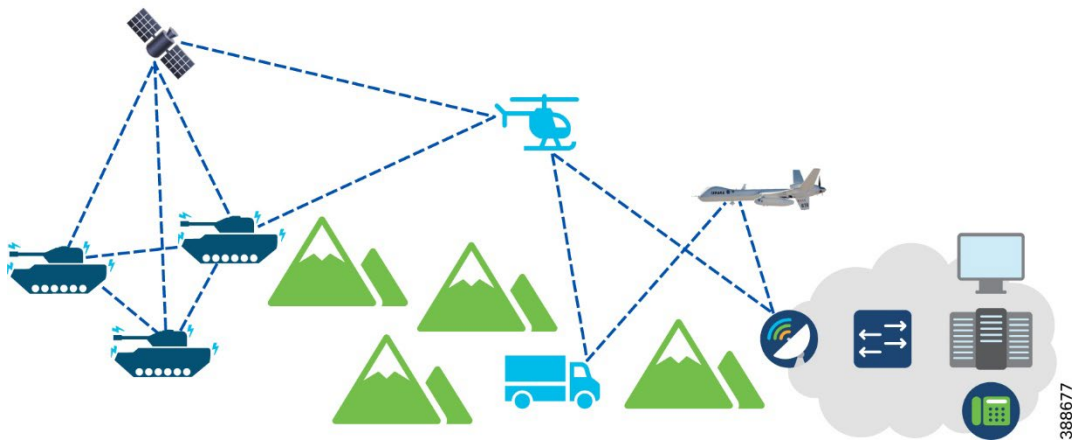
Going beyond the physical requirements, embedded network components may also have requirements around features like encryption, resiliency, data retention, and various protocols to provide interoperability with the larger network.

## Use Cases

### Defense

Defense sector use cases are some of the most challenging for communications networks. A variety of assets needs regular (or constant) communication to be effective. From forward operating bases and soldiers, to armored vehicles, and even aerial drones — each type of asset has unique characteristics and requirements. Military forces often operate in some of the harshest environmental conditions that include extreme temperatures, dust, and moisture, as well as shock and vibration if the asset is on the move.

**Figure 1. Defense Network**



The modern defense force must be able to move dynamically and maintain communications with leadership to relay orders, share intelligence, and achieve operational efficiency. Moving around the land, sea, and air requires that the communications systems in play can adapt to the changing terrain, weather conditions, and spatial locations of the connected assets. In vehicular applications, flight critical systems will typically have their own dedicated communications, but all other systems can leverage a centralized network comprised of embedded routers, switches, and backhaul links.

Wireless networks are essential to maintaining connectivity in battlefield scenarios. Various wireless backhaul technologies such as cellular, satellite (SATCOM), microwave, tropospheric scatter (Tropo) radios, terrestrial line of sight (TriLOS) radios, and more can all be leveraged to connect assets over long distances. Mobile Ad-hoc Networks (MANET) are ideal for dynamic environments such as this where the network may look different from one moment to the next. They can leverage radio-aware routing to make intelligent path selections based on the current wireless environment conditions.

Security is top of mind in defense applications to ensure that operations, personnel, intelligence, and other assets are not compromised. Data must be secured both on devices as well as in flight over wireless communication methods to prevent adversaries from being able to make use of any data they may obtain.

All of these requirements must be met in a package which meets stringent size, weight, and power

specifications (SWaP) as more and more technology is added into modern tactical assets each year. US Department of Defense (DoD) applications also commonly require Trade Agreement Act (TAA) compliance to ensure that the equipment it uses is sourced from designated countries.

### Emergency Response and Public Safety

In an emergency response situation where the normal infrastructure has been destroyed, communications play a crucial role in coordinating efforts, disseminating information, and providing assistance to affected areas. Without reliable communication channels, responders would struggle to effectively organize their operations, leading to delays and inefficiencies that can hinder life-saving efforts. Therefore, establishing a functional and resilient communication network becomes paramount.

One key aspect of an emergency response communication system is its ability to work on the move. Responders need to have access to communication tools and devices that can be easily deployed as they navigate through different areas. This ensures that they can maintain constant connectivity while being mobile, enabling them to communicate with other team members, receive real-time updates, and coordinate their actions accordingly. Whether it is handheld radios, satellite phones, or small-scale cellular towers, the availability of on-the-move communication infrastructure is vital for efficient emergency response operations.

Mobile Communications Centers, as defined by the [Federal Emergency Management Agency \(FEMA\)](#), are self-contained units designed to provide critical communication support during emergency response operations. These centers are typically equipped with advanced communication systems, satellite capabilities, and various technologies to facilitate seamless and reliable information exchange in disaster-affected areas. They are deployed to disaster zones to establish and maintain communication links, allowing responders and incident commanders to coordinate their actions effectively.

These centers are equipped with specialized equipment, including radio systems, satellite dishes, antennas, and other networking equipment, to ensure connectivity and enable reliable communication. The primary purpose of Mobile Communications Centers is to establish a communication backbone that supports various response agencies and personnel operating on the ground. These centers serve as command posts, enabling incident commanders to gather and analyze real-time information, make informed decisions, and coordinate the deployment of resources and assets. They facilitate the exchange of critical data, such as situational updates, resource requests, and emergency notifications, among different response entities involved in the disaster response.

**Figure 2. Cisco NERV Truck and example of a Mobile Communications Center**



Mobile Communications Centers are designed to be mobile and rapidly deployable to disaster-impacted areas. They are equipped with power generators, fuel supplies, and other necessary resources to ensure self-sufficiency in remote or damaged locations where the normal infrastructure may be compromised or unavailable. These centers are staffed by trained personnel who specialize in communication operations and support the effective utilization of the deployed communication systems.

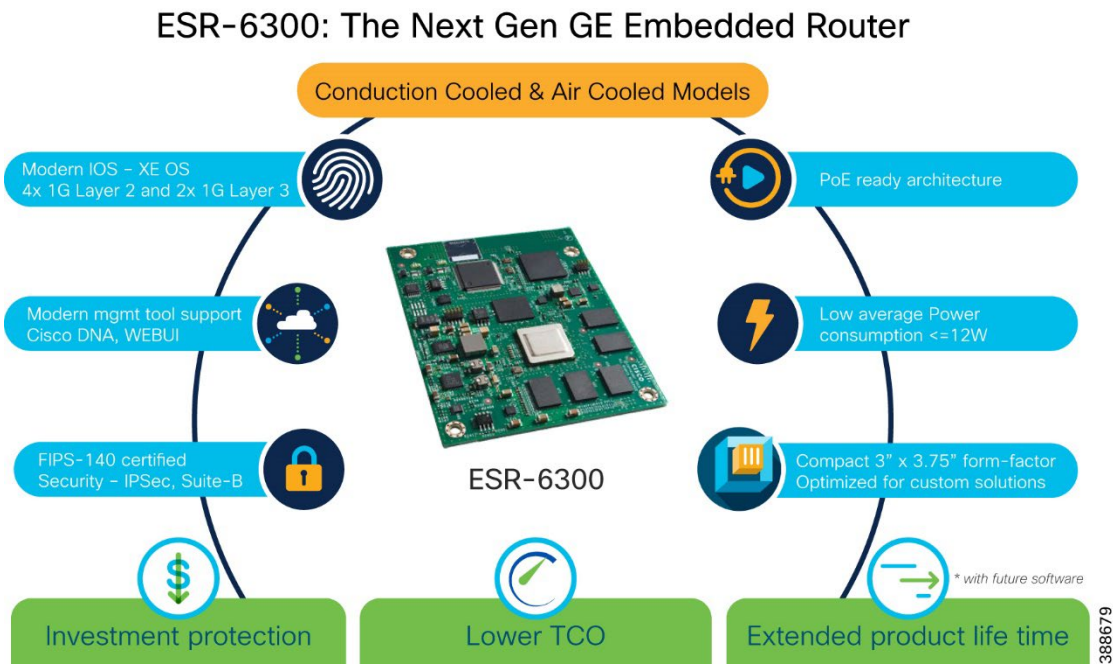
Additionally, a robust emergency communication network must support different types of backhaul connectivity technologies. Since the normal infrastructure is destroyed, traditional wired connections may not be available. Therefore, alternative backhaul options such as satellite, microwave, or even mesh networks need to be utilized.

# Network Components

## Cisco ESR6300 Embedded Series Router

The Cisco ESR6300 router is designed to meet the demanding needs of unique use cases and harsh environments. The embedded router is designed for third party integrators to build into other systems that provide the physical interface connections, power, cooling, and physical enclosure. This section covers the hardware specifications for the ESR6300 including details for how it integrates with external components and highlights the software functionality that is available.

**Figure 3. ESR6300 - The Next Gen GE Embedded Router**







The table below summarizes the key hardware and physical specifications for the Cisco ESR6300:

**Table 1. Cisco ESR6300 System Specifications**

Specification	Detail
CPU, Memory, and Storage	CPU - QUAD core 1.2GHz Memory - 4GB DDR4 with ECC Storage - 8GB eMMC with 4GB available (pseudo SLC mode)
Ethernet Ports	4 x Layer 2 - Gigabit Ethernet copper port (integrator's carrier board supplies the magnetics and optional PoE controller)  2X RJ45/SFP (Layer 3-Gigabit Combo Ports - integrator's carrier board supplies the magnetics)
Serial Ports	1x EIA 232 Async
Board Dimensions	3.0" x 3.775" (76.2mm x 95.885mm)
Mass	81 grams
Mounting	SAMTEC SEAF-40-05.0-S-06-2-A-K 240-pin female connector and 4 holes sized for 4-40 screws roughly at the 4 corners of the board
Power Input	+5Vdc 2.2A max (+/- 5%) and +3.3Vdc 0.5A max (+/- 3%)
Typical Power Consumption (Maximum)	5.0W typical at idle, at +77F (+25C) 7.5W typical with full traffic, at +158F (+70C) 12W max with full traffic, over full temperature range -40 to 158F

For more information on the ESR6300 specifications, refer to the datasheet:

<https://www.cisco.com/c/en/us/products/collateral/routers/datasheet-c78-742901.html>

#### Embedded Platform Integration

The demanding use cases that the ESR6300 and other Cisco embedded platforms are designed for typically have unique and stringent requirements. To best suit these requirements, Cisco provides the ESR6300 hardware and software with the necessary interfaces, features, and documentation that an integrator will need to build the router into the end system. This end system built by the integrator will provide the physical interfaces, environmental protections, cooling, power, and other specific specifications that are needed for a particular application. Working with an integrator allows end users to have the robust IOS-XE feature set available in a package that can survive whatever working conditions the use case presents.

#### Software Features, Ordering and Licensing

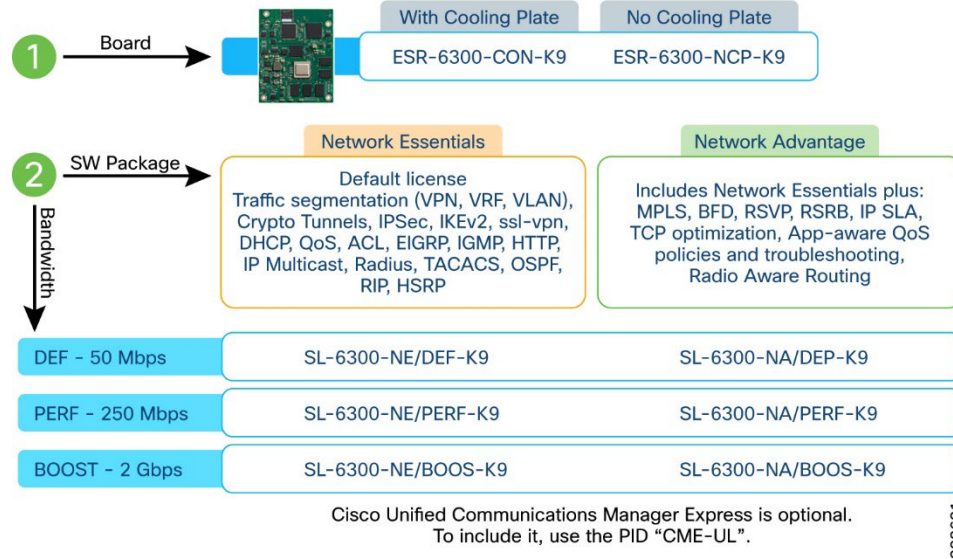
When ordering the Cisco ESR6300, three choices must be made:

- Hardware configuration – with or without built-in cooling plate
- Software package – Network Essentials or Network Advantage
- Bandwidth level – Default (50 Mbps), Performance (250 Mbps), or Boost (2 Gbps)

The diagram below summarizes the available options for the ESR6300.

Figure 5. ESR6300 Licensing

## ESR-6300 Licensing/Ordering



*Note: A Network Advantage license is required to support Radio-Aware Routing functionality, including DLEP.*

### Cisco Embedded Services 3300 Series Switches

Cisco Embedded Services 3300 Series Switches feature the same ability as the ESR6300 routers to be integrated into third party systems to meet the strict requirements of defense and other use cases. The ESS3300 is often used alongside the ESR6300 to provide up to an additional 24 Gigabit and 2 Ten Gigabit ethernet ports for connecting various subsystems and devices. Connectivity from the ESR6300 can be extended to the ESS3300 with VLANs to provide segmentation between subnets and groups of devices.

### Radios

The Cisco ESR6300 support for DLEP technology is agnostic to the type of WAN radios that are used. While some examples of possible wireless radios include cellular, microwave, satellite, and laser – any radio system that supports the DLEP protocol will work with the ESR6300.

For users to become familiar with using DLEP, they can leverage the MIT Lincoln Laboratory DLEP simulator software, which is freely available on Github at this link: <https://github.com/mit-ll/LL-DLEP>. This software will simulate a radio modem that supports the DLEP protocol. The simulated radio modem can be connected to the ESR6300 and used to test DLEP functionality in a lab environment before deploying the network with real wireless radios.

The second half of this document covers the detailed setup and configuration of a test network based on the ESR6300 router, and the Lincoln Lab DLEP simulator.

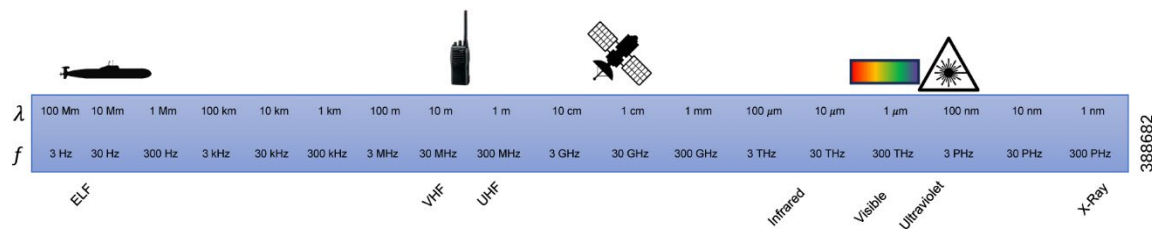
# Architecture and Best Practices

## Technology Overview

### Mobile Ad-hoc Networks (MANET)

Mobile Ad-hoc Networks (MANET) describe wireless mesh networks that are dynamic in nature as the network nodes are moving around in environments that have changing RF conditions from moment to moment. These networks can be built with a wide variety and mix of wireless backhaul technologies. These wireless radios can span the electro-magnetic spectrum from ELF for submarine communication, all the way up to laser wavelengths for line-of-sight applications. Regardless of the underlying radio technology, the network needs to be reliable and resilient, able to independently adapt to the current operating conditions.

**Figure 6. Wireless Communications across the Electromagnetic Spectrum**



### Radio-Aware Routing

Each of the nodes (or routers) in a MANET network needs to have visibility into the radio to provide optimal routing and reconvergence as the conditions change. Radio-aware routing (RAR) refers to giving the router detailed information about the attached radio uplink(s) in terms of connectivity to far end radios, signal quality, bandwidth, and other metrics. This communication between the router and radio allows the router to immediately make changes to the routing path selection when a radio connection is made or lost, instead of waiting for upper layer protocols which are dependent on timers to detect the change. Link quality can also be evaluated to make routing decisions more intelligent – going beyond just whether a link is up or down.

Other benefits of RAR include reducing the impact on radio equipment by minimizing the need for internal queuing or buffering by implementing flow control, and it contributes to a consistent quality of service for networks with multiple radios. Existing routing protocols like OSPFv3 and EIGRP can be utilized in conjunction with RAR by adjusting routing metrics as the network conditions change.

Cisco has implemented two options for the ESR6300 router to communicate to connected radios for RAR functionality:

RFC-5578 – “PPP over Ethernet Extensions for Credit Flow and Link Metrics”

RFC-8175 – Dynamic Link Exchange Protocol

The sections that follow describe these two options. RFC-5578 is only covered at a high level, and RFC-8175 is covered in detail in this document.

Figure 7. RAR Protocols Comparison

## RAR Protocols - Comparison

Feature	RFC 5578	Dynamic Link Exchange Protocol (DLEP)
Transport	Point-to-Point Protocol over Ethernet (PPPoE)	TCP
Packet Transport	Point-to-Point Point-to-Multipoint	Broadcast Multi-access
Flow Control	Credit or Rate-based	Rate-based
Convergence Events	Yes	Yes
Metrics	Defined in RFC 5578	Same metrics as RFC 5578
Modem Support	Split-stack PPPoE to router	UDP for neighbor discovery / TCP for radio to router messages Transparent bridge on data path
RFC Status	Informational	Standards-track
Supports Modem Multiple Hops from Router	No, PPPoE discovery is broadcast	Yes

The actual choice of protocols is largely dependent on the radio vendor and the intended applications and optimization of their devices. RFC 5578 primarily for TDMA style radios and RFC 8175 is primarily for multi-access shared media radios that is very similar to WiFi.

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*Note: In either case, RFC-5578 or RFC-8175, both the router and modem must include support for the feature.*

### RFC-5578 – PPP over Ethernet (PPPoE) Extensions for Credit Flow and Link Metrics

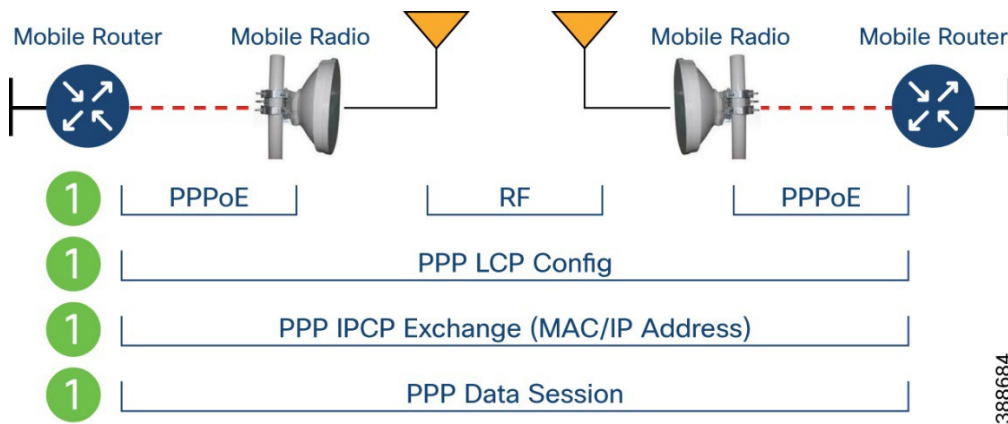
This solution, based on Internet Engineering Task Force (IETF) Request for Comments (RFC) 5578, employs PPP over Ethernet (PPPoE) sessions to facilitate intranodal communications between a router and a compliant device, such as a mobile radio or satellite modem. A PPPoE session is established between router and radio on behalf of every other router/radio neighbor. Once these PPPoE sessions are established, a PPP session is established end to end. This protocol is particularly suited for TDMA style radios.

**Cisco Radio Aware Routing (RAR) using RFC 5578 is specifically targeted at routing over directional radio networks that are built with point-to-point links.**

From the abstract of the RFC Document:

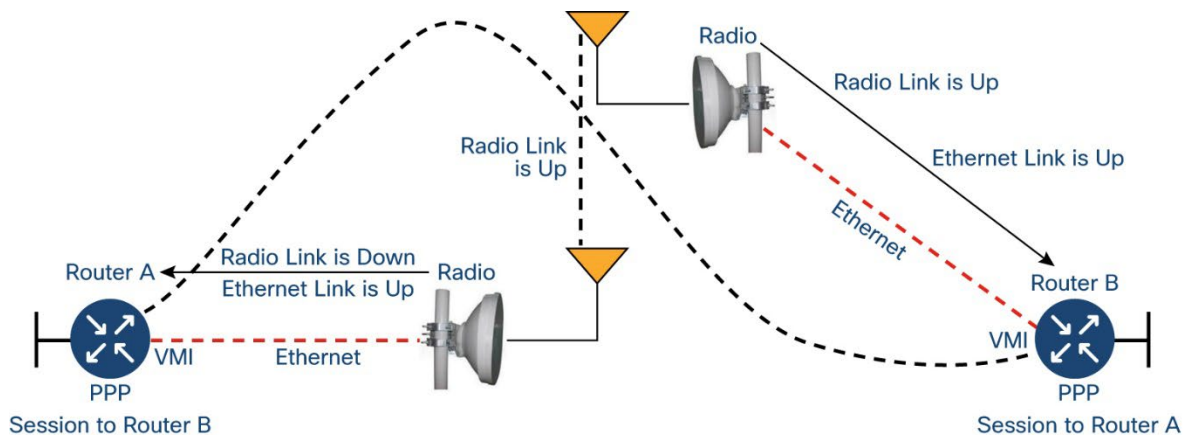
*“This document extends the Point-to-Point Protocol over Ethernet (PPPoE) with an optional credit-based flow control mechanism and an optional Link Quality Metric report. These optional extensions improve the performance of PPPoE over media with variable bandwidth and limited buffering, such as mobile point-to-point radio links.”*

Figure 8. RFC5578 Signaling Components



- **Neighbor Up/Down Signaling:** Enables Cisco routers to provide faster network convergence by reacting to link status signals generated by the radio, rather than waiting for protocol timers to expire. The routing protocols (OSPFv3 or EIGRP) respond immediately to these link status signals by expediting adjacency formation or tear-down.
- **Link Quality Metrics Reporting:** The PPPoE protocol has been extended to enable a radio to report link quality metric information to a router. Cisco routers have been enhanced so that OSPFv3 or EIGRP routing protocols can factor link quality metrics into route cost calculations.
- **PPPoE Credit-Based Flow Control:** This PPPoE extension allows a receiver to control the rate at which a sender can transmit data for each PPPoE session, so that the need for queuing in the radio is minimized.

Figure 9. RFC5578 Example Messaging



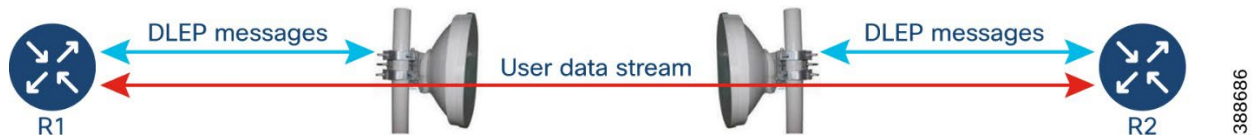
## RFC-8175 – Dynamic Link Exchange Protocol (DLEP)

## Overview

Dynamic Link Exchange Protocol is defined in RFC-8175 which states in its abstract:

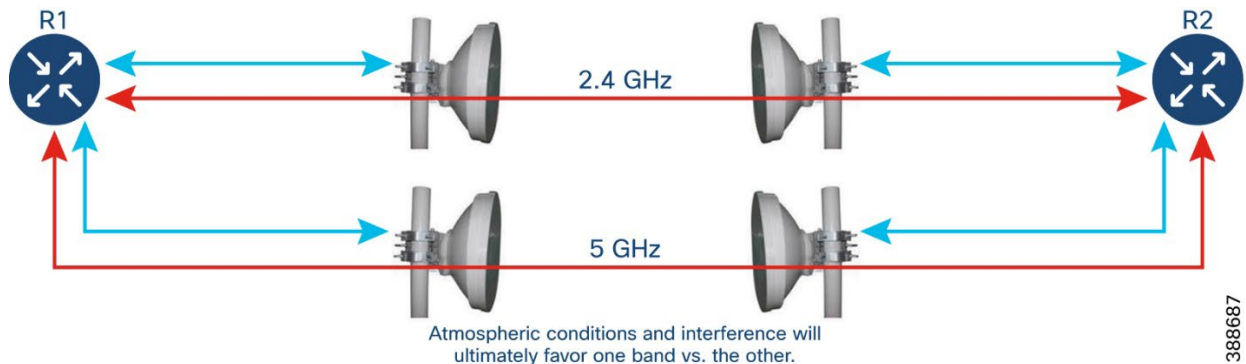
*When routing devices rely on modems to effect communications over wireless links, they need timely and accurate knowledge of the characteristics of the link (speed, state, etc.) in order to make routing decisions. In mobile or other environments where these characteristics change frequently, manual configurations or the inference of state through routing or transport protocols does not allow the router to make the best decisions. This document introduces a new protocol called the Dynamic Link Exchange Protocol (DLEP), which provides a bidirectional, event-driven communication channel between the router and the modem to facilitate communication of changing link characteristics.*

**Figure 10. DLEP Messaging between Router and Radio**



DLEP is a protocol running between a router and a connected radio modem, both of which must support the protocol. The bi-directional communication between router and locally connected radio exchange information about the quality of the link. The DLEP signaling does not traverse the wireless radio link to another remote radio and router. User traffic will be forwarded out the router's wired connection to the attached radio, and over the wireless link to the far side.

**Figure 11. Routers with two DLEP-enable wireless links**



In the simple setup above, the two routers are connected by two wireless interfaces, operating on different bands (2.4 and 5 GHz). Without DLEP, the two links would appear as equal cost paths to the router which has no visibility into the current RF conditions that impact the link quality. Using DLEP, the attached radios can relay information about the signal strength, noise levels, and more to the router in real time so it can favor the better link as conditions change. This information from the radio can also be fed into the router's Quality of Service policy to adjust the traffic shaping as required.

