

配置LISP并排除故障

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简介

思科定位器/ID分离协议(LISP)通过创建两个新命名空间来更改当前IP地址语义：分配给终端主机的终端标识符(EID)和分配给组成全局路由系统的设备（主要是路由器）的路由定位器(RLOC)。

当路由器具有完整的互联网路由表时，它需要内存和进程利用率，LISP可帮助降低内存利用率。

先决条件

思科建议您具备LISP的基本知识。

使用的组件

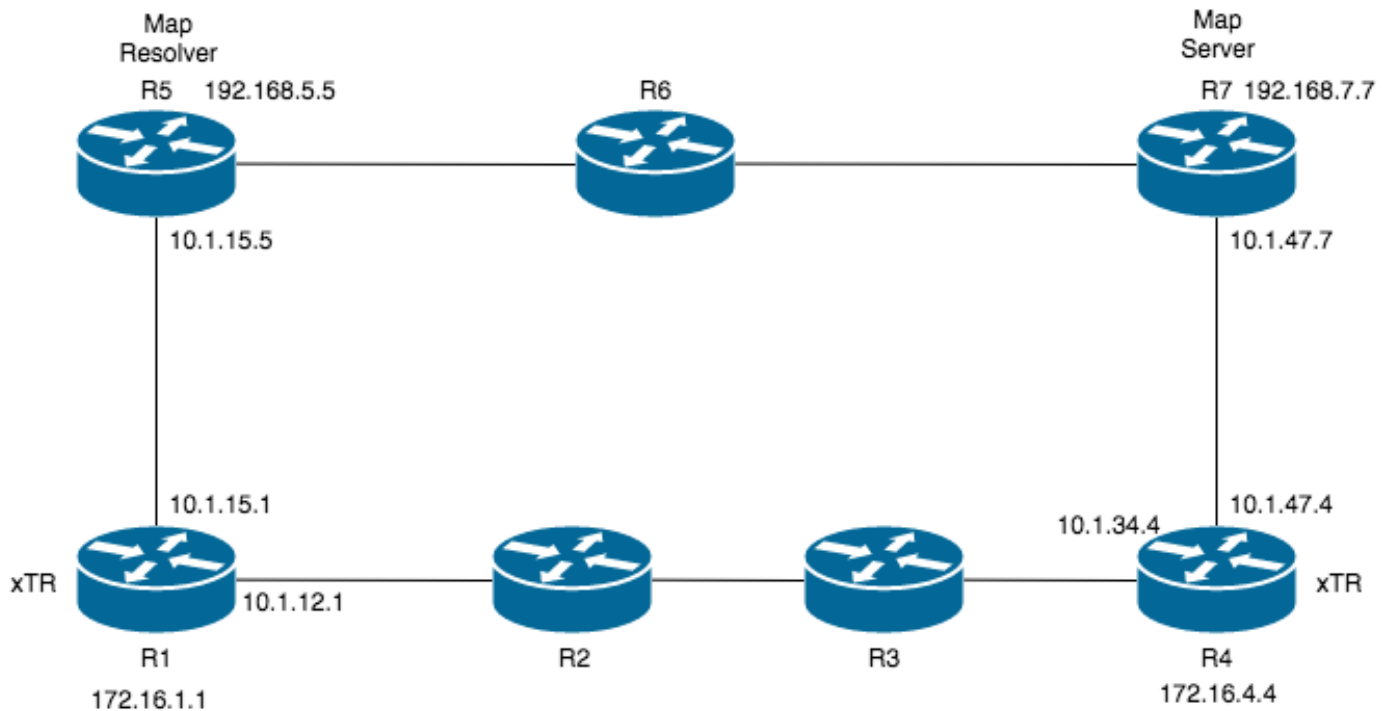
本文档不限于特定的软件和硬件版本。

本文档中的信息都是基于特定实验室环境中的设备编写的。本文档中使用的所有设备最初均采用原始（默认）配置。如果您使用的是真实网络，请确保您已经了解所有命令的潜在影响。

