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LISP in Campus Networks

BRKCRS-3510

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Abstract

Session ID
BRKCRS-3510

Title
LISP in Campus Networks

Abstract
This session introduces LISP (Locator/ID Separation Protocol) on the Catalyst 6500/6800. LISP is a routing architecture designed to enhance route scalability and efficient IP addressing in a network. The session will go over some of the use-cases of Layer 3 LISP in campus networks, and how LISP can be used to provide efficient multi-tenancy and seamless IPv6 transition. This session will provide an overall understanding of the benefits and applications of LISP in the campus, and how the technology is implemented on the Catalyst 6500/6800 platform with Supervisor 2T. Details of data-plane forwarding and control-plane operation of LISP will be covered, along with packet-walks. The configuration aspects of LISP on IOS will also be addressed in this session.

Agenda

- Introduction to LISP (Locator/ID Separation Protocol)
- LISP Deployments in Campus Networks
  - Multihoming
  - IPv6 Transition
  - Multi-tenancy and Virtualisation
- LISP Implementation on Catalyst 6K
  - Hardware and Software support
  - Packet Forwarding
  - Configuration guidelines
  - Interoperability with other features
- LISP Examples and Summary

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Next Generation Campus Architecture Requirements

Motivation for a New Routing Architecture

Meet New Requirements

Optimal Routing	Flexible IP addressing	Ease of Manageability	Address Family Independent
How do I better aggregate the routes in my network?	How do I assign IP addresses independent of topology or location?	How can I easily migrate subnets and scale my network?	How can I employ flexibility in end host addressing?

Campus Architecture

Preserve Underlying Architecture

Preserve core routing protocols	No changes to end hosts	Retain L2/L3 boundaries	Use the same infrastructure and protocols for IPv4 and IPv6

Next Generation Campus Architecture Requirements

Motivation for a New Routing Architecture

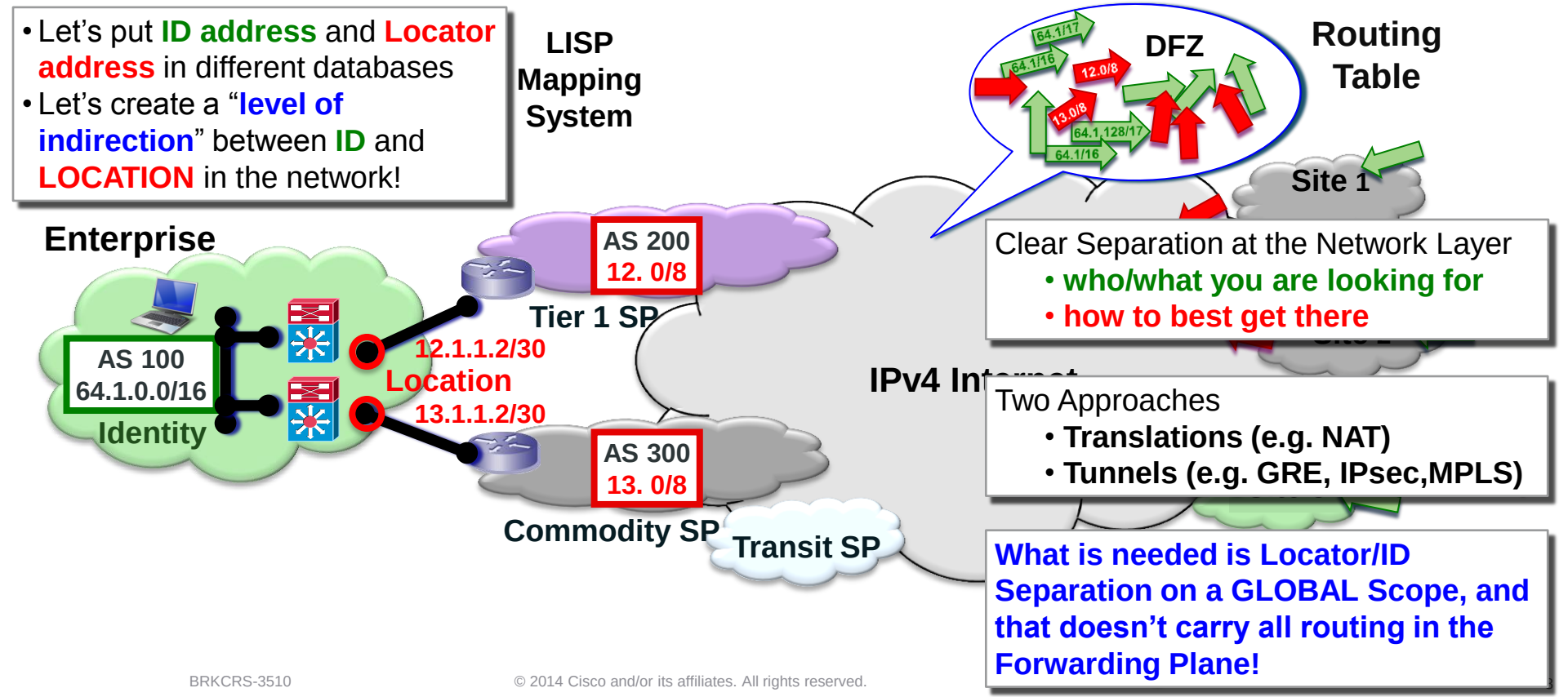
The key lies in Locator/ID Separation

A routing protocol that separates
routable IP addresses of networking devices
from endpoint IP addresses of hosts

Concept of Locator / ID Separation

Address Translation Mechanisms

- Let's put **ID address** and **Locator address** in different databases
- Let's create a "**level of indirection**" between **ID** and **LOCATION** in the network!



Clear Separation at the Network Layer

- **who/what you are looking for**
- **how to best get there**

Two Approaches

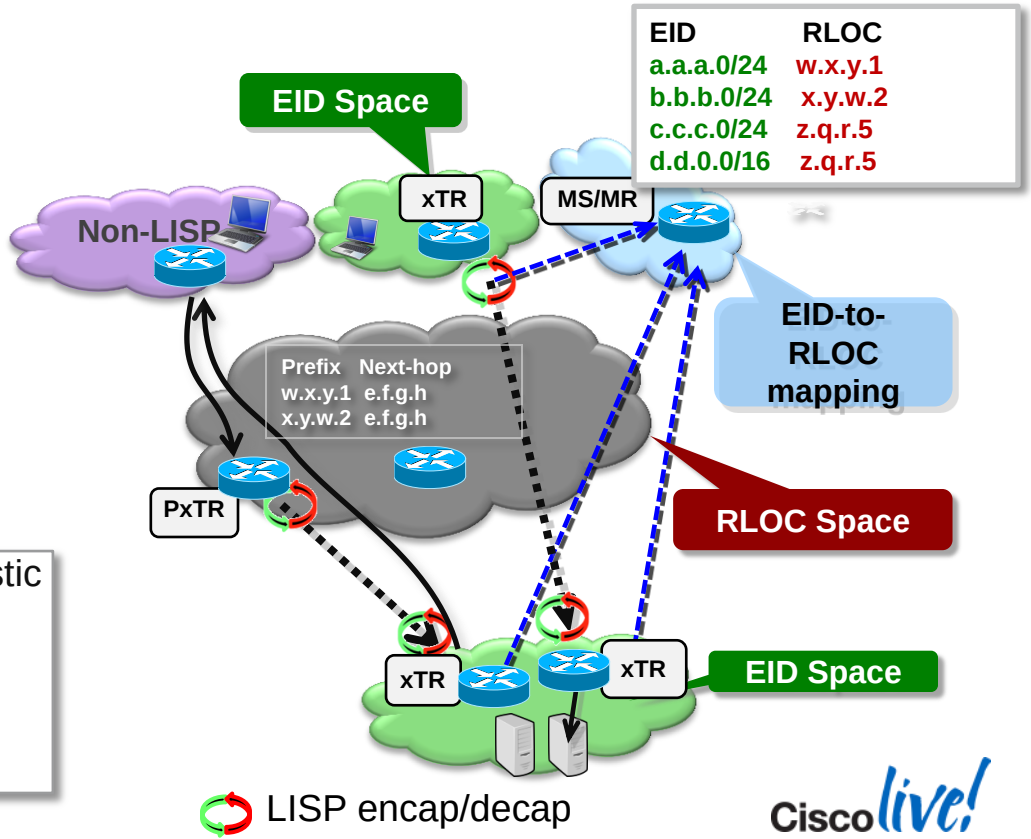
- **Translations (e.g. NAT)**
- **Tunnels (e.g. GRE, IPsec,MPLS)**

What is needed is Locator/ID Separation on a GLOBAL Scope, and that doesn't carry all routing in the Forwarding Plane!

LISP Approach
"Map and Encap"

- LISP namespaces
  - **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**

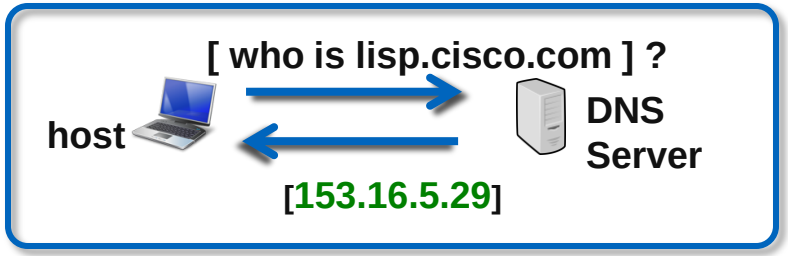
- Network-based solution
- No host changes
- Minimal configuration
- No DNS changes
- Address Family agnostic
- Incrementally deployable (support LISP and non-LISP)
- Support for mobility



What is LISP?

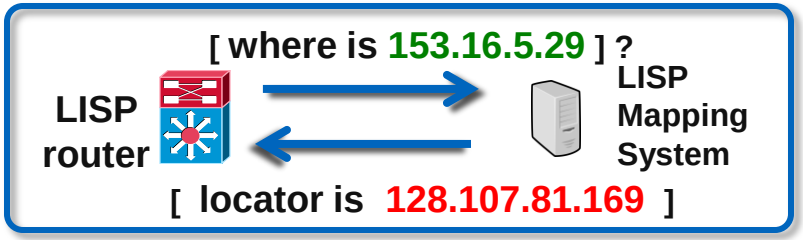
Mapping System

- LISP “Level of Indirection” is analogous to a DNS lookup
  - DNS resolves **IP addresses** for **URL** **Answering the “WHO IS” question**



DNS
Name-to-IP
URL Resolution

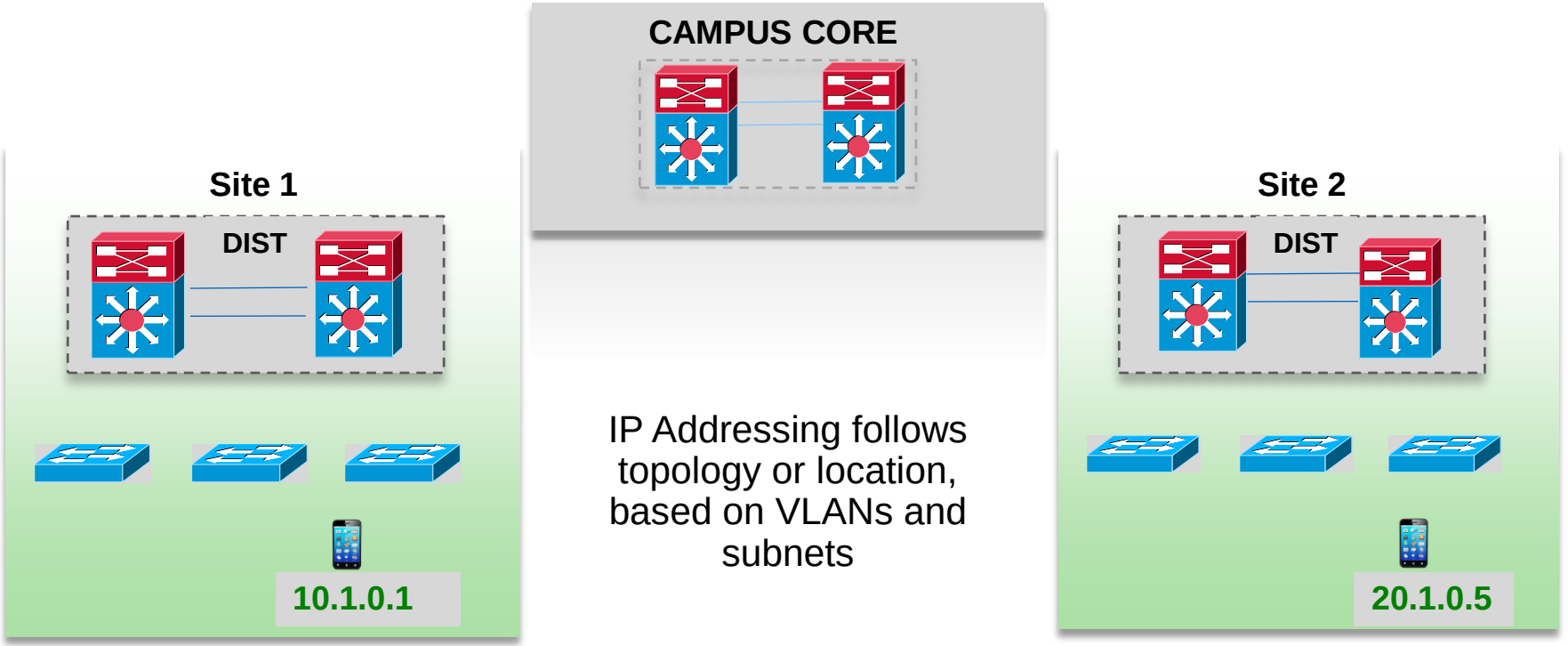
  - LISP resolves **locators** for queried **identities** **Answering the “WHERE IS” question**



LISP
Identity-to-locator
Mapping Resolution

Traditional Routing Architecture in Campus

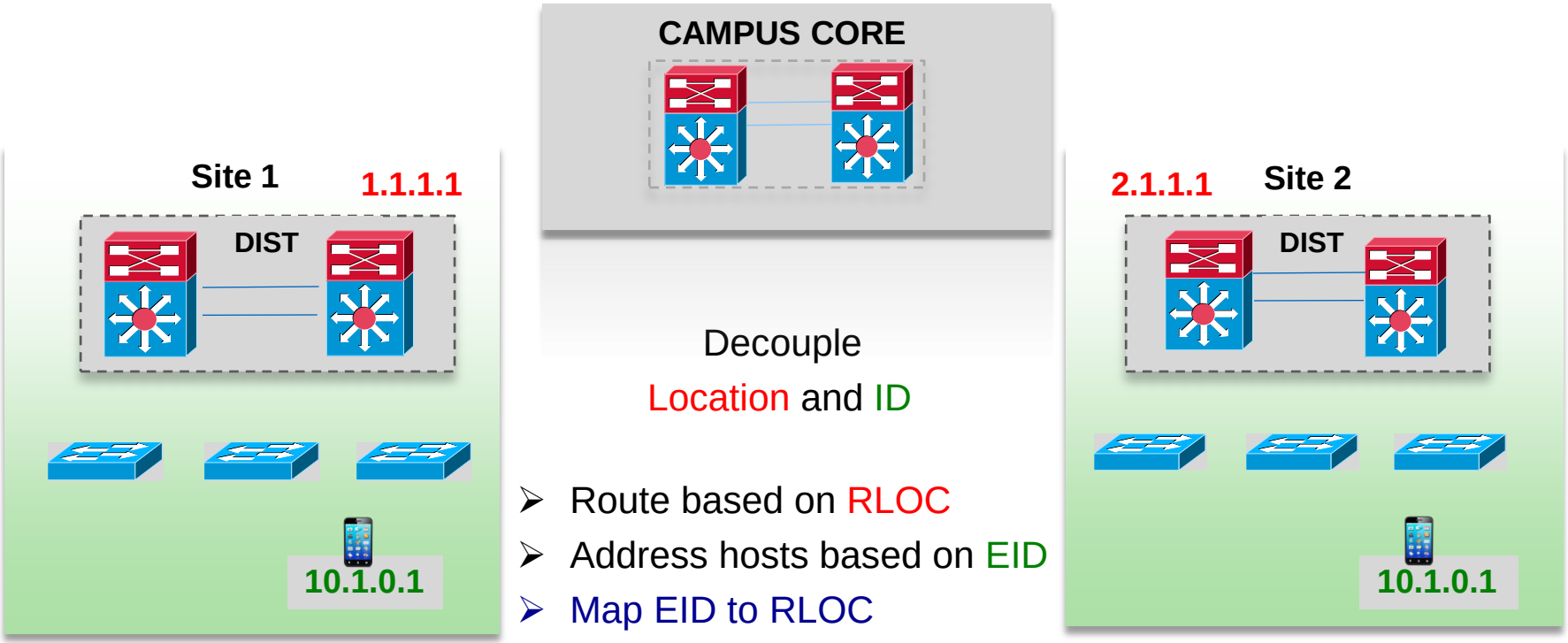
Topology-based Addressing and Routing



IP Addressing follows topology or location, based on VLANs and subnets

Concept of LISP in Campus

Implementing Locator/ID Separation



Note: VM mobility is not yet supported on the Catalyst platform, this denotes manual database mapping

LISP Operations

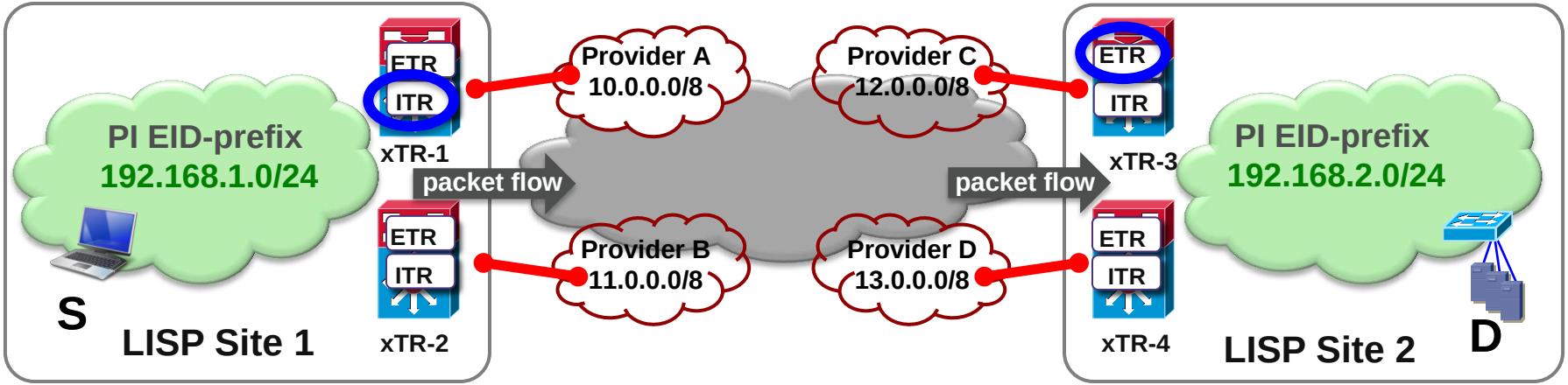
Data Plane Devices – Ingress and Egress Tunnel Routers