## Interfaces

### Virtual Multipoint Interface (VMI)

The VMI interface acts as an umbrella interface for all virtual access interfaces, which 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.

Generally, one VMI is created for each physical interface connected to an external DLEP radio.

### Virtual Template (VT)

Virtual Template serves as the template for every Virtual Access interface. Additionally, any quality of service policy can be assigned to this interface, affecting the related virtual access interfaces.

### Virtual Access (VA) interface

One VA is created dynamically based on the Virtual Template, for each DLEP Neighbor (Radio) 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)

## DLEP Configuration Modes

There are different configuration modes for DLEP. These define the way that the router and radio find and communicate with each other.

- ✓ Discovery mode with well-known multi-cast address [RECOMMENDED]
- ✓ Discovery mode without well-known multi-cast address
- ✓ Client/Server templates with port base
- ✓ Dynamic port on server with port-based client

Currently, only the first mode (discovery with well-known multicast address) is used in radios on the market. Other configuration modes can be useful in test scenarios with radio simulators for example.

Generalized TTL Security Mechanism (GTSM), defined in RFC 5082, is optional and can be used with any of the four configuration modes for additional security by modifying the TTL of egress packets to help prevent spoofing and other attacks.

## Metrics

DLEP will periodically gather information about the current state of the radio link and relay this information to the router. These metrics can be used to dynamically adjust quality of service or routing protocol behavior.

- Maximum Data Rate (MDR): The theoretical maximum data rate of the radio link.
- Current Data Rate (CDR): The current data rate achieved on the link.
- Latency: The transmission delay packets encounter, in milliseconds.



- Resources: A percentage (0 to 100) that can represent the remaining amount of a resource (such as battery power).
- Relative link quality: A numeric value (0 to 100) representing relative quality, with 100 being the highest quality.

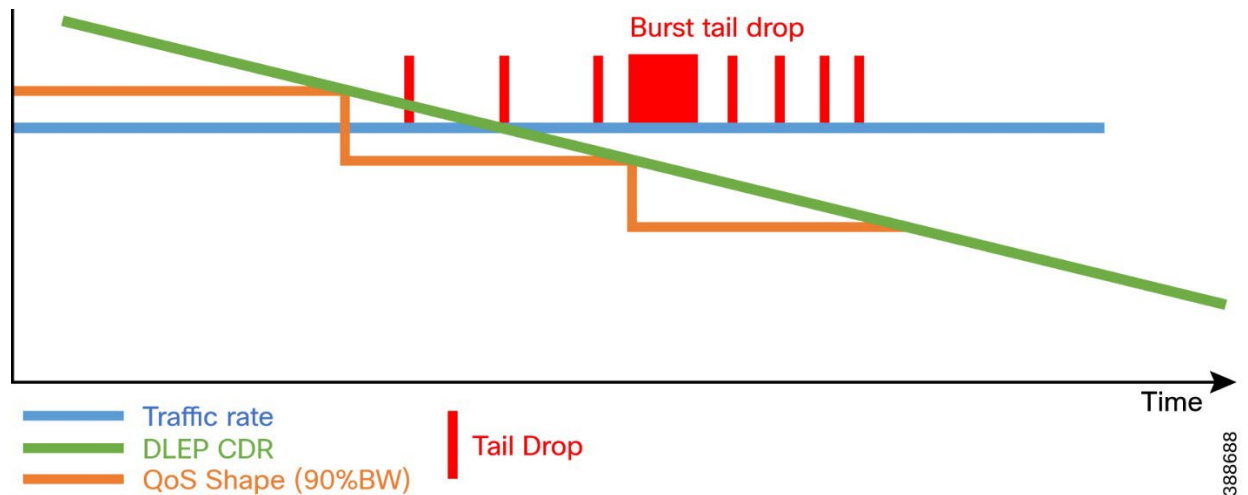
### Quality of Service

The DLEP protocol running on an IOS-XE interface can relay the current data rate (CDR metric) to the QoS process for the purpose of dynamically adjusting the shape rate.

A QoS policy is defined and associated with the VMI interface for the WAN connection (DLEP radio).

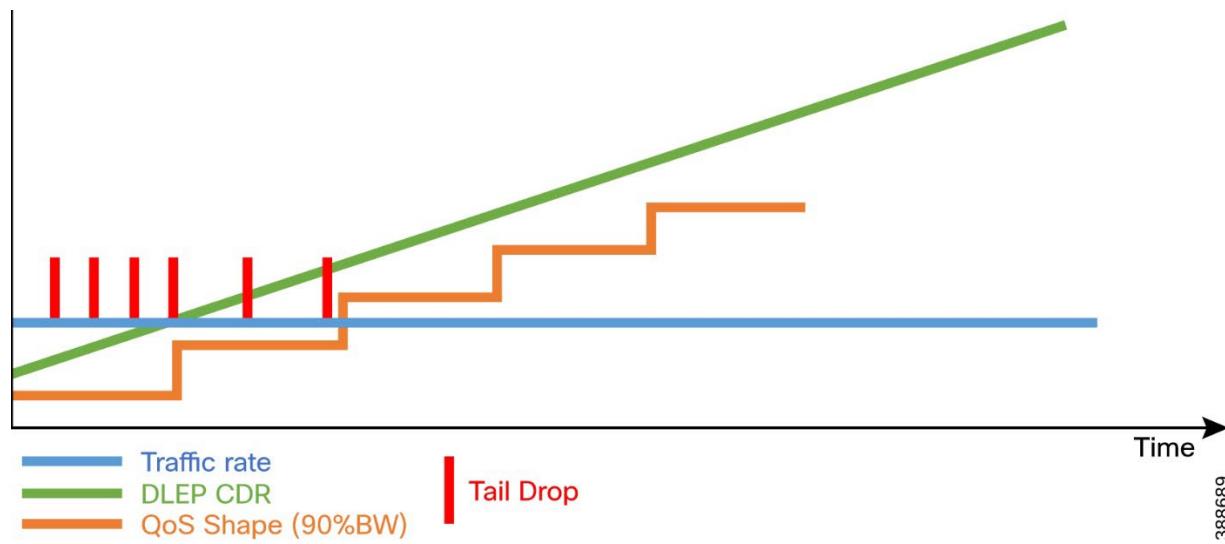
As depicted in the diagram below, when the DLEP reported CDR goes down over time (meaning RF conditions are worsening), the router QoS policy will cause the queue limit, and thereby the shape rate to adjust dynamically to maintain the 90% of interface bandwidth (as configured). When the traffic rate destined out the interface towards the DLEP radio exceeds the shape rate, IOS-XE will use a tail drop to remove the extra packets.

**Figure 12. QoS Tail drop events with CDR change**



When the RF signal improves over time, the QoS shape rate increases based on the DLEP reported CDR again to the point where the actual traffic rate is less than the shape rate, and no tail drops are required.

Figure 13. DLEP CDR Increasing vs. QoS



The queue limit is calculated with visible bandwidth.

$$\text{queue-limit} = (\text{visible bandwidth} / 8 \text{ bits}) * 50\text{mS} / \text{MTU}$$

QoS shape rate depends on DLEP CDR; when CDR change up to the threshold, it will reset QoS rate.

Tail drop will depend on QoS shape rate and real wired traffic rate. When the traffic rate is larger than QoS shape rate, there will be tail drop. When the CDR decreases, the visible bandwidth will decrease, and the queue-limit will decrease. The queue limit impacts the latency for a packet arriving to a nearly full queue. The QoS queue limit depends on the QoS shape rate. If there is tail drop and then queue limit decrease, there will be burst tail drop. If queue limit is configured, it will not change, there will not be burst tail drop.

[https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/qos\\_mqc/configuration/xs-16-8/qos-mqc-xe-16-8-book/qos-scheduling.html](https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/qos_mqc/configuration/xs-16-8/qos-mqc-xe-16-8-book/qos-scheduling.html)

[https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/qos\\_mqc/configuration/xs-16-8/qos-mqc-xe-16-8-book/qos-limits-wred.html](https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/qos_mqc/configuration/xs-16-8/qos-mqc-xe-16-8-book/qos-limits-wred.html)

*Note: While DLEP can be used influence QoS, it will not be covered in the lab portion of this document.*

#### *OSPFv3 and EIGRP Compatibility*

The VMI interface is unique in that it can utilize the DLEP metrics to update OSPFv3 and EIGRP routing protocols' own metrics for the purpose of determining the best path across the network. This results in automatic and fast reconvergence if the network topology changes. This is especially important in a MANET environment where the topology can be changing constantly as network nodes move around and radio signal quality is fluctuating.

For OSPFv3, in addition to relaying DLEP metrics, this compatibility includes other improvements geared towards optimizing performance in MANET use cases:

- Tightly couples OSPFv3 with Radio Aware Routing (RAR)-compliant radios to provide faster convergence and reconvergence through neighbor presence indications and help determine accurate, real-time link metric costs.
- Minimizes OSPFv3 packet size by implementing incremental hellos.
- Minimizes the number of OSPFv3 packet transmissions by caching multicast link-state advertisements (LSAs).
- Implements optimized flooding (overlapping relay) functionality to minimize the number of flooded LSAs.
- Implements selective peering to reduce the OSPF network overhead by minimizing the number of redundant full adjacencies that an OSPF node maintains.

OSPFv3 and EIGRP receive raw radio-link data and computes a composite. In computing these metrics, you should consider these factors:

- Maximum data rate--the theoretical maximum data rate of the radio link, in bytes per second
- Current data rate--the current data rate achieved on the link, in bytes per second
- Resources--a percentage (0 to 100) that can represent the remaining amount of a resource (such as battery power)
- Latency--the transmission delay packets encounter, in milliseconds
- Relative link quality (RLQ)--a numeric value (0 to 100) representing relative quality, with 100 being the highest quality

You can weight metrics during the configuration process to emphasize or de-emphasize particular characteristics. For example, if throughput is a particular concern, you can weight the current data rate metric so that it is factored more heavily into the composite metric. Similarly, you can omit a metric that is of no concern from the composite calculation.

Link metrics can change rapidly, often by very small degrees, which can result in a flood of meaningless routing updates. In a worst-case scenario, the network churns almost continuously as it struggles to react to minor variations in link quality. To alleviate this concern, you can use a tunable dampening mechanism to configure threshold values. Any metric change that falls below the threshold is ignored.

With the tunable hysteresis mechanism, you can adjust the threshold to the routing changes that occur when the router receives a signal that a new peer has been discovered, or that an existing peer is unreachable. The tunable metric is weighted and is adjusted dynamically to account for these characteristics:

- Current and maximum bandwidth
- Resources
- Latency
- Hysteresis

You can deconfigure individual weights and clear all weights so that the cost is returned to the default value for the interface type. Based on the routing changes that occur, the cost can be determined by the application of these metrics.

[https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mob\\_ntwks/configuration/xe-17-2/mob\\_ntwks-xe-17-book/imo-adhoc-ospfv3-ext.html](https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mob_ntwks/configuration/xe-17-2/mob_ntwks-xe-17-book/imo-adhoc-ospfv3-ext.html)

[https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mob\\_ntwks/configuration/xe-17-2/mob\\_ntwks-xe-17-book/imo-eigrp-dyn-metrics-calc.html](https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/mob_ntwks/configuration/xe-17-2/mob_ntwks-xe-17-book/imo-eigrp-dyn-metrics-calc.html)

# Implementing DLEP Testbed with Cisco ESR6300 and Radio Simulator

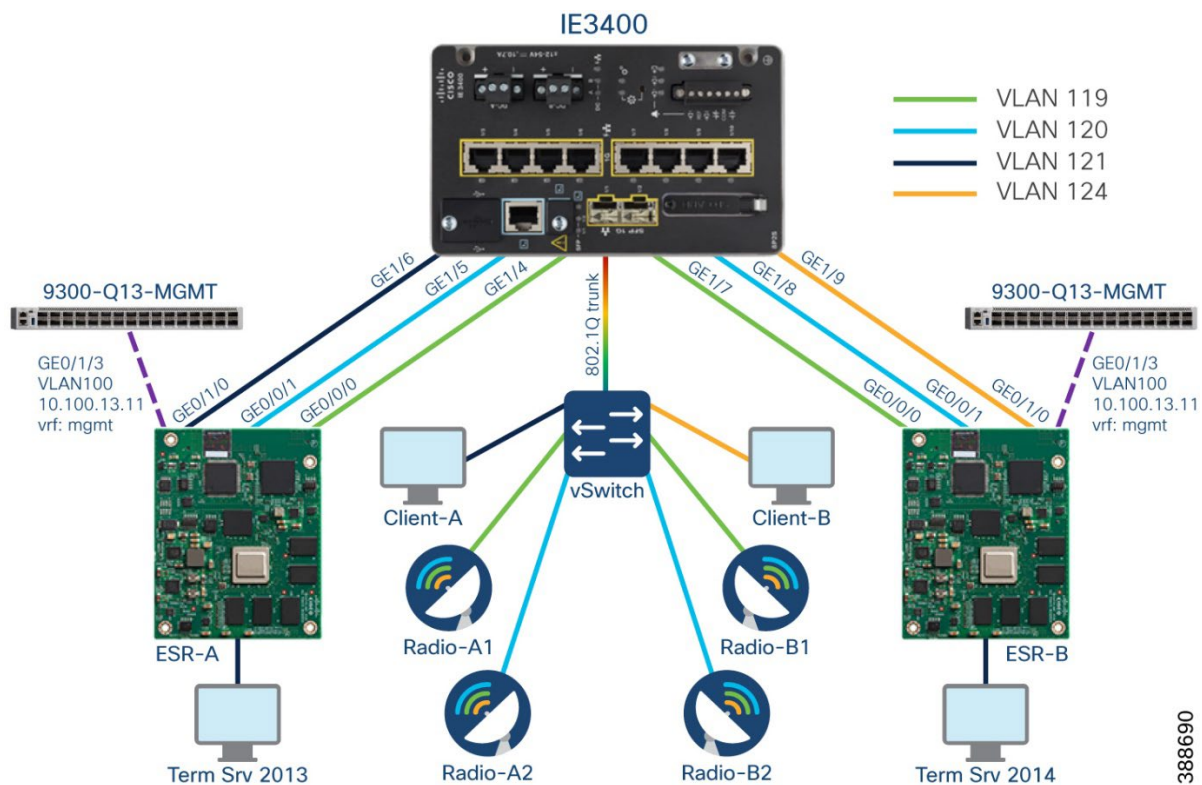
## Introduction

This section documents the steps required to build a lab environment for demonstrating the operation of DLEP with the Cisco ESR6300. Setting up a DLEP lab requires the use of radios to connect the various routers in the network. Real over-the-air radios can be expensive and difficult to use in an indoor environment, therefore this document utilizes a [simulated radio from MIT Lincoln Labs](#) that is able to communicate with the Cisco routers with DLEP.

The lab environment consists of two Cisco ESR6300 routers, four simulated radios running as virtual machines, and a Cisco switch to provide wired connectivity. Optionally, client computers can also be connected behind the routers to perform connectivity tests.

The physical topology of the lab environment is shown below. The various ethernet links between devices are color coded to denote different VLANs on the Cisco IE3400 switch and VMware vSwitch.

Figure 14. DLEP Lab Physical Topology



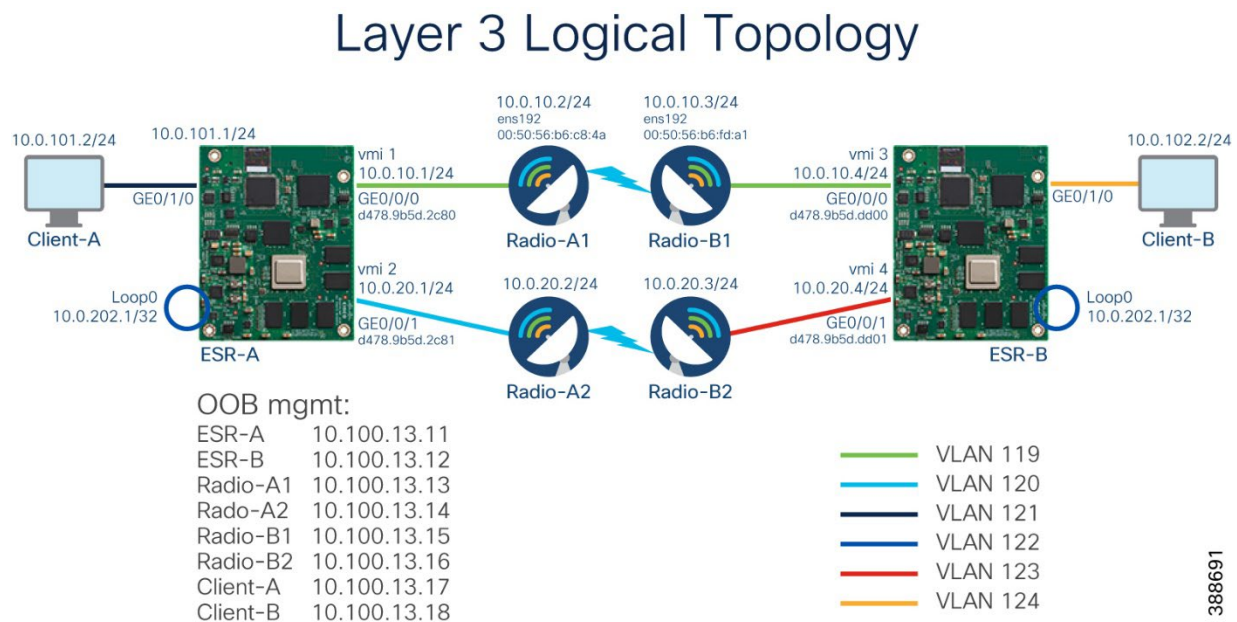
The following hardware components and software versions were used in creating this document. Other software versions and combinations are likely to work but have not been verified in this environment.

**Table 2. Validated Hardware and Software Details**

Place in Network	Hardware	Software	Notes
<b>Router</b>	Cisco ESR6300 EVK (qty 2)	IOS-XE 17.13.1	
<b>Radio</b>	Ubuntu 16.04 LTS virtual machine (qty 4) <ul style="list-style-type: none"> <li>- 2 vCPU</li> <li>- 8 GB RAM</li> <li>- 30 GB disk</li> <li>- 2 vNIC</li> </ul>	MIT Lincoln Labs “LL-DLEP” simulator Release 2.1	<a href="https://github.com/mit-ll/LL-DLEP/tree/master">https://github.com/mit-ll/LL-DLEP/tree/master</a>
<b>Hypervisor</b>	Cisco UCS C220-M3S	VMware ESXi 6.7	
<b>Switch</b>	Cisco IE3400	IOS-XE 17.13.1	

The subsections that follow go through the detailed process of installing and configuring the relevant components in the lab, based on the local topology below. Refer to this diagram to better understand how the interface names, IP addresses, and MAC address are used in the configuration, operation, and verification of the DLEP lab.

**Figure 15. DLEP Lab Logical Topology**



*\*Note: The logical diagram above shows an “over-the-air” connection between radios A1 and B1, for example. In reality, all connections are wired. Both routers’ Gig0/0/0 interfaces and Radio-A1 / B1 “ens192” interfaces are connected to the same VLAN, which provides connectivity between devices.*

## Building the MIT Lincoln Labs DLEP Simulator virtual machines

1. Start by creating virtual machines in your hypervisor and installing the base operating system. Lincoln Lab recommends one of the following versions, but newer releases should also work:
  - Ubuntu Linux version 14.04 LTS
  - Ubuntu Linux version 16.04 LTS
  - CentOS 7
  - CentOS 6
  - Mac OS X (10.12.6)

Other teams within Cisco have successfully used Ubuntu 20.04 LTS.

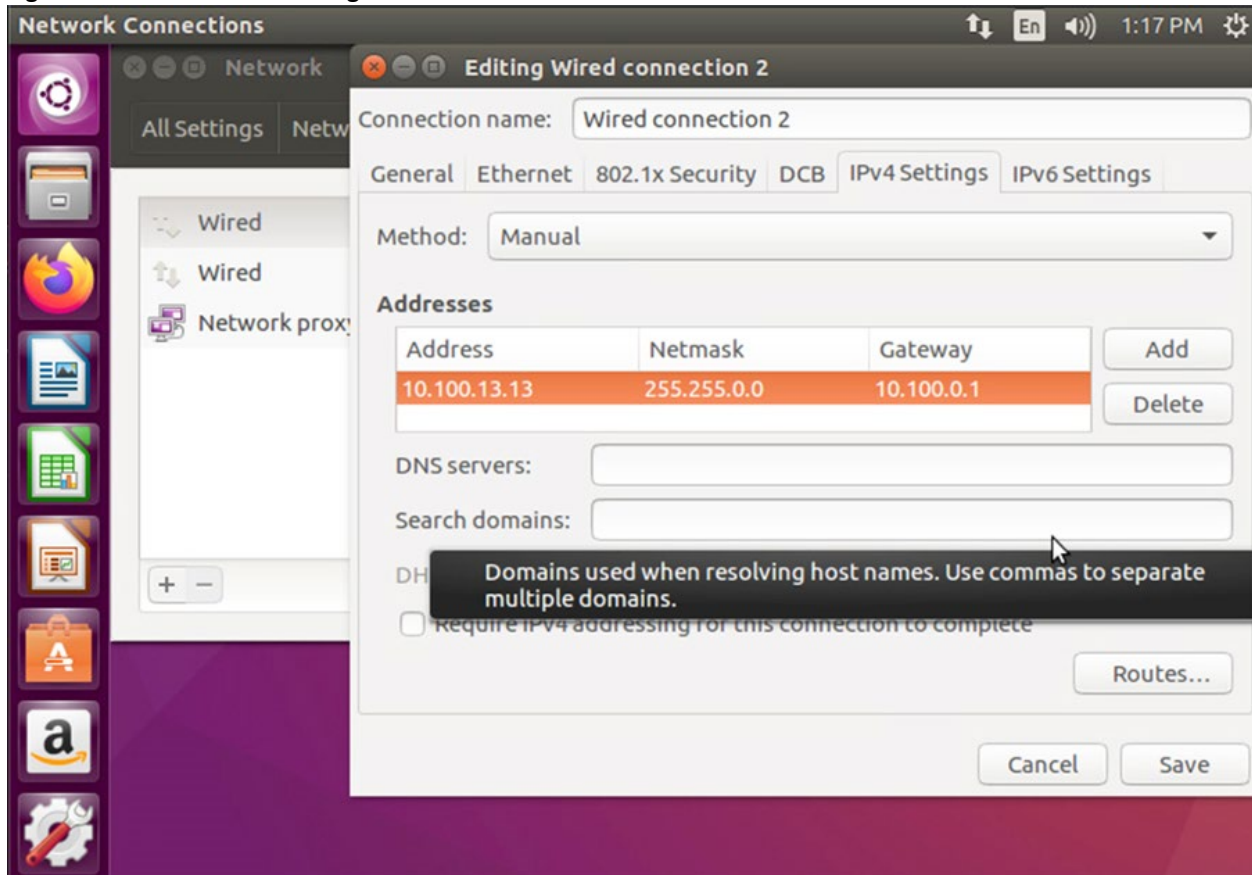
Throughout this document [Ubuntu 16.04 LTS \(Desktop\)](#) was used. Details for installing the OS in the hypervisor are beyond the scope of this document.

When creating the VM and installing the OS, it is recommended to configure two network interfaces (naming can vary depending on OS, etc):

- ens160 – used for out of band (OOB) management of the VM/radio. This interface has internet access for downloading software and updates, and is used for remote access (SSH).
- ens192 – used for connection to the switched network, and ultimately the Cisco ESR6300.

Use the OS settings to configure the interfaces with IP address, mask, gateway, and DNS.

