A Decentralized Mapping System

draft-farinacci-lisp-decent-03

IETF Prague
March 2019

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Draft Status

A Decent LISP Mapping System (LISP-Decent)
draft-farinacci-lisp-decent-03

<table>
<thead>
<tr>
<th>Status</th>
<th>IESG evaluation record</th>
<th>IESG writeups</th>
<th>Email expansions</th>
<th>History</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

After implementation of Pull-Based

B.1. Changes to draft-farinacci-lisp-decent-03
- Posted March 2019.
- Introduce the Hash Mask which is used to grab common bits from a registered prefix and a lookup prefix.
- Spec how multicast lookups are done in the pull-based mapping system.
- Indicate the hash string includes the unicast EID mask-length and multicast group and source mask-lengths.

B.2. Changes to draft-farinacci-lisp-decent-02
- Posted November 2018.
- Changed references from peer-group to seed-group to make the algorithms in this document more like how blockchain networks initialize the peer-to-peer network.
- Added pull mechanism to compliment the push mechanism. The pull mechanism could be used as a seed-group to bootstrap the push mechanism.

B.3. Changes to draft-farinacci-lisp-decent-01
- Posted July 2018.
- Document timez and reference update.

B.4. Changes to draft-farinacci-lisp-decent-00
- Initial draft posted January 2018.

Colon presented -01 in Montreal

Dino presented -00 in London

Added Pull-Based to Draft
Problem Statement

• What if LISP xTRs didn’t need to depend on a third-party

• What if LISP xTRs could multi-home and roam to inform each other about new RLOCs

• What if LISP xTRs could be their own mapping system

• Let’s build a purely democratized and decentralized control-plane
Use-Cases

• Crypto-Currency & Blockchain Applications
• Emergency Networking (Mesh Networks)
• Plug-and-Play VPN Networking
• Space Networking (Software-Defined Satellites)
• Sharable Economy Apps
Today’s Model Mapping System
LISP Control-Plane Messages

Map-Register
10.0.0.0/8 to 3.3.3.3

Map-Register
10.0.0.0/8 to 1.1.1.1

Map-Register
2001:5:3::/48 to 2.2.2.2

Map-Register
2001:5:3::/48 to 4.4.4.4
Network Connectivity

Diagram showing network connectivity with EID space mapping system and Internet RLOC space.
Decentralized Map-Server?

- **Push-Based** Model
  - What if each xTR was a Map-Server
  - What if each xTR could Map-Register to each xTR
  - The mapping system would be synchronized
  - An xTR could be a Map-Resolver for itself

- **Pull-Based** Model
  - Subset of xTRs are co-located Map-Resolvers & Map-Servers
  - Registrations are sharded (just like today)
  - The EID as input to a hash function define where Map-Requests and Map-Registers go
  - Redundancy achieved through DNS level of indirection
Definition of a **Push-Based Mapping System**

- A consolidated mapping system is identified by a multicast group address
- The xTRs that are part of a mapping system join the same multicast group
- Map-Registers are sent to the group - all xTRs receive all mappings
- Efficient distribution when underlay supports multicast or head-end replication at each xTR
- Map-Request lookup has low latency
- xTRs build and send **1** Map-Register for **n** xTRs
- Management simplified by accessing one xTR to get all mappings
LISP-Decent (Push-Based) Control-Plane Messages

1.0.0.0/8 -> xTR1
3.0.0.0/8 -> xTR3
5.0.0.0/8 -> xTR5

1.0.0.0/8 to 224.0.1.1
224.0.1.1 to 1.0.0.0/8

3.0.0.0/8 to 224.1.1.1
224.1.1.1 to 3.0.0.0/8

5.0.0.0/8 to 224.1.1.1
224.1.1.1 to 5.0.0.0/8

2001:5:2::/48 to 224.2.2.2
224.2.2.2 to 2001:5:2::/48

2001:5:4::/48 to 224.2.2.2
224.2.2.2 to 2001:5:4::/48

2001:5:6::/48 to 224.2.2.2
224.2.2.2 to 2001:5:6::/48

2001:5:2::/48 -> xTR2
2001:5:4::/48 -> xTR4
2001:5:6::/48 -> xTR6
Definition of a Pull-Based Mapping System

- Map-Server sets are defined by a DNS-name prefix
- EID is hashed to produce a Modulus Index
- Modulus Index selects a DNS-name
- DNS-name has A-records for each Map-Server
- Map-Registers and Map-Requests go to same Map-Server Set
- A Pull-Based mapping system can bootstrap a Push-Based mapping system
- A Pull-Based mapping system does not need LISP-DDT or LISP-ALT
LISP-Decent (Pull-Based) Control-Plane Messages