ITR – Ingress Tunnel Router

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

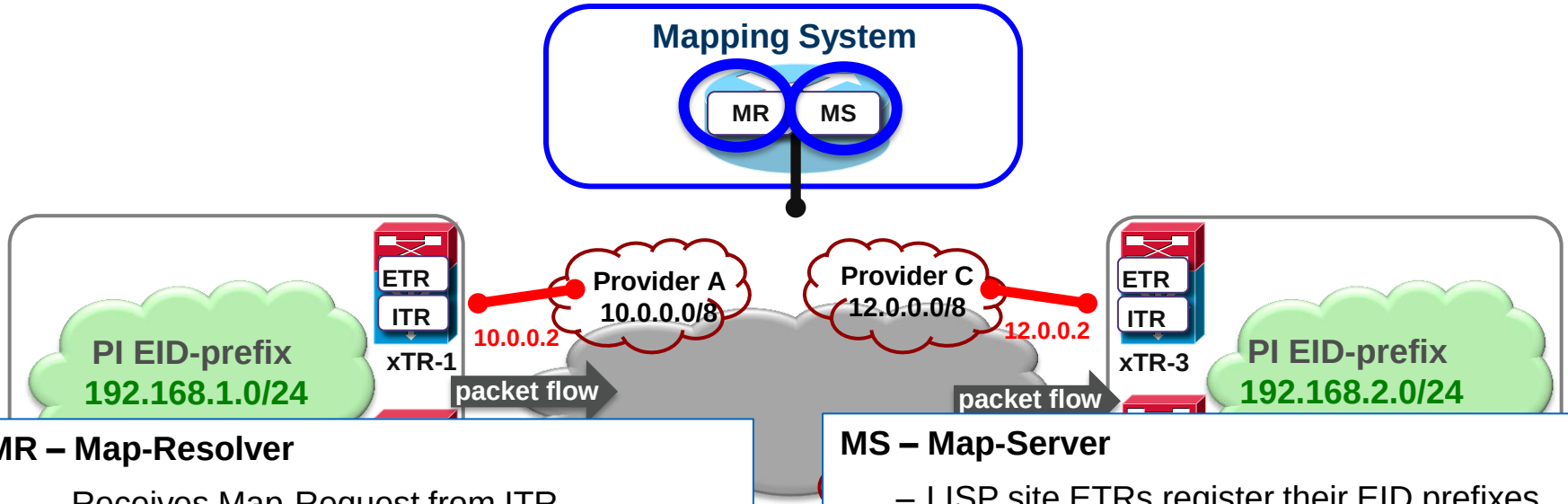
ETR – Egress Tunnel Router

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



LISP Operations

Control Plane Devices – Map Server and Map Resolver



MR – Map-Resolver

- Receives Map-Request from ITR
- Forwards Map-Request to Mapping System
- Sends Negative Map-Replies in response to Map-Requests for non-LISP sites

MS – Map-Server

- LISP site ETRs register their EID prefixes here; requires configured “lisp site” policy, authentication key
- Receives Map-Requests via Mapping System, forwards them to registered ETRs

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LISP Multihoming /Redundancy

Load-balancing and Ingress Traffic Engineering

Needs

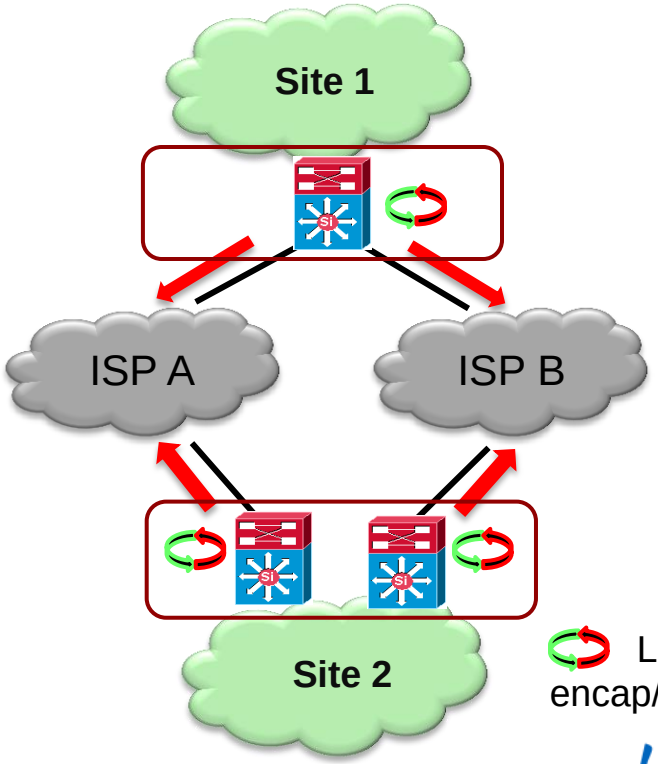
- Site connectivity to multiple providers
- Low OpEx/CapEx

LISP Solution

- LISP provides a streamlined solution for handling multi-provider connectivity and policy without BGP complexity

Benefits

- Multi-homing across different providers
- Simple policy management
- Ingress Traffic Engineering



LISP for IPv6 Transition

Establish IPv6 Internet Web-Presence

PC with IPv6 address

Public IPv6

PxTR

Map Server
Map Resolver

Public v4

Public Internet

Enterprise

RLOC
1.1.1.1

Ingress/Egress Tunnel Router

Catalyst 6500
LISP xTR

EID

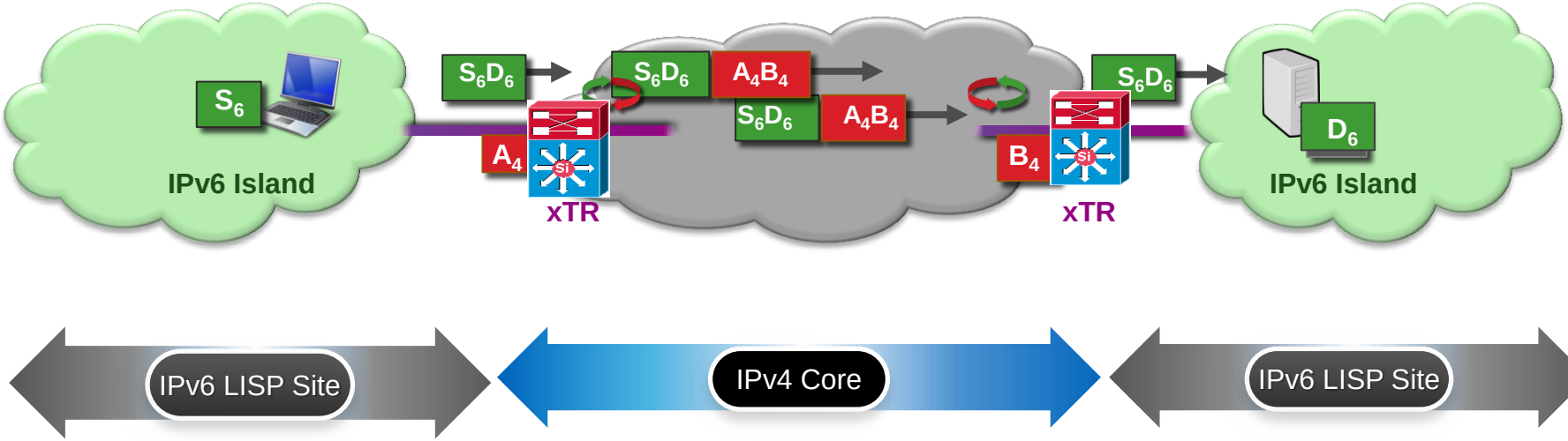
http://www.webserver.com

http://www.ipv6.webserver.com

LISP encap/decap

LISP for IPv6 Transition

LISP to connect IPv6 Islands



- No disruption to existing WAN connectivity
- IPv4 and IPv6 use same infrastructure and protocols
- LISP can transport IPv4 over IPv4, IPv6 over IPv4, IPv6 over IPv6 and IPv4 over IPv6

LISP Virtualisation

Multi-tenancy using Shared mode virtualisation

Needs

- Integrated Segmentation
- Ease of operations
- Global Scale

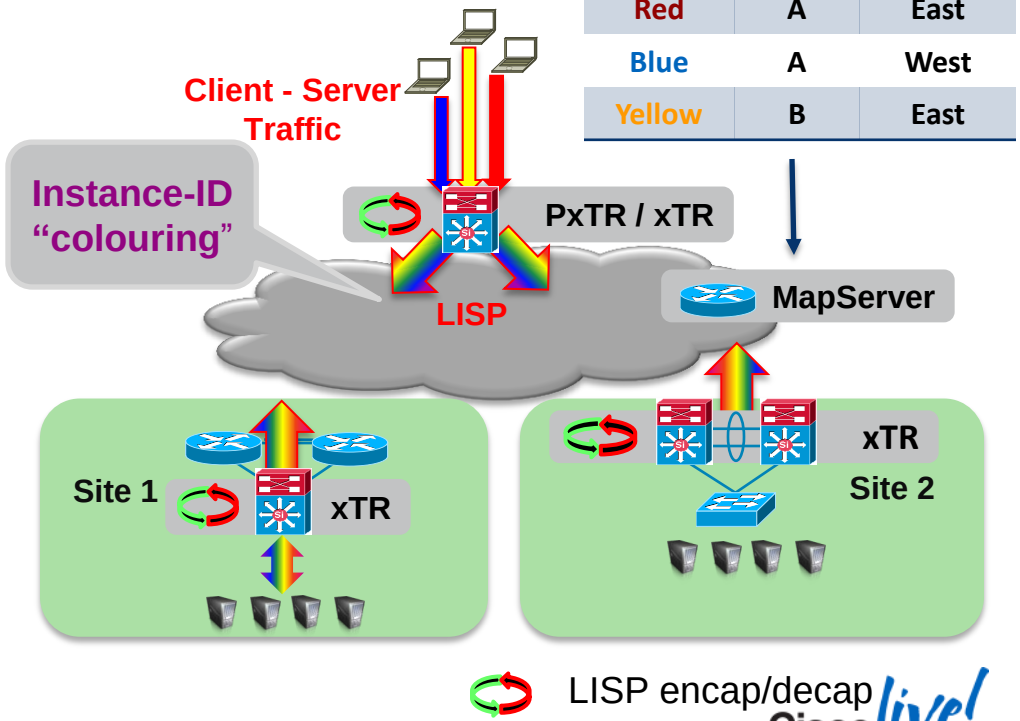
LISP Solution

- Use an **Instance-ID** to “colour” mappings, control traffic and data traffic
- Mapping DB and LISP Cache on xTRs is “instance-aware”
- On xTRs use VRFs as map cache contexts

Benefits

- End to end virtualisation irrespective of the underlying core network

Instance	IP	Location
Red	A	East
Blue	A	West
Yellow	B	East



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Forwarding Architecture

LISP Functionality on Catalyst 6500

Feature support

Supervisor 2T with 6900 Series Linecards and 15.1(1)SY1 software

LISP Functions

- Ingress/Egress Tunnel Router (ITR/ETR)
- Proxy Ingress/Egress Tunnel Router (PITR/PETR)
- Map Server and Map Resolver

LISP Features

- IPv6 Transition (IPv4-only RLOC)
- Multihoming
- Shared-mode Virtualisation

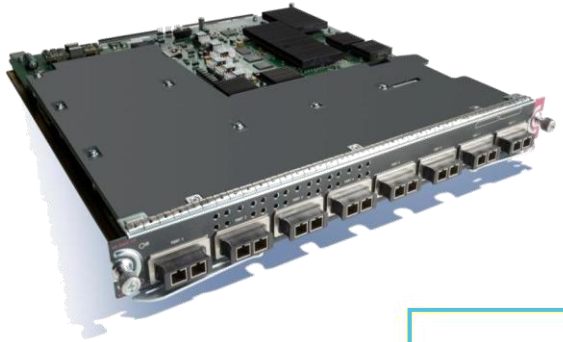
6807-XL

6880-X

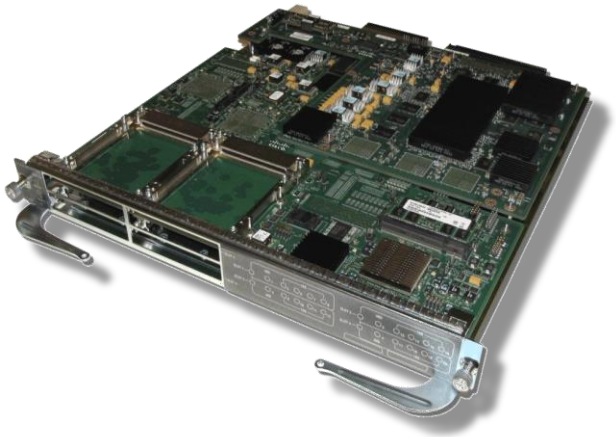
6500-E

LISP Forwarding on Catalyst 6500 / 6800

Supervisor and Linecard portfolio



8-port 10GE



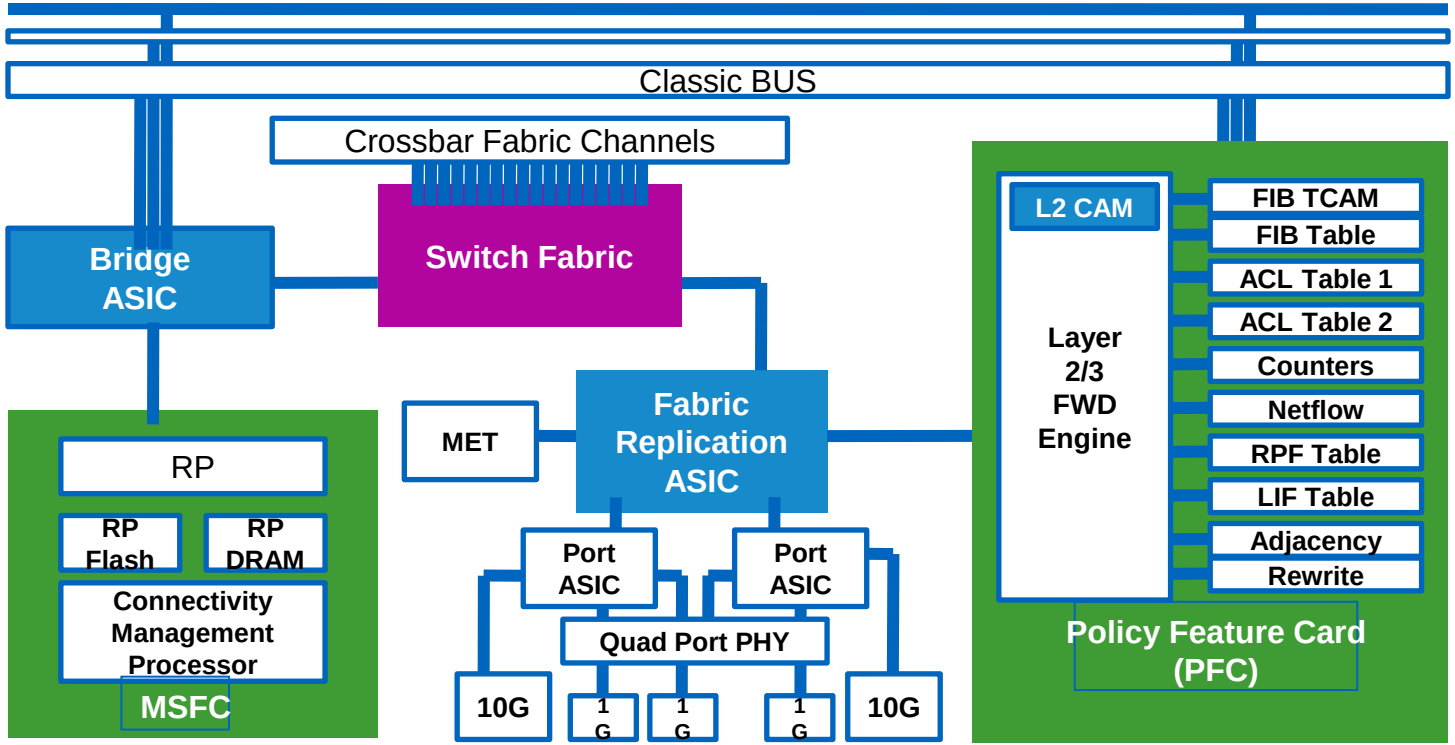
4-port 40GE

16-port 1/10GE

- LISP is available on Catalyst 6500 and 6800 with Supervisor 2T on IOS 15.1(1)SY1 onwards
- 6900 Series line cards required for Encap/Decap
- 6880-X and Future generation Linecards on 6500-E/6807-XL support LISP

Supervisor 2T Architecture

PFC4 and MSFC5 – Runs the Control Plane for LISP



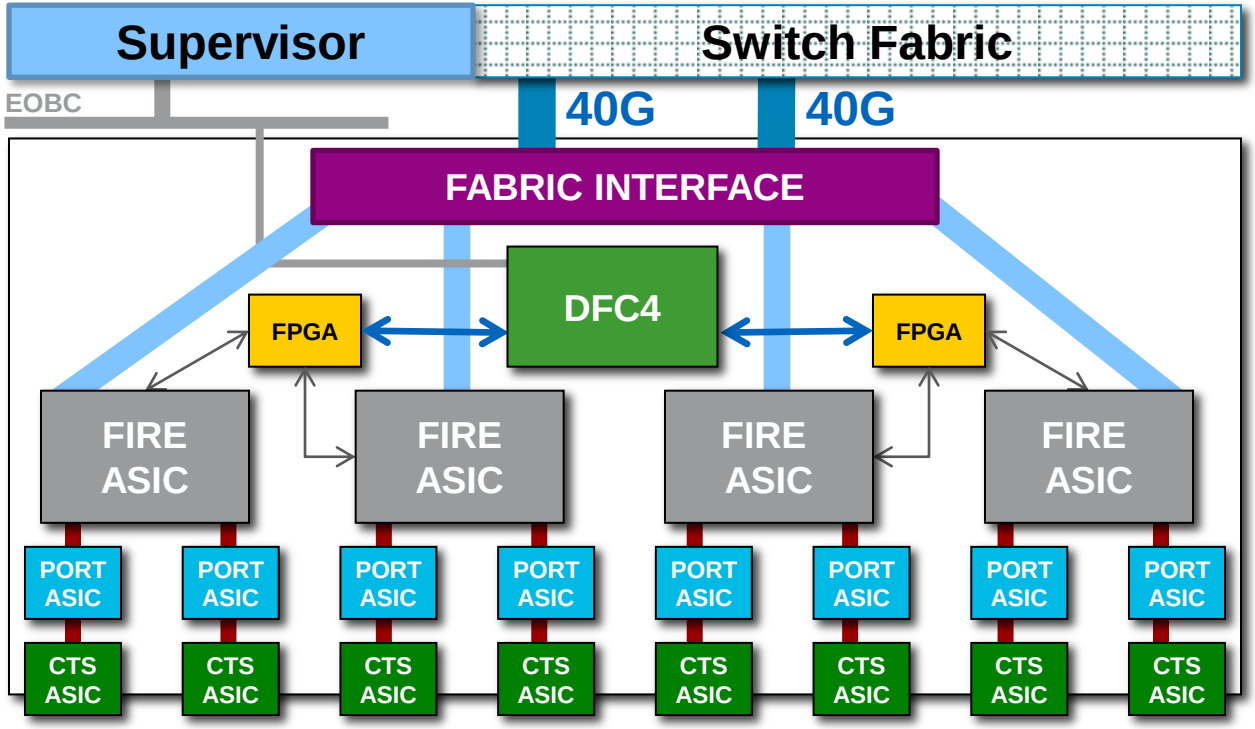
MSFC5 runs the software control plane – needed for LISP mapping