配置

网络图

以下图像将用作文档其余部分的示例拓扑：



xTR = LISP路由器可以是ITR或ETR，具体取决于流量方向。如果流量从LISP路由器流出，它将成为该流的ITR，而接收端LISP路由器将成为该路由器的ETR。

ITR = 入口隧道路由器

ETR = 出口隧道路由器

映射解析器(MR) = 映射解析器是LISP站点ITR在解析EID到RLOC映射时向其发送LISP映射请求查询的LISP基础设施设备。R5是本文中的MR。

映射服务器(MS) = 映射服务器是LISP站点ETR使用其EID前缀注册到的LISP基础设施设备。映射服务器将注册的EID前缀的聚合通告给LISP映射系统。所有LISP站点都使用LISP映射系统来解析EID到RLOC的映射。R7是本文中的MS。

终端标识符(EID)地址：EID地址包括IP地址和标识终端的前缀。通过解析EID到RLOC的映射，可实现LISP站点间的EID可达性。

路由定位器(RLOC)地址：RLOC地址包括IP地址和标识IP网络中不同路由器的前缀。RLOC空间内的可达性通过传统路由方法实现。

ALT (备用逻辑拓扑)：连接映射解析器和映射服务器的链路通过R6，是此图中的ALT，仅用于两者之间的控制平面通信。此链路从不用于xTR之间的实际流量。

alt-vrf: 此虚拟路由和转发(VRF)用于配置定位器/ID分离协议(LISP)在通过IPv4端点标识符到路由定位器 (EID到RLOC) 映射直接发送映射请求时应使用的支持IPv4地址系列的VRF实例备用逻辑拓扑(ALT)

R1配置

```
!
router lisp
database-mapping 172.16.1.1/32 10.1.12.1 priority 5 weight 100 -----> EID Mapping with RLOC
```

```

ipv4 itr map-resolver 192.168.5.5
ipv4 itr
ipv4 etr map-server 192.168.7.7 key cisco ---> ETR will send the map-register message to map server for EID
ipv4 etr
exit
!

```

R4配置

```

!
router lisp
database-mapping 172.16.4.4/32 10.1.34.4 priority 5 weight 100 -----> EID Mapping with RLOC
ipv4 itr map-resolver 192.168.5.5
ipv4 itr
ipv4 etr map-server 192.168.7.7 key cisco ---> ETR will send the map-register message to map server for EID
ipv4 etr
exit
!

```

R5：映射解析器配置

在Map-Resolved下，它强制将vrf定义为alt-vrf，该alt-vrf将用于在MR和MS之间形成MPBGP对等，然后用于共享通过xTR注册到MS的远程站点的EID。

```

!
vrf definition lisp
rd 100:1
!
address-family ipv4
route-target export 100:1
route-target import 100:1
exit-address-family
!
!
interface Tunnel1
vrf forwarding lisp
ip address 10.1.45.4 255.255.255.0
tunnel source Ethernet0/1
tunnel destination 10.1.67.7
!
!
router lisp
ipv4 map-resolver
ipv4 alt-vrf lisp >>> This command defines "lisp" as the alt-vrf.
exit
!
router bgp 65000
!
address-family ipv4 vrf lisp
neighbor 10.1.45.5 remote-as 65000
neighbor 10.1.45.5 activate
exit-address-family
!

```

R7:MAP-Server配置

与MR类似，在MS上也需要配置alt-vrf。

```

!
router lisp
  site 1
    authentication-key cisco
    eid-prefix 172.16.4.4/32 accept-more-specifics
  exit
!
  site 2
    authentication-key cisco
    eid-prefix 172.16.1.1/32 accept-more-specifics
  exit
!
  ipv4 map-server
  ipv4 alt-vrf lisp                >>>>>> ALT VRF is lisp
  exit
!
vrf definition lisp
  rd 100:1
  !
  address-family ipv4
    route-target export 100:1
    route-target import 100:1
  exit-address-family
!
!
interface Tunnel1
  vrf forwarding lisp
  ip address 10.1.45.5 255.255.255.0
  tunnel source Ethernet0/0
  tunnel destination 10.1.56.5
!
router bgp 65000
!
  address-family ipv4 vrf lisp
  redistribute lisp
  neighbor 10.1.45.4 remote-as 65000
  neighbor 10.1.45.4 activate
  exit-address-family
!
end

