

LISP

Use cases and configurations

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Agenda

- **LISP Basics**
- Scenario 1: Basic Configuration
- Scenario 2: Dynamic Locator
- Scenario 3: IPv6 over IPv4
- Scenario 4: LISP Virtualization and L3 VPNs
- Scenario 5: LISP VM Mobility
- Demo: LISP VM Mobility
- LISP Summary
- Q&A

LISP Basics



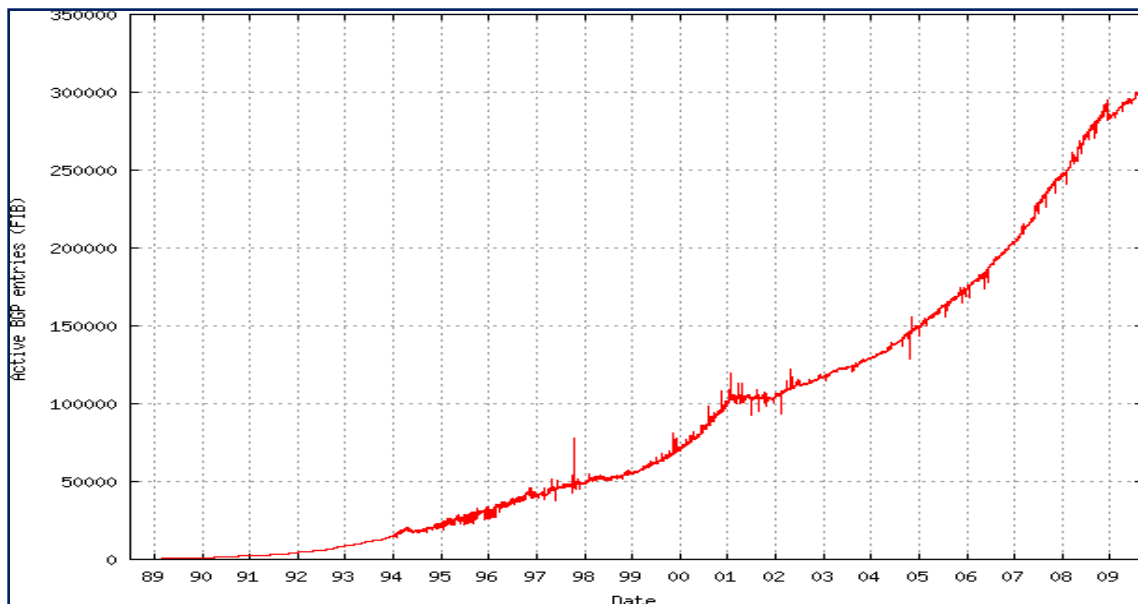
LISP Guiding Principles

- Open Standards
- Incrementally Deployable Technology
- Continuous Technology Validation through
 - running code
 - deployed global network
 - customer input and feedback
- Focus on solving real world problems and customer issues through innovative solutions



LISP – A Solution to Real World Problems

- LISP originally conceived to address Internet Scaling



Many customers have been requesting Cisco to look into this issue

".... routing scalability is the most important problem facing the Internet today and must be solved...."

Attendees of IAB workshop in October 2006 (written in RFC4984)

Without
LISP

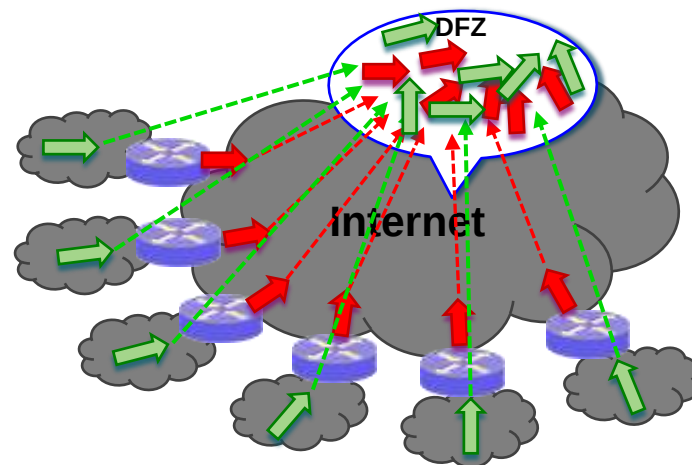


LISP Overview

Locator/ID Split helps resolve route scaling problems

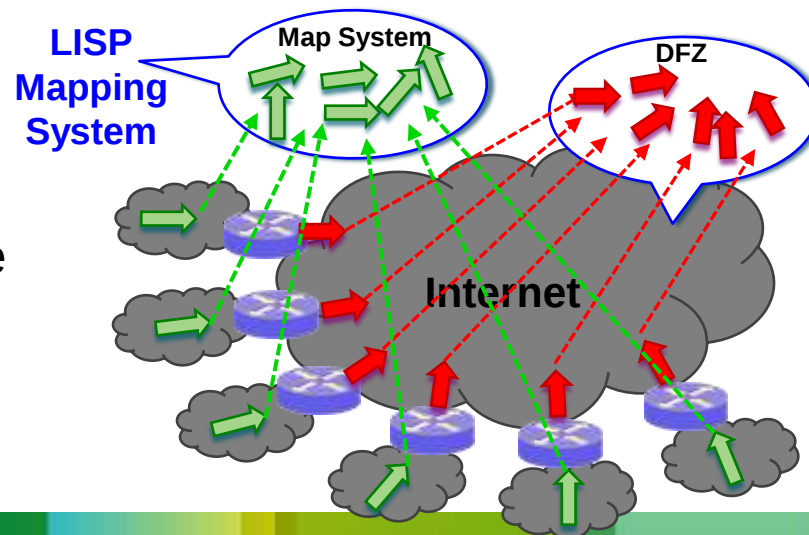
■ Today's Internet Behavior

- The “Default Free Zone” (DFZ) contains all types of routes:
 - Edge (site) routes
 - Core (Provider) route
 - More specifics of both types for TE purposes
- In this model, everything goes in the DFZ



■ LISP Behavior

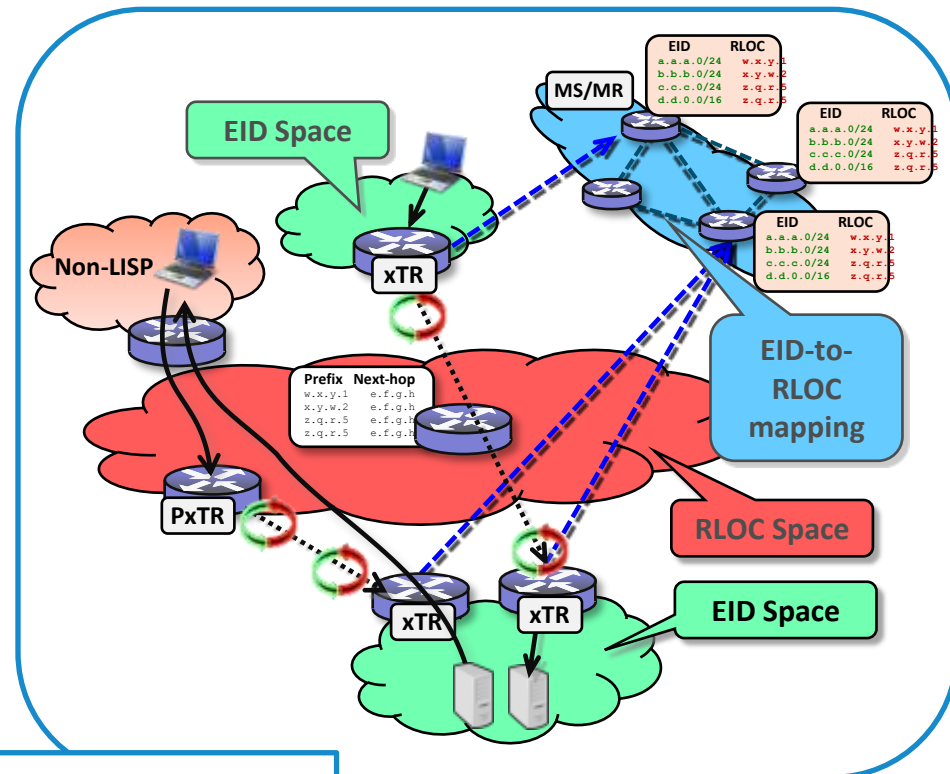
- Locator/ID “split” architecture treats “core” and “site” prefixes differently
- In this model, prefixes describing core topology (**locators**) go in the DFZ; prefixes describing end sites (**EIDs**) go in the LISP mapping system



LISP - A level of indirection for IP addressing

Main attributes of LISP

- **EID (Endpoint Identifier)** is the IP address of a host – just as it is today
- **RLOC (Routing Locator)** is the IP address of the LISP router for the host
- **EID-to-RLOC mapping** is the distributed architecture that maps **EIDs** to **RLOCs**



- Network-based solution
- No host changes
- Minimal configuration
- No DNS changes
- Address Family agnostic
- Incrementally deployable (support LISP and non-LISP)
- Support for mobility

LISP Encapsulation Combinations

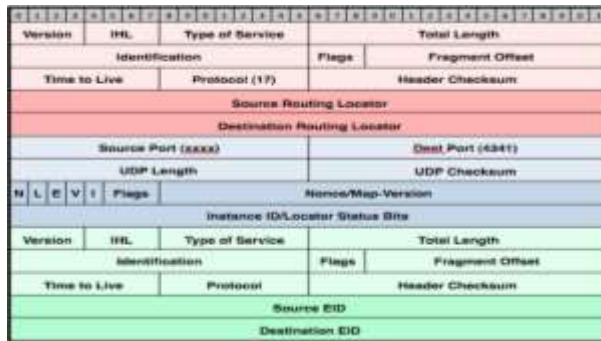
IPv4 and IPv6 Supported

draft-ietf-lisp-19

IPv4
Outer
Header

UDP
LISP

IPv4
Inner
Header



IPv4/IPv4

IPv4
Outer
Header

UDP
LISP

IPv6
Inner
Header



IPv4/IPv6

IPv6
Outer
Header

UDP
LISP

IPv6
Inner
Header



IPv6/IPv6

IPv6
Outer
Header

UDP
LISP

IPv4
Inner
Header

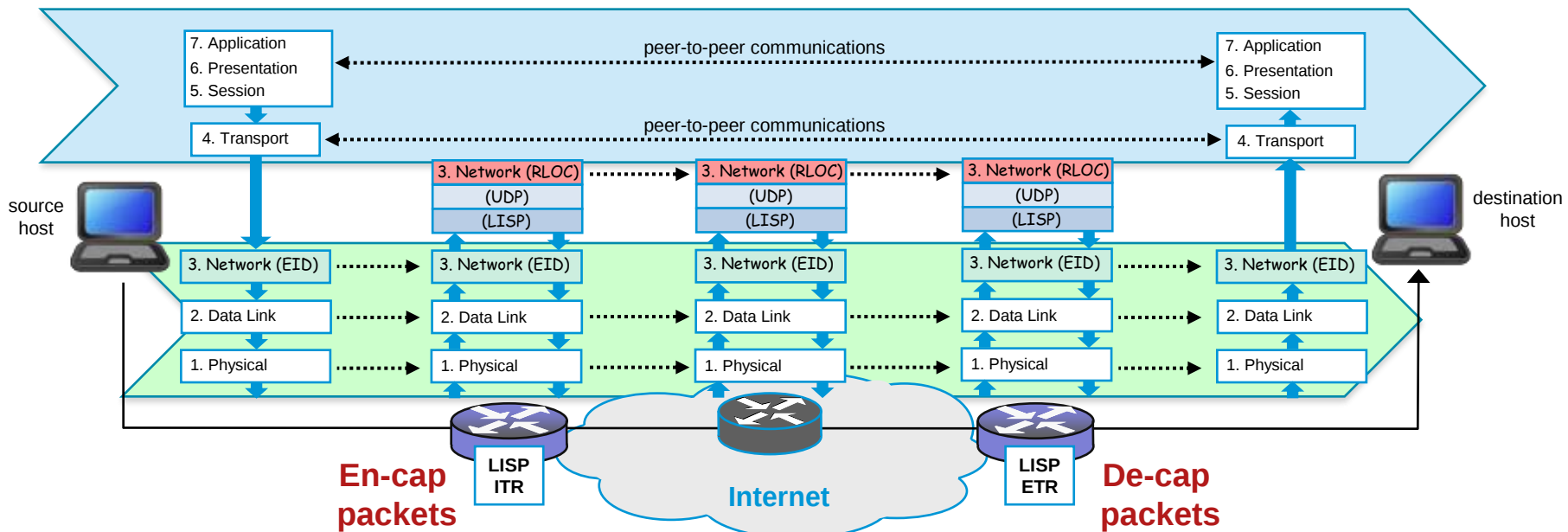


IPv6/IPv4

LISP – Data Plane

Session Persistence

- LISP nodes advertize locator policies through mapping system to adjacent nodes
- Session Persistence (beneficial for LISP Mobile nodes, VM Mobility, etc.)
- Optimized routing – avoids triangular routing



LISP Operations

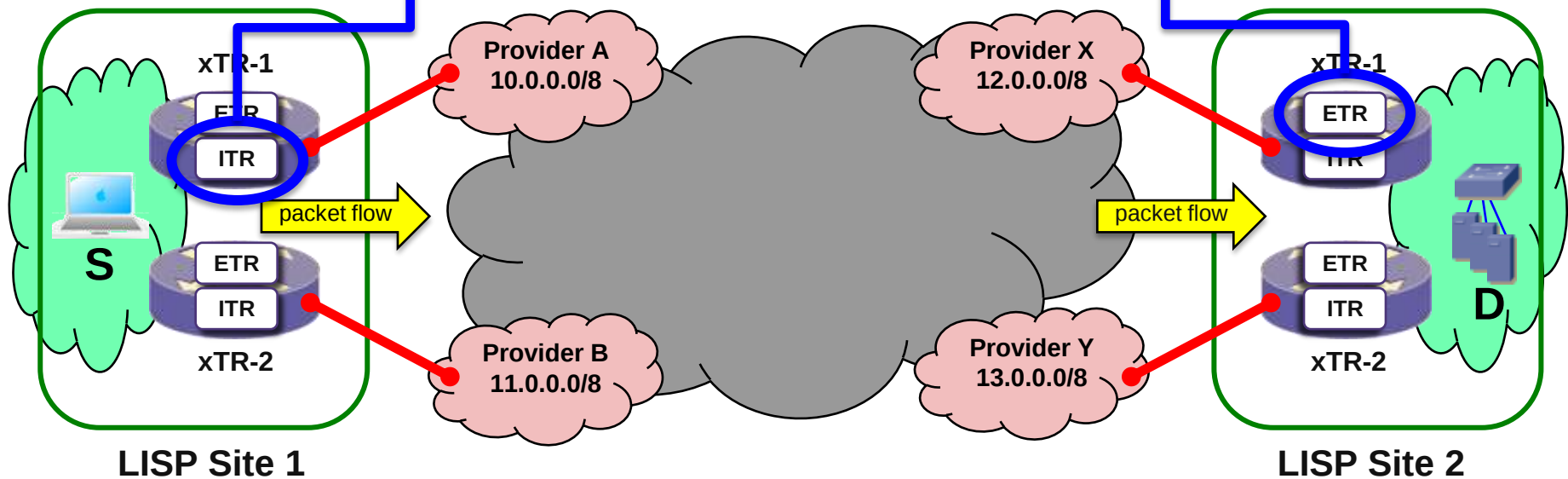
LISP Data Plane :: Ingress/Egress Tunnel Router (xTR)

ITR – Ingress Tunnel Router

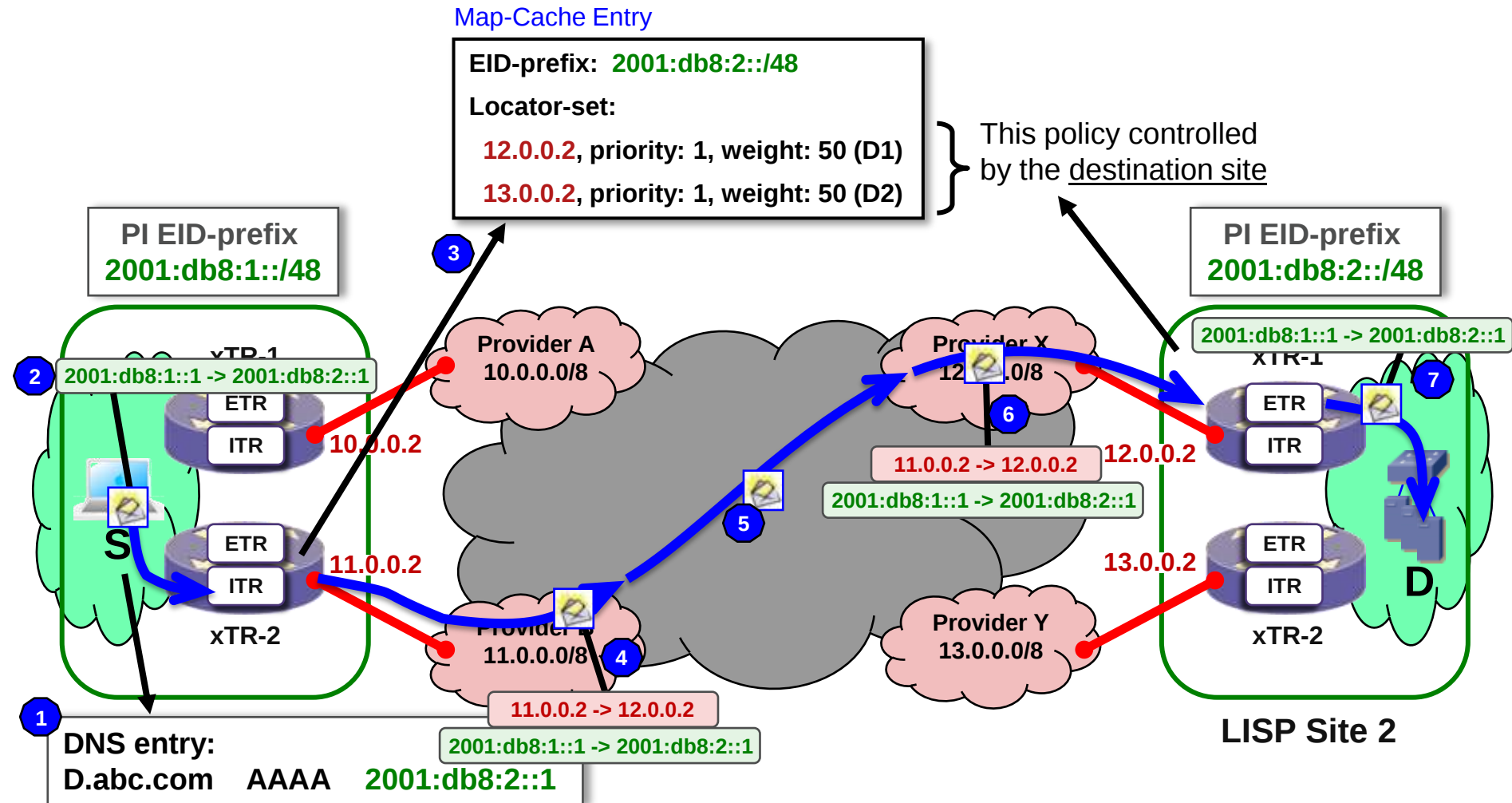
- Receives packets from site-facing interfaces
- Encap to remote LISP sites, or native-fwd to non-LISP sites

ETR – Egress Tunnel Router

- Receives packets from core-facing interfaces
- De-cap, deliver packets to local **EIDs** at site



LISP Data Plane :: Unicast Packet Forwarding

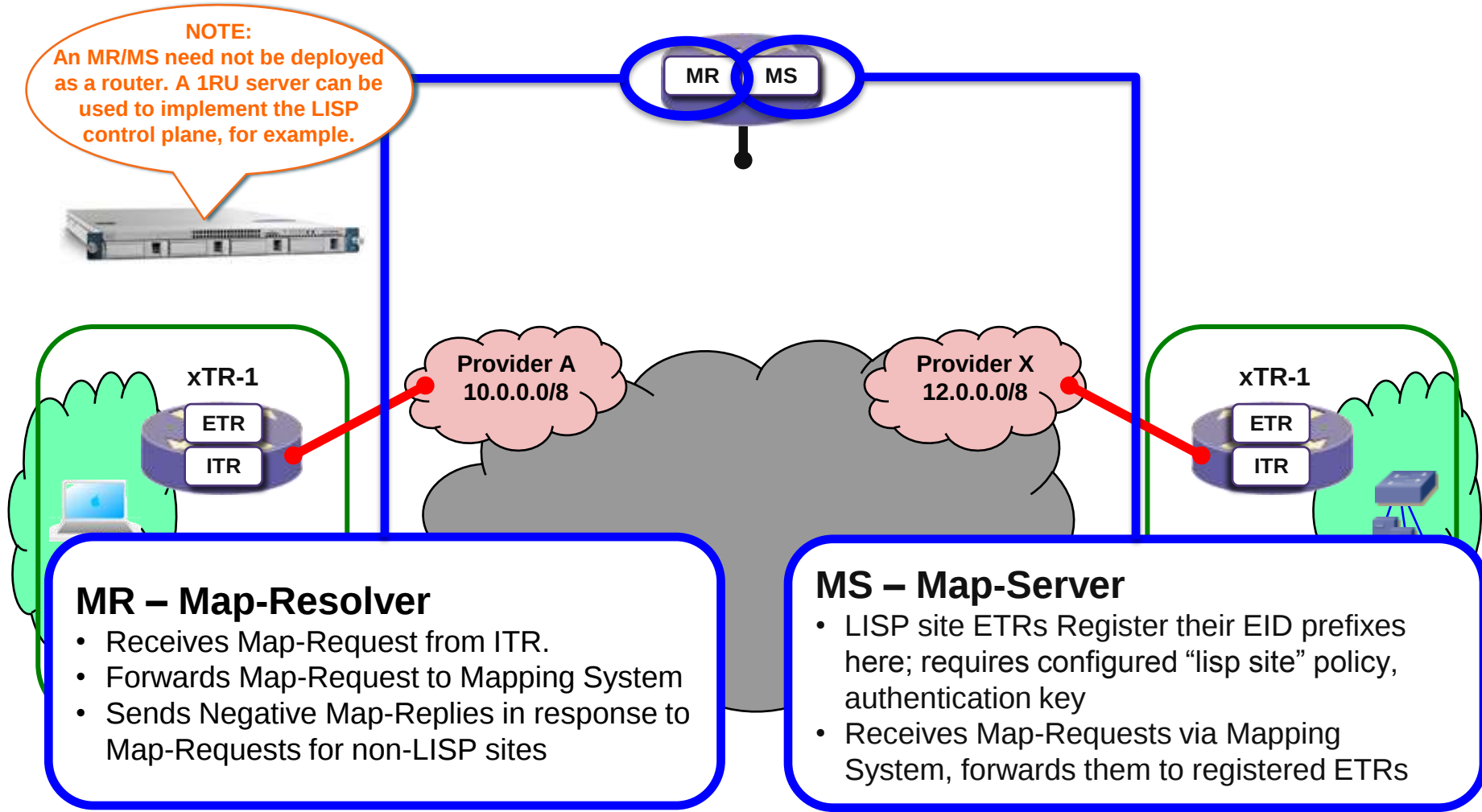


LISP Operations

LISP Control Plane :: Map-Server/Map-Resolver (MS/MR)

NOTE:

An MR/MS need not be deployed as a router. A 1RU server can be used to implement the LISP control plane, for example.