PFC4 runs the hardware control plane for forwarding

DFC4 on modules does LISP forwarding

6908 Architecture

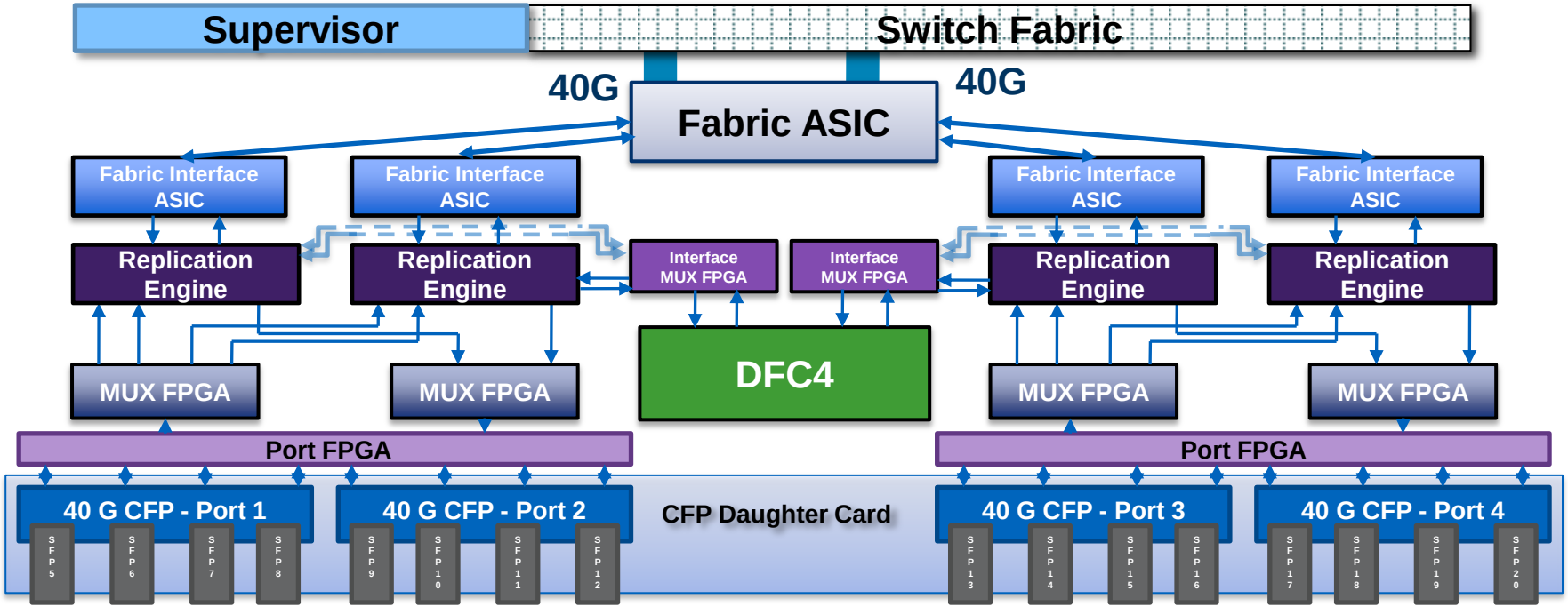
DFC4 and FPGA needed for LISP encap/decap



- dCEF2T LAN modules connect into the Switch fabric via dual 40Gb Fabric channels providing an overall bandwidth of 80Gb.
- They come with a DFC4 pre-installed with no option for a CFC. DFC4 performs all the lookups and features (NetFlow, QoS, etc.)
- Module includes FPGA for LISP encap/decap

6904 Architecture

DFC4 and FPGA needed for LISP encap/decap

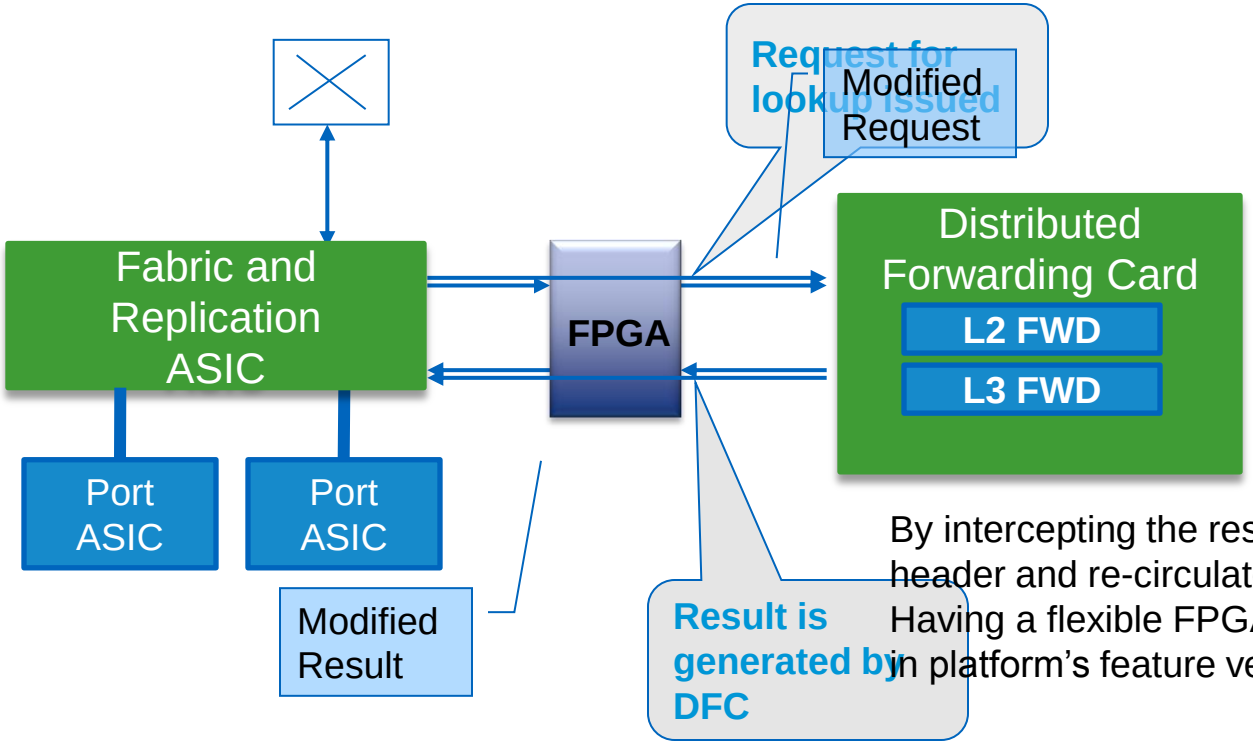


6904 Linecard is the most flexible – it can work in 1G/10G/40G or mixed modes, and supports LISP and Instant Access. The 6880-X architecture is also based on the 6904 linecard.

LISP Encapsulation and Decapsulation

FPGA Intervention

Limitation: LISP encap not supported natively in EARL with current Hardware logic

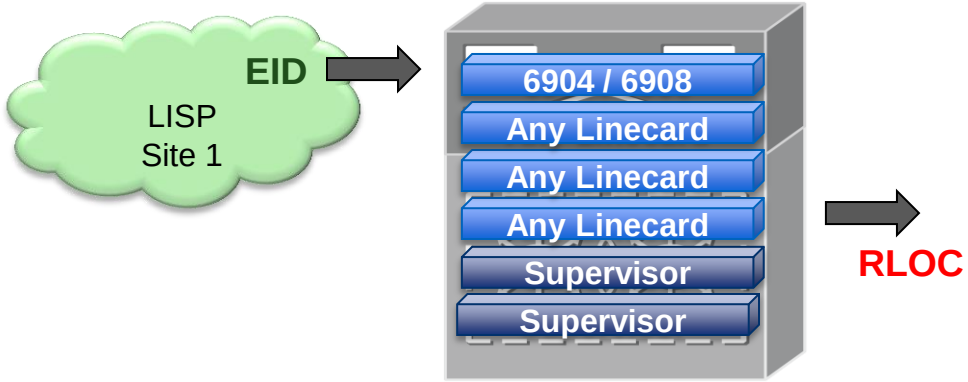


- **FPGA only present in 6900 series linecards**
- **We can add functionality to this FPGA and implement any new rewrites**
- **FPGA needs to be on Ingress linecard for LISP Encap or Decap**

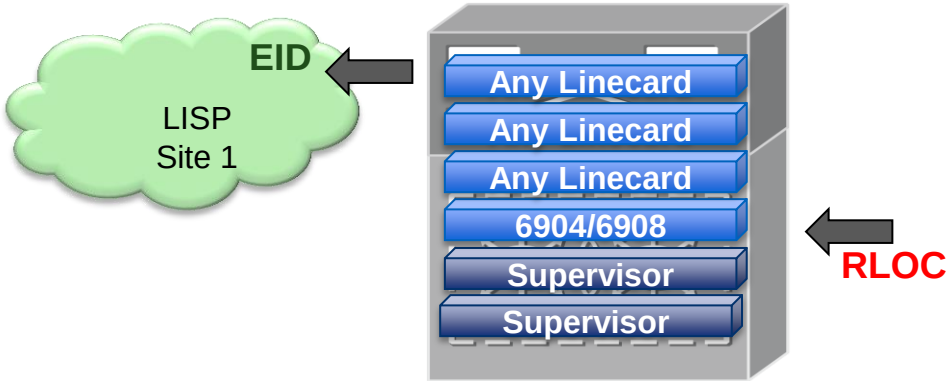
By intercepting the result, we could do many things to header and re-circulate for additional processing. Having a flexible FPGA at appropriate points would help in platform's feature velocity

LISP Topologies

6900 Linecard Requirement



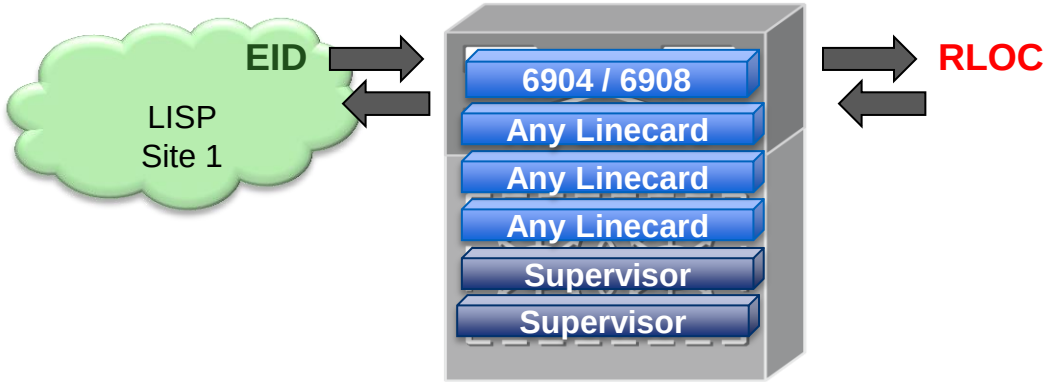
ITR : Ingress Linecard does the Encapsulation



ETR : Ingress Linecard does the Decapsulation

LISP Topologies

6900 Linecard Requirement



ITR/ETR = Same Switch

xTR

LISP interfaces containing both EID and RLOC need to be on 6904 / 6908 linecards

WS-X6908-10G-2T, WS-X6908-10G-2TXL

WS-X6904-40G-2T, WS-X6904-40G-2TXL

LISP Forwarding on 6500

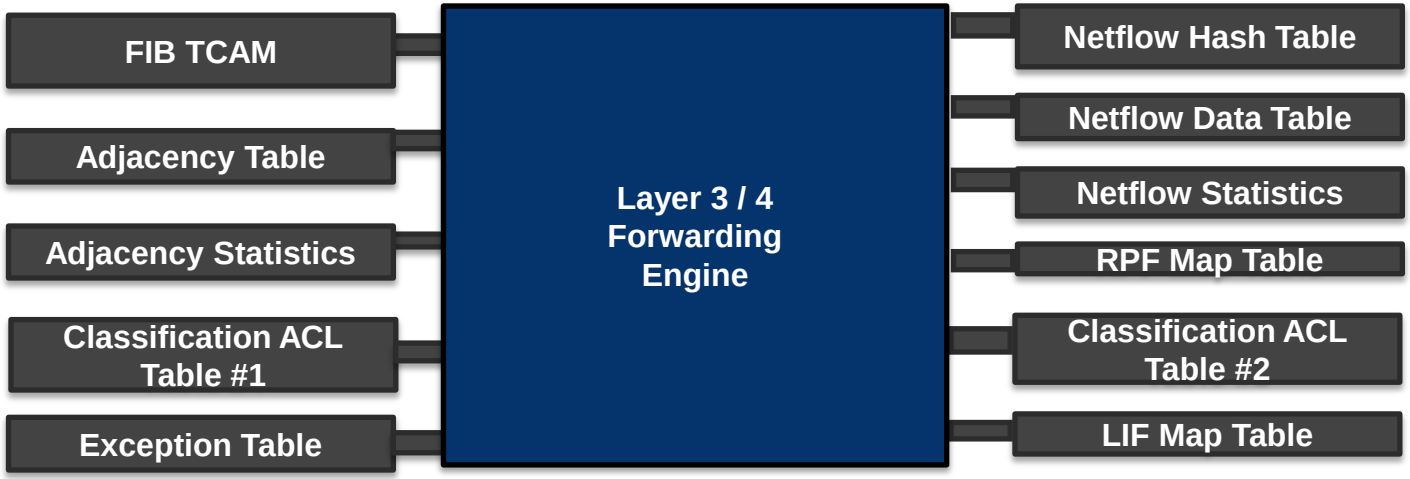
DFC4 Architecture on 6900 Series Linecards

CEF entries pushed to FIB under VPN ID

LISP0 adjacency

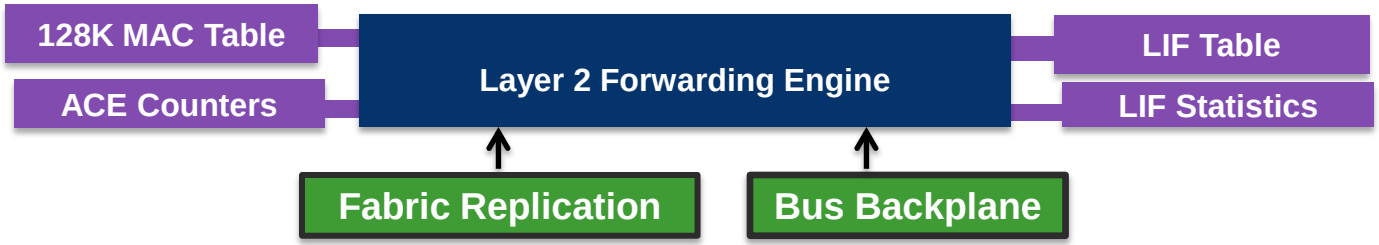
ACL to match EID

Needed for CoPP



Netflow cache and statistics on ingress, egress

Logical interfaces used to do source interface lookup for EID check

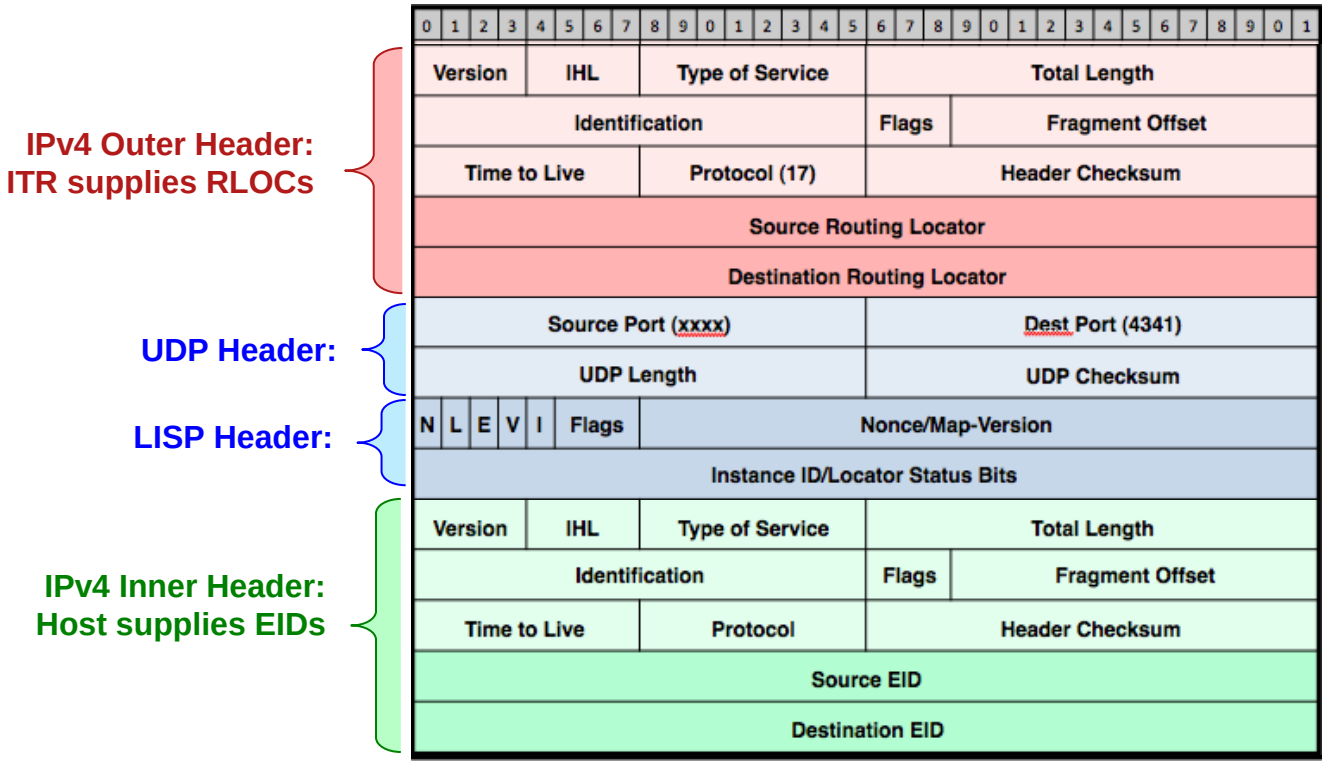





Packet Forwarding

LISP Packet Walk

RFC 6830 Header Format



Encapsulation:

