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When to use RFC 6553, 6554 and IPv6-in-IPv6 draft-robles-roll-useofrplinfo-00

Abstract

This document states different cases where RFC 6553, RFC 6554 and IPv6-in-IPv6 encapsulation is required to set the bases to help defining the compression of RPL routing information in LLN environments.

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1. Introduction

RPL [RFC6550] defines RPL Option to transmit routing information. RFC 6553 [RFC6553] defines how to transmit in a Hop-By-Hop Option RPL Information,such as information to avoid and detect loops. RFC 6554 [RFC6554] defines the use of Extension header for Source Routing.

Several discussions in ROLL/6lo/6tisch Mailing Lists took place focusing in the definition how to compress RPL Information in constrained environment. ROLL Virtual Interim Meeting (02-2015) concluded that there is a need to define how to use RFC 6553, RFC6554 and tunneling (IP-in-IP) to be able to set the correct environment for compression.

2. Terminology and Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC 2119 [RFC2119].

Terminology defined in [RFC7102]

3. Sample/reference topology

In a typical topology we found 6LBR (6LoWPAN Border Router), 6lR (6LoWPAN Router) and 6LN (6LoWPAN Node) as leaf connected in a DODAG (Destination Oriented Directed Acyclic Graph). Between these entities messages such as DIS, DIO and DAO are transmitted. RPL defines the RPL Control message as an ICMPv6 information message with a Type of 155. RPL supports two modes of Downward traffic: Storing, it is fully stateful or Non-Storing it is fully source routed. Any given RPL Instance is either storing or non-storing.