```

验证

要触发LISP通信，需要满足以下条件之一：

1. xTR上的默认路由应指向空0。
2. 到远程xTR的EID的特定路由不应存在于任何xTR上。

以下是操作顺序：

1. 两个ETR都应将映射注册消息发送到映射服务器，以获取其EID和RLOC地址。
2. 当从ITR对ETR执行ping操作（即从172.16.1.1到172.16.4.4）时，ITR 172.16.1.1将向映射解析器172.16.5.5发送映射请求消息，映射解析器将通过ALT拓扑将请求转发到映射服务器。
3. 一旦MS收到来自MR的请求，它将相同的映射请求转发到远程ETR。
4. ETR收到映射请求后，将直接使用其RLOC地址回复ITR。

```
R1_XTR#sh ip route 172.16.4.4 -----> R4's EID
```

```
% Subnet not in table
```

```
R1_XTR#sh ip route 0.0.0.0
Routing entry for 0.0.0.0/0, supernet
  Known via "static", distance 1, metric 0 (connected), candidate default path
  Routing Descriptor Blocks:
    * directly connected, via Null0
      Route metric is 0, traffic share count is 1
```

如上所示，路由到R4的EID:17.16.4.4不在路由表中。而是静态配置了指向null0的默认路由。满足必要的触发条件后，对17.16.4.4执行ping操作将触发LISP封装。

```
R1_XTR#ping 172.16.4.4 source lo1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.4.4, timeout is 2 seconds:
Packet sent with a source address of 172.16.1.1
..!!!
Success rate is 60 percent (3/5), round-trip min/avg/max = 1/4/7 ms
R1_XTR#
```

为了使上述ping工作，R4通过LISP通信将有关目的xTR的信息发送到R1:

```
R1_XTR#sh ip lisp map-cache
LISP IPv4 Mapping Cache for EID-table default (IID 0), 2 entries

0.0.0.0/0, uptime: 06:10:24, expires: never, via static send map-request
  Negative cache entry, action: send-map-request
172.16.4.4/32, uptime: 05:55:27, expires: 18:04:32, via map-reply, complete
Locator      Uptime      State      Pri/Wgt
10.1.34.4    05:55:27   up         1/100
```

故障排除

以下是一些调试输出和数据包捕获，用于检查LISP数据包流。已启用以下debug命令以捕获信息：“debug lisp control-plane all”。

注意：请注意，debug命令会生成大量数据，需要在受控环境中运行。

在xTR-R1上调试

在下面的调试消息中，R1正在向MS注册其EID，然后MS将确认。同样，R4也将向MS注册其EID。

```
*Oct 16 12:46:09.398: LISP-0: IPv4 Map Server IID 0 192.168.7.7, Sending map-register (src_rloc
10.1.15.1) nonce 0xBEB73F0C-0xFE3EBC4E.
*Oct 16 12:46:09.403: LISP: Processing received Map-Notify message from 192.168.7.7 to 10.1.15.1
现在，从R1向R4的EID发起ping，源自R1的EID，R1立即向MR发送映射请求数据包。
```

```
R1_XTR#ping 172.16.4.4 source 172.16.1.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.16.4.4, timeout is 2 seconds:
Packet sent with a source address of 172.16.1.1
```

```
*Oct 16 12:46:23.380: LISP: Send map request type remote EID prefix
*Oct 16 12:46:23.380: LISP: Send map request for EID prefix IID 0 172.16.4.4/32
*Oct 16 12:46:23.380: LISP-0: Remote EID IID 0 prefix 172.16.4.4/32, Send map request (1)
(sources: <signal>, state: incomplete, rlocs: 0).
*Oct 16 12:46:23.380: LISP-0: AF IPv4, Sending map-request from 10.1.12.1 to 172.16.4.4 for EID
172.16.4.4/32, ITR-RLOCs 1, nonce 0x99255979-0x30A1BAC1 (encap src 10.1.15.1, dst 192.168.5.5).
收到数据包时，MR与MS联系以标识为此EID注册的xTR，并将映射请求消息转发到R4。R4作为回
报，将映射应答发送回R1，其RLOC为：
```

```
*Oct 16 12:46:23.389: LISP: Processing received Map-Reply message from 10.1.34.4 to 10.1.12.1
*Oct 16 12:46:23.389: LISP: Received map reply nonce 0x99255979-0x30A1BAC1, records 1
*Oct 16 12:46:23.389: LISP: Processing Map-Reply mapping record for IID 0 172.16.4.4/32, ttl
1440, action none, authoritative, 1 locator
10.1.34.4 pri/wei=1/100 LpR
*Oct 16 12:46:23.389: LISP-0: Map Request IID 0 prefix 172.16.4.4/32 remote EID prefix[LL],
Received reply with rtt 9ms.
*Oct 16 12:46:23.389: LISP: Processing mapping information for EID prefix IID 0 172.16.4.4/32
```