36 bytes for IPv4

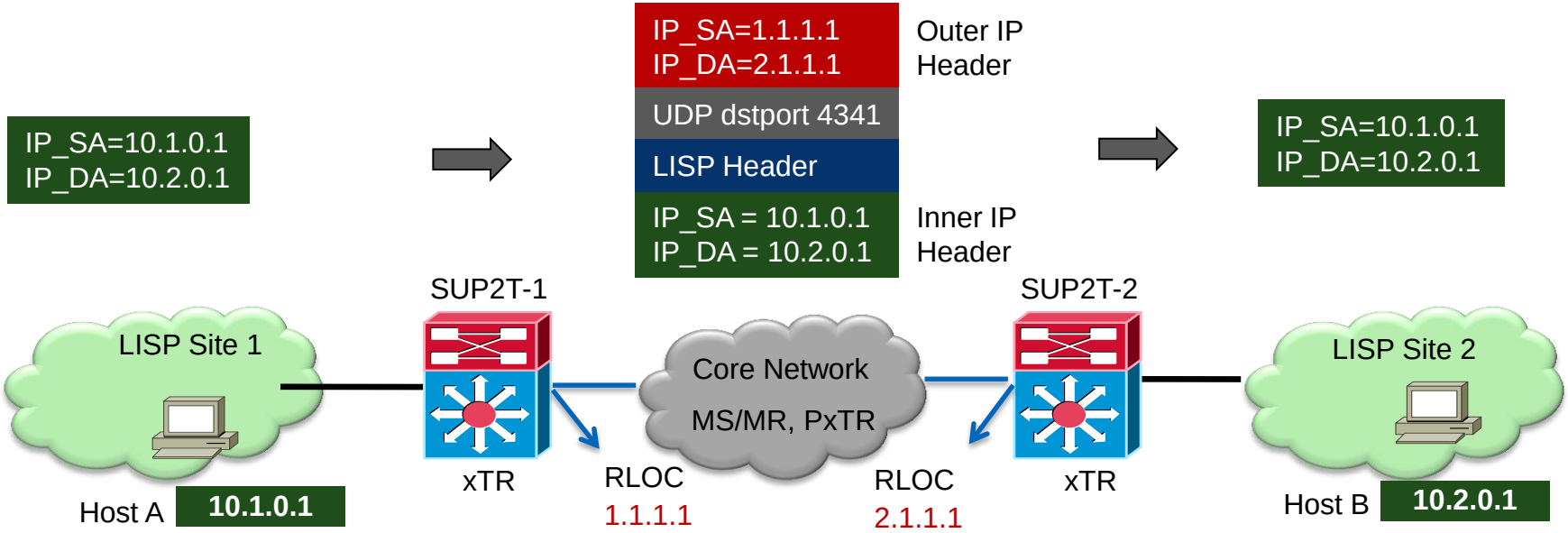
56 bytes for IPv6

UDP source port is different per flow

Can use link aggregation or equal cost paths to spread traffic evenly

LISP Packet Forwarding

Unicast IPv4 – Data Plane



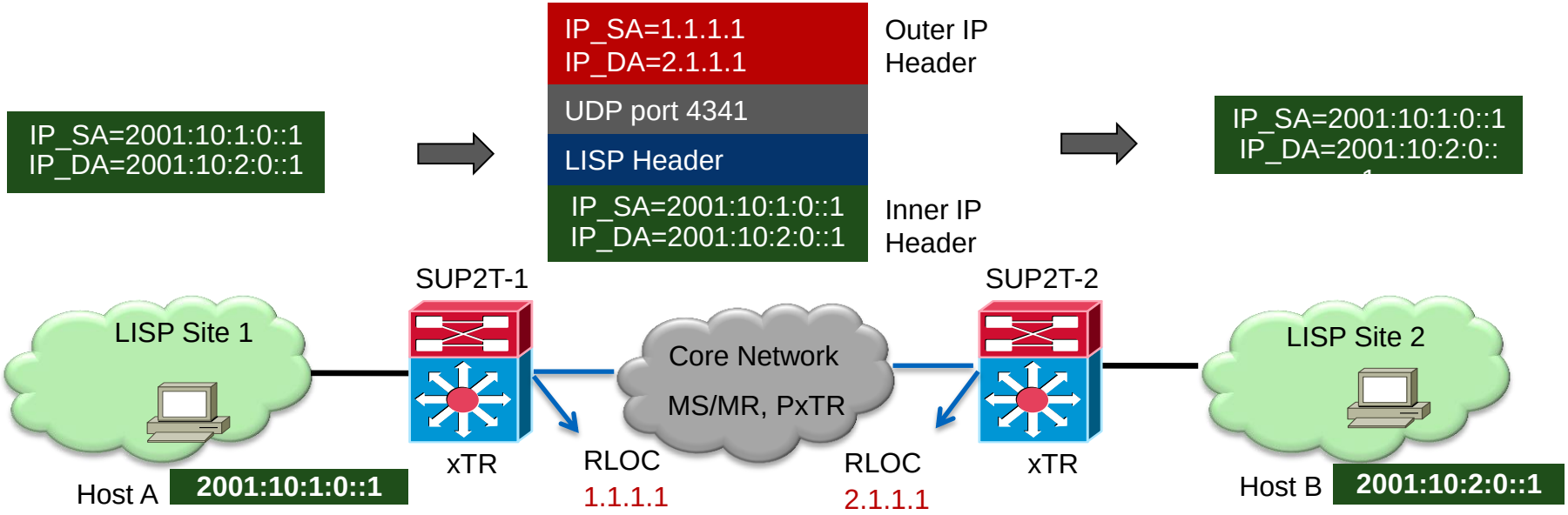
Mapping Database:
EID Prefix 10.1.0.0/24 -> RLOC 1.1.1.1

Map Cache:
10.2.0.0/24 -> RLOC 2.1.1.1

Mapping Database:
EID Prefix 10.2.0.0/24 -> RLOC 2.1.1.1

LISP Packet Forwarding

Unicast IPv6 – Data Plane



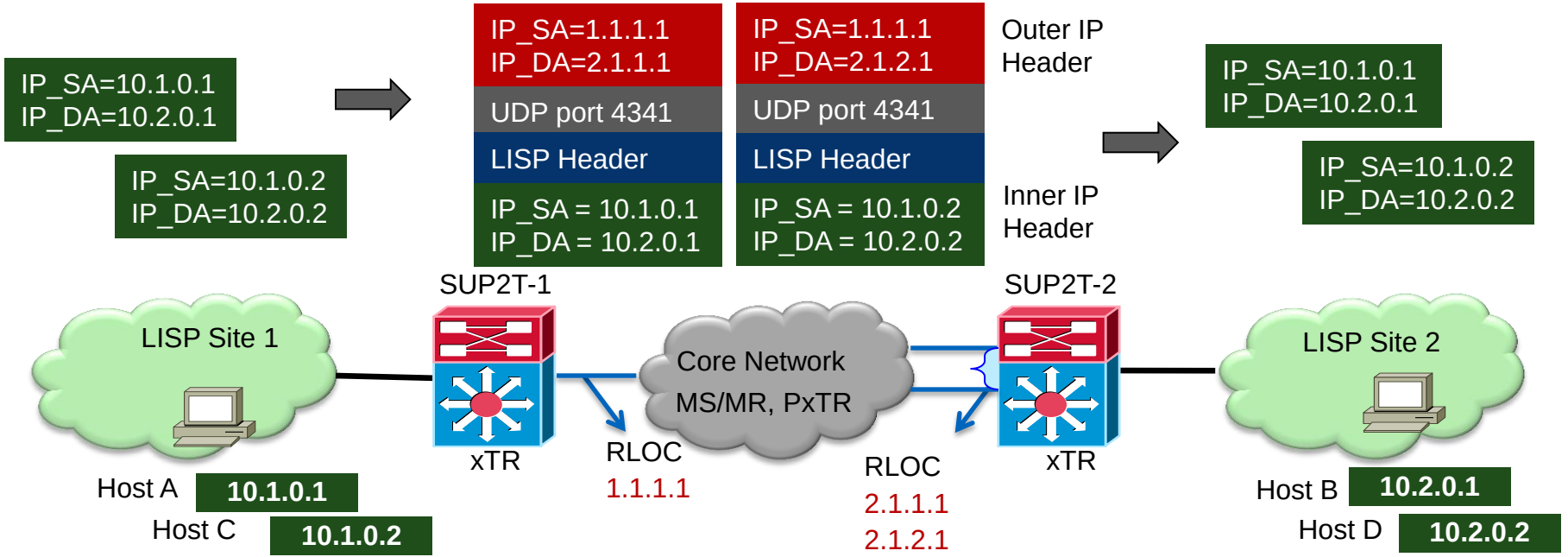
Mapping Database:
EID Prefix 2001:10:1:0::/64-> RLOC 1.1.1.1

Map Cache:
2001:10:2:0::/64 -> RLOC 2.1.1.1

Mapping Database:
EID Prefix 2001:10:2:0::/64 -> RLOC 2.1.1.1

LISP Packet Forwarding

Unicast IPv4 with Multihoming – Data Plane



Mapping Database:
EID Prefix 10.1.0.0/24 -> RLOC 1.1.1.1

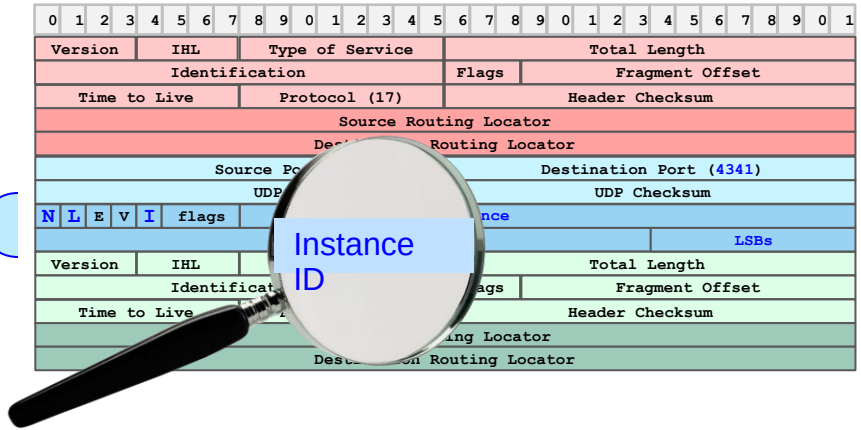
Mapping Database:
EID Prefix 10.2.0.0/24 -> RLOC 2.1.1.1 and 2.1.2.1

Map Cache:
10.2.0.0/24 -> RLOC 2.1.1.1 and 2.1.2.1(priority and weight)

Using Virtualisation and Segmentation with LISP

LISP with Multi-tenancy

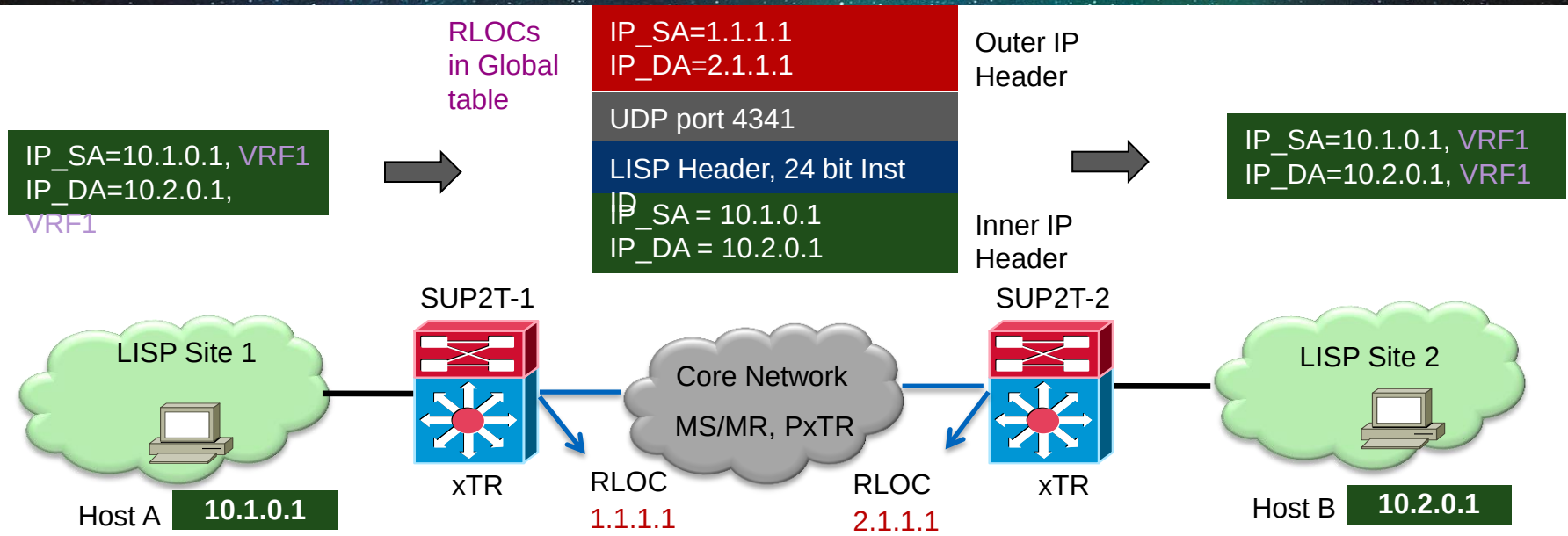
LISP Header:



- When network needs to be virtualised, Instance ID can be transported in the LISP header
- 802.1Q VLAN tag or VPN identifier could be used as 24-bit Instance ID when the **"I"** bit is set

LISP Packet Forwarding

Unicast IPv4 with Virtualisation – Data Plane



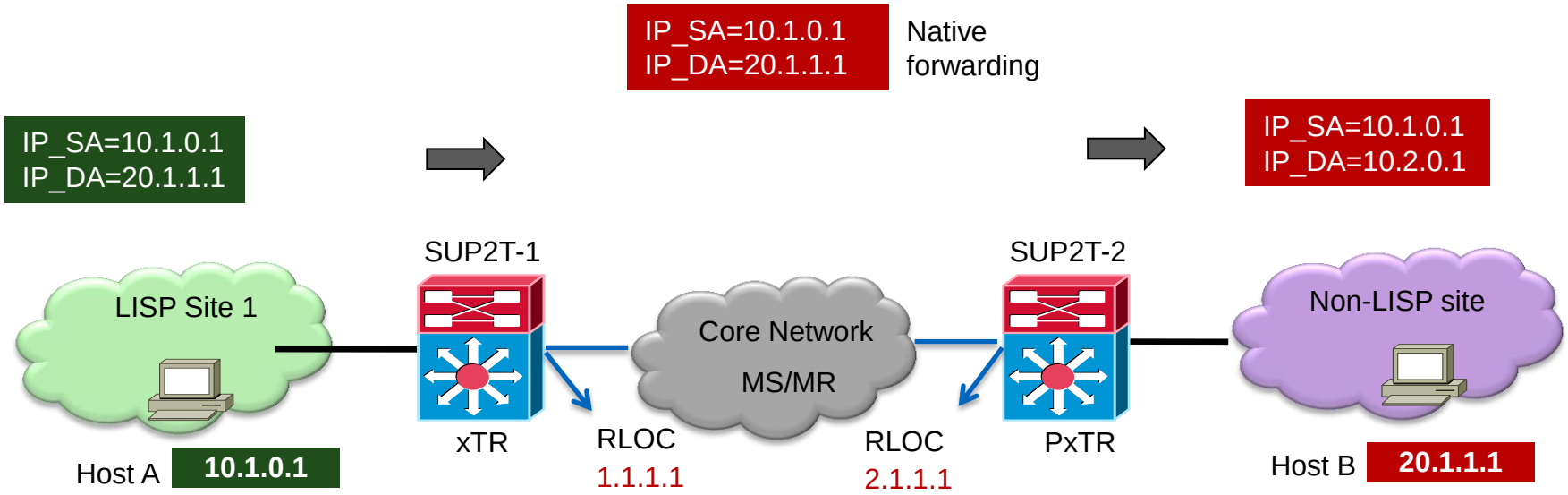
Mapping Database:
VRF1: EID Prefix 10.1.0.0/24 -> RLOC 1.1.1.1

Map Cache:
VRF1: 10.2.0.0/24 -> RLOC 2.1.1.1

Mapping Database:
VRF1: EID Prefix 10.2.0.0/24 -> RLOC 2.1.1.1

LISP Packet Walk

LISP to non-LISP site IPv4



Mapping Database:
EID Prefix 10.1.0.0/24 -> RLOC 1.1.1.1

Map Request for 20.1.1.1 -> Negative Map Reply

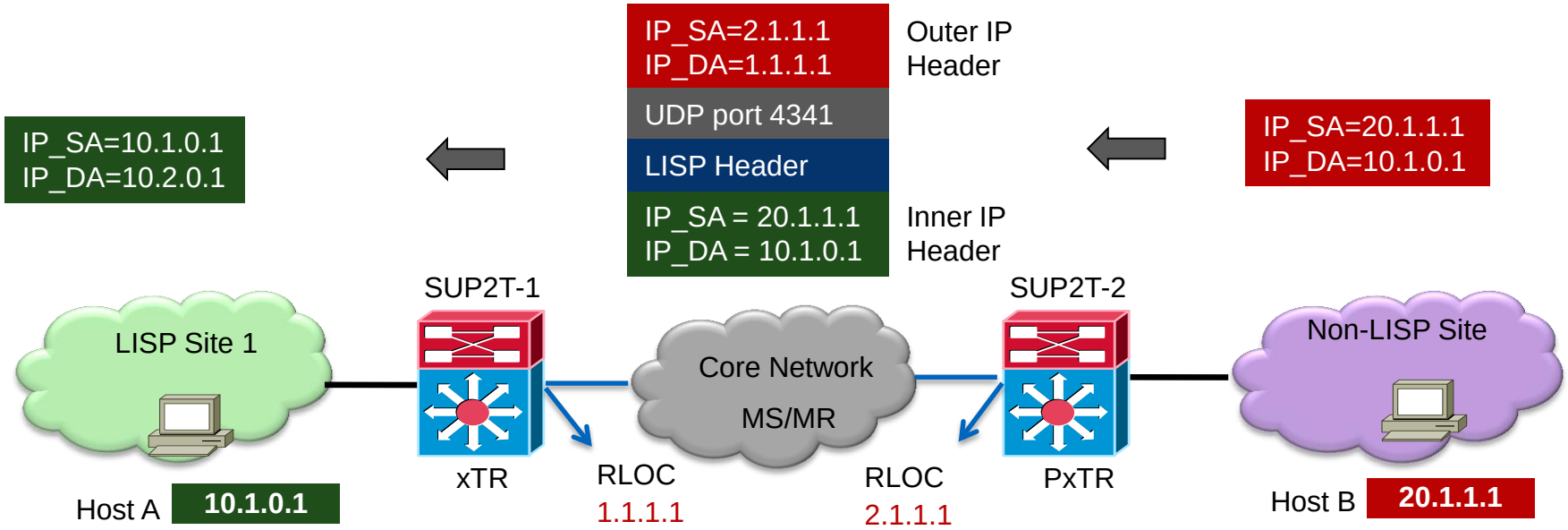
- Forward Native

Advertise all 10.1.0.0/16 prefixes

Note: xTR replaced with PxTR
PxTR need not be inline

LISP Packet Forwarding

Non-LISP to LISP site – IPv4



Mapping Database:
EID Prefix 10.1.0.0/24 -> RLOC 1.1.1.1

Advertise all 10.1.0.0/16 prefixes

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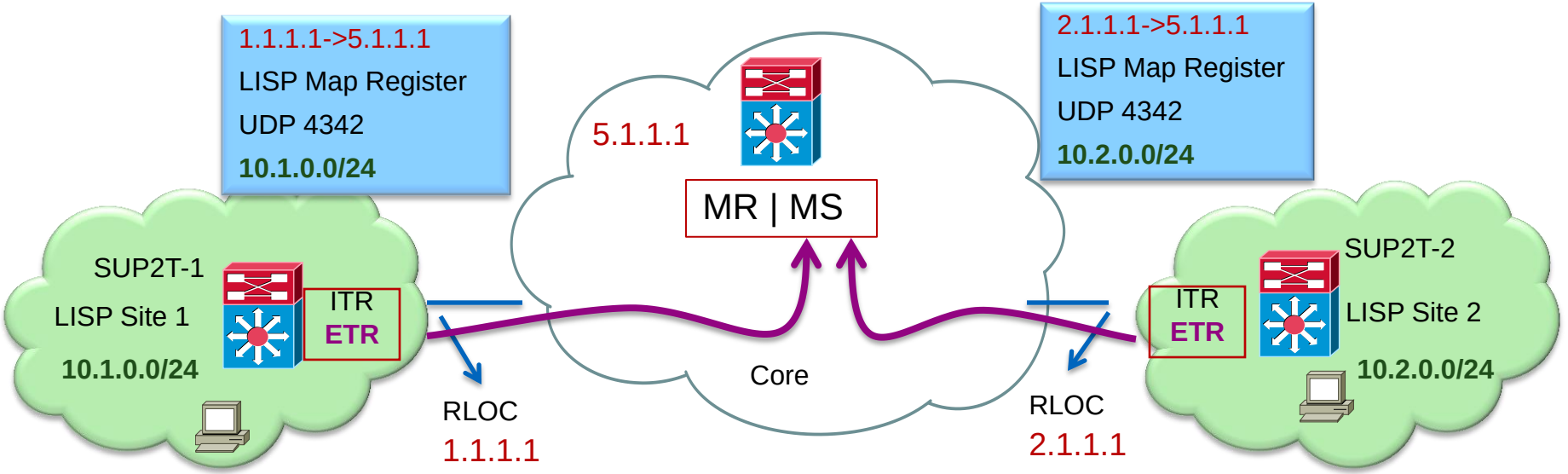
PxTR need not be inline

