Overview of Radio Aware Routing

Introduction

Tech adoption plays a vital role in driving optimization and efficiency across all sectors today, including the Defence Industry, state and local government for search and rescue, law enforcement, and disaster assessment. These disciplines require the right information, in the right place, at the right time and mobile ad hoc networks are emerging to address these needs. The RFC5578 defines a PPP-over-Ethernet (PPPoE) based mechanism for integrating IP routers and mobile radios in ad hoc networks, enabling faster convergence, more efficient route selection, and better performance for traffic that is sensitive to delays.

In large mobile networks, connections to the routing neighbors are often interrupted due to distance and radio obstructions. When these signals do not reach the routing protocols, protocol timers are used to update the status of a neighbor. However, routing protocols have lengthy timers, which is not recommended in mobile networks.

Radio-Aware Routing (RAR) is a mechanism that uses radios to interact with the routing protocol OSPFv3 and EIGRP to signal the appearance, disappearance, and link conditions of one-hop routing neighbors. It addresses several of the challenges faced when merging IP routing and radio communications in mobile networks, especially those exhibiting mobile ad hoc (MANET) behaviour.

Mobile Ad Hoc Networking (MANET)

Mobile ad hoc networks are emerging as a means for delivering the benefits of IP networking to users operating beyond the reach of a fixed network. In ad hoc networks, mobile nodes associate on an extemporaneous or ad hoc basis. Ad hoc networks have numerous distinguishing characteristics when compared to conventional networking solutions:

- **`Self-forming`** — Nodes that come within radio range of each other can establish a network association without any pre-configuration or manual intervention.
- **`Self-healing`** — Nodes can join or leave rapidly without affecting operation of the remaining nodes.
- **`No infrastructure`** — In an ad hoc network, mobile nodes form their own network, and essentially become their own infrastructure.
- **`Peer to peer`** — Traditional networks typically support end systems operating in client-server mode. In an ad hoc network, mobile nodes can communicate and exchange information without prior arrangement and without reliance on centralized resources.
- **`Predominantly wireless`** — Historically networks have been mostly wired, and enhanced or extended through wireless access. The ad hoc environment is essentially wireless, but can be extended to support wired resources.

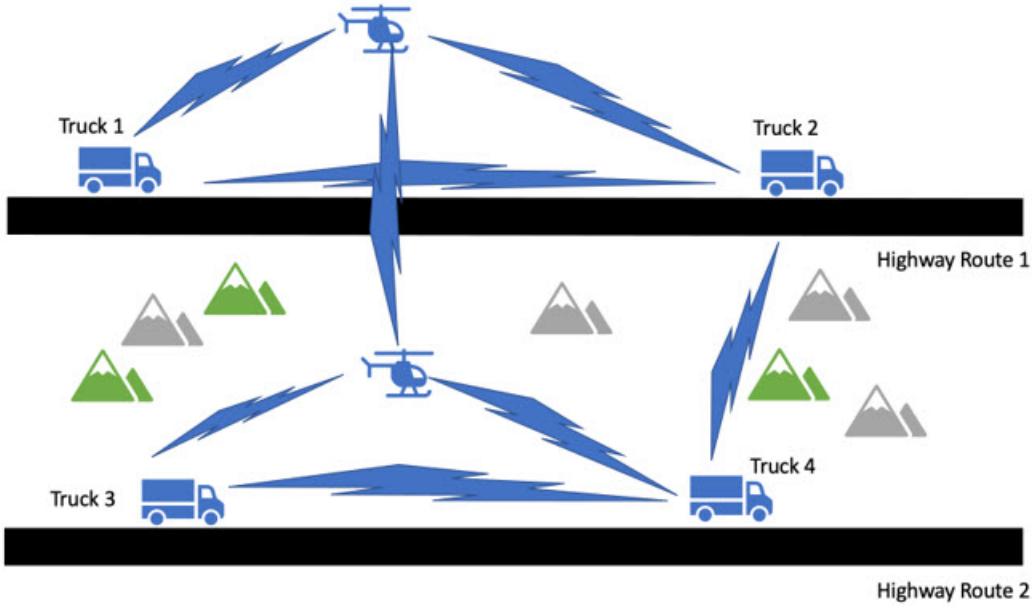
- **`Highly dynamic`** — Mobile nodes are in continuous motion and ad hoc networking topologies are constantly changing.

Collectively, these characteristics will enable ad hoc networks to deliver timely information to a new and underserved class of users. Ad hoc networking solutions can be applied to virtually any scenario that involves a cadre of highly mobile users or platforms (which may include stationary devices as well), a strong need to share IP-based information, and an environment in which fixed infrastructure is impractical, impaired, or impossible.

A Real-World Problem Description

The figure below shows a voice, video, data network between moving vehicles that consists of both ground and air vehicles, hence the network is mobile and it is a peer to peer mesh that changes as topographical obstructions are encountered. Networks with such topology are called mobile ad hock network, or MANET for short.

Figure 1: Mobile Ad-Hoc Network Topology



In the scenario in the drawing, all 4 trucks always have connectivity with the helicopters that are flying over the same road. The two helicopters always have line of sight and will always have a connection between each other. The trucks may even be able to connect to the other helicopter or a truck on the opposite road when conditions are favorable.

Here we see that the path between trucks 1 and 3 are completely blocked. The path between Truck 2 and 4 is about to be blocked.

Our existing routing protocols such as OSPFv3 and EIGRP need to adjust its path metrics very quickly to maintain a cohesive operational network. The routing protocol also needs a way to get that information from the radios and that requires a radio to router protocol that is delivered by Cisco Radio Aware Routing in the form of two open protocols:

- PPP over Ethernet (PPPoE)

- Dynamic Link Exchange Protocol (DLEP)

Both protocols are discussed later in this document.

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Feature Information for Radio Aware Routing

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

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

Table 1: Feature Information for Radio Aware Routing

Feature Name	Releases	Feature Information
Radio Aware Routing	Cisco IOS XE Release 17.8.1a	This feature was introduced for the following platforms: • Cisco Catalyst 8000V Edge Software
	Cisco IOS XE Release 17.11.1a	This feature was introduced for the the following platforms: • Cisco Catalyst 8200 Series Edge Platforms • Cisco Catalyst 8300 Series Edge Platforms • Cisco Catalyst 8500 Series Edge Platforms

Benefits of Radio Aware Routing

Radio Aware Routing offers the following benefits:

- Provides faster network convergence through immediate recognition of topographic obstructions and changes.
- Enables routing for failing or fading radio links.
- Allows easy routing between line-of-sight and non-line-of-sight paths.
- Provides faster convergence and optimal route selection so that traffic that is sensitive to delays, such as voice and video, is not disrupted.

- Provides efficient radio resources and bandwidth usage.
- Reduces impact on the radio links by performing congestion control in the router.
- Allows route selection based on radio power conservation.
- Enables decoupling of the routing and radio functionalities.
- Provides simple ethernet connection to PPPoE Extension and DLEP compliant radios.