

配置LISP並對其進行故障排除

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簡介

Cisco Locator/ID Separation Protocol(LISP)通過建立兩個新名稱空間來更改當前IP地址語義：分配給終端主機的端點識別符號(EID)和分配給組成全域性路由系統的裝置（主要是路由器）的路由定位器(RLOC)。

當路由器具有完整的internet路由表時，需要記憶體和進程利用率，LISP可以幫助減少記憶體利用率。

必要條件

思科建議您瞭解LISP的基本知識。

採用元件

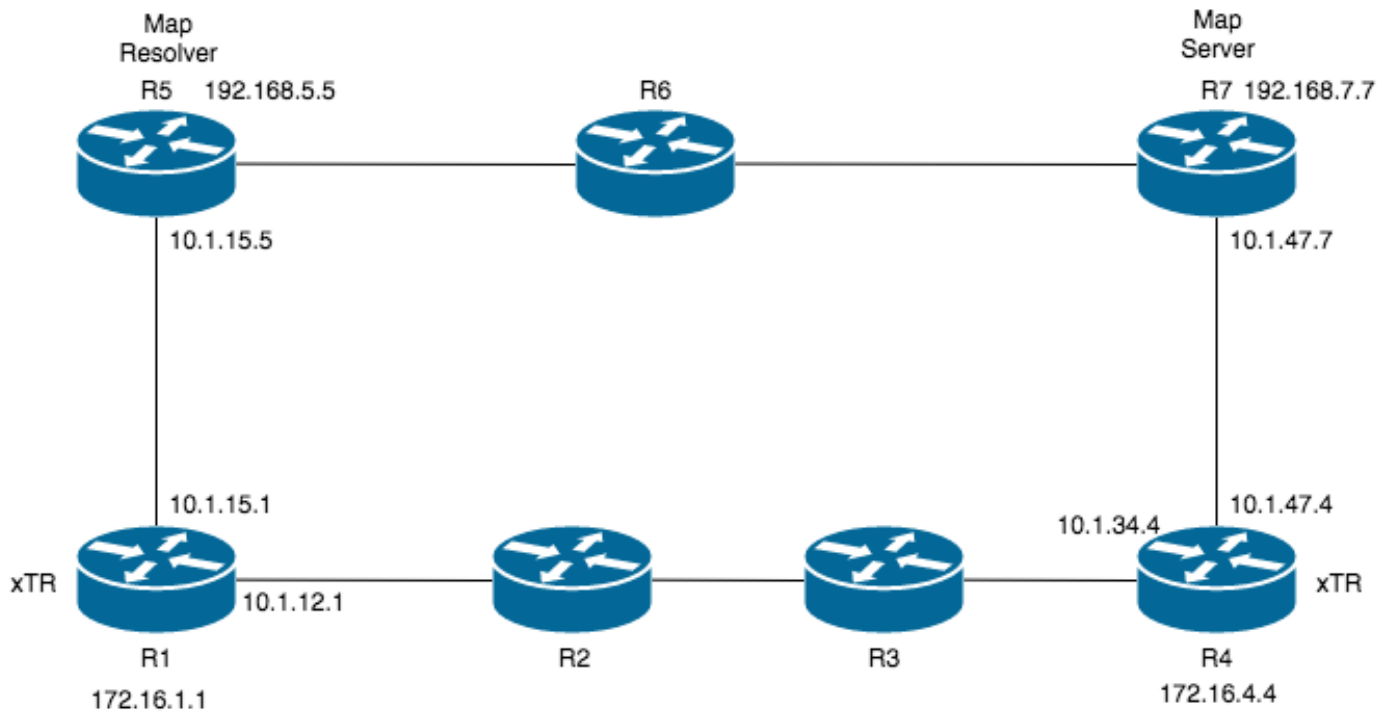
本文件所述內容不限於特定軟體和硬體版本。

本文中的資訊是根據特定實驗室環境內的裝置所建立。文中使用到的所有裝置皆從已清除（預設）的組態來啟動。如果您的網路正在作用，請確保您已瞭解任何指令可能造成的影響。

設定

網路圖表

以下影象將用作本文檔其餘部分的示例拓撲：



xTR = LISP路由器可以是ITR或ETR，具體取決於流量方向。如果流量從LISP路由器流出，則該流量將成為ITR，接收端LISP路由器將成為ETR。

ITR =輸入通道路由器

ETR =輸出通道路由器

對映解析器(MR) = 對映解析器是LISP基礎結構裝置，在解析EID到RLOC的對映時，LISP站點ITR會將LISP對映請求查詢傳送到該裝置。R5是本文中的MR。

對映伺服器(MS) = 對映伺服器是LISP基礎結構裝置，LISP站點ETR使用其EID字首註冊到該裝置。對映伺服器向LISP對映系統通告已註冊EID字首的聚合。所有LISP站點都使用LISP對映系統解析EID到RLOC的對映。R7是本文中的MS。