LISP Packet Walk

Unicast IPv4- Control Plane : Map Registration

ETRs register their EID prefixes with Map Server



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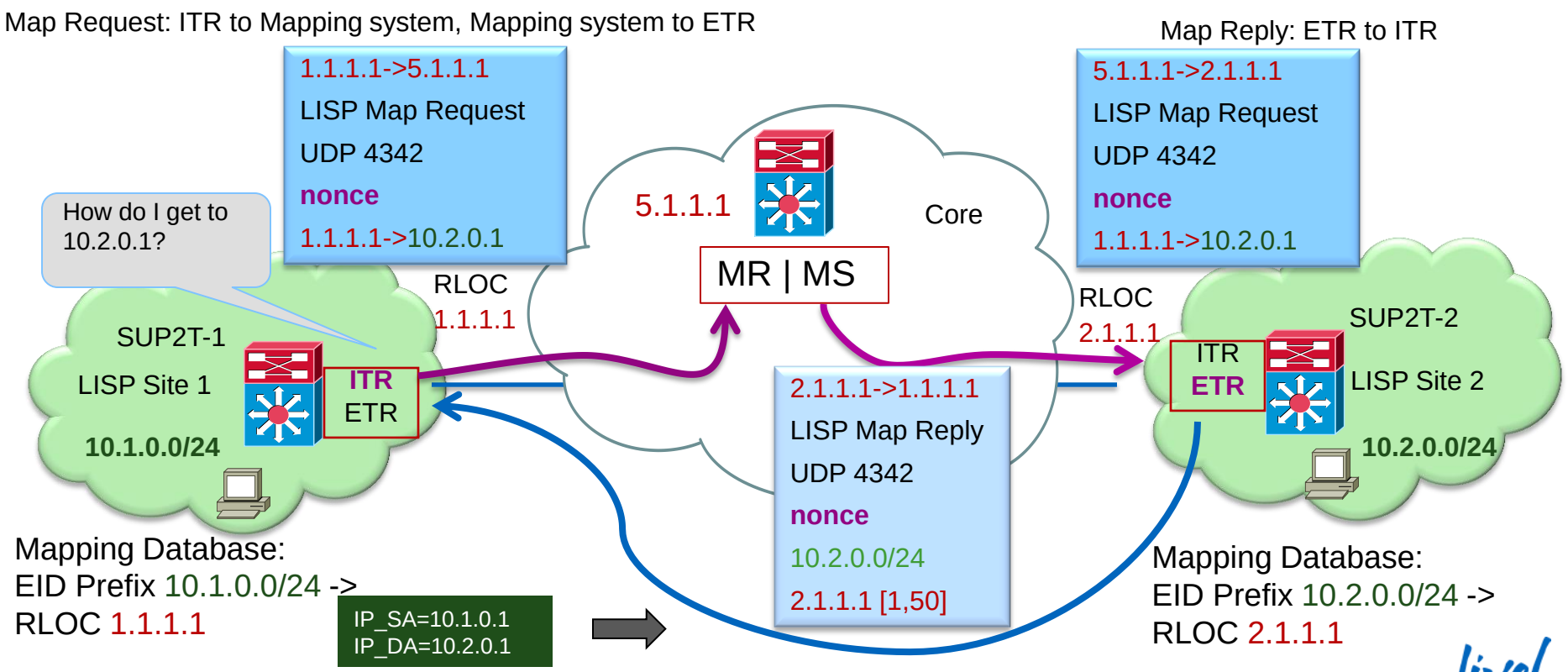
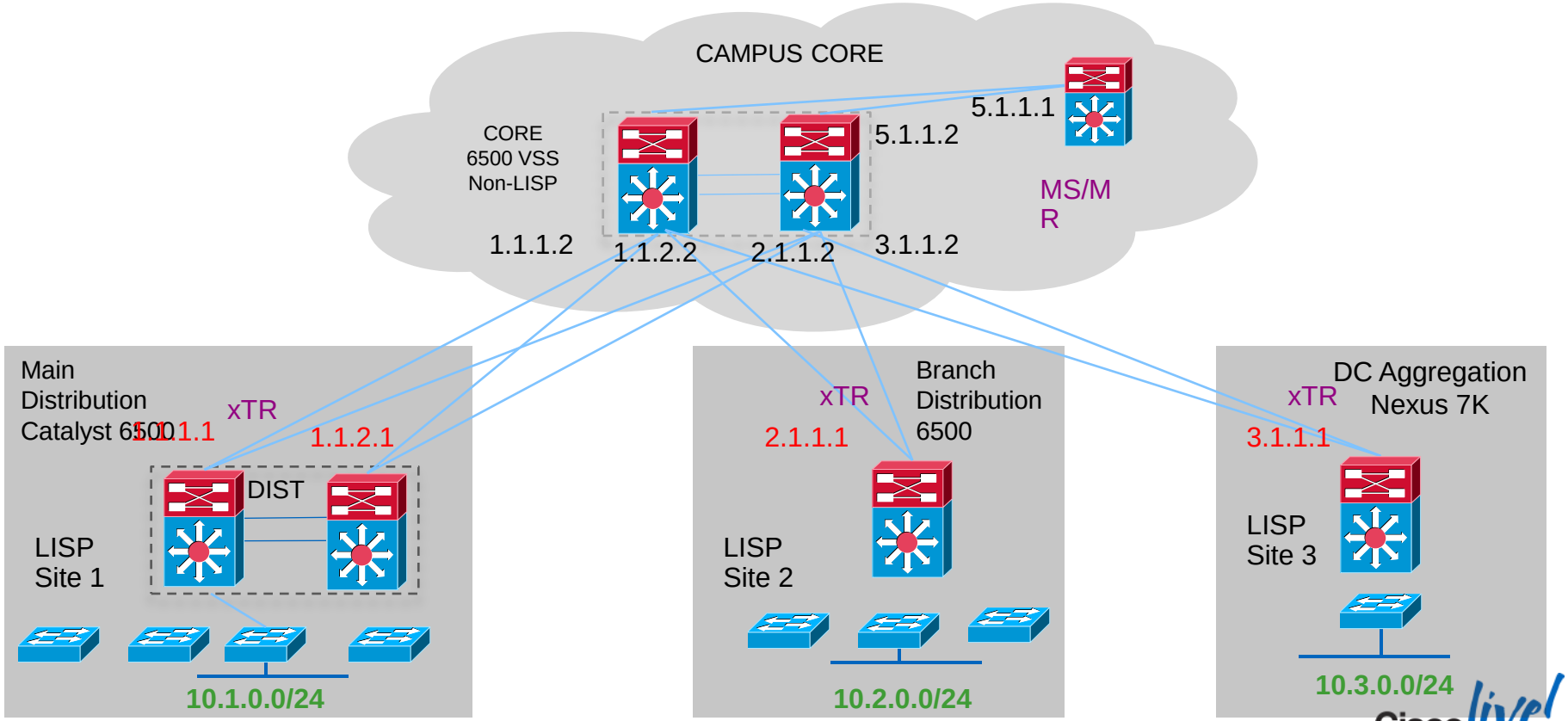
LISP Packet Walk

Unicast IPv4- Control Plane : Map Request and Map Reply



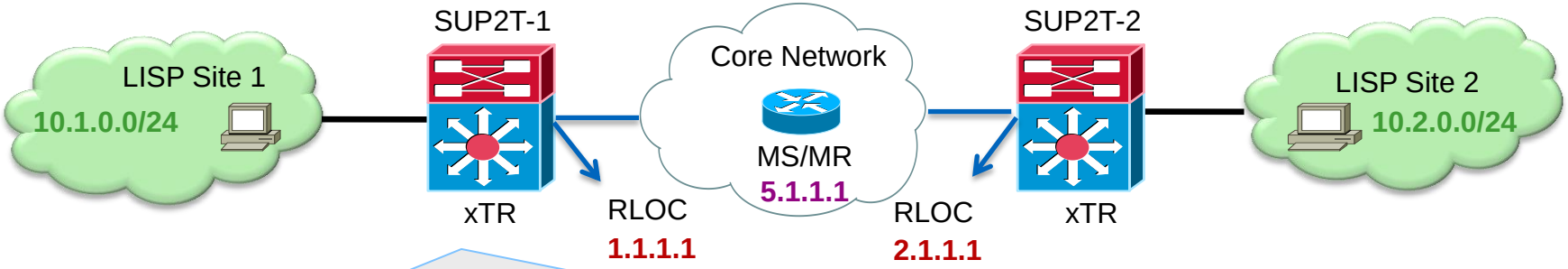
Configuration Guidelines and Verification

Topology



LISP Configuration

Enabling LISP and configuring an ITR/ETR

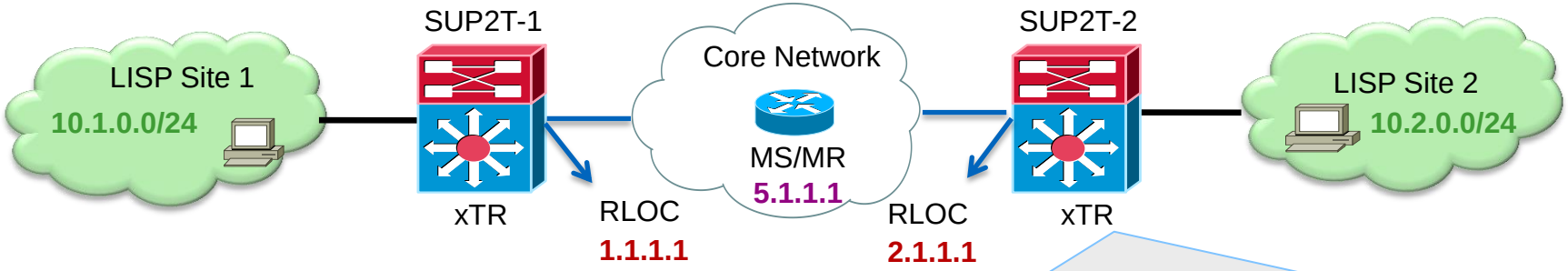


Site 1 Config

```
router lisp
 eid-table default instance-id 0
  database-mapping 10.1.0.0/24 1.1.1.1 priority 1 weight 100
  exit
 !
 ipv4 itr map-resolver 5.1.1.1
 ipv4 itr
 ipv4 etr map-server 5.1.1.1 key Site-1
 ipv4 etr
 exit
ip route 0.0.0.0 0.0.0.0 1.1.1.2
```

LISP Configuration

Enabling LISP and configuring an ITR/ETR

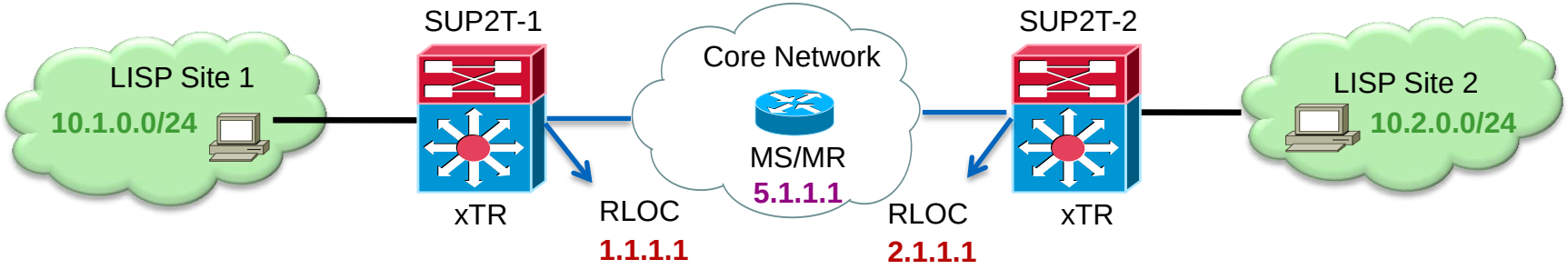


Site 2 Config

```
router lisp
 eid-table default instance-id 0
  database-mapping 10.2.0.0/24 2.1.1.1 priority 1 weight 100
  exit
 !
 ipv4 itr map-resolver 5.1.1.1
 ipv4 itr
 ipv4 etr map-server 5.1.1.1 key Site-2
 ipv4 etr
 exit
ip route 0.0.0.0 0.0.0.0 2.1.1.2
```

LISP Configuration

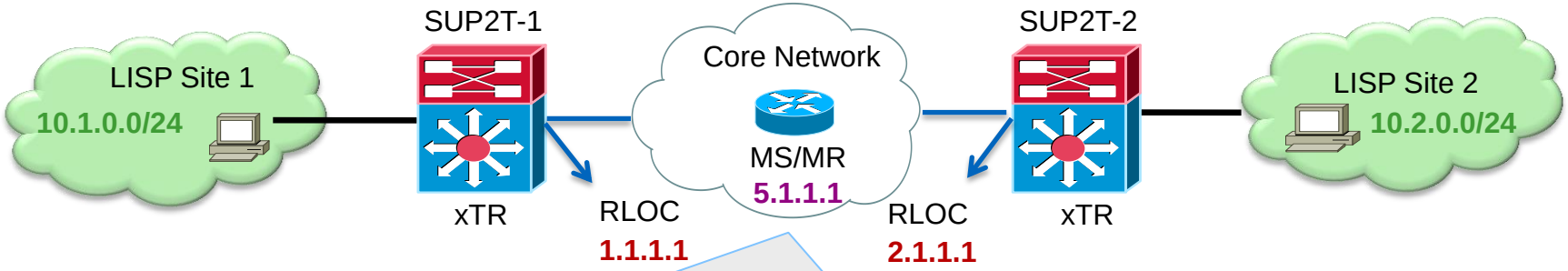
Enabling LISP and configuring an ITR/ETR



- LISP is enabled like other routing protocols
- Simple CLI for mapping EID to RLOC
- Mapping can be within an instance-ID which maps to a VRF

LISP Configuration

Configuring the Mapping System



Map Server
and
Map Resolver
Config

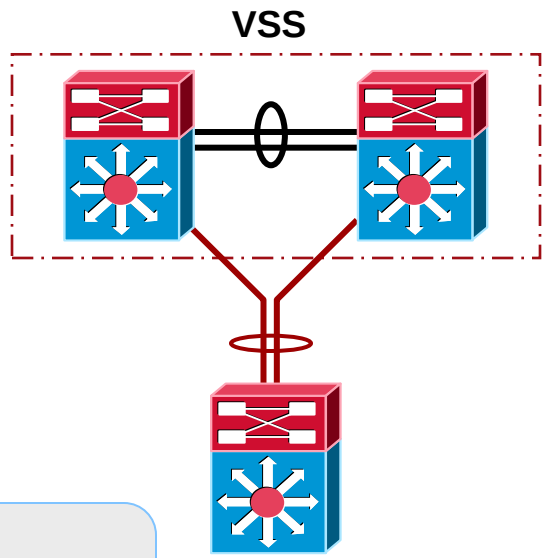
```
router lisp
 site Site-1
  authentication-key Site-1
  eid-prefix 10.1.0.0/24
  exit
 !
 site Site-2
  authentication-key Site-2
  eid-prefix 10.2.0.0/24
  exit
 !
 ipv4 map-server
 ipv4 map-resolver
```

LISP Feature Interaction

LISP and SVI/Etherchannel

Deploying LISP on the Distribution Layer with Redundancy

- LISP can be deployed in standalone chassis (single or dual supervisor) or in VSS mode (dual or quad supervisor)
- LISP interfaces can be on SVI (commonly used for EID)
- LISP can be enabled on Portchannels (commonly used for both EID and RLOC)
- The “platform lisp-enable” command needs to be configured on SVI and L3 Portchannels to enable LISP

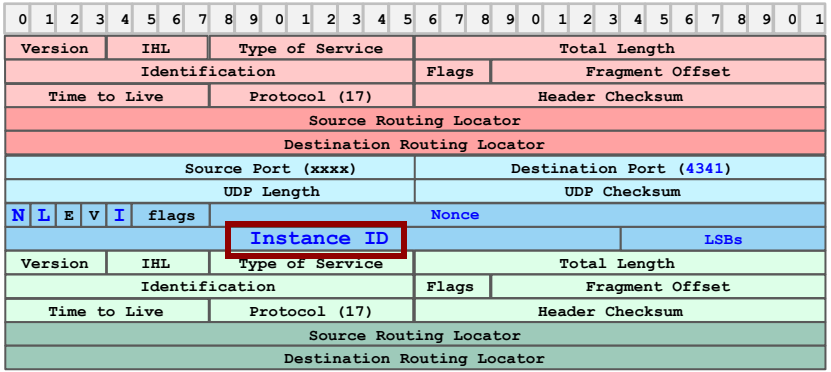



```
interface Vlan102
 description EID
 ip address 10.2.0.1 255.255.255.0
platform lisp-enable
```

LISP and VRFs

LISP enables Virtualisation using VRF-Lite

LISP on 6K works with VRFs using Shared mode Virtualisation using the 24-bit Instance ID field in the LISP header (EVN integration coming in later phase)



Verification commands for LISP can be run under routing context but * LISP commands do not work under « routing-context »

SUP2T-1#routing-context vrf VRF-1

SUP2T-1%VRF-1# ping 20.1.0.1 source 20.2.0.2

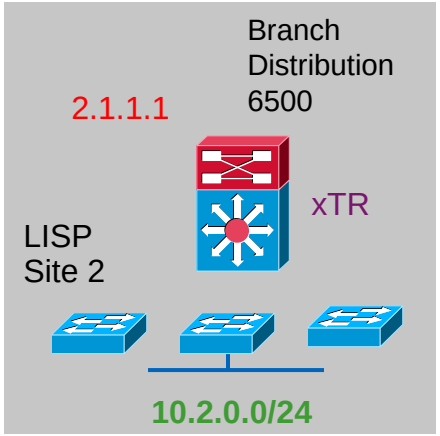
LISP and Flexible NetFlow

Use NetFlow to monitor flows before and after LISP Encap

Configure NetFlow on Ingress and Egress interfaces

```
flow record LISP-Record
 match datalink vlan input
 match routing vrf input
 match ipv4 version
 match ipv4 tos
 match ipv4 precedence
 match ipv4 dscp
 match ipv4 source address
 match ipv4 destination address
 match transport source-port
 match transport destination-port
```

```
flow monitor LISP-Mon-Data
 record LISP-Record
```

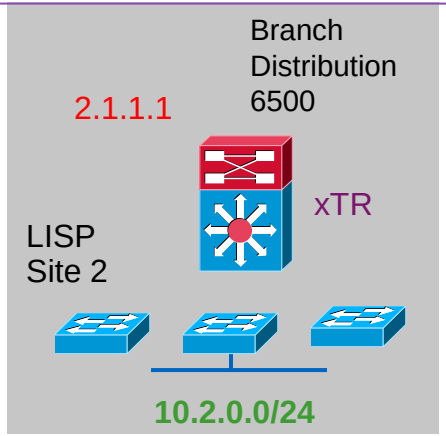



```
interface TenGigabitEthernet5/1
 description RLOC [CORE-VSS::t1/2/3]
 ip address 2.1.1.1 255.255.255.0
 ip flow monitor LISP-Mon-Data input
!
interface TenGigabitEthernet5/2
 description EID [AccessSw-2::t1/49]
 ip address 10.2.0.1 255.255.255.0
 ip flow monitor LISP-Mon-Data input
```