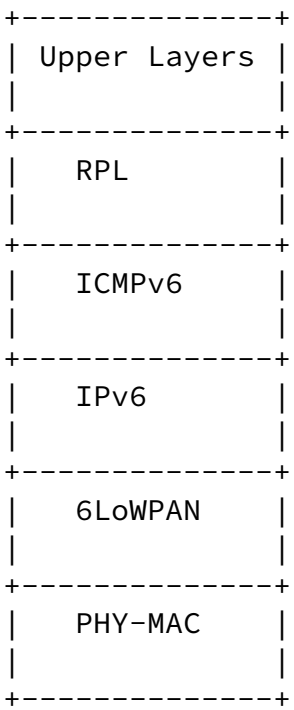


Figure 1: RPL Stack

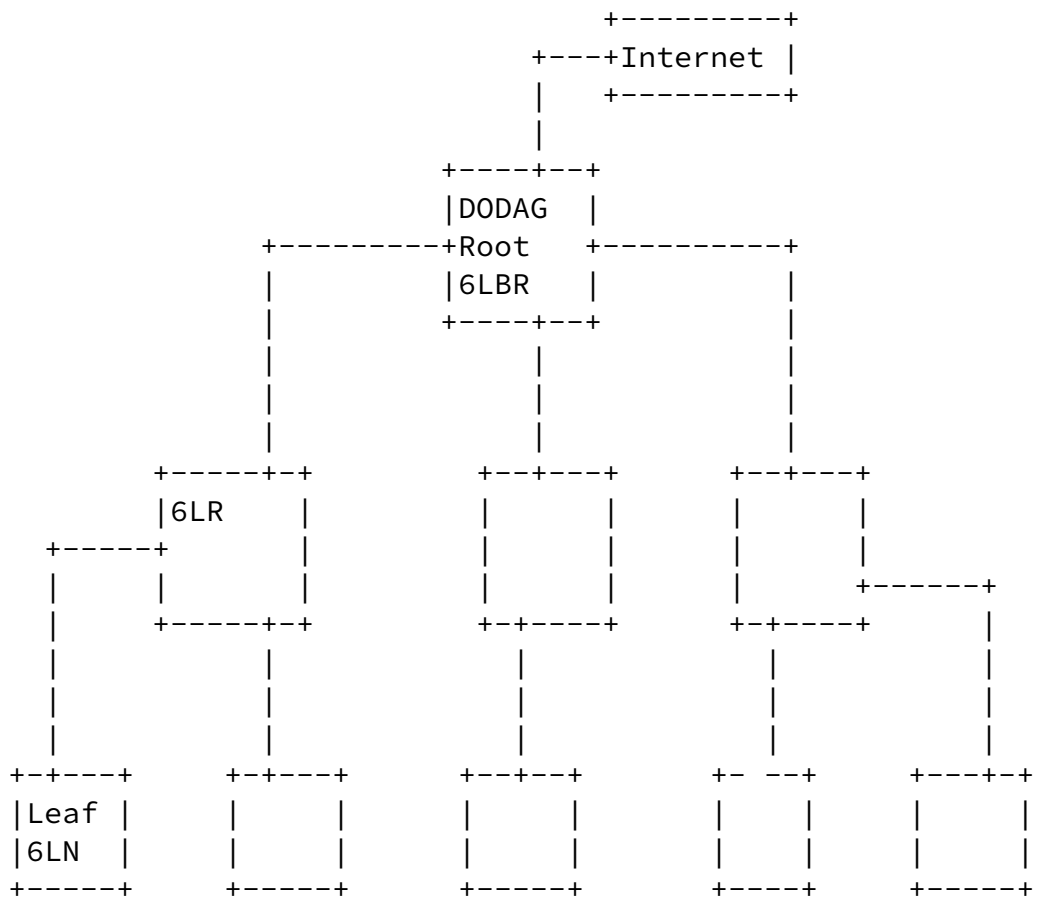


Figure 2: A reference RPL Topology

In different scenarios the use of RFC 6553, RFC 6554 and tunneling

can take place:

-Flow from leaf to root

-Flow from leaf to Internet

-Flow from leaf to leaf

-Flow from Internet to leaf

-Flow from leaf to root

4. Example flow from leaf to root

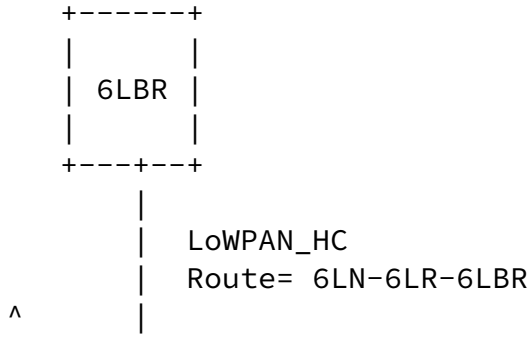
A leaf node generates DAO and DIS messages and in general does not accept them. Additionally, this kind of nodes accepts DIO messages, but in general do not generate them. (In inconsistency A leaf node generates DIO with infinite rank, to fix it).

4.1. Non-storing

In non-storing in this case the leaf node uses Hop-By-Hop option (RFC 6553) to indicate the routing information to send messages to the DODAG root, this message is going to be analyzed in each node until arrive the DODAG root.

RFC 6554 was created to strictly send information between RPL routers in the same RPL routing domain. How it would be in 6554?

TBD: Tunneling is necessary in case that there is information to send outside RPL Domain and other cases?



