LISP: Practice and Experience

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Agenda

- LISP in a Nutshell
- Currently Deployed Network
- Deployment Model
- Numbers and Names
- Configuring LISP
- Futures
- A Few Open Questions
- Active Internet Drafts
- Q/A
**LISP in a Nutshell**

- Locator/ID Separation Protocol
  - Endpoint Identifiers (EIDs) to number hosts
  - Topological Routing Locators (RLOCs) for routing
  - Network-based *map-and-encap* solution
  - No changes to hosts whatsoever
  - No new addressing changes to site devices
  - Very few configuration file changes
  - Imperative to be incrementally deployable
  - Address family agnostic

- For more, see tutorials at [http://www.lisp4.net](http://www.lisp4.net)
New Network Elements

• Ingress Tunnel Router (ITR)
  – Finds EID to RLOC mapping
    • This is the **map** part of map-and-encap
  – Encapsulates to Locators at source site
    • This is the **encap** part of map-and-encap

• Egress Tunnel Router (ETR)
  – Authoritative for its EID to RLOC mapping
  – Decapsulates at destination site
How the LISP Data Plane Works

PI EID-prefix 1.0.0.0/8

Provider A
10.0.0.0/8

Provider B
11.0.0.0/8

Provider Y
13.0.0.0/8

Provider X
12.0.0.0/8

S1

S2

ITR

ETR

S

D

1.0.0.1 -> 2.0.0.2

11.0.0.1 -> 12.0.0.2

10.0.0.1 -> 12.0.0.2

12.0.0.2

13.0.0.2

10.0.0.1

11.0.0.1

Mapping Entry

EID-prefix: 2.0.0.0/8

Locator-set:

12.0.0.2, priority: 1, weight: 50 (D1)

13.0.0.2, priority: 1, weight: 50 (D2)

Policy controlled by destination site

Legend:

EIDs -> Green
Locators -> Red

DNS entry:
D.abc.com A 2.0.0.2

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Finding an ETR: LISP+ALT

• Hybrid push/pull approach
  - ALT pushes aggregates, LISP pulls specifics
• Hierarchical EID prefix assignment
• Aggregation of EID prefixes
• GRE-based overlay network
• BGP used to advertise EIDs on overlay
• Option for data-triggered Map-Replies
How the ALT Works

Legend:
- EIDs → Green
- Locators → Red
- GRE Tunnel
- Low Opex
- Physical link
- Data Packet
- Map-Request
- Map-Reply

EID-prefix
240.0.0.0/24

ITR
240.0.0.1 → 240.1.1.1

ALT-rtr
11.0.0.1 → 240.1.1.1
240.0.0.1 → 240.1.1.1

ALT-rtr
240.0.0.1 → 240.1.1.1

ETR
240.0.0.1 → 240.1.1.1

EID-prefix
240.1.1.0/24

1.1.1.1
2.2.2.2
3.3.3.3

240.0.0.1 → 240.1.1.1
11.0.0.1 → 240.1.1.1

ALT-rtr
11.0.0.1

ALT-rtr
1.1.1.1

240.1.1.0/16

12.0.0.1

11.0.0.1

240.1.2.0/24

240.1.0.0/16

ALTR-TR
240.0.0.1 → 240.1.1.1

11.0.0.1 → 1.1.1.1
240.0.0.1 → 240.1.1.1

3.3.3.3

240.2.1.0/24

11.0.0.1 → 240.1.1.1

240.1.1.0/24

How the ALT Works

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What the Network Looks Like

LISP and LISP+ALT Network

Addressing Plan
- Regional
  - 192.58.0/16
  - 2030::/32
- Global
  - 2001:0:1::/8
  - 2001:0:2::/8
- IPv6
  - 2001:0:1::/8
  - 2001:0:2::/8

Legend
- Sites
- LISP Alpha Sites
- LISP+ALT Alpha Sites
- LISP+ALT Beta Sites
- LISP+ALT Tunnels
- GNE Tunnels

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Deployment Model

- Currently deployed LISP network elements are 1RU PCs ("titanium") running a LISP-capable version of NXOS
  - There are also IOS and Open Source implementations underway

- Endpoint Identifier (EID) Assignment Strategy
  - The basic idea: Geographic (probably)
  - With "ALT-Aggregators" strategically placed within a geography

- GRE tunnel topology
  - Partially meshed ALT-Aggregators, with sites arranged in a star around one or more ALT-Aggregators
  - ALT-Aggregators are typically "ALT-only"
  - Note the ALT doesn’t require GRE
Deployment Model: Interworking

- LISP Translation
  - “LISP NAT”

- Proxy Tunnel Router (PTR)
  - Advertises coarsely aggregated EID-prefix(es) into the DFZ to attract traffic for those prefixes
  - Behaves like an ITR for that traffic
Deployment Model: Interworking

• You can also respond to a Map-Request for a v6 EID with a v4 locator (and vice versa)

• We call this “mixed locators”

• This allows you to, for example, connect sites deploying IPv6 EIDs over IPv4 locators without an intervening native IPv6 capable network

• More on Interworking in a minute
Network Numbers

- EID Prefixes
  - 153.16/16, geographically subdivided
    - i.e. 153.16.32.0/20 is EU
  - 2610:00d0::/32, sites get 2610:D0:xyzz::/48
    - x is continent, y is region, zz is site
  - Note that both of these are advertised into the DFZ for interworking (PTR) purposes

- GRE tunnels numbered out of 240/4

- ALT uses 4-byte ASNs (32768.x for now)
Network Names

- lisp4.net
  - IPv4 EIDs
  - Exception:
    - www.translate.lisp4.net
    - IPv4 RLOC LISP-translated to an EID
    - More on LISP translation in a moment