DNS-prefix: `ms.lispers.net`, Modulus: 4

0.ms.lispers.net: 1.1.1.1 2.2.2.2
1.ms.lispers.net: 3.3.3.3 4.4.4.4
2.ms.lispers.net: 5.5.5.5 6.6.6.6
3.ms.lispers.net: 7.7.7.7 8.8.8.8

Map-Request 1.1.1.1 hashes to 0.ms.lispers.net
Map-Request sent to 1.1.1.1 or 2.2.2.2

Map-Register 1.1.0.0/24 hashes to 0.ms.lispers.net
Map-Register to 1.1.1.1 and 2.2.2.2

Map-Register 2001:5:2::/48 hashes to 3.ms.lispers.net
Map-Register to 7.7.7.7 and 8.8.8.8
Brief Push-Based Demo

- 3 containers each running a lispers.net xTR
- Docker bridge NOT doing multicast
- xTRs are doing head-end replication
- xTRs register an IPv4 EID-prefix and a Name EID
LISP-Decent in Action
Brief Pull-Based Demo

- 1 mrms container simulating all 8 map-servers/map-resolvers
- 1 etr container Map-Registering a variety of EID-types
- 1 itr container Map-Requesting
- DNS-prefix is ms.lispers.net, Modulus is 4
DNS Configuration

```python
>>> import socket
>>> socket.gethostbyname_ex("0.ms.lispers.net")
('0.ms.lispers.net', [], ['1.1.1.1', '2.2.2.2'])
>>> 
>>> socket.gethostbyname_ex("1.ms.lispers.net")
('1.ms.lispers.net', [], ['3.3.3.3', '4.4.4.4'])
>>> 
>>> socket.gethostbyname_ex("2.ms.lispers.net")
('2.ms.lispers.net', [], ['5.5.5.5', '6.6.6.6'])
>>> 
>>> socket.gethostbyname_ex("3.ms.lispers.net")
('3.ms.lispers.net', [], ['7.7.7.7', '8.8.8.8'])
```
<table>
<thead>
<tr>
<th>Site Name</th>
<th>EID-Prefix or (S,G)</th>
<th>Registered</th>
<th>Last Registerer</th>
<th>Last Registered</th>
<th>First Registered</th>
<th>Registration Flags</th>
</tr>
</thead>
<tbody>
<tr>
<td>registrations</td>
<td>[0]</td>
<td>(ams)</td>
<td>--</td>
<td>never</td>
<td>never</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>[0]2.2.2.2/32</td>
<td>yes (dynamic)</td>
<td>[0]172.17.0.3</td>
<td>0:00:08</td>
<td>0:11:08</td>
<td>p-s-l-t-r-m-n</td>
</tr>
<tr>
<td></td>
<td>[0]+000140871820010/64</td>
<td>yes (dynamic)</td>
<td>[0]172.17.0.3</td>
<td>0:00:08</td>
<td>0:11:08</td>
<td>p-s-l-t-r-m-n</td>
</tr>
<tr>
<td></td>
<td>[0]1.1.1.1/32</td>
<td>yes (dynamic)</td>
<td>[0]172.17.0.3</td>
<td>0:00:08</td>
<td>0:11:08</td>
<td>p-s-l-t-r-m-n</td>
</tr>
<tr>
<td></td>
<td>[0]'dino'</td>
<td>yes (dynamic)</td>
<td>[0]172.17.0.3</td>
<td>0:00:07</td>
<td>0:11:08</td>
<td>p-s-l-t-r-m-n</td>
</tr>
<tr>
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<td>[0](1.1.1.1/32, 224.1.1.1/32)</td>
<td>yes (dynamic)</td>
<td>[0]172.17.0.3</td>
<td>0:00:07</td>
<td>0:11:08</td>
<td>p-s-l-t-r-m-n</td>
</tr>
<tr>
<td></td>
<td>[0]0000-1111-2222/48</td>
<td>yes (dynamic)</td>
<td>[0]172.17.0.3</td>
<td>0:00:07</td>
<td>0:11:08</td>
<td>p-s-l-t-r-m-n</td>
</tr>
<tr>
<td></td>
<td>[0]2001::2/128</td>
<td>yes (dynamic)</td>
<td>[0]172.17.0.3</td>
<td>0:00:08</td>
<td>0:11:08</td>
<td>p-s-l-t-r-m-n</td>
</tr>
<tr>
<td></td>
<td>[0]48-51-12-N-2-20-55-E/100</td>
<td>yes (dynamic)</td>
<td>[0]172.17.0.3</td>
<td>0:00:08</td>
<td>0:11:08</td>
<td>p-s-l-t-r-m-n</td>
</tr>
<tr>
<td></td>
<td>[0]+1223344556677880/64</td>
<td>yes (dynamic)</td>
<td>[0]172.17.0.3</td>
<td>0:00:08</td>
<td>0:11:08</td>
<td>p-s-l-t-r-m-n</td>
</tr>
<tr>
<td></td>
<td>[0]+0000000000000000/8</td>
<td>yes (dynamic)</td>
<td>[0]172.17.0.3</td>
<td>0:00:08</td>
<td>0:11:08</td>
<td>p-s-l-t-r-m-n</td>
</tr>
<tr>
<td></td>
<td>[0]2001::1/128</td>
<td>yes (dynamic)</td>
<td>[0]172.17.0.3</td>
<td>0:00:07</td>
<td>0:11:08</td>
<td>p-s-l-t-r-m-n</td>
</tr>
</tbody>
</table>
ETR Sending Map-Registers

