排除IOS XE路由器上的PMIP隧道建立故障

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简介

本文档介绍如何对Cisco IOS® XE的PMIPv6技术进行故障排除。

先决条件

要求

Cisco 建议您了解以下主题：

- IP移动性：PMIPv6配置指南，Cisco IOS XE 17.x
- Cisco ISR和CGR的Verizon 4G LTE部署指南：专用网络部署

使用的组件

本文档中的信息基于Cisco IOS XE软件。

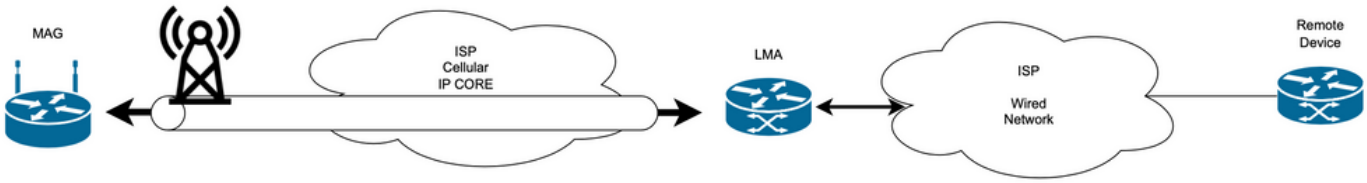
本文档中的信息都是基于特定实验室环境中的设备编写的。本文档中使用的所有设备最初均采用原始（默认）配置。如果您的网络处于活动状态，请确保您了解所有命令的潜在影响。

背景信息

对移动IP技术进行故障排除时，主要考虑的是蜂窝网接口和无线网络控制器(RNC)之间是否具有良好信号。 您的Internet服务提供商(ISP)提供用于在移动接入网关(MAG)和本地移动锚点(LMA)之间建立隧道的IP地址。

MAG不会建立指向LMA的PMIPv6隧道。

本部分提供在MAG上创建Tunnel0的常见问题的解决方案。我们以下面的网络图为例。



在此图中，MAG无法建立通向LMA的Tunnel0。

```
 MAG#show ip interface brief | exclude unassigned
Interface              IP-Address      OK? Method Status                Protocol
Cellular0/1/0          203.0.113.1     YES NVRAM  up                    up
Ethernet0/1            198.51.100.254  YES NVRAM  up                    up
```

诊断问题

1. 检查移动接入网关(MAG)上的配置并验证ISP提供的信息是否正确：

- APN =定义与本地IP核心数据包网络的数据连接，以实现蜂窝连接
- NAI =从MAG到ISP的网络ID
- LMA的IP地址=本地ISP提供的IP地址

此信息可在蜂窝网接口上找到。

<#root>

```
Router#sh cellular 0/1/0 all
Hardware Information
====================
Modem Firmware Version = <version>
Modem Firmware built = 2015/03/04 21:30:23
Hardware Version = 1.0
Device Model ID: xxxx
Package Identifier ID: Cisco ID

International Mobile Subscriber Identity (IMSI) = 310410901877700


International Mobile Equipment Identity (IMEI) = xxxxxxxxxxxxxx


Integrated Circuit Card ID (ICCID) = < ICCID Number >
Mobile Subscriber Integrated Services
Digital Network-Number (MSISDN) =  < MSISDN ID >
Modem Status = Online
Current Modem Temperature = 33 deg C
PRI SKU ID = <SKU ID>, PRI version = 005.026, Carrier = ISP
```

OEM PRI version = <version>

路由器配置示例。

配置密钥字段
<#root> ipv6 mobile pmipv6-domain LMA-DOMAIN replay-protection timestamp window 255 encap gre-ipv4 lma LMA_SVC **ipv4-address**   **nai IMSI@APN**   lma LMA_SVC **ipv6 mobile pmipv6-mag**   **domain LMA-DOMAIN**   role 3GPP **apn**   address dynamic roaming interface Cellular0/1/0 priority 1 egress-ATT LTE label MAG replay-protection timestamp window no generate grekey ignore grekey **interface Loopback0 < Logical Mobile Node Interface >**

```
lma LMA_SVC LMA-DOMAIN
ipv4-address




encap gre-ipv4
logical-mn IMSI@




mobile network Ethernet0/1 < Interface to be advertised over the Tunnel0>


home interface Loopback0 < Logical Mobile Node Interface >
```

