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LISP Generic Protocol Extension
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Abstract

This document describes extentions to the Locator/ID Separation Protocol (LISP) Data-Plane, via changes to the LISP header, to support multi-protocol encapsulation.

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Table of Contents

1. Introduction

The LISP Data-Plane is defined in [I-D.ietf-lisp-rfc6830bis]. It specifies an encapsulation format that carries IPv4 or IPv6 packets (henceforth jointly referred to as IP) in a LISP header and outer UDP/IP transport.

The LISP Data-Plane header does not specify the protocol being encapsulated and therefore is currently limited to encapsulating only IP packet payloads. Other protocols, most notably Virtual eXtensible Local Area Network (VXLAN) [RFC7348] (which defines a similar header format to LISP), are used to encapsulate Layer-2 (L2) protocols such as Ethernet.

This document defines an extension for the LISP header, as defined in [I-D.ietf-lisp-rfc6830bis], to indicate the inner protocol, enabling

the encapsulation of Ethernet, IP or any other desired protocol all the while ensuring compatibility with existing LISP deployments.

A flag in the LISP header, called the P-bit, is used to signal the presence of the 8-bit Next Protocol field. The Next Protocol field,

when present, uses 8 bits of the field allocated to the echo-noncing and map-versioning features. The two features are still available, albeit with a reduced length of Nonce and Map-Version.

1.1. Conventions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

1.2. Definition of Terms

This document uses terms already defined in [I-D.ietf-lisp-rfc6830bis].

2. LISP Header Without Protocol Extensions

As described in Section 1, the LISP header has no protocol identifier that indicates the type of payload being carried. Because of this, LISP is limited to carrying IP payloads.

The LISP header [I-D.ietf-lisp-rfc6830bis] contains a series of flags (some defined, some reserved), a Nonce/Map-version field and an instance ID/Locator-status-bit field. The flags provide flexibility to define how the various fields are encoded. Notably, Flag bit 5 is the last reserved bit in the LISP header.

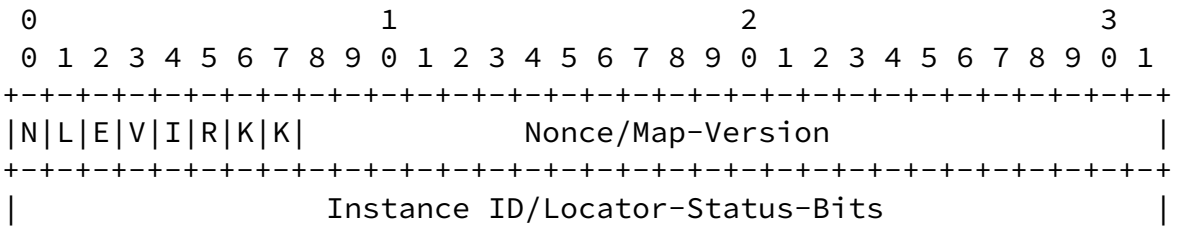

Figure 1: LISP Header

3. Generic Protocol Extension for LISP (LISP-GPE)

This document defines two changes to the LISP header in order to support multi-protocol encapsulation: the introduction of the P-bit and the definition of a Next Protocol field. This is shown in Figure 2 and described below.

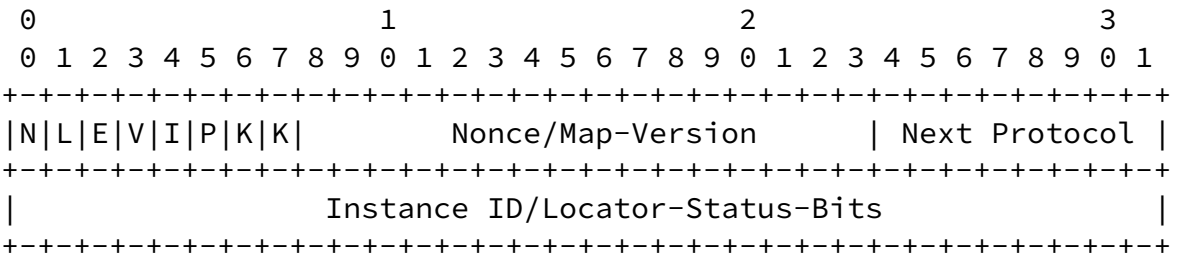

Figure 2: LISP-GPE Header

P-Bit: Flag bit 5 is defined as the Next Protocol bit.

If the P-bit is clear (0) the LISP header conforms to the definition in [I-D.ietf-lisp-rfc6830bis].

The P-bit is set to 1 to indicate the presence of the 8 bit Next Protocol field.

Nonce/Map-Version: In [I-D.ietf-lisp-6834bis], LISP uses the lower 24 bits of the first word for a nonce, an echo-nonce, or to support map- versioning. These are all optional capabilities that are indicated in the LISP header by setting the N, E, and V bits respectively.

When the P-bit and the N-bit are set to 1, the Nonce field is the middle 16 bits (i.e., encoded in 16 bits, not 24 bits). Note that

the E-bit only has meaning when the N-bit is set.

When the P-bit and the V-bit are set to 1, the Version fields use the middle 16 bits: the Source Map-Version uses the high-order 8 bits, and the Dest Map-Version uses the low-order 8 bits.

When the P-bit is set to 1 and the N-bit and the V-bit are both 0, the middle 16-bits MUST be set to 0 on transmission and ignored on receipt.