**Figure 16. Linux Network Configuration**



2. After network connectivity is established, ensure the OS has installed latest updates:

```
sudo apt-get update
```

3. Install all required libraries and dependencies for the Lincoln Labs DLEP (LL-DLEP) software:

```
sudo apt install libboost-thread-dev libboost-system-dev libboost-test-dev libxml2  
libxml2-dev libxml2-utils libreadline6-dev libprotobuf-dev protobuf-compiler doxygen  
graphviz cmake git build-essential
```

4. Create a new directory and install LL-DLEP software from Github:

```
cd ~  
  
mkdir dlep-top  
  
cd dlep-top/  
  
git clone https://github.com/mit-ll/LL-DLEP  
  
cd LL-DLEP/build/  
  
cmake ..  
  
make  
  
sudo make install
```

5. Verify the software is installed and accessible from the user's path:

```
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$ which Dlep  
  
/usr/local/bin/Dlep
```

## Configure Cisco IE3400 and ESR6300 for basic connectivity

6. Configure Cisco IE3400 switch by creating VLANs and assigning them to interfaces:

```
vlan 119-124  
  
interface GigabitEthernet1/3  
description Cisco UCS-C220-M3S  
switchport mode trunk  
  
interface GigabitEthernet1/4  
description ESR-A GE0/0/0  
switchport access vlan 119  
speed 1000  
  
interface GigabitEthernet1/5  
description ESR-A GE0/0/1  
switchport access vlan 120  
speed 1000
```



```
interface GigabitEthernet1/6
  description ESR-A GE0/1/0
  switchport access vlan 121
  speed 1000
```

```
interface GigabitEthernet1/7
  description ESR-B GE0/0/0
  switchport access vlan 119
  speed 1000
```

```
interface GigabitEthernet1/8
  description ESR-B GE0/0/1
  switchport access vlan 120
  speed 1000
```

```
interface GigabitEthernet1/9
  description ESR-B GE0/1/0
  switchport access vlan 124
  speed 1000
```

Configure ESR-A basic connectivity:

```
!
hostname ESR-A
!
ip vrf mgmt
!
ip multicast-routing distributed
ip name-server 8.8.8.8
ip name-server vrf mgmt 8.8.8.8
ip domain name cisco.com
!
interface Loopback0
  ip address 10.0.201.1 255.255.255.255
  ipv6 enable
!
interface GigabitEthernet0/0/0
  description Radio-A1
```

```
ip address 10.0.10.1 255.255.255.0
negotiation auto
ipv6 enable
!
interface GigabitEthernet0/0/1
description Radio-A2
ip address 10.0.20.1 255.255.255.0
negotiation auto
ipv6 enable
!
interface GigabitEthernet0/1/0
switchport access vlan 121
!
interface GigabitEthernet0/1/1
!
interface GigabitEthernet0/1/2
!
interface GigabitEthernet0/1/3
switchport access vlan 100
!
interface Vlan100
ip vrf forwarding mgmt
ip address 10.100.13.11 255.255.0.0
!
interface Vlan121
description Client-A
ip address 10.0.101.1 255.255.255.0
!
interface Async0/2/0
no ip address
encapsulation scada
!
ip forward-protocol nd
ip tftp source-interface Vlan100
ip ftp source-interface Vlan100
ip ftp username cisco
```

```
ip ftp password cisco,123
ip http server
ip http authentication local
ip http secure-server
ip http client source-interface Vlan1
!
ip route vrf mgmt 0.0.0.0 0.0.0.0 10.100.0.1
!
!
!
line con 0
  exec-timeout 0 0
  stopbits 1
  speed 115200
line vty 0 4
  exec-timeout 360 0
  login local
  transport input all
!
```

**Configure ESR-B basic connectivity:**

```
!
hostname ESR-B
!
ip vrf mgmt
!
ip multicast-routing distributed
ip name-server 8.8.8.8
ip name-server vrf mgmt 8.8.8.8
ip domain name cisco.com
!
interface Loopback0
  ip address 10.0.202.1 255.255.255.255
  ipv6 enable
!
interface GigabitEthernet0/0/0
  description Radio-B1
```

```
ip address 10.0.10.4 255.255.255.0
negotiation auto
ipv6 enable
!
interface GigabitEthernet0/0/1
description Radio-B2
ip address 10.0.20.4 255.255.255.0
negotiation auto
ipv6 enable
!
interface GigabitEthernet0/1/0
switchport access vlan 124
!
interface GigabitEthernet0/1/1
!
interface GigabitEthernet0/1/2
!
interface GigabitEthernet0/1/3
switchport access vlan 100
!
interface Vlan100
ip vrf forwarding mgmt
ip address 10.100.13.12 255.255.0.0
!
interface Vlan124
description Client-B
ip address 10.0.102.1 255.255.255.0
!
interface Async0/2/0
no ip address
encapsulation scada
!
ip forward-protocol nd
ip tftp source-interface Vlan100
ip ftp source-interface Vlan100
ip ftp username cisco
```

```
ip ftp password cisco,123
ip http server
ip http authentication local
ip http secure-server
ip http client source-interface Vlan1
!
ip route vrf mgmt 0.0.0.0 0.0.0.0 10.100.0.1
!
!
!
line con 0
  exec-timeout 0 0
  stopbits 1
  speed 115200
line vty 0 4
  exec-timeout 360 0
  login local
  transport input all
```

!

## Start LL-DLEP Simulators

7. Create a new file on each DLEP radio simulator virtual machine. This XML file will contact basic configuration for the radio. Change the value of <discovery-iface> if your OS uses a different interface name for the interface connected to the switch and router.

```
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$ more ~/radio.xml
<?xml version="1.0" ?>
<!--
Configuration file that allows non-root users to run the example DLEP client
as a modem.
-->
<config>
  <params>
    <local-type>modem</local-type>
    <discovery-enable>1</discovery-enable>

    <!-- change this to reflect your chosen interface -->
    <discovery-iface>ens192</discovery-iface>
```

```

<!-- override default privileged port 854 -->
<discovery-port>854</discovery-port>

<!-- override default privileged address 224.0.0.117 -->
<discovery-mcast-address>224.0.0.117</discovery-mcast-address>
<discovery-interval>5</discovery-interval>

<!-- override default privileged port 854 -->
<session-port>55556</session-port>
<heartbeat-interval>5</heartbeat-interval>
<heartbeat-threshold>2</heartbeat-threshold>
<peer-type>emulated-modem</peer-type>
<log-file>dlep-modem.log</log-file>

<!-- Protocol Config File -->
<protocol-config-file>/usr/local/etc/dlep/dlep-rfc-8175-
noext.xml</protocol-config-file>
  </params>
</config>

```

8. The contents of “/usr/local/etc/dlep/dlep-rfc-8175-noext.xml”, as referenced above, are contained in the appendix in this document. These are protocol specific parameters. This XML file also needs to be uploaded to each DLEP radio simulator.

Before starting the simulator software, it is recommended to run it inside of a tmux session. This allows the application to keep running even if the user SSH session is disconnected. To start a tmux session:

```

sudo tmux
[sudo] password for cisco:

```

*Note: Instead of “tmux”, an alternative application such as “screen” can be used to provide similar functionality.*

If the SSH session is ever disconnected, and the user reconnects, the existing tmux session can be found with:

```

sudo tmux ls
[sudo] password for cisco:
0: 1 windows (created Thu Sep 28 14:56:50 2023) [72x40]

```

Finally, the tmux session can be attached to resume control:

```
sudo tmux attach-session -t 0
```

When starting the DLEP simulator application, reference the “radio.xml” file uploaded earlier:

```
Dlep config-file /home/cisco/radio.xml
```

9. At this point, the application should be running. To see a list of the support commands from the DLEP application CLI, type “help”.

```
emulated-modem> help
help : print a help message
quit : exit the program cleanly
dest up mac-address [data-item-name data-item-value]...
    declare a destination to be up (modem) or announced (router)
    [data-item-name data-item-value] can be repeated to specify multiple data items
    data-item-names come from 'show dataitems'
dest update mac-address [data-item-name data-item-value]...
    update attributes of an existing (up) destination
dest down mac-address [data-item-name data-item-value]...
    declare a destination to be down
dest response mac-address status-code-name
    define response to a future destination up for mac-address
    status-code-name comes from 'show statuscodes'
linkchar request mac-address [data-item-name data-item-value]...
    request link characteristics for a destination
linkchar reply peer_id mac-address [data-item-name data-item-value]...
    reply with link characteristics for a destination
peer update [data-item-name data-item-value]...
    update the local peer with data-items and send peer updates to all existing peers
set param-name param-value
    set a config parameter value
show [ dataitems | config | signals | modules | statuscodes | peer | dest ]
    show requested information
show peer [ peer-id ]
    without peer-id, lists all peers
    with peer-id, prints detailed information about that peer
show dest [ mac-address ]
    without mac-address, prints info about all destinations
    with mac-address, prints info about that destination
```

- The next step is to bring up the session between the radio and router (repeat for each simulator).

In the simplified topology below, it is important to find the MAC address of the router interfaces connected to the simulated radios.

Figure 17. Device MAC Addresses

```

Terminal
Network
All Settings Network
Airplane Mode OFF
Wired
Connected - 10000 Mb/s
cisco@dlep-sim-radio-a1: ~
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.
cisco@dlep-sim-radio-a1:~$ ifconfig
ens160  Link encap:Ethernet  HWaddr 00:50:56:b6:1e:e1
        inet addr:10.100.0.12  Bcast:10.100.255.255  Mask:255.255.0.0
        inet6 addr: fe80::a361:8828:fd02:4a50/64  Scope:Link
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:1224 errors:0 dropped:0 overruns:0 frame:0
        TX packets:529 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:1296990 (1.2 MB)  TX bytes:45039 (45.0 KB)

ens192  Link encap:Ethernet  HWaddr 00:50:56:b6:c8:4a
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:2 errors:0 dropped:0 overruns:0 frame:0
        TX packets:119 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:120 (120.0 B)  TX bytes:20624 (20.6 KB)

lo      Link encap:Local Loopback
        inet addr:127.0.0.1  Mask:255.0.0.0
        inet6 addr: ::1/128  Scope:Host
        UP LOOPBACK RUNNING  MTU:65536  Metric:1
  
```

Note: to find the MAC address in Linux, use the “ifconfig” command. In Cisco IOS-XE, use the “show int Gig0/0/0” command.

- On each radio simulator, issue the following command to start advertising radio parameters to the connected router. The MAC and IP addresses here are for the far router. For example on Radio-A1, advertise the GE0/0/0 interface on ESR-B to the connected ESR-A.

```

dest up d4:78:9b:5c:dd:00 IPv4_Address 1;10.0.10.4 Current_Data_Rate_Receive 1000000
Current_Data_Rate_Transmit 1000000 Latency 100000 Resources 100 Maximum_Data_Rate_Receive
10000000 Maximum_Data_Rate_Transmit 10000000 Maximum_Transmission_Unit 1500
Relative_Link_Quality_Receive 100 Relative_Link_Quality_Transmit 100
  
```

The other parameters, like data rate and latency, are set to an initial realistic value.

- Repeat this step for all DLEP simulated radios.



13. To simulate a loss of connectivity between radios, you can use the following command:

```
dest down d4:78:9b:5c:dd:00
```

## Configure ESR6300 routers for DLEP

14. The Cisco ESR6300 routers are next configured for client / server-based communication with defined port numbers.

### Configure ESR-A:

```
interface GigabitEthernet0/0/0
  description Radio-A1
  ip pim sparse-dense-mode
  ip dlep vtemplate 1 port 55556 client ip 10.0.10.2 port 55556
  ipv6 enable
!
interface GigabitEthernet0/0/1
  description Radio-A2
  ip pim sparse-dense-mode
  ip dlep vtemplate 2 port 55556 client ip 10.0.20.2 port 55556
  ipv6 enable
!
interface Virtual-Template1
  ip unnumbered GigabitEthernet0/0/0
  ipv6 enable
!
interface Virtual-Template2
  ip unnumbered GigabitEthernet0/0/1
  ipv6 enable
!
interface vml1
  ip unnumbered GigabitEthernet0/0/0
  ipv6 address FE80::D678:9BFF:FE5D:2C80 link-local
  ipv6 enable
  physical-interface GigabitEthernet0/0/0
!
```

```
interface vmi2
  ip unnumbered GigabitEthernet0/0/1
  ipv6 address FE80::D678:9BFF:FE5D:2C81 link-local
  ipv6 enable
  physical-interface GigabitEthernet0/0/1
!
```

## Configure ESR6300 routers for DLEP

15. The Cisco ESR6300 routers are next configured for client / server-based communication with defined port numbers.

### Configure ESR-A:

```
interface GigabitEthernet0/0/0
  description Radio-A1
  ip pim sparse-dense-mode
  ip dlep vtemplate 1 port 55556 client ip 10.0.10.2 port 55556
  ipv6 enable
!
interface GigabitEthernet0/0/1
  description Radio-A2
  ip pim sparse-dense-mode
  ip dlep vtemplate 2 port 55556 client ip 10.0.20.2 port 55556
  ipv6 enable
!
interface Virtual-Template1
  ip unnumbered GigabitEthernet0/0/0
  ipv6 enable
!
interface Virtual-Template2
  ip unnumbered GigabitEthernet0/0/1
  ipv6 enable
!
interface vmi1
  ip unnumbered GigabitEthernet0/0/0
  ipv6 address FE80::D678:9BFF:FE5D:2C80 link-local
  ipv6 enable
```

```
physical-interface GigabitEthernet0/0/0
!
interface vmi2
ip unnumbered GigabitEthernet0/0/1
ipv6 address FE80::D678:9BFF:FE5D:2C81 link-local
ipv6 enable
physical-interface GigabitEthernet0/0/1
!
```

## Initial verification

### On ESR-A:

The first command shows the status of the far end router(s), as advertised by the connected radio simulator:

```
ESR-A#show dlep neighbor

DLEP Neighbors for all interfaces:

DLEP Neighbors for Interface GigabitEthernet0/0/0
DLEP Local IP=10.0.10.1:55556 Sock=0
SID=2150 Remote End-point MAC_Address=d478.9b5c.dd00

Addresses:
DLEP Remote IP : 10.0.10.4 DLEP Remote IPv6 LL : FE80::D678:9BFF:FE5C:DD00
Associated virtual access interface : Virtual-Access2

Supported Metrics:
RLQ RX Metric : 100
RLQ TX Metric : 100
Resources Metric : 100
MTU Metric : 1500
Latency Metric : 100000 microseconds
CDR RX Metric : 1000000 bps
CDR TX Metric : 1000000 bps
MDR RX Metric : 10000000 bps
MDR TX Metric : 10000000 bps

DLEP Neighbors for Interface GigabitEthernet0/0/1
DLEP Local IP=10.0.20.1:55556 Sock=2
```

```
SID=2151 Remote End-point MAC_Address=d478.9b5c.dd01
Addresses:
  DLEP Remote IP : 10.0.20.4 DLEP Remote IPv6 LL : FE80::D678:9BFF:FE5C:DD01
  Associated virtual access interface : Virtual-Access3
Supported Metrics:
  RLQ RX Metric : 100
  RLQ TX Metric : 100
  Resources Metric : 100
  MTU Metric : 1500
  Latency Metric : 100000 microseconds
  CDR RX Metric : 1000000 bps
  CDR TX Metric : 1000000 bps
  MDR RX Metric : 10000000 bps
  MDR TX Metric : 10000000 bps
```

The next command shows the status of the connected radio(s):

```
ESR-A#show dlep client

DLEP Clients for all interfaces:

DLEP Clients for Interface GigabitEthernet0/0/0
DLEP Local IP=10.0.10.1:55556 Sock=0

DLEP Local Radio IP=10.0.10.2:55556 TCP Socket fd=1
Peer ID=3, Virtual template=1
Description: emulated-modem
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 : 1500
Link Latency Metric : 100000 microseconds
Link CDR RX Metric : 1000000 bps
Link CDR TX Metric : 1000000 bps
Link MDR RX Metric : 10000000 bps
Link MDR TX Metric : 10000000 bps
```

```
DLEP Clients for Interface GigabitEthernet0/0/1
DLEP Local IP=10.0.20.1:55556 Sock=2
```

```
DLEP Local Radio IP=10.0.20.2:55556 TCP Socket fd=3
Peer ID=4, Virtual template=2
Description: emulated-modem
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 : 1500
Link Latency Metric : 100000 microseconds
Link CDR RX Metric : 1000000 bps
Link CDR TX Metric : 1000000 bps
Link MDR RX Metric : 10000000 bps
Link MDR TX Metric : 10000000 bps
```

**On Radio-A1:**

```
emulated-modem> show peer
peer ids:
10.0.10.1:55556
DlepService returns: ok
```

## Tuning radio parameters

The simulated radio supports configuring a variety of parameters. Many of these were set in the “`dest up`” command earlier. To see all configurable parameters, issue the command “`show dataitems`”:

```
emulated-modem> show dataitems

Configured data items:

ID Name                                Type          Units          Module  Flags
14 Current_Data_Rate_Receive            u64           bits/second   core   metric
15 Current_Data_Rate_Transmit           u64           bits/second   core   metric
6  Extensions_Supported                 v_extid                               core
5  Heartbeat_Interval                   u32           milliseconds  core
8  IPv4_Address                         u8_ipv4                               core
10 IPv4_Attached_Subnet                 u8_ipv4_u8                               core
2  IPv4_Connection_Point                u8_ipv4_u16                              core
9  IPv6_Address                         u8_ipv6                               core
11 IPv6_Attached_Subnet                 u8_ipv6_u8                               core
3  IPv6_Connection_Point                u8_ipv6_u16                              core
16 Latency                              u64           microseconds  core   metric
7  MAC_Address                          dlepmac                               core
12 Maximum_Data_Rate_Receive            u64           bits/second   core   metric
13 Maximum_Data_Rate_Transmit           u64           bits/second   core   metric
20 Maximum_Transmission_Unit            u16           octets        core   metric
4  Peer_Type                             u8_string                               core
18 Relative_Link_Quality_Receive        u8            percentage    core   metric
19 Relative_Link_Quality_Transmit       u8            percentage    core   metric
17 Resources                            u8            percentage    core   metric
1  Status                                u8_string                               core
```

If the destination is already up, parameters can be adjusted on the fly to simulate changing RF conditions between the radios:

```
emulated-modem> peer update Latency 250000
```

## Configure and verify OSPFv3

Next the two ESR6300 routers are configured with OSPFv3 to exchange routes with each other. The OSPFv3 process will also work with the DLEP process to monitor the current link status metrics and factor them into the routing calculation for best path.

ESR-A Configuration:

```
interface Loopback0
```

```
ip address 10.0.201.1 255.255.255.255
ipv6 enable
ospfv3 1 ipv4 area 0
!
interface Vlan121
description Client-A
ip address 10.0.101.1 255.255.255.0
ipv6 enable
ospfv3 1 ipv4 area 0
!
interface vmi1
ospfv3 1 network manet
ospfv3 1 ipv4 area 0
!
interface vmi2
ospfv3 network manet
ospfv3 1 ipv4 area 0
!
router ospfv3 1
!
address-family ipv4 unicast
exit-address-family
!
```

#### ESR-B Configuration:

```
interface Loopback0
ip address 10.0.202.1 255.255.255.255
ipv6 enable
ospfv3 1 ipv4 area 0
!
interface Vlan124
description Client-B
ip address 10.0.102.1 255.255.255.0
ipv6 enable
ospfv3 1 ipv4 area 0
!
```

```

interface vmi1
 ip unnumbered GigabitEthernet0/0/0
 ipv6 address FE80::D678:9BFF:FE5C:DD00 link-local
 ipv6 enable
 ospfv3 1 network manet
 ospfv3 1 ipv4 area 0
 physical-interface GigabitEthernet0/0/0
!
interface vmi2
 ip unnumbered GigabitEthernet0/0/1
 ipv6 address FE80::D678:9BFF:FE5C:DD01 link-local
 ipv6 enable
 ospfv3 network manet
 ospfv3 1 ipv4 area 0
 physical-interface GigabitEthernet0/0/1
!
router ospfv3 1
!
 address-family ipv4 unicast
 exit-address-family
!

```

**ESR-A Verification:**

```
ESR-A#show ip route
```

```
Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP
```

```
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
```

```
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
```

```
E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP
```

```
n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA
```

```
i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2
```

```
ia - IS-IS inter area, * - candidate default, U - per-user static route
```

```
H - NHRP, G - NHRP registered, g - NHRP registration summary
```

```
o - ODR, P - periodic downloaded static route, l - LISP
```

```
a - application route
```

```
+ - replicated route, % - next hop override, p - overrides from PFR
```

```
& - replicated local route overrides by connected
```



Gateway of last resort is not set

```

10.0.0.0/8 is variably subnetted, 11 subnets, 2 masks
C       10.0.10.0/24 is directly connected, GigabitEthernet0/0/0
L       10.0.10.1/32 is directly connected, GigabitEthernet0/0/0
C       10.0.10.4/32 is directly connected, vmi1
C       10.0.20.0/24 is directly connected, GigabitEthernet0/0/1
L       10.0.20.1/32 is directly connected, GigabitEthernet0/0/1
C       10.0.20.4/32 is directly connected, vmi2
C       10.0.101.0/24 is directly connected, Vlan121
L       10.0.101.1/32 is directly connected, Vlan121
O       10.0.102.0/24 [110/59093] via 10.0.20.4, 00:00:48, vmi2
          [110/59093] via 10.0.10.4, 00:00:48, vmi1
C       10.0.201.1/32 is directly connected, Loopback0
O       10.0.202.1/32 [110/59092] via 10.0.20.4, 00:04:03, vmi2
          [110/59092] via 10.0.10.4, 00:05:09, vmi1

```

In the output above from ESR-A, the routing table contains two equal cost paths to the 10.0.102.0/24 and 10.0.202.1/32 networks that belong to ESR-B. The paths are equal cost because all metrics being advertised by DLEP from the radio are the same for the two links, as shown below:

```

ESR-A#show dlep neigh
DLEP Neighbors for all interfaces:

DLEP Neighbors for Interface GigabitEthernet0/0/0
DLEP Local IP=10.0.10.1:55556 Sock=0
SID=2152 Remote End-point MAC_Address=d478.9b5c.dd00
Addresses:
DLEP Remote IP : 10.0.10.4 DLEP Remote IPv6 LL : FE80::D678:9BFF:FE5C:DD00
Associated virtual access interface : Virtual-Access2
Supported Metrics:
RLQ RX Metric : 100
RLQ TX Metric : 100
Resources Metric : 100
MTU Metric : 1500
Latency Metric : 100000 microseconds
CDR RX Metric : 1000000 bps
CDR TX Metric : 1000000 bps

```

```
MDR RX Metric : 10000000 bps
MDR TX Metric : 10000000 bps

DLEP Neighbors for Interface GigabitEthernet0/0/1
DLEP Local IP=10.0.20.1:55556 Sock=2

SID=2153 Remote End-point MAC_Address=d478.9b5c.dd01
Addresses:
DLEP Remote IP : 10.0.20.4 DLEP Remote IPv6 LL : FE80::D678:9BFF:FE5C:DD01
Associated virtual access interface : Virtual-Access3
Supported Metrics:
RLQ RX Metric : 100
RLQ TX Metric : 100
Resources Metric : 100
MTU Metric : 1500
Latency Metric : 100000 microseconds
CDR RX Metric : 1000000 bps
CDR TX Metric : 1000000 bps
MDR RX Metric : 10000000 bps
MDR TX Metric : 10000000 bps
```

To force OSPF to choose one radio link, alter the advertised metrics on one of the links on Radio-A1 to make it more favorable:

```
emulated-modem>peer update Current_Data_Rate_Receive 2000000 Current_Data_Rate_Transmit
2000000
DlepService returns: ok
emulated-modem>
Peer down, peer id = 10.0.10.1:55556

emulated-modem> peer id = 10.0.10.1:55556
session init data items to send:
Status 0;
Peer_Type 0;emulated-modem
Heartbeat_Interval 5000
Maximum_Data_Rate_Receive 10000000
Maximum_Data_Rate_Transmit 10000000
```

```

Current_Data_Rate_Receive 2000000
Current_Data_Rate_Transmit 2000000

Latency 100000

Resources 0

Relative_Link_Quality_Receive 0
Relative_Link_Quality_Transmit 0

Maximum_Transmission_Unit 0

IPv4_Address 1;10.0.10.4

Peer up, peer id = 10.0.10.1:55556
type =
heartbeat interval = 5000

```

After the metric update from the radio, ESR-A sees the change advertised by DLEP:

```

ESR-A#show dlep neigh
...
DLEP Neighbors for Interface GigabitEthernet0/0/0
DLEP Local IP=10.0.10.1:55556 Sock=0

SID=2157 Remote End-point MAC_Address=d478.9b5c.dd00

Addresses:
DLEP Remote IP : 10.0.10.4

Associated virtual access interface : Virtual-Access2

Supported Metrics:
RLQ RX Metric : 100
RLQ TX Metric : 100
Resources Metric : 100
MTU Metric : 1500
Latency Metric : 100000 microseconds

CDR RX Metric : 2000000 bps
CDR TX Metric : 2000000 bps

MDR RX Metric : 10000000 bps
MDR TX Metric : 10000000 bps

```

Correspondingly, ESR-A's OSPFv3 process has recalculated the best path to only use a single path – interface “vmi1” which connects to radio advertising the better CDR metrics via DLEP:

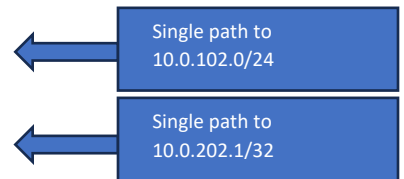
```
ESR-A#show ip route
```

Codes: L - local, C - connected, S - static, R - RIP, M - mobile, B - BGP  
 D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
 N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
 E1 - OSPF external type 1, E2 - OSPF external type 2, m - OMP  
 n - NAT, Ni - NAT inside, No - NAT outside, Nd - NAT DIA  
 i - IS-IS, su - IS-IS summary, L1 - IS-IS level-1, L2 - IS-IS level-2  
 ia - IS-IS inter area, \* - candidate default, U - per-user static route  
 H - NHRP, G - NHRP registered, g - NHRP registration summary  
 o - ODR, P - periodic downloaded static route, l - LISP  
 a - application route  
 + - replicated route, % - next hop override, p - overrides from PfR  
 & - replicated local route overrides by connected

Gateway of last resort is not set

```

10.0.0.0/8 is variably subnetted, 11 subnets, 2 masks
C       10.0.10.0/24 is directly connected, GigabitEthernet0/0/0
L       10.0.10.1/32 is directly connected, GigabitEthernet0/0/0
C       10.0.10.4/32 is directly connected, vmi1
C       10.0.20.0/24 is directly connected, GigabitEthernet0/0/1
L       10.0.20.1/32 is directly connected, GigabitEthernet0/0/1
C       10.0.20.4/32 is directly connected, vmi2
C       10.0.101.0/24 is directly connected, Vlan121
L       10.0.101.1/32 is directly connected, Vlan121
O       10.0.102.0/24 [110/52539] via 10.0.10.4, 00:03:34, vmi1
C       10.0.201.1/32 is directly connected, Loopback0
O       10.0.202.1/32 [110/52538] via 10.0.10.4, 00:03:34, vmi1
    
```



## Additional Information

MIT Lincoln Labs DLEP Simulator documentation:

<https://github.com/mit-ll/LL-DLEP/blob/master/doc/doxygen/markdown/UserGuide.md>

<https://github.com/mit-ll/LL-DLEP/blob/master/doc/doxygen/markdown/Design.md>

Cisco documentation:

[Radio Aware Routing: Enabling Communications on the Move White Paper](#)

[Cisco ESR6300 Embedded Series Router Data Sheet](#)

[Cisco Embedded Service 6300 Series Software Configuration Guide](#)