LISP and Flexible NetFlow

Use NetFlow to monitor flows before and after LISP Encap

```
Access-Sw2#ping 10.1.0.100 source 10.2.0.100
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.0.100, timeout is 2 seconds:
Packet sent with a source address of 10.2.0.100
..!!!
Success rate is 60 percent (3/5), round-trip min/avg/max = 1/2/4 ms
Access-Sw2#
```



View NetFlow Cache on Ingress and Egress Interfaces

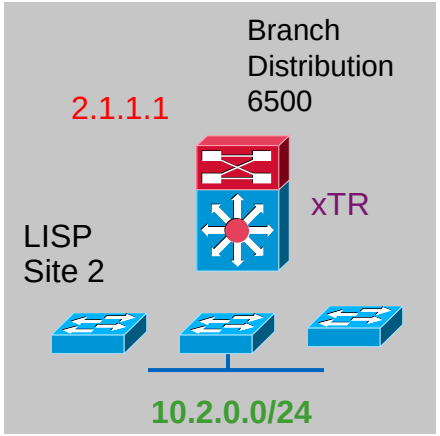
Before Encap

DATALINK VLAN INPUT: 1012
IP VRF ID INPUT: 0 (DEFAULT)
IPV4 SOURCE ADDRESS: 10.2.0.100
IPV4 DESTINATION ADDRESS: 10.1.0.100 ←
TRNS SOURCE PORT: 0
TRNS DESTINATION PORT: 2048 ←
IP VERSION: 4
IP TOS: 0x00
IP DSCP: 0x00
IP PRECEDENCE: 0

LISP and Flexible NetFlow

Use NetFlow to monitor flows before and after LISP Encap

```
Access-Sw2#ping 10.1.0.100 source 10.2.0.100
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.1.0.100, timeout is 2 seconds:
Packet sent with a source address of 10.2.0.100
..!!!
Success rate is 60 percent (3/5), round-trip min/avg/max = 1/2/4 ms
Access-Sw2#
```



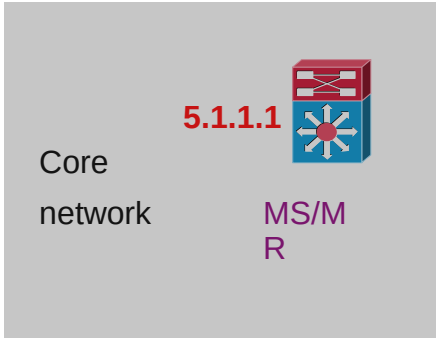
View NetFlow Cache on Ingress and Egress Interfaces

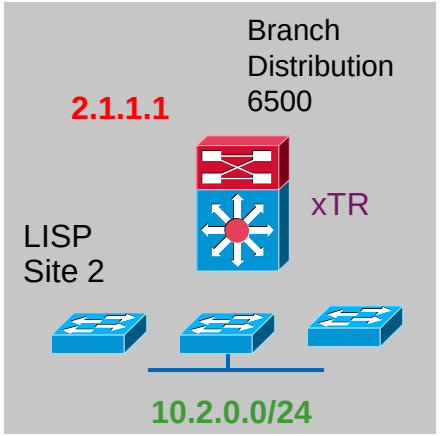
After Encap

DATALINK VLAN INPUT: 1012
IP VRF ID INPUT: 0 (DEFAULT)
IPV4 SOURCE ADDRESS: 1.1.1.1
IPV4 DESTINATION ADDRESS: 2.1.1.1 ←
TRNS SOURCE PORT: 49154
TRNS DESTINATION PORT: 4341 ←
IP VERSION: 4
IP TOS: 0x00
IP DSCP: 0x00
IP PRECEDENCE: 0

LISP and Flexible NetFlow

Use NetFlow to monitor flows before and after LISP Encap





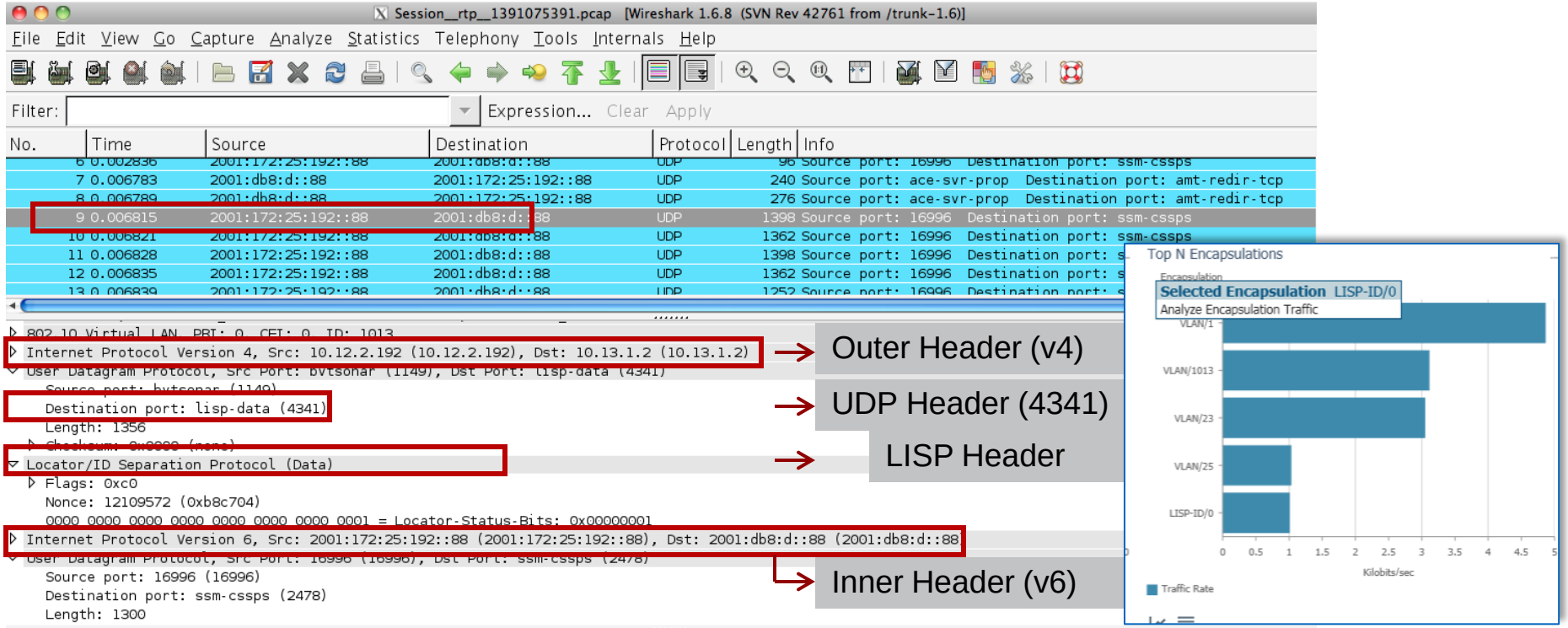
View NetFlow Cache on for Control Packets

Mapping

DATALINK VLAN INPUT: 1012
IP VRF ID INPUT: 0 (DEFAULT)
IPV4 SOURCE ADDRESS: 5.1.1.1
IPV4 DESTINATION ADDRESS: 2.1.1.1
TRNS SOURCE PORT: 4342
TRNS DESTINATION PORT: 4342
IP VERSION: 4
IP TOS: 0x00
IP DSCP: 0x00
IP PRECEDENCE: 0

LISP and NAM-3

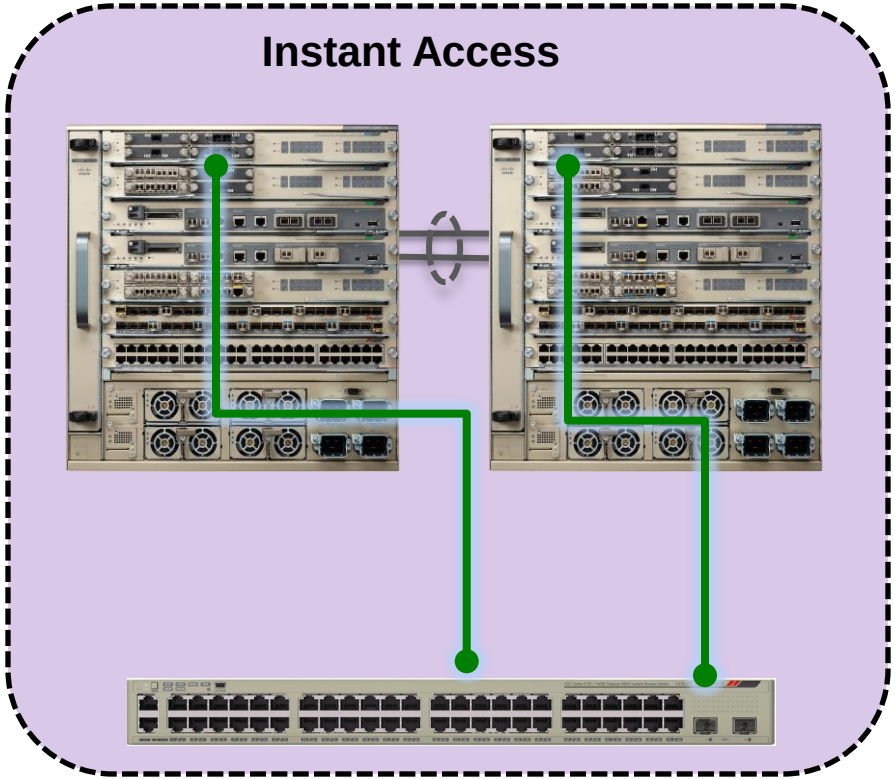
LISP Packet Analysis using the Network Analysis Module



The NAM-3 version 6.0 supports LISP packet analysis

LISP and Instant Access

Implementing both VNTAG and LISP on the same module



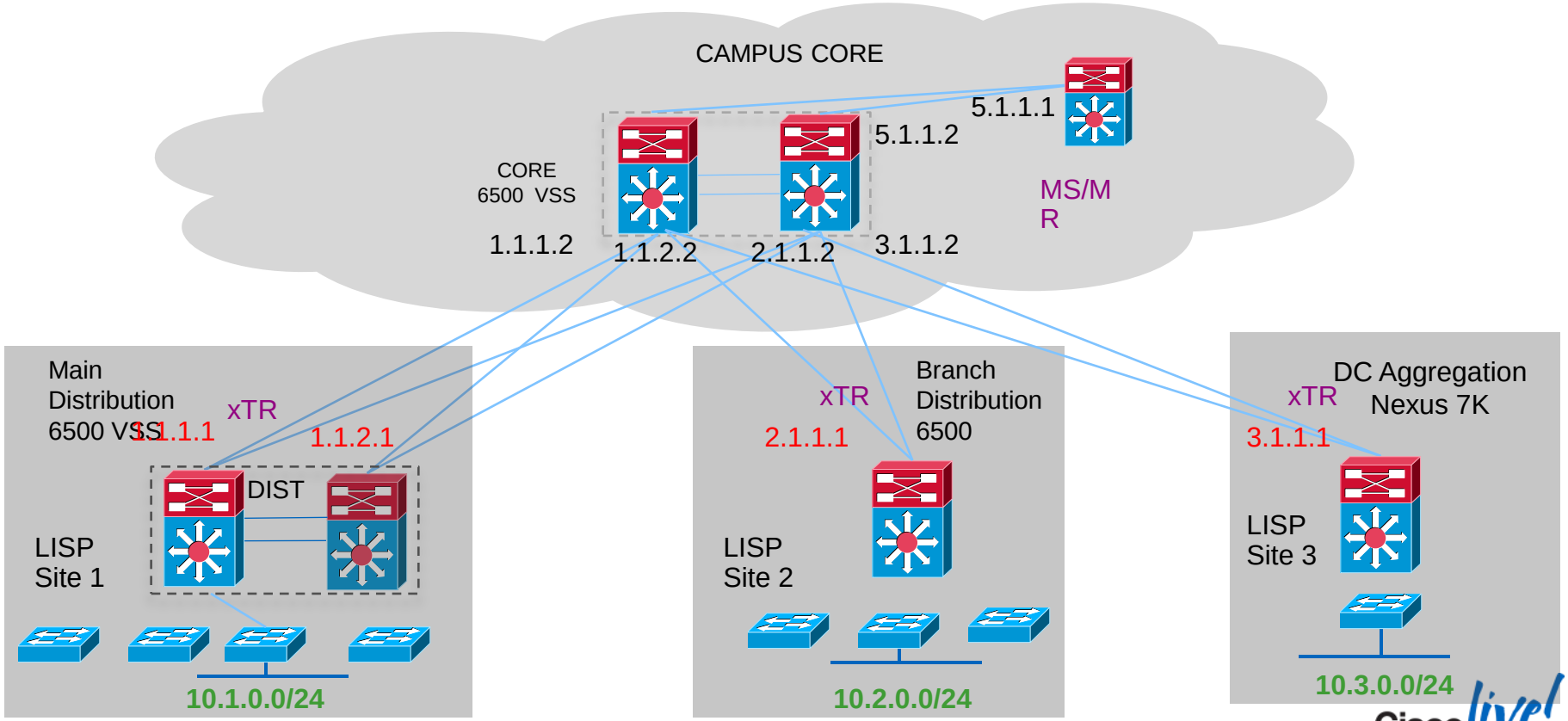
- Instant Access uses VNTAG to encapsulate packets between client and parent
- Parent switch can be 6880-X or 6500-E/6807-XL with 6904 linecard
- Same linecard can also be used for LISP encap when used as LISP xTR
- LISP Encap will be processed after VNTAG decap to provide end to end solution with LISP and IA

Agenda

- Introduction to LISP (Locator/ID Separation Protocol)
- LISP Deployments in Campus Networks
  - Multihoming
  - IPv6 Transition
  - Multi-tenancy and Virtualisation
- LISP Implementation on Catalyst 6K
  - Hardware and Software support
  - Packet Forwarding
  - Configuration guidelines
  - Interoperability with other features
- **LISP Examples and Summary**

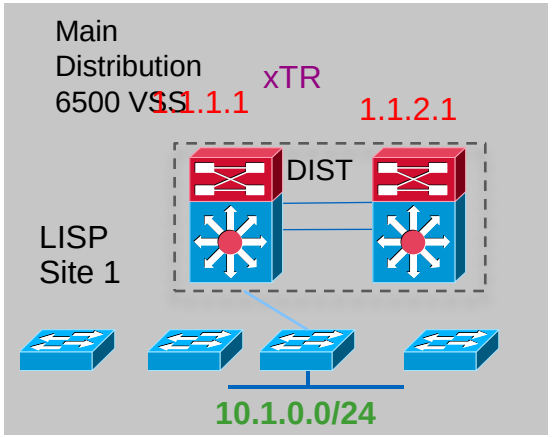
Scenario 1: LISP in Campus Deployment

Topology



LISP Verification Commands

Verify LISP database and map cache on each xTR



Verify that the ETR registers its local EID Prefixes

```
DIST-VSS#show ip lisp database
LISP ETR IPv4 Mapping Database for EID-table default (IID 0), LSBs: 0x1, 1 entries

EID-prefix: 10.1.0.0/24
  1.1.1.1, priority: 1, weight: 50, state: site-self, reachable
DIST-VSS#
```

Initial state of map cache on ITR – no remote EID Prefixes

```
DIST-VSS#show ip lisp map-cache
LISP IPv4 Mapping Cache for EID-table default (IID 0), 1 entries

0.0.0.0/0, uptime: 1w2d, expires: never, via static send map-request
  Negative cache entry, action: send-map-request
DIST-VSS#
```

LISP Verification Commands

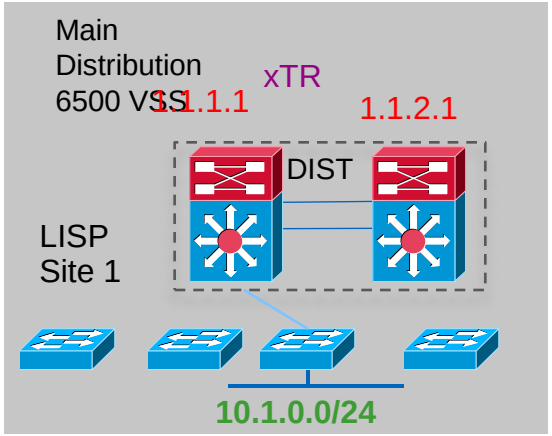
Verify LISP map cache

Generate traffic to trigger EID-RLOC mapping for remote EID

```
Access-Sw1#ping 10.2.0.100 source 10.1.0.100
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 10.2.0.100, timeout is 2 seconds:
Packet sent with a source address of 10.1.0.100
..!!!
Success rate is 60 percent (3/5), round-trip min/avg/max = 1/2/4 ms
Access-Sw1#

DIST-VSS#show ip lisp map-cache
LISP IPv4 Mapping Cache for EID-table default (IID 0), 2 entries

0.0.0.0/0, uptime: 1w2d, expires: never, via static send map-request
  Negative cache entry, action: send-map-request
10.2.0.0/24, uptime: 00:00:34, expires: 23:59:18, via map-reply, complete
  Locator  Uptime    State      Pri/Wgt
  2.1.1.1  00:00:34  up         1/100
DIST-VSS#
```

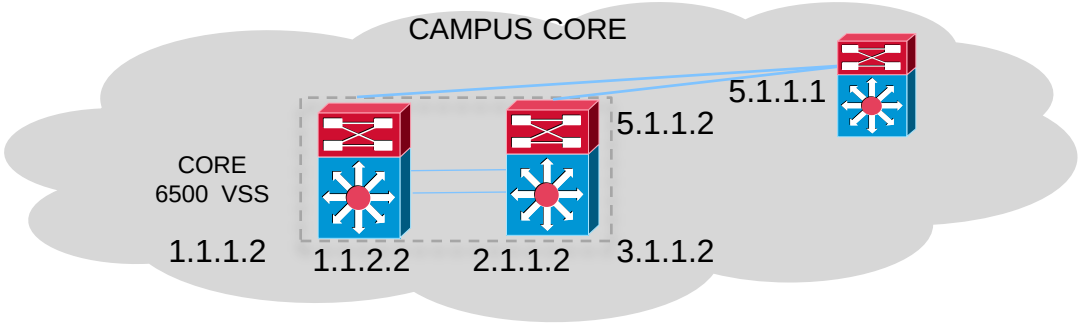


LISP Config Guidelines and Caveats

Map Server and Map Resolver status

```
MS-MR#sh lisp site detail
LISP Site Registration Information

Site name: Site-1
Allowed configured locators: any
Allowed EID-prefixes:
  EID-prefix: 10.1.0.0/24
    First registered:     4d18h
    Routing table tag:    0
    Origin:               Configuration
    Registration errors:
      Authentication failures:   0
      Allowed locators mismatch: 0
    ETR 1.1.1.1, last registered 00:00:15, no proxy-reply, no map-notify
                 TTL 1d00h
      Locator  Local  State      Pri/Wgt
      1.1.1.1  yes    up         1/50
Site name: Site-2
Allowed configured locators: any
---<snip>
MS-MR#
```

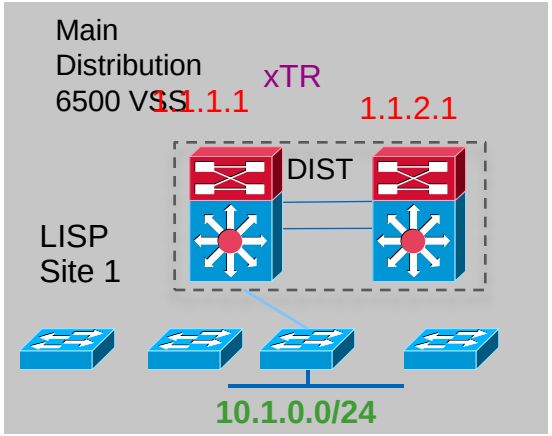


LISP Config Guidelines and Caveats

Platform specific verification commands

Verify CEF Entries on Catalyst 6500

```
DIST-VSS#sh platform hardware cef lookup 10.2.1.0
Codes: decap - Decapsulation, + - Push Label
Index  Prefix              Adjacency
526337 10.2.1.0/24         Te1/2/1          ,001f.269c.4800
DIST-VSS#
```



