LISP – A Next-Generation Networking Architecture

LISP Disjointed RLOC Space Technical Details

Version 0.8 – 30 October 2013
LISP Disjointed RLOC Space Details

Agenda

- LISP Disjointed RLOC Space Technical Details
- LISP Disjointed RLOC Space Example Concepts
- LISP Disjointed RLOC Space Example Configurations
LISP Disjointed RLOC Space Technical Details
LISP Disjointed RLOC Space Details

Disjointed RLOC Space::: Technical Details

- Locator/ID separation creates two namespaces: EIDs and RLOCs
  - EID space is the overlay of Enterprise prefixes
  - RLOC space is the underlay network connectivity

- The fundamental principal of any network is that connectivity must exist between sites

- LISP supports sites being connected to locator spaces that have no connectivity to each other!
  - In LISP, this is known as a “disjointed RLOC set”

One obvious example of disjointed RLOC spaces is for IPv4 and IPv6 attached sites
LISP Disjointed RLOC Space Details

Disjointed RLOC Space:: Technical Details

- Locator/ID separation creates two namespaces: EIDs and RLOCs
  - EID space is the overlay of Enterprise prefixes
  - RLOC space is the underlay network connectivity
- The fundamental principal of any network is that connectivity must exist between sites
- LISP supports sites being connected to locator spaces that have no connectivity to each other!
  - In LISP, this is known as a “disjointed RLOC set”

The same situation occurs for distinct core networks of the same address family. Two MPLS VPN cores, for example, exhibit disjointed RLOC properties.
LISP Disjointed RLOC Space Details

Disjointed RLOC Space:: Technical Details

- LISP Disjointed RLOC Space Feature – Description
  - Automates communications between LISP sites that have locators in disjointed locator spaces
    - Cross-AF (IPv4/IPv6) locators – a trivial case (0.0.0.0/0 and ::/0)
    - Distinct IPv4 or IPv6 cores – a more common case, e.g. two different MPLS VPN SPs
  - Control Plane :: a new Map-Server command set takes advantage of site locator space information known to the Mapping System
    - When a LISP site registers, it provides information about its own locators
  - Data Plane :: a new component – the Re-encapsulating Tunnel Router (RTR) provides date plane connectivity between disjointed locator spaces
    - An RTR decapsulates packets sent to it, then re-encapsulates and forwards them
The LISP Disjointed RLOC Space – Feature Components

- No configuration changes needed on xTRs
- Minimal configuration added to the Map-Server handles the control plane
  - New `locator-set` configuration defines RTR RLOCs per scope
  - New `locator-scope` configuration defines disjointed RLOC scopes
- New “re-encapsulating tunnel router” (RTR) handles the data plane
  - New `map-request itr-rlocs` configuration defines RTR RLOCs used in map-request messages generated by RTR
- `show` and `debug` output text now includes locator-scope information
LISP Disjointed RLOC Space Details

Disjointed RLOC Space:: Technical Details

- The LISP Disjointed RLOC Space – Deployment Requirements
  - Map-Servers and RTRs must have connectivity to both (all) locator spaces
    - IPv4/IPv6 disjointed RLOC space is an obvious use-case
    - Common-AF but distinct cores, such as multiple MPLS cores is a less obvious case
  - Map-Servers and RTRs can join up to 8 locator scopes
    - LISP DDT can be used to extend coverage to span additional scopes
LISP Disjointed RLOC Space Details

Disjointed RLOC Space:: Technical Details

- The LISP Disjointed RLOC Space – **Map-Server Details**
  - Map-Server disjointed RLOC logic is triggered by the existence of `locator-scope` sets
    - If `locator-scope` sets are not configured, the Map-Server will not consider disjointed RLOCs in its map-request handling logic
    - Configuration concepts:

```
router lisp
locator-set rtr-set1
  10.1.3.1 priority 1 weight 1
  exit
!.
locator-set rtr-set2
  10.2.3.1 priority 1 weight 1
  exit
!.
locator-scope s1
  rtr-locator-set rtr-set1
  rloc-prefix 10.1.0.0/16
  exit
!.
locator-scope s2
  rtr-locator-set rtr-set2
  rloc-prefix 10.2.0.0/16
  exit
!.
```

Where 10.1.3.1 and 10.2.3.1 are the RLOCs connecting the RTR to each IPv4 locator space, and where 10.1.0.0/16 and 10.2.0.0/16 are the respective locator-scopes for each locator space (IPv6 would be similar)
Disjointed RLOC Space Details

The LISP Disjointed RLOC Space – Map-Server Details (cont.)

- A Map-Server uses its knowledge of [a] configured of locator-scope sets, [b] ETR RLOC(s) from site registrations, and [c] ITR RLOC(s) present in map-request messages to determine the action to follow.
LISP Disjointed RLOC Space Details

Disjointed RLOC Space: Technical Details

- The LISP Disjointed RLOC Space – Map-Server Details (cont.)

Map-Request

Compare:
- ITR RLOC(s) sent in Map-Request, and
- ETR RLOC(s) in EID registration, against
- configured locator-scopes

ITR and ETR share AT LEAST ONE RLOC of the same AF in the same locator-scope

YES

Map-Server handles Map-Request as normal:
- Forward Map-Request to ETR

NO

ITR and ETR share NO RLOCs of the same AF in the same locator-scope

YES

Map-Server must Proxy-Reply:
- Proxy-Reply RTR RLOC List or NMR to ITR in ITR RLOC scope
  - [1] [2] [3]

NO

ITR and ETR RLOCs match NO locator-scope

YES

Map-Server handles Map-Request as normal:
- Forward Map-Request to ETR
  - [4]

NOTES:
1) Proxy- Replies are always non-authoritative and TTL = 15 minutes
2) Proxy-reply RLOCs are extracted from the configured rtr-locator-set configured in the locator-scope matching the ITR RLOC
3) If no RTR RLOCs are defined in the locator-scope, a Negative Map-Reply (forward native) is returned
4) RLOCs are assumed reachable via routing (even though not defined in any locator-scope config)
### LISP Disjointed RLOC Space Details

Disjointed RLOC Space: Technical Details

- The LISP Disjointed RLOC Space – Map-Server Details (cont.)

<table>
<thead>
<tr>
<th>ITR RLOC List</th>
<th>ETR RLOC List</th>
<th>MS Route/Reachable</th>
<th>Disjoint Results</th>
<th>MS Response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scope 1</td>
<td>Scope 2</td>
<td>Default</td>
<td>Scope 1</td>
<td>Scope 2</td>
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<tr>
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</tr>
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</tr>
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</tr>
<tr>
<td>X</td>
<td>X</td>
<td>yes</td>
<td>yes</td>
<td>NO</td>
</tr>
</tbody>
</table>
LISP Disjointed RLOC Space Details

Disjointed RLOC Space:: Technical Details

- LISP Disjointed RLOC Space Feature – RTR Details

  - A Re-encapsulating Tunnel Router (RTR) performs functions similar to a Proxy Ingress/Egress Tunnel Router (PxTR)

    - A PETR (generally) decapsulates LISP traffic and forwards it natively to non-LISP destinations
      - Used for LISP EID sources communicating with non-LISP destinations (notably for RLOC AF hop-over)
    - A PITR (generally) advertises EID space into an underlying (non-LISP) core network in order to attract traffic, and then it encapsulates this traffic to LISP sites
      - Used for Non-LISP sources communicating with LISP EID destinations (ingress TE, RLOC AF hop-over, et al.)
    - An RTR performs decapsulation and then re-encapsulation of LISP-to-LISP traffic
      - Used for LISP to LISP traffic between xTRs that do not share common RLOC space
    - An RTR (generally) does not need to advertise EID space into underlying core networks; LISP traffic is encapsulated to it (and it re-encapsulates egress traffic)
LISP Disjointed RLOC Space Details

Disjointed RLOC Space:: Technical Details

- LISP Disjointed RLOC Space Feature – RTR Details (cont.)
  - An RTR uses the LISP control plane to send map-requests to a Map-Resolver to drive the population of its map-cache
    - A map-request message contains an ITR RLOC field that is populated with one or more entries corresponding to the locators of the (map-request) originating device
    - A PITR populates the ITR RLOC field with the locators specified in the CLI commands used to enable Proxy ITR functionality for IPv4 and/or IPv6 EIDs, for example:
      ```
      ipv4 proxy-itr 10.1.1.1 2001:db8:F::1
      ipv6 proxy-itr 2001:db8:F::1 10.1.1.1
      ```
    - The above approach can be sufficient for an RTR also, but only in the corner case where the RTR is connecting IPv4 and IPv6 disjointed RLOC spaces
    - In more general cases, for example where an RTR is connecting two or more disjointed RLOC spaces of the same Address Family, the above approach is not sufficient; RLOCs (for the RTR) from within each locator scope that the RTR is connecting must be configured with the `locator-set` command set
LISP Disjointed RLOC Space Details

Disjointed RLOC Space:: Technical Details

- LISP Disjointed RLOC Space Feature – RTR Details (cont.)
  - RTR Map-Request message ITR RLOC field population:
    - An RTR populates the ITR RLOC field of a map-request message with the RLOCs specific in a locator-set, for example:

```
router lisp
locator-set set_ALL
  10.1.3.1 priority 1 weight 1
  10.2.3.1 priority 1 weight 1
exit
!
map-request itr-rlocs set_ALL
```

Where 10.1.3.1 and 10.2.3.1 are the RLOCs connecting the RTR to each IPv4 locator space (IPv6 would be similar)
LISP Disjointed RLOC Space Details

Disjointed RLOC Space:: Technical Details

- LISP Disjointed RLOC Space Feature – RTR Details (cont.)
  - RTR Map-Request message ITR RLOC field population:
    - An RTR still requires PETR and PITR functions to be enabled for each EID address family it is handling; thus, it is still necessary to use the `ipv4|ipv6 proxy-itr` commands
    - It is possible for RTR to be configured to join two IPv4-only or IPv6-only RLOC spaces, but to be handling both IPv4 and IPv6 EID spaces – in this case a “dummy” IPv6 address (loopback is ok) must be configured for use specifically in the `ipv6 proxy-itr` command:

```
interface Loopback0
  no ip address
  ipv6 address 1:1:1::1/128
!
router lisp
---<skip>---
ipv4 proxy-itr 10.2.3.1
ipv6 proxy-itr 10.2.3.1 1:1:1::1
```