## Appendix 1. dlep-rfc-8175-noext.xml

```
<?xml version="1.0" encoding="UTF-8"?>

<!--
* Dynamic Link Exchange Protocol (DLEP)
*
* Copyright (C) 2015, 2016 Massachusetts Institute of Technology
-->

<!--
This protocol configuration file conforms to DLEP RFC 8175.
-->

<dlep xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
      xmlns:xi="http://www.w3.org/2001/XInclude">

  <signal_prefix>DLEP</signal_prefix>

  <field_sizes>
    <signal_length>2</signal_length>
    <signal_id>2</signal_id>
    <data_item_length>2</data_item_length>
    <data_item_id>2</data_item_id>
    <extension_id>2</extension_id>
    <status_code>1</status_code>
  </field_sizes>

  <module>
    <name>core</name>
    <draft>RFC8175</draft>

    <!-- Data Items -->
```

```
<data_item>
```

```
  <name>Status</name>
```

```
  <type>u8_string</type>
```

```
  <id>1</id>
```

```
  <metric>>false</metric>
```

```
</data_item>
```

```
<data_item>
```

```
  <name>IPv4_Connection_Point</name>
```

```
  <type>u8_ipv4_u16</type>
```

```
  <id>2</id>
```

```
  <metric>>false</metric>
```

```
</data_item>
```

```
<data_item>
```

```
  <name>IPv6_Connection_Point</name>
```

```
  <type>u8_ipv6_u16</type>
```

```
  <id>3</id>
```

```
  <metric>>false</metric>
```

```
</data_item>
```

```
<data_item>
```

```
  <name>Peer_Type</name>
```

```
  <type>u8_string</type>
```

```
  <id>4</id>
```

```
  <metric>>false</metric>
```

```
</data_item>
```

```
<data_item>
```

```
  <name>Heartbeat_Interval</name>
```

```
  <type>u32</type>
```

```
  <id>5</id>
```

```
<metric>>false</metric>
<units>milliseconds</units>
</data_item>

<data_item>
  <name>Extensions_Supported</name>
  <type>v_extid</type>
  <id>6</id>
  <metric>>false</metric>
</data_item>

<data_item>
  <name>MAC_Address</name>
  <type>dlepmac</type>
  <id>7</id>
  <metric>>false</metric>
</data_item>

<data_item>
  <name>IPv4_Address</name>
  <type>u8_ipv4</type>
  <id>8</id>
  <metric>>false</metric>
</data_item>

<data_item>
  <name>IPv6_Address</name>
  <type>u8_ipv6</type>
  <id>9</id>
  <metric>>false</metric>
</data_item>

<data_item>
```



```
<name>IPv4_Attached_Subnet</name>
<type>u8_ipv4_u8</type>
<id>10</id>
<metric>false</metric>
</data_item>

<data_item>
  <name>IPv6_Attached_Subnet</name>
  <type>u8_ipv6_u8</type>
  <id>11</id>
  <metric>false</metric>
</data_item>

<data_item>
  <name>Maximum_Data_Rate_Receive</name>
  <type>u64</type>
  <id>12</id>
  <metric>true</metric>
  <units>bits/second</units>
</data_item>

<data_item>
  <name>Maximum_Data_Rate_Transmit</name>
  <type>u64</type>
  <id>13</id>
  <metric>true</metric>
  <units>bits/second</units>
</data_item>

<data_item>
  <name>Current_Data_Rate_Receive</name>
  <type>u64</type>
  <id>14</id>
```

```
<metric>true</metric>
<units>bits/second</units>
</data_item>

<data_item>
  <name>Current_Data_Rate_Transmit</name>
  <type>u64</type>
  <id>15</id>
  <metric>true</metric>
  <units>bits/second</units>
</data_item>

<data_item>
  <name>Latency</name>
  <type>u64</type>
  <id>16</id>
  <metric>true</metric>
  <units>microseconds</units>
</data_item>

<data_item>
  <name>Resources</name>
  <type>u8</type>
  <id>17</id>
  <metric>true</metric>
  <units>percentage</units>
</data_item>

<data_item>
  <name>Relative_Link_Quality_Receive</name>
  <type>u8</type>
  <id>18</id>
  <metric>true</metric>
```

```
<units>percentage</units>
</data_item>

<data_item>
  <name>Relative_Link_Quality_Transmit</name>
  <type>u8</type>
  <id>19</id>
  <metric>>true</metric>
  <units>percentage</units>
</data_item>

<data_item>
  <name>Maximum_Transmission_Unit</name>
  <type>u16</type>
  <id>20</id>
  <metric>>true</metric>
  <units>octets</units>
</data_item>

<!-- Signals -->

<signal>
  <name>Peer_Discovery</name>
  <id>1</id>
  <message>>false</message>
  <sender>router</sender>

  <data_item>
    <name>Peer_Type</name>
    <occurs>0-1</occurs>
  </data_item>
</signal>
```

```
<signal>
  <name>Peer_Offer</name>
  <id>2</id>
  <message>>false</message>
  <sender>modem</sender>

  <data_item>
    <name>Peer_Type</name>
    <occurs>0-1</occurs>
  </data_item>

  <data_item>
    <name>IPv4_Connection_Point</name>
    <occurs>0+</occurs>
  </data_item>

  <data_item>
    <name>IPv6_Connection_Point</name>
    <occurs>0+</occurs>
  </data_item>

</signal>

<signal>
  <name>Session_Initialization_Response</name> <!-- aka Peer Initialization ACK -->
  <id>2</id>
  <message>>true</message>
  <sender>modem</sender>

  <data_item>
    <name>Status</name>
    <occurs>1</occurs>
  </data_item>

```

<data\_item>

<name>Peer\_Type</name>

<occurs>1</occurs>

</data\_item>

<data\_item>

<name>Heartbeat\_Interval</name>

<occurs>1</occurs>

</data\_item>

<data\_item>

<name>Maximum\_Data\_Rate\_Receive</name>

<occurs>1</occurs>

</data\_item>

<data\_item>

<name>Maximum\_Data\_Rate\_Transmit</name>

<occurs>1</occurs>

</data\_item>

<data\_item>

<name>Current\_Data\_Rate\_Receive</name>

<occurs>1</occurs>

</data\_item>

<data\_item>

<name>Current\_Data\_Rate\_Transmit</name>

<occurs>1</occurs>

</data\_item>

<data\_item>

<name>Latency</name>

```
<occurs>1</occurs>
</data_item>

<data_item>
  <name>Resources</name>
  <occurs>0-1</occurs>
</data_item>

<data_item>
  <name>Relative_Link_Quality_Receive</name>
  <occurs>0-1</occurs>
</data_item>

<data_item>
  <name>Relative_Link_Quality_Transmit</name>
  <occurs>0-1</occurs>
</data_item>

<data_item>
  <name>Maximum_Transmission_Unit</name>
  <occurs>0-1</occurs>
</data_item>

<data_item>
  <name>Extensions_Supported</name>
  <occurs>0-1</occurs>
</data_item>

<data_item>
  <name>IPv4_Address</name>
  <occurs>0+</occurs>
</data_item>
```

```
<data_item>
  <name>IPv6_Address</name>
  <occurs>0+</occurs>
</data_item>
```

```
<data_item>
  <name>IPv4_Attached_Subnet</name>
  <occurs>0+</occurs>
</data_item>
```

```
<data_item>
  <name>IPv6_Attached_Subnet</name>
  <occurs>0+</occurs>
</data_item>
```

```
</signal>
```

```
<signal>
  <name>Session_Initialization</name> <!-- aka Peer Initialization -->
  <id>1</id>
  <message>true</message>
  <sender>router</sender>
  <response>Session_Initialization_Response</response>
```

```
<data_item>
  <name>Heartbeat_Interval</name>
  <occurs>1</occurs>
</data_item>
```

```
<data_item>
  <name>Peer_Type</name>
  <occurs>1</occurs>
</data_item>
```

```
<data_item>
  <name>Extensions_Supported</name>
  <occurs>0-1</occurs>
</data_item>

<data_item>
  <name>IPv4_Address</name>
  <occurs>0+</occurs>
</data_item>

<data_item>
  <name>IPv6_Address</name>
  <occurs>0+</occurs>
</data_item>

<data_item>
  <name>IPv4_Attached_Subnet</name>
  <occurs>0+</occurs>
</data_item>

<data_item>
  <name>IPv6_Attached_Subnet</name>
  <occurs>0+</occurs>
</data_item>
</signal>

<signal>
  <name>Session_Update_Response</name> <!-- aka Peer Update ACK -->
  <id>4</id>
  <message>true</message>
  <sender>both</sender>

  <data_item>
```



```
<name>Status</name>
<occurs>1</occurs>
</data_item>
</signal>

<signal>
  <name>Session_Update</name> <!-- aka Peer Update -->
  <id>3</id>
  <message>true</message>
  <sender>both</sender>
  <response>Session_Update_Response</response>

  <data_item>
    <name>IPv4_Address</name>
    <occurs>0+</occurs>
  </data_item>

  <data_item>
    <name>IPv6_Address</name>
    <occurs>0+</occurs>
  </data_item>

  <data_item>
    <name>IPv4_Attached_Subnet</name>
    <occurs>0+</occurs>
  </data_item>

  <data_item>
    <name>IPv6_Attached_Subnet</name>
    <occurs>0+</occurs>
  </data_item>

  <data_item>
```

```
<name>Maximum_Data_Rate_Receive</name>  
<occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Maximum_Data_Rate_Transmit</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Current_Data_Rate_Receive</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Current_Data_Rate_Transmit</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Latency</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Resources</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Relative_Link_Quality_Receive</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>
  <name>Relative_Link_Quality_Transmit</name>
  <occurs>0-1</occurs>
</data_item>
```

```
<data_item>
  <name>Maximum_Transmission_Unit</name>
  <occurs>0-1</occurs>
</data_item>
```

```
</signal>
```

```
<signal>
  <name>Session_Termination_Response</name> <!-- aka Peer Termination ACK -->
  <id>6</id>
  <message>>true</message>
  <sender>both</sender>
</signal>
```

```
<signal>
  <name>Session_Termination</name> <!-- aka Peer Termination -->
  <id>5</id>
  <message>>true</message>
  <sender>both</sender>
  <response>Session_Termination_Response</response>
```

```
<data_item>
  <name>Status</name>
  <occurs>1</occurs>
</data_item>
```

```
</signal>
```

```
<signal>
```

```
<name>Destination_Up_Response</name> <!-- aka Destination Up ACK -->
<id>8</id>
<message>>true</message>
<sender>router</sender>

<data_item>
  <name>MAC_Address</name>
  <occurs>1</occurs>
</data_item>

<data_item>
  <name>Status</name>
  <occurs>1</occurs>
</data_item>
</signal>

<signal>
  <name>Destination_Up</name>
  <id>7</id>
  <message>>true</message>
  <sender>modem</sender>
  <response>Destination_Up_Response</response>

  <data_item>
    <name>MAC_Address</name>
    <occurs>1</occurs>
  </data_item>

  <data_item>
    <name>Maximum_Data_Rate_Receive</name>
    <occurs>0-1</occurs>
  </data_item>
```

```
<data_item>  
  <name>Maximum_Data_Rate_Transmit</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Current_Data_Rate_Receive</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Current_Data_Rate_Transmit</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Latency</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Resources</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Relative_Link_Quality_Receive</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Relative_Link_Quality_Transmit</name>  
  <occurs>0-1</occurs>
```

</data\_item>

<data\_item>

<name>Maximum\_Transmission\_Unit</name>

<occurs>0-1</occurs>

</data\_item>

<data\_item>

<name>IPv4\_Address</name>

<occurs>0+</occurs>

</data\_item>

<data\_item>

<name>IPv6\_Address</name>

<occurs>0+</occurs>

</data\_item>

<data\_item>

<name>IPv4\_Attached\_Subnet</name>

<occurs>0+</occurs>

</data\_item>

<data\_item>

<name>IPv6\_Attached\_Subnet</name>

<occurs>0+</occurs>

</data\_item>

</signal>

<signal>

<name>Destination\_Announce\_Response</name>

<id>10</id>

<message>>true</message>

<sender>modem</sender>

<data\_item>

<name>MAC\_Address</name>

<occurs>1</occurs>

</data\_item>

<data\_item>

<name>Maximum\_Data\_Rate\_Receive</name>

<occurs>0-1</occurs>

</data\_item>

<data\_item>

<name>Maximum\_Data\_Rate\_Transmit</name>

<occurs>0-1</occurs>

</data\_item>

<data\_item>

<name>Current\_Data\_Rate\_Receive</name>

<occurs>0-1</occurs>

</data\_item>

<data\_item>

<name>Current\_Data\_Rate\_Transmit</name>

<occurs>0-1</occurs>

</data\_item>

<data\_item>

<name>Latency</name>

<occurs>0-1</occurs>

</data\_item>

<data\_item>

<name>Resources</name>

```
<occurs>0-1</occurs>
</data_item>

<data_item>
  <name>Relative_Link_Quality_Receive</name>
  <occurs>0-1</occurs>
</data_item>

<data_item>
  <name>Relative_Link_Quality_Transmit</name>
  <occurs>0-1</occurs>
</data_item>

<data_item>
  <name>Maximum_Transmission_Unit</name>
  <occurs>0-1</occurs>
</data_item>

<data_item>
  <name>IPv4_Address</name>
  <occurs>0+</occurs>
</data_item>

<data_item>
  <name>IPv6_Address</name>
  <occurs>0+</occurs>
</data_item>

<data_item>
  <name>IPv4_Attached_Subnet</name>
  <occurs>0+</occurs>
</data_item>
```



```
<data_item>
  <name>IPv6_Attached_Subnet</name>
  <occurs>0+</occurs>
</data_item>

<data_item>
  <name>Status</name>
  <occurs>1</occurs>
</data_item>
</signal>

<signal>
  <name>Destination_Announce</name>
  <id>9</id>
  <message>>true</message>
  <sender>router</sender>
  <response>Destination_Announce_Response</response>
  <data_item>
    <name>MAC_Address</name>
    <occurs>1</occurs>
  </data_item>

  <data_item>
    <name>IPv4_Address</name>
    <occurs>0+</occurs>
  </data_item>

  <data_item>
    <name>IPv6_Address</name>
    <occurs>0+</occurs>
  </data_item>
</signal>
```

```
<signal>
  <name>Destination_Down_Response</name> <!-- aka Destination Down ACK -->
  <id>12</id>
  <message>true</message>
  <sender>both</sender>
```

```
<data_item>
  <name>MAC_Address</name>
  <occurs>1</occurs>
</data_item>
```

```
<data_item>
  <name>Status</name>
  <occurs>1</occurs>
</data_item>
```

```
</signal>
```

```
<signal>
  <name>Destination_Down</name>
  <id>11</id>
  <message>true</message>
  <sender>both</sender>
  <response>Destination_Down_Response</response>
```

```
<data_item>
  <name>MAC_Address</name>
  <occurs>1</occurs>
</data_item>
```

```
</signal>
```

```
<signal>
  <name>Destination_Update</name>
  <id>13</id>
```

<message>true</message>

<sender>modem</sender>

<data\_item>

<name>MAC\_Address</name>

<occurs>1</occurs>

</data\_item>

<data\_item>

<name>Maximum\_Data\_Rate\_Receive</name>

<occurs>0-1</occurs>

</data\_item>

<data\_item>

<name>Maximum\_Data\_Rate\_Transmit</name>

<occurs>0-1</occurs>

</data\_item>

<data\_item>

<name>Current\_Data\_Rate\_Receive</name>

<occurs>0-1</occurs>

</data\_item>

<data\_item>

<name>Current\_Data\_Rate\_Transmit</name>

<occurs>0-1</occurs>

</data\_item>

<data\_item>

<name>Latency</name>

<occurs>0-1</occurs>

</data\_item>

```
<data_item>  
  <name>Resources</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Relative_Link_Quality_Receive</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Relative_Link_Quality_Transmit</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Maximum_Transmission_Unit</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>IPv4_Address</name>  
  <occurs>0+</occurs>  
</data_item>
```

```
<data_item>  
  <name>IPv6_Address</name>  
  <occurs>0+</occurs>  
</data_item>
```

```
<data_item>  
  <name>IPv4_Attached_Subnet</name>  
  <occurs>0+</occurs>
```

</data\_item>

<data\_item>

<name>IPv6\_Attached\_Subnet</name>

<occurs>0+</occurs>

</data\_item>

</signal>

<signal>

<name>Link\_Characteristics\_Response</name> <!-- aka Link Characteristics ACK -->

<id>15</id>

<message>>true</message>

<sender>modem</sender>

<data\_item>

<name>MAC\_Address</name>

<occurs>1</occurs>

</data\_item>

<data\_item>

<name>Maximum\_Data\_Rate\_Receive</name>

<occurs>0-1</occurs>

</data\_item>

<data\_item>

<name>Maximum\_Data\_Rate\_Transmit</name>

<occurs>0-1</occurs>

</data\_item>

<data\_item>

<name>Current\_Data\_Rate\_Receive</name>

<occurs>0-1</occurs>

</data\_item>

```
<data_item>  
  <name>Current_Data_Rate_Transmit</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Latency</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Resources</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Relative_Link_Quality_Receive</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Relative_Link_Quality_Transmit</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Maximum_Transmission_Unit</name>  
  <occurs>0-1</occurs>  
</data_item>
```

```
<data_item>  
  <name>Status</name>
```

```
<occurs>1</occurs>
</data_item>
</signal>

<signal>
  <name>Link_Characteristics_Request</name>
  <id>14</id>
  <message>true</message>
  <sender>router</sender>
  <response>Link_Characteristics_Response</response>

  <data_item>
    <name>MAC_Address</name>
    <occurs>1</occurs>
  </data_item>

  <data_item>
    <name>Current_Data_Rate_Receive</name>
    <occurs>0-1</occurs>
  </data_item>

  <data_item>
    <name>Current_Data_Rate_Transmit</name>
    <occurs>0-1</occurs>
  </data_item>

  <data_item>
    <name>Latency</name>
    <occurs>0-1</occurs>
  </data_item>
</signal>

<signal>
```

```
<name>Heartbeat</name>
<id>16</id>
<message>>true</message>
<sender>both</sender>
</signal>
```

```
<!-- Status Codes -->
```

```
<status_code>
  <name>Success</name>
  <id>0</id>
  <failure_mode>continue</failure_mode>
</status_code>
```

```
<status_code>
  <name>Not_Interested</name>
  <id>1</id>
  <failure_mode>continue</failure_mode>
</status_code>
```

```
<status_code>
  <name>Request_Denied</name>
  <id>2</id>
  <failure_mode>continue</failure_mode>
</status_code>
```

```
<status_code>
  <name>Inconsistent_Data</name>
  <id>3</id>
  <failure_mode>continue</failure_mode>
</status_code>
```

```
<status_code>
```



```
<name>Unknown_Message</name>
<id>128</id>
<failure_mode>terminate</failure_mode>
</status_code>
```

```
<status_code>
  <name>Unexpected_Message</name>
  <id>129</id>
  <failure_mode>terminate</failure_mode>
</status_code>
```

```
<status_code>
  <name>Invalid_Data</name>
  <id>130</id>
  <failure_mode>terminate</failure_mode>
</status_code>
```

```
<status_code>
  <name>Invalid_Destination</name>
  <id>131</id>
  <failure_mode>terminate</failure_mode>
</status_code>
```

```
<status_code>
  <name>Timed_Out</name>
  <id>132</id>
  <failure_mode>terminate</failure_mode>
</status_code>
```

```
</module>
```

```
<!--
```

Include extension modules like this:

```
<xi:include href="example-extension-00.xml"/>
```

The included XML file *must* be well-formed XML by itself.

Arbitrary chunks of XML taken out of context may not be well-formed. The same chunks of XML can pass validation when present directly in the file, but can fail when moved to an included file. The recommended approach is for each included file to contain one module, enclosed in <module> ... </module>.

```
-->
```

```
<!--
```

```
<xi:include href="latency-range-03.xml"/>
```

```
<xi:include href="multi-hop-06.xml"/>
```

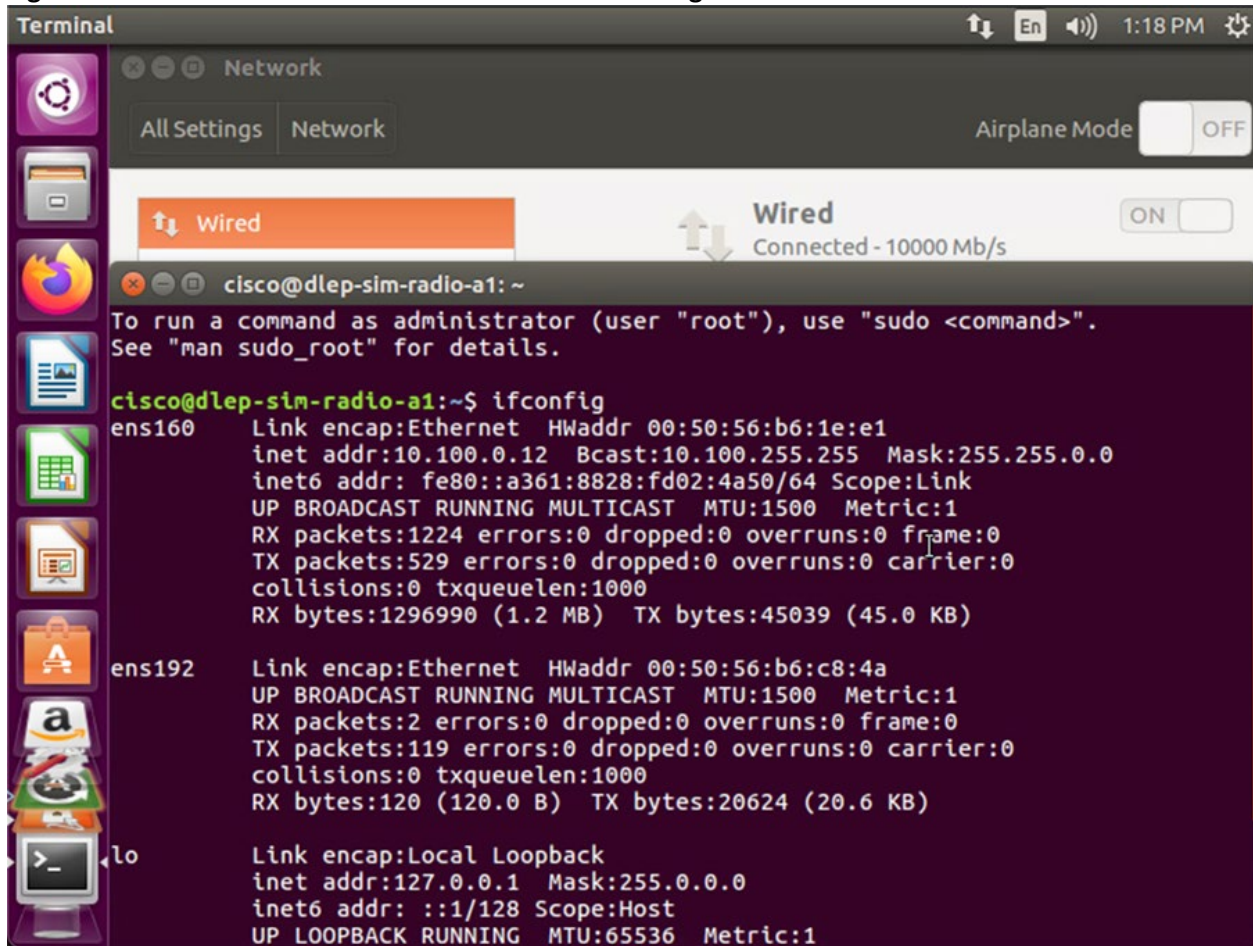
```
-->
```

```
</dlep>
```

## Appendix 2. DLEP Simulator Installation Logs

Initial Ubuntu network config via VMware console:

Figure 17 – Simulator install screenshot – interface config



The screenshot shows a terminal window titled "Terminal" with a system tray at the top indicating the time as 1:18 PM. Below the terminal, there is a network settings panel for "Wired" which is connected at 10000 Mb/s. The terminal output shows the results of the `ifconfig` command for three interfaces: `ens160`, `ens192`, and `lo`.

```
Terminal
Network
All Settings Network
Airplane Mode OFF
Wired
Connected - 10000 Mb/s
cisco@dlep-sim-radio-a1: ~
To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.
cisco@dlep-sim-radio-a1:~$ ifconfig
ens160  Link encap:Ethernet  HWaddr 00:50:56:b6:1e:e1
        inet addr:10.100.0.12  Bcast:10.100.255.255  Mask:255.255.0.0
        inet6 addr: fe80::a361:8828:fd02:4a50/64  Scope:Link
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:1224 errors:0 dropped:0 overruns:0 frame:0
        TX packets:529 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:1296990 (1.2 MB)  TX bytes:45039 (45.0 KB)

ens192  Link encap:Ethernet  HWaddr 00:50:56:b6:c8:4a
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
        RX packets:2 errors:0 dropped:0 overruns:0 frame:0
        TX packets:119 errors:0 dropped:0 overruns:0 carrier:0
        collisions:0 txqueuelen:1000
        RX bytes:120 (120.0 B)  TX bytes:20624 (20.6 KB)

lo      Link encap:Local Loopback
        inet addr:127.0.0.1  Mask:255.0.0.0
        inet6 addr: ::1/128  Scope:Host
        UP LOOPBACK RUNNING  MTU:65536  Metric:1
```

Figure 18 – Simulator install screenshot – OpenSSH Server

```

cisco@dlep-sim-radio-a1:~$
cisco@dlep-sim-radio-a1:~$ sudo apt-get install openssh-server
[sudo] password for cisco:
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following additional packages will be installed:
  ncurses-term openssh-sftp-server ssh-import-id
Suggested packages:
  ssh-askpass rssh molly-guard monkeysphere
The following NEW packages will be installed:
  ncurses-term openssh-server openssh-sftp-server ssh-import-id
0 upgraded, 4 newly installed, 0 to remove and 191 not upgraded.
Need to get 633 kB of archives.
After this operation, 5,136 kB of additional disk space will be used.
Do you want to continue? [Y/n]
Get:1 http://us.archive.ubuntu.com/ubuntu xenial/main amd64 ncurses-term all 6.0
+20160213-1ubuntu1 [249 kB]
Get:2 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 openssh-sftp
-server amd64 1:7.2p2-4ubuntu2.10 [38.8 kB]
Get:3 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 openssh-serv
er amd64 1:7.2p2-4ubuntu2.10 [335 kB]
Get:4 http://us.archive.ubuntu.com/ubuntu xenial/main amd64 ssh-import-id all 5.
5-0ubuntu1 [10.2 kB]