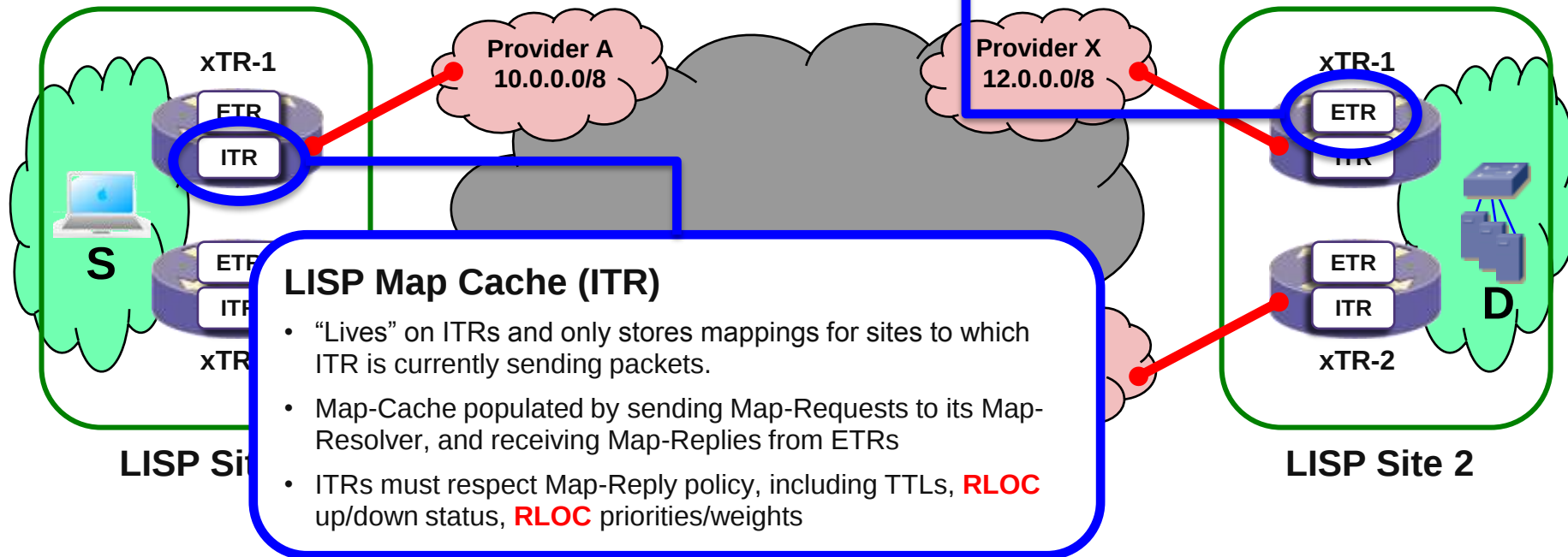


LISP Operations

LISP Control Plane :: Mapping Database (ETR), Map-Cache (ITR)

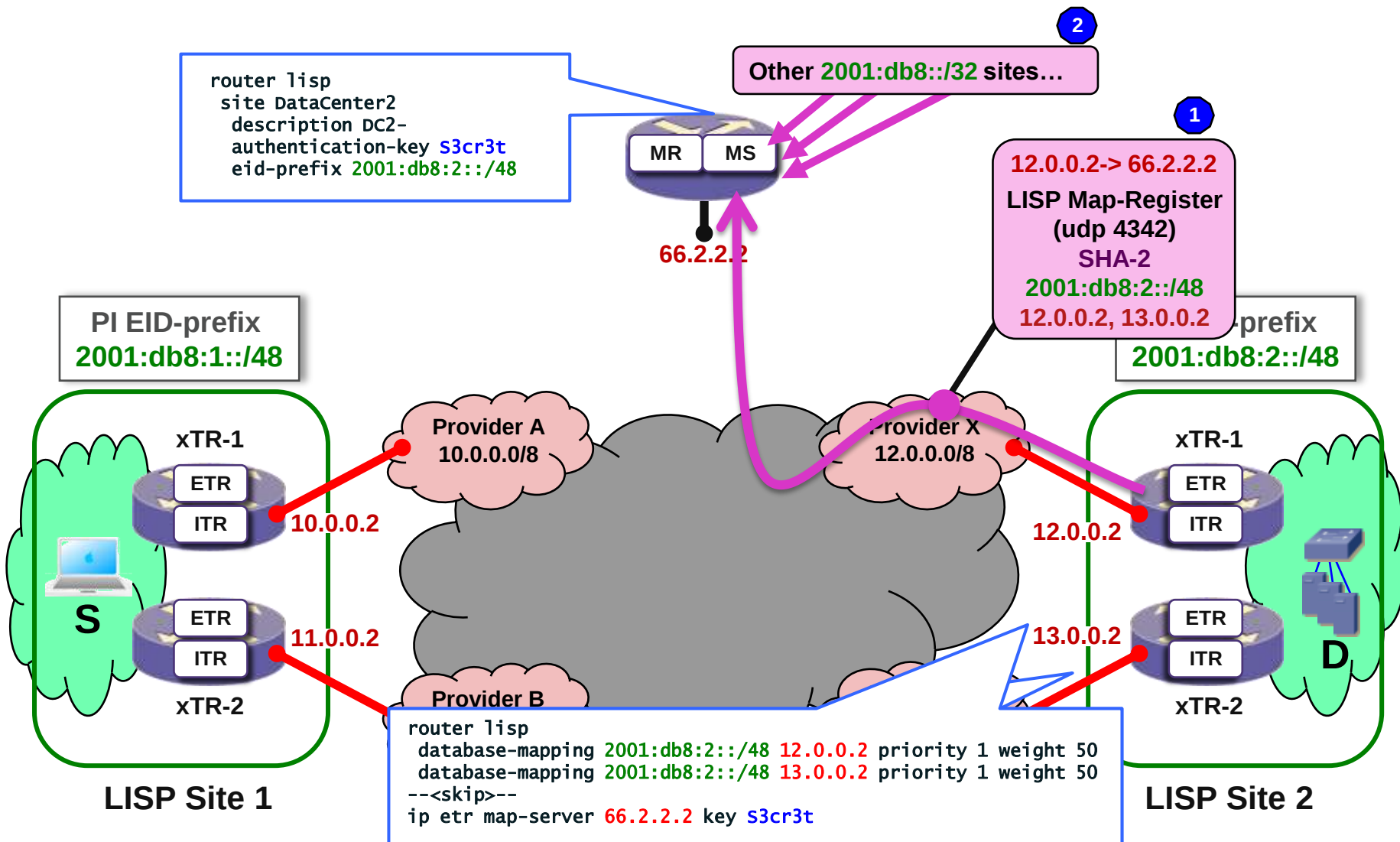
LISP Site Mapping-Database (ETR)

- **EID**-to-**RLOC** mappings in all ETRs for local LISP site
- ETR is “authoritative” for its **EIDs**, sends Map-Replies to ITRs
- ETRs can tailor policy based on Map-Request source
- Decentralization increases attack resiliency



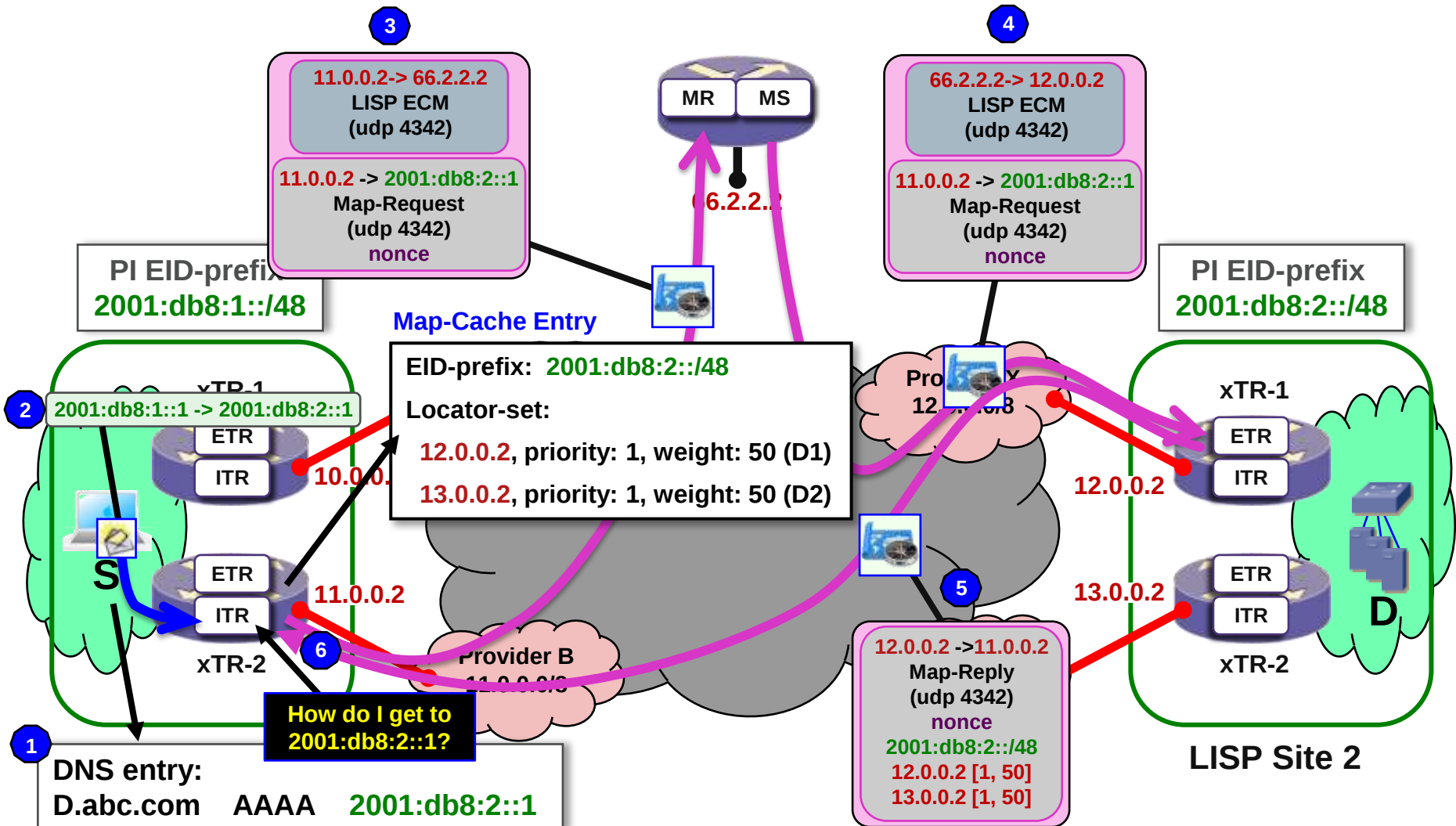
LISP Operations

LISP Control Plane :: Map Registration Example



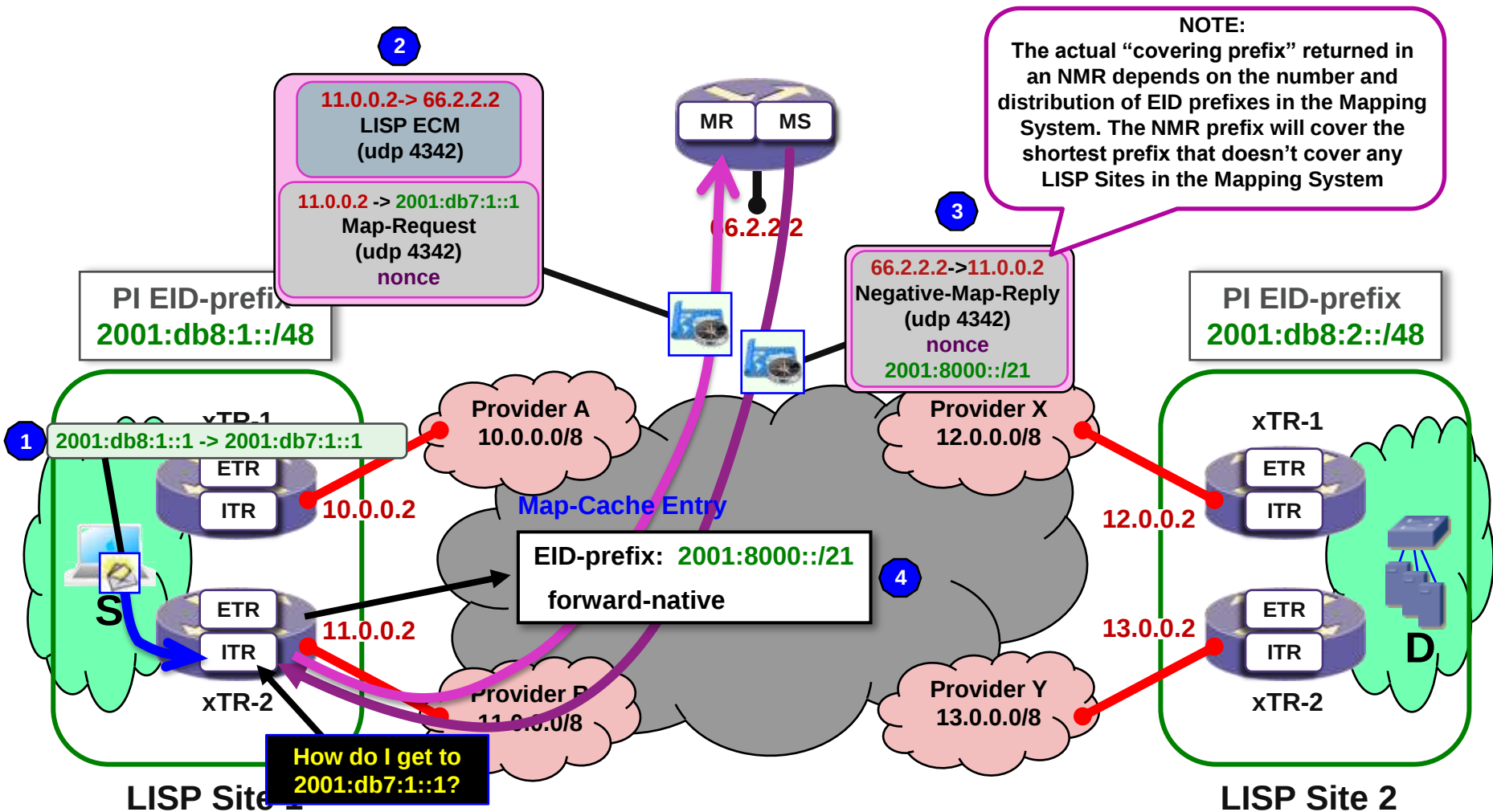
LISP Operations

LISP Control Plane :: Map Request/Map Reply Example



LISP Operations

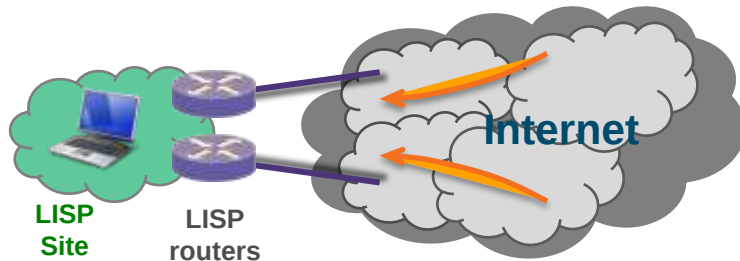
LISP Control Plane :: Negative Map Reply Example



LISP use cases

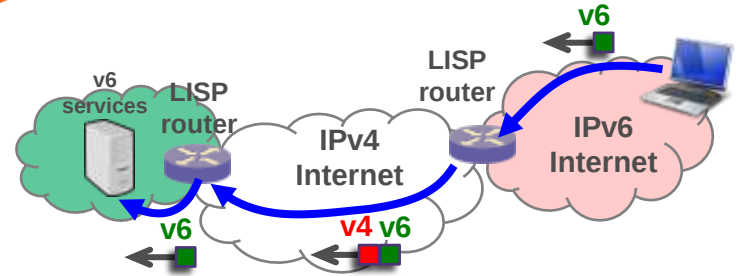
Some Examples

Efficient Multi-Homing



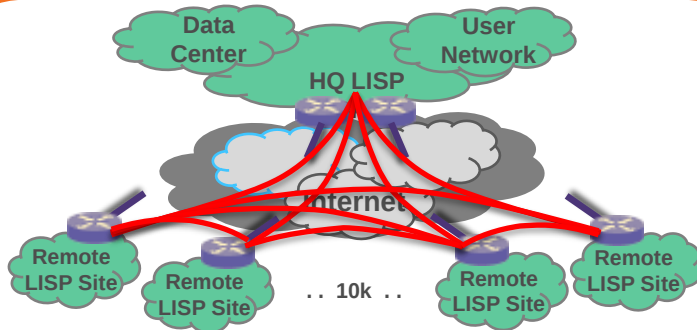
- IP Portability
- Ingress Traffic Engineering without BGP

IPv6 Transition Support



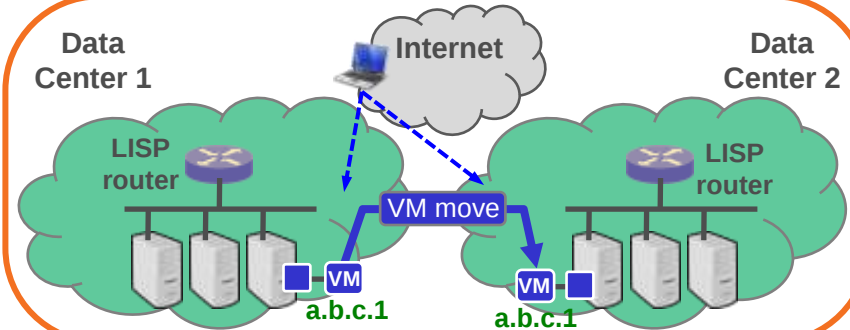
- v6-over-v4, v6-over-v6
- v4-over-v6, v4-over-v4