- Note that (when configured) `map-request itr-rlocs` RLOCs take precedence over those configured for the `ipv4|ipv6 proxy-itr` commands
LISP Disjointed RLOC Space Details

Disjointed RLOC Space:: Technical Details

- LISP Disjointed RLOC Space Feature – RTR Details (cont.)
  - Locator-Status-Bits Impact
    - LISP data plane traffic includes the locator-status-bits (LSB) field of the LISP encap header
    - Upon reception, an ETR will check the LSB against the map-cache entry it uses (assuming it is also an ITR) for return traffic
    - In the case of disjoint RLOC there are cases where the LSB check will always fail
      - Example: When a LISP site has multiple xTRs belonging to different RLOC scopes, it is not possible to synchronize LSB information between the xTRs; transmission of status reports must be disabled
      - The command `loc-status-alg lsb-reports do-not-transmit` disables LSB checks (the “L” bit is not set)
LISP Disjointed RLOC Space Details

Disjointed RLOC Space:: Technical Details

- LISP Disjointed RLOC Space Feature – Failure Scenarios
  - LISP deployments using Disjointed RLOC Space support can have failure scenarios that require consideration
    - there is the usual problem of cleaning the map-caches, both for the remote xTRs as well as for the xTR losing connectivity to a scope
      - rloc-probing is useful
LISP Disjointed RLOC Space Details

Disjointed RLOC Space:: Technical Details

- LISP Disjointed RLOC Space Feature – HW/Deployment Options
  - Software:

<table>
<thead>
<tr>
<th>Software</th>
<th>IOS</th>
<th>IOS XE</th>
<th>IOS XR</th>
<th>NX-OS</th>
</tr>
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<td>Engineering Release</td>
<td>IOS 15.2(4)XB12</td>
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<tr>
<td>Mainline Release</td>
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<td>IOS-XE XE3.11</td>
<td>IOS XR 5.1.1</td>
<td>TBD</td>
</tr>
</tbody>
</table>

- Services that have been tested and can be combined on the same platform:
  - Map-Server/Map-Resolver + Proxy-ITR/Proxy-ETR + RTR
- Unsupported Options
  - Extranet in Parallel model
    - Re-encapsulation between VRFs requires the use of external elements to the LISP component
LISP Disjointed RLOC Example Concepts
LISP – Disjointed RLOC Space Feature

Example: Cross Address-Family Connectivity

* Core Cross-AF – IPv4 and IPv6
LISP – Disjointed RLOC Space Feature

Example: Two, Identical Address-Family Connectivity

* Core single-AF – IPv4 or IPv6 – but segmented
LISP – Disjointed RLOC Space Feature

Example: General, Identical Address-Family Connectivity

* Core single-AF – IPv4 or IPv6 – Multiple segmented cores
LISP – Disjointed RLOC Space Feature

Example: General, Cross Address-Family Connectivity

* Core mixed-AF – IPv4 and IPv6 – Multiple segmented cores
LISP Disjointed RLOC Example 1:
Cross Address-Family (IPv4/IPv6) Configuration Details
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example – Topology
LISP – Disjointed RLOC Space Feature

Disjointed RLOC Space Example – Configurations

```
! interface Loopback0
 ip address 4.4.4.4 255.255.255.0
 ipv6 address 4:4:4::4/64
!
interface LISP0
!
interface Ethernet0/0
 description Conn to R1 Core (v4 only)
 ip address 10.0.4.1 255.255.255.252
!
router lisp
 locator-set R4
  10.0.4.1 priority 1 weight 1
  exit
!
eid-table default instance-id 0
 database-mapping 4.4.4.0/24 locator-set R4
 database-mapping 4:4:4::/48 locator-set R4
 exit
!
loc-reach-algorithm rloc-probing
 ipv4 use-petr 10.0.3.1
 ipv4 itr map-resolver 10.0.2.1
 ipv4 itr
 ipv4 etr map-server 10.0.2.1 key R4KEY
 ipv4 etr
 ipv6 use-petr 10.0.3.1
 ipv6 itr map-resolver 10.0.2.1
 ipv6 itr
 ipv6 etr map-server 10.0.2.1 key R4KEY
 ipv6 etr
 exit
!
ip route 0.0.0.0 0.0.0.0 10.0.4.2
```

IPv4 Internet
0.0.0.0/0 (scope 1)
IPv6 Internet
::/0 (scope 2)

EID - 4.4.4.0/24
EID - 4:4:4::/48

10.0.4.0/30

IPv4 Internet
0.0.0.0/0

IPv6 Internet
::/0

10.0.2.1
10:0:2::1
10.0.3.1
10:0:3::1
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example

IPv4 Internet 0.0.0.0/0 (scope 1)
IPv6 Internet ::/0 (scope 2)

xTR6

EID – 6.6.6.0/24
EID – 6:6:6::/48

MSMR

10.0.2.1
10:0:2::1

RTR

10.0.3.1
10:0:3::1

interface Loopback0
ip address 6.6.6.6 255.255.255.0
ipv6 address 6:6:6::/64

interface LISP0

interface Ethernet0/0
description Conn to R1 Core (v6 only)
ipv6 address 10:0:6::1/64

router lisp
locator-set R6
10:0:6::1 priority 1 weight 1
exit

eid-table default instance-id 0
database-mapping 6.6.6.0/24 locator-set R6
database-mapping 6:6:6::/48 locator-set R6
exit

lloc-reach-algorithm rloc-probing
ipv4 use-petr 10:0:3::1
ipv4 itr map-resolver 10:0:2::1
ipv4 itr
ipv4 etr map-server 10:0:2::1 key R6KEY
ipv4 etr
ipv6 use-petr 10:0:3::1
ipv6 itr map-resolver 10:0:2::1
ipv6 itr
ipv6 etr map-server 10:0:2::1 key R6KEY
ipv6 etr
exit

ipv6 route ::/0 10:0:6::2

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LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example – Configurations

IPv4 Internet
0.0.0.0/0 (scope 1)
IPv6 Internet
::/0 (scope 2)

xTR4
10.0.4.0/30
EID – 4.4.4.0/24
EID – 4:4:4::/48

MSMR
RTR
10.0.3.1
10:0:3::1
10.0.2.1
10:0:2::1

---<continued>---
interface Ethernet0/0
description Conn to R1 Core (v4 and v6)
ip address 10.0.2.1 255.255.255.252
ipv6 address 10:0:2::1/64

router lisp
locator-set rtr-set1
10.0.3.1 priority 1 weight 1
exit

locator-set rtr-set2
10:0:3::1 priority 1 weight 1
exit

locator-scope s1
rtr-locator-set rtr-set1
rloc-prefix 0.0.0.0/0
exit

locator-scope s2
rtr-locator-set rtr-set2
rloc-prefix ::/0
exit

site R4
description LISP Site R4 - v4 RLOC only
authentication-key R4KEY
eid-prefix 4.4.4.0/24
eid-prefix 4:4:4::/48
exit

---<continued>---
site R6
description LISP Site R6 - v6 RLOC only
authentication-key R6KEY
eid-prefix 6.6.6.0/24
eid-prefix 6:6:6::/48
exit

ipv4 map-server
ipv4 map-resolver
ipv6 map-server
ipv6 map-resolver
exit

ip route 0.0.0.0 0.0.0.0 10.0.2.2
ipv6 route ::/0 10:0:2::2

---<continued>---
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example – Configurations

IPv4 Internet 0.0.0.0/0 (scope 1)
IPv6 Internet ::/0 (scope 2)

---

! interface LISP0
! interface Ethernet0/0
  description Conn to R1 Core (v4 and v6)
  ip address 10.0.3.1 255.255.255.252
  ipv6 address 10:0:3::1/64
! router lisp
  locator-set setALL
    10.0.3.1 priority 1 weight 1
    10:0:3::1 priority 1 weight 1
  exit
! map-request itr-rlocs setALL
  eid-table default instance-id 0
  map-cache 0.0.0.0/0 map-request
  map-cache ::/0 map-request
  exit
! ipv4 map-request-source 10.0.3.1
  ipv4 map-cache-limit 100000
  ipv4 proxy-etr
  ipv4 proxy-itr 10.0.3.1 10:0:3::1
  ipv4 itr map-resolver 10.0.2.1
  ipv4 itr map-resolver 10:0:2::1
  ipv6 map-request-source 10:0:3::1
  ipv6 map-cache-limit 100000
  ipv6 proxy-etr
  ipv6 proxy-itr 10:0:3::1 10.0.3.1
  ipv6 itr map-resolver 10.0.2.1
  ipv6 itr map-resolver 10:0:2::1
  exit
! ip route 0.0.0.0 0.0.0.0 10.0.3.2
  ipv6 route ::/0 10:0:3::2
!
LISP – Disjointed RLOC Space Feature
Cross Address-Family Disjointed RLOC Space Example

IPv4 Internet
0.0.0.0/0 (scope 1)

IPv6 Internet
::/0 (scope 2)

xTR4

10.0.4.0/30

EID – 4.4.4.0/24
EID – 4:4:4::/48

xTR4# sh ip lisp database
---<skip>---
4.4.4.0/24, locator-set R4
Locator Pri/Wgt Source State
10.0.4.1 1/1 cfg-addr site-self, reachable

xTR4# sh ipv6 lisp database
---<skip>---
4:4:4::/48, locator-set R4
Locator Pri/Wgt Source State
10.0.4.1 1/1 cfg-addr site-self, reachable

xTR6

10:0:6::/64

EID – 6:6:6.0/24
EID – 6:6:6::/48

xTR6# sh ipv6 lisp database
---<skip>---
6:6:6.0/24, locator-set R6
Locator Pri/Wgt Source State
10:0:6::1 1/1 cfg-addr site-self, reachable

xTR6# sh ip lisp database
---<skip>---
6:6:6::/48, locator-set R6
Locator Pri/Wgt Source State
10:0:6::1 1/1 cfg-addr site-self, reachable

xTR6#
LISP – Disjointed RLOC Space Feature
Cross Address-Family Disjointed RLOC Space Example