The encoding of the Nonce field in LISP-GPE, compared with the one used in [I-D.ietf-lisp-rfc6830bis] for the LISP data plane encapsulation, reduces the length of the nonce from 24 to 16 bits. As per [I-D.ietf-lisp-rfc6830bis], Ingress Tunnel Routers (ITRs) are required to generate different nonces when sending to different Routing Locators (RLOCs), but the same nonce can be used for a period of time when encapsulating to the same Egress Tunnel Router (ETR). The use of 16 bits nonces still allows an ITR to

determine to and from reachability for up to 64k RLOCs at the same time.

Similarly, the encoding of the Source and Dest Map-Version fields, compared with [I-D.ietf-lisp-rfc6830bis], is reduced from 12 to 8 bits. This still allows to associate 256 different versions to each Endpoint Identifier to Routing Locator (EID-to-RLOC) mapping to inform commmunicating ITRs and ETRs about modifications of the mapping.

Next Protocol: The lower 8 bits of the first 32-bit word are used to carry a Next Protocol. This Next Protocol field contains the protocol of the encapsulated payload packet.

This document defines the following Next Protocol values:

0x1 : IPv4

0x2 : IPv6

0x3 : Ethernet

0x4 : Network Service Header (NSH) [RFC8300]

The values are tracked in an IANA registry as described in Section 5.1.

4. Backward Compatibility

LISP-GPE uses the same UDP destination port (4341) allocated to LISP.

The next Section describes a method to determine the Data-Plane capabilities of a LISP ETR, based on the use of the "Multiple Data-Planes" LISP Canonical Address Format (LCAF) type defined in [RFC8060]. Other mechanisms can be used, including static ETR/ITR (xTR) configuration, but are out of the scope of this document.

When encapsulating IP packets to a non LISP-GPE capable router the P-bit MUST be set to 0. That is, the encapsulation format defined in this document MUST NOT be sent to a router that has not indicated that it supports this specification because such a router would ignore the P-bit (as described in [I-D.ietf-lisp-rfc6830bis]) and so would misinterpret the other LISP header fields possibly causing significant errors.

A LISP-GPE router MUST NOT encapsulate non-IP packets to a non LISP-GPE capable router.

4.1. Use of "Multiple Data-Planes" LCAF to Determine ETR Capabilities

LISP Canonical Address Format (LCAF) [RFC8060] defines the "Multiple Data-Planes" LCAF type, that can be included by an ETR in a Map-Reply to encode the encapsulation formats supported by a given RLOC. In this way an ITR can be made aware of the capability to support LISP-GPE, as well as other encapsulations, on a given RLOC of that ETR.

The 3rd 32-bit word of the "Multiple Data-Planes" LCAF type, as defined in [RFC8060], is a bitmap whose bits are set to one (1) to represent support for each Data-Plane encapsulation. The values are tracked in an IANA registry as described in Section 5.2.

This document defines bit 24 in the third 32-bit word of the "Multiple Data-Planes" LCAF as:

g-Bit: The RLOCs listed in the Address Family Identifier (AFI) encoded addresses in the next longword can accept LISP-GPE (Generic Protocol Extension) encapsulation using destination UDP port 4341

4.2. Type of Service

When a LISP-GPE router performs Ethernet encapsulation, the inner 802.1Q [IEEE.802.1Q_2014] priority code point (PCP) field MAY be mapped from the encapsulated frame to the Type of Service field in the outer IPv4 header, or in the case of IPv6 the 'Traffic Class' field

4.3. VLAN Identifier (VID)

When a LISP-GPE router performs Ethernet encapsulation, the inner header 802.1Q [IEEE.802.1Q_2014] VLAN Identifier (VID) MAY be mapped to, or used to determine the LISP Instance IDentifier (IID) field.

5. IANA Considerations

5.1. LISP-GPE Next Protocol Registry

IANA is requested to set up a registry of LISP-GPE "Next Protocol". These are 8-bit values. Next Protocol values in the table below are defined in this document. New values are assigned via Standards Action [RFC8126]. The protocols that are being assigned values do not themselves need to be IETF standards track protocols.

Next Protocol	Description	Reference
0	Reserved	This Document
1	IPv4	This Document
2	IPv6	This Document
3	Ethernet	This Document
4	NSH	This Document

5..255	Unassigned	

5.2. Multiple Data-Planes Encapsulation Bitmap Registry

IANA is requested to set up a registry of "Multiple Data-Planes Encapsulation Bitmap" to identify the encapsulations supported by an ETR in the Multiple Data-Planes LCAF Type defined in [RFC8060]. The bitmap is the 3rd 32-bit word of the Multiple Data-Planes LCAF type. Each bit of the bitmap represents a Data-Plane Encapsulation. New values are assigned via Standards Action [RFC8126].

Bits 0-23 are unassigned. This document assigns bit 24 (g-bit) to LISP-GPE. Bits 25-31 are assigned in [RFC8060]).

Bit Position	Bit Name	Assigned to	Reference
0-23		Unassigned	
24	g	LISP Generic Protocol Extension (LISP-GPE)	This Document
25	U	Generic UDP Encapsulation (GUE)	[RFC8060]
26	G	Generic Network Virtualization Encapsulation (GENEVE)	[RFC8060]
27	N	Network Virtualization - Generic Routing Encapsulation (NV-GRE)	[RFC8060]
28	v	VXLAN Generic Protocol Extension (VXLAN-GPE)	[RFC8060]
29	V	Virtual eXtensible Local Area Network (VXLAN)	[RFC8060]
30	l	Layer 2 LISP (LISP-L2)	[RFC8060]
31	L	Locator/ID Separation Protocol (LISP)	[RFC8060]

6. Security Considerations

LISP-GPE security considerations are similar to the LISP security considerations and mitigation techniques documented in [RFC7835].

With LISP-GPE, issues such as data-plane spoofing, flooding, and traffic redirection may depend on the particular protocol payload encapsulated.

7. Acknowledgements and Contributors

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