配置示例

```
<#root>

ipv6 mobile pmipv6-domain LMA-DOMAIN
replay-protection timestamp window 255
encap gre-ipv4
lma LMA_SVC
ipv4-address 203.0.113.10


nai 310410901877700@13511.mcs


lma LMA_SVC
ipv6 mobile pmipv6-mag MAG819 domain LMA-DOMAIN
role 3GPP
apn 13511.mcs


address dynamic
roaming interface Cellular0/1/0 priority 1 egress-ATT LTE label MAG replay-protection timestamp window
no generate grekey
ignore grekey
interface Loopback0
lma LMA_SVC LMA-DOMAIN
ipv4-address 203.0.113.10


encap gre-ipv4
logical-mn 310410901877700@13511.mcs
```

```
mobile network Ethernet0/1

home interface Loopback0
```

2.验证MAG的状态。INIT状态表示MAG尝试连接到LMA。

<#root>

a) non-working example

MAG#

show ipv6 mobile pmipv6 mag binding

```
Total number of bindings: 1
----------------------------------------
[Binding][MN]: Domain: LMA-DOMAIN, Nai: 310410901877700@13511.mcs
    [Binding][MN]:
```

State: INIT

```
    [Binding][MN]: Interface: Loopback0
    [Binding][MN]:
```

Hoa: 0.0.0.0, Att: 4, llid: 310410901877700@135

```
    [Binding][MN]: HNP: 0
    [Binding][MN]: APN: 13511.mcs
    [Binding][MN][LMA]: Id: LMA_SVC
    [Binding][MN][LMA]: Lifetime: 0
    [Binding][MN]: Yes
    [Binding][MN][Mobile Network]: Ethernet0/1
    [Binding][MN][PATH]: interface: Cellular0/1/0, Label: MAG
        State: PATH_INIT
        Refresh time: 0(sec), Refresh time Remaining: 0(sec)
----------------------------------------
```

b) working example

MAG#show ipv6 mobile pmipv6 mag binding

```
Total number of bindings: 1
----------------------------------------
[Binding][MN]: Domain: LMA-DOMAIN, Nai: 310410901877700@13511.mcs
    [Binding][MN]:
```