Verify LISP adjacency on Catalyst 6500

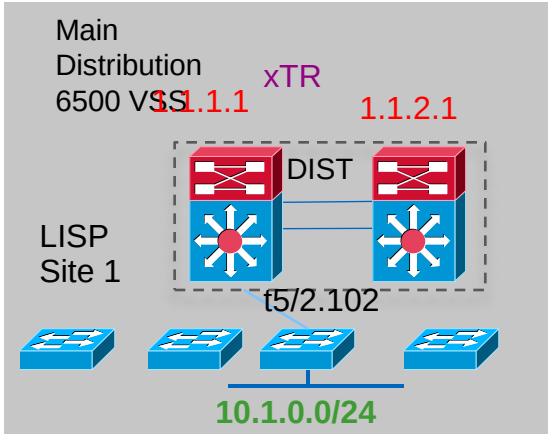
```
DIST-VSS#show adjacency LISP0
Protocol Interface              Address
IP       LISP0                  2.1.1.1(7)
DIST-VSS#
```

LISP Config Guidelines and Caveats

Platform-specific troubleshooting tip!

```
SUP2T-1#show platform datapath ingress-interface t5/2.102
Capturing from TenGigabitEthernet5/2.102 src_index 257[0x101] vlan 102
SUP2T-1#
```

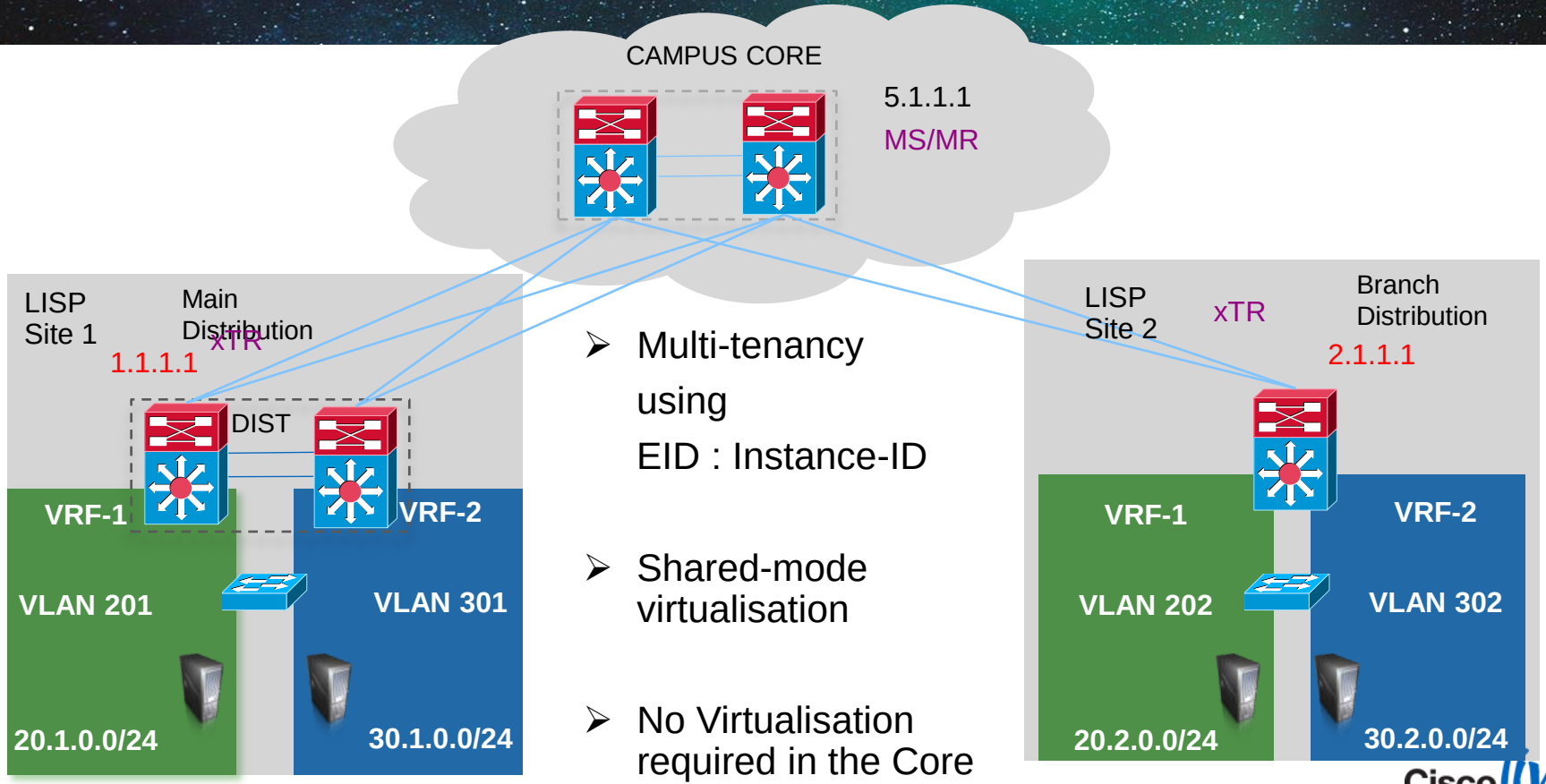
```
        Basic Packet Flow
        -----------------
 Packet   ICMP(1)[len=118]R: 10.2.0.100 -> 10.1.0.100
   |          Dscp/Tos 0/0x0 Ttl 255
   |      RouterMAC 0013.5f4d.fc00 SMAC 0019.5629.4ebf
   |      Vlan 102 CoS 0 1q 1
   V
Te5/2[101] Ingress Lif 0x404E Vlan 102
   |      ILM 0x404E Lif_Sel 1 Lif_Base 0x0
   |      Cpp_en
   V
Ingress    ACL: Permit (Default) Lbl_A 2049 Lbl_B 2
Features   QoS: Default (Tcam_Lkup_Disabled)
   V
Ingress    Key[81029]: Profile[7/9] T[Create 0x9700 Last 0xA150]
Netflow
   V
 FIB-L3    Key: 10.1.0.0 [VPN 4096]
   |      TCAM[35392] Adj 0x3800A N_Push 1
   V
Adjacency  [FIB] L3_Enable Rdt Dec_Ttl ADJ[IP][0x3800A]
   |      Tnl_Enc[IP_Tnl/2]
   V
EgressLIF  0x404F DstIdx[7FFB] Vlan 1012 IpMtu 1482[20] Base 0x0
...
```



Path of the packet through the forwarding engine can be traced using the command shown

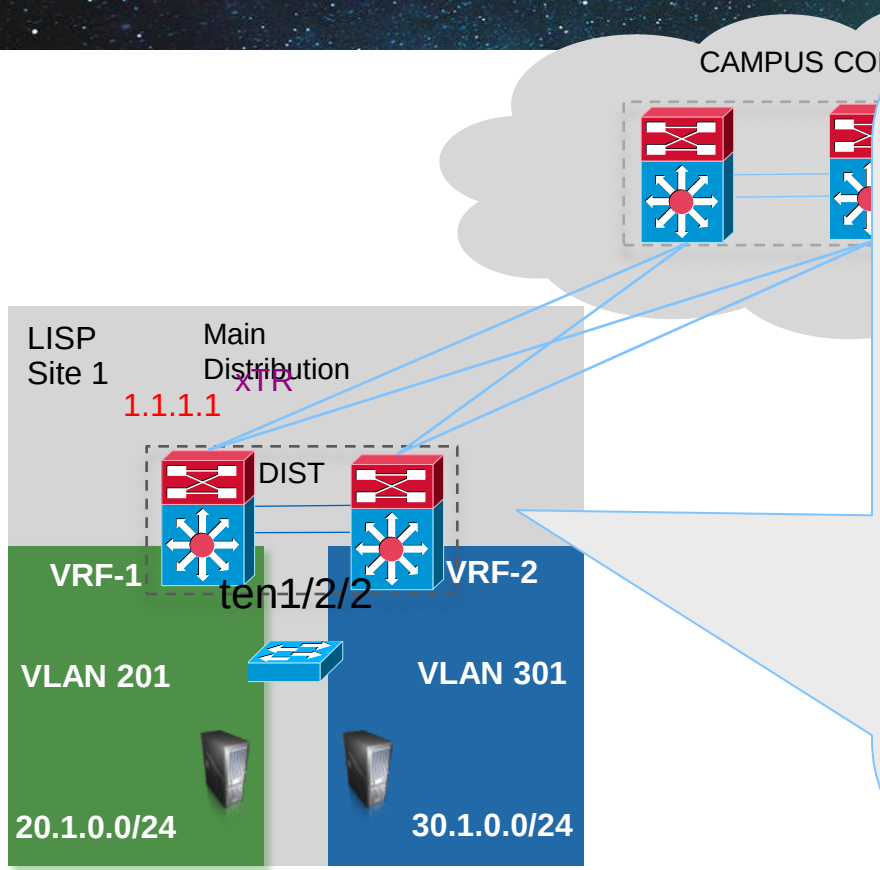
Scenario 2: LISP and Multi-tenancy

Topology



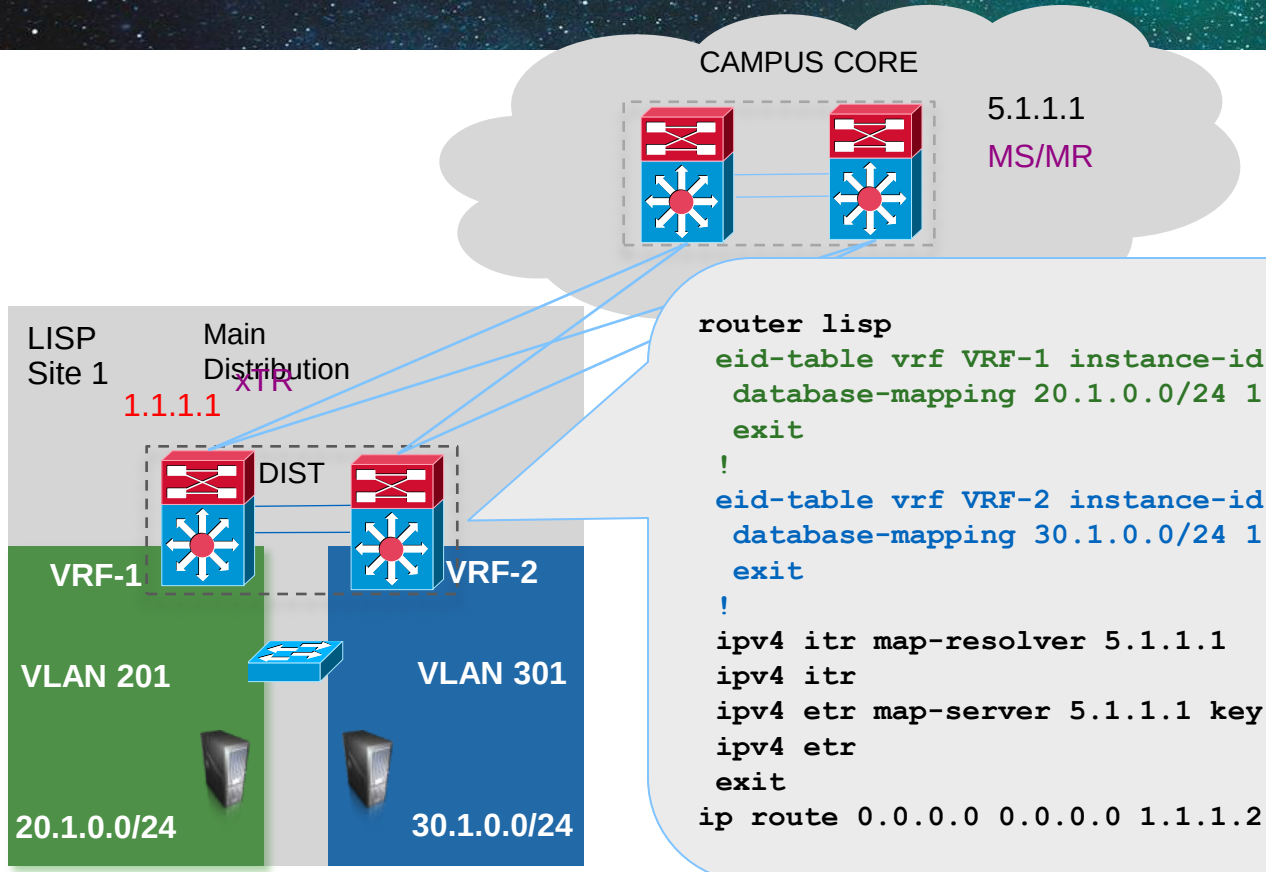
- Multi-tenancy using EID : Instance-ID
- Shared-mode virtualisation
- No Virtualisation required in the Core

Configuration – Site 1 VRF Commands




```
vrf definition VRF-1
 !
 address-family ipv4
 exit-address-family
!
vrf definition VRF-2
 !
 address-family ipv4
 exit-address-family
!
interface TenGigabitEthernet1/2/2
!
interface TenGigabitEthernet1/2/2.201
 encapsulation dot1Q 201
 vrf forwarding VRF-1
 ip address 20.1.0.1 255.255.255.0
!
interface TenGigabitEthernet1/2/2.301
 encapsulation dot1Q 301
 vrf forwarding VRF-2
 ip address 30.1.0.1 255.255.255.0
!
```

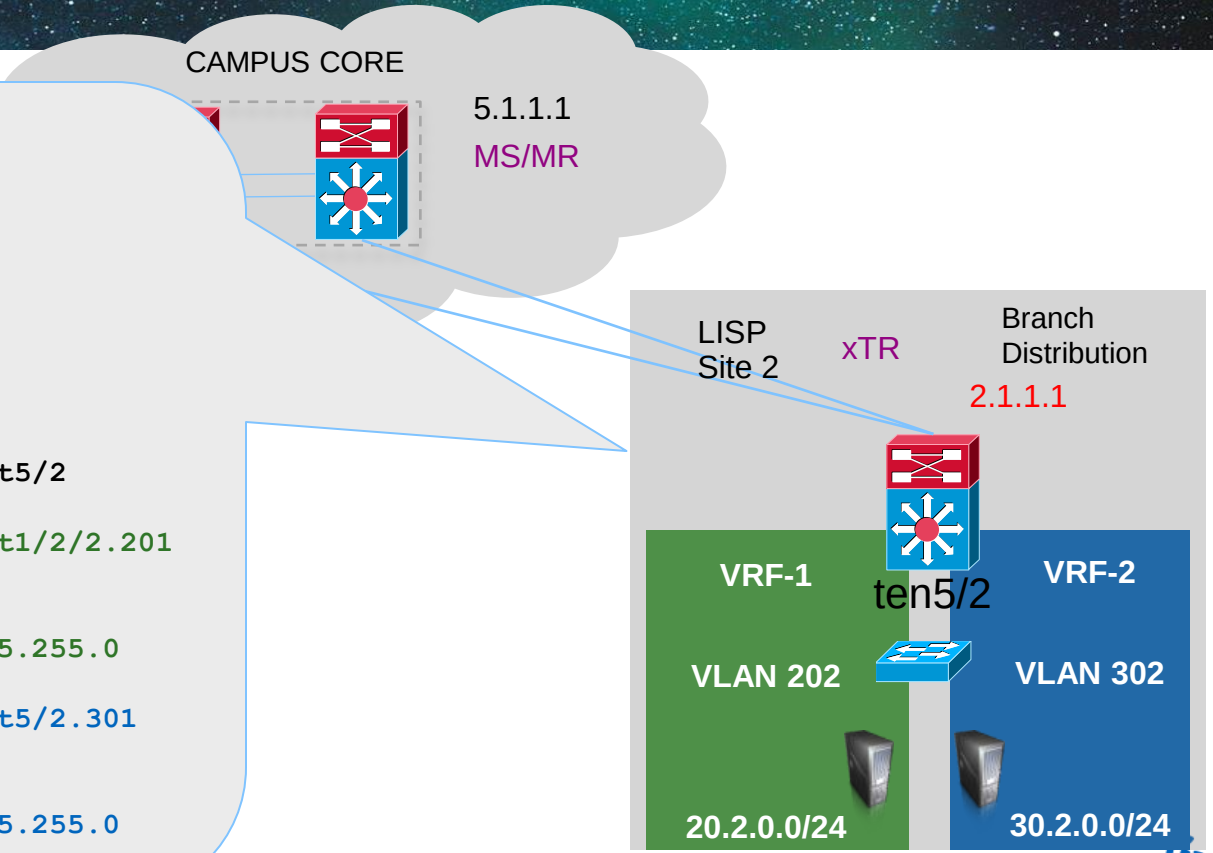
Configuration – Site 1 LISP Commands



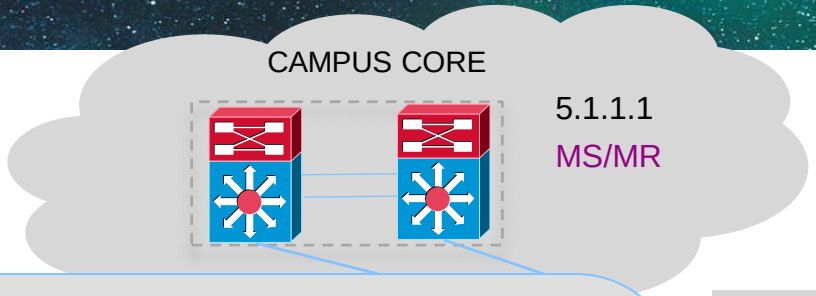

```
router lisp
 eid-table vrf VRF-1 instance-id 1
  database-mapping 20.1.0.0/24 1.1.1.1 priority 1 weight 100
  exit
 !
 eid-table vrf VRF-2 instance-id 2
  database-mapping 30.1.0.0/24 1.1.1.1 priority 1 weight 100
  exit
 !
 ipv4 itr map-resolver 5.1.1.1
 ipv4 itr
 ipv4 etr map-server 5.1.1.1 key Site-1
 ipv4 etr
 exit
ip route 0.0.0.0 0.0.0.0 1.1.1.2
```

Configuration – Site 2 VRF Commands

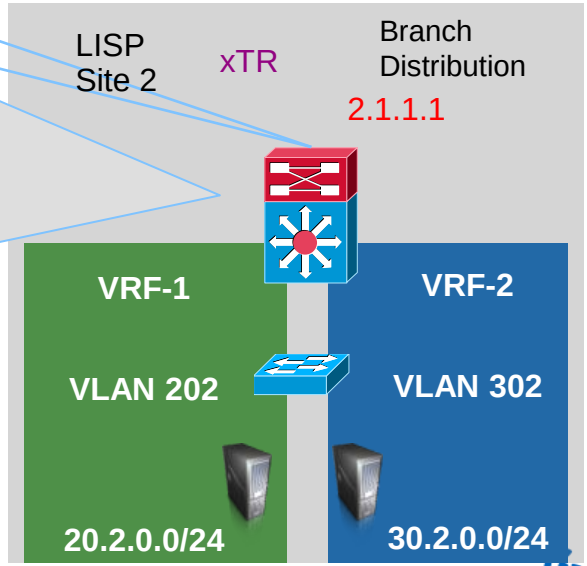
```
vrf definition VRF-1
 !
 address-family ipv4
 exit-address-family
!
vrf definition VRF-2
 !
 address-family ipv4
 exit-address-family
!
interface TenGigabitEthernet5/2
!
interface TenGigabitEthernet1/2/2.201
 encapsulation dot1Q 201
 vrf forwarding VRF-1
 ip address 20.2.0.1 255.255.255.0
!
interface TenGigabitEthernet5/2.301
 encapsulation dot1Q 301
 vrf forwarding VRF-2
 ip address 30.2.0.1 255.255.255.0
!
```