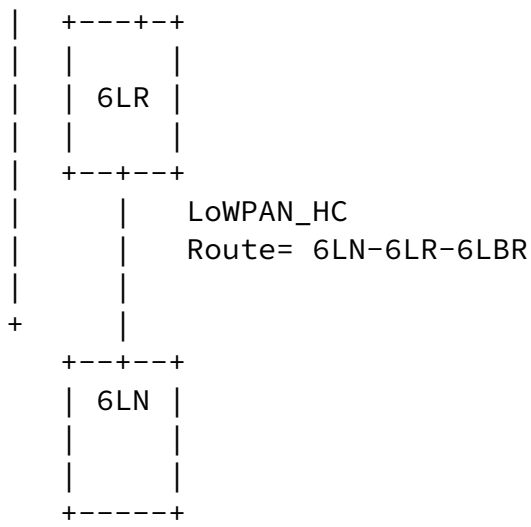
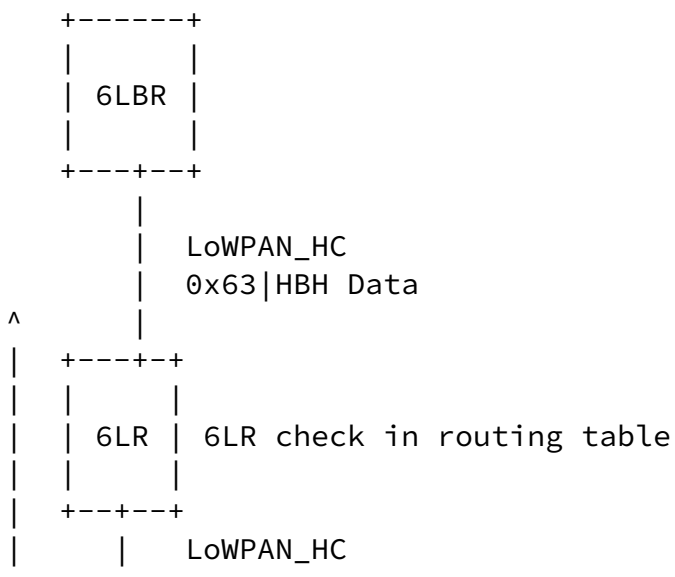


Figure 3: From leaf to Root - Non-Storing Mode

4.2. Storing

IP6 6553{X,Y] ?ipip payload. In storing mode is suitable the use of RFC 6553 to send RPL Information through HBH field checking the routing table to find out where to send the message. It may include IP-in-IP encapsulation to transmit information not related with the RPL domain.



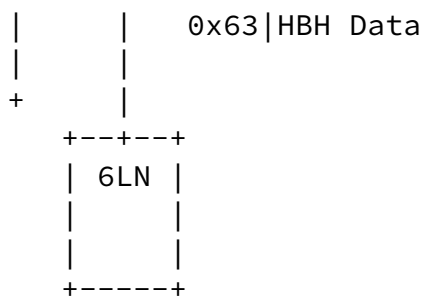


Figure 4: From leaf to Root - Storing Mode

5. Example flow from leaf to Internet

5.1. Non-storing

In this case the IP-in-IP encapsulation should take place to send information not related to the RPL domain inside of the RPL domain.

RPL information from RFC 6553 should not go out to Internet. The router sould take this information out before send the packet to Internet. The HBH Option is going to be analyzed in each node to the root.

Related to RFC 6554 the Source Header route is added and removed by DODAG root. However, RFC 6554 was created to strictly send information between RPL routers in the same RPL routing domain. How it would be in 6554?

5.2. Storing

In storing the information of RFC 6553 should take away by DODAG root before go to Internet.

6. Example flow from leaf to leaf

can leafs insert appropriate headers, without ipip? In [RFC6550] RPL

allows a simple one-hop P2P optimization for both storing and non-storing networks. A node may send a P2P packet destined to a one-hop neighbor direclty to that node. Section 9 in [RFC6550].

6.1. Traditional storing

The route go through an ancestor that knows the route to the destination, using HBH [RFC6553] to carry RPL Information.

6.2. Traditional non-storing

The route go through the DODAG root, using source routing [RFC6554].

6.3. P2P non-storing

(p2p storing? TBD)

7. Example flow from Internet to leaf

A DODAG root do not add routing extension to incoming packets, it instead uses tunneling.

7.1. Storing

DODAG root adds the HBH header [RFC6553] and send the packet downward to the destination.

7.2. Non-storing

DODAG root is going to add the source route header [RFC6554]

8. Example flow from root to leaf

8.1. Storing

DODAG root adds the HBH header [RFC6553] and send the packet downward to the destination.

8.2. Non-storing

DODAG root is going to add the source route header [RFC6554]

9. IANA Considerations

There are no IANA considerations related to this document.

10. Security Considerations

TBD.

11. Acknowledgements

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