State: ACTIVE

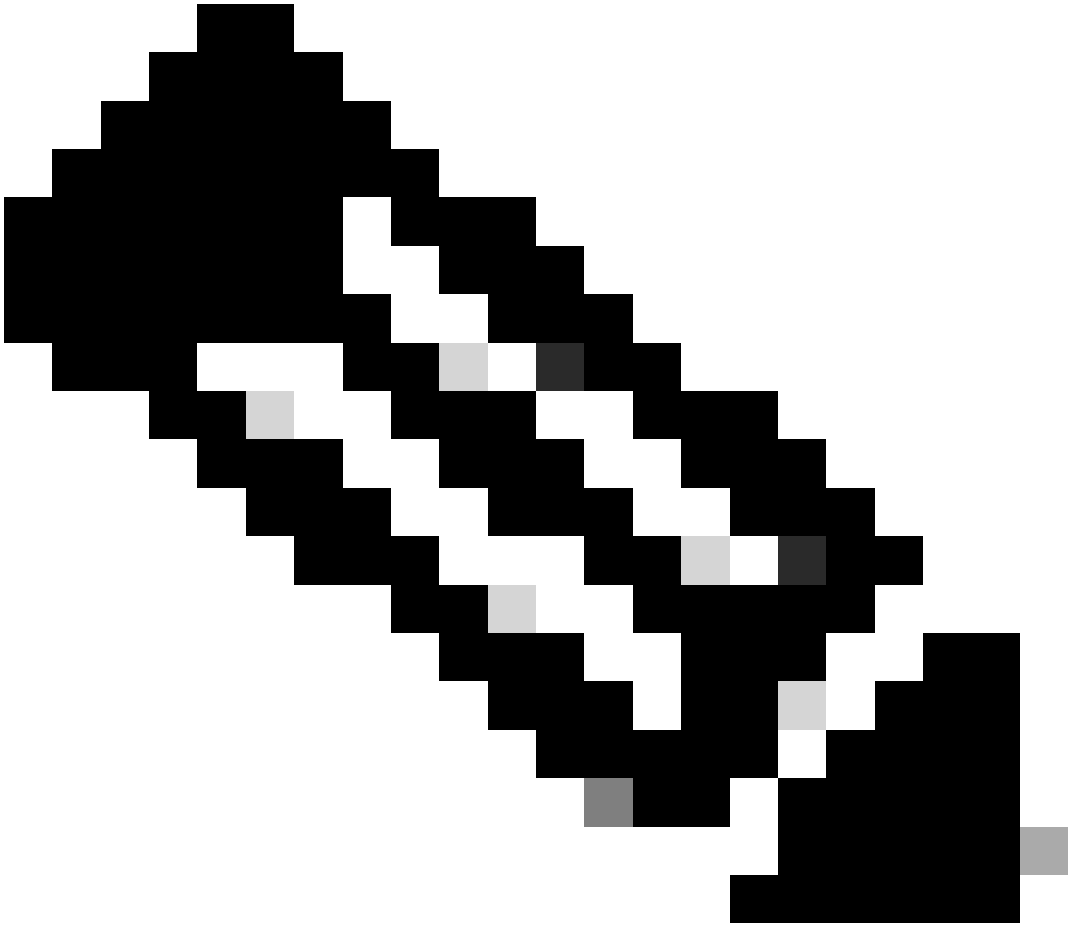
```
    [Binding][MN]: Interface: Loopback0
    [Binding][MN]:

 Hoa: x.x.x.x, Att: 4, llid: 310410901877700@135

    [Binding][MN]: HNP: 0
    [Binding][MN]: APN: 13511.mcs
    [Binding][MN][LMA]: Id: LMA_SVC
    [Binding][MN][LMA]: Lifetime: 3600
    [Binding][MN]: Yes
    [Binding][MN][Mobile Network]: Ethernet0/1
    [Binding][MN][PATH]: interface: Cellular0/1/0, Label: MAG
        State: PATH_ACTIVE
        Tunnel: Tunnel0
        Refresh time: 300(sec), Refresh time Remaining: 299(sec)
        [Binding][MN][PATH][GREKEY]: Upstream: 0, Downstream: 0
----------------------------------------
```

3.验证路由器上的MAG状态。感兴趣的消息是PBU和PBA，它们是从MAG到LMA绑定的请求和应答。

<#root>

```
MAG#show ipv6 mobile pmipv6 mag stats
----------------------------------------
[MAG819]: Total Bindings    : 1

[MAG819]: PBU Sent        : 6
[MAG819]: PBA Rcvd        : 0

[MAG819]: PBRI Sent        : 0
[MAG819]: PBRI Rcvd        : 0
[MAG819]: PBRA Sent        : 0
[MAG819]: PBRA Rcvd        : 0
[MAG819]: No Of handoff    : 0

Detailed Statistics Information

< snip >
```