```

Figure 19 – Simulator install screenshot – verify SSH server running

```

DSA)
Creating SSH2 ECDSA key; this may take some time ...
256 SHA256:n/UsRTh580gR4CetWhV40qB983TnzZJXCpzGyVm74HQ root@dlep-sim-radio-a1 (E
CDSA)
Creating SSH2 ED25519 key; this may take some time ...
256 SHA256:F2Uz7pfUtbnDn5mL7soy5ATo02uL1F89aBqRJYyef7Y root@dlep-sim-radio-a1 (E
D25519)
Setting up ssh-import-id (5.5-0ubuntu1) ...
Processing triggers for ureadahead (0.100.0-19.1) ...
Processing triggers for systemd (229-4ubuntu21.28) ...
Processing triggers for ufw (0.35-0ubuntu2) ...
cisco@dlep-sim-radio-a1:~$ sudo service ssh status
● ssh.service - OpenBSD Secure Shell server
   Loaded: loaded (/lib/systemd/system/ssh.service; enabled; vendor preset: enab
   Active: active (running) since Thu 2023-08-03 13:20:06 EDT; 10s ago
   Main PID: 3630 (sshd)
   CGroup: /system.slice/ssh.service
           └─3630 /usr/sbin/sshd -D

Aug 03 13:20:06 dlep-sim-radio-a1 systemd[1]: Starting OpenBSD Secure Shell serv
Aug 03 13:20:06 dlep-sim-radio-a1 sshd[3630]: Server listening on 0.0.0.0 port 2
Aug 03 13:20:06 dlep-sim-radio-a1 sshd[3630]: Server listening on :: port 22.
Aug 03 13:20:06 dlep-sim-radio-a1 systemd[1]: Started OpenBSD Secure Shell serve
cisco@dlep-sim-radio-a1:~$

```

```
ssh cisco@10.100.13.13
```

```
The authenticity of host '10.100.13.13 (10.100.13.13)' can't be established.
```

```
ED25519 key fingerprint is SHA256:F2Uz7pfUtbnDn5mL7soy5ATo02uL1F89aEqRJYyef7Y.
```

```
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '10.100.13.13' (ED25519) to the list of known hosts.
cisco@10.100.13.13's password:
Welcome to Ubuntu 16.04.7 LTS (GNU/Linux 4.15.0-112-generic x86_64)
```

```
* Documentation: https://help.ubuntu.com
* Management: https://landscape.canonical.com
* Support: https://ubuntu.com/advantage
```

```
197 packages can be updated.
164 updates are security updates.
```

```
New release '18.04.6 LTS' available.
Run 'do-release-upgrade' to upgrade to it.
```

The programs included with the Ubuntu system are free software; the exact distribution terms for each program are described in the individual files in `/usr/share/doc/*/*copyright`.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by applicable law.

```
cisco@dlep-sim-radio-a1:~$ sudo apt-get update
[sudo] password for cisco:
Hit:1 http://security.ubuntu.com/ubuntu xenial-security InRelease
Hit:2 http://us.archive.ubuntu.com/ubuntu xenial InRelease
Hit:3 http://us.archive.ubuntu.com/ubuntu xenial-updates InRelease
Hit:4 http://us.archive.ubuntu.com/ubuntu xenial-backports InRelease
Reading package lists... Done
cisco@dlep-sim-radio-a1:~$ date
Thu Aug 3 13:29:29 EDT 2023
cisco@dlep-sim-radio-a1:~$ sudo apt install libboost-thread-dev libboost-system-dev libboost-test-dev libxml2 libxml2-dev libxml2-
utils libreadline6-dev libprotobuf-dev protobuf-compiler doxygen graphviz cmake git build-essential
Reading package lists... Done
Building dependency tree
Reading state information... Done
build-essential is already the newest version (12.1ubuntu2).
libxml2 is already the newest version (2.9.3+dfsg1-1ubuntu0.7).
The following additional packages will be installed:
  cmake-data git-man icu-devtools libboost-atomic1.58-dev libboost-atomic1.58.0 libboost-chrono1.58-dev libboost-chrono1.58.0
libboost-date-time1.58-dev libboost-serialization1.58-dev
  libboost-serialization1.58.0 libboost-system1.58-dev libboost-test1.58-dev libboost-test1.58.0 libboost-thread1.58-dev libboost-
thread1.58.0 libboost1.58-dev libcdt5 libcgraph6 libclang1-3.8
  liberror-perl libgvc6 libgvpr2 libicu-dev libjsoncpp1 libobjc5-dev libobjc4 libpathplan4 libprotoc9v5 libtinfo-dev zlib1g-dev
Suggested packages:
  codeblocks eclipse ninja-build doxygen-latex doxygen-doc doxygen-gui git-daemon-run | git-daemon-sysvinit git-doc git-el git-email
git-gui gitk gitweb git-arch git-cvs git-mediawiki git-svn graphviz-doc
  libboost1.58-doc libboost-context1.58-dev libboost-coroutine1.58-dev libboost-exception1.58-dev libboost-filesystem1.58-dev
libboost-graph1.58-dev libboost-graph-parallel1.58-dev
  libboost-iostreams1.58-dev libboost-locale1.58-dev libboost-log1.58-dev libboost-math1.58-dev libboost-mpi1.58-dev libboost-mpi-
python1.58-dev libboost-program-options1.58-dev libboost-python1.58-dev
  libboost-random1.58-dev libboost-regex1.58-dev libboost-signals1.58-dev libboost-timer1.58-dev libboost-wave1.58-dev
libboost1.58-tools-dev libmpfr++-dev libntl-dev icu-doc readline-doc
The following NEW packages will be installed:
  cmake cmake-data doxygen git git-man graphviz icu-devtools libboost-atomic1.58-dev libboost-atomic1.58.0 libboost-chrono1.58-
dev libboost-chrono1.58.0 libboost-date-time1.58-dev
```

```

libboost-serialization1.58-dev libboost-serialization1.58.0 libboost-system-dev libboost-system1.58-dev libboost-test-dev libboost-
test1.58-dev libboost-test1.58.0 libboost-thread-dev
libboost-thread1.58-dev libboost-thread1.58.0 libboost1.58-dev libcdt5 libcgraph6 libclang1-3.8 liberror-perl libgvc6 libgvpr2 libicu-
dev libjsoncpp1 libobjc-5-dev libobjc4 libpathplan4 libprotobuf-dev
libprotoc9v5 libreadline6-dev libtinfo-dev libxml2-dev libxml2-utils protobuf-compiler zlib1g-dev
0 upgraded, 42 newly installed, 0 to remove and 191 not upgraded.
Need to get 35.3 MB of archives.
After this operation, 258 MB of additional disk space will be used.
Do you want to continue? [Y/n]
Get:1 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 cmake-data all 3.5.1-1ubuntu3 [1,121 kB]
Get:2 http://us.archive.ubuntu.com/ubuntu xenial/main amd64 libjsoncpp1 amd64 1.7.2-1 [73.0 kB]
Get:3 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 cmake amd64 3.5.1-1ubuntu3 [2,623 kB]
Get:4 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 libobjc4 amd64 5.4.0-6ubuntu1~16.04.12 [111 kB]
Get:5 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 libobjc-5-dev amd64 5.4.0-6ubuntu1~16.04.12 [381 kB]
Get:6 http://us.archive.ubuntu.com/ubuntu xenial-updates/universe amd64 libclang1-3.8 amd64 1:3.8-2ubuntu4 [4,139 kB]
Get:7 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 doxygen amd64 1.8.11-1ubuntu0.1 [3,679 kB]
Get:8 http://us.archive.ubuntu.com/ubuntu xenial/main amd64 liberror-perl all 0.17-1.2 [19.6 kB]
Get:9 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 git-man all 1:2.7.4-0ubuntu1.10 [737 kB]
Get:10 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 git amd64 1:2.7.4-0ubuntu1.10 [3,183 kB]
Get:11 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 libcdt5 amd64 2.38.0-12ubuntu2.1 [23.4 kB]
Get:12 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 libcgraph6 amd64 2.38.0-12ubuntu2.1 [43.6 kB]
Get:13 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 libpathplan4 amd64 2.38.0-12ubuntu2.1 [26.6 kB]
Get:14 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 libgvc6 amd64 2.38.0-12ubuntu2.1 [591 kB]
Get:15 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 libgvpr2 amd64 2.38.0-12ubuntu2.1 [170 kB]
Get:16 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 graphviz amd64 2.38.0-12ubuntu2.1 [680 kB]
Get:17 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 icu-devtools amd64 55.1-7ubuntu0.5 [166 kB]
Get:18 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 libboost1.58-dev amd64 1.58.0+dfsg-5ubuntu3.1 [6,222 kB]
Get:19 http://us.archive.ubuntu.com/ubuntu xenial-updates/universe amd64 libboost-atomic1.58.0 amd64 1.58.0+dfsg-5ubuntu3.1
[7,120 B]
Get:20 http://us.archive.ubuntu.com/ubuntu xenial-updates/universe amd64 libboost-atomic1.58-dev amd64 1.58.0+dfsg-5ubuntu3.1
[5,026 B]
Get:21 http://us.archive.ubuntu.com/ubuntu xenial-updates/universe amd64 libboost-chrono1.58.0 amd64 1.58.0+dfsg-5ubuntu3.1
[13.2 kB]
Get:22 http://us.archive.ubuntu.com/ubuntu xenial-updates/universe amd64 libboost-chrono1.58-dev amd64 1.58.0+dfsg-
5ubuntu3.1 [15.6 kB]
Get:23 http://us.archive.ubuntu.com/ubuntu xenial-updates/universe amd64 libboost-serialization1.58.0 amd64 1.58.0+dfsg-
5ubuntu3.1 [113 kB]
Get:24 http://us.archive.ubuntu.com/ubuntu xenial-updates/universe amd64 libboost-serialization1.58-dev amd64 1.58.0+dfsg-
5ubuntu3.1 [147 kB]
Get:25 http://us.archive.ubuntu.com/ubuntu xenial-updates/universe amd64 libboost-date-time1.58-dev amd64 1.58.0+dfsg-
5ubuntu3.1 [27.4 kB]
Get:26 http://us.archive.ubuntu.com/ubuntu xenial-updates/universe amd64 libboost-system1.58-dev amd64 1.58.0+dfsg-
5ubuntu3.1 [8,526 B]
Get:27 http://us.archive.ubuntu.com/ubuntu xenial/universe amd64 libboost-system-dev amd64 1.58.0.1ubuntu1 [2,930 B]
Get:28 http://us.archive.ubuntu.com/ubuntu xenial-updates/universe amd64 libboost-test1.58.0 amd64 1.58.0+dfsg-5ubuntu3.1 [188
kB]
Get:29 http://us.archive.ubuntu.com/ubuntu xenial-updates/universe amd64 libboost-test1.58-dev amd64 1.58.0+dfsg-5ubuntu3.1
[232 kB]
Get:30 http://us.archive.ubuntu.com/ubuntu xenial/universe amd64 libboost-test-dev amd64 1.58.0.1ubuntu1 [2,830 B]
Get:31 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 libboost-thread1.58.0 amd64 1.58.0+dfsg-5ubuntu3.1 [47.0
kB]
Get:32 http://us.archive.ubuntu.com/ubuntu xenial-updates/universe amd64 libboost-thread1.58-dev amd64 1.58.0+dfsg-5ubuntu3.1
[48.8 kB]
Get:33 http://us.archive.ubuntu.com/ubuntu xenial/universe amd64 libboost-thread-dev amd64 1.58.0.1ubuntu1 [2,818 B]
Get:34 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 libicu-dev amd64 55.1-7ubuntu0.5 [8,546 kB]
Get:35 http://us.archive.ubuntu.com/ubuntu xenial/main amd64 libprotoc9v5 amd64 2.6.1-1.3 [273 kB]
Get:36 http://us.archive.ubuntu.com/ubuntu xenial/main amd64 libtinfo-dev amd64 6.0+20160213-1ubuntu1 [77.4 kB]
Get:37 http://us.archive.ubuntu.com/ubuntu xenial/main amd64 libreadline6-dev amd64 6.3-8ubuntu2 [124 kB]
Get:38 http://us.archive.ubuntu.com/ubuntu xenial-updates/main amd64 libxml2-dev amd64 2.9.3+dfsg1-1ubuntu0.7 [744 kB]

```

Get:39 <http://us.archive.ubuntu.com/ubuntu/xenial-updates/main/amd64/libxml2-utils> amd64 2.9.3+dfsg1-1ubuntu0.7 [35.0 kB]  
Get:40 <http://us.archive.ubuntu.com/ubuntu/xenial-updates/main/amd64/zlib1g-dev> amd64 1:1.2.8.dfsg-2ubuntu4.3 [167 kB]  
Get:41 <http://us.archive.ubuntu.com/ubuntu/xenial/main/amd64/libprotobuf-dev> amd64 2.6.1-1.3 [473 kB]  
Get:42 <http://us.archive.ubuntu.com/ubuntu/xenial/main/amd64/protobuf-compiler> amd64 2.6.1-1.3 [20.4 kB]  
Fetched 35.3 MB in 1s (18.0 MB/s)  
Extracting templates from packages: 100%  
Selecting previously unselected package cmake-data.  
(Reading database ... 179852 files and directories currently installed.)  
Preparing to unpack .../cmake-data\_3.5.1-1ubuntu3\_all.deb ...  
Unpacking cmake-data (3.5.1-1ubuntu3) ...  
Selecting previously unselected package libjsoncpp1:amd64.  
Preparing to unpack .../libjsoncpp1\_1.7.2-1\_amd64.deb ...  
Unpacking libjsoncpp1:amd64 (1.7.2-1) ...  
Selecting previously unselected package cmake.  
Preparing to unpack .../cmake\_3.5.1-1ubuntu3\_amd64.deb ...  
Unpacking cmake (3.5.1-1ubuntu3) ...  
Selecting previously unselected package libobjc4:amd64.  
Preparing to unpack .../libobjc4\_5.4.0-6ubuntu1~16.04.12\_amd64.deb ...  
Unpacking libobjc4:amd64 (5.4.0-6ubuntu1~16.04.12) ...  
Selecting previously unselected package libobjc-5-dev:amd64.  
Preparing to unpack .../libobjc-5-dev\_5.4.0-6ubuntu1~16.04.12\_amd64.deb ...  
Unpacking libobjc-5-dev:amd64 (5.4.0-6ubuntu1~16.04.12) ...  
Selecting previously unselected package libclang1-3.8:amd64.  
Preparing to unpack .../libclang1-3.8\_1%3a3.8-2ubuntu4\_amd64.deb ...  
Unpacking libclang1-3.8:amd64 (1:3.8-2ubuntu4) ...  
Selecting previously unselected package doxygen.  
Preparing to unpack .../doxygen\_1.8.11-1ubuntu0.1\_amd64.deb ...  
Unpacking doxygen (1.8.11-1ubuntu0.1) ...  
Selecting previously unselected package liberror-perl.  
Preparing to unpack .../liberror-perl\_0.17-1.2\_all.deb ...  
Unpacking liberror-perl (0.17-1.2) ...  
Selecting previously unselected package git-man.  
Preparing to unpack .../git-man\_1%3a2.7.4-0ubuntu1.10\_all.deb ...  
Unpacking git-man (1:2.7.4-0ubuntu1.10) ...  
Selecting previously unselected package git.  
Preparing to unpack .../git\_1%3a2.7.4-0ubuntu1.10\_amd64.deb ...  
Unpacking git (1:2.7.4-0ubuntu1.10) ...  
Selecting previously unselected package libcdt5.  
Preparing to unpack .../libcdt5\_2.38.0-12ubuntu2.1\_amd64.deb ...  
Unpacking libcdt5 (2.38.0-12ubuntu2.1) ...  
Selecting previously unselected package libcgraph6.  
Preparing to unpack .../libcgraph6\_2.38.0-12ubuntu2.1\_amd64.deb ...  
Unpacking libcgraph6 (2.38.0-12ubuntu2.1) ...  
Selecting previously unselected package libpathplan4.  
Preparing to unpack .../libpathplan4\_2.38.0-12ubuntu2.1\_amd64.deb ...  
Unpacking libpathplan4 (2.38.0-12ubuntu2.1) ...  
Selecting previously unselected package libgvc6.  
Preparing to unpack .../libgvc6\_2.38.0-12ubuntu2.1\_amd64.deb ...  
Unpacking libgvc6 (2.38.0-12ubuntu2.1) ...  
Selecting previously unselected package libgvpr2.  
Preparing to unpack .../libgvpr2\_2.38.0-12ubuntu2.1\_amd64.deb ...  
Unpacking libgvpr2 (2.38.0-12ubuntu2.1) ...  
Selecting previously unselected package graphviz.  
Preparing to unpack .../graphviz\_2.38.0-12ubuntu2.1\_amd64.deb ...  
Unpacking graphviz (2.38.0-12ubuntu2.1) ...  
Selecting previously unselected package icu-devtools.  
Preparing to unpack .../icu-devtools\_55.1-7ubuntu0.5\_amd64.deb ...  
Unpacking icu-devtools (55.1-7ubuntu0.5) ...  
Selecting previously unselected package libboost1.58-dev:amd64.

```
Preparing to unpack .../libboost1.58-dev_1.58.0+dfsg-5ubuntu3.1_amd64.deb ...
Unpacking libboost1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Selecting previously unselected package libboost-atomic1.58.0:amd64.
Preparing to unpack .../libboost-atomic1.58.0_1.58.0+dfsg-5ubuntu3.1_amd64.deb ...
Unpacking libboost-atomic1.58.0:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Selecting previously unselected package libboost-atomic1.58-dev:amd64.
Preparing to unpack .../libboost-atomic1.58-dev_1.58.0+dfsg-5ubuntu3.1_amd64.deb ...
Unpacking libboost-atomic1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Selecting previously unselected package libboost-chrono1.58.0:amd64.
Preparing to unpack .../libboost-chrono1.58.0_1.58.0+dfsg-5ubuntu3.1_amd64.deb ...
Unpacking libboost-chrono1.58.0:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Selecting previously unselected package libboost-chrono1.58-dev:amd64.
Preparing to unpack .../libboost-chrono1.58-dev_1.58.0+dfsg-5ubuntu3.1_amd64.deb ...
Unpacking libboost-chrono1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Selecting previously unselected package libboost-serialization1.58.0:amd64.
Preparing to unpack .../libboost-serialization1.58.0_1.58.0+dfsg-5ubuntu3.1_amd64.deb ...
Unpacking libboost-serialization1.58.0:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Selecting previously unselected package libboost-serialization1.58-dev:amd64.
Preparing to unpack .../libboost-serialization1.58-dev_1.58.0+dfsg-5ubuntu3.1_amd64.deb ...
Unpacking libboost-serialization1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Selecting previously unselected package libboost-date-time1.58-dev:amd64.
Preparing to unpack .../libboost-date-time1.58-dev_1.58.0+dfsg-5ubuntu3.1_amd64.deb ...
Unpacking libboost-date-time1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Selecting previously unselected package libboost-system1.58-dev:amd64.
Preparing to unpack .../libboost-system1.58-dev_1.58.0+dfsg-5ubuntu3.1_amd64.deb ...
Unpacking libboost-system1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Selecting previously unselected package libboost-system-dev:amd64.
Preparing to unpack .../libboost-system-dev_1.58.0.1ubuntu1_amd64.deb ...
Unpacking libboost-system-dev:amd64 (1.58.0.1ubuntu1) ...
Selecting previously unselected package libboost-test1.58.0:amd64.
Preparing to unpack .../libboost-test1.58.0_1.58.0+dfsg-5ubuntu3.1_amd64.deb ...
Unpacking libboost-test1.58.0:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Selecting previously unselected package libboost-test1.58-dev:amd64.
Preparing to unpack .../libboost-test1.58-dev_1.58.0+dfsg-5ubuntu3.1_amd64.deb ...
Unpacking libboost-test1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Selecting previously unselected package libboost-test-dev:amd64.
Preparing to unpack .../libboost-test-dev_1.58.0.1ubuntu1_amd64.deb ...
Unpacking libboost-test-dev:amd64 (1.58.0.1ubuntu1) ...
Selecting previously unselected package libboost-thread1.58.0:amd64.
Preparing to unpack .../libboost-thread1.58.0_1.58.0+dfsg-5ubuntu3.1_amd64.deb ...
Unpacking libboost-thread1.58.0:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Selecting previously unselected package libboost-thread1.58-dev:amd64.
Preparing to unpack .../libboost-thread1.58-dev_1.58.0+dfsg-5ubuntu3.1_amd64.deb ...
Unpacking libboost-thread1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Selecting previously unselected package libboost-thread-dev:amd64.
Preparing to unpack .../libboost-thread-dev_1.58.0.1ubuntu1_amd64.deb ...
Unpacking libboost-thread-dev:amd64 (1.58.0.1ubuntu1) ...
Selecting previously unselected package libicu-dev:amd64.
Preparing to unpack .../libicu-dev_55.1-7ubuntu0.5_amd64.deb ...
Unpacking libicu-dev:amd64 (55.1-7ubuntu0.5) ...
Selecting previously unselected package libprotoc9v5:amd64.
Preparing to unpack .../libprotoc9v5_2.6.1-1.3_amd64.deb ...
Unpacking libprotoc9v5:amd64 (2.6.1-1.3) ...
Selecting previously unselected package libtinfo-dev:amd64.
Preparing to unpack .../libtinfo-dev_6.0+20160213-1ubuntu1_amd64.deb ...
Unpacking libtinfo-dev:amd64 (6.0+20160213-1ubuntu1) ...
Selecting previously unselected package libreadline6-dev:amd64.
Preparing to unpack .../libreadline6-dev_6.3-8ubuntu2_amd64.deb ...
Unpacking libreadline6-dev:amd64 (6.3-8ubuntu2) ...
```



```
Selecting previously unselected package libxml2-dev:amd64.
Preparing to unpack .../libxml2-dev_2.9.3+dfsg1-1ubuntu0.7_amd64.deb ...
Unpacking libxml2-dev:amd64 (2.9.3+dfsg1-1ubuntu0.7) ...
Selecting previously unselected package libxml2-utils.
Preparing to unpack .../libxml2-utils_2.9.3+dfsg1-1ubuntu0.7_amd64.deb ...
Unpacking libxml2-utils (2.9.3+dfsg1-1ubuntu0.7) ...
Selecting previously unselected package zlib1g-dev:amd64.
Preparing to unpack .../zlib1g-dev_1%3a1.2.8.dfsg-2ubuntu4.3_amd64.deb ...
Unpacking zlib1g-dev:amd64 (1:1.2.8.dfsg-2ubuntu4.3) ...
Selecting previously unselected package libprotobuf-dev:amd64.
Preparing to unpack .../libprotobuf-dev_2.6.1-1.3_amd64.deb ...
Unpacking libprotobuf-dev:amd64 (2.6.1-1.3) ...
Selecting previously unselected package protobuf-compiler.
Preparing to unpack .../protobuf-compiler_2.6.1-1.3_amd64.deb ...
Unpacking protobuf-compiler (2.6.1-1.3) ...
Processing triggers for man-db (2.7.5-1) ...
Processing triggers for libc-bin (2.23-0ubuntu11.2) ...
Processing triggers for install-info (6.1.0.dfsg.1-5) ...
Setting up cmake-data (3.5.1-1ubuntu3) ...
Setting up libjsoncpp1:amd64 (1.7.2-1) ...
Setting up cmake (3.5.1-1ubuntu3) ...
Setting up libobjc4:amd64 (5.4.0-6ubuntu1~16.04.12) ...
Setting up libobjc-5-dev:amd64 (5.4.0-6ubuntu1~16.04.12) ...
Setting up libclang1-3.8:amd64 (1:3.8-2ubuntu4) ...
Setting up doxygen (1.8.11-1ubuntu0.1) ...
Setting up liberror-perl (0.17-1.2) ...
Setting up git-man (1:2.7.4-0ubuntu1.10) ...
Setting up git (1:2.7.4-0ubuntu1.10) ...
Setting up libcdt5 (2.38.0-12ubuntu2.1) ...
Setting up libcgraph6 (2.38.0-12ubuntu2.1) ...
Setting up libpathplan4 (2.38.0-12ubuntu2.1) ...
Setting up libgvc6 (2.38.0-12ubuntu2.1) ...
Setting up libgvpr2 (2.38.0-12ubuntu2.1) ...
Setting up graphviz (2.38.0-12ubuntu2.1) ...
Setting up icu-devtools (55.1-7ubuntu0.5) ...
Setting up libboost1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Setting up libboost-atomic1.58.0:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Setting up libboost-atomic1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Setting up libboost-chrono1.58.0:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Setting up libboost-chrono1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Setting up libboost-serialization1.58.0:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Setting up libboost-serialization1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Setting up libboost-date-time1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Setting up libboost-system1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Setting up libboost-system-dev:amd64 (1.58.0.1ubuntu1) ...
Setting up libboost-test1.58.0:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Setting up libboost-test1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Setting up libboost-test-dev:amd64 (1.58.0.1ubuntu1) ...
Setting up libboost-thread1.58.0:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Setting up libboost-thread1.58-dev:amd64 (1.58.0+dfsg-5ubuntu3.1) ...
Setting up libboost-thread-dev:amd64 (1.58.0.1ubuntu1) ...
Setting up libicu-dev:amd64 (55.1-7ubuntu0.5) ...
Setting up libprotoc9v5:amd64 (2.6.1-1.3) ...
Setting up libtinfo-dev:amd64 (6.0+20160213-1ubuntu1) ...
Setting up libreadline6-dev:amd64 (6.3-8ubuntu2) ...
Setting up libxml2-dev:amd64 (2.9.3+dfsg1-1ubuntu0.7) ...
Setting up libxml2-utils (2.9.3+dfsg1-1ubuntu0.7) ...
Setting up zlib1g-dev:amd64 (1:1.2.8.dfsg-2ubuntu4.3) ...
Setting up libprotobuf-dev:amd64 (2.6.1-1.3) ...
```

```

Setting up protobuf-compiler (2.6.1-1.3) ...
Processing triggers for libc-bin (2.23-0ubuntu11.2) ...
cisco@dlep-sim-radio-a1:~$
cisco@dlep-sim-radio-a1:~$
cisco@dlep-sim-radio-a1:~$
cisco@dlep-sim-radio-a1:~$ pwd
/home/cisco
cisco@dlep-sim-radio-a1:~$ mkdir dlep
cisco@dlep-sim-radio-a1:~$ cd dlep
cisco@dlep-sim-radio-a1:~/dlep$ cd ..
cisco@dlep-sim-radio-a1:~$ rmdir dlep
cisco@dlep-sim-radio-a1:~$ mkdir dlep-top
cisco@dlep-sim-radio-a1:~$ cd dlep-top/
cisco@dlep-sim-radio-a1:~/dlep-top$ git clone https://github.com/mit-ll/LL-DLEP
Cloning into 'LL-DLEP'...
remote: Enumerating objects: 503, done.
remote: Total 503 (delta 0), reused 0 (delta 0), pack-reused 503
Receiving objects: 100% (503/503), 560.70 KiB | 0 bytes/s, done.
Resolving deltas: 100% (292/292), done.
Checking connectivity... done.
cisco@dlep-sim-radio-a1:~/dlep-top$ ls
LL-DLEP
cisco@dlep-sim-radio-a1:~/dlep-top$ ls LL-DLEP/
astylerc      Dataltem.h      destadvert.proto DlepInit.h      DlepServiceImpl.cpp  IdTypes.h      MultiHop.h
PeerDiscovery.h  ProtocolConfigImpl.h Table.cpp
build      DestAdvert.cpp  DlepClient.h      DlepLogger.cpp  DlepServiceImpl.h    InfoBaseMgr.cpp NetUtils.cpp
Peer.h          ProtocolMessage.cpp Table.h
build-defs.h.in DestAdvertDataBase.h DlepCommon.h      DlepLogger.h      doc                InfoBaseMgr.h  NetUtils.h
PeriodicMcastSendRcv.cpp ProtocolMessage.h  tests
CMakeLists.txt DestAdvert.h      Dlep.cpp          DlepMac.cpp      ExampleDlepClientImpl.cpp LatencyRange.h package
PeriodicMcastSendRcv.h README.md          Thread.h
config     DestAdvertInfo.h Dlep.h            DlepMac.h        ExampleDlepClientImpl.h libdlep.pc.in  Peer.cpp
ProtocolConfig.h  RELEASENOTES.md
Dataltem.cpp     DestAdvertMessage.h DlepInit.cpp      DlepService.h     ExampleMain.cpp      LICENSE
PeerDiscovery.cpp ProtocolConfigImpl.cpp Serialize.h
cisco@dlep-sim-radio-a1:~/dlep-top$ cd LL-DLEP/
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP$ ls
astylerc      Dataltem.h      destadvert.proto DlepInit.h      DlepServiceImpl.cpp  IdTypes.h      MultiHop.h
PeerDiscovery.h  ProtocolConfigImpl.h Table.cpp
build      DestAdvert.cpp  DlepClient.h      DlepLogger.cpp  DlepServiceImpl.h    InfoBaseMgr.cpp NetUtils.cpp
Peer.h          ProtocolMessage.cpp Table.h
build-defs.h.in DestAdvertDataBase.h DlepCommon.h      DlepLogger.h      doc                InfoBaseMgr.h  NetUtils.h
PeriodicMcastSendRcv.cpp ProtocolMessage.h  tests
CMakeLists.txt DestAdvert.h      Dlep.cpp          DlepMac.cpp      ExampleDlepClientImpl.cpp LatencyRange.h package
PeriodicMcastSendRcv.h README.md          Thread.h
config     DestAdvertInfo.h Dlep.h            DlepMac.h        ExampleDlepClientImpl.h libdlep.pc.in  Peer.cpp
ProtocolConfig.h  RELEASENOTES.md
Dataltem.cpp     DestAdvertMessage.h DlepInit.cpp      DlepService.h     ExampleMain.cpp      LICENSE
PeerDiscovery.cpp ProtocolConfigImpl.cpp Serialize.h
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP$ cd build
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$ pwd
/home/cisco/dlep-top/LL-DLEP/build
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$ cmake ..
-- The C compiler identification is GNU 5.4.0
-- The CXX compiler identification is GNU 5.4.0
-- Check for working C compiler: /usr/bin/cc
-- Check for working C compiler: /usr/bin/cc -- works
-- Detecting C compiler ABI info
-- Detecting C compiler ABI info - done