VPNs and Segmentation



- Over-the-Top
- Multi-tenancy

VM-Mobility



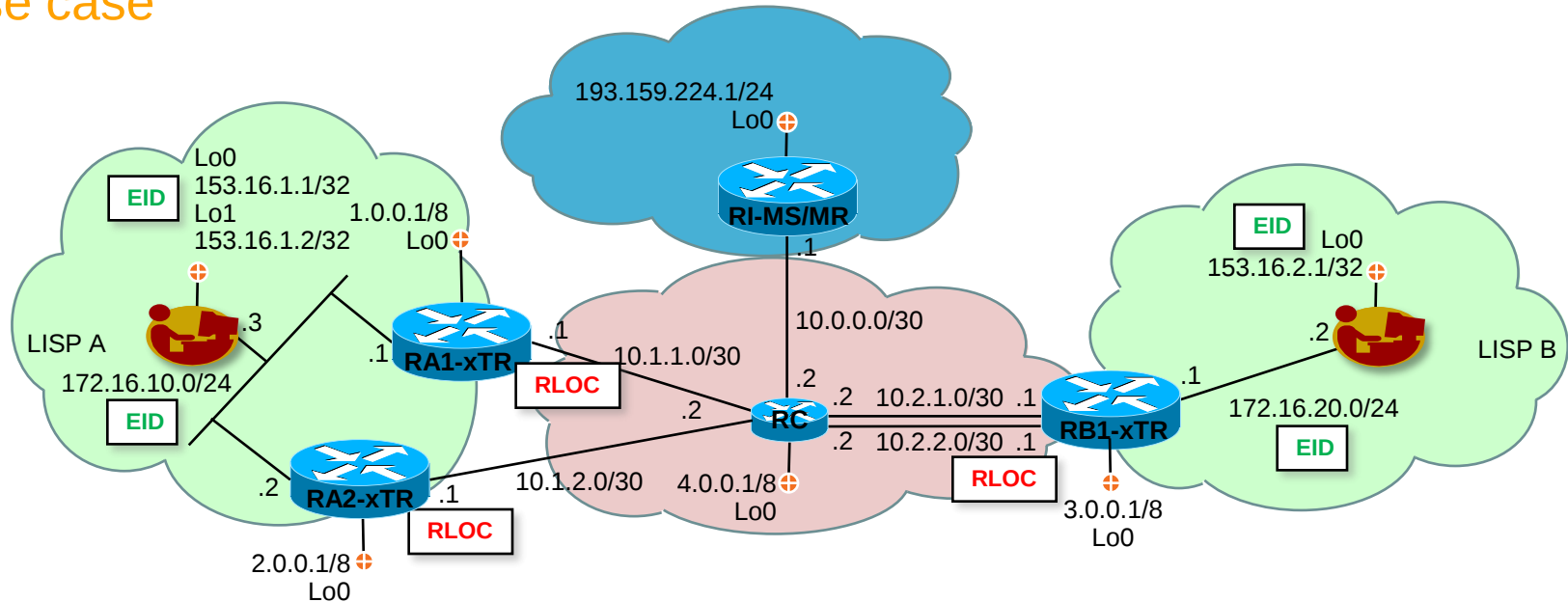
- Cloud / Layer 3 VM moves
- Segmentation

Scenario 1: Basic Configuration



Scenario 1: Basic Configuration

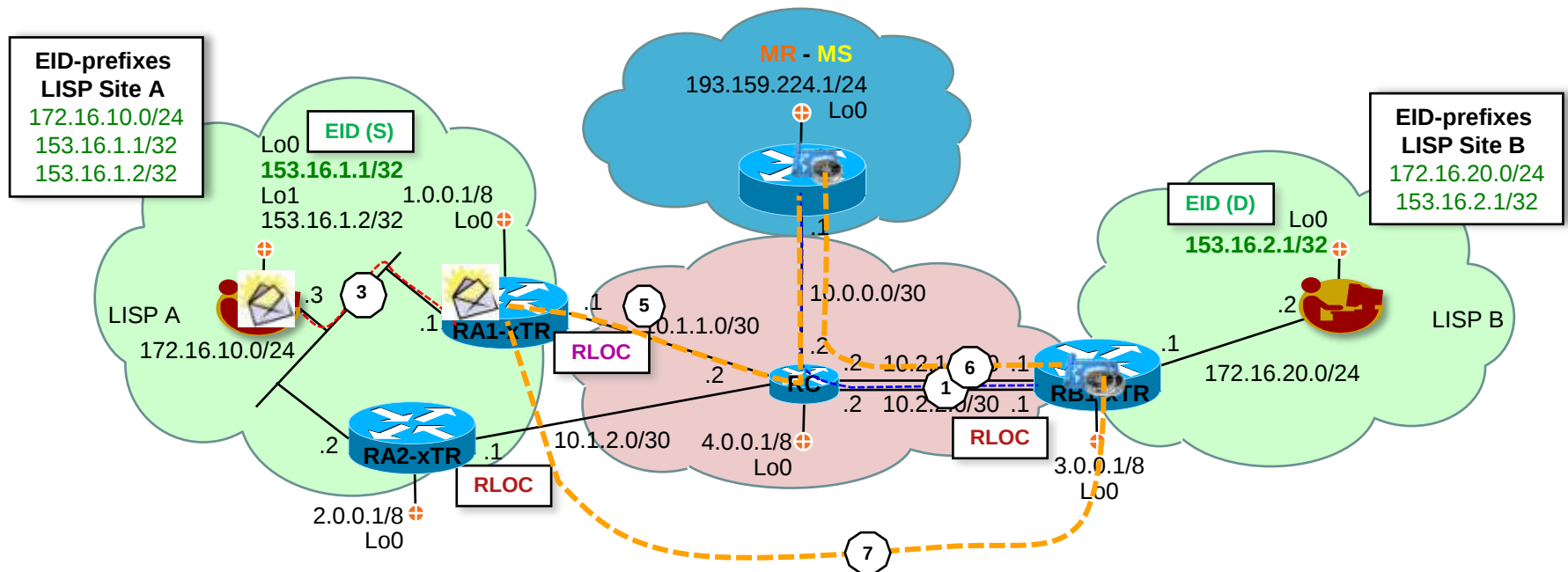
Use case



- IP portability (flexible use of PI/PA/RFC addresses)
- multihoming w/ loadbalancing & traffic engineering
- high scalable VPNs (combine w/ ACL and IPsec)
- ... what could be your usecase?

LISP – Control Plane

Mapping Database (ETR) and Map Cache (ITR)



ETR – Registration

10.2.1.1 -> 10.0.0.1

LISP Map-Register
153.16.2.1/32

MS and MR
on a single router.
No ALT advertisement

Map Request

153.16.1.1 -> 153.16.2.1

How do I get to
153.16.2.1?

10.1.1.1 -> 10.0.0.1
LISP ECM to MR

10.1.1.1 -> 153.16.2.1
Map-Request to ETR

10.0.0.1 -> 10.2.1.1
LISP ECM to ETR

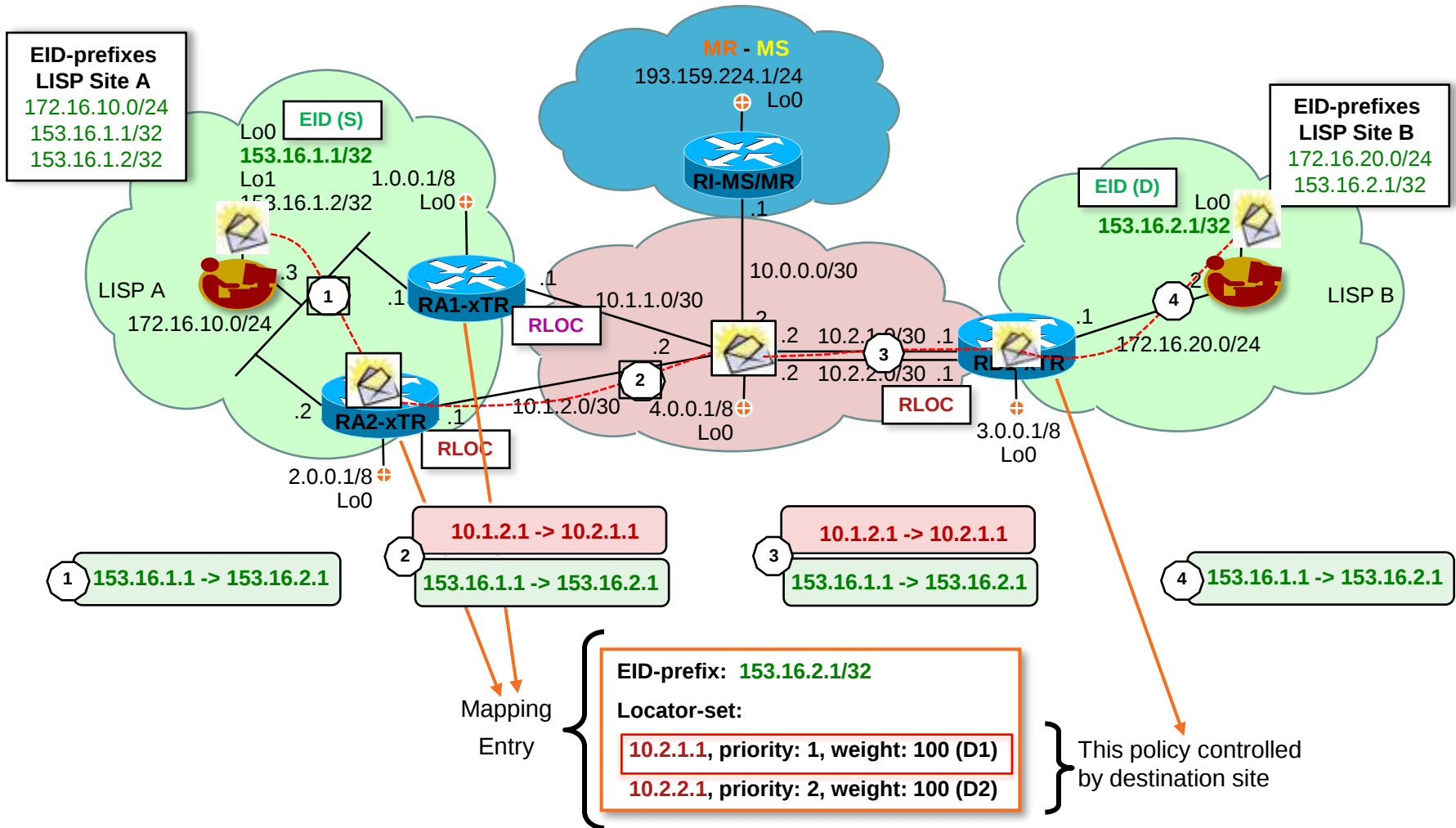
10.1.1.1 -> 153.16.2.1
Map-Request to ETR

10.2.1.1 -> 10.1.1.1
Map-Reply to ITR

153.16.2.1/32
10.2.1.1 [1,100]
10.2.2.1 [2,100]

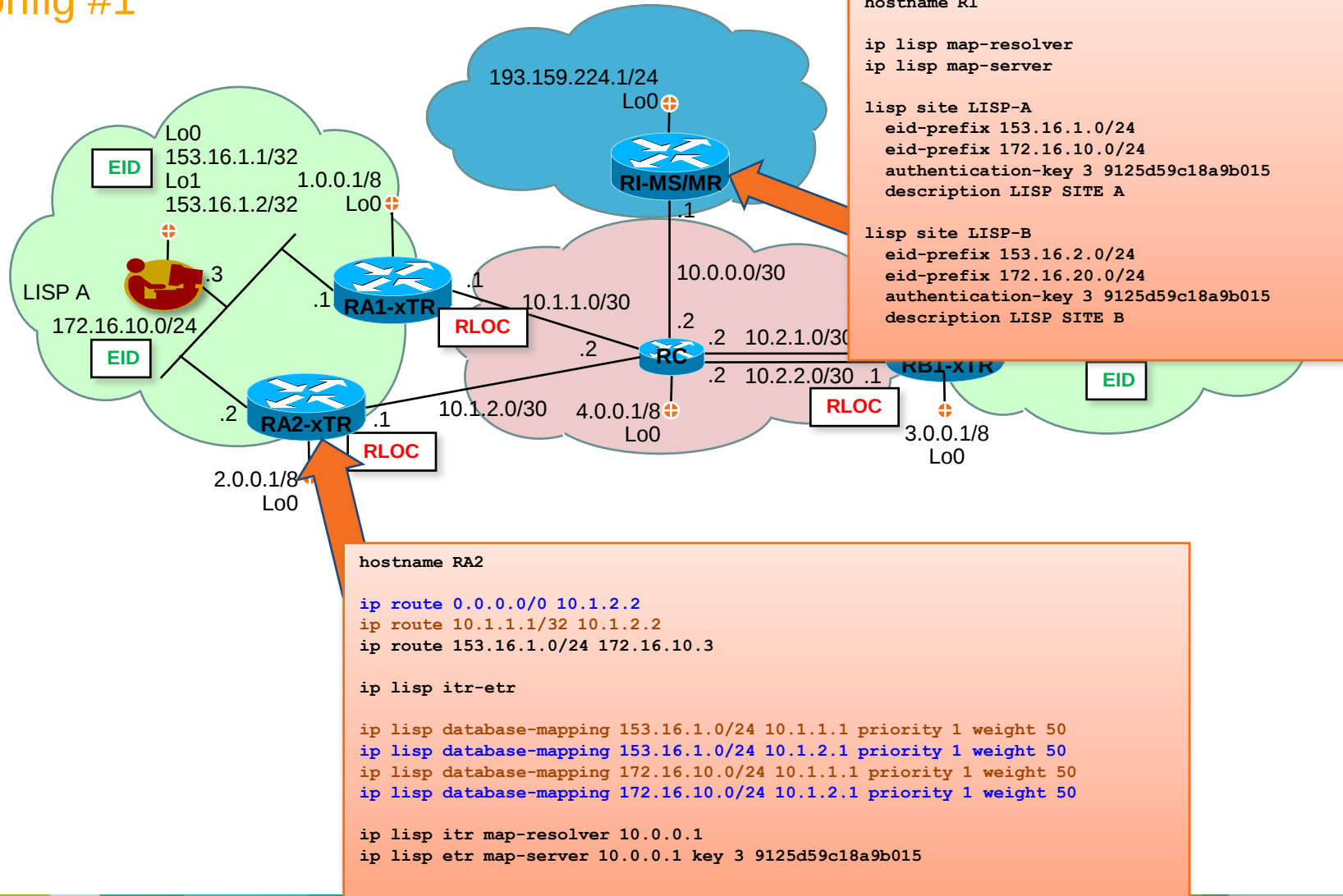
LISP – Data Plane

Unicast Packet Forwarding



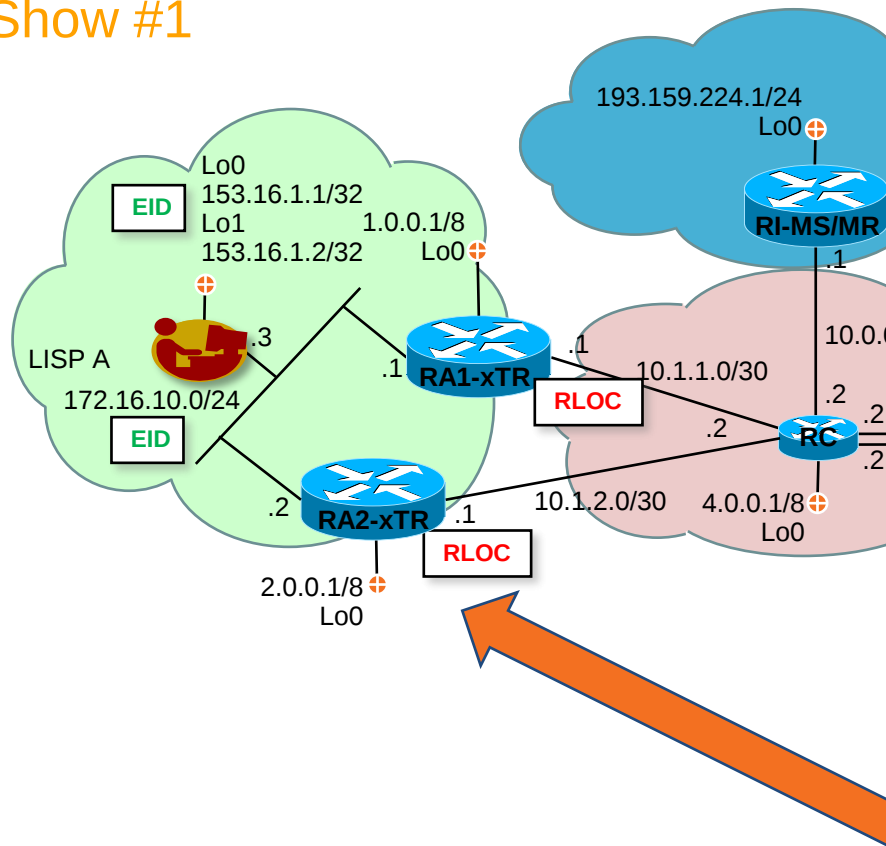
Scenario 1: Basic Configuration

Config #1



Scenario 1: Basic Configuration

Show #1

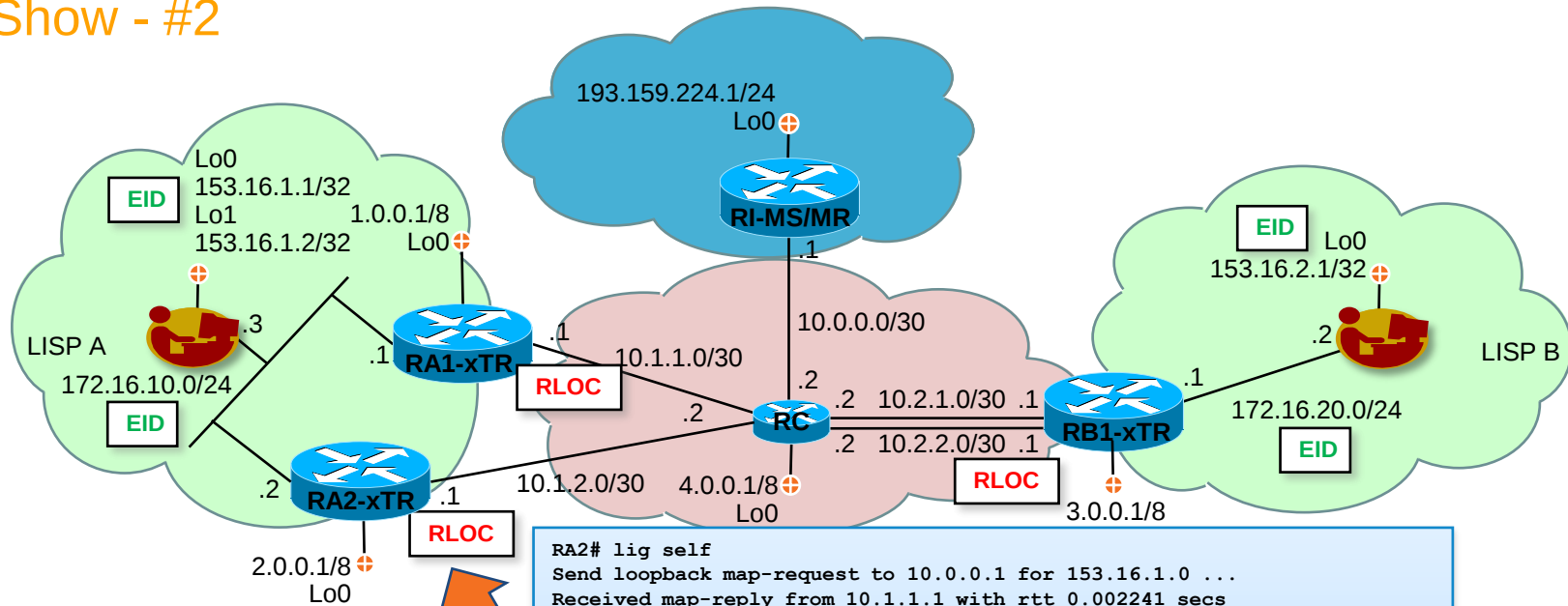


```
RA2# sh ip lisp
LISP IP Configuration Information for VRF "default" (iid 0)
  Ingress Tunnel Router (ITR):      enabled
  Egress Tunnel Router (ETR):      enabled
  Proxy-ITR Router (PTR):          disabled
  Proxy-ETR Router (PETR):         disabled
  Map Resolver (MR):               disabled
  Map Server (MS):                 disabled
  Locator VRF:                     default
  Last-resort source locator:       2.0.0.1
  LISP-NAT Interworking:           disabled
  ITR send Map-Request:            enabled
  ITR send Data-Probe:             disabled
  LISP ALT-VRF:                    not configured
  ITR Map-Resolver:                10.0.0.1, last used: 00:14:10
  ETR Map-Server(s):              10.0.0.1
  Last Map-Register sent to MS:    00:00:50
  ETR glean mapping:               disabled, verify disabled
  ETR accept mapping data:         disabled, verify disabled
  ETR map-cache TTL:               24 hours
  Shortest EID-prefix allowed:     /16
  Locator Reachability Algorithms:
    Echo-nonce algorithm:          disabled
    TCP-counts algorithm:          disabled
    RLOC-probe algorithm:          enabled
  Static mappings configured:       0
  Map-cache limit:                  1000
  Map-cache size:                   2
  ETR Database, global LSBs: 0x00000003:
    EID-prefix: 153.16.1.0/24, instance-id: 0, LSBs: 0x00000003
      Locator: 10.1.1.1, priority: 1, weight: 50
      Uptime: 3d18h, state: up
      Locator: 10.1.2.1, priority: 1, weight: 50
      Uptime: 3d18h, state: up, local
    EID-prefix: 172.16.10.0/24, instance-id: 0, LSBs: 0x00000003
      Locator: 10.1.1.1, priority: 1, weight: 50
      Uptime: 3d18h, state: up
      Locator: 10.1.2.1, priority: 1, weight: 50
      Uptime: 3d18h, state: up, local
```