MSMR#sh lisp site detail
---<skip>---
Site name: R4
---<skip>---
EID-prefix: 4.4.4.0/24
---<skip>---
ETR 10.0.4.1, last registered 00:00:52, no proxy-reply, map-notify
TTL 1d00h, no merge, hash-function sha1, nonce 0x28517C31-0x7B233E66
state complete, no security-capability
xTR-ID 0xEC52ECC2-0x006CEAFE-0x814263B3-0x89675EB6
site-ID unspecified
Locator   Local  State      Pri/Wgt  Scope
10.0.4.1  yes    up           1/1    s1
---<skip>---
EID-prefix: 4:4:4::/48
---<skip>---
ETR 10.0.4.1, last registered 00:00:39, no proxy-reply, map-notify
TTL 1d00h, no merge, hash-function sha1, nonce 0xF91CB211-0x5B00E72C
state complete, no security-capability
xTR-ID 0xEC52ECC2-0x006CEAFE-0x814263B3-0x89675EB6
site-ID unspecified
Locator   Local  State      Pri/Wgt  Scope
10.0.4.1  yes    up           1/1    s1
---<skip>---
**LISP – Disjointed RLOC Space Feature**

**Cross Address-Family Disjointed RLOC Space Example**

```
MSMR#sh lisp site detail
---<skip>---
Site name: R6
---<skip>---
EID-prefix: 6.6.6.0/24
---<skip>---
ETR 10:0:6::1, last registered 00:00:26, no proxy-reply, map-notify
   TTL 1d00h, no merge, hash-function sha1, nonce 0x65BD031F-0xDCD27D22
   state complete, no security-capability
   xTR-ID 0x4C8D6115-0xEC9AF511-0x5A21D580-0x3D2E2429
   site-ID unspecified
   Locator    Local  State      Pri/Wgt  Scope
   10:0:6::1  yes    up           1/1    s2
EID-prefix: 6:6:6::/48
---<skip>---
ETR 10:0:6::1, last registered 00:00:27, no proxy-reply, map-notify
   TTL 1d00h, no merge, hash-function sha1, nonce 0xD3DD29FD-0x0E405971
   state complete, no security-capability
   xTR-ID 0x4C8D6115-0xEC9AF511-0x5A21D580-0x3D2E2429
   site-ID unspecified
   Locator    Local  State      Pri/Wgt  Scope
   10:0:6::1  yes    up           1/1    s2
---<skip>---
```

```
RTR#sh ip lisp map-cache
LISP IPv4 Mapping Cache for EID-table default (IID 0), 1 entries
0.0.0.0/0, uptime: 00:00:04, expires: never, via static send map-request
Negative cache entry, action: send-map-request
RTR#sh ipv6 lisp map-cache
LISP IPv6 Mapping Cache for EID-table default (IID 0), 1 entries
::/0, uptime: 00:00:05, expires: never, via static send map-request
Negative cache entry, action: send-map-request
RTR#```

---

**IPv4 Internet**

0.0.0.0/0

---

**IPv6 Internet**

::/0

---

**Site name: R6**

---

**EID-prefix: 6.6.6.0/24**

---

**ETR 10:0:6::1, last registered 00:00:26, no proxy-reply, map-notify**

---

**TTL 1d00h, no merge, hash-function sha1, nonce 0x65BD031F-0xDCD27D22**

---

**State complete, no security-capability**

---

**xTR-ID 0x4C8D6115-0xEC9AF511-0x5A21D580-0x3D2E2429**

---

**Site-ID unspecified**

---

**Locator    Local  State      Pri/Wgt  Scope**

---

**10:0:6::1  yes    up           1/1    s2**

---

**IPv4 Internet**

0.0.0.0/0

---

**IPv6 Internet**

::/0
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example

How do I forward to 6:6:6::6?
1. Check FIB – NO
2. Check map-cache – NO
3. Maybe 6:6:6::6 is a LISP destination?
   Send Map-Request
LISP – Disjointed RLOC Space Feature
Cross Address-Family Disjointed RLOC Space Example

IPv4 Internet
0.0.0.0/0
(scope 1)

IPv6 Internet
::/0
(scope 2)

xTR4

10.0.4.0/30
EID – 4.4.4.0/24
EID – 4:4:4::/48

EID – 4:4:4::4
itr-rloc: 10.0.4.1

Type 1 (map-request)
Nonce
src-eid: [2] 4:4:4::4

LISP ECM
(udp 4342)

10.0.4.1-> 10.0.2.1

1

10.0.4.1

2

4:4:4::4 -> 6:6:6::6

xTR6

IPv4 Internet
0.0.0.0/0
(scope 1)

IPv6 Internet
::/0
(scope 2)

MSMR

10.0.3.1

RTR

10.0.2.1

10:0:6::/64
EID – 6.6.6.0/24
EID – 6:6:6::/48

10.0.2.1

3

10.0.2.1

4:4:4::4

10.0.4.1

EID – 4:4:4::4

*Aug 25 01:00:32.108: LISP-0: AF IPv6, Sending map-request from 4:4:4::4 to 6:6:6::6 for EID 6:6:6::6/128, ITR-RLOCs 1, nonce 0xA0E6CC5A-0x7A1D2EEC (encap src 10.0.4.1, dst 10.0.2.1).
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example

1. 4:4:4::4 -> 6:6:6::6
   - Type 1 (map-request)
   - Nonce
   - itr-rloc: 10.0.4.1

2. Rec’vd Map-Request for 6:6:6::6
   - ETR RLOC is scope s2 (10:0:6::1)
   - ITR RLOC is scope s1 (10.0.4.1)
   - Disjoint scope - YES
   - Send Proxy Map-Reply with RTR 10.0.3.1
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example

**Figure 1:**
- IPv4 Internet: 0.0.0.0/0 (scope 1)
- IPv6 Internet: ::/0 (scope 2)

**Example:**
1. 4:4:4::4 -> 6:6:6::6
2. Type 1 (map-request)
   - Nonce
   - itr-rloc: 10.0.4.1
3. 10.0.2.1 -> 10.0.4.1
   - udp 4342
   - Type 2 (map-reply) [P]
   - Nonce/TTL
   - 6:6:6::/48
   - 10.0.3.1 [1, 1]

**MSMR#**
- Aug 25 01:11:45.734: LISP: Processing received Encap-Control(8) message on Ethernet0/0 from 10.0.4.1:4342 to 10.0.2.1:4342
- Aug 25 01:11:45.734: LISP: Processing received Map-Request(1) message on Ethernet0/0 from 4:4:4::4.4342 to 6:6:6::6.4342
- Aug 25 01:11:45.734: LISP: Received map request for IID 0 6:6:6::/128, source_eid IID 0 4:4:4::4, ITR-RLOCs: 10.0.4.1, records 1, nonce 0x5A0206C2-0xF706E61B
- Aug 25 01:11:45.734: LISP-0: MS EID IID 0 prefix 6:6:6::/48 site R6, No common scopes between ITR and ETR RLOCs, proxy reply.
- Aug 25 01:11:45.734: LISP-0: MS EID IID 0 prefix 6:6:6::48 site R6, Sending scope forced proxy reply to 10.0.4.1.
LISP – Disjointed RLOC Space Feature
Cross Address-Family Disjointed RLOC Space Example

1. **IPv4 Internet**
   - 0.0.0.0/0 (scope 1)

2. **IPv6 Internet**
   - ::/0 (scope 2)

3. **xTR4**
   - EID – 4.4.4.0/24
   - EID – 4:4:4::/48
   - 10.0.4.0/30

4. **xTR6**
   - EID – 6.6.6.0/24
   - EID – 6:6:6::/48

**LISP ECM (udp 4342)**

1. **Type 1 (map-request)**
   - Itr-rloc: 10.0.4.1

2. **Nonce**
   - [2]

3. **10.0.2.1**
   - 10.0:0:3::1
   - 10.0:0:2::1

4. **10.0.3.1**
   - 10:0:3::1

5. **10.0:0:6::/64**
   - EID – 6:6:6.0/24

**LISP ECM**

1. **Type 2 (map-reply)**
   - Nonce/TTL
   - 6:6:6::/48
   - 10.0.3.1 [1, 1]

**IPv6 Internet (::/0)**

1. **IPv4 Internet (0.0.0.0/0, scope 1)**

**xTR4#show ipv6 lisp map-cache**

LISP IPv6 Mapping Cache for EID-table default (IID 0), 2 entries
---<skip>---

6:6:6::/48, uptime: 00:02:18, expires: 00:12:44, via map-reply, complete
   Locator Uptime State Pri/Wgt
   10.0.3.1 00:02:18 up   1/1

xTR4#
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example

1. 4:4::4 -> 6:6:6::6

2. 10.0.4.1 -> 10.0.2.1
   LISP ECM (udp 4342)
   Type 1 (map-request)
   Nonce
   src-eid: [2] 4:4:4::4
   itr-rloc: 10.0.4.1

3. 10.0.4.1 -> 10.0.3.1
   udp 4342
   Type 2 (map-reply)
   Nonce/TTL
   6:6:6::/48
   10.0.3.1 [1, 1]

4. 4:4::4 -> 6:6:6::6
   10.0.4.1 -> 10.0.3.1
   4:4:4::4 -> 6:6:6::6

How do I forward to 6:6:6::6?
1. Check FIB – NO
2. Check map-cache (send map-req)
   Send Map-Request...

IPv4 Internet
0.0.0.0/0 (scope 1)
IPv6 Internet
::/0

xTR4
EID – 4.4.4.0/24
EID – 4:4:4::/48

MSMR
RTR
10.0.3.1
10.0.2.1

xTR6
EID – 6.6.6.0/24
EID – 6:6:6::/48

IPv4 Internet
0.0.0.0/0 (scope 1)
IPv6 Internet
::/0

encap
decap

10.4.0.0/30

Nonce
src-eid: [2] 4:4:4::4
itr-rloc: 10.0.4.1

Send Map-Request...
LISP – Disjointed RLOC Space Feature
Cross Address-Family Disjointed RLOC Space Example

1. 4:4::4 -> 6:6:6::6
2. 10.0.4.1 -> 10.0.2.1
   LISP ECM (udp 4342)
   Type 1 (map-request) Nonce
   src-eid: [2] 4:4:4::4
   itr-rloc: 10.0.4.1
3. 10.0.4.1 -> 10.0.3.1
   udp 4342
   Type 2 (map-reply)
   Nonce/TTL
   src-eid: [2] 4:4:4::4
   itr-rloc: 10.0.4.1
   itr-rloc: 10.0.3.1

RTR#
*Aug 25 01:18:17.328: LISP-0: AF IPv6, Sending map-request from 10:0:3::1 to 6:6:6::6 for EID 6:6:6::6/128, ITR-RLOCs 2, nonce 0xC437B6B6-0xCD1B12C2 (encap src 10.0.3.1, dst 10.0.2.1), FromPITR.
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example

1. Cross Address Family: IPv4 and IPv6
   - IPv4 Internet: 0.0.0.0/0 (scope 1)
   - IPv6 Internet: ::/0 (scope 2)

2. ETR RLOCs
   - xTR4: 10.0.4.0/30
   - EID – 4.4.4.0/24
   - EID – 4:4:4::/48

3. PITR RLOCs
   - xTR6: 10:0:6::/64
   - EID – 6.6.6.0/24
   - EID – 6:6:6::/48

4. RTR
   - 10.0.3.1: 10:0:3::1
   - 10.0.2.1: 10:0:2::1

5. LISP ECM
   - UDP 4342

6. Cross Address Family Disjointed RLOC Example
   - 4:4:4::4 -> 6:6:6::6
   - 10.0.4.1 -> 10.0.2.1

**LISP ECM (udp 4342)**

- Type 1 (map-request)
  - Nonce
  - itr-rloc: 10.0.4.1

- Type 2 (map-reply)
  - Nonce/TTL
  - 6:6:6::/48
  - 10.0.3.1 [1, 1]

**MSMR**

- Encap: decap
- 4:4:4::4 -> 6:6:6::6
- 10.0.4.1 -> 10.0.3.1

**Rec’vd Map-Request for 6:6:6::6**

1. ETR RLOC is scope s2 (10:0:6::1)
2. PITR RLOC is scope s1 (10.0.3.1) and scope s2 (10:0:3::1)
3. Disjoint scope - NO
4. Forward Map-Request to 10:0:6::1

**Forwarding Map Request to ETR RLOC 10:0:6::1**

**Encapsulation and Decapsulation**

- xTR4
- xTR6

**IPv4 Internet**

- 10.0.4.1
- 10.0.2.1

**IPv6 Internet**

- 10:0:6::1
- 6:6:6::6