```

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-- Detecting C compile features
-- Detecting C compile features - done
-- Check for working CXX compiler: /usr/bin/c++
-- Check for working CXX compiler: /usr/bin/c++ -- works
-- Detecting CXX compiler ABI info
-- Detecting CXX compiler ABI info - done
-- Detecting CXX compile features
-- Detecting CXX compile features - done
-- Performing Test COMPILER_SUPPORTS_CXX11
-- Performing Test COMPILER_SUPPORTS_CXX11 - Success
-- Found LibXml2: /usr/lib/x86_64-linux-gnu/libxml2.so (found version "2.9.3")
-- Looking for pthread.h
-- Looking for pthread.h - found
-- Looking for pthread_create
-- Looking for pthread_create - not found
-- Looking for pthread_create in pthreads
-- Looking for pthread_create in pthreads - not found
-- Looking for pthread_create in pthread
-- Looking for pthread_create in pthread - found
-- Found Threads: TRUE
-- Found Protobuf: /usr/lib/x86_64-linux-gnu/libprotobuf.so
-- Boost version: 1.58.0
-- Found the following Boost libraries:
-- system
-- thread
-- chrono
-- date_time
-- atomic
-- Found Doxygen: /usr/bin/doxygen (found version "1.8.11")
-- Boost version: 1.58.0
-- Found the following Boost libraries:
-- unit_test_framework
-- Configuring done
-- Generating done
-- Build files have been written to: /home/cisco/dlep-top/LL-DLEP/build
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$ make
[ 3%] Running C++ protocol buffer compiler on destadvert.proto
Scanning dependencies of target dlepObj
[ 6%] Building CXX object CMakeFiles/dlepObj.dir/DestAdvert.cpp.o
[ 9%] Building CXX object CMakeFiles/dlepObj.dir/DlepInit.cpp.o
[ 12%] Building CXX object CMakeFiles/dlepObj.dir/DlepLogger.cpp.o
[ 16%] Building CXX object CMakeFiles/dlepObj.dir/Dlep.cpp.o
[ 19%] Building CXX object CMakeFiles/dlepObj.dir/Peer.cpp.o
[ 22%] Building CXX object CMakeFiles/dlepObj.dir/InfoBaseMgr.cpp.o
[ 25%] Building CXX object CMakeFiles/dlepObj.dir/PeerDiscovery.cpp.o
[ 29%] Building CXX object CMakeFiles/dlepObj.dir/DlepServiceImpl.cpp.o
[ 32%] Building CXX object CMakeFiles/dlepObj.dir/DlepMac.cpp.o
[ 35%] Building CXX object CMakeFiles/dlepObj.dir/PeriodicMcastSendRcv.cpp.o
[ 38%] Building CXX object CMakeFiles/dlepObj.dir/NetUtils.cpp.o
[ 41%] Building CXX object CMakeFiles/dlepObj.dir/ProtocolMessage.cpp.o
[ 45%] Building CXX object CMakeFiles/dlepObj.dir/DataItem.cpp.o
[ 48%] Building CXX object CMakeFiles/dlepObj.dir/ProtocolConfigImpl.cpp.o
[ 51%] Building CXX object CMakeFiles/dlepObj.dir/destadvert.pb.cc.o
[ 51%] Built target dlepObj

```

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Scanning dependencies of target dlepStatic
[ 54%] Linking CXX static library libdlep.a
[ 54%] Built target dlepStatic
Scanning dependencies of target dlepShared
[ 58%] Linking CXX shared library libdlep.so
[ 58%] Built target dlepShared
Scanning dependencies of target Dlep
[ 61%] Building CXX object CMakeFiles/Dlep.dir/ExampleMain.cpp.o
[ 64%] Building CXX object CMakeFiles/Dlep.dir/ExampleDlepClientImpl.cpp.o
[ 67%] Building CXX object CMakeFiles/Dlep.dir/Table.cpp.o
[ 70%] Linking CXX executable Dlep
[ 70%] Built target Dlep
Scanning dependencies of target doc
[ 74%] Generating documentation with doxygen
[ 74%] Built target doc
Scanning dependencies of target lib_tests
[ 77%] Building CXX object tests/CMakeFiles/lib_tests.dir/serialize.cpp.o
[ 80%] Building CXX object tests/CMakeFiles/lib_tests.dir/dataitems.cpp.o
[ 83%] Building CXX object tests/CMakeFiles/lib_tests.dir/messages.cpp.o
[ 87%] Building CXX object tests/CMakeFiles/lib_tests.dir/lib_interface.cpp.o
[ 90%] Building CXX object tests/CMakeFiles/lib_tests.dir/dest_advert.cpp.o
[ 93%] Building CXX object tests/CMakeFiles/lib_tests.dir/LogFile.cpp.o
[ 96%] Building CXX object tests/CMakeFiles/lib_tests.dir/TestClientImpl.cpp.o
[100%] Linking CXX executable lib_tests
[100%] Built target lib_tests
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$ ls
build-defs.h  CMakeFiles  config      CPackSourceConfig.cmake  destadvert.pb.cc  Dlep  libdlep.a  libdlep.so.2.1
pkgconfig
CMakeCache.txt  cmake_install.cmake  CPackConfig.cmake  CTestTestfile.cmake  destadvert.pb.h  doc  libdlep.so  Makefile
tests
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$ cd ..
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP$ ls
astylerc      Dataltem.h      destadvert.proto  DlepInit.h      DlepServiceImpl.cpp  IdTypes.h      MultiHop.h
PeerDiscovery.h  ProtocolConfigImpl.h  Table.cpp
build        DestAdvert.cpp  DlepClient.h      DlepLogger.cpp  DlepServiceImpl.h      InfoBaseMgr.cpp  NetUtils.cpp
Peer.h       ProtocolMessage.cpp  Table.h
build-defs.h.in  DestAdvertDataBase.h  DlepCommon.h      DlepLogger.h  doc                    InfoBaseMgr.h  NetUtils.h
PeriodicMcastSendRcv.cpp  ProtocolMessage.h  tests
CMakeLists.txt  DestAdvert.h      Dlep.cpp          DlepMac.cpp      ExampleDlepClientImpl.cpp  LatencyRange.h  package
PeriodicMcastSendRcv.h  README.md          Thread.h
config        DestAdvertInfo.h  Dlep.h            DlepMac.h      ExampleDlepClientImpl.h  libdlep.pc.in  Peer.cpp
ProtocolConfig.h  RELEASNOTES.md
Dataltem.cpp  DestAdvertMessage.h  DlepInit.cpp      DlepService.h  ExampleMain.cpp        LICENSE
PeerDiscovery.cpp  ProtocolConfigImpl.cpp  Serialize.h
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP$ ls doc
CMakeLists.txt  doxygen  doxygen.config.in
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP$ which Dlep
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP$ cd build
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$ make test
Running tests...
Test project /home/cisco/dlep-top/LL-DLEP/build
  Start 1: wellformedxml_protocol/dlep-rfc-8175.xml
1/9 Test #1: wellformedxml_protocol/dlep-rfc-8175.xml ..... Passed   0.03 sec
  Start 2: wellformedxml_protocol/protocol-config.xsd
2/9 Test #2: wellformedxml_protocol/protocol-config.xsd ..... Passed   0.00 sec
  Start 3: wellformedxml_protocol/example-extension-00.xml
3/9 Test #3: wellformedxml_protocol/example-extension-00.xml ... Passed   0.00 sec
  Start 4: wellformedxml_protocol/multi-hop-06.xml
4/9 Test #4: wellformedxml_protocol/multi-hop-06.xml ..... Passed   0.00 sec

```

```

Start 5: wellformedxml_protocol/latency-range-03.xml
5/9 Test #5: wellformedxml_protocol/latency-range-03.xml ..... Passed 0.00 sec
Start 6: wellformedxml_protocol/dlep-draft-29.xml
6/9 Test #6: wellformedxml_protocol/dlep-draft-29.xml ..... Passed 0.00 sec
Start 7: validatedxml_protocol/dlep-rfc-8175.xml
7/9 Test #7: validatedxml_protocol/dlep-rfc-8175.xml ..... Passed 0.04 sec
Start 8: validatedxml_protocol/dlep-draft-29.xml
8/9 Test #8: validatedxml_protocol/dlep-draft-29.xml ..... Passed 0.01 sec
Start 9: BoostTests
9/9 Test #9: BoostTests ..... Passed 37.80 sec

```

100% tests passed, 0 tests failed out of 9

Total Test time (real) = 37.90 sec

```

cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$ make VERBOSE=1
/usr/bin/cmake -H/home/cisco/dlep-top/LL-DLEP -B/home/cisco/dlep-top/LL-DLEP/build --check-build-system
CMakeFiles/Makefile.cmake 0
/usr/bin/cmake -E cmake_progress_start /home/cisco/dlep-top/LL-DLEP/build/CMakeFiles /home/cisco/dlep-top/LL-
DLEP/build/CMakeFiles/progress.marks
make -f CMakeFiles/Makefile2 all
make[1]: Entering directory '/home/cisco/dlep-top/LL-DLEP/build'
make -f CMakeFiles/dlepObj.dir/build.make CMakeFiles/dlepObj.dir/depend
make[2]: Entering directory '/home/cisco/dlep-top/LL-DLEP/build'
cd /home/cisco/dlep-top/LL-DLEP/build && /usr/bin/cmake -E cmake_depends "Unix Makefiles" /home/cisco/dlep-top/LL-DLEP
/home/cisco/dlep-top/LL-DLEP /home/cisco/dlep-top/LL-DLEP/build /home/cisco/dlep-top/LL-DLEP/build /home/cisco/dlep-top/LL-
DLEP/build/CMakeFiles/dlepObj.dir/DependInfo.cmake --color=
make[2]: Leaving directory '/home/cisco/dlep-top/LL-DLEP/build'
make -f CMakeFiles/dlepObj.dir/build.make CMakeFiles/dlepObj.dir/build
make[2]: Entering directory '/home/cisco/dlep-top/LL-DLEP/build'
make[2]: Nothing to be done for 'CMakeFiles/dlepObj.dir/build'.
make[2]: Leaving directory '/home/cisco/dlep-top/LL-DLEP/build'
[ 51%] Built target dlepObj
make -f CMakeFiles/dlepStatic.dir/build.make CMakeFiles/dlepStatic.dir/depend
make[2]: Entering directory '/home/cisco/dlep-top/LL-DLEP/build'
cd /home/cisco/dlep-top/LL-DLEP/build && /usr/bin/cmake -E cmake_depends "Unix Makefiles" /home/cisco/dlep-top/LL-DLEP
/home/cisco/dlep-top/LL-DLEP /home/cisco/dlep-top/LL-DLEP/build /home/cisco/dlep-top/LL-DLEP/build /home/cisco/dlep-top/LL-
DLEP/build/CMakeFiles/dlepStatic.dir/DependInfo.cmake --color=
make[2]: Leaving directory '/home/cisco/dlep-top/LL-DLEP/build'
make -f CMakeFiles/dlepStatic.dir/build.make CMakeFiles/dlepStatic.dir/build
make[2]: Entering directory '/home/cisco/dlep-top/LL-DLEP/build'
make[2]: Nothing to be done for 'CMakeFiles/dlepStatic.dir/build'.
make[2]: Leaving directory '/home/cisco/dlep-top/LL-DLEP/build'
[ 54%] Built target dlepStatic
make -f CMakeFiles/dlepShared.dir/build.make CMakeFiles/dlepShared.dir/depend
make[2]: Entering directory '/home/cisco/dlep-top/LL-DLEP/build'
cd /home/cisco/dlep-top/LL-DLEP/build && /usr/bin/cmake -E cmake_depends "Unix Makefiles" /home/cisco/dlep-top/LL-DLEP
/home/cisco/dlep-top/LL-DLEP /home/cisco/dlep-top/LL-DLEP/build /home/cisco/dlep-top/LL-DLEP/build /home/cisco/dlep-top/LL-
DLEP/build/CMakeFiles/dlepShared.dir/DependInfo.cmake --color=
make[2]: Leaving directory '/home/cisco/dlep-top/LL-DLEP/build'
make -f CMakeFiles/dlepShared.dir/build.make CMakeFiles/dlepShared.dir/build
make[2]: Entering directory '/home/cisco/dlep-top/LL-DLEP/build'
make[2]: Nothing to be done for 'CMakeFiles/dlepShared.dir/build'.
make[2]: Leaving directory '/home/cisco/dlep-top/LL-DLEP/build'
[ 58%] Built target dlepShared
make -f CMakeFiles/Dlep.dir/build.make CMakeFiles/Dlep.dir/depend
make[2]: Entering directory '/home/cisco/dlep-top/LL-DLEP/build'
cd /home/cisco/dlep-top/LL-DLEP/build && /usr/bin/cmake -E cmake_depends "Unix Makefiles" /home/cisco/dlep-top/LL-DLEP
/home/cisco/dlep-top/LL-DLEP /home/cisco/dlep-top/LL-DLEP/build /home/cisco/dlep-top/LL-DLEP/build /home/cisco/dlep-top/LL-
DLEP/build/CMakeFiles/Dlep.dir/DependInfo.cmake --color=

```

```

make[2]: Leaving directory '/home/cisco/dlep-top/LL-DLEP/build'
make -f CMakeFiles/Dlep.dir/build.make CMakeFiles/Dlep.dir/build
make[2]: Entering directory '/home/cisco/dlep-top/LL-DLEP/build'
make[2]: Nothing to be done for 'CMakeFiles/Dlep.dir/build'.
make[2]: Leaving directory '/home/cisco/dlep-top/LL-DLEP/build'
[ 70%] Built target Dlep
make -f doc/CMakeFiles/doc.dir/build.make doc/CMakeFiles/doc.dir/depend
make[2]: Entering directory '/home/cisco/dlep-top/LL-DLEP/build'
cd /home/cisco/dlep-top/LL-DLEP/build && /usr/bin/cmake -E cmake_depends "Unix Makefiles" /home/cisco/dlep-top/LL-DLEP
/home/cisco/dlep-top/LL-DLEP/doc /home/cisco/dlep-top/LL-DLEP/build /home/cisco/dlep-top/LL-DLEP/build/doc /home/cisco/dlep-
top/LL-DLEP/build/doc/CMakeFiles/doc.dir/DependInfo.cmake --color=
make[2]: Leaving directory '/home/cisco/dlep-top/LL-DLEP/build'
make -f doc/CMakeFiles/doc.dir/build.make doc/CMakeFiles/doc.dir/build
make[2]: Entering directory '/home/cisco/dlep-top/LL-DLEP/build'
[ 74%] Generating documentation with doxygen
cd /home/cisco/dlep-top/LL-DLEP/build/doc && /usr/bin/doxygen /home/cisco/dlep-top/LL-DLEP/build/doc/doxygen.config
make[2]: Leaving directory '/home/cisco/dlep-top/LL-DLEP/build'
[ 74%] Built target doc
make -f tests/CMakeFiles/lib_tests.dir/build.make tests/CMakeFiles/lib_tests.dir/depend
make[2]: Entering directory '/home/cisco/dlep-top/LL-DLEP/build'
cd /home/cisco/dlep-top/LL-DLEP/build && /usr/bin/cmake -E cmake_depends "Unix Makefiles" /home/cisco/dlep-top/LL-DLEP
/home/cisco/dlep-top/LL-DLEP/tests /home/cisco/dlep-top/LL-DLEP/build /home/cisco/dlep-top/LL-DLEP/build/tests
/home/cisco/dlep-top/LL-DLEP/build/tests/CMakeFiles/lib_tests.dir/DependInfo.cmake --color=
make[2]: Leaving directory '/home/cisco/dlep-top/LL-DLEP/build'
make -f tests/CMakeFiles/lib_tests.dir/build.make tests/CMakeFiles/lib_tests.dir/build
make[2]: Entering directory '/home/cisco/dlep-top/LL-DLEP/build'
make[2]: Nothing to be done for 'tests/CMakeFiles/lib_tests.dir/build'.
make[2]: Leaving directory '/home/cisco/dlep-top/LL-DLEP/build'
[100%] Built target lib_tests
make[1]: Leaving directory '/home/cisco/dlep-top/LL-DLEP/build'
/usr/bin/cmake -E cmake_progress_start /home/cisco/dlep-top/LL-DLEP/build/CMakeFiles 0
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$ sudo make install
[sudo] password for cisco:
[ 51%] Built target dlepObj
[ 54%] Built target dlepStatic
[ 58%] Built target dlepShared
[ 70%] Built target Dlep
[ 74%] Generating documentation with doxygen
[ 74%] Built target doc
[100%] Built target lib_tests
Install the project...
-- Install configuration: ""
-- Installing: /usr/local/lib/libdlep.so.2.1
-- Installing: /usr/local/lib/libdlep.so
-- Set runtime path of "/usr/local/lib/libdlep.so.2.1" to "/usr/local/lib"
-- Installing: /usr/local/bin/Dlep
-- Set runtime path of "/usr/local/bin/Dlep" to "/usr/local/lib"
-- Installing: /usr/local/include/DlepInit.h
-- Installing: /usr/local/include/DlepClient.h
-- Installing: /usr/local/include/DlepService.h
-- Installing: /usr/local/include/DlepCommon.h
-- Installing: /usr/local/include/Dataltem.h
-- Installing: /usr/local/include/ProtocolConfig.h
-- Installing: /usr/local/include/IdTypes.h
-- Installing: /usr/local/include/DlepMac.h
-- Installing: /usr/local/include/Serialize.h