映射解析器数据包流

如下所示，MR首先收到来自R1的映射请求消息，以了解172.16.4.4的RLOC。然后，在从MS获取的EID中检查其BGP lisp vrf表是否匹配，并在发现匹配时MR将映射请求转发到MS:

```
LISP_Resolver#show ip bgp vpv4 vrf lisp
```

```
BGP table version is 3, local router ID is 192.168.5.5
Status codes: s suppressed, d damped, h history, * valid, > best, i - internal,
               r RIB-failure, S Stale, m multipath, b backup-path, f RT-Filter,
               x best-external, a additional-path, c RIB-compressed,
Origin codes: i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found
   Network          Next Hop          Metric LocPrf Weight Path
Route Distinguisher: 100:1 (default for vrf lisp)
*>i 172.16.1.1/32    10.1.145.5        1     100     0 ?
*>i 172.16.4.4/32    10.1.145.5        1     100     0 ?
```

```
*Oct 16 12:46:23.384: LISP: Processing received Map-Request message from 10.1.12.1 to 172.16.4.4
*Oct 16 12:46:23.384: LISP: Received map request for IID 0 172.16.4.4/32, source_eid IID 0
172.16.1.1, ITR-RLOCs: 10.1.12.1, records 1, nonce 0x99255979-0x30A1BAC1
*Oct 16 12:46:23.384: LISP-0: AF IID 0 IPv4, Forwarding map request to 172.16.4.4 on the ALT.
```

注意：即使日志消息显示映射请求正被转发到172.16.4.4，它实际上也会根据BGP表中的下一跳条目发送到MS。

映射服务器数据包流

在MS上运行的调试显示先从R1和R4注册各自ETR的映射注册消息：

```
*Oct 16 12:46:09.398: LISP: Processing Map-Register mapping record for IID 0 172.16.1.1/32, ttl
1440, action none, authoritative, 1 locator
```

10.1.12.1 pri/wei=5/100 LpR

*Oct 16 12:46:09.398: LISP-0: MS registration IID 0 prefix 172.16.1.1/32 10.1.15.1 site 2, Updating.

*Oct 16 12:46:41.445: LISP: **Processing Map-Register mapping record for IID 0 172.16.4.4/32**, ttl 1440, action none, authoritative, 1 locator

10.1.34.4 pri/wei=1/100 LpR

*Oct 16 12:46:41.445: LISP-0: MS registration IID 0 prefix 172.16.4.4/32 10.1.47.4 site 1, Updating.