**Native Plane**

- Data Plane
- LISP-Encap

**Control Plane**

- Map-Req
- Map-Rep

---

*MSMR#*

*Aug 25 01:36:16.684: LISP: Processing received Encap-Control(8) message on Ethernet0/0 from 10.0.3.1:4342 to 10.0.2:1:4342


*Aug 25 01:36:16.685: LISP: Received map request for IID 0 6:6:6::6/128, source_eid IID 0 4:4:4::4, ITR-ROCs: 10.0:3.1 10:0:3::1, records 1, nonce 0x098BCD65-0xE60542F, FromPITR

LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example

1. 4:4:4::4 -> 6:6:6::6
2. Type 1 (map-request) Nonce
   src-eid: [2] 4:4:4::4
   itr-rloc: 10.0.4.1
3. 10.0.2.1 -> 10.0.4.1
4. Type 2 (map-reply)
   Nonce/TTL
   6:6:6::/48
   10.0.3.1 [1, 1]
5. 10.0.2.1 -> 10.0.4.1
6. 10.0.2:1 -> 10.0:6::1

Rec’d Map-Request for 6:6:6::6
1. ETR RLOC is (10:0:6::1)
2. PITR RLOC is (10.0.3.1) and (10:0:3::1)
3. Send Map-Reply to 10:0:3::1

EID – 4.4.4.0/24
EID – 4:4:4::/48
xTR4
encap

EID – 6.6.6.0/24
EID – 6:6:6::/48
xTR6
decap

ETR

PITR

Type 1 (map-request) Nonce
src-eid: [2] 4:4:4::4
itr-rloc: 10.0.4.1

Type 1 (map-request) Nonce
src-eid: [2] 10:0:3::1
itr-rloc: 10.0.3.1
itr-rloc: 10:0:3::1

LISP ECM (udp 4342)

10.0.4.1 -> 10.0.2.1
10.0.2.1
10.0.4.1 -> 10.0.3.1
10.0.3.1

Type 1 (map-request) Nonce
src-eid: [2] 10:0:3::1
itr-rloc: 10.0.3.1
itr-rloc: 10:0:3::1

Type 1 (map-request) Nonce
src-eid: [2] 10:0:3::1
itr-rloc: 10.0.3.1
itr-rloc: 10:0:3::1

*Aug 25 01:46:56.022: LISP: Processing received Encap-Control(8) message on Ethernet0/0 from 10:0:2::1.4342 to 10:0:6::1.4342
*Aug 25 01:46:56.022: LISP: Processing received Map-Request(1) message on Ethernet0/0 from 10:0:3::1.4342 to 6:6:6::6.4342
*Aug 25 01:46:56.022: LISP: Received map request for IID 6 6:6:6:6/128, source_eid IID 0 4:4:4::4, ITR-RLOCs: 10.0:3.1 10.0:3::1, records 1, nonce 0x634D8861-0xDBA36771, FromPITR
*Aug 25 01:46:56.022: LISP: Sending map-reply from 10:0:6::1 to 10:0:3::1.
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example

1. 4:4:4::4 -> 6:6:6::6
   - Type 1 (map-request)
     - Nonce
     - itr-rloc: 10.0.4.1

2. 10.0.4.1 -> 10.0.2.1
   - LISP ECM (udp 4342)

3. 10.0.2.1 -> 10.0.3.1
   - Type 1 (map-request)
     - Nonce
     - src-eid: [2] 10.0.3.1
     -(itr-rloc: 10.0.3.1)

4. 10.0.3.1 -> 10.0.2.1
   - LISP ECM (udp 4342)

5. 10.0.2.1 -> 10.0.3.1
   - Type 1 (map-request)
     - Nonce
     - src-eid: [2] 10.0.3.1
     - itr-rloc: 10.0.3.1

6. 10:0:2::1 -> 10:0:6::1
   - LISP ECM (udp 4342)

7. 10:0:6::1 -> 10:0:3::1
   - Type 1 (map-request)
     - Nonce
     - src-eid: [2] 10:0:3::1
     - itr-rloc: 10:0:3::1

RTR#show ipv6 lisp map-cache
---<skip>---
6:6:6::/48, uptime: 00:05:17, expires: 23:54:53, via map-reply, complete
   Locator Uptime State Pri/Wgt
   10:0:6::1 00:05:17 up 1/1
RTR#
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example

1. 4:4:4::4 -> 6:6:6::6
   - 10.0.4.1 -> 10.0.2.1
     - LISP ECM (udp 4342)
     - Type 1 (map-request)
     - Nonce
     - itr-rloc: 10.0.4.1

2. 10.0.4.1 -> 10.0.2.1
   - LISP ECM (udp 4342)
   - Type 1 (map-request)
   - Nonce
   - itr-rloc: 10.0.4.1

3. 10.0.2.1 -> 10.0.3.1
   - LISP ECM (udp 4342)
   - Type 1 (map-request)
   - Nonce
   - src-eid: [2] 10:0:3::1
   - itr-rloc: 10.0.3.1

4. 10.0.3.1 -> 10.0.2.1
   - LISP ECM (udp 4342)
   - Type 1 (map-request)
   - Nonce
   - src-eid: [2] 10:0:3::1
   - itr-rloc: 10.0.3.1

5. 10.0.2.1 -> 10.0.4.1
   - LISP ECM (udp 4342)
   - Type 1 (map-request)
   - Nonce
   - src-eid: [2] 10:0:3::1
   - itr-rloc: 10.0.3.1

6. 10.0.3.1 -> 10.0.4.1
   - LISP ECM (udp 4342)
   - Type 1 (map-request)
   - Nonce
   - src-eid: [2] 10:0:3::1
   - itr-rloc: 10.0.3.1

7. 10.0.4.1 -> 10.0.3.1
   - LISP ECM (udp 4342)
   - Type 1 (map-request)
   - Nonce
   - itr-rloc: 10.0.4.1

8. 10.0.3.1 -> 10.0.4.1
   - LISP ECM (udp 4342)
   - Type 1 (map-request)
   - Nonce
   - src-eid: [2] 10:0:3::1
   - itr-rloc: 10.0.3.1

9. 10.0.4.1 -> 10.0.3.1
   - LISP ECM (udp 4342)
   - Type 1 (map-request)
   - Nonce
   - itr-rloc: 10.0.4.1

10. 10.0.3.1 -> 10.0.4.1
    - LISP ECM (udp 4342)
    - Type 1 (map-request)
    - Nonce
    - src-eid: [2] 10:0:3::1
    - itr-rloc: 10.0.3.1

11. 10.0.4.1 -> 10.0.3.1
    - LISP ECM (udp 4342)
    - Type 1 (map-request)
    - Nonce
    - itr-rloc: 10.0.4.1

12. 10.0.3.1 -> 10.0.4.1
    - LISP ECM (udp 4342)
    - Type 1 (map-request)
    - Nonce
    - src-eid: [2] 10:0:3::1
    - itr-rloc: 10.0.3.1

13. 10.0.4.1 -> 10.0.3.1
    - LISP ECM (udp 4342)
    - Type 1 (map-request)
    - Nonce
    - itr-rloc: 10.0.4.1

14. 10.0.3.1 -> 10.0.4.1
    - LISP ECM (udp 4342)
    - Type 1 (map-request)
    - Nonce
    - src-eid: [2] 10:0:3::1
    - itr-rloc: 10.0.3.1

15. 10.0.4.1 -> 10.0.3.1
    - LISP ECM (udp 4342)
    - Type 1 (map-request)
    - Nonce
    - itr-rloc: 10.0.4.1

16. 10.0.3.1 -> 10.0.4.1
    - LISP ECM (udp 4342)
    - Type 1 (map-request)
    - Nonce
    - src-eid: [2] 10:0:3::1
    - itr-rloc: 10.0.3.1

17. 10.0.4.1 -> 10.0.3.1
    - LISP ECM (udp 4342)
    - Type 1 (map-request)
    - Nonce
    - itr-rloc: 10.0.4.1

18. 10.0.3.1 -> 10.0.4.1
    - LISP ECM (udp 4342)
    - Type 1 (map-request)
    - Nonce
    - src-eid: [2] 10:0:3::1
    - itr-rloc: 10.0.3.1

19. 10.0.4.1 -> 10.0.3.1
    - LISP ECM (udp 4342)
    - Type 1 (map-request)
    - Nonce
    - itr-rloc: 10.0.4.1

20. 10.0.3.1 -> 10.0.4.1
    - LISP ECM (udp 4342)
    - Type 1 (map-request)
    - Nonce
    - src-eid: [2] 10:0:3::1
    - itr-rloc: 10.0.3.1

21. 10.0.4.1 -> 10.0.3.1
    - LISP ECM (udp 4342)
    - Type 1 (map-request)
    - Nonce
    - itr-rloc: 10.0.4.1

22. 10.0.3.1 -> 10.0.4.1
    - LISP ECM (udp 4342)
    - Type 1 (map-request)
    - Nonce
    - src-eid: [2] 10:0:3::1
    - itr-rloc: 10.0.3.1
LISP – Disjointed RLOC Space Feature
Cross Address-Family Disjointed RLOC Space Example – Topology

Now let’s add a dual-homed device that is connected to BOTH locator scopes
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example – Configurations

---<continued>---
ipv4 etr map-server 10.0.2.1 key R5KEY
ipv4 etr map-server 10:0:2::1 key R5KEY
ipv4 etr
ipv6 use-petr 10.0.3.1
ipv6 use-petr 10:0:3::1
ipv6 itr map-resolver 10.0.2.1
ipv6 itr map-resolver 10:0:2::1
ipv6 itr
ipv6 etr map-server 10.0.2.1 key R5KEY
ipv6 etr map-server 10:0:2::1 key R5KEY
ipv6 etr
exit
ip route 0.0.0.0 0.0.0.0 10.0.5.2
ipv6 route ::/0 10:0:5::2

---<cont>---

LISP Disjointed RLOCs v0.8
LISP – Disjointed RLOC Space Feature
Cross Address-Family Disjointed RLOC Space Example – Configurations

---<continued>---
ipv4 etr map-server 10.0.2.1 key R5KEY
ipv4 etr map-server 10:0:2::1 key R5KEY
ipv4 etr
ipv6 use-petr 10.0.3.1
ipv6 use-petr 10:0:3::1
ipv6 itr map-resolver 10.0.2.1
ipv6 itr map-resolver 10:0:2::1
ipv6 itr
ipv6 etr map-server 10.0.2.1 key R5KEY
ipv6 etr map-server 10:0:2::1 key R5KEY
ipv6 etr
exit
ip route 0.0.0.0 0.0.0.0 10.0.5.2
ipv6 route ::/0 10:0:5::2

---<cont>---
LISP – Disjointed RLOC Space Feature
Cross Address-Family Disjointed RLOC Space Example

IPv4 Internet 0.0.0.0/0 (scope 1)
IPv6 Internet 0::/0 (scope 2)

xTR4
10.0.4.0/30

xTR5
10.0.5.0/30

xTR5#
sh ip lisp database
---<skip>---
5.5.5.0/24, locator-set R5
 Locator Pri/Wgt Source State
  10.0.5.1 1/1 cfg-addr site-self, reachable
  10.0.5.1 1/1 cfg-addr site-self, reachable

xTR5#
sh ipv6 lisp database
---<skip>---
5:5:5::/48, locator-set R5
 Locator Pri/Wgt Source State
  10.0.5.1 1/1 cfg-addr site-self, reachable
  10.0.5.1 1/1 cfg-addr site-self, reachable

xTR5#

sh ip lisp database
---<skip>---
5.5.5.0/24, locator-set R5
 Locator Pri/Wgt Source State
  10.0.5.1 1/1 cfg-addr site-self, reachable
  10.0.5.1 1/1 cfg-addr site-self, reachable

xTR5#

sh ipv6 lisp database
---<skip>---
5:5:5::/48, locator-set R5
 Locator Pri/Wgt Source State
  10.0.5.1 1/1 cfg-addr site-self, reachable
  10.0.5.1 1/1 cfg-addr site-self, reachable

xTR5#

IPv4 Internet 0.0.0.0/0 (scope 1)
IPv6 Internet 0::/0 (scope 2)

xTR4
10.0.4.0/30

xTR5
10.0.5.0/30

xTR5#
sh ip lisp database
---<skip>---
5.5.5.0/24, locator-set R5
 Locator Pri/Wgt Source State
  10.0.5.1 1/1 cfg-addr site-self, reachable
  10.0.5.1 1/1 cfg-addr site-self, reachable

xTR5#
sh ipv6 lisp database
---<skip>---
5:5:5::/48, locator-set R5
 Locator Pri/Wgt Source State
  10.0.5.1 1/1 cfg-addr site-self, reachable
  10.0.5.1 1/1 cfg-addr site-self, reachable

xTR5#

IPv4 Internet 0.0.0.0/0 (scope 1)
IPv6 Internet 0::/0 (scope 2)

xTR4
10.0.4.0/30

xTR5
10.0.5.0/30

xTR5#
sh ip lisp database
---<skip>---
5.5.5.0/24, locator-set R5
 Locator Pri/Wgt Source State
  10.0.5.1 1/1 cfg-addr site-self, reachable
  10.0.5.1 1/1 cfg-addr site-self, reachable

xTR5#
sh ipv6 lisp database