4.验证蜂窝网接口是否有通向ISP的良好信号。



备注:蜂窝网故障排除超出本文档的范围。

5.在平台上启用调试，以验证MAG和LMA之间的报文交换。

<#root>

MAG#debug ipv6 mobile mag events

```
*Apr 14 20:53:30.772: PMIPv6 RIB_RWATCH: Debugging is ON
*Apr 14 20:53:30.773: [PMIPV6_LMN_EVENT]: Attach Timer expired
*Apr 14 20:53:30.773: [PMIPV6_LMN_EVENT]: Event received Attach timer expiry in state: LMN_READY, new s
*Apr 14 20:53:30.773: [PMIPV6_LMN_EVENT]: Logical MN (310410901877700@13511.mcs) sending Attach trigger
*Apr 14 20:53:30.773: [PMIPV6_LMN_EVENT]: Starting Logical MN attach timer, period (5000)
*Apr 14 20:53:30.773: [PMIPV6_MAG_EVENT]: Trigger request received (Session create trigger) from (31041
*Apr 14 20:53:30.773: [PMIPV6_MAG_EVENT]: Trigger attach request received
*Apr 14 20:53:30.773: [PMIPV6_MAG_EVENT]: Event received Old MN intf attached for Nai: 310410901877700@
*Apr 14 20:53:30.773: [PMIPV6_MAG_EVENT]: Event received First path created for Nai: 310410901877700@13
*Apr 14 20:53:33.397: [PMIPV6_MAG_EVENT]: Retx Timer expired for Nai: 310410901877700@13511.mcs
```

```
*Apr 14 20:53:33.397: [PMIPV6_MAG_EVENT]: Event received ReTx timer exhausted for Nai: 310410901877700@
*Apr 14 20:53:33.397: [PMIPV6_MAG_EVENT]: Event received Last path Down for Nai: 310410901877700@13511.
*Apr 14 20:53:33.397: [PMIPV6_MAG_EVENT]:

Event received New MN intf attached for Nai: 310410901877700@13511.mcs in path state machine, path: Cell

*Apr 14 20:53:33.398: [PMIPV6_MAG_EVENT]: Starting Retx timer, period (1000)
*Apr 14 20:53:33.398: [PMIPV6_MM_EVENT]: Allocated packet of size 152 with tlv length 140
*Apr 14 20:53:33.398: [PMIPV6_MAG_EVENT]:

PBU message sent for Nai: 310410901877700@13511.mcs

*Apr 14 20:53:33.398: [PMIPV6_MAG_EVENT]: Event received First path created for Nai: 310410901877700@13
*Apr 14 20:53:34.423: [PMIPV6_MAG_EVENT]: Retx Timer expired for Nai: 310410901877700@13511.mcs
*Apr 14 20:53:34.423: [PMIPV6_MAG_EVENT]:

Event received PBU Retx timer expired for Nai: 310410901877700@13511.mcs in path state machine, path: Ce

*Apr 14 20:53:34.423: [PMIPV6_MM_EVENT]: Allocated packet of size 152 with tlv length 140
*Apr 14 20:53:34.423: [PMIPV6_MAG_EVENT]: PBU message sent for Nai: 310410901877700@13511.mcs
*Apr 14 20:53:34.423: [PMIPV6_MAG_EVENT]: Starting Retx timer for Nai: 310410901877700@13511.mcs,period
*Apr 14 20:53:34.423: [PMIPV6_MAG_EVENT]: Event received First path created for Nai: 310410901877700@13
```

要考虑的重要日志：

A)MAG启动与LMA的连接。

*Apr 14 20:53:33.397:[PMIPV6_MAG_EVENT]:事件已收到为Nai附加的新MN intf:310410901877700@13511.mcs在路径状态机中，路径：Cellular0/1/0，状态：PATH_NULL，新状态：PATH_INIT

B)发送到LMA以建立隧道0的PBU消息

*Apr 14 20:53:33.398:[PMIPV6_MAG_EVENT]:为Nai发送的PBU消息：310410901877700@13511.mcs

C)MAG未收到来自LMA的确认(PBA)。MAG尝试发送另一个PBU以建立隧道。

*Apr 14 20:53:34.423:[PMIPV6_MAG_EVENT]:收到事件的PBU Retx计时器已过期，用于Nai:310410901877700@13511.mcs在路径状态机中，路径：Cellular0/1/0，状态：PATH_INIT，新状态：PATH_INIT

6.继续嵌入式数据包捕获(EPC)，验证LMA未发送PBA数据包。嵌入式数据包捕获配置指南。

<#root>

MAG#

monitor capture cap control-plane both access-list tac buffer size 10

MAG#