```

```
-- Installing: /usr/local/include/LatencyRange.h
-- Installing: /usr/local/include/MultiHop.h
-- Installing: /usr/local/share/pkgconfig
-- Installing: /usr/local/share/pkgconfig/libdlep.pc
-- Installing: /usr/local/share/dlep/copyright
-- Installing: /usr/local/etc/dlep/dlep-rfc-8175.xml
-- Installing: /usr/local/etc/dlep/protocol-config.xsd
-- Installing: /usr/local/etc/dlep/example-extension-00.xml
-- Installing: /usr/local/etc/dlep/multi-hop-06.xml
-- Installing: /usr/local/etc/dlep/latency-range-03.xml
-- Installing: /usr/local/etc/dlep/dlep-draft-29.xml
-- Up-to-date: /usr/local/share/dlep
-- Installing: /usr/local/share/dlep/html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1PeerDiscovery__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/namespaces.html
-- Installing: /usr/local/share/dlep/html/tab_s.png
-- Installing: /usr/local/share/dlep/html/Serialize_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div__u8_ipv6__u8__t.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadSignalName-members.html
-- Installing: /usr/local/share/dlep/html/classDlepClientImpl__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_36.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadModuleName__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/Peer_8cpp.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ResponsePending__coll__graph.png
-- Installing: /usr/local/share/dlep/html/DlepLogger_8cpp_incl.map
-- Installing: /usr/local/share/dlep/html/ProtocolConfigImpl_8h.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadSignalId__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1PeerDiscovery__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/functions_func_f.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_12.map
-- Installing: /usr/local/share/dlep/html/PeriodicMcastSendRcv_8cpp_incl.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1DestinationInfo__coll__graph.png
-- Installing: /usr/local/share/dlep/html/DlepLogger_8cpp.html
-- Installing: /usr/local/share/dlep/html/ProtocolConfig_8h_incl.png
-- Installing: /usr/local/share/dlep/html/Thread_8h.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemFlagsVisitor__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/PeerDiscovery_8h_incl.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemEqualVisitor__coll__graph.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemValidateVisitor__coll__graph.map
-- Installing: /usr/local/share/dlep/html/open.png
-- Installing: /usr/local/share/dlep/html/DestAdvertDataBase_8h_incl.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1PeerDiscovery-members.html
-- Installing: /usr/local/share/dlep/html/DlepMac_8h.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div__v_extid__t-members.html
-- Installing: /usr/local/share/dlep/html/nav_h.png
-- Installing: /usr/local/share/dlep/html/tab_h.png
-- Installing: /usr/local/share/dlep/html/DlepMac_8h_source.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ResponsePending.html
-- Installing: /usr/local/share/dlep/html/DataItem_8h_incl.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1DestinationInfo__coll__graph.map
-- Installing: /usr/local/share/dlep/html/Peer_8h.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_27.png
-- Installing: /usr/local/share/dlep/html/DlepInit_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/DataItem_8cpp_incl.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DlepClient-members.html
-- Installing: /usr/local/share/dlep/html/ExampleMain_8cpp_incl.map
-- Installing: /usr/local/share/dlep/html/LatencyRange_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadDataItemId__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/LatencyRange_8h.html
```

```
-- Installing: /usr/local/share/dlep/html/PeriodicMcastSendRcv_8h__incl.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemFlagsVisitor-members.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1SignalInfo-members.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1ProtocolConfig__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1SignalIdNotInitialized.html
-- Installing: /usr/local/share/dlep/html/config_2CMakeLists_8txt.html
-- Installing: /usr/local/share/dlep/html/inherit__graph_20.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DlepServiceImpl__coll__graph.map
-- Installing: /usr/local/share/dlep/html/DestAdvertInfo_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/inherit__graph_14.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1Peer.html
-- Installing: /usr/local/share/dlep/html/NetUtils_8h__dep__incl.map
-- Installing: /usr/local/share/dlep/html/splitbar.png
-- Installing: /usr/local/share/dlep/html/ProtocolConfigImpl_8cpp__incl.map
-- Installing: /usr/local/share/dlep/html/functions__enum.html
-- Installing: /usr/local/share/dlep/html/ProtocolConfig_8h__dep__incl.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div__u16__sub__data__items__t.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1Peer__coll__graph.png
-- Installing: /usr/local/share/dlep/html/Dlep_8cpp__incl.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadStatusCodeId__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/DestAdvertDataBase_8h__source.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadDataItemName__coll__graph.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DestAdvert__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadModuleName-members.html
-- Installing: /usr/local/share/dlep/html/DlepInit_8cpp__incl.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1PeriodicMcastSendRcv-members.html
-- Installing: /usr/local/share/dlep/html/inherit__graph_15.map
-- Installing: /usr/local/share/dlep/html/DestAdvertMessage_8h__incl.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1DataItemWrongType-members.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DlepLogger-members.html
-- Installing: /usr/local/share/dlep/html/multi_hop_config.html
-- Installing: /usr/local/share/dlep/html/DlepInit_8h__incl.map
-- Installing: /usr/local/share/dlep/html/DataItem_8cpp__incl.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1PeriodicMcastSendRcv.html
-- Installing: /usr/local/share/dlep/html/functions__u.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div__u8__ipv6__u8__t-members.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1Dlep-members.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadDataItemName-members.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1DataItemWrongType.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1ProtocolConfigImpl__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/inherit__graph_12.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DlepService__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/namespaceLLDLEP_1_1internal_1_1NetUtils.html
-- Installing: /usr/local/share/dlep/html/InfoBaseMgr_8h.html
-- Installing: /usr/local/share/dlep/html/DestAdvertMessage_8h__dep__incl.map
-- Installing: /usr/local/share/dlep/html/Thread_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div__sub__data__items__t-members.html
-- Installing: /usr/local/share/dlep/html/functions__g.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1ProtocolConfigImpl__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/Peer_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1DestinationInfo-members.html
-- Installing:
/usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1DataItemNotPresent__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/md__home_cisco_dlep-top_LL-DLEP_README.html
-- Installing: /usr/local/share/dlep/html/RELEASENOTES_8md.html
-- Installing: /usr/local/share/dlep/html/classTable-members.html
-- Installing: /usr/local/share/dlep/html/MultiHop_8h__source.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1StatusCodeInfo.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1Dlep__coll__graph.png
```



```
-- Installing: /usr/local/share/dlep/html/MultiHop_8h.html
-- Installing: /usr/local/share/dlep/html/md_home_cisco_dlep-top_LL-DLEP_RELEASENOTES.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemEqualVisitor_coll_graph.png
-- Installing: /usr/local/share/dlep/html/DestAdvertMessage_8h_incl.png
-- Installing: /usr/local/share/dlep/html/ExampleDlepClientImpl_8cpp.html
-- Installing: /usr/local/share/dlep/html/PeerDiscovery_8h_source.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadSignalId.html
-- Installing: /usr/local/share/dlep/html/functions_t.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1DataItemWrongType_coll_graph.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1DestAdvertDBEntry.html
-- Installing: /usr/local/share/dlep/html/DlepMac_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/DataItem_8h_source.html
-- Installing: /usr/local/share/dlep/html/ProtocolMessage_8h_incl.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1d_mac-members.html
-- Installing: /usr/local/share/dlep/html/DlepCommon_8h_source.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1DestAdvertInfo_coll_graph.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemToStringVisitor_inherit_graph.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_29.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1ProtocolConfigImpl-members.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1SubDataItem-members.html
-- Installing: /usr/local/share/dlep/html/DestAdvert_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/NetUtils_8h_incl.map
-- Installing: /usr/local/share/dlep/html/DlepMac_8cpp.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadProtocolConfig_coll_graph.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1DlepServiceImpl_1_1InitializationError.html
-- Installing: /usr/local/share/dlep/html/functions_func_o.html
-- Installing: /usr/local/share/dlep/html/DlepCommon_8h.html
-- Installing: /usr/local/share/dlep/html/LatencyRange_8h_dep_incl.png
-- Installing: /usr/local/share/dlep/html/PeerDiscovery_8cpp_incl.png
-- Installing: /usr/local/share/dlep/html/DestAdvertDataBase_8h_incl.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1PeerData-members.html
-- Installing: /usr/local/share/dlep/html/doc.png
-- Installing: /usr/local/share/dlep/html/hierarchy.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1Dlep_inherit_graph.png
-- Installing: /usr/local/share/dlep/html/functions_c.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1DestAdvertInfo-members.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1Dlep.html
-- Installing: /usr/local/share/dlep/html/functions_func_q.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1DataItemNotPresent.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemToStringVisitor-members.html
-- Installing: /usr/local/share/dlep/html/ProtocolMessage_8h_source.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1Peer_coll_graph.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1Dlep_inherit_graph.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DlepClient_1_1BadParameterName_inherit_graph.png
-- Installing: /usr/local/share/dlep/html/InfoBaseMgr_8h_source.html
-- Installing: /usr/local/share/dlep/html/DestAdvert_8h.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_3.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1ProtocolConfig.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u64_u64_t-members.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_31.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemValidateVisitor-members.html
-- Installing: /usr/local/share/dlep/html/ProtocolMessage_8cpp_incl.map
-- Installing: /usr/local/share/dlep/html/functions_0x7e.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1SignalIdNotInitialized-members.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_34.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_33.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1PeerDiscovery_coll_graph.map
-- Installing: /usr/local/share/dlep/html/functions_func_u.html
-- Installing: /usr/local/share/dlep/html/namespacemembers.html
```

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-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1SignalIdNotInitialized__coll__graph.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DlepClient_1_1BadParameterName__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_17.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadSignalName__coll__graph.map
-- Installing: /usr/local/share/dlep/html/functions_func_n.html
-- Installing: /usr/local/share/dlep/html/functions_func_c.html
-- Installing: /usr/local/share/dlep/html/NetUtils_8h.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadStatusCodeId.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1DlepServiceImpl_1_1InitializationError__coll__graph.map
-- Installing: /usr/local/share/dlep/html/namespacemembers_type.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_11.png
-- Installing: /usr/local/share/dlep/html/classDlepCli.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadDataItemId-members.html
-- Installing: /usr/local/share/dlep/html/Serialize_8h__incl.map
-- Installing: /usr/local/share/dlep/html/functions_func_0x7e.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_8.png
-- Installing: /usr/local/share/dlep/html/functions_b.html
-- Installing: /usr/local/share/dlep/html/DlepServiceImpl_8cpp__incl.png
-- Installing: /usr/local/share/dlep/html/ExampleDlepClientImpl_8h__dep__incl.map
-- Installing: /usr/local/share/dlep/html/functions_d.html
-- Installing: /usr/local/share/dlep/html/Design_8md.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u8_ipv4__t.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1PeerData.html
-- Installing: /usr/local/share/dlep/html/nav_g.png
-- Installing: /usr/local/share/dlep/html/InfoBaseMgr_8cpp__incl.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_19.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemValidateVisitor__coll__graph.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_38.map
-- Installing: /usr/local/share/dlep/html/ProtocolConfig_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/functions_func_v.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DlepServiceImpl__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_23.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1PeriodicMcastSendRcv__coll__graph.png
-- Installing: /usr/local/share/dlep/html/InfoBaseMgr_8cpp__incl.map
-- Installing: /usr/local/share/dlep/html/InfoBaseMgr_8h__incl.png
-- Installing: /usr/local/share/dlep/html/IdTypes_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/PeerDiscovery_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/ProtocolMessage_8h.html
-- Installing: /usr/local/share/dlep/html/DataItem_8h__incl.map
-- Installing: /usr/local/share/dlep/html/Table_8cpp__incl.map
-- Installing: /usr/local/share/dlep/html/DlepClient_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/DlepMac_8h__incl.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1PeriodicMcastSendRcv__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/Serialize_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/DestAdvertMessage_8h.html
-- Installing: /usr/local/share/dlep/html/namespacemembers_vars.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadSignalName.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_26.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadSignalName__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/ExampleDlepClientImpl_8h_source.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_30.map
-- Installing: /usr/local/share/dlep/html/ExampleDlepClientImpl_8h.html
-- Installing: /usr/local/share/dlep/html/DlepInit_8h__incl.png
-- Installing: /usr/local/share/dlep/html/DlepInit_8cpp.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadSignalId__coll__graph.map
-- Installing:
/usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1SignalIdNotInitialized__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_7.png
-- Installing: /usr/local/share/dlep/html/DestAdvert_8h__dep__incl.png
```

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-- Installing: /usr/local/share/dlep/html/DlepService_8h__incl.png
-- Installing: /usr/local/share/dlep/html/Table_8h__incl.png
-- Installing: /usr/local/share/dlep/html/NetUtils_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1DestAdvertInfo.html
-- Installing: /usr/local/share/dlep/html/Peer_8cpp__incl.png
-- Installing: /usr/local/share/dlep/html/DlepLogger_8h.html
-- Installing: /usr/local/share/dlep/html/DestAdvertInfo_8h__incl.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_23.png
-- Installing: /usr/local/share/dlep/html/ProtocolMessage_8h__incl.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u8_ipv4_u8__t.html
-- Installing: /usr/local/share/dlep/html/Table_8h_source.html
-- Installing: /usr/local/share/dlep/html/ProtocolMessage_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DestAdvert-members.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DlepServiceImpl__coll__graph.png
-- Installing: /usr/local/share/dlep/html/PeriodicMcastSendRcv_8h__incl.map
-- Installing: /usr/local/share/dlep/html/userguide.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DlepClient_1_1BadParameterName.html
-- Installing: /usr/local/share/dlep/html/DlepServiceImpl_8h__incl.map
-- Installing: /usr/local/share/dlep/html/functions_l.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1DataItemNotPresent-members.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadModuleName__coll__graph.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DestAdvert__inherit_graph.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadSignalName__inherit_graph.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_10.map
-- Installing: /usr/local/share/dlep/html/functions_func_r.html
-- Installing: /usr/local/share/dlep/html/latency_range_config.html
-- Installing: /usr/local/share/dlep/html/CMakeLists_8txt.html
-- Installing: /usr/local/share/dlep/html/ProtocolConfigImpl_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/classprint_config_visitor__coll__graph.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_v_extid__t.html
-- Installing: /usr/local/share/dlep/html/Dlep_8h.html
-- Installing: /usr/local/share/dlep/html/ProtocolConfigImpl_8h_source.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemSerializeVisitor-members.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_1.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DlepServiceImpl.html
-- Installing: /usr/local/share/dlep/html/namespaceLLDLEP_1_1internal.html
-- Installing: /usr/local/share/dlep/html/functions_n.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemToStringVisitor__coll__graph.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItem-members.html
-- Installing: /usr/local/share/dlep/html/Peer_8h__incl.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_2.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_38.png
-- Installing: /usr/local/share/dlep/html/functions_func_h.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadProtocolConfig__inherit_graph.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemSerializeVisitor__coll__graph.png
-- Installing: /usr/local/share/dlep/html/search
-- Installing: /usr/local/share/dlep/html/search/enums_6.html
-- Installing: /usr/local/share/dlep/html/search/classes_7.js
-- Installing: /usr/local/share/dlep/html/search/classes_1.html
-- Installing: /usr/local/share/dlep/html/search/classes_7.html
-- Installing: /usr/local/share/dlep/html/search/functions_6.html
-- Installing: /usr/local/share/dlep/html/search/variables_b.js
-- Installing: /usr/local/share/dlep/html/search/files_5.html
-- Installing: /usr/local/share/dlep/html/search/variables_2.js
-- Installing: /usr/local/share/dlep/html/search/enums_0.js
-- Installing: /usr/local/share/dlep/html/search/classes_5.js
-- Installing: /usr/local/share/dlep/html/search/typedefs_2.js
-- Installing: /usr/local/share/dlep/html/search/files_1.js
-- Installing: /usr/local/share/dlep/html/search/defines_0.html
```

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-- Installing: /usr/local/share/dlep/html/search/variables_3.js
-- Installing: /usr/local/share/dlep/html/search/all_11.html
-- Installing: /usr/local/share/dlep/html/search/all_2.js
-- Installing: /usr/local/share/dlep/html/search/variables_3.html
-- Installing: /usr/local/share/dlep/html/search/pages_3.html
-- Installing: /usr/local/share/dlep/html/search/functions_0.js
-- Installing: /usr/local/share/dlep/html/search/all_7.html
-- Installing: /usr/local/share/dlep/html/search/files_9.html
-- Installing: /usr/local/share/dlep/html/search/functions_1.js
-- Installing: /usr/local/share/dlep/html/search/classes_6.js
-- Installing: /usr/local/share/dlep/html/search/search.css
-- Installing: /usr/local/share/dlep/html/search/all_1.html
-- Installing: /usr/local/share/dlep/html/search/all_b.js
-- Installing: /usr/local/share/dlep/html/search/pages_3.js
-- Installing: /usr/local/share/dlep/html/search/enumvalues_4.html
-- Installing: /usr/local/share/dlep/html/search/classes_1.js
-- Installing: /usr/local/share/dlep/html/search/pages_1.html
-- Installing: /usr/local/share/dlep/html/search/enums_2.html
-- Installing: /usr/local/share/dlep/html/search/classes_0.html
-- Installing: /usr/local/share/dlep/html/search/typedefs_7.html
-- Installing: /usr/local/share/dlep/html/search/namespaces_0.html
-- Installing: /usr/local/share/dlep/html/search/variables_6.html
-- Installing: /usr/local/share/dlep/html/search/all_2.html
-- Installing: /usr/local/share/dlep/html/search/enumvalues_2.html
-- Installing: /usr/local/share/dlep/html/search/enums_0.html
-- Installing: /usr/local/share/dlep/html/search/enums_4.html
-- Installing: /usr/local/share/dlep/html/search/enums_5.html
-- Installing: /usr/local/share/dlep/html/search/classes_6.html
-- Installing: /usr/local/share/dlep/html/search/files_3.js
-- Installing: /usr/local/share/dlep/html/search/variables_e.html
-- Installing: /usr/local/share/dlep/html/search/all_6.html
-- Installing: /usr/local/share/dlep/html/search/variables_d.html
-- Installing: /usr/local/share/dlep/html/search/typedefs_1.html
-- Installing: /usr/local/share/dlep/html/search/functions_c.html
-- Installing: /usr/local/share/dlep/html/search/classes_4.js
-- Installing: /usr/local/share/dlep/html/search/all_11.js
-- Installing: /usr/local/share/dlep/html/search/functions_15.html
-- Installing: /usr/local/share/dlep/html/search/pages_4.js
-- Installing: /usr/local/share/dlep/html/search/all_3.js
-- Installing: /usr/local/share/dlep/html/search/all_c.js
-- Installing: /usr/local/share/dlep/html/search/functions_13.js
-- Installing: /usr/local/share/dlep/html/search/enumvalues_b.js
-- Installing: /usr/local/share/dlep/html/search/variables_8.js
-- Installing: /usr/local/share/dlep/html/search/variables_8.html
-- Installing: /usr/local/share/dlep/html/search/enumvalues_9.js
-- Installing: /usr/local/share/dlep/html/search/enumvalues_1.html
-- Installing: /usr/local/share/dlep/html/search/search.js
-- Installing: /usr/local/share/dlep/html/search/functions_b.html
-- Installing: /usr/local/share/dlep/html/search/functions_d.html
-- Installing: /usr/local/share/dlep/html/search/functions_3.js
-- Installing: /usr/local/share/dlep/html/search/functions_9.html
-- Installing: /usr/local/share/dlep/html/search/pages_5.js
-- Installing: /usr/local/share/dlep/html/search/typedefs_3.html
-- Installing: /usr/local/share/dlep/html/search/enums_2.js
-- Installing: /usr/local/share/dlep/html/search/variables_10.html
-- Installing: /usr/local/share/dlep/html/search/variables_2.html
-- Installing: /usr/local/share/dlep/html/search/classes_4.html
-- Installing: /usr/local/share/dlep/html/search/close.png
-- Installing: /usr/local/share/dlep/html/search/enumvalues_6.html
```

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-- Installing: /usr/local/share/dlep/html/search/typedefs_5.html
-- Installing: /usr/local/share/dlep/html/search/all_e.html
-- Installing: /usr/local/share/dlep/html/search/all_9.html
-- Installing: /usr/local/share/dlep/html/search/functions_0.html
-- Installing: /usr/local/share/dlep/html/search/files_1.html
-- Installing: /usr/local/share/dlep/html/search/all_a.html
-- Installing: /usr/local/share/dlep/html/search/all_3.html
-- Installing: /usr/local/share/dlep/html/search/variables_5.html
-- Installing: /usr/local/share/dlep/html/search/defines_2.html
-- Installing: /usr/local/share/dlep/html/search/enumvalues_a.html
-- Installing: /usr/local/share/dlep/html/search/typedefs_2.html
-- Installing: /usr/local/share/dlep/html/search/all_c.html
-- Installing: /usr/local/share/dlep/html/search/pages_2.js
-- Installing: /usr/local/share/dlep/html/search/files_7.html
-- Installing: /usr/local/share/dlep/html/search/files_0.html
-- Installing: /usr/local/share/dlep/html/search/all_5.js
-- Installing: /usr/local/share/dlep/html/search/files_a.js
-- Installing: /usr/local/share/dlep/html/search/files_2.html
-- Installing: /usr/local/share/dlep/html/search/enumvalues_3.html
-- Installing: /usr/local/share/dlep/html/search/all_e.js
-- Installing: /usr/local/share/dlep/html/search/pages_0.html
-- Installing: /usr/local/share/dlep/html/search/all_15.html
-- Installing: /usr/local/share/dlep/html/search/all_f.js
-- Installing: /usr/local/share/dlep/html/search/enumvalues_1.js
-- Installing: /usr/local/share/dlep/html/search/functions_b.js
-- Installing: /usr/local/share/dlep/html/search/files_b.html
-- Installing: /usr/local/share/dlep/html/search/pages_5.html
-- Installing: /usr/local/share/dlep/html/search/variables_4.js
-- Installing: /usr/local/share/dlep/html/search/variables_c.js
-- Installing: /usr/local/share/dlep/html/search/variables_0.js
-- Installing: /usr/local/share/dlep/html/search/typedefs_4.js
-- Installing: /usr/local/share/dlep/html/search/all_0.js
-- Installing: /usr/local/share/dlep/html/search/functions_14.js
-- Installing: /usr/local/share/dlep/html/search/all_4.js
-- Installing: /usr/local/share/dlep/html/search/functions_10.js
-- Installing: /usr/local/share/dlep/html/search/classes_5.html
-- Installing: /usr/local/share/dlep/html/search/typedefs_0.js
-- Installing: /usr/local/share/dlep/html/search/enums_1.html
-- Installing: /usr/local/share/dlep/html/search/all_6.js
-- Installing: /usr/local/share/dlep/html/search/functions_2.js
-- Installing: /usr/local/share/dlep/html/search/typedefs_1.js
-- Installing: /usr/local/share/dlep/html/search/search_r.png
-- Installing: /usr/local/share/dlep/html/search/variables_6.js
-- Installing: /usr/local/share/dlep/html/search/functions_12.html
-- Installing: /usr/local/share/dlep/html/search/typedefs_6.js
-- Installing: /usr/local/share/dlep/html/search/all_12.js
-- Installing: /usr/local/share/dlep/html/search/enums_1.js
-- Installing: /usr/local/share/dlep/html/search/enumvalues_8.js
-- Installing: /usr/local/share/dlep/html/search/all_9.js
-- Installing: /usr/local/share/dlep/html/search/all_14.html
-- Installing: /usr/local/share/dlep/html/search/all_5.html
-- Installing: /usr/local/share/dlep/html/search/defines_1.js
-- Installing: /usr/local/share/dlep/html/search/functions_14.html
-- Installing: /usr/local/share/dlep/html/search/functions_13.html
-- Installing: /usr/local/share/dlep/html/search/enums_3.html
-- Installing: /usr/local/share/dlep/html/search/typedefs_7.js
-- Installing: /usr/local/share/dlep/html/search/functions_2.html
-- Installing: /usr/local/share/dlep/html/search/all_d.js
-- Installing: /usr/local/share/dlep/html/search/enumvalues_0.html
```

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-- Installing: /usr/local/share/dlep/html/search/search_m.png
-- Installing: /usr/local/share/dlep/html/search/variables_f.js
-- Installing: /usr/local/share/dlep/html/search/enumvalues_8.html
-- Installing: /usr/local/share/dlep/html/search/variables_9.html
-- Installing: /usr/local/share/dlep/html/search/enumvalues_3.js
-- Installing: /usr/local/share/dlep/html/search/defines_2.js
-- Installing: /usr/local/share/dlep/html/search/files_8.js
-- Installing: /usr/local/share/dlep/html/search/enumvalues_7.js
-- Installing: /usr/local/share/dlep/html/search/files_9.js
-- Installing: /usr/local/share/dlep/html/search/files_5.js
-- Installing: /usr/local/share/dlep/html/search/files_b.js
-- Installing: /usr/local/share/dlep/html/search/functions_1.html
-- Installing: /usr/local/share/dlep/html/search/functions_f.html
-- Installing: /usr/local/share/dlep/html/search/all_13.js
-- Installing: /usr/local/share/dlep/html/search/classes_0.js
-- Installing: /usr/local/share/dlep/html/search/variables_e.js
-- Installing: /usr/local/share/dlep/html/search/typedefs_3.js
-- Installing: /usr/local/share/dlep/html/search/variables_1.js
-- Installing: /usr/local/share/dlep/html/search/enumvalues_b.html
-- Installing: /usr/local/share/dlep/html/search/all_12.html
-- Installing: /usr/local/share/dlep/html/search/pages_0.js
-- Installing: /usr/local/share/dlep/html/search/files_7.js
-- Installing: /usr/local/share/dlep/html/search/classes_3.js
-- Installing: /usr/local/share/dlep/html/search/functions_7.html
-- Installing: /usr/local/share/dlep/html/search/pages_2.html
-- Installing: /usr/local/share/dlep/html/search/typedefs_5.js
-- Installing: /usr/local/share/dlep/html/search/variables_4.html
-- Installing: /usr/local/share/dlep/html/search/functions_7.js
-- Installing: /usr/local/share/dlep/html/search/variables_1.html
-- Installing: /usr/local/share/dlep/html/search/functions_a.html
-- Installing: /usr/local/share/dlep/html/search/all_10.html
-- Installing: /usr/local/share/dlep/html/search/enumvalues_2.js
-- Installing: /usr/local/share/dlep/html/search/defines_1.html
-- Installing: /usr/local/share/dlep/html/search/search_l.png
-- Installing: /usr/local/share/dlep/html/search/functions_12.js
-- Installing: /usr/local/share/dlep/html/search/functions_8.js
-- Installing: /usr/local/share/dlep/html/search/classes_2.html
-- Installing: /usr/local/share/dlep/html/search/functions_5.html
-- Installing: /usr/local/share/dlep/html/search/functions_9.js
-- Installing: /usr/local/share/dlep/html/search/enumvalues_9.html
-- Installing: /usr/local/share/dlep/html/search/variables_a.js
-- Installing: /usr/local/share/dlep/html/search/enumvalues_0.js
-- Installing: /usr/local/share/dlep/html/search/functions_8.html
-- Installing: /usr/local/share/dlep/html/search/files_6.js
-- Installing: /usr/local/share/dlep/html/search/enumvalues_7.html
-- Installing: /usr/local/share/dlep/html/search/functions_3.html
-- Installing: /usr/local/share/dlep/html/search/enums_4.js
-- Installing: /usr/local/share/dlep/html/search/all_b.html
-- Installing: /usr/local/share/dlep/html/search/mag_sel.png
-- Installing: /usr/local/share/dlep/html/search/variables_d.js
-- Installing: /usr/local/share/dlep/html/search/files_0.js
-- Installing: /usr/local/share/dlep/html/search/files_a.html
-- Installing: /usr/local/share/dlep/html/search/all_f.html
-- Installing: /usr/local/share/dlep/html/search/variables_5.js
-- Installing: /usr/local/share/dlep/html/search/functions_11.js
-- Installing: /usr/local/share/dlep/html/search/functions_11.html
-- Installing: /usr/local/share/dlep/html/search/files_6.html
-- Installing: /usr/local/share/dlep/html/search/enums_6.js
-- Installing: /usr/local/share/dlep/html/search/files_3.html
```