---<skip>---
5:5:5::/48, locator-set R5
 Locator Pri/Wgt Source State
  10.0.5.1 1/1 cfg-addr site-self, reachable
  10.0.5.1 1/1 cfg-addr site-self, reachable

xTR5#
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example

MSMR#sh lisp site detail
---<skip>---
Site name: R5
---<skip>---
EID-prefix: 5.5.5.0/24
---<skip>---
  ETR 10:0:5::1, last registered 00:00:30, no proxy-reply, map-notify
    TTL 1d00h, no merge, hash-function sha1, nonce 0x46E697F2-0x9AE1A359
    state complete, no security-capability
    xTR-ID 0x69FF5D6A-0x06823D0B-0x3524CB6F-0x0771F2A7
    site-ID unspecified

Locator  Local  State    Pri/Wgt  Scope
10.0.5.1  yes    up       1/1    s1
10:0:5::1 yes    up       1/1    s2
EID-prefix: 5:5:5::/48
---<skip>---
  ETR 10.0.5.1, last registered 00:00:22, no proxy-reply, map-notify
    TTL 1d00h, no merge, hash-function sha1, nonce 0x7CA04153-0xE236EBD8
    state complete, no security-capability
    xTR-ID 0x69FF5D6A-0x06823D0B-0x3524CB6F-0x0771F2A7
    site-ID unspecified

Locator  Local  State    Pri/Wgt  Scope
10.0.5.1  yes    up       1/1    s1
10:0:5::1 yes    up       1/1    s2
---<skip>---
LISP – Disjointed RLOC Space Feature
Cross Address-Family Disjointed RLOC Space Example

IPv4 Internet 0.0.0.0/0 (scope 1)
IPv6 Internet ::/0 (scope 2)

xTR4
- EID – 4.4.4.0/24
- EID – 4:4:4::/48
- 10.0.4.0/30

MSMR
- 10.0.2.1
- 10.0.3.1

xTR5
- 10.0.5.0/30
- EID – 5.5.5.0/24
- EID – 5:5:5::/48
- 5:5:5::5 -> 6:6:6::6

xTR6
- EID – 6.6.6.0/24
- EID – 6:6:6::/48
- 10.0.6.0/30

How do I forward to 6:6:6::6?
1. Check FIB – NO
2. Check map-cache – NO
3. Maybe 6:6:6::6 is a LISP destination?
   Send Map-Request
LISP – Disjointed RLOC Space Feature
Cross Address-Family Disjointed RLOC Space Example

IPv4 Internet 0.0.0.0/0 (scope 1)
IPv6 Internet ::/0 (scope 2)

xTR4
EID – 4.4.4.0/24
EID – 4:4:4::/48

xTR5
EID – 5.5.5.0/24
EID – 5:5:5::/48

xTR6
EID – 6.6.6.0/24
EID – 6:6:6::/48

MSMR
RTR

10.0.2.1 -> 10:0:2::1
Type 1 (map-request)
Nonce
src-eid: [2] 10:0:5::1
itr-rloc: 10.0.5.1
itr-rloc: 10:0:5::1

10:0:5::1 -> 10:0:2::1
LISP ECM (udp 4342)

5:5:5::5 -> 6:6:6:6

*Aug 27 03:29:41.401: LISP-0: AF IPv6, Sending map-request from 10:0:5::1 to 6:6:6::6 for EID 6:6:6::6/128, ITR-RLOCs 2, nonce 0x6DA3049B-0x40684054 (encap src 10:0:5::1, dst 10:0:2::1).
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example

IPv4 Internet
0.0.0.0/0 (scope 1)

IPv6 Internet
::/0 (scope 2)

xTR4
EID – 4.4.4.0/24
EID – 4:4:4::/48

xTR5
EID – 5.5.5.0/24
EID – 5:5:5::/48

xTR6
EID – 6.6.6.0/24
EID – 6:6:6::/48

xTR5
10.0.5.0/30
EID – 5.5.5.0/24
EID – 5:5:5::/48

xTR6
10.0:6::/64
EID – 6.6.6.0/24
EID – 6:6:6::/48

xTR4
10.0.4.0/30
EID – 4.4.4.0/24
EID – 4:4:4::/48

10.0.2.1
10:0:2::1

10:0:5::1
10.0:5::1

10:0:3.1
10.0:3.1

10:0:6::1
10.0:6::1

10:0:6::6

Type 1 (map-request)
Nonce
src-eid: [2] 10:0:5::1
itr-rloc: 10.0.5.1
itr-rloc: 10:0:5::1

10:0:2::1 -> 10:0:6::1
LISP ECM
(udp 4342)

10:0:5::1 -> 10:0:2::1
LISP ECM
(udp 4342)

Rec'vd Map-Request for 6:6:6::6
1. ETR RLOC is scope s2 (10:0:6::1)
2. ITR RLOC is scope s1 (10.0.5.1) and scope s2 (10:0:5::1)
3. Disjoint scope - NO
4. Forward Map-Request to 10:0:6::1

*Aug 27 03:45:51.783: LISP: Processing received Encap-Control(8) message on Ethernet0/0 from 10:0:5::1.4342 to 10:0:2::1.4342
*Aug 27 03:45:51.783: LISP: Processing received Map-Request(1) message on Ethernet0/0 from 10:0:5::1.4342 to 10:0:5::1.4342
*Aug 27 03:45:51.783: LISP: Received map request for IID 0 6:6:6:6/128, source_eid IID 0 5:5:5::5, ITR-RLOCs: 10.0.5.1 10:0:5::1, records 1, nonce 0x240C5E9E-0x898C174D
*Aug 27 03:45:51.783: LISP-0: MS EID IID 0 prefix 6:6:6::/48 site R6, Forwarding map request to ETR RLOC 10:0:6::1.
LISP – Disjointed RLOC Space Feature
Cross Address-Family Disjointed RLOC Space Example

IPv6 Internet
::/0
(scope 2)

xTR4
EID – 4.4.4.0/24
EID – 4:4:4::/48

10.0.4.0/30

10.0.2.1

10:0:2::1

LISP ECM
(udp 4342)

Type 1 (map-request)
Nonce
src-eid: [2] 10:0:5::1
itr-rloc: 10.0.5.1
itr-rloc: 10:0:5::1

xTR5
EID – 5.5.5.0/24
EID – 5:5:5::/48

10.0.5.0/30

10:0:5::1

10.0.3.1

10.0.2.1

10:0:2::1

LISP ECM
(udp 4342)

Type 1 (map-request)
Nonce
src-eid: [2] 10:0:5::1
itr-rloc: 10.0.5.1
itr-rloc: 10:0:5::1

xTR6
EID – 6.6.6.0/24
EID – 6:6:6::/48

10:0:6::/64

10:0:5::/64

Rec’vd Map-Request for 6:6:6::6
1. ETR RLOC is (10:0:6::1)
2. ITR RLOC is (10.0.3.1) and (10:0:3::1)
3. Send Map-Reply to 10:0:3::1

xTR6#
*Aug 27 04:18:03.285: LISP: Processing received Encap-Control(8) message on Ethernet0/0 from 10:0:2::1.4342 to 10:0:6::1.4342
*Aug 27 04:18:03.285: LISP: Processing received Map-Request(1) message on Ethernet0/0 from 10:0:5::1.4342 to 6:6:6::6.4342
*Aug 27 04:18:03.285: LISP: Received map request for IID 0 6:6:6::6/128, source_eid IID 0 5:5:5::5, ITR-RLOCs: 10.0.5.1 10:0:5::1, records 1, nonce 0x7471270-0x28C975B7
*Aug 27 04:18:03.285: LISP-0: Sending map-reply from 10:0:6::1 to 10:0:3::1.
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example

IPv4 Internet
0.0.0.0/0 (scope 1)
IPv6 Internet
::/0 (scope 2)

xTR4
EID – 4.4.4.0/24
EID – 4:4:4::/48

10.0.4.0/30
EID – 4.4.4.0/24
EID – 4:4:4::/48

xTR5
EID – 5.5.5.0/24
EID – 5:5:5::/48

5:5:5:5 -> 6:6:6:6

xTR6
EID – 6.6.6.0/24
EID – 6:6:6::/48

10:0:6::/64

LISP ECM (udp 4342)
Type 1 (map-request)
Nonce
src-eid: [2] 10:0:5::1
itr-rloc: 10.0.5.1
itr-rloc: 10:0:5::1

Type 1 (map-request)
Nonce
src-eid: [2] 10:0:5::1
itr-rloc: 10.0.5.1
itr-rloc: 10:0:5::1

Type 2 (map-reply)
Nonce/TTL
6:6:6::/48
10:0:6::1 [1, 1]
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example

IPv4 Internet

0.0.0.0/0 (scope 1)

IPv6 Internet

::/0 (scope 2)

xTR4

EID – 4.4.4.0/24

EID – 4:4:4::/48

xTR5

EID – 5.5.5.0/24

EID – 5:5:5::/48

xTR6

EID – 6.6.6.0/24

EID – 6:6:6::/48

xTR5#

show ipv6 lisp map-cache
LISP IPv6 Mapping Cache for EID-table default (IID 0), 2 entries
---<skip>---
Locator Uptime State Pri/Wgt
10:0:6::1 00:23:51 up 1/1

xTR5#

1

5:5:5::5 -> 6:6:6::6

xTR5#

show ipv6 lisp map-cache
LISP IPv6 Mapping Cache for EID-table default (IID 0), 2 entries
---<skip>---
Locator Uptime State Pri/Wgt
10:0:6::1 00:23:51 up 1/1

xTR5#

2

10:0:5::1 -> 10:0:2::1

LISP ECM

(udp 4342)

Type 1 (map-request)

Nonce

src-eid: [2] 10:0:5::1
itr-rloc: 10.0.5.1

3

10:0:2::1 -> 10:0:6::1

LISP ECM

(udp 4342)

Type 1 (map-request)

Nonce

src-eid: [2] 10:0:5::1
itr-rloc: 10.0.5.1

4

10:0:6::1 -> 10:0:5::1

udp 4342

Type 2 (map-reply)

Nonce/ITL

6:6:6::48

10:0:6::1 [1, 1]
LISP – Disjointed RLOC Space Feature

Cross Address-Family Disjointed RLOC Space Example

**IPv4 Internet**
- 0.0.0.0/0 (scope 1)

**IPv6 Internet**
- ::/0 (scope 2)

**xTR4**
- EID – 4.4.4.0/24
- EID – 4:4:4::/48

**xTR5**
- 10.0.5.0/30
- EID – 5.5.5.0/24
- EID – 5:5:5::/48

**xTR6**
- 10:0:6::/64
- EID – 6.6.6.0/24
- EID – 6:6:6::/48

**MSMR**

**RTR**
- 10.0.2.1
- 10:0:2::1
- 10.0.3.1
- 10:0:3::1

**LISP ECM**
- (udp 4342)

**Type 1 (map-request)**
- Nonce
- src-eid: [2] 10:0:5::1
- itr-rloc: 10.0.5.1
- itr-rloc: 10:0:5::1

**10:0:2::1 -> 10:0:6::1**

**Encapsulation**

**Type 2 (map-reply)**
- Nonce/TTL
- 6:6:6::/48
- 10:0:6::1 [1, 1]

**Decapsulation**

**LISP ECM**
- (udp 4342)

**Type 1 (map-request)**
- Nonce
- src-eid: [2] 10:0:5::1
- itr-rloc: 10.0.5.1
- itr-rloc: 10:0:5::1

**10:0:5::1 -> 10:0:2::1**
LISP Disjointed RLOC Example 2:
Disjointed Common Address-Family Configuration Details
LISP – Disjointed RLOC Space Feature
Disjointed Common Address-Family RLOC Example – Topology
LISP – Disjointed RLOC Space Feature

Disjointed Common Address-Family RLOC Example – Configurations

**IPv4**
- 10.1.0.0/16 (scope 1)
- 10.2.0.0/16

**IPv6**
- 10.1.4.0/30
- 4:4:4::/48

**EID**
- 4.4.4.0/24
- 4:4:4::/48

**MSMR**
**RTR**

**Interfaces**
- **interface Loopback0**
  - ip address 4.4.4.4 255.255.255.0
  - ipv6 address 4:4:4::4/64
- **interface LISP0**
- **interface Ethernet0/0**
  - description conn to Core1
  - ip address 10.1.4.1 255.255.255.252
- **router lisp**
  - locator-set R4
    - 10.1.4.1 priority 1 weight 1
  - exit
- **eid-table default instance-id 0**
  - database-mapping 4.4.4.0/24 locator-set R4
  - database-mapping 4:4:4::/48 locator-set R4
  - exit
- **loc-reach-algorithm rloc-probing**
  - ipv4 use-petr 10.1.3.1
  - ipv4 itr map-resolver 10.1.2.1
  - ipv4 itr
  - ipv4 etr map-server 10.1.2.1 key R4KEY
  - ipv4 etr
  - ipv6 use-petr 10.1.3.1
  - ipv6 itr map-resolver 10.1.2.1
  - ipv6 itr
  - ipv6 etr map-server 10.1.2.1 key R4KEY
  - ipv6 etr
  - exit
- **ip route 0.0.0.0 0.0.0.0 10.1.4.2**
LISP – Disjointed RLOC Space Feature

Disjointed Common Address-Family RLOC Example –