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>Event</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>03/25/19</td>
<td>23:07:32.419</td>
<td>etr: EID-prefix</td>
<td>[0]240.1.1.1/32 for ms-name 'all', decent-index 3</td>
</tr>
<tr>
<td>03/25/19</td>
<td>23:07:32.419</td>
<td>etr: EID-prefix</td>
<td>[0]1.1.1.1/32 for ms-name 'all', decent-index 1</td>
</tr>
<tr>
<td>03/25/19</td>
<td>23:07:32.420</td>
<td>etr: EID-prefix</td>
<td>[0]2.2.2.2/32 for ms-name 'all', decent-index 0</td>
</tr>
<tr>
<td>03/25/19</td>
<td>23:07:32.420</td>
<td>etr: EID-prefix</td>
<td>[0]2001::1/128 for ms-name 'all', decent-index 2</td>
</tr>
<tr>
<td>03/25/19</td>
<td>23:07:32.420</td>
<td>etr: EID-prefix</td>
<td>[0]2001::2/128 for ms-name 'all', decent-index 3</td>
</tr>
<tr>
<td>03/25/19</td>
<td>23:07:32.421</td>
<td>etr: EID-prefix</td>
<td>[0]'dino' for ms-name 'all', decent-index 1</td>
</tr>
<tr>
<td>03/25/19</td>
<td>23:07:32.421</td>
<td>etr: EID-prefix</td>
<td>[0](1.1.1.1/32, 224.1.1.1/32) for ms-name 'all', decent-index 1</td>
</tr>
<tr>
<td>03/25/19</td>
<td>23:07:32.422</td>
<td>etr: EID-prefix</td>
<td>[0]48-51-12-N-2-20-55-E/100 for ms-name 'all', decent-index 3</td>
</tr>
<tr>
<td>03/25/19</td>
<td>23:07:32.422</td>
<td>etr: EID-prefix</td>
<td>[0]+1223344556677880/64 for ms-name 'all', decent-index 3</td>
</tr>
<tr>
<td>03/25/19</td>
<td>23:07:32.422</td>
<td>etr: EID-prefix</td>
<td>[0]+000140871820010/64 for ms-name 'all', decent-index 0</td>
</tr>
<tr>
<td>03/25/19</td>
<td>23:07:32.422</td>
<td>etr: EID-prefix</td>
<td>[0]+000000000000000/8 for ms-name 'all', decent-index 3</td>
</tr>
<tr>
<td>03/25/19</td>
<td>23:07:32.422</td>
<td>etr: Send Map-Register to map-server</td>
<td>[0]2.2.2.2, ms-name 'all', decent-index 0.ms.lispers.net</td>
</tr>
<tr>
<td>03/25/19</td>
<td>23:07:32.425</td>
<td>etr: Send Map-Register to map-server</td>
<td>[0]1.1.1.1, ms-name 'all', decent-index 0.ms.lispers.net</td>
</tr>
<tr>
<td>03/25/19</td>
<td>23:07:32.427</td>
<td>etr: Send Map-Register to map-server</td>
<td>[0]4.4.4.4, ms-name 'all', decent-index 1.ms.lispers.net</td>
</tr>
<tr>
<td>03/25/19</td>
<td>23:07:32.429</td>
<td>etr: Send Map-Register to map-server</td>
<td>[0]8.8.8.8, ms-name 'all', decent-index 3.ms.lispers.net</td>
</tr>
<tr>
<td>03/25/19</td>
<td>23:07:32.431</td>
<td>etr: Send Map-Register to map-server</td>
<td>[0]6.6.6.6, ms-name 'all', decent-index 2.ms.lispers.net</td>
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<tr>
<td>03/25/19</td>
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<td>etr: Send Map-Register to map-server</td>
<td>[0]7.7.7.7, ms-name 'all', decent-index 3.ms.lispers.net</td>
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<tr>
<td>03/25/19</td>
<td>23:07:32.434</td>
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<td>[0]3.3.3.3, ms-name 'all', decent-index 1.ms.lispers.net</td>
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<td>etr: Send Map-Register to map-server</td>
<td>[0]5.5.5.5, ms-name 'all', decent-index 2.ms.lispers.net</td>
</tr>
</tbody>
</table>
ITR Sending Map-Requests
Questions/Reactions/Tomatoes?