```
-- Installing: /usr/local/share/dlep/html/search/enums_3.js
-- Installing: /usr/local/share/dlep/html/search/all_15.js
-- Installing: /usr/local/share/dlep/html/search/functions_d.js
-- Installing: /usr/local/share/dlep/html/search/functions_e.html
-- Installing: /usr/local/share/dlep/html/search/variables_c.html
-- Installing: /usr/local/share/dlep/html/search/functions_6.js
-- Installing: /usr/local/share/dlep/html/search/functions_4.html
-- Installing: /usr/local/share/dlep/html/search/all_0.html
-- Installing: /usr/local/share/dlep/html/search/variables_a.html
-- Installing: /usr/local/share/dlep/html/search/functions_f.js
-- Installing: /usr/local/share/dlep/html/search/functions_15.js
-- Installing: /usr/local/share/dlep/html/search/all_d.html
-- Installing: /usr/local/share/dlep/html/search/all_a.js
-- Installing: /usr/local/share/dlep/html/search/enumvalues_4.js
-- Installing: /usr/local/share/dlep/html/search/all_7.js
-- Installing: /usr/local/share/dlep/html/search/all_8.html
-- Installing: /usr/local/share/dlep/html/search/typedefs_6.html
-- Installing: /usr/local/share/dlep/html/search/classes_2.js
-- Installing: /usr/local/share/dlep/html/search/defines_0.js
-- Installing: /usr/local/share/dlep/html/search/functions_a.js
-- Installing: /usr/local/share/dlep/html/search/functions_4.js
-- Installing: /usr/local/share/dlep/html/search/all_8.js
-- Installing: /usr/local/share/dlep/html/search/variables_10.js
-- Installing: /usr/local/share/dlep/html/search/files_2.js
-- Installing: /usr/local/share/dlep/html/search/all_13.html
-- Installing: /usr/local/share/dlep/html/search/functions_c.js
-- Installing: /usr/local/share/dlep/html/search/files_4.html
-- Installing: /usr/local/share/dlep/html/search/files_8.html
-- Installing: /usr/local/share/dlep/html/search/typedefs_4.html
-- Installing: /usr/local/share/dlep/html/search/all_4.html
-- Installing: /usr/local/share/dlep/html/search/variables_0.html
-- Installing: /usr/local/share/dlep/html/search/variables_7.html
-- Installing: /usr/local/share/dlep/html/search/enumvalues_5.html
-- Installing: /usr/local/share/dlep/html/search/functions_10.html
-- Installing: /usr/local/share/dlep/html/search/all_10.js
-- Installing: /usr/local/share/dlep/html/search/nomatches.html
-- Installing: /usr/local/share/dlep/html/search/enumvalues_a.js
-- Installing: /usr/local/share/dlep/html/search/enumvalues_5.js
-- Installing: /usr/local/share/dlep/html/search/all_1.js
-- Installing: /usr/local/share/dlep/html/search/namespaces_0.js
-- Installing: /usr/local/share/dlep/html/search/enums_5.js
-- Installing: /usr/local/share/dlep/html/search/typedefs_0.html
-- Installing: /usr/local/share/dlep/html/search/enumvalues_6.js
-- Installing: /usr/local/share/dlep/html/search/functions_5.js
-- Installing: /usr/local/share/dlep/html/search/variables_f.html
-- Installing: /usr/local/share/dlep/html/search/variables_9.js
-- Installing: /usr/local/share/dlep/html/search/all_14.js
-- Installing: /usr/local/share/dlep/html/search/files_4.js
-- Installing: /usr/local/share/dlep/html/search/pages_1.js
-- Installing: /usr/local/share/dlep/html/search/pages_4.html
-- Installing: /usr/local/share/dlep/html/search/classes_3.html
-- Installing: /usr/local/share/dlep/html/search/searchdata.js
-- Installing: /usr/local/share/dlep/html/search/variables_7.js
-- Installing: /usr/local/share/dlep/html/search/variables_b.html
-- Installing: /usr/local/share/dlep/html/search/functions_e.js
-- Installing: /usr/local/share/dlep/html/ProtocolConfigImpl_8h__dep__incl.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_34.map
-- Installing: /usr/local/share/dlep/html/PeerDiscovery_8cpp__incl.map
-- Installing: /usr/local/share/dlep/html/functions_func_s.html
```

```
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadProtocolConfig-members.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItem.html
-- Installing: /usr/local/share/dlep/html/arrowdown.png
-- Installing: /usr/local/share/dlep/html/functions_vars.html
-- Installing: /usr/local/share/dlep/html/ProtocolConfigImpl_8cpp_incl.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u8_string_t-members.html
-- Installing: /usr/local/share/dlep/html/dynsections.js
-- Installing: /usr/local/share/dlep/html/inherit_graph_29.map
-- Installing: /usr/local/share/dlep/html/Dlep_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_11.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1DlepServiceImpl_1_1InitializationError-members.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadStatusCodeName_coll_graph.png
-- Installing: /usr/local/share/dlep/html/DlepServiceImpl_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_18.png
-- Installing: /usr/local/share/dlep/html/PeriodicMcastSendRcv_8cpp_incl.map
-- Installing: /usr/local/share/dlep/html/index.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadModuleName_inherit_graph.png
-- Installing: /usr/local/share/dlep/html/functions_o.html
-- Installing: /usr/local/share/dlep/html/functions_i.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemSerializeVisitor_coll_graph.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u8_ipv4_u16_t.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1ProtocolConfig_inherit_graph.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadStatusCodeName_inherit_graph.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemToStringVisitor_inherit_graph.map
-- Installing: /usr/local/share/dlep/html/DlepClient_8h_source.html
-- Installing: /usr/local/share/dlep/html/functions_func_t.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadDataItemName.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1PeerInfo.html
-- Installing: /usr/local/share/dlep/html/Dlep_8h_source.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u8_u8_t.html
-- Installing: /usr/local/share/dlep/html/Dlep_8h_incl.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemValidateVisitor_inherit_graph.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DestAdvert_coll_graph.png
-- Installing: /usr/local/share/dlep/html/globals_defs.html
-- Installing: /usr/local/share/dlep/html/Dlep_8h_dep_incl.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_0.map
-- Installing: /usr/local/share/dlep/html/functions_func_i.html
-- Installing: /usr/local/share/dlep/html/classprint_config_visitor_inherit_graph.map
-- Installing: /usr/local/share/dlep/html/namespaceLLDLEP.html
-- Installing: /usr/local/share/dlep/html/DlepDestAdvertDataBase_8h_dep_incl.png
-- Installing: /usr/local/share/dlep/html/InfoBaseMgr_8h_dep_incl.png
-- Installing: /usr/local/share/dlep/html/namespacemembers_enum.html
-- Installing: /usr/local/share/dlep/html/DlepInit_8cpp_incl.map
-- Installing: /usr/local/share/dlep/html/functions_func_d.html
-- Installing: /usr/local/share/dlep/html/MultiHop_8h_dep_incl.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadDataItemName_coll_graph.map
-- Installing: /usr/local/share/dlep/html/Table_8h_incl.map
-- Installing: /usr/local/share/dlep/html/Main_8md.html
-- Installing: /usr/local/share/dlep/html/bdwn.png
-- Installing: /usr/local/share/dlep/html/DlepClient_8h.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u8_ipv4_u16_t-members.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_19.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_7.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_22.png
-- Installing: /usr/local/share/dlep/html/nav_f.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u16_vu8_t-members.html
-- Installing: /usr/local/share/dlep/html/DlepCommon_8h_dep_incl.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ResponsePending-members.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_25.map
```



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-- Installing: /usr/local/share/dlep/html/DlepServiceImpl_8cpp.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_24.map
-- Installing: /usr/local/share/dlep/html/Peer_8cpp__incl.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_28.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u8_ipv6__t.html
-- Installing: /usr/local/share/dlep/html/LatencyRange_8h_source.html
-- Installing: /usr/local/share/dlep/html/Table_8cpp__incl.png
-- Installing: /usr/local/share/dlep/html/classprint__config__visitor__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/ExampleMain_8cpp.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_4.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1ModuleInfo.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_6.png
-- Installing: /usr/local/share/dlep/html/DlepCommon_8h__incl.map
-- Installing:
/usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1DataItemWrongType__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1ProtocolMessage.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1DestAdvertDBEntry__coll__graph.png
-- Installing: /usr/local/share/dlep/html/DataItem_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/functions_v.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadDataItemId__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1DlepServiceImpl_1_1InitializationError__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_28.map
-- Installing: /usr/local/share/dlep/html/UserGuide_8md.html
-- Installing: /usr/local/share/dlep/html/PeriodicMcastSendRcv_8h_source.html
-- Installing: /usr/local/share/dlep/html/Table_8h.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1Peer__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/Table_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1Peer-members.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadDataItemId.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemEqualVisitor.html
-- Installing: /usr/local/share/dlep/html/DlepLogger_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/PeriodicMcastSendRcv_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/DlepService_8h__dep__incl.map
-- Installing: /usr/local/share/dlep/html/jquery.js
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DestAdvert__coll__graph.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_37.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u8_ipv6_u16__t.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1DestinationInfo.html
-- Installing: /usr/local/share/dlep/html/classDlepClientImpl.html
-- Installing: /usr/local/share/dlep/html/functions_func_b.html
-- Installing: /usr/local/share/dlep/html/dest-advert-sequence.png
-- Installing: /usr/local/share/dlep/html/rfc8175.html
-- Installing: /usr/local/share/dlep/html/Dlep_8h__incl.map
-- Installing: /usr/local/share/dlep/html/classprint__config__visitor.html
-- Installing: /usr/local/share/dlep/html/DlepLogger_8h__dep__incl.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1Peer__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1PeerDiscovery__coll__graph.png
-- Installing: /usr/local/share/dlep/html/ProtocolConfigImpl_8cpp.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1DestAdvertInfo__coll__graph.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadStatusCodeName-members.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u16_sub_data_items__t-members.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1Dlep__coll__graph.map
-- Installing: /usr/local/share/dlep/html/tab_a.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadSignalId-members.html
-- Installing:
/usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1SignalIdNotInitialized__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_39.png
-- Installing: /usr/local/share/dlep/html/ExampleDlepClientImpl_8cpp__incl.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DlepServiceImpl__inherit__graph.map

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-- Installing: /usr/local/share/dlep/html/DlepInit_8h.html
-- Installing: /usr/local/share/dlep/html/PeerDiscovery_8cpp.html
-- Installing: /usr/local/share/dlep/html/Serialize_8h.html
-- Installing: /usr/local/share/dlep/html/NetUtils_8h__incl.png
-- Installing: /usr/local/share/dlep/html/graph_legend.png
-- Installing: /usr/local/share/dlep/html/InfoBaseMgr_8h__dep__incl.map
-- Installing: /usr/local/share/dlep/html/IdTypes_8h_source.html
-- Installing: /usr/local/share/dlep/html/README_8md.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemValueFromStringStreamVisitor-members.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemValueFromStringStreamVisitor-members.html
-- Installing: /usr/local/share/dlep/html/DlepMac_8cpp__incl.map
-- Installing: /usr/local/share/dlep/html/globals_func.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_22.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1DataItemInfo-members.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DestinationData.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_sub_data_items_t.html
-- Installing: /usr/local/share/dlep/html/functions_func_p.html
-- Installing: /usr/local/share/dlep/html/designnotes.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemValidateVisitor.html
-- Installing: /usr/local/share/dlep/html/Thread_8h__incl.png
-- Installing: /usr/local/share/dlep/html/annotated.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadSignalId__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/functions_f.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1ModuleInfo-members.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_31.png
-- Installing: /usr/local/share/dlep/html/modem-router-mac.png
-- Installing: /usr/local/share/dlep/html/classDlepClientImpl__coll__graph.map
-- Installing: /usr/local/share/dlep/html/ProtocolMessage_8cpp__incl.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_26.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_20.png
-- Installing: /usr/local/share/dlep/html/DlepLogger_8h__incl.map
-- Installing: /usr/local/share/dlep/html/proto_config_schema.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ResponsePending__coll__graph.map
-- Installing: /usr/local/share/dlep/html/DlepMac_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1StatusCodeInfo-members.html
-- Installing: /usr/local/share/dlep/html/ProtocolConfig_8h.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadDataItemName__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/functions_func_w.html
-- Installing: /usr/local/share/dlep/html/DestAdvertInfo_8h_source.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u8_ipv6_t-members.html
-- Installing: /usr/local/share/dlep/html/ProtocolConfig_8h__incl.map
-- Installing: /usr/local/share/dlep/html/NetUtils_8cpp__incl.map
-- Installing: /usr/local/share/dlep/html/Serialize_8h__incl.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemImpFlagsVisitor.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_8.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemValueFromStringStreamVisitor__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/bc_s.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_9.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_35.png
-- Installing: /usr/local/share/dlep/html/DestAdvertInfo_8h.html
-- Installing: /usr/local/share/dlep/html/namespaceLLDLEP_1_1ProtocolStrings.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DestinationData-members.html
-- Installing: /usr/local/share/dlep/html/functions_q.html
-- Installing: /usr/local/share/dlep/html/DlepServiceImpl_8h__incl.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadProtocolConfig.html
-- Installing: /usr/local/share/dlep/html/InfoBaseMgr_8cpp.html
-- Installing: /usr/local/share/dlep/html/ExampleDlepClientImpl_8h__incl.png
-- Installing: /usr/local/share/dlep/html/DlepService_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_6.map
```

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-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u8_ipv4_t-members.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadDataItemId_coll_graph.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DlepClient_1_1BadParameterName-members.html
-- Installing: /usr/local/share/dlep/html/functions_func_g.html
-- Installing: /usr/local/share/dlep/html/functions.html
-- Installing: /usr/local/share/dlep/html/DlepLogger_8h_source.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadProtocolConfig_coll_graph.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadSignalId_coll_graph.png
-- Installing: /usr/local/share/dlep/html/Serialize_8h_source.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1DestAdvertDBEntry_coll_graph.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1DlepServiceImpl_1_1InitializationError_inherit_graph.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemToStringVisitor_coll_graph.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_0.png
-- Installing: /usr/local/share/dlep/html/DlepService_8h_source.html
-- Installing: /usr/local/share/dlep/html/ProtocolConfig_8h_source.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemPFlagsVisitor_inherit_graph.map
-- Installing: /usr/local/share/dlep/html/ProtocolConfigImpl_8h_incl.png
-- Installing: /usr/local/share/dlep/html/PeriodicMcastSendRcv_8cpp.html
-- Installing: /usr/local/share/dlep/html/DataItem_8cpp.html
-- Installing: /usr/local/share/dlep/html/DlepService_8h.html
-- Installing: /usr/local/share/dlep/html/doxygen.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DlepServiceImpl-members.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1PeerInfo-members.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_27.map
-- Installing: /usr/local/share/dlep/html/tab_b.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1DestAdvertDBEntry-members.html
-- Installing: /usr/local/share/dlep/html/Thread_8h_dep_incl.map
-- Installing:
/usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1DataItemWrongType_inherit_graph.png
-- Installing: /usr/local/share/dlep/html/DlepClient_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/NetUtils_8cpp.html
-- Installing: /usr/local/share/dlep/html/functions_h.html
-- Installing: /usr/local/share/dlep/html/DlepService_8h_dep_incl.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DlepClient.html
-- Installing: /usr/local/share/dlep/html/classDlepClientImpl_coll_graph.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemPEqualVisitor-members.html
-- Installing: /usr/local/share/dlep/html/DlepServiceImpl_8h.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_15.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_4.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_35.map
-- Installing: /usr/local/share/dlep/html/Peer_8h_source.html
-- Installing: /usr/local/share/dlep/html/Peer_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemSerializeVisitor.html
-- Installing: /usr/local/share/dlep/html/DlepService_8h.html
-- Installing: /usr/local/share/dlep/html/ExampleDlepClientImpl_8h_incl.map
-- Installing: /usr/local/share/dlep/html/PeerDiscovery_8h_incl.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadStatusCodeName_inherit_graph.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemValueFromstringstreamVisitor_inherit_graph.map
-- Installing: /usr/local/share/dlep/html/DlepService_8h_incl.map
-- Installing: /usr/local/share/dlep/html/functions_w.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1DataItemInfo.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_16.map
-- Installing: /usr/local/share/dlep/html/Table_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/DlepCommon_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/inherits.html
-- Installing: /usr/local/share/dlep/html/MultiHop_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/classes.html
-- Installing: /usr/local/share/dlep/html/doc_2CMakeLists_8txt.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DlepService-members.html

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-- Installing: /usr/local/share/dlep/html/sync_on.png
-- Installing: /usr/local/share/dlep/html/NetUtils_8cpp_incl.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DlepClient_1_1BadParameterName__coll__graph.map
-- Installing: /usr/local/share/dlep/html/files.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_1.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemValidateVisitor__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemPFlagsVisitor__coll__graph.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_30.png
-- Installing: /usr/local/share/dlep/html/arrowright.png
-- Installing: /usr/local/share/dlep/html/functions_func_m.html
-- Installing: /usr/local/share/dlep/html/Thread_8h_source.html
-- Installing: /usr/local/share/dlep/html/DlepService_8h_incl.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DlepClient_1_1BadParameterName__coll__graph.png
-- Installing: /usr/local/share/dlep/html/DataItem_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/IdTypes_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/PeerDiscovery_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemPFlagsVisitor__coll__graph.png
-- Installing: /usr/local/share/dlep/html/ProtocolMessage_8h_dep_incl.map
-- Installing: /usr/local/share/dlep/html/doxygen.css
-- Installing: /usr/local/share/dlep/html/ProtocolMessage_8cpp.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DlepService.html
-- Installing: /usr/local/share/dlep/html/DestAdvert_8cpp_incl.map
-- Installing: /usr/local/share/dlep/html/DestAdvert_8h_source.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadStatusCodeName.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemPEqualVisitor__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/classprint__config__visitor__coll__graph.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DestAdvert.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadDataItemName__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1SignalInfo.html
-- Installing: /usr/local/share/dlep/html/globals.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1ProtocolConfigImpl__coll__graph.map
-- Installing: /usr/local/share/dlep/html/functions_e.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_9.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u8_u8_t-members.html
-- Installing:
/usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1DataItemNotPresent__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/functions_func_l.html
-- Installing: /usr/local/share/dlep/html/DlepServiceImpl_8cpp_incl.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1PeriodicMcastSendRcv__coll__graph.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadStatusCodeId-members.html
-- Installing: /usr/local/share/dlep/html/classDlepCli-members.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_18.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_32.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1SignalIdNotInitialized__coll__graph.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_3.map
-- Installing: /usr/local/share/dlep/html/namespacemembers_eval.html
-- Installing: /usr/local/share/dlep/html/namespacemembers_func.html
-- Installing: /usr/local/share/dlep/html/functions_m.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1InfoBaseMgr.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_16.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1ProtocolConfig-members.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemToStringVisitor.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadStatusCodeId__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/ExampleMain_8cpp_incl.png
-- Installing: /usr/local/share/dlep/html/DestAdvert_8h_incl.png
-- Installing: /usr/local/share/dlep/html/functions_p.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u64_u64_t.html
-- Installing: /usr/local/share/dlep/html/classDlepClientImpl__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/Peer_8h_incl.png
```

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-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadModuleName.html
-- Installing: /usr/local/share/dlep/html/closed.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1SubDataItem.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1DlepLogger.html
-- Installing: /usr/local/share/dlep/html/DlepClient_8h__incl.map
-- Installing: /usr/local/share/dlep/html/DestAdvert_8cpp__incl.png
-- Installing: /usr/local/share/dlep/html/Dlep_8cpp__incl.png
-- Installing: /usr/local/share/dlep/html/functions_func_e.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_5.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1DlepServiceImpl_1_1InitializationError__coll__graph.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1PeriodicMcastSendRcv__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemSerializeVisitor__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/PeerDiscovery_8h.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_24.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1ProtocolConfigImpl__coll__graph.png
-- Installing: /usr/local/share/dlep/html/DestAdvert_8cpp.html
-- Installing: /usr/local/share/dlep/html/PeriodicMcastSendRcv_8h__dep__incl.map
-- Installing: /usr/local/share/dlep/html/Dlep_8cpp.html
-- Installing: /usr/local/share/dlep/html/Thread_8h__incl.map
-- Installing: /usr/local/share/dlep/html/DlepInit_8h_source.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemSerializeVisitor__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/DlepClient_8h__incl.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_13.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u8__ipv4__u8__t-members.html
-- Installing: /usr/local/share/dlep/html/sync_off.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1DataItemNotPresent__coll__graph.map
-- Installing: /usr/local/share/dlep/html/graph_legend.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DlepService__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1d__mac.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_5.map
-- Installing: /usr/local/share/dlep/html/ProtocolConfigImpl_8h__incl.map
-- Installing: /usr/local/share/dlep/html/LL_icon.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_32.png
-- Installing: /usr/local/share/dlep/html/classDlepClientImpl-members.html
-- Installing: /usr/local/share/dlep/html/NetUtils_8h_source.html
-- Installing: /usr/local/share/dlep/html/DestAdvert_8h__incl.map
-- Installing: /usr/local/share/dlep/html/DlepLogger_8h__incl.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_21.png
-- Installing: /usr/local/share/dlep/html/DestAdvertInfo_8h__dep__incl.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadProtocolConfig__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/DlepServiceImpl_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/PeriodicMcastSendRcv_8h.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1DataItemNotPresent__coll__graph.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadSignalName__coll__graph.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadModuleName__coll__graph.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemValueFromStringStreamVisitor__coll__graph.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_25.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1internal_1_1ProtocolMessage_1_1DataItemWrongType__coll__graph.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1ProtocolConfigImpl.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_13.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadDataItemId__coll__graph.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemEqualVisitor__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_39.map
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1InfoBaseMgr-members.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_37.map
-- Installing: /usr/local/share/dlep/html/tabs.css
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemValueFromStringStreamVisitor__coll__graph.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_33.png
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u8__ipv6__u16__t-members.html
```

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-- Installing: /usr/local/share/dlep/html/functions_func.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DlepClient__inherit__graph.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_21.map
-- Installing: /usr/local/share/dlep/html/functions_eval.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadStatusCodeId__coll__graph.map
-- Installing: /usr/local/share/dlep/html/pages.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DataItemValueFromStringStreamVisitor.html
-- Installing: /usr/local/share/dlep/html/folderclosed.png
-- Installing: /usr/local/share/dlep/html/DlepServiceImpl_8h_source.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_10.png
-- Installing: /usr/local/share/dlep/html/DlepLogger_8cpp__incl.png
-- Installing: /usr/local/share/dlep/html/functions_type.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u8__string__t.html
-- Installing: /usr/local/share/dlep/html/ExampleDlepClientImpl_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/DlepInit_8h__dep__incl.png
-- Installing: /usr/local/share/dlep/html/InfoBaseMgr_8h__incl.map
-- Installing: /usr/local/share/dlep/html/inherit_graph_14.map
-- Installing: /usr/local/share/dlep/html/IdTypes_8h.html
-- Installing: /usr/local/share/dlep/html/functions_r.html
-- Installing: /usr/local/share/dlep/html/inherit_graph_17.map
-- Installing: /usr/local/share/dlep/html/ExampleDlepClientImpl_8cpp__incl.map
-- Installing: /usr/local/share/dlep/html/DlepAdvertDataBase_8h__dep__incl.map
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadStatusCodeId__coll__graph.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_2.png
-- Installing: /usr/local/share/dlep/html/DlepMac_8h__incl.png
-- Installing: /usr/local/share/dlep/html/DlepMac_8cpp__incl.png
-- Installing: /usr/local/share/dlep/html/DataItem_8h.html
-- Installing: /usr/local/share/dlep/html/folderopen.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1ProtocolMessage-members.html
-- Installing: /usr/local/share/dlep/html/DlepAdvertMessage_8h_source.html
-- Installing: /usr/local/share/dlep/html/Table_8cpp.html
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1internal_1_1PeerDiscovery.html
-- Installing: /usr/local/share/dlep/html/modem-using-dest-advert.png
-- Installing: /usr/local/share/dlep/html/inherit_graph_36.png
-- Installing: /usr/local/share/dlep/html/classLLDLEP_1_1DlepClient__inherit__graph.png
-- Installing: /usr/local/share/dlep/html/functions_s.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1ProtocolConfig_1_1BadStatusCodeName__coll__graph.map
-- Installing: /usr/local/share/dlep/html/DlepCommon_8h__incl.png
-- Installing: /usr/local/share/dlep/html/classTable.html
-- Installing: /usr/local/share/dlep/html/structLLDLEP_1_1Div_u16__vu8__t.html
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$ which Dlep
/usr/local/bin/Dlep
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$ dlep help
No command 'dlep' found, did you mean:
  Command 'delp' from package 'fp-utils-3.0.0' (universe)
dlep: command not found
cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build$ Dlep help
extraneous argument help
Usage: Dlep [parameters]
Any of these parameters can appear either on the command line or in the config file:

```

Parameter name	Default	Description
ack-probability	100	Probability (%) of sending required ACK signals (for testing)
ack-timeout	3	Seconds to wait for ACK signals
config-file		XML config file containing parameter settings

```

destination-advert-enable    0          Should the modem run the Destination Advertisement protocol?
destination-advert-expire-count 0        Time to keep Destination Advertisements
destination-advert-hold-interval 0        Time to wait for Destination Advertisement after destination up
destination-advert-iface    emane0    Interface that the destination discovery protocol uses, rf interface
destination-advert-mcast-address 225.6.7.8 address to send Destination Advertisements to
destination-advert-port    33445    UDP Port to send Destination Advertisements to
destination-advert-rf-id    RF ID of the local modem
destination-advert-send-interval 5        Time between sending Destination Advertisements
discovery-enable           1          Should the router run the PeerDiscovery protocol?
discovery-iface            eth0       Interface that the router uses for the PeerDiscovery protocol
discovery-interval         60        Time between sending PeerDiscovery signals
discovery-mcast-address    224.0.0.117 address to send PeerDiscovery signals to
discovery-port             854       UDP Port to send PeerDiscovery signals to
discovery-ttl              255       IP TTL to use on PeerDiscovery signals
heartbeat-interval         60        Time between sending Heartbeat signals
heartbeat-threshold        4          Number of missed Heartbeats to tolerate
linkchar-autoreply         1          Automatically send reply to linkchar requests?
local-type                 modem      Which DLEP role to play, modem or router?
log-file                   dlep.log  File to write log messages to
log-level                  3          1=most logging, 5=least
peer-flags                 0          Flags field value of Peer Type data item
peer-type                  Peer Type data item value
protocol-config-file       /usr/local/etc/dlep/dlep-rfc-8175.xml XML file containing DLEP protocol configuration
protocol-config-schema     /usr/local/etc/dlep/protocol-config.xsd XML schema file for protocol-config-file
send-tries                 3          Number of times to send a signal before giving up
session-address            IP address that the modem listens on for session connections
session-iface              Interface that the router uses for session connections
session-port               854       TCP port number that the modem listens on for session connections
session-ttl                255       IP TTL to use on session connections

```

**cisco@dlep-sim-radio-a1:~/dlep-top/LL-DLEP/build\$**