```
! interface Loopback0
  ip address 6.6.6.6 255.255.255.0
  ipv6 address 6:6:6::6/64
!
! interface Ethernet0/0
description conn to Core2
  ip address 10.2.6.1 255.255.255.252
!
router lisp
  locator-set R6
  10.2.6.1 priority 1 weight 1
  exit
!
edid-table default instance-id 0
database-mapping 6.6.6.0/24 locator-set R6
database-mapping 6:6:6::/48 locator-set R6
  exit
!
loc-reach-algorithm rloc-probing
  ipv4 use-petr 10.2.3.1
  ipv4 itr map-resolver 10.2.2.1
  ipv4 itr
  ipv4 etr map-server 10.2.2.1 key R6KEY
  ipv4 etr
  ipv6 use-petr 10.2.3.1
  ipv6 itr map-resolver 10.2.2.1
  ipv6 itr
  ipv6 etr map-server 10.2.2.1 key R6KEY
  ipv6 etr
  exit
!
ip route 0.0.0.0 0.0.0.0 10.2.6.2
```
LISP – Disjointed RLOC Space Feature

Disjointed Common Address-Family RLOC Example – Configurations

```plaintext
! interface Ethernet0/0
description conn to Core1
ip address 10.1.2.1 255.255.255.252
!
interface Ethernet0/1
description conn to Core2
ip address 10.2.2.1 255.255.255.252
!
router lisp
locator-set rtr-set1
  10.1.3.1 priority 1 weight 1
  exit
!
locator-set rtr-set2
  10.2.3.1 priority 1 weight 1
  exit
!
locator-scope s1
  rtr-locator-set rtr-set1
  rloc-prefix 10.1.0.0/16
  exit
!
locator-scope s2
  rtr-locator-set rtr-set2
  rloc-prefix 10.2.0.0/16
  exit
!
site R4
  description LISP Site R4 – Core1 only
  authentication-key R4KEY
  eid-prefix 4.4.4.0/24
  eid-prefix 4:4:4::/48
  exit
!
---<continued>---
!
site R6
  description LISP Site R6 – Core2 only
  authentication-key R6KEY
  eid-prefix 6.6.6.0/24
  eid-prefix 6:6:6::/48
  exit
!
ipv4 map-server
ipv4 map-resolver
ipv6 map-server
ipv6 map-resolver
exit
!
ip route 10.1.0.0 255.255.0.0 10.1.2.2
ip route 10.2.0.0 255.255.0.0 10.2.2.2
```

---<continued>---

IPv4
IPv6
10.1.0.0/16 (scope 1)
10.2.0.0/16 (scope 2)
10.1.4.0/30
EID – 4.4.4.0/24
EID – 4:4:4::/48
MSMR
RTR
10.1.3.1
10.2.3.1
10.1.2.1
10.2.2.1
```
LISP – Disjointed RLOC Space Feature