- lisp6.net
  - IPv6 EIDs
ITR Configuration

• Enable ITR Functionality
  – ip lisp itr
  – ipv6 lisp itr

• Use the ALT to resolve mappings
  – ip lisp alt-vrf lisp

• Map-Requests vs. Data-Probes
  – ip lisp itr send-data-probe
    • Don’t use data-probes
ETR Configuration

- Enable ETR Functionality
  - `ip lisp etr`
  - `ipv6 lisp etr`

- Configure an EID-to-RLOC database entry
  - `ip lisp database-mapping <EID-Prefix> <RLOC> priority <p> weight <w>`
  - Priority tells the ETR which mappings to use first
  - Weight is a percentage of traffic (covered by EID-Prefix) that should be sent to RLOC
  - Weight can be used to implement active-active BGP-free multihoming (among other things)
ETR Configuration

- An ETR will typically advertise its EID-prefix into the ALT
  - Attracts Map-Requests to the authoritative ETR

- If you want “Mixed Locators”
  - ipv6 lisp database-mapping 2610:00d0:1200::/48 128.223.156.134 priority 1 weight 100
  - ipv6 lisp database-mapping 2610:00d0:1200::/48 2001:468:D01:9C:80DF:9C86 priority 2 weight 100

- And if you want the Map-Reply to come back over IPv4
  - ipv6 lisp etr send-ip-map-reply
Advertising an EID-Prefix into the ALT (pretty standard stuff)

...  
  vrf context lisp  
  ip route 153.16.10.0/24 null0 tag 1  
  ipv6 route 2610:D0:1200::/48 null0 tag 1  
...

  router bgp 32768.1  
  vrf lisp  
    address-family ipv4 unicast  
      redistribute static route-map static-to-bgp  
    address-family ipv6 unicast  
      redistribute static route-map static-to-bgp  
  vrf lisp  
    neighbor FC00:FFFF:FFFF:FFFF::10:0:0:2 remote-as 32768.613  
    address-family ipv6 unicast  
    route-map my-eid-prefixes out  
  vrf lisp  
    neighbor 240.0.254.135 remote-as 32768.100  
    address-family ipv4 unicast  
    route-map my-eid-prefixes out  

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On the Low OPEX xTR (note: BGP-free):

```
static ip route 153.16.0.0/16 240.0.254.140
static ipv6 route 2610:00d0::/32 2610:00d0:1fff::0240:0000:0254:0140/127
```

On the upstream ALT-Aggregator:

```
static ip route 153.16.19.0/24 tunnel3 tag 613
static ipv6 route 2610:00d0:1303::/48 tunnel3 tag 613
```

This is equivalent to static routing a customer
Interworking - LISP Translate

• Essentially “LISP-NAT”
• A router which is upstream from translating ETR advertises the “outside prefix” (usually part of a larger aggregate) into the DFZ, and points the prefix at the ETR doing the translation; standard NAT configuration

• ETR configuration for the translate case:
  - `ip lisp etr`
  - `ip lisp database-mapping 153.16.10.0/24 128.223.156.134 priority 1 weight 100`
  - `ip lisp translate inside 153.16.10.5 outside 128.223.157.65`

• Note that the “inside” EID (153.16.10.5 in this case) must be covered by the EID prefix in the database-mapping command (153.16.10.0/24 in this case)
• Try http://www.translate.lisp4.net
Interworking - LISP PTR

- The PTR advertises the aggregated EID prefix (e.g., 153.16/16 and/or 2610:D0::/32) into the DFZ
  - This attracts traffic addressed to an EID which originates on the Internet to the PTR

- Upon receiving the traffic (addressed to an EID), the PTR functions as an ITR
  - i.e., it queries the ALT to get the EID-to-RLOC mapping and
  - LISP-encapsulates packets to the destination ETR’s RLOC

- Note that the PTR doesn’t have mapping state since it’s not really a LISP site
IPv6 LISP PTR Config

! Use the LISP VRF for the ALT
!
ipv6 lisp alt-vrf lisp
!
! Enable the PTR
!
ipv6 lisp proxy-itr 2001:0468:0d01:009C::80df:9c23

That’s really it.

Futures

• Continue to develop LISP software base
  – NXOS, IOS, OpenLISP,…
  – Recent packet format changes
    • Piggyback mappings on map-requests
    • draft-farinacci-lisp-09.txt

• Continue to build out the network
  – New sites: L3 (London), ARIN, UY
  – Several boxes “in-flight”
    • Let us know if you are interested…

• Simplify ALT configuration and operation
Open Questions

- Who runs the mapping system, and what is the business model?
- Complexity of the mapping system?
- Negative Map-Replies?
- Using LISP for IPv4 Address Conservation
- Effects of the mapping system on applications
  - first packet loss/lookup latency
- Scalability of the ALT
- PMTU effects
- “Stretch” effects
- Caching behavior in xTRs
- ...

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LISP Internet Drafts

draft-farinacci-lisp-09.txt
draft-fuller-lisp-alt-02.txt
draft-lewis-lisp-interworking-01.txt
draft-farinacci-lisp-multicast-00.txt
draft-meyer-lisp-eid-block-01.txt
draft-mathy-lisp-dht-00.txt
draft-iannone-openlisp-implementation-01.txt
draft-brim-lisp-analysis-00.txt
draft-meyer-lisp-cons-04.txt
draft-lear-lisp-nerd-04.txt
draft-curran-lisp-emacs-00.txt
Questions/Comments?

Contact us: lisp-interest@lists.civil-tongue.net
Information: http://www.lisp4.net
http://www.lisp6.net
OpenLISP: http://inl.info.ucl.ac.be/softwares/openlisp

Thanks!

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