RA2#

Scenario 1: Basic Configuration

Show - #2



```
RA2# lig self
Send loopback map-request to 10.0.0.1 for 153.16.1.0 ...
Received map-reply from 10.1.1.1 with rtt 0.002241 secs

Map-cache entry for EID 153.16.1.0:
153.16.1.0/24, uptime: 00:00:50, expires: 23:59:57, via map-reply, self
Locator  Uptime   State      Priority/  Data    Control
          Weight   in/out    in/out
10.1.1.1  00:00:50  up         1/50      0/0     1/0
10.1.2.1  00:00:50  up         1/50      0/0     0/0

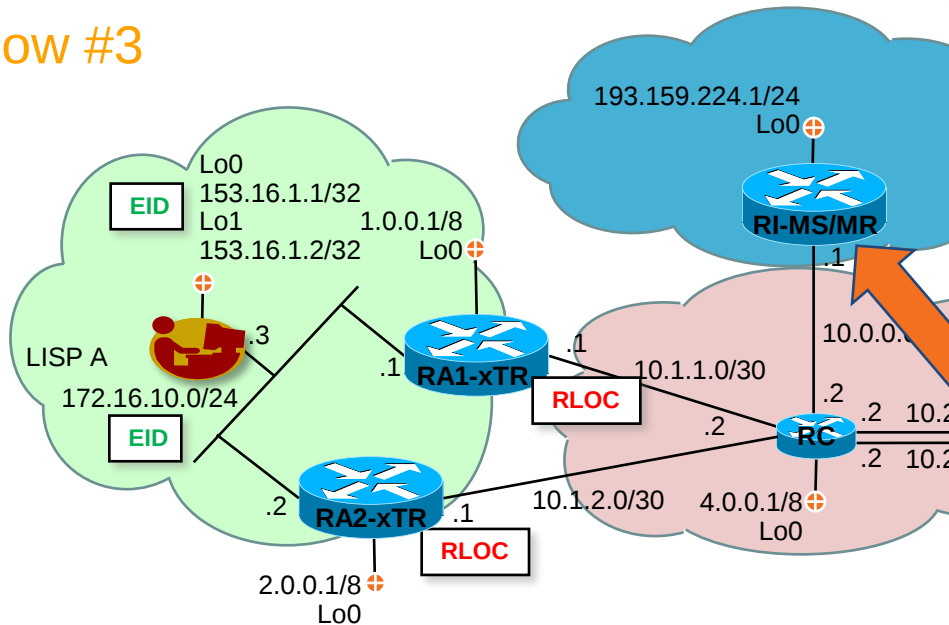
RA2# lig 153.16.2.1
Send map-request to 10.0.0.1 for 153.16.2.1 ...
Received map-reply from 10.2.2.1 with rtt 0.003445 secs

Map-cache entry for EID 153.16.2.1:
153.16.2.0/24, uptime: 1d00h, expires: 23:59:57, via map-reply, auth
Locator  Uptime   State      Priority/  Data    Control
          Weight   in/out    in/out
10.2.1.1  1d00h    up         1/50      0/9     4/5
10.2.2.1  23:51:49 up         1/50      0/0     2/0

RA2#
```

Scenario 1: Basic Configuration

Show #3



```
RI# sh lisp site
LISP Site Registration Information for VRF "default"
* = truncated IPv6 address, -x = more-specifics count
```

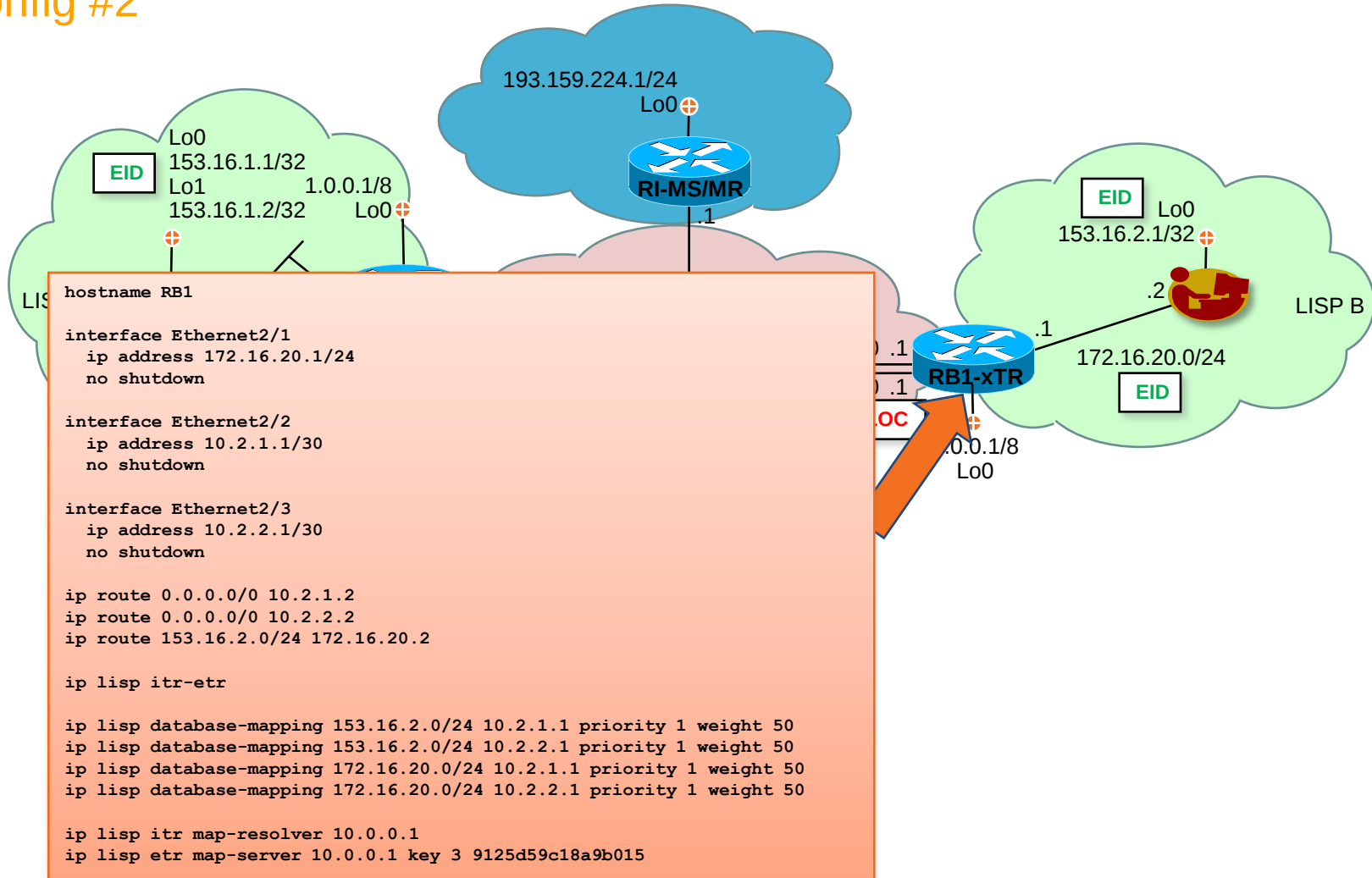
Site Name	Last Registered	Actively Registered	Who last Registered	EID-prefix
LISP-A	00:00:53	yes	10.1.2.1	172.16.10.0/24
LISP-B	00:00:53	yes	10.1.2.1	153.16.1.0/24
LISP-B	00:00:07	yes	10.2.2.1	172.16.20.0/24
LISP-B	00:00:07	yes	10.2.2.1	153.16.2.0/24

```
RI# sh lisp site LISP-A detail
LISP Site Registration Information for VRF "default"
* = truncated IPv6 address, -x = more-specifics count

Site name: "LISP-A"
Description: LISP SITE A
Allowed configured locators: any
Configured EID-prefix: 172.16.10.0/24, instance-id: 0
Currently registered: yes
First registered: 1w0d
Last registered: 00:00:16
Who last registered: 10.1.2.1
Routing table tag: 0x00000000
Proxy Replying: no
Wants Map-Notifications: no
Registered TTL: 1440 minutes
Registered locators:
  10.1.1.1 (up), priority: 1, weight: 50
  10.1.2.1 (up), priority: 1, weight: 50
Registration errors:
  Authentication failures: 0
  Allowed locators mismatch: 0
Configured EID-prefix: 153.16.1.0/24, instance-id: 0
Currently registered: yes
First registered: 1w0d
Last registered: 00:00:16
Who last registered: 10.1.2.1
Routing table tag: 0x00000000
Proxy Replying: no
Wants Map-Notifications: no
Registered TTL: 1440 minutes
Registered locators:
  10.1.1.1 (up), priority: 1, weight: 50
  10.1.2.1 (up), priority: 1, weight: 50
Registration errors:
  Authentication failures: 0
  Allowed locators mismatch: 0
```

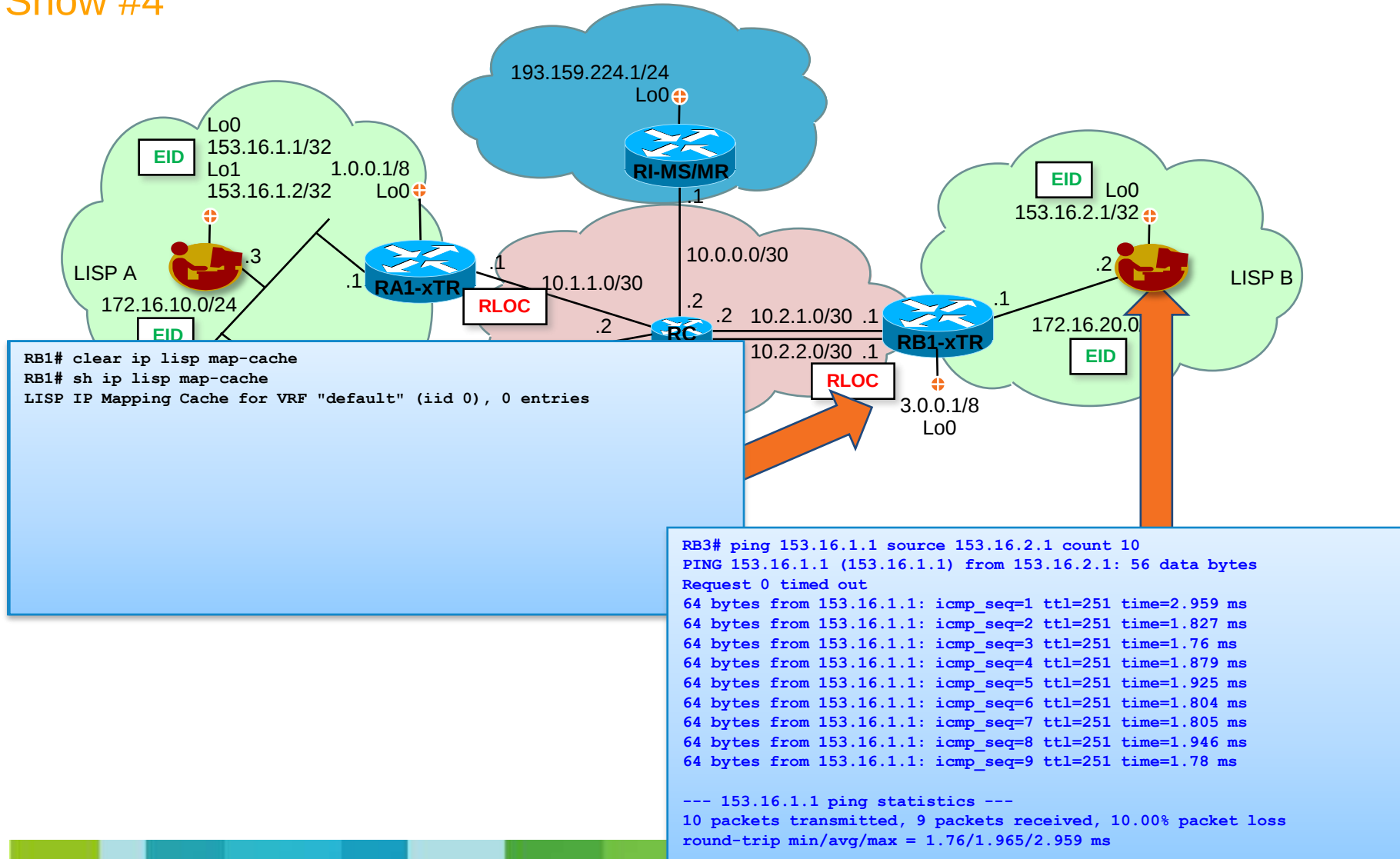
Scenario 1: Basic Configuration

Config #2



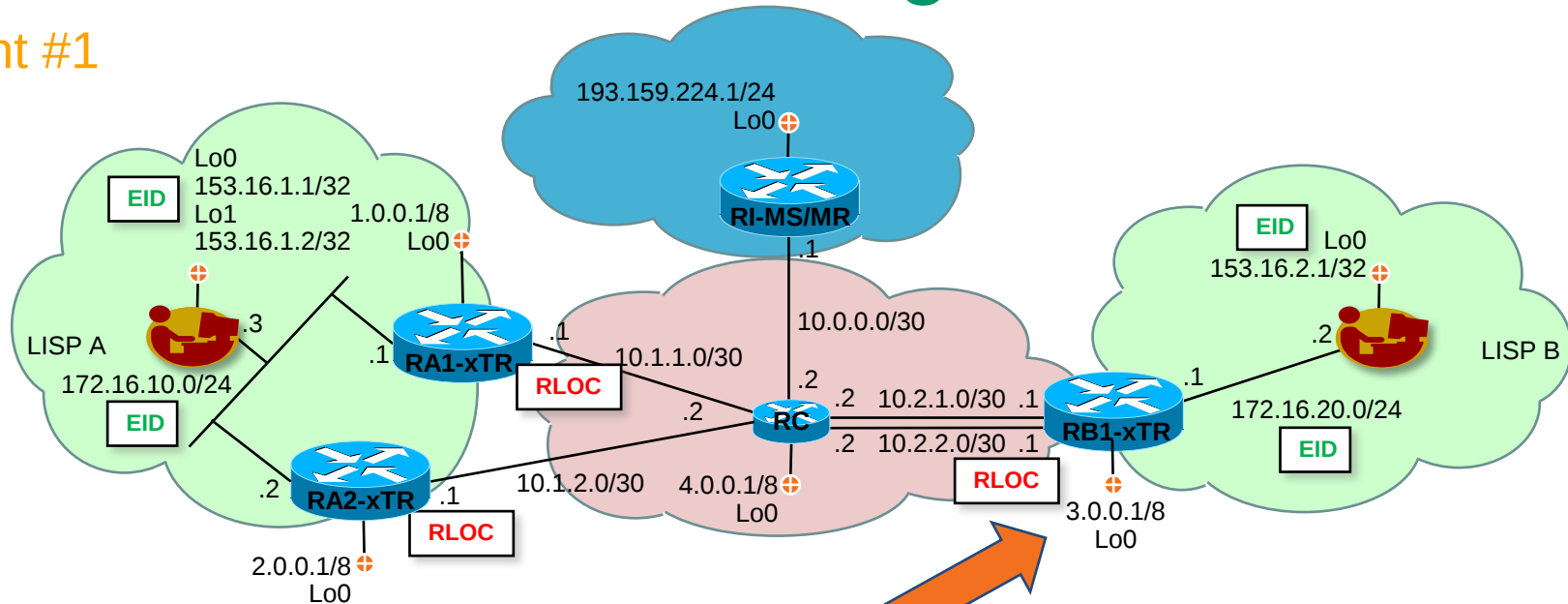
Scenario 1: Basic Configuration

Show #4



Scenario 1: Basic Configuration

Hint #1



loadbalancing:

```
RB1# sh ip lisp locator-hash 172.16.20.1 172.16.10.1
LISP Locator Hashing for VRF "default"

EIDs 172.16.20.1 -> 172.16.10.1 yields:
  RLOCs 10.2.1.1 -> 10.1.1.1 (Ethernet2/2)
  Address hash: 0x1e (30), hash bucket: 5, RLOC index: 0

RB1# sh ip lisp locator-hash 172.16.20.1 172.16.10.7
LISP Locator Hashing for VRF "default"

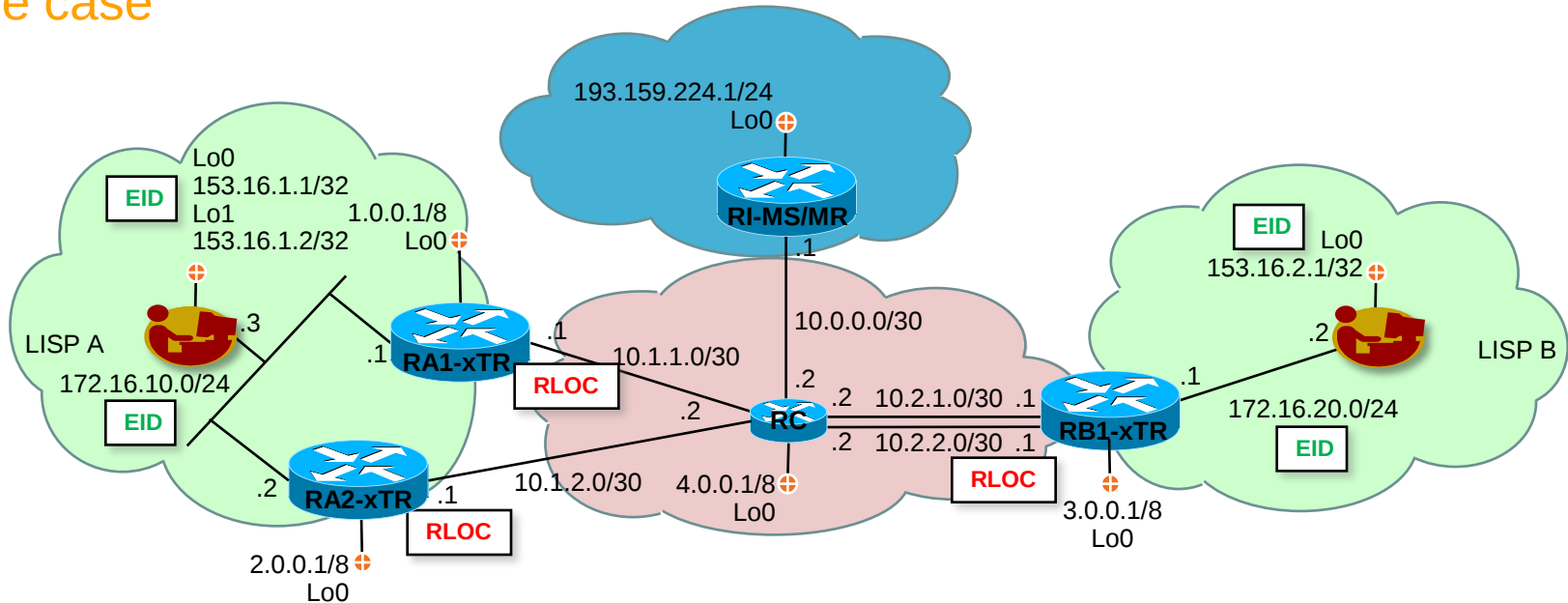
EIDs 172.16.20.1 -> 172.16.10.7 yields:
  RLOCs 10.2.1.1 -> 10.1.2.1 (Ethernet2/2)
  Address hash: 0x18 (24), hash bucket: 24, RLOC index: 1
RB1#
```

Scenario 2: Dynamic Locator



Scenario 2: Dynamic Locator

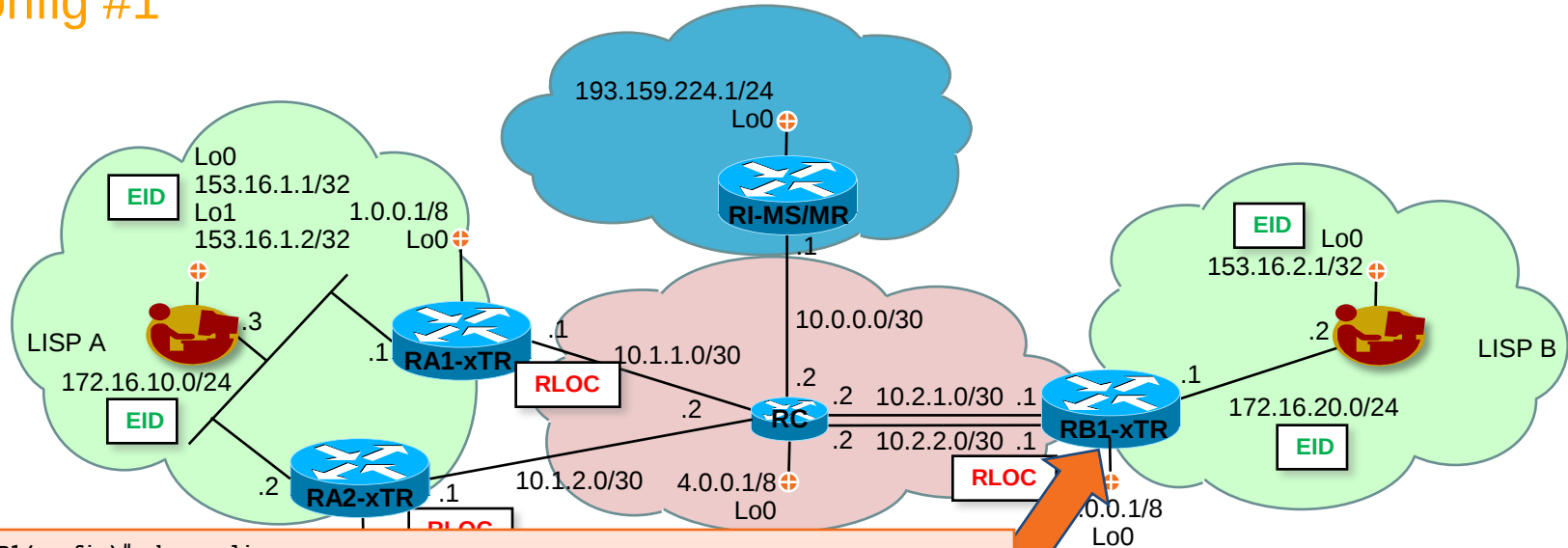
Use case



- low opex connections: e.g. DSL w/ dyn. IP addr.
- branch connections w/ NAT
- moving LISP router (car, airplane, ...)
- ...

Scenario 2: Dynamic Locator

Config #1



```
RB1(config)# sh run lisp
```

```
!Command: show running-config lisp
!Time: Sat Jan 8 04:37:22 2012
```

```
version 5.0(3)
feature lisp
ip lisp itr-etr
```

```
ip lisp database-mapping 153.16.2.0/24 dynamic Ethernet2/3 priority 1 weight 50
ip lisp database-mapping 153.16.2.0/24 10.2.1.1 priority 1 weight 50
ip lisp database-mapping 172.16.20.0/24 dynamic Ethernet2/3 priority 1 weight 50
ip lisp database-mapping 172.16.20.0/24 10.2.1.1 priority 1 weight 50
ip lisp itr map-resolver 10.0.0.1
ip lisp etr map-server 10.0.0.1 key 3 9125d59c18a9b015
```

```
RB1(config)#
```

Scenario 2: IPv6 over IPv4



LISP Use Cases

LISP Use Case 2 :: IPv6 Transition – c

World IPv6 Day Sites using LISP

Cisco

lisp.cisco.com (AAAA: 2610:d0:110c:1::3, ::4)

Facebook

www.lisp6.facebook.com (AAAA: 2610:D0:FACE::9)

Qualcomm

www.ipv6.eudora.com (AAAA: 2610:d0:120d::10)

jobs.qualcomm.com (no longer AAAA)

Deutsche Bank

www.ipv6-db.com (AAAA: 2610:d0:2113:3::3)

Munich Airport

lisp6.munich-airport.de (AAAA: 2610:d0:211d:1::2)

Isarnet

lisp.isarnet.net (AAAA: 2610:d0:211f:ffe::101)

InTouch

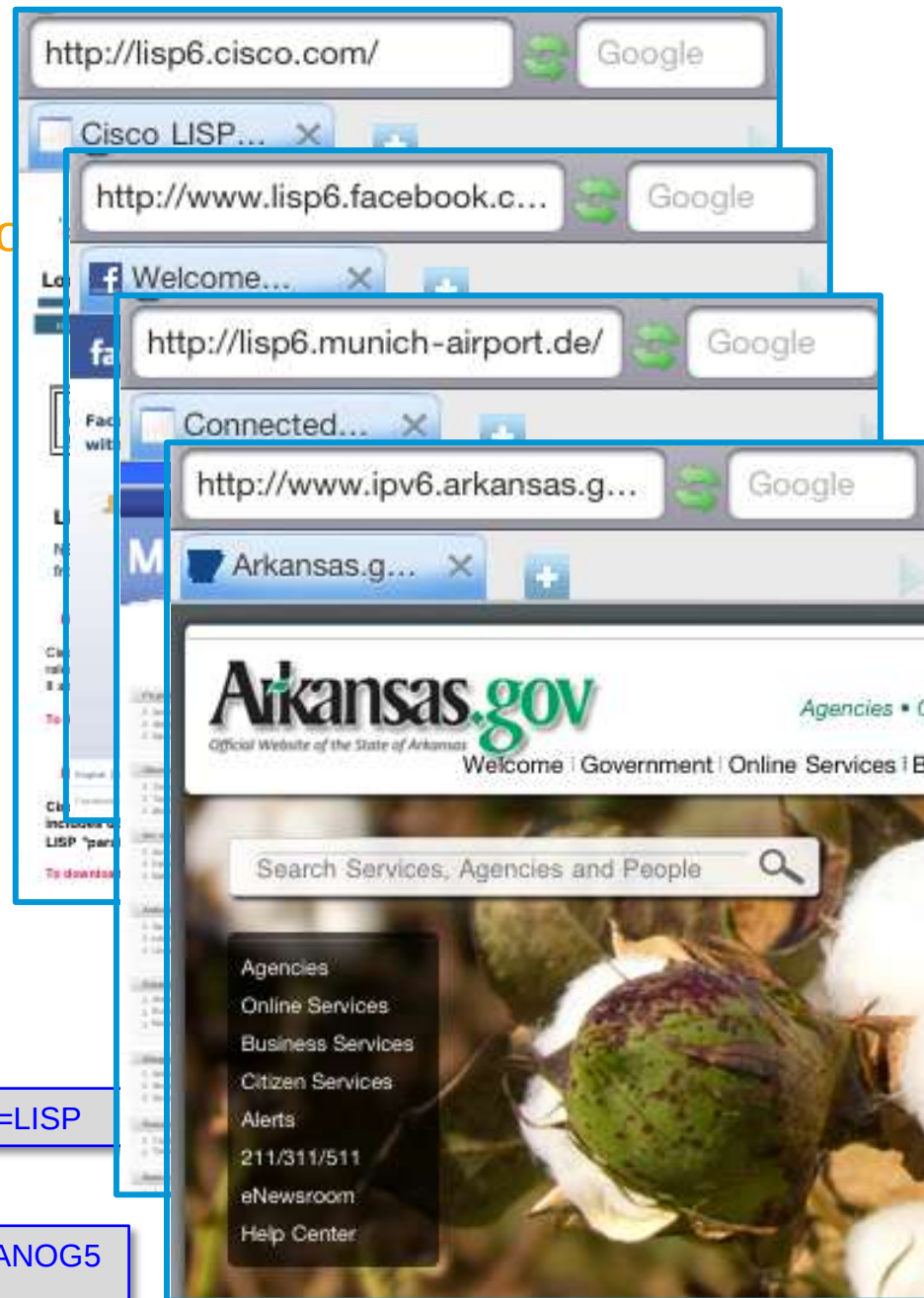
www.lisp.intouch.eu (AAAA: 2610:d0:210f:100::101)

World IPv6 Day Sites Statistics (and current)

<http://honeysuckle.noc.ucla.edu/cgi-bin/smokeping.cgi?target=LISP>

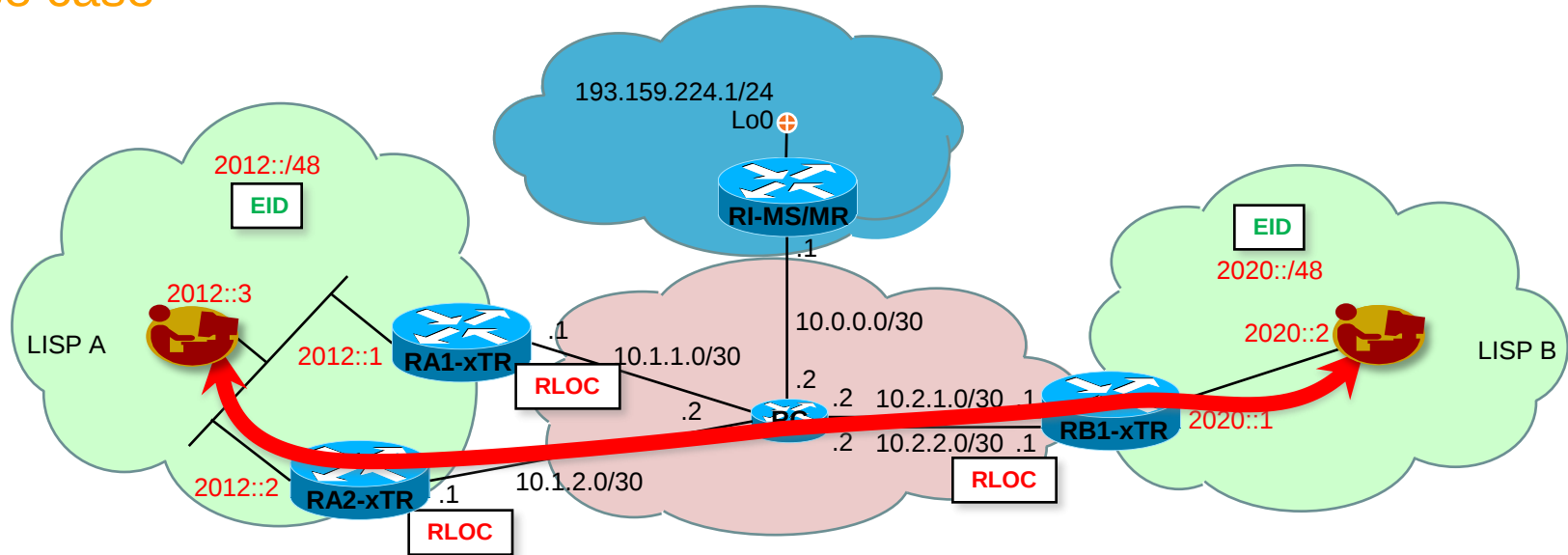
Facebook IPv6 Experience with LISP

http://nanog.org/meetings/nanog50/presentations/Tuesday/NANOG50.Talk9.lee_nanog50_atlanta_oct2012_007_publish.pdf



Scenario 3: IPv6 over IPv4

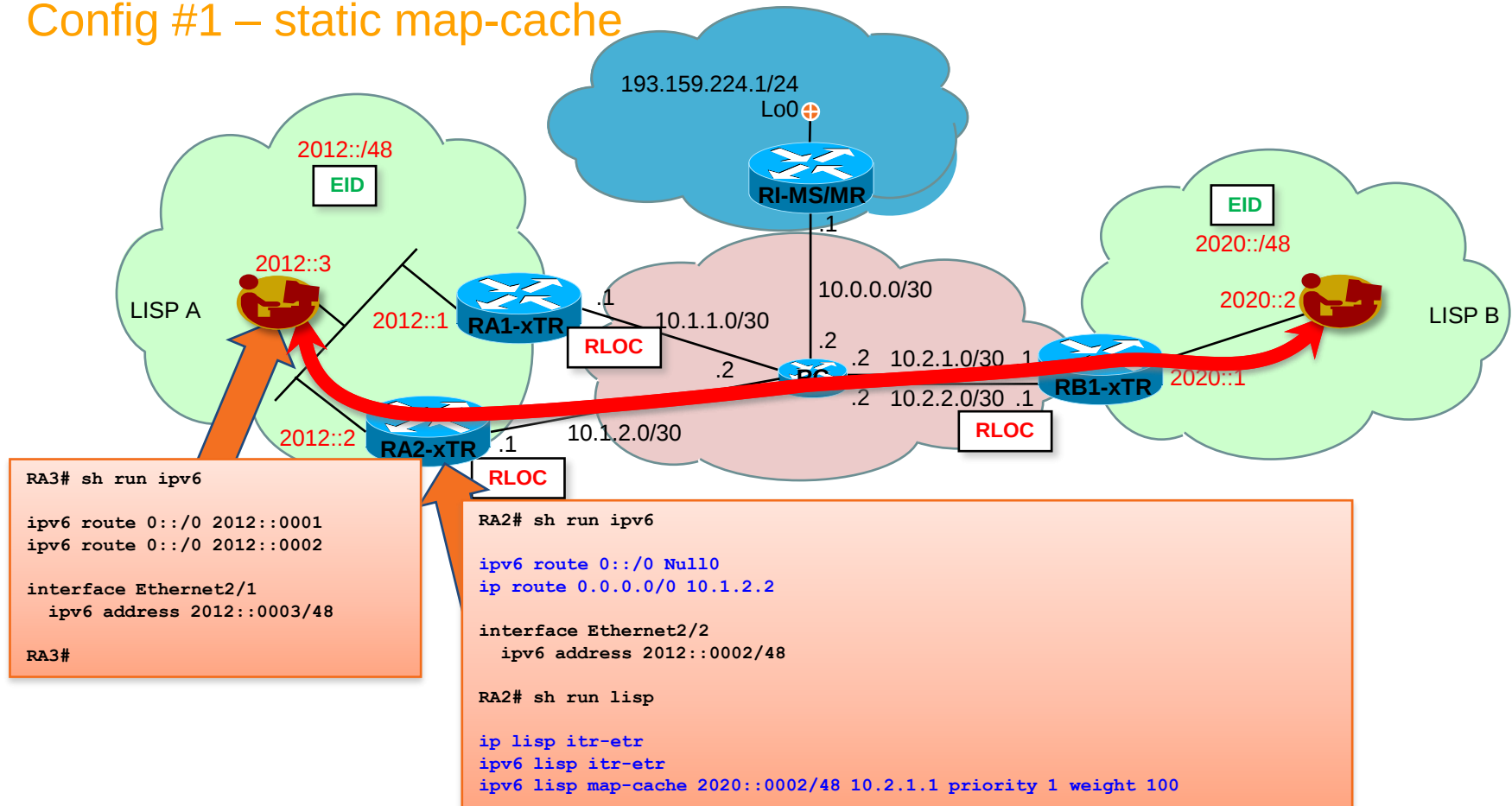
Use case



- Easy and scalable IPv6 connectivity over IPv4:
 - p2p w/ static mapping for single branch
 - p2mp w/ MS/MR dynamic config

Scenario 3: IPv6 over IPv4

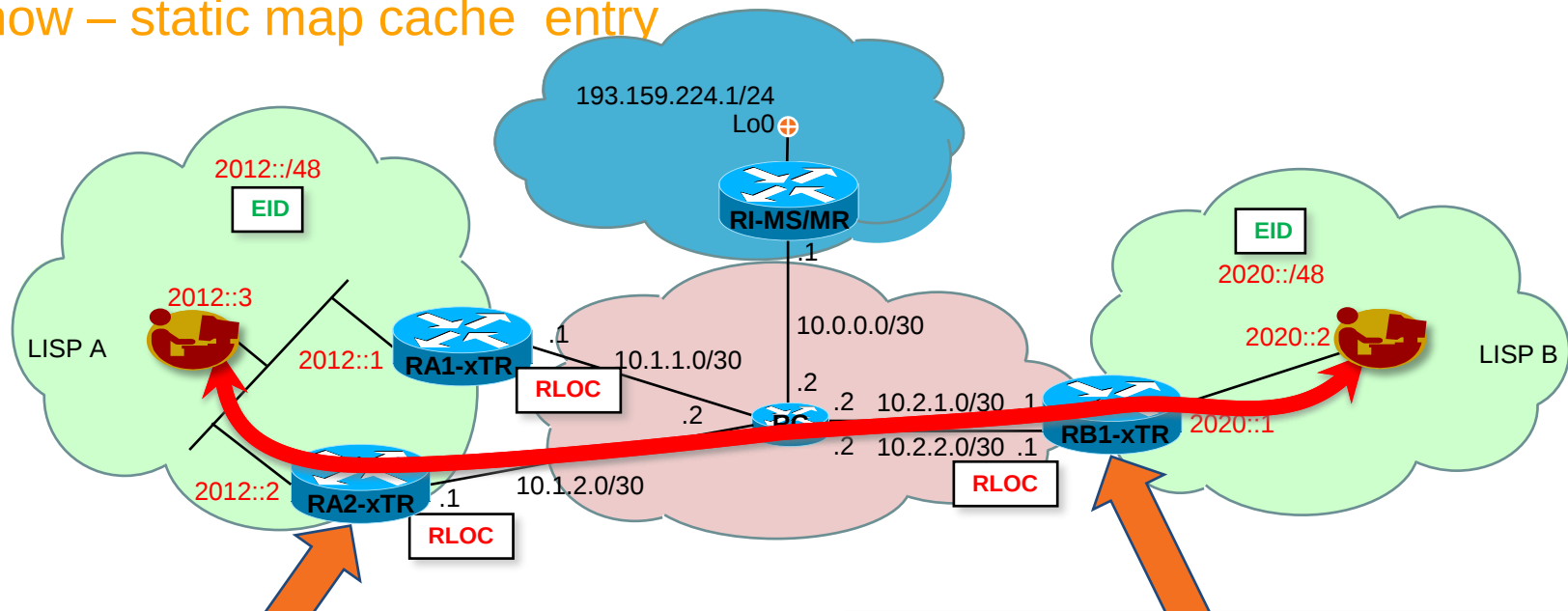
Config #1 – static map-cache



- No involvement of MS/MR

Scenario 3: IPv6 over IPv4

Show – static map cache entry



```

RA2# sh ipv6 lisp database
LISP ETR IPv6 Mapping Database for VRF "default" (iid 0),
global LSBs: 0x00000003

EID-prefix: 2012::3/48, instance-id: 0, LSBs: 0x00000003
Locator: 10.1.1.1, priority: 1, weight: 50
Uptime: 00:05:38, state: up
Locator: 10.1.2.1, priority: 1, weight: 50
Uptime: 00:05:38, state: up, local
RA2# sh ipv6 lisp map
LISP IPv6 Mapping Cache for VRF "default" (iid 0), 1 entries

2020::2/48, uptime: 00:05:53, expires: 0.000000, via static
Locator  Uptime  State      Priority/  Data      Control
Weight   in/out   in/out
10.2.1.1 00:05:53  up         1/100     0/0       0/0

RA2#
    
```

```

RB1# sh ipv6 lisp database
LISP ETR IPv6 Mapping Database for VRF "default" (iid 0),
global LSBs: 0x00000003

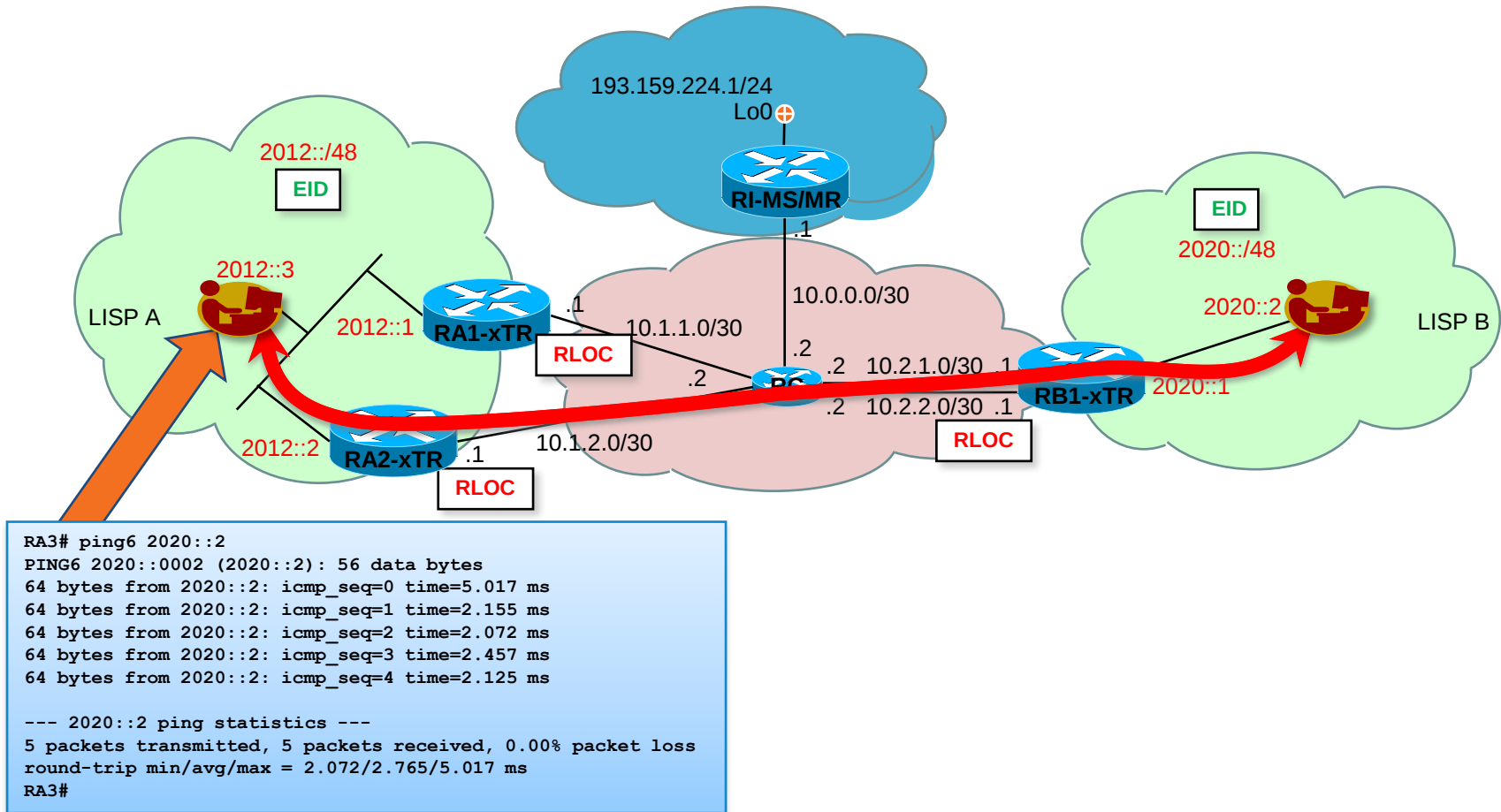
EID-prefix: 2020::2/48, instance-id: 0, LSBs: 0x00000003
Locator: 10.2.1.1, priority: 1, weight: 50
Uptime: 02:46:24, state: up, local
Locator: 10.2.2.1, priority: 1, weight: 50
Uptime: 02:46:24, state: up, local
RB1# sh ipv6 lisp map-cache
LISP IPv6 Mapping Cache for VRF "default" (iid 0), 1 entries

2012::3/48, uptime: 02:46:35, expires: 0.000000, via static
Locator  Uptime  State      Priority/  Data      Control
Weight   in/out   in/out
10.1.1.1 02:46:35  up         1/100     0/0       0/0

RB1#
    
```

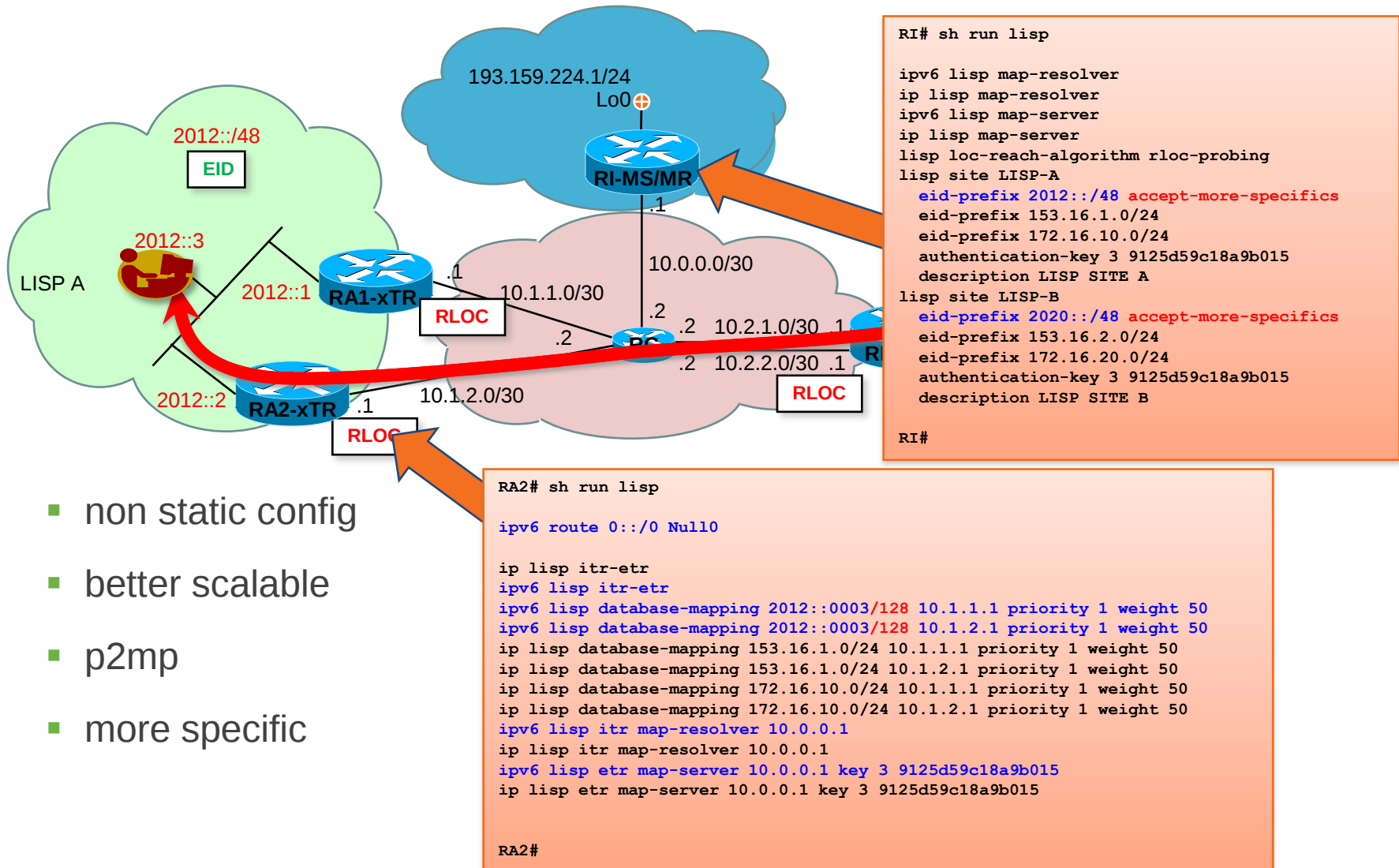
Scenario 3: IPv6 over IPv4

Static map cache entry & ping



Scenario 3: IPv6 over IPv4

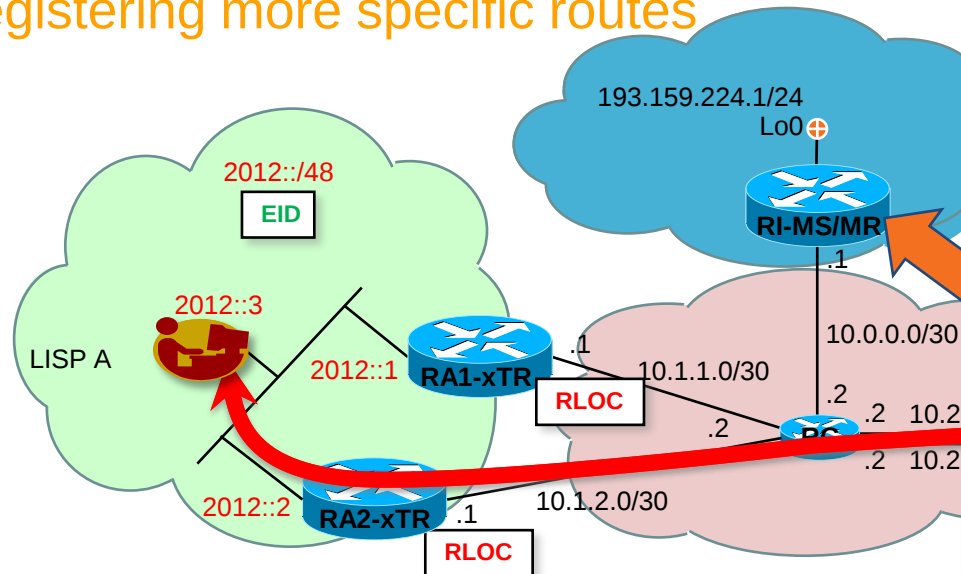
Scaling using MS/MR + accept more specific prefix



- non static config
- better scalable
- p2mp
- more specific

Scenario 3: IPv6 over IPv4

Registering more specific routes



```
RI# sh lisp site
LISP Site Registration Information for VRF "default"
* = truncated IPv6 address, -x = more-specifics count
```

Site Name	Last Registered	Actively Registered	Who last Registered	EID-prefix
LISP-A	00:00:54	yes	10.1.1.1	153.16.1.0/24
	00:00:54	yes	10.1.1.1	172.16.10.0/24
	03:50:27	no	10.1.1.1	2012::/48-1
LISP-B	00:00:45	yes	10.2.2.1	153.16.2.0/24
	00:00:45	yes	10.2.2.1	172.16.20.0/24
	03:50:41	no	10.2.2.1	2020::/48-1

RA2#

```
RI# sh lisp site LISP-A details
LISP Site Registration Information for VRF "default"
* = truncated IPv6 address, -x = more-specifics count
```

Site name: "LISP-A"
Description: LISP SITE A
Allowed configured locators: any

Configured EID-prefix: 2012::/48, instance-id: 0

More-specifics registered: 1
Currently registered: no
First registered: 23:03:21
Last registered: 06:12:13
Who last registered: 10.1.1.1
Routing table tag: 0x00000000
Proxy Replying: no
Wants Map-Notifications: no
Registered TTL: 1440 minutes
Registered locators: none
Registration errors:

Authentication failures: 0
Allowed locators mismatch: 0

More-specific EID-prefix: 2012::3/128, instance-id: 0

Currently registered: yes
First registered: 02:37:04
Last registered: 00:00:13
Who last registered: 10.1.1.1
Routing table tag: 0x00000000
Proxy Replying: no
Wants Map-Notifications: no
Registered TTL: 1440 minutes
Registered locators:
10.1.1.1 (up), priority: 1, weight: 50
10.1.2.1 (up), priority: 1, weight: 50

Registration errors:
Authentication failures: 0
Allowed locators mismatch: 0

RI#

Scenario 4: LISP L3 VPNs



LISP Virtualization – L3 VPNs

LISP Virtualization

- A technique to Virtualize EID and RLOC namespaces
- The LISP 24-bit Instance-ID is the mechanism to separate address spaces in the control and data planes

Instance-ID

- a 24-bit unstructured number
- Data-plane: in LISP encapsulation header
- Control-plane: EID encoded in LCAF format

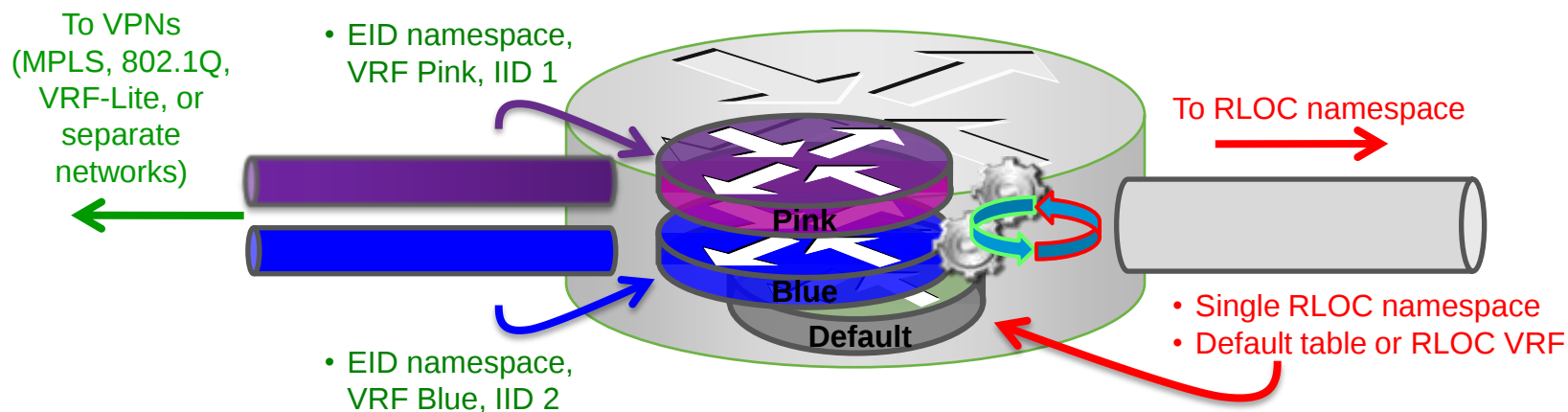
Benefits

- Very high scale tenant segmentation over Multi-provider core
- IP-based “overlay” solution, No Inter-AS complexity

LISP Use Cases

Efficient Virtualization/Multi-Tenancy – Shared Model

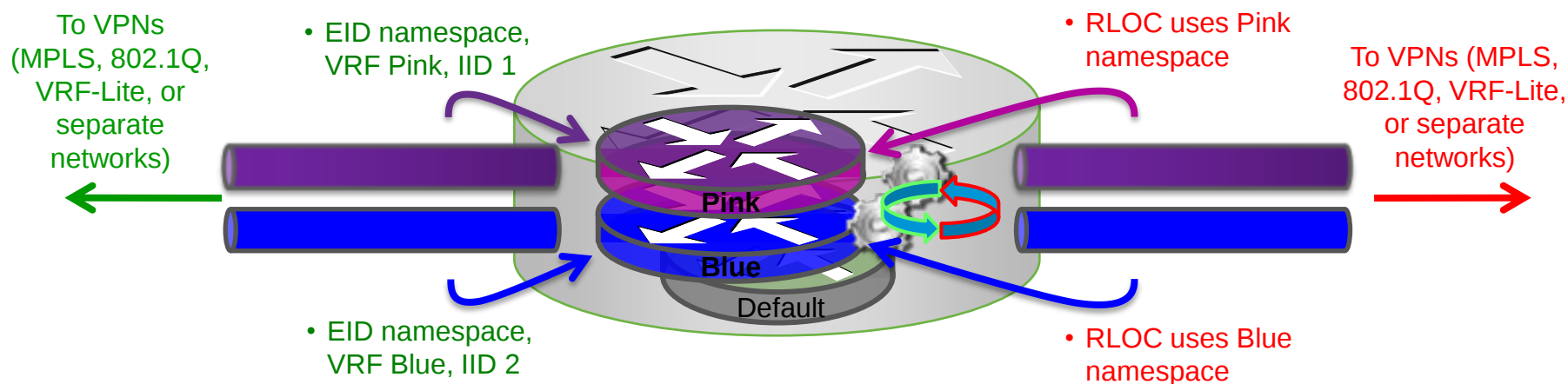
- Shared Model – at the device level
 - Multiple EID-prefixes are allocated privately using VRFs
 - EID lookups are in the VRF associated with an Instance-ID
 - All RLOC lookups are in a single table – default
 - The Mapping System is part of the locator address space and is shared



LISP Use Cases

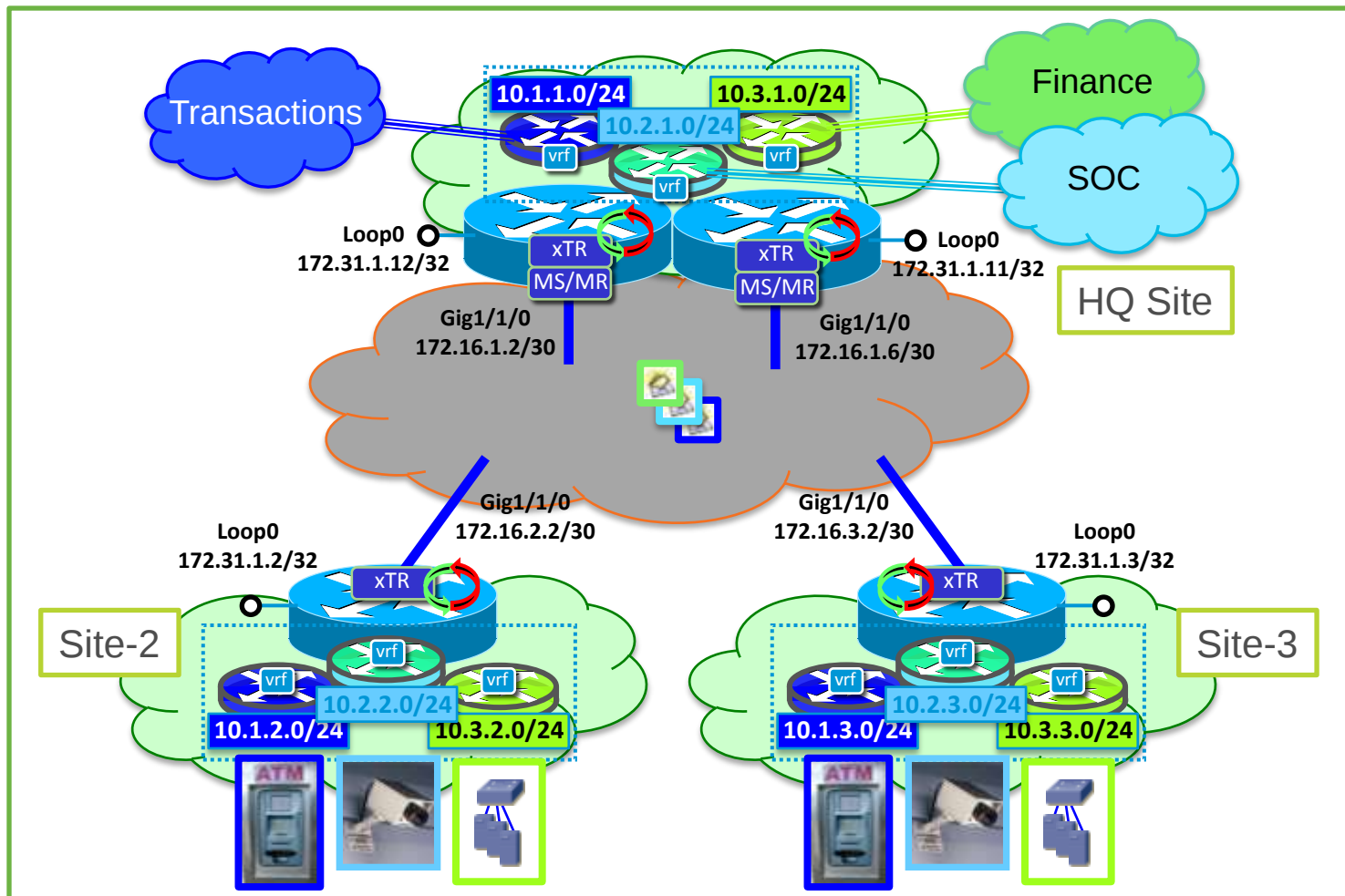
Efficient Virtualization/Multi-Tenancy – Parallel Model

- Parallel Model – at the device level
 - Multiple EID-prefixes are allocated privately using **VRFs**
 - EID lookups are in the **VRF** associated with an **Instance-ID**
 - RLOC lookups are in the **VRF** associated with the **locator table**
 - A Mapping System must be part of each locator address space



LISP Use Cases

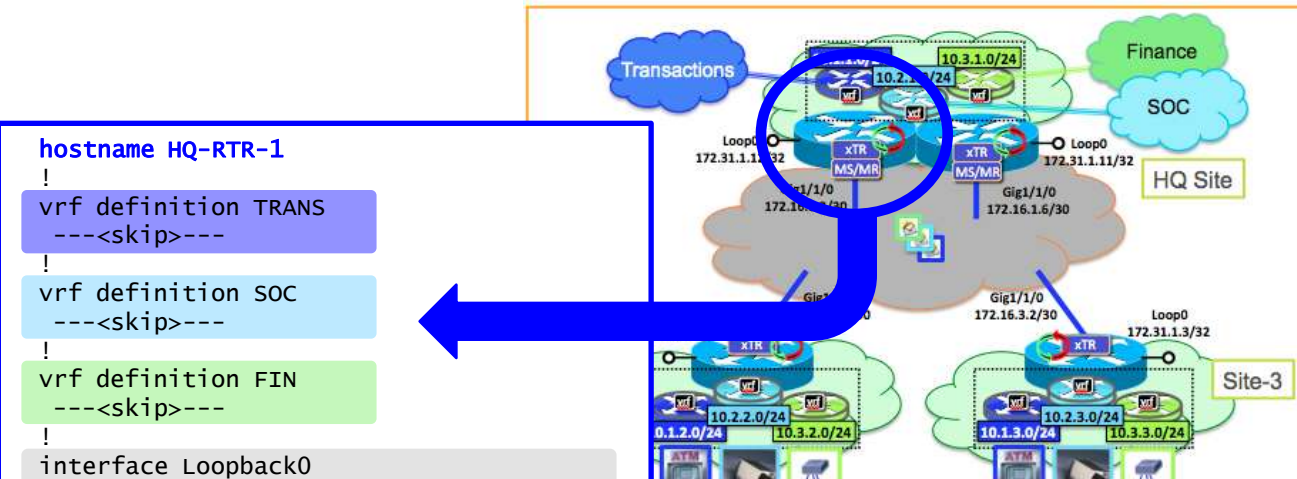
Efficient Virtualization – example/overview



LISP Use Cases

IOS/XE

Efficient Virtualization – example/configurations



Main Configs...
Combo xTR/MS/MR at Hub Site
-- this is the "xTR" part of the config

```
hostname HQ-RTR-1
```

```
!
vrf definition TRANS
---<skip>---
```

```
!
vrf definition SOC
---<skip>---
```

```
!
vrf definition FIN
---<skip>---
```

```
!
interface Loopback0
ip address 172.31.1.1 255.255.255.255
```

```
!
interface GigabitEthernet0/0/0
ip address 172.16.1.2 255.255.255.252
negotiation auto
```

```
!
interface GigabitEthernet0/0/1
vrf forwarding TRANS
ip address 10.1.1.1 255.255.255.0
negotiation auto
```

```
!
interface GigabitEthernet0/0/2
vrf forwarding SOC
ip address 10.2.1.1 255.255.255.0
negotiation auto
```

```
!
interface GigabitEthernet0/0/3
vrf forwarding FIN
ip address 10.3.1.1 255.255.255.0
negotiation auto
```

```
router lisp
```

```
eid-table default instance-id 0
database-mapping 172.31.1.1/32 172.16.1.2 priority 1 weight 50
database-mapping 172.31.1.1/32 172.16.1.6 priority 1 weight 50
exit
```

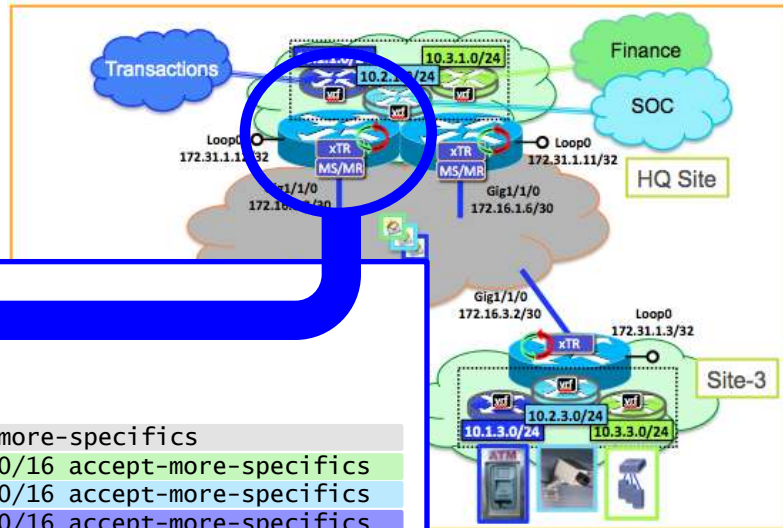
```
!
eid-table vrf TRANS instance-id 1
database-mapping 10.1.1.0/24 172.16.1.2 priority 1 weight 50
database-mapping 10.1.1.0/24 172.16.1.6 priority 1 weight 50
exit
```

```
!
eid-table vrf SOC instance-id 2
database-mapping 10.2.1.0/24 172.16.1.2 priority 1 weight 50
database-mapping 10.2.1.0/24 172.16.1.6 priority 1 weight 50
exit
```

```
!
eid-table vrf FIN instance-id 3
database-mapping 10.3.1.0/24 172.16.1.2 priority 1 weight 50
database-mapping 10.3.1.0/24 172.16.1.6 priority 1 weight 50
exit
```

LISP Use Cases

Efficient Virtualization – example/configurations



Main Configs...
Combo xTR/MS/MR at Hub Site
 -- this is the "MS" part of the config

```
router lisp
---<continued>---
!
site All-Sites
 authentication-key secret
 eid-prefix 172.31.1.0/24 accept-more-specifics
 eid-prefix instance-id 3 10.3.0.0/16 accept-more-specifics
 eid-prefix instance-id 2 10.2.0.0/16 accept-more-specifics
 eid-prefix instance-id 1 10.1.0.0/16 accept-more-specifics
 exit
!
ipv4 map-server
ipv4 map-resolver
ipv4 itr map-resolver 172.16.1.2
ipv4 itr map-resolver 172.16.1.6
ipv4 itr
ipv4 etr map-server 172.16.1.2 key S3CR3T
ipv4 etr map-server 172.16.1.6 key S3CR3T
ipv4 etr
 exit
!
ip route 0.0.0.0 0.0.0.0 172.16.1.1
```

NOTE: no IGP between sites!
Layer 3 reachability provided by LISP!

LISP Use Cases

IOS/XE

Efficient Virtualization – example/configurations

hostname SITE-2

vrf definition TRANS
---<skip>---

vrf definition SOC
---<skip>---

vrf definition FIN
---<skip>---

interface Loopback0
ip address 172.31.1.2 255.255.255.255

interface GigabitEthernet0/0/0
ip address 172.16.2.2 255.255.255.252
negotiation auto

interface GigabitEthernet0/0/1
vrf forwarding TRANS
ip address 10.1.2.1 255.255.255.0
negotiation auto

interface GigabitEthernet0/0/2
vrf forwarding SOC
ip address 10.2.2.1 255.255.255.0
negotiation auto

interface GigabitEthernet0/0/3
vrf forwarding FIN
ip address 10.3.2.1 255.255.255.0
negotiation auto

Spoke Configs...
-- this is the "xTR" part of the config

```
router lisp
eid-table default instance-id 0
  database-mapping 172.31.1.2/32 172.16.2.2 priority 1 weight 100
  exit
!
eid-table vrf TRANS instance-id 1
  database-mapping 10.1.2.0/24 172.16.1.2 priority 1 weight 100
  exit
!
eid-table vrf SOC instance-id 2
  database-mapping 10.2.2.0/24 172.16.1.2 priority 1 weight 100
  exit
!
eid-table vrf FIN instance-id 3
  database-mapping 10.3.2.0/24 172.16.1.2 priority 1 weight 100
  exit
!
ipv4 itr map-resolver 172.16.1.2
ipv4 itr map-resolver 172.16.1.6
ipv4 itr
ipv4 etr map-server 172.16.1.2 key S3CR3T
ipv4 etr map-server 172.16.1.6 key S3CR3T
ipv4 etr
exit
!
ip route 0.0.0.0 0.0.0.0 172.16.2.1
```

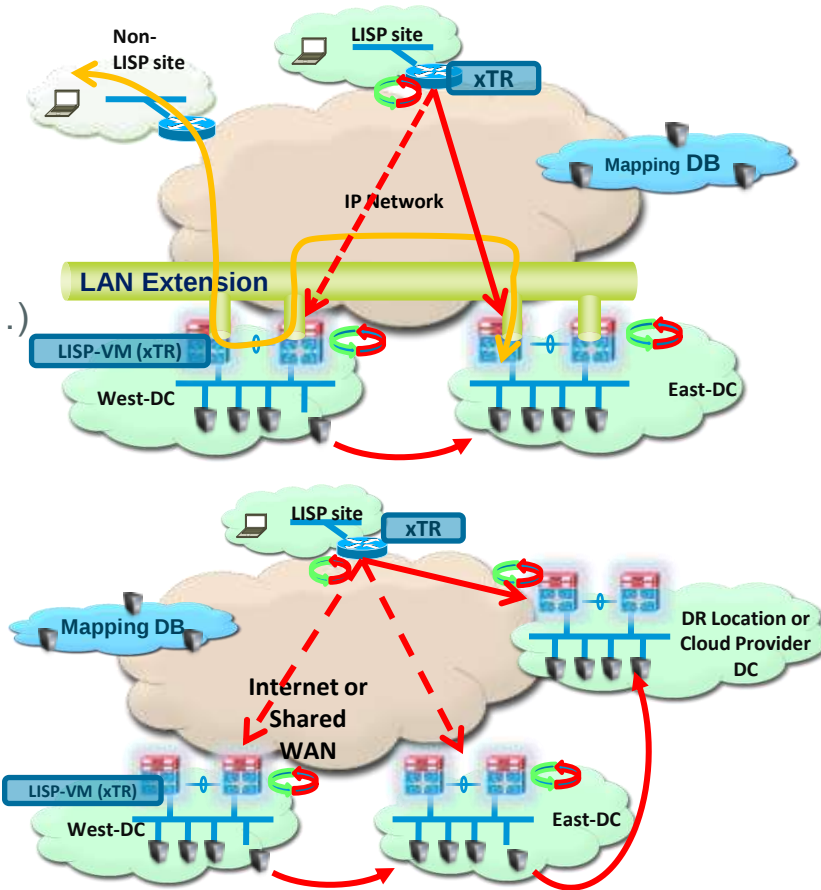
Scenario 4: LISP VM Mobility



LISP VM Mobility

LISP relevance to DCI, DR and Cloud

- Routing for extended subnets – ESM
ingress path optimization
needs L2 transport between DC (L1, A-VPLS, OTV, ...)
DCI for VM mobility
- IP mobility across subnets – ASM
cross IP mobility (foreign subnet)
disaster recovery, cross-organizational
moving nodes and networks

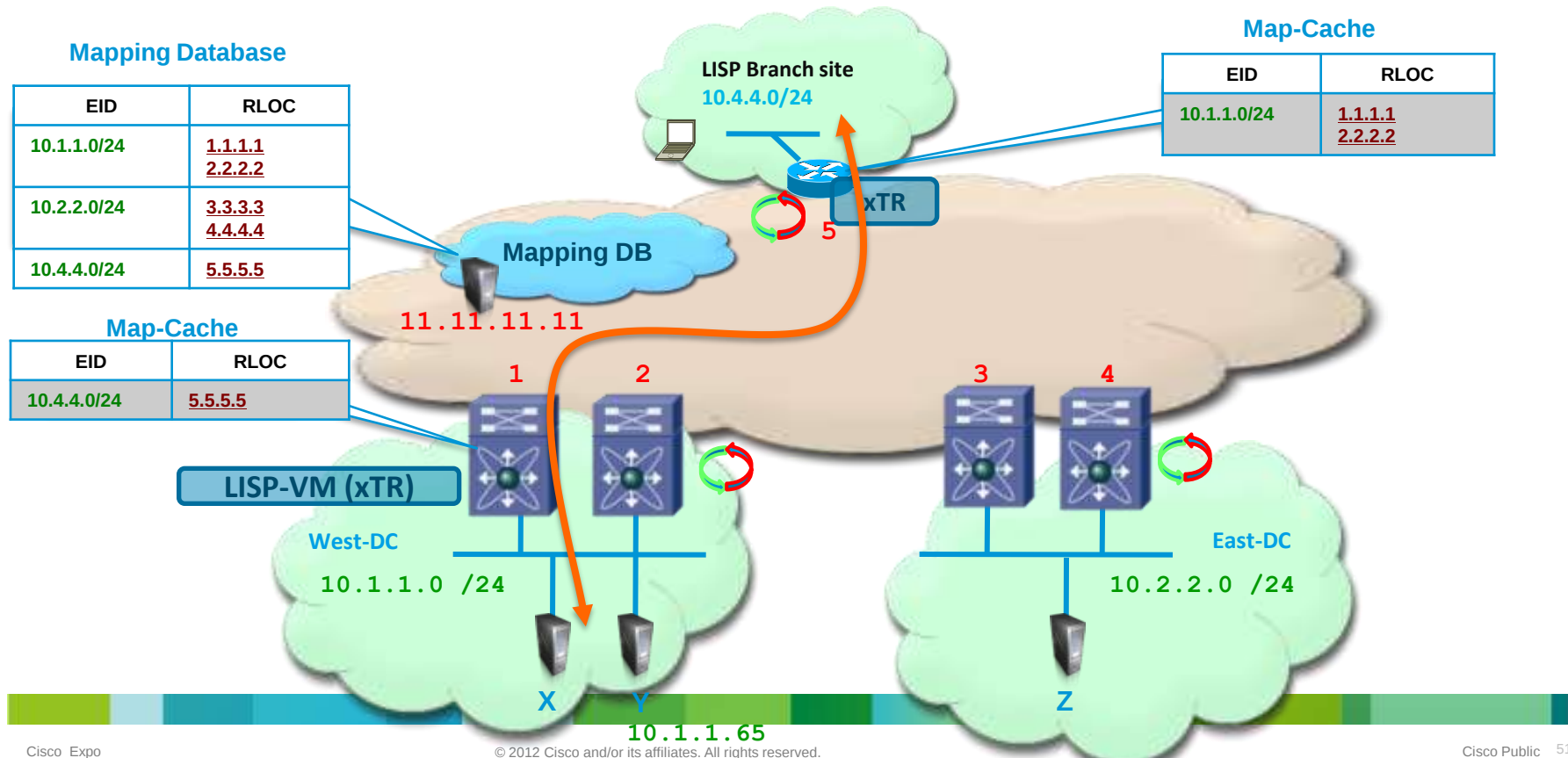


IPv4 and/or IPv6
Transparent to hosts

Incrementally deployable
Scalable (Internet)

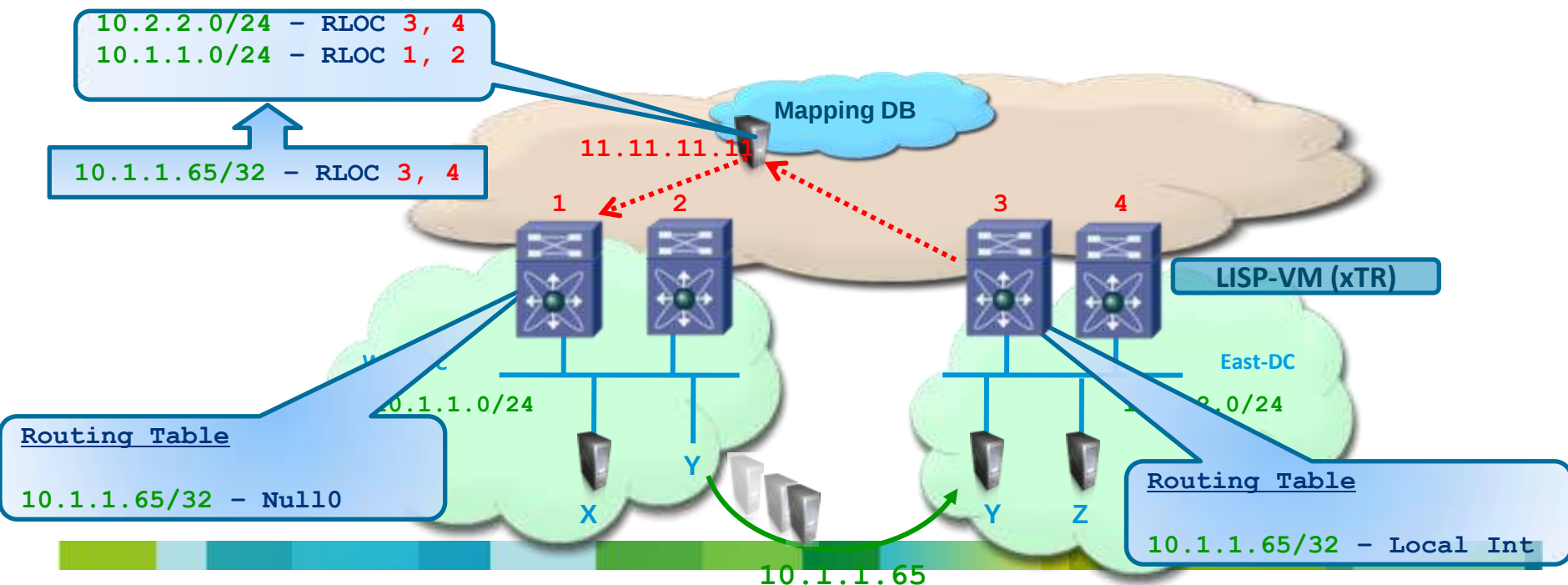
Initial State (Across Subnet) Before move

- Regular LISP static mappings registered with MS
- ITRs Map-Cache updated for any LISP Site-to-Site Traffic
- All local routes follows traditional routing



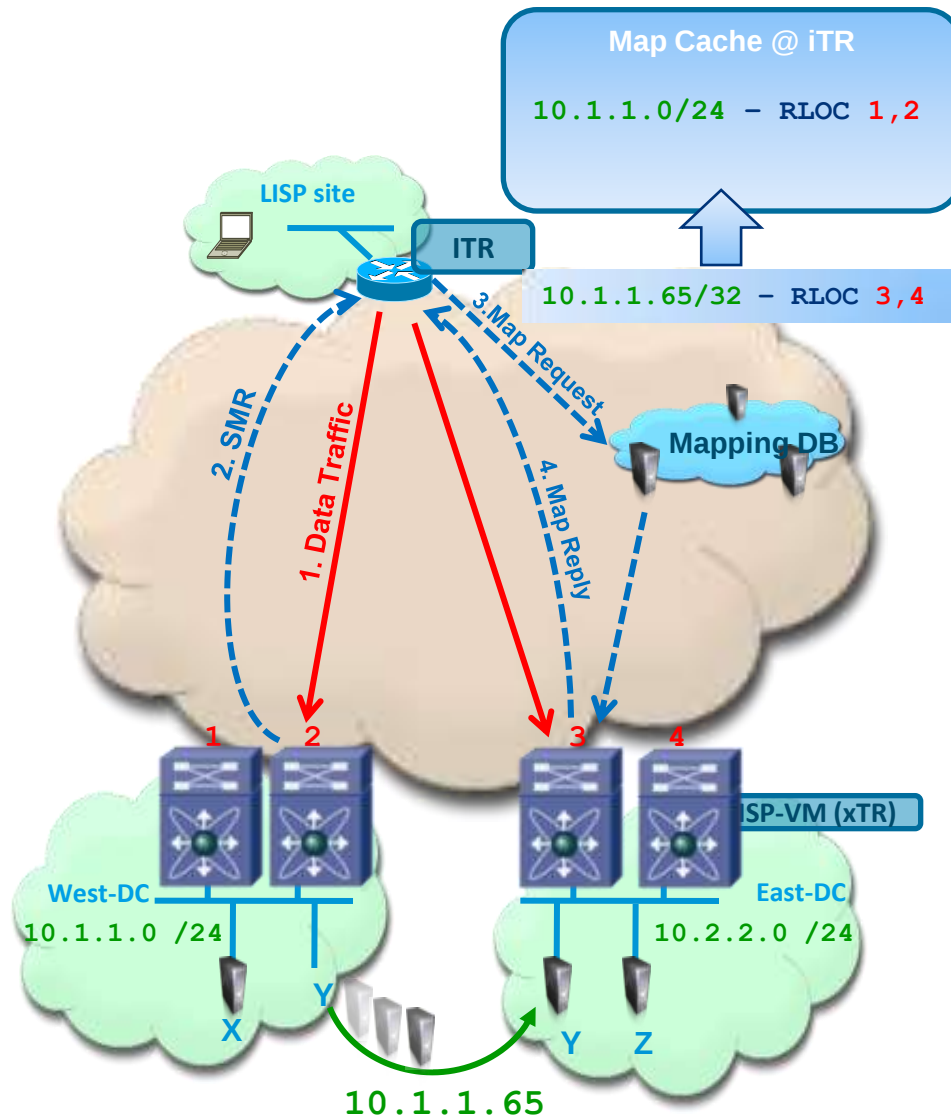
Dyn-EID Move Detection and Map registration

- Dyn-EID Host traffic fails uRPF check and matches the Dynamic-EID range
- An interface host route (/32) is installed at the new xTR
- The New eTR registers the roaming host as a /32 with MS
- MS Notify the site of origin of the move
- The old xTR installs a Null0 route for the moved host