Disjointed Common Address-Family RLOC Example – Configurations

```dublin parlour

! interface Loopback0
  no ip address
  ipv6 address 1:1:1::1/128
! interface LISP0
! interface Ethernet0/0
  description conn to Core1
  ip address 10.1.3.1 255.255.255.252
! interface Ethernet0/1
  description conn to Core2
  ip address 10.2.3.1 255.255.255.252
! router lisp
  locator-set setALL
    10.1.3.1 priority 1 weight 1
    10.2.3.1 priority 1 weight 1
  exit
! map-request itr-rlocs setALL
  eid-table default instance-id 0
  map-cache 0.0.0.0/0 map-request
  map-cache ::/0 map-request
  exit
!---<cont>---
```
LISP – Disjointed RLOC Space Feature

Disjointed Common Address-Family RLOC Example

xTR4
IPv4
10.1.4.0/30
EID – 4.4.4.0/24
EID – 4:4:4::/48

xTR6
IPv4
10.2.6.0/30
EID – 6.6.6.0/24
EID – 6:6:6::/48

xTR4# sh ipv6 lisp database
---<skip>---
4:4:4::/48, locator-set R4
Locator Pri/Wgt Source State
10.1.4.1 1/1 cfg-addr site-self, reachable

xTR4# sh ipv6 lisp database
---<skip>---
6:6:6::/48, locator-set R6
Locator Pri/Wgt Source State
10.2.6.1 1/1 cfg-addr site-self, reachable

xTR6# sh ipv6 lisp database
---<skip>---
4.4.4.0/24, locator-set R4
Locator Pri/Wgt Source State
10.1.4.1 1/1 cfg-addr site-self, reachable

xTR6# sh ipv6 lisp database
---<skip>---
6.6.6.0/24, locator-set R6
Locator Pri/Wgt Source State
10.2.6.1 1/1 cfg-addr site-self, reachable

---<skip>---
---<skip>---
---<skip>---
---<skip>---
LISP – Disjointed RLOC Space Feature
Disjointed Common Address-Family RLOC Example

MSMR#sh lisp site detail
---<skip>---
Site name: R4
---<skip>---
EID-prefix: 4.4.4.0/24
---<skip>---
ETR 10.1.4.1, last registered 00:00:47, no proxy-reply, map-notify
  TTL 1d00h, no merge, hash-function sha1, nonce 0x75D4D489-0x4D10CD75
  state complete, no security-capability
  xTR-ID 0xDA6C7D3F-0x03CE8C4E-0x4E0AEFC2-0xD1D00B76
  site-ID unspecified
Locator  Local  State      Pri/Wgt  Scope
10.1.4.1  yes    up           1/1    s1
---<skip>---
EID-prefix: 4:4:4::/48
---<skip>---
ETR 10.1.4.1, last registered 00:00:10, no proxy-reply, map-notify
  TTL 1d00h, no merge, hash-function sha1, nonce 0x258943F8-0xA96219B8
  state complete, no security-capability
  xTR-ID 0xDA6C7D3F-0x03CE8C4E-0x4E0AEFC2-0xD1D00B76
  site-ID unspecified
Locator  Local  State      Pri/Wgt  Scope
10.1.4.1  yes    up           1/1    s1
---<skip>---
**LISP – Disjointed RLOC Space Feature**

**Disjointed Common Address-Family RLOC Example**

---

**MSMR#sh lisp site detail**
---<skip>---
Site name: R6
---<skip>---
EID-prefix: 6.6.6.0/24
---<skip>---
  ETR 10.2.6.1, last registered 00:00:38, no proxy-reply, map-notify
    TTL 1d00h, no merge, hash-function sha1, nonce 0x1CFC38E1-0xE2F182B2
    state complete, no security-capability
    xTR-ID 0xEAC43680-0x40F2C2D5-0x01018DC6-0x44A83C9E
    site-ID unspecified

  Locator   Local  State      Pri/Wgt  Scope
  10.2.6.1  yes    up           1/1    s2

EID-prefix: 6:6:6::/48
---<skip>---
  ETR 10.2.6.1, last registered 00:00:30, no proxy-reply, map-notify
    TTL 1d00h, no merge, hash-function sha1, nonce 0x0D556029-0x0E07029D
    state complete, no security-capability
    xTR-ID 0xEAC43680-0x40F2C2D5-0x01018DC6-0x44A83C9E
    site-ID unspecified

  Locator   Local  State      Pri/Wgt  Scope
  10.2.6.1  yes    up           1/1    s2
---<skip>---

**RTR#sh ip lisp map-cache**
LISP IPv4 Mapping Cache for EID-table default (IID 0), 1 entries
0.0.0.0/0, uptime: 00:10:44, expires: never, via static send map-request
Negative cache entry, action: send-map-request

**RTR#sh ipv6 lisp map-cache**
LISP IPv6 Mapping Cache for EID-table default (IID 0), 1 entries
::/0, uptime: 1d04h, expires: never, via static send map-request
Negative cache entry, action: send-map-request

---

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LISP – Disjointed RLOC Space Feature

Disjointed Common Address-Family RLOC Example

How do I forward to 6:6:6::6?
1. Check FIB – NO
2. Check map-cache – NO
3. Maybe 6:6:6::6 is a LISP destination?
   Send Map-Request
LISP – Disjointed RLOC Space Feature

Disjointed Common Address-Family RLOC Example

IPv4
10.1.0.0/16 (scope 1)
IPv4
10.2.0.0/16 (scope 2)

10.1.4.0/30
EID – 4:4:4::4
EID – 4:4:4::4

10.2.6.0/30
EID – 6:6:6::6
EID – 6:6:6::6

xTR4#
*Aug 24 17:40:43.840: LISP-0: AF IPv6, Sending map-request from 4:4:4::4 to 6:6:6::6 for EID 6:6:6::6/128, ITR-RLOCs 1, nonce 0xB847A83B-0xB5A05BF8 (encap src 10.1.4.1, dst 10.1.2.1).
LISP – Disjointed RLOC Space Feature

Disjointed Common Address-Family RLOC Example

1. **Type 1 (map-request)**
   - **Nonce**
     - itr-rloc: 10.1.4.1

2. Rec’vd Map-Request for 6:6:6::6
   - 1. ETR RLOC is scope s2 (10.2.6.1)
   - 2. ITR RLOC is scope s1 (10.1.4.1)
   - 3. Disjoint scope - YES
   - 4. Send Proxy Map-Reply with RTR 10.1.3.1
LISP – Disjointed RLOC Space Feature
Disjointed Common Address-Family RLOC Example

MSMR#
*Aug 24 18:07:49.533: LISP: Processing received Encap-Control(8) message on Ethernet0/0 from 10.1.4.1:4342 to 10.1.2.1:4342
*Aug 24 18:07:49.533: LISP: Processing received Map-Request(1) message on Ethernet0/0 from 4:4:4::4.4342 to 6:6:6::6.4342
*Aug 24 18:07:49.533: LISP: Received map request for IID 0 6:6:6::/128, source_eid IID 0 4:4:4::4, ITR-RLOCs: 10.1.4.1, records 1, nonce 0x3C69BF55-0x0532E710
*Aug 24 18:07:49.533: LISP-0: MS EID IID 0 prefix 6:6:6::/48 site R6, No common scopes between ITR and ETR RLOCs, proxy reply.
*Aug 24 18:07:49.533: LISP-0: MS EID IID 0 prefix 6:6:6::/48 site R6, Sending scope forced proxy reply to 10.1.4.1.
LISP – Disjointed RLOC Space Feature

Disjointed Common Address-Family RLOC Example

1. IPv4 10.1.0.0/16 (scope 1)
2. IPv4 10.2.0.0/16 (scope 2)

xTR4# show ipv6 lisp map-cache
LISP IPv6 Mapping Cache for EID-table default (IID 0), 2 entries
---<skip>---
6:6:6::/48, uptime: 00:02:52, expires: 00:12:12, via map-reply, complete
Locator Uptime State Pri/Wgt
10.1.3.1 00:02:52 up 1/1

IPv4
10.1.4.0/30
EID – 4:4:4::/24
EID – 4:4:4::/48

IPv4
10.2.6.0/30
EID – 6:6:6::/24
EID – 6:6:6::/48

Type 1 (map-request)
Nonce
src-eid: [2] 4:4:4::4
itr-rloc: 10.1.4.1

Type 2 (map-reply)
Nonce/TTL
6:6:6::/48
10.1.3.1 [1, 1]

10.1.4.1 -> 10.1.2.1
LISP ECM (udp 4342)

10.1.4.1 -> 10.1.3.1
10.1.4.1 -> 10.1.3.1
udp 4342

xTR4# show ipv6 lisp map-cache
LISP IPv6 Mapping Cache for EID-table default (IID 0), 2 entries
---<skip>---
6:6:6::/48, uptime: 00:02:52, expires: 00:12:12, via map-reply, complete
Locator Uptime State Pri/Wgt
10.1.3.1 00:02:52 up 1/1

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LISP – Disjointed RLOC Space Feature

Disjointed Common Address-Family RLOC Example

1. **4:4:4::4 -> 6:6:6::6**

Type 1 (map-request)
- **Nonce**
  - src-eid: 4:4:4::4
  - itr-rloc: 10.1.4.1
- record-1: 6:6:6::6

2. **10.1.4.1 -> 10.1.2.1**

LISP ECM (udp 4342)