終端識別符號(EID)地址：EID地址由標識終端的IP地址和字首組成。通過解析EID到RLOC的對映，可以跨LISP站點實現EID可達性。

路由定位器(RLOC)地址：RLOC地址由標識IP網路中不同路由器的IP地址和字首組成。RLOC空間內的可達性是通過傳統的路由方法實現的。

ALT (替代邏輯拓撲)：通過R6連線對映解析器和對映伺服器的鏈路，是此圖中的ALT，僅用於兩者之間的控制平面通訊。此鏈路從未用於xTR之間的實際流量。

alt-vrf：此**虛擬路由和轉送(VRF)**用於配置當直接通過備用邏輯拓撲(ALT)傳送IPv4端點識別符號到路由定位器 (EID到RLOC) 對映的對映請求時，定位器/ID分離協定(LISP)應使用哪個VRF例項支援該IPv4地址系列

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:對映解析程式配置

在Map-Resolved下，強制將vrf定義為alt-vrf，這將用於在MR和MS之間形成MPBGP對等，然後用於共用由xTR註冊到MS的遠端站點的EID。

```

!
vrf definition lisp
rd 100:1
!
address-family ipv4
route-target export 100:1
route-target import 100:1
exit-address-family
!
!
interface Tunnell
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 Config

與MR類似，MS上也需配置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

```

驗證

為了觸發LISP通訊，需要滿足以下條件之一：

1. xTR上的預設路由應指向空值0。
2. 通向遠端xTR的EID的特定路由不應出現在任何xTR上。

操作順序如下：

1. 兩個ETR都應該向對映伺服器傳送對映註冊消息以查詢其EID和RLOC地址。
2. 從ITR對ETR執行ping操作時，即從172.16.1.1到172.16.4.4，然後 ITR 172.16.1.1將對映請求消息傳送到對映解析器172.16.5.5，對映解析器將請求通過ALT拓撲轉發到對映伺服器。
3. 一旦MS從MR接收該請求，它將將該對映請求轉發到遠端ETR。
4. 一旦ETR收到對映請求，它將直接使用其RLOC地址回覆ITR。

```
% 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，到達R4的EID的路由：17.16.4.4不在路由表中。而是靜態配置了指向null0的預設路由。在滿足必要的觸發條件時，對17.16.4.4執行ping操作現在將觸發LISP封裝。

```
R1_XTR#ping 172.16.4.4 source lol
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#
```

為了讓上述ping正常工作，R4通過LISP通訊將目標xTR的資訊傳送到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
```

疑難排解

以下是一些調試輸出和資料包捕獲檢查LISP資料包流。已啟用以下debug命令以擷取資訊："debug lisp control-plane all"。

附註：請注意，debug命令會產生大量資料，需要在受控環境中運行。

在xTR- R1上調試

在下面的調試消息中，R1向MS註冊其EID，然後MS進行確認。同樣地，R4也會將其EID註冊到MS。

```
*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
現在，從R1向R4的EID發起來自R1的ping，並且R1立即向MR傳送對映請求資料包。
```

```
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).
接收資料包的MR會聯絡MS以標識為該EID註冊的xTR，並將對映請求消息轉發給R4。R4作為交換
，將對映應答傳送回R1及其RLOC:
```

```
*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
```

對映解析程式資料包流

如下所示，MR首先從R1收到對映請求消息，以瞭解172.16.4.4的RLOC。然後它會檢查其BGP lisp vrf表，以查詢從MS獲取的EID中的匹配項，找到匹配項後，MR將對映請求轉發給MS:

```
LISP_Resolver#show ip bgp vpnv4 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    10.1.45.5         1    100     0 ?
*>i 172.16.4.4/32    10.1.45.5         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.
```

附註：即使日誌消息表明對映請求正在轉發到172.16.4.4，它實際上根據BGP表中的下一跳條目傳送到MS。

對映伺服器資料包流

在MS上運行的調試顯示來自R1和R4的對映暫存器消息首先註冊它們各自的ETR:

```
*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.

現在，兩個xTR均已成功註冊其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

從R1執行ping操作且MR向MS傳送對映請求消息時，MS上可看到以下日誌：

*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資料包流

R4上發生以下事件：

1. R4收到來自R7 (即MS) 的LISP封裝消息。
2. 資料包被解除封裝，並被發現與R1之前傳送到R5 (即MS) 的對映請求相同，該對映請求後來從MR轉發到MS。
3. 然後R4將對映回覆消息直接傳送到R1。

```
*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.
```

封包擷取

在MR上

以下資料包捕獲用於來自R1的R4的對映請求：

```
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

對映暫存器資料包捕獲如下：

```
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

從R4接收的R1上捕獲的Map-Reply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