现在，两个xTR均已成功注册其EID:

R7#show lisp site detail

LISP Site Registration Information

Site name: 1

Allowed configured locators: any

Allowed EID-prefixes:

EID-prefix: 172.16.4.4/32

First registered: 05:02:48 Routing table tag: 0
Origin: Configuration, accepting more specifics
Merge active: No
Proxy reply: No
TTL: 1d00h
State: complete

Registration errors:

Authentication failures: 0
Allowed locators mismatch: 0

ETR 10.1.47.4, last registered 00:00:21, no proxy-reply, map-notify
TTL 1d00h, no merge, hash-function sha1, nonce 0x56D89121-0xC39C2892
state complete, no security-capability
xTR-ID 0xF7DE6C93-0x06F8DDA4-0x7D6400B1-0x19EC9669
site-ID unspecified

Locator	Local	State	Pri/Wgt
10.1.34.4	yes	up	1/100

Site name: 2

Allowed configured locators: any

Allowed EID-prefixes:

EID-prefix: 172.16.1.1/32

First registered: 05:02:46
Routing table tag: 0
Origin: Configuration, accepting more specifics
Merge active: No
Proxy reply: No
TTL: 1d00h
State: complete

Registration errors:

Authentication failures: 0
Allowed locators mismatch: 0

ETR 10.1.15.1, last registered 00:00:50, no proxy-reply, map-notify
TTL 1d00h, no merge, hash-function sha1, nonce 0xBEB73F0C-0xFE3EBC4E
state complete, no security-capability
xTR-ID 0xCF7E1300-0x302FF91A-0x1C2D0499-0x8A105258
site-ID unspecified

Locator	Local	State	Pri/Wgt
10.1.12.1	yes	up	5/100

当从R1执行ping操作，MR向MS发送映射请求消息时，MS上可以看到以下日志：

*Oct 16 12:46:23.388: LISP: Processing received Map-Request message from 10.1.12.1 to 172.16.4.4

*Oct 16 12:46:23.388: LISP: Received map request for IID 0 172.16.4.4/32, source_eid IID 0 172.16.1.1, ITR-RLOCs: 10.1.12.1, records 1, nonce 0x99255979-0x30A1BAC1

*Oct 16 12:46:23.388: LISP-0: MS EID IID 0 prefix 172.16.4.4/32 site 1, Forwarding map request to ETR RLOC 10.1.34.4.

xTR2-R4数据包流

R4上发生以下事件：

1. R4从R7 (即MS) 接收LISP封装消息。
2. 数据包被解封，发现它与R1之前发送到R5 (即MS) 的映射请求相同，后来从MR转发到MS。
3. 然后R4直接向R1发送映射应答消息。

```
*Oct 16 13:32:40.700: LISP: Processing received Encap-Control message from 10.1.47.7 to
10.1.34.4
*Oct 16 13:32:40.702: LISP: Processing received Map-Request message from 10.1.12.1 to 172.16.4.4
*Oct 16 13:32:40.702: LISP: Received map request for IID 0 172.16.4.4/32, source_eid IID 0
172.16.1.1, ITR-RLOCs: 10.1.12.1, records 1, nonce 0x188823A0-0xAFF029C8
*Oct 16 13:32:40.702: LISP: Processing map request record for EID prefix IID 0 172.16.4.4/32
*Oct 16 13:32:40.702: LISP-0: Sending map-reply from 10.1.34.4 to 10.1.12.1.
```

数据包捕获

在MR上

下面的数据包捕获用于从R1发出的R4的映射请求：

```
Internet Protocol Version 4, Src: 10.1.15.1 (10.1.15.1), Dst: 192.168.5.5 (192.168.5.5)
  Version: 4
  Header Length: 20 bytes
  Differentiated Services Field: 0xc0 (DSCP 0x30: Class Selector 6; ECN: 0x00: Not-ECT (Not
ECN-Capable Transport))
  Total Length: 120
  Identification: 0x1446 (5190)
  Flags: 0x00
  Fragment offset: 0
  Time to live: 31
  Protocol: UDP (17)
  Header checksum: 0xa7c0 [validation disabled]
  Source: 10.1.15.1 (10.1.15.1)
  Destination: 192.168.5.5 (192.168.5.5)
  [Source GeoIP: Unknown]
  [Destination GeoIP: Unknown]
User Datagram Protocol, Src Port: 4342 (4342), Dst Port: 4342 (4342)
Locator/ID Separation Protocol
Internet Protocol Version 4, Src: 10.1.12.1 (10.1.12.1), Dst: 172.16.4.4 (172.16.4.4)
  Version: 4
  Header Length: 20 bytes
  Differentiated Services Field: 0xc0 (DSCP 0x30: Class Selector 6; ECN: 0x00: Not-ECT (Not
ECN-Capable Transport))
  Total Length: 88
  Identification: 0x1445 (5189)
  Flags: 0x00
  Fragment offset: 0
  Time to live: 32
  Protocol: UDP (17)
  Header checksum: 0xbf7a [validation disabled]
  Source: 10.1.12.1 (10.1.12.1)
  Destination: 172.16.4.4 (172.16.4.4)
  [Source GeoIP: Unknown]
  [Destination GeoIP: Unknown]
User Datagram Protocol, Src Port: 4342 (4342), Dst Port: 4342 (4342)
```