3. **10.1.2.1 -> 10.1.4.1**

udp 4342

Type 2 (map-reply)
- **Nonce/TTL**
  - 6:6:6::/48
  - 10.1.3.1 [1, 1]

4. **4:4:4::4 -> 6:6:6::6**

10.1.4.1 -> 10.1.3.1
- udp 4342
- Type 2 (map-reply)
- Nonce/TTL
  - 6:6:6::/48
  - 10.1.3.1 [1, 1]

**How do I forward to 6:6:6::6?**

1. Check FIB – **NO**
2. Check map-cache (send map-req)
   - Send Map-Request...
LISP – Disjointed RLOC Space Feature
Disjointed Common Address-Family RLOC Example

1. 4:4:4::4 -> 6:6:6::6
   - Type 1 (map-request)
   - ITR-RLOC: 10.1.4.1

2. 10.1.4.1 -> 10.1.2.1
   - LISP ECM (udp 4342)

3. 10.1.3.1 -> 10.1.2.1
   - LISP ECM (udp 4342)
   - Type 1 (map-request)
   - Nonce/TTL 6:6:6::/48
   - ITR-RLOC 10.1.3.1
   - ITR-RLOC 10.2.3.1

4. 4:4:4::4 -> 6:6:6::6
   - Type 2 (map-reply)
   - Nonce/TTL 6:6:6::/48
   - ITR-RLOC 10.1.3.1
   - ITR-RLOC 10.2.3.1

5. 10.1.2.1 -> 10.1.4.1
   - LISP ECM (udp 4342)
   - Type 1 (map-request)
   - Nonce/TTL 6:6:6::/48
   - ITR-RLOC 10.1.3.1
   - ITR-RLOC 10.2.3.1

RTR# *Aug 24 17:40:45.803: LISP-0: AF IPv6, Sending map-request from 1:1:1::1 to 6:6:6::6 for EID 6:6:6::/128, ITR-RLOCs 2, nonce 0x0085377D-0x6BF93DB5 (encap src 10.2.3.1, dst 10.2.2.1), FromPITR.*
LISP – Disjointed RLOC Space Feature
Disjointed Common Address-Family RLOC Example

1. IPv4 10.1.0.0/16 (scope 1)
2. IPv4 10.2.0.0/16 (scope 2)
3. EID – 4.4.4.0/24
4. EID – 4:4:4::/48

LISP ECM (udp 4342)
Type 1 (map-request)
Nonce
src-eid: [2] 4:4:4::4
itr-rloc: 10.1.4.1

Rec’vd Map-Request for 6:6:6::6
1. ETR RLOC is scope s2 (10.2.6.1)
2. PITR RLOC is scope s1 (10.1.3.1) and scope s2 (10.2.3.1)
3. Disjoint scope - NO
4. Forward Map-Request to 10.2.6.1

Rec’vd Map-Request for 6:6:6::6
1. ETR RLOC is scope s2 (10.2.6.1)
2. PITR RLOC is scope s1 (10.1.3.1) and scope s2 (10.2.3.1)
3. Disjoint scope - NO
4. Forward Map-Request to 10.2.6.1
LISP – Disjointed RLOC Space Feature

Disjointed Common Address-Family RLOC Example

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Type 1 (map-request) Nonce src-eid: 4:4:4::4 itr-rloc: 10.1.4.1 record-1: 6:6:6::6</td>
</tr>
<tr>
<td>2</td>
<td>10.1.2.1 -&gt; 10.1.4.1 LISP ECM (udp 4342)</td>
</tr>
<tr>
<td>3</td>
<td>10.1.4.1 -&gt; 10.1.3.1 Type 2 (map-reply) Nonce</td>
</tr>
<tr>
<td>4</td>
<td>10.1.4.1 -&gt; 10.1.3.1 LISP ECM (udp 4342)</td>
</tr>
<tr>
<td>5</td>
<td>10.1.3.1 -&gt; 10.1.2.1 LISP ECM (udp 4342)</td>
</tr>
<tr>
<td>6</td>
<td>10.2.2.1 -&gt; 10.2.6.1 LISP ECM (udp 4342)</td>
</tr>
</tbody>
</table>

xTR6#

*Aug 24 17:40:52.935: LISP: Processing received Encap-Control(8) message on Ethernet0/0 from 10.2.2.1:4342 to 10.2.6.1:4342
*Aug 24 17:40:52.935: LISP: Processing received Map-Request(1) message on Ethernet0/0 from 1:1.1::1:4342 to 6:6:6::6:4342
*Aug 24 17:40:52.935: LISP: Received map request for IID 0 6:6:6::6/128, source_eid IID 0 4:4:4::4, ITR-RLOCs: 10.1.3.1 10.2.3.1, records 1, nonce 0x55C59929-0x716E6CED, FromPITR
*Aug 24 17:40:52.935: LISP: Processing map request record for EID prefix IID 0 6:6:6::6/128
*Aug 24 17:40:52.935: LISP: Sending map-reply from 10.2.6.1 to 10.2.3.1.
LISP – Disjointed RLOC Space Feature

Disjointed Common Address-Family RLOC Example

1. **IPv4** 10.1.0.0/16 (scope 1)
2. **IPv4** 10.2.0.0/16 (scope 2)
3. **IPv4** 10.1.3.1
4. **IPv4** 10.2.3.1
5. **IPv4** 10.1.2.1
6. **IPv4** 10.2.2.1
7. **IPv4** 10.2.6.1

**LISP ECM** (udp 4342)

Type 1 (map-request)
Nonce
src-eid: [2] 4:4:4::4
itr-rloc: 10.1.4.1

Type 2 (map-reply)
Nonce/TTL
6:6:6::/48
10.1.3.1 [1, 1]

xTR4

**Encap**

**Decap**

**map-rep**

native

lisp-encap

data plane

core plane

xTR6#

*Aug 24 17:40:52.935: LISP: Processing received Encap-Control(8) message on Ethernet0/0 from 10.2.2.1:4342 to 10.2.6.1:4342

*Aug 24 17:40:52.935: LISP: Processing received Map-Request(1) message on Ethernet0/0 from 1:1:1::1:4342 to 6:6:6::6:4342

*Aug 24 17:40:52.935: LISP: Received map request for IID 0 6:6:6::6/128, source_eid IID 0 4:4:4::4, ITR-RLOCs: 10.1.3.1 10.2.3.1, records 1, nonce 0x55C59929-0x716E6CED, FromPITR

*Aug 24 17:40:52.935: LISP: Processing map request record for EID prefix IID 0 6:6:6::6/128

*Aug 24 17:40:52.935: LISP: Sending map-reply from 10.2.6.1 to 10.2.3.1.
LISP – Disjointed RLOC Space Feature
Disjointed Common Address-Family RLOC Example

1. 4:4::4 -> 6:6::6

2. 10.1.4.1 -> 10.1.2.1
LISP ECM (udp 4342)
Type 1 (map-request)
Nonce
src-eid: [2] 4:4:4::4
itr-rloc: 10.1.4.1

3. 10.1.4.1 -> 10.1.3.1
udp 4342
Type 2 (map-reply)
Nonce/TTL
6:6:6::/48
10.1.3.1 [1, 1]

4. 10.1.2.1 -> 10.1.4.1
udp 4342
Type 1 (map-request)
Nonce
src-eid: [2] 4:4:4::4
itr-rloc: 10.1.4.1

5. 10.1.3.1 -> 10.1.2.1
udp 4342
Type 1 (map-request)
Nonce
src-eid: [2] 1:1:1::1
itr-rloc: 10.1.3.1

6. 6:6:6::/48, uptime: 00:17:12, expires: 23:43:27, via map-reply, complete
Locator   Uptime    State      Pri/Wgt
10.2.6.1  00:17:12  up           1/1

7. 10.2.6.1 -> 10.2.3.1
udp 4342
Type 2 (map-reply)
Nonce/TTL
6:6:6::/48
10.2.6.1 [1, 1]
LISP – Disjointed RLOC Space Feature
Disjointed Common Address-Family RLOC Example

1. 4:4:4::4 -> 6:6:6::6
2. 10.1.4.1 -> 10.1.2.1
   - LISP ECM (udp 4342)
   - Type 1 (map-request)
   - Nonce
   - itr-rloc: 10.1.4.1
3. 10.1.2.1 -> 10.1.4.1
   - LISP ECM (udp 4342)
   - Type 1 (map-request)
   - Nonce
   - src-eid: [2] 1:1:1::1
   - itr-rloc: 10.1.3.1
   - itr-rloc: 10.2.3.1
4. 4:4:4::4 -> 10.1.4.1
   - LISP ECM (udp 4342)
   - Type 2 (map-reply)
   - Nonce/TTL
5. 10.1.2.1 -> 10.1.3.1
   - LISP ECM (udp 4342)
   - Type 1 (map-request)
   - Nonce
   - src-eid: [2] 1:1:1::1
   - itr-rloc: 10.1.3.1
   - itr-rloc: 10.2.3.1
6. 10.2.6.1 -> 10.2.3.1
   - LISP ECM (udp 4342)
   - Type 2 (map-reply)
   - Nonce/TTL
   - 6:6:6::/48
7. 10.2.2.1 -> 10.2.6.1
   - LISP ECM (udp 4342)
   - Type 1 (map-request)
   - Nonce
   - src-eid: [2] 1:1:1::1
   - itr-rloc: 10.1.3.1
8. 4:4:4::4 -> 6:6:6::6
9. 10.2.3.1 -> 10.2.6.1
   - LISP ECM (udp 4342)
   - Type 1 (map-request)
   - Nonce
   - src-eid: [2] 1:1:1::1
   - itr-rloc: 10.1.3.1
   - itr-rloc: 10.2.3.1

IPv4
- 10.1.0.0/16 (scope 1)
- 10.2.0.0/16 (scope 2)

MSMR
- RTR
- 10.1.1
- 10.2.1
IPv4
- 10.1.2.1
- 10.2.2.1
IPv4
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- 10.2.3.1
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- 10.2.26.1
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- 10.1.27.1
- 10.2.27.1
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- 10.1.28.1
- 10.2.28.1
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- 10.1.29.1
- 10.2.29.1
IPv4
- 10.1.30.1
- 10.2.30.1
IPv4
- 10.1.31.1
- 10.2.31.1