An Open Control-Plane Implementation for LISP networks

Dung Phung Chi
VNU, Hanoi, Vietnam
LIP6/UPMC, Paris, France
dungpc@vnu.edu.vn

Stefano Secci, Guy Pujolle
LIP6/UPMC, Paris, France
firstname.lastname@lip6.fr

Patrick Raad, Pascal Gallard
NSS, Lognes, France.
firstname.lastname@nss.fr

ABSTRACT

Among many options to tackle scalability issues of the current Internet routing architecture, the Locator Identity Separation Protocol (LISP) seems to be a feasible and effective one [1]. LISP brings renewed scale and flexibility to the network, enabling advanced mobility management, with acceptable scalability and security. This paper gives a brief presentation about an open control-plane implementation of LISP currently working in the lisp4.net testbed. Our implementation includes most LISP control-plane functions, and also a module to allow the integration with an OpenLISP dataplane and, therefore, the deployment of a complete standalone Open-Source LISP Tunnel Router interoperable with existing Cisco LISP implementation.

Categories and Subject Descriptors

C.2.1 [**Network Architecture and Design**]: Network communications; C.2.5 [**Local and Wide-Area Network**]: Internet

General Terms

Design, Algorithms, Management.

Keywords

LISP, Internet Routing, Control-Plane, VM Mobility.

1. INTRODUCTION

The basic idea of LISP is to implement a two-level routing on the top of IP, separating transit networks from edge networks, mapping an IP address, or Endpoint Identifier (EID), to one or many Routing Locators (RLOCs). RLOCs remain globally routable, while EIDs become provider independent and routable beyond RLOCs [2].

At the data-plane, a "map-and-encap" operation is performed using a mapping cache. The control-plane communications (with a mapping system) handle EID-to-RLOC registrations and resolutions. Many RLOCs can be registered for the same EID; priority and weight metrics are associated with each RLOC to decide which one to use (best priority), or how to do load-balancing (if equal priorities) [3]. When a host communicates with another host on another LISP site, the source sends a native IP packet with EID as the destination IP address; the packet reaches a border router, acting as an Ingress Tunnel Router (ITR), which does mapping lookups for EID-to-RLOCs, appends a LISP header and an external IP header with the ITR as source and an RLOC as destination. The destination RLOC, or Egress Tunnel Router (ETR), strips the outer header and sends the native packet to the destination.

OpenLISP [4] is an open-source implementation of the LISP data-plane, in a FreeBSD environment. Standalone, an OpenLISP node is not able to handle all control-plane signaling within a LISP network, so it has to depend on xTR proxies. Our control-plane implementation aims at filling this gap, including an optional module using the OpenLISP mapping socket, yet being independent from OpenLISP, as detailed hereafter. The control-plane implementation is currently used to interconnect the LIP6, UNIROMA1, VNU Hanoi and the U. Prague LISP sites to the worldwide testbed operated by Cisco (`http://www.lisp4.net`), across which the use case will be demonstrated.

2. LISP CONTROL-PLANE

The LISP Mapping System includes two node types: Map Resolver (MR) and Map Server (MS). A MR accepts requests sent from an ITR and resolves the EID-to-RLOC mapping using a mapping database. Whereas a MS learns authoritative EID-to-RLOC mappings from an ETR, then includes them in a mapping database [5]. [2] describes the format and the different types of the control-plane Mapping System messages, without specifying how the Mapping System is structured; therefore, Mapping System architectures have been proposed (e.g., [6]). The control-plane messages we implemented are:

- MAP-REGISTER: EID-to-RLOC message (authenticated) sent by an ETR to MS;
- MAP-REQUEST: message sent by an ITR, or relayed by MS, to an ETR;
- MAP-REPLY: message sent by an ITR in response

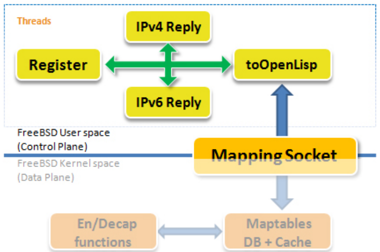

Figure 1: Control-plane Threads

to a MAP-REQUEST;
- ENCAPSULATED-CONTROL-MESSAGE (ECM): is an encapsulated MAP-REQUEST sent by ITR to MR;
- SOLICIT-MAP-REQUEST (SMR): a MAP-REQUEST message soliciting a mapping update to an ITR.

3. IMPLEMENTATION OVERVIEW

Once started, our control-plane program (running in the user space) listens on the UDP LISP control port, and creates four threads: one sends periodically a MAP-REGISTER message to the Map Servers; two others (reply threads) handle IPv4 and IPv6 independently, treat MAP-REQUEST and CPM messages (described below), and respond with MAP-REPLY messages; the last thread communicates directly with the OpenLISP data-plane (Fig. 1). Moreover, the reply threads share two sockets (on IPv4 and IPv6) to be able to accept ECMs that may have an IPv4 inner header and an IPv6 outer header, or the other way around.

The control-plane implementation requires basic information in a configuration file: the mapping between the EID-to-RLOC managed locally by the xTR, the IPs of the map servers, the authentication key (many keys can handle multiple mapping systems). The file is divided into two main sections: one is for the Map Server's IPs, the other one can be divided into multiple subsections and handles the EID-to-RLOC mapping database. The source code and more details can be found in `http://www.lisp.ipv6.lip6.fr` (accessible via LISP!).

4. VM MOBILITY USE CASE

Despite the main purpose behind LISP (improve the Internet routing scalability by decreasing the routing table and offering novel traffic engineering features), its major field of application today is datacenter routing management. There are currently two approaches to handle virtual machine mobility (VMM): one is based on mapping updates upon data-plane traffic detection [7], the other consists in implementing control-plane directly in the mobile node as suggested by [8]. However, the first suffers from security issues and low performance for streaming VMs, and the second goes de-facto against the LISP philosophy of separating transit from edge networks, and puts too much burden on the VM in terms of control-plane signaling.

An alternative possible way, is to use a novel CHANGE PRIORITY MESSAGE (CPM) containing the VM's EID whose RLOC priority needs to be changed and all the IP addresses that the VM was communicating with, before the migration, along with an authentication field. Thus, when a VM migrates from a datacenter to another, the hypervisor detects the end of the migration and triggers a CPM destined to its xTR. Upon Reception, the xTR processes the message: matches its EID in the database and changes its priority. In order to refresh the global mapping system, the xTR sends respectively Map-Registers to MSs and SMRs to ITRs. In this way, we avoid implementing xTR functions in the mobile nodes, while guaranteeing control-plane authorization and service seamlessness. CPM structure details are included and implemented in the control-plane implementation and it will be object of the demo too.

5. PERSPECTIVES

Our control-plane implementation allows connecting a LISP site to the lisp4.net testbed without the need to buy a Cisco router. Another advantage is to be able to use novel control-plane messages, such as the CPM message, without the need to wait for standardization and inclusion in a commercial router OS. Moreover, our implementation allows working simultaneously with different mapping systems. The path forward is the implementation of a Mapping Server as in [6], to push forward the development of new functions for LISP (i.e., incremental MAP-REGISTER messages), and to surround current limitations in the Cisco implementation (e.g., locator count limited to 5 of the 8 available bits).

6. REFERENCES

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