Locator/ID Separation Protocol

在MS上

映射寄存器数据包捕获如下：

```
Internet Protocol Version 4, Src: 10.1.47.4 (10.1.47.4), Dst: 192.168.7.7 (192.168.7.7)
User Datagram Protocol, Src Port: 4342 (4342), Dst Port: 4342 (4342)
Locator/ID Separation Protocol
  0011 .... = Type: Map-Register (3)
  .... 0... = P bit (Proxy-Map-Reply): Not set
  .... .0.. = S bit (LISP-SEC capable): Not set
  .... ..1. = I bit (xTR-ID present): Set
  .... ...0 = R bit (Built for an RTR): Not set
  .... .... 0000 0000 0000 000. = Reserved bits: 0x000000
  .... .... ..1 = M bit (Want-Map-Notify): Set
Record Count: 1
Nonce: 0x56d89121c39c2892
Key ID: 0x0001
Authentication Data Length: 20
Authentication Data: ce8f37f14c76d49e52717d1c5407e638e2733015
Mapping Record 1, EID Prefix: 172.16.4.4/32, TTL: 1440, Action: No-Action, Authoritative
  Record TTL: 1440
  Locator Count: 1
  EID Mask Length: 32
  000. .... = Action: No-Action (0)
  ...1 .... = Authoritative bit: Set
  .... .000 0000 0000 = Reserved: 0x0000
  0000 .... = Reserved: 0x0000
  .... 0000 0000 0000 = Mapping Version: 0
  EID Prefix AFI: IPv4 (1)
  EID Prefix: 172.16.4.4 (172.16.4.4)
  Locator Record 1, Local RLOC: 10.1.34.4, Reachable, Priority/Weight: 1/100, Multicast
  Priority/Weight: 255/0
  xTR-ID: f7de6c9306f8dda47d6400b119ec9669
  Site-ID: 0000000000000000
```

在R1上

从R4接收R1上捕获的映射应答消息

```
Internet Protocol Version 4, Src: 10.1.34.4 (10.1.34.4), Dst: 10.1.12.1 (10.1.12.1)
User Datagram Protocol, Src Port: 4342 (4342), Dst Port: 4342 (4342)
Locator/ID Separation Protocol
  0010 .... = Type: Map-Reply (2)
  .... 0... = P bit (Probe): Not set
  .... .0.. = E bit (Echo-Nonce locator reachability algorithm enabled):
Not set
  .... ..0. = S bit (LISP-SEC capable): Not set
  .... ...0 0000 0000 0000 0000 = Reserved bits: 0x000000
Record Count: 1
Nonce: 0xe9ee73f07b0cb7d6
Mapping Record 1, EID Prefix: 172.16.4.4/32, TTL: 1440, Action: No-Action, Authoritative
  Record TTL: 1440
  Locator Count: 1
  EID Mask Length: 32
  000. .... = Action: No-Action (0)
  ...1 .... = Authoritative bit: Set
  .... .000 0000 0000 = Reserved: 0x0000
  0000 .... = Reserved: 0x0000
```

.... 0000 0000 0000 = Mapping Version: 0

EID Prefix AFI: IPv4 (1)

EID Prefix: 172.16.4.4 (172.16.4.4)

Locator Record 1, **Local RLOC: 10.1.34.4**, Reachable, Priority/Weight: 1/100, Multicast
Priority/Weight: 255/0