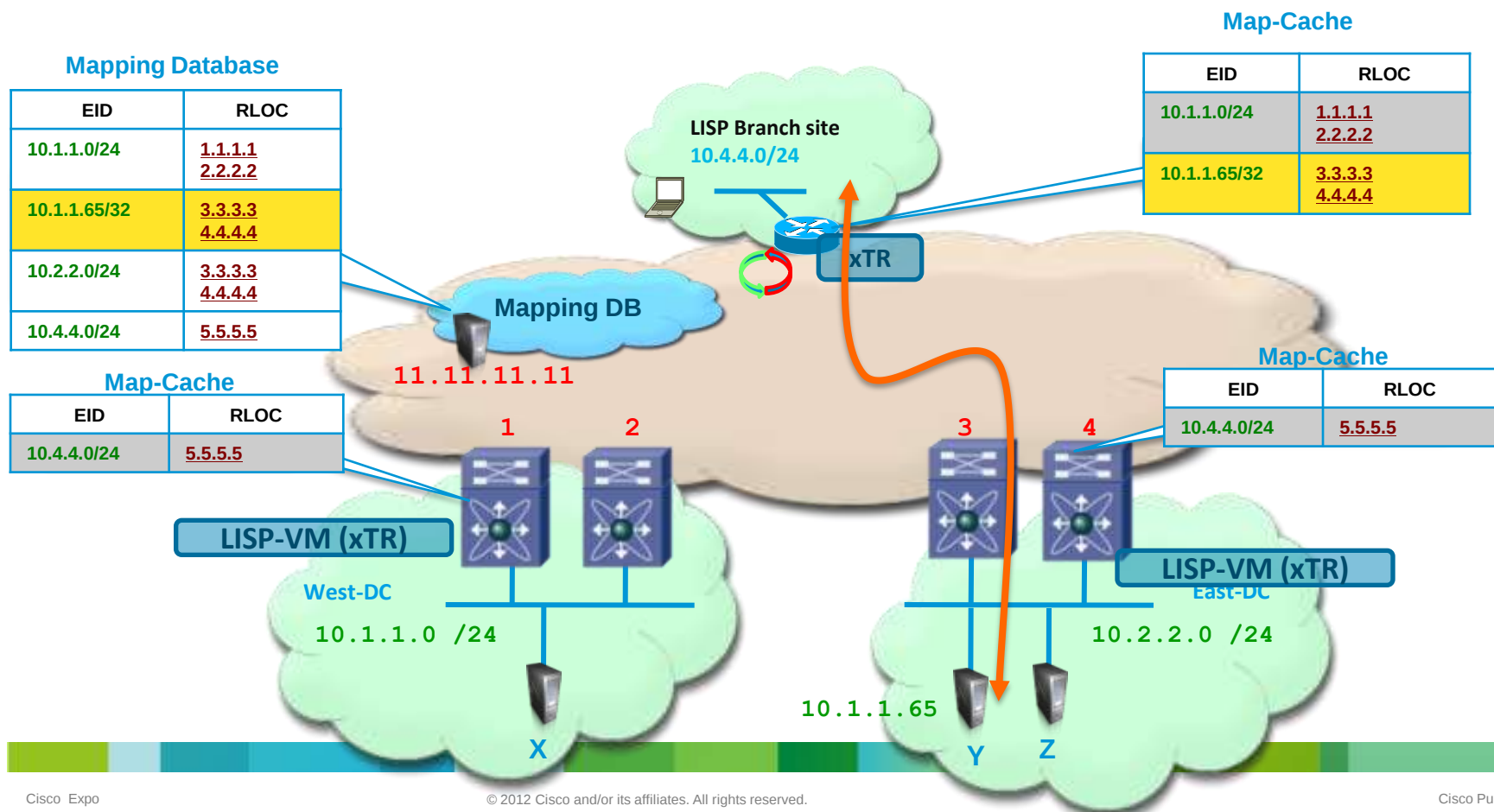
Map Cache Refresh

1. LISP Sites with old cache continue to send traffic to the old locators
 1. The old xTR knows the host is away moved (Null0 route).
2. Old xTR sends Solicit Map Request (SMR)
3. The ITR initiates a new map request
4. The ITR Map Cache is updated
5. Traffic is now re-directed



Final State (Across Subnet) After move

- iTRs Map-Cache are updated for any LISP Site-to-Site Traffic using Data Driven SMR
- Traffic is re-directed to Dyn-EID new location



LISP VM-Mobility Configuration

Across Subnet



```
ip lisp itr-etr
ip lisp database-mapping 10.1.1.0/24 1.1.1.1
ip lisp database-mapping 10.1.1.0/24 2.2.2.2
ip lisp itr map-resolver 11.11.11.11
ip lisp etr map-server 11.11.11.11 key abcd
```

```
lisp dynamic-eid LISP_ACROSS_SUBNET
  database-mapping 10.1.1.0/24 1.1.1.1
  database-mapping 10.1.1.0/24 2.2.2.2
map-notify-group 239.1.1.11
interface vlan 907
  ip address 10.1.1.2 /24
lisp mobility LISP_ACROSS_SUBNET
ip proxy-arp
hsrp 17
  mac-address 0000.0e1d.010c
  ip 10.1.1.1
```

```
ip lisp itr-etr
ip lisp database-mapping 10.2.2.0/24 3.3.3.3
ip lisp database-mapping 10.2.2.0/24 4.4.4.4
ip lisp itr map-resolver 11.11.11.11
ip lisp etr map-server 11.11.11.11 key abcd
```

```
lisp dynamic-eid LISP_ACROSS_SUBNET
  database-mapping 10.1.1.0/24 3.3.3.3
  database-mapping 10.1.1.0/24 4.4.4.4
map-notify-group 239.1.1.12
interface vlan 908
  ip address 10.2.2.2 /24
lisp mobility LISP_ACROSS_SUBNET
ip proxy-arp
hsrp 102
  mac-address 0000.0e1d.010c
  ip 10.2.2.1
```

LISP-VM (xTR)

West-DC

IP-Adr.: 10.1.1.23
Default-GW: 10.1.1.1

10.1.0.0 /16

X

Mapping DB

```
ip lisp map-resolver
ip lisp map-server
```

```
lisp site BRANCH
  eid-prefix 193.159.224.0/24
  authentication-key abcd
lisp site DATA_CENTER
  eid-prefix 10.1.1.0/24 accept-more-specifics
  eid-prefix 10.2.2.0/24
  authentication-key abcd
```

LISP VM Mobility Demo



LISP – VM-Mobility demo

non-LISP to mobile-vm@odd-xTR

You Are Here

Non-LISP

193.162.145.46

212.114.159.212/30

195.50.116.11

212.114.208.86/31

212.114.208.80/31

212.114.208.94/31

212.114.208.92/31

RLOC

212.114.204.219/32

VLAN 153

153.16.41.0/24

LISP Site odd

EID: 153.16.41.0/24

Dyn-EID: 153.16.39.111/32

Dyn-EID (D)

153.16.39.111/32
eth0

ESX-odd
vmware
vSphere

traceroute -I -m 50 212.114.204.219 [RLOC]

[...]

```
12 ge-7-2-0.xt2.ams2.alter.net (212.136.176.41) 25.327 ms 25.718 ms 25.673 ms
13 pos2-0.br1.ams3.alter.net (146.188.3.218) 25.356 ms 25.458 ms 29.321 ms
14 ams-e3-i.ams.nl.net.dtag.de (146.188.57.94) 32.290 ms 28.682 ms 30.097 ms
15 217.239.41.46 (217.239.41.46) 144.650 ms 47.514 ms 62.010 ms
16 80.156.161.54 (80.156.161.54) 43.351 ms 145.472 ms 45.128 ms
17 gi1-5.r2.nue2.m-online.net (212.18.6.82) 47.179 ms 48.345 ms 50.483 ms
18 f1cons-m08-0002-f1.flv4.net (212.114.159.214) 46.334 ms 46.225 ms 64.681 ms
19 212.114.208.81 (212.114.208.81) 53.807 ms 56.459 ms 47.499 ms
20 lisp-odd.toocoolforyou.net (212.114.204.219) 46.549 ms 163.128 ms 64.873 ms
```

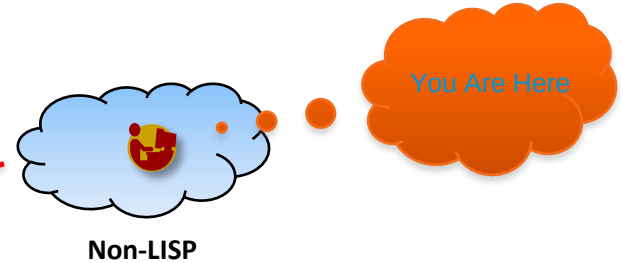
traceroute -I -m 50 153.16.39.111 [dyn-EID]

[...]

```
4 t2a4-s4-1-1.de-mun.eu.bt.net (166.49.193.193) 18.602 ms 2.458 ms 2.942 ms
5 t2c2-ge7-0.de-mun.eu.bt.net (166.49.174.172) 2.183 ms 2.293 ms 2.224 ms
6 t2c1-p2-0.de-fra.eu.bt.net (166.49.195.130) 8.314 ms 8.586 ms 12.552 ms
7 t2a7-ge7-0-0.de-fra.eu.bt.net (166.49.172.33) 8.566 ms 8.246 ms 9.264 ms
8 xe-2-3-0.ffm2nqp1.de.ip.tdc.net (80.81.192.16) 9.444 ms 10.077 ms 11.227 ms
9 ge3-0-0.sltncx98.dk.ip.tdc.net (83.88.31.154) 35.201 ms 34.906 ms 35.143 ms
10 tdc-pxtr.rloc.lisp4.net (193.162.145.46) 35.191 ms 35.259 ms 35.001 ms
11 ge5-2.sltncx98.dk.ip.tdc.net (193.162.145.45) 35.014 ms 35.770 ms 35.730 ms
12 kbn-b1.telia.net (195.215.109.2) 49.378 ms 45.624 ms 40.604 ms
13 kbn-bb1-link.telia.net (80.91.253.236) 40.543 ms 42.734 ms 42.058 ms
14 hbg-bb1-link.telia.net (80.91.247.224) 53.298 ms 52.271 ms 67.155 ms
15 ffm-bb1-link.telia.net (80.91.245.40) 51.670 ms 137.006 ms 52.937 ms
16 ffm-b6-link.telia.net (80.91.249.82) 62.057 ms 52.997 ms 52.926 ms
17 mnet-112649-ffm-b6.c.telia.net (213.248.96.218) 62.777 ms 64.466 ms 95.579 ms
18 f1cons-m08-0002-f1.flv4.net (212.114.159.214) 80.372 ms 67.179 ms 142.284 ms
19 212.114.208.81 (212.114.208.81) 67.350 ms 67.713 ms 73.694 ms
20 212.114.208.92 (212.114.208.92) 67.350 ms 67.713 ms 73.694 ms
21 wolfgang-mobile-vm.lisp4.net (153.16.39.111)
```

LISP – VM-Mobility demo

non-LISP to mobile-vm@even-xTR



PXTR
193.162.145.46

```
traceroute -I -m 50 212.114.204.220 [RLOC]
```

```
[...]  
12 ge-7-2-0.xt1.ams2.alter.net (212.136.176.37) 25.618 ms 25.018 ms 34.654 ms  
13 pos1-0.br1.ams3.alter.net (146.188.3.214) 36.857 ms 25.559 ms 25.684 ms  
14 ams-e3-i.ams.nl.net.dtag.de (146.188.57.94) 26.306 ms 25.652 ms 31.245 ms  
15 217.239.41.46 (217.239.41.46) 43.972 ms  
    217.239.41.98 (217.239.41.98) 63.857 ms 44.167 ms  
16 80.156.161.54 (80.156.161.54) 43.608 ms 49.099 ms 60.087 ms  
17 gi1-5-r2.nue2.m-online.net (212.18.6.82) 42.418 ms 42.672 ms 43.056 ms  
18 flcons-m08-0001-f1.f1v4.net (212.114.159.210) 45.626 ms 56.999 ms 45.308 ms  
19 212.114.208.85 (212.114.208.85) 46.634 ms 48.140 ms 57.659 ms  
20 lisp-even.toocoolforyou.net (212.114.204.220) 46.529 ms 46.424 ms 45.899 ms
```

```
traceroute -I -m 50 153.16.39.111 [dyn-EID]
```

```
[...]  
4 t2a4-s4-1-1.de-mun.eu.bt.net (166.49.193.193) 18.602 ms 2.458 ms 2.942 ms  
5 t2c2-ge7-0.de-mun.eu.bt.net (166.49.174.172) 2.183 ms 2.293 ms 2.224 ms  
6 t2c1-p2-0.de-fra.eu.bt.net (166.49.195.130) 8.314 ms 8.586 ms 12.552 ms  
7 t2a7-ge7-0-0.de-fra.eu.bt.net (166.49.172.33) 8.566 ms 8.246 ms 9.264 ms  
8 xe-2-3-0 ffm2nqp1.de.ip.tdc.net (80.81.192.16) 9.444 ms 10.077 ms 11.227 ms  
9 ge3-0-0.sltncx98.dk.ip.tdc.net (83.88.31.154) 35.201 ms 34.906 ms 35.143 ms  
10 tdc-pxtr.rloc.lisp4.net (193.162.145.46) 35.191 ms 35.259 ms 35.001 ms  
11 ge5-2.sltncx98.dk.ip.tdc.net (193.162.145.45) 35.014 ms 35.770 ms 35.730 ms  
12 kbn-b1.telia.net (195.215.109.2) 49.378 ms 45.624 ms 40.604 ms  
13 kbn-bb1-link.telia.net (80.91.253.236) 40.543 ms 42.734 ms 42.058 ms  
14 hbg-bb1-link.telia.net (80.91.247.224) 53.298 ms 52.271 ms 67.155 ms  
15 ffm-bb1-link.telia.net (80.91.245.40) 51.670 ms 137.006 ms 52.937 ms  
16 ffm-b6-link.telia.net (80.91.249.82) 62.057 ms 52.997 ms 52.926 ms  
17 mnet-112649-ffm-b6.c.telia.net (213.248.96.218) 62.777 ms 64.466 ms 95.579 ms  
19 flcons-m08-0001-f1.f1v4.net (212.114.159.210) 46.900 ms 50.607 ms 46.989 ms  
20 212.114.208.85 (212.114.208.85) 56.471 ms 46.721 ms 52.626 ms  
20 212.114.208.88 (212.114.208.88) 56.471 ms 46.721 ms 52.626 ms  
21 wolfgang-mobile-vm.lisp4.net (153.16.39.111)
```

MR - MS
50.116.18/32

212.114.159.208/30

212.114.208.82/31

212.114.208.84/31

212.114.208.90/31

212.114.208.88/31

even-xTR
RLOC
212.114.204.220/32

VLAN 153
153.16.42.0/24

ESX-even
vmware
vSphere

LISP Site even
EID: 153.16.42.0/24
Dyn-EID: 153.16.39.111/32

LISP Status and Summary



LISP is here now!

- With real implementation experience!
- With real deployment experience!
- With real customer engagement!
- <http://www.lisp4.net> & <http://www.lisp6.net>
- <http://lisp.cisco.com>
- lisp-support@cisco.com

LISP Status

Available Releases

■ Cisco Releases

Cisco LISP Releases: <http://lisp.cisco.com>

- IOS since December 2009... ISR, ISRG2, 7200
- IOS-XE since March 2010... ASR1K
- NX-OS since December 2009... Nexus 7000, UCS C200
- Coming soon... Catalyst 6500, ASR9K, CRS-3, and others...

■ Other LISP Releases

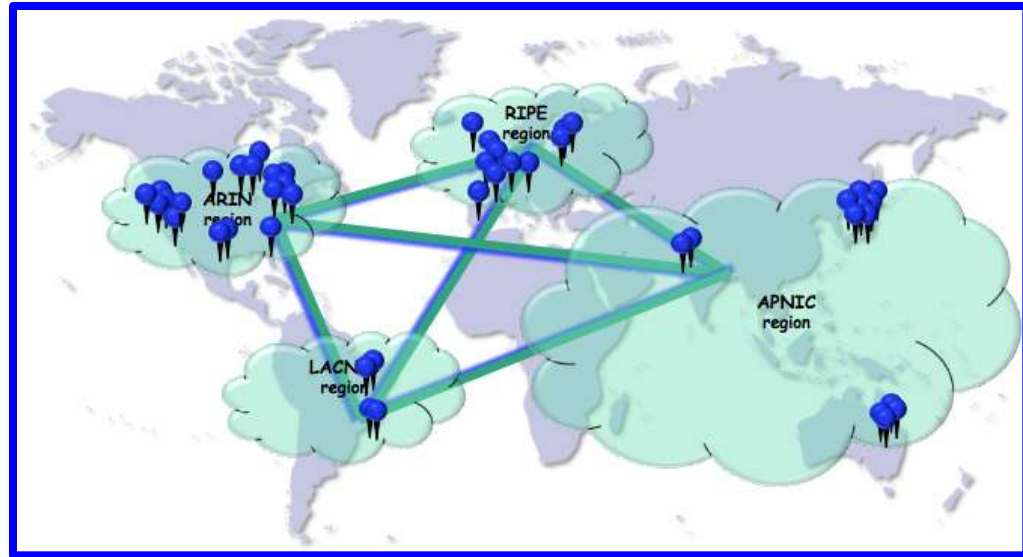
Other LISP Releases: <http://www.lisp4.net>
<http://www.lisp6.net>

- Furukawa Network Solutions Corp
- FreeBSD
 - OpenLISP
- Linux
 - Aless
 - LISPMob
 - OpenWrt (coming soon...)
- Android
 - Gingerbread (coming soon...)
- Other vendors... Check back!!

LISP Status

LISP Deployments - International LISP Beta Network

- LISP Community Operated
 - > 4 years operational
 - > 140+ sites, 26 countries
- Nine LISP implementations deployed today
 - Cisco: IOS, IOS-XE, NX-OS
 - Furukawa Network Solution Corporation FITElnet-G21
 - FreeBSD: OpenLISP
 - Linux: OpenWrt, Aless, LISPmob
 - Android (Gingerbread)
 - Plus a few others... ;-)



<http://lisp.cisco.com>



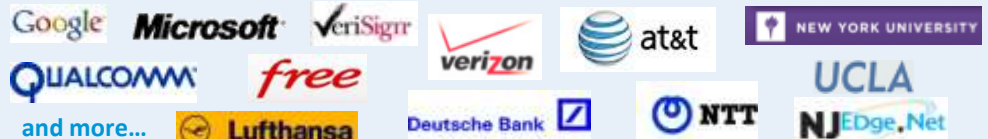
<http://www.lisp.intouch.eu/>

facebook

<http://www.lisp6.facebook.com>



<http://lisp.isarnet.net/>



LISP Status

LISP Standardization Effort Status

Draft	Next Steps/Target
LISP base protocol (draft-ietf-lisp-19)	IESG Evaluation...
LISP+ALT (draft-ietf-lisp-alt-10)	IESG Evaluation...
LISP Map Server (draft-ietf-lisp-ms-14)	IESG Evaluation...
LISP Interworking (draft-ietf-lisp-interworking-02)	AD Evaluation...
LISP Map Versioning (draft-ietf-lisp-map-versioning-06)	IESG Evaluation...
LISP Multicast (draft-ietf-lisp-multicast-12)	IESG Evaluation...
LISP Internet Groper (draft-ietf-lisp-lig-06)	RFC Ed Queue...
LISP Mobile Node (draft-meyer-lisp-mn-06)	Proposed for WG adoption (3 prototypes available)
LISP Canonical Address Format (draft-farinacci-lisp-lcaf-06)	Proposed for WG adoption
LISP MIB (draft-ietf-lisp-mib-03)	Active...
LISP Deployment (draft-ietf-lisp-deployment-02)	Active...
LISP SEC (draft-ietf-lisp-sec-01)	Active...
LISP Threats (draft-ietf-lisp-threats-00)	Active...
LISP EID Block (draft-ietf-lisp-eid-block-01)	Active...

IETF LISP WG: <http://tools.ietf.org/wg/lisp/>

LISP References

LISP Information

- IANA Address Family Numbers
<http://www.iana.org/assignments/address-family-numbers/address-family-numbers.xml>
- LISP Canonical Address Format (LCAF) – <http://tools.ietf.org/wg/lisp/>
- IETF LISP Working Group – <http://tools.ietf.org/wg/lisp/>
- LISP Beta Network – <http://www.lisp4.net> and <http://www.lisp6.net>
- Cisco LISP Site – <http://lisp.cisco.com> (IPv4 and IPv6)
- Cisco LISP Marketing – <http://www.cisco.com/go/lisp>

Mailing Lists

- IETF LISP WG – lisp@ietf.org
- LISP Interest (public) – lisp-interest@puck.nether.net
- Cisco LISP Questions – lisp-support@cisco.com



Thank you.