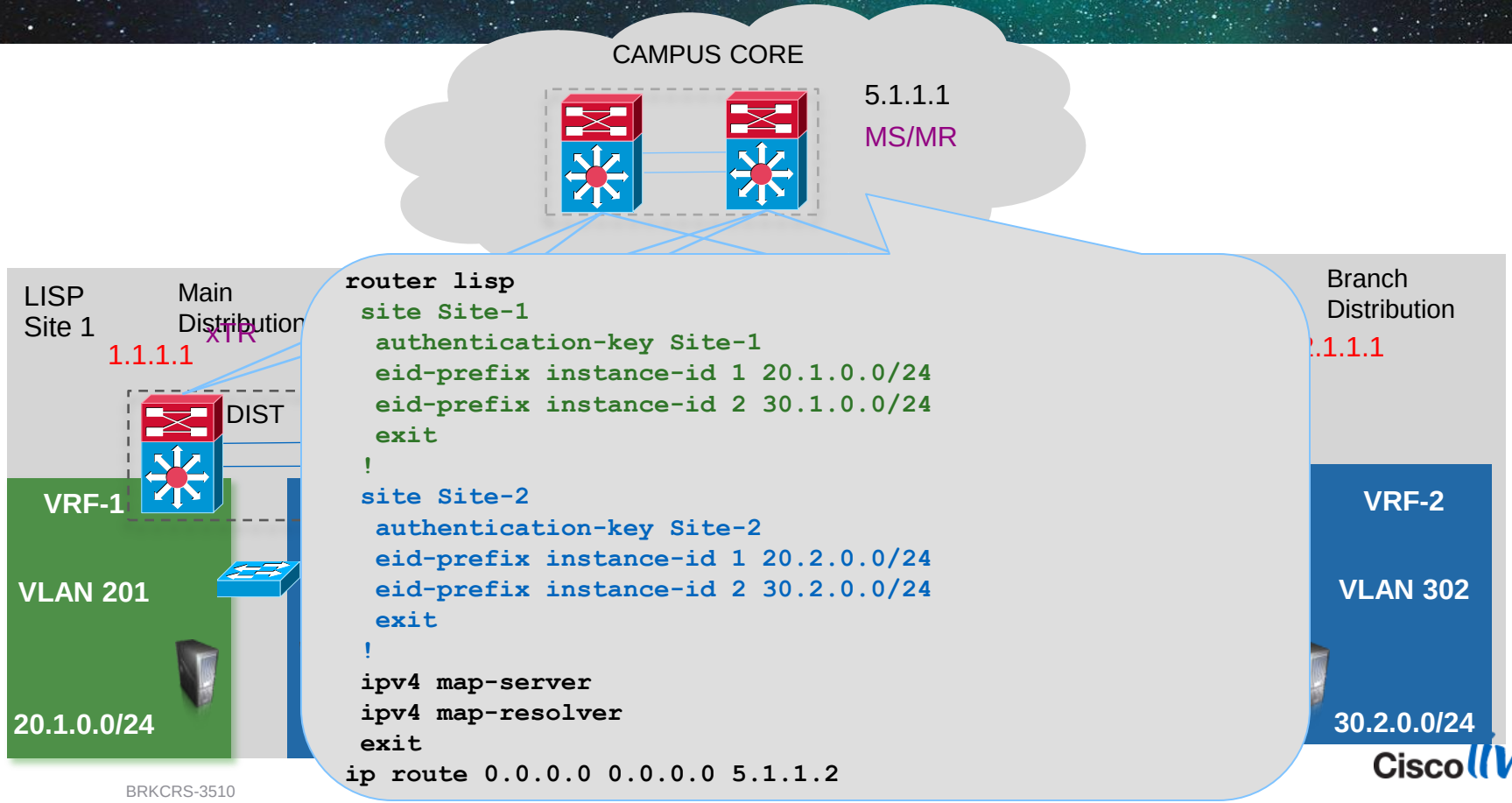
Configuration – Site 2 LISP Commands




```
router lisp
 eid-table vrf VRF-1 instance-id 1
  database-mapping 20.2.0.0/24 2.1.1.1 priority 1 weight 100
  exit
 !
 eid-table vrf VRF-2 instance-id 2
  database-mapping 30.2.0.0/24 2.1.1.1 priority 1 weight 100
  exit
 !
 ipv4 itr map-resolver 5.1.1.1
 ipv4 itr
 ipv4 etr map-server 5.1.1.1 key Site-2
 ipv4 etr
 exit
ip route 0.0.0.0 0.0.0.0 2.1.1.2
```



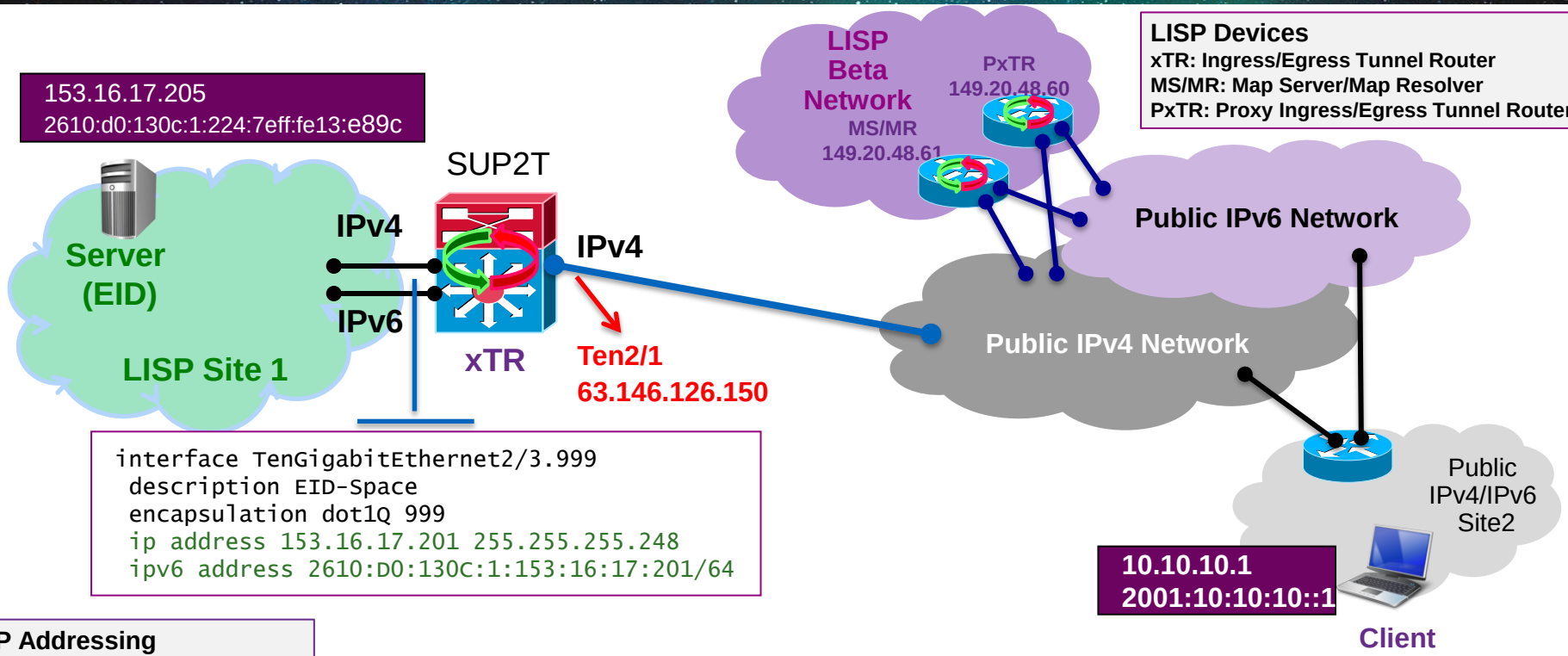
Configuration – Map Server and Map Resolver



Scenario 3 – LISP to enable IPv6 Internet Web-presence

LISP for IPv6 Web-presence

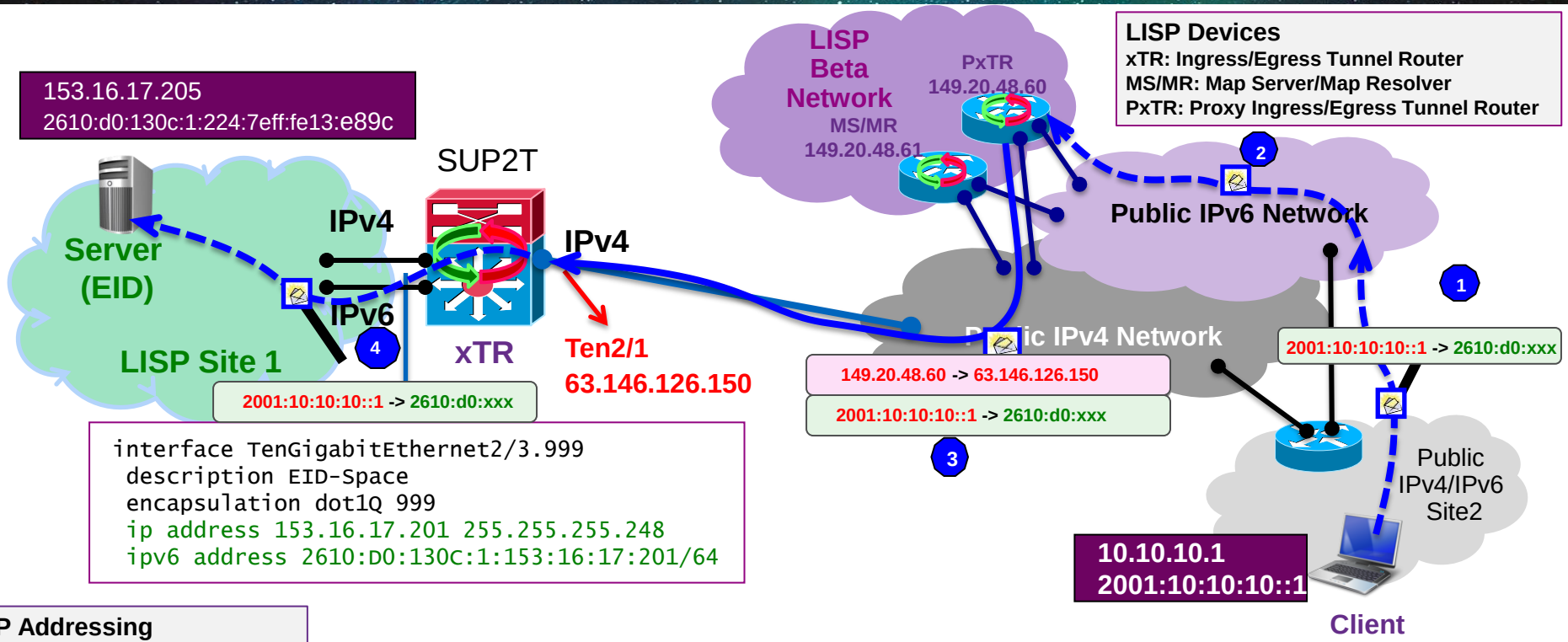
Packet Flow from Public IPv6 Internet to LISP Site



Note: MS/MR and PxTR are provided by the LISP Beta Network

LISP for IPv6 Web-presence

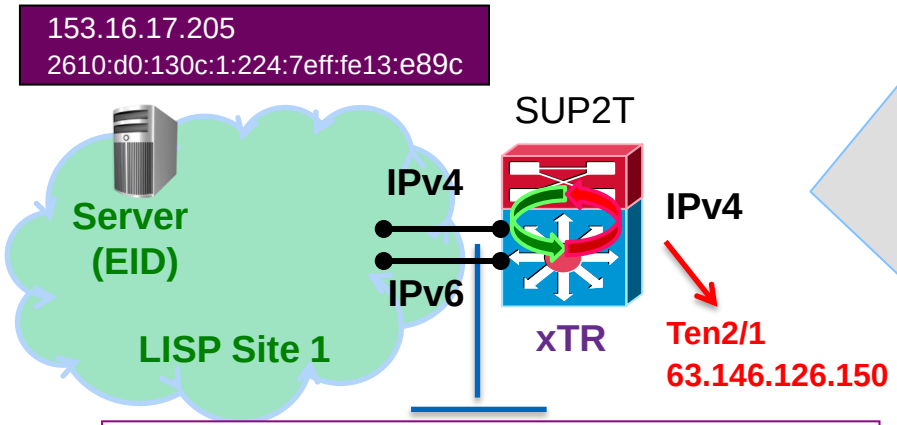
Packet Flow from Public IPv6 Internet to LISP Site



Note: MS/MR and PxTR are provided by the LISP Beta Network

LISP for IPv6 Web-presence

Configuration




```
interface TenGigabitEthernet2/3.999
 description EID-Space
 encapsulation dot1Q 999
 ip address 153.16.17.201 255.255.255.248
 ipv6 address 2610:D0:130C:1:153:16:17:201/64
```

```
router lisp
 eid-table default instance-id 0
  database-mapping 153.16.17.192/28 63.146.126.150
priority 1 weight 100
  database-mapping 2610:D0:130C::/48 63.146.126.150
priority 1 weight 100
  exit
 !
 ipv4 use-petr 149.20.48.60
 ipv4 itr map-resolver 149.20.48.61
 ipv4 itr map-resolver 173.36.254.164
 ipv4 itr
 ipv4 etr map-server 149.20.48.61 key divya-xtr
 ipv4 etr map-server 173.36.254.164 key divya-xtr
 ipv4 etr
 ipv6 use-petr 149.20.48.60
 ipv6 itr map-resolver 149.20.48.61
 ipv6 itr map-resolver 173.36.254.164
 ipv6 itr
 ipv6 etr map-server 149.20.48.61 key divya-xtr
 ipv6 etr map-server 173.36.254.164 key divya-xtr
 ipv6 etr
 exit
!
```

IP Addressing
EID: Endpoint Identifier
RLOC: Routing Locator

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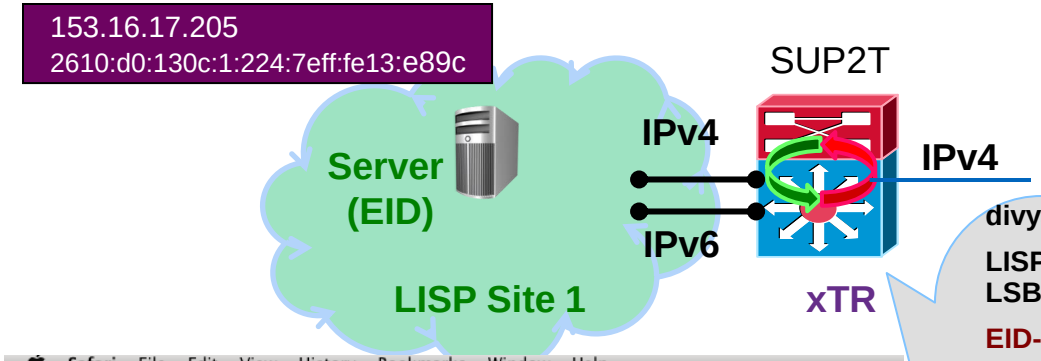
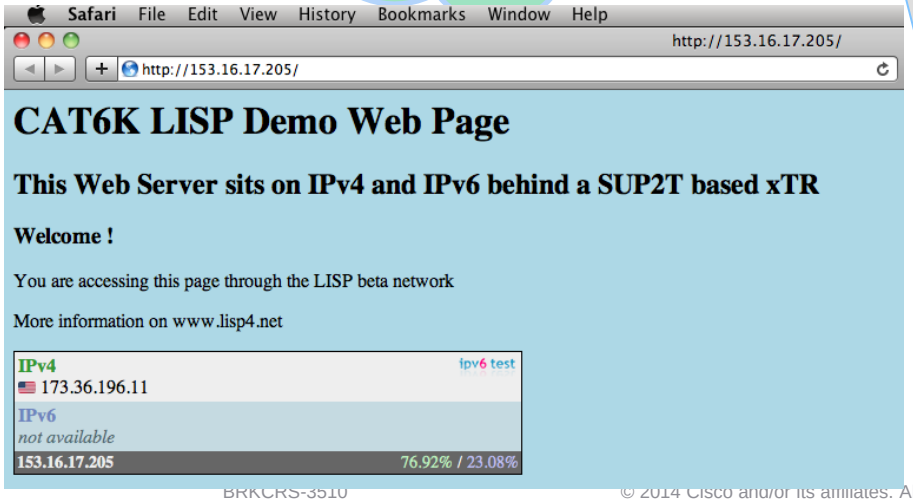
Verification






```
divya-xtr#show ip lisp database
LISP ETR IPv4 Mapping Database for EID-table default (IID 0), LSBs: 0x1, 1 entries
EID-prefix: 153.16.17.192/28
  63.146.126.150, priority: 1, weight: 100, state: site-self, reachable
divya-xtr#
divya-xtr#show ip lisp map-cache
LISP IPv4 Mapping Cache for EID-table default (IID 0), 2 entries
0.0.0.0/0, uptime: 8w4d, expires: never, via static send map-request
  Negative cache entry, action: send-map-request
160.0.0.0/3, uptime: 00:02:12, expires: 00:07:40, via map-reply, forward-native
  Encapsulating to proxy ETR
divya-xtr#
```

Summary

LISP Highlights

LISP is a routing architecture, not a feature

- LISP enables IP address portability (using EIDs)
- LISP enables pull versus push routing (using mapping)
- LISP is address-family agnostic (IPv6 deployment)
- LISP has inherent advantages in multihoming and virtualisation
- LISP is an open standard (approved RFC in experimental section)

LISP Status

RFCs and Drafts

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

Draft	Next Steps/Target
Locator/ID Separation Protocol (LISP) base document	**RFC 6830**
LISP+ALT	**RFC 6836**
LISP Map Server	**RFC 6833**
LISP Interworking	**RFC 6832**
LISP Map Versioning	**RFC 6834**
LISP Multicast	**RFC 6831**
LISP Internet Groper	**RFC 6835**
LISP MIB (draft-ietf-lisp-mib-09)	Waiting for AD approval…
LISP Canonical Address Format (draft-ietf-lisp-lcaf-02)	Active Working Group Document…
LISP Deployment (draft-ietf-lisp-deployment-06)	Active Working Group Document…
LISP SEC (draft-ietf-lisp-sec-04)	Active Working Group Document…
LISP DDT (draft-fuller-lisp-ddt-00)	Active Working Group Document…
LISP Mobile Node (draft-meyer-lisp-mn-08)	Proposed for WG adoption (3 prototypes available)

LISP References

Mailing lists and URLs

- LISP Information
  - IETF LISP Working Group ……..… http://tools.ietf.org/wg/lisp/
  - LISP Beta Network Site ……..…… http://www.lisp4.net or http://www.lisp6.net
  - Cisco LISP Site ……. http://lisp.cisco.com (IPv4 and IPv6)
  - Cisco LISP Marketing Site ..…….. http://www.cisco.com/go/lisp/
  - Cisco mailing list for LISP..…….. Lisp-support@cisco.com
- White Papers

Enterprise IPv6 Transition Strategy Using the Locator/ID Separation Protocol

http://www.cisco.com/en/US/prod/collateral/iosswrel/ps6537/ps6554/ps6599/ps10800/white_paper_c11-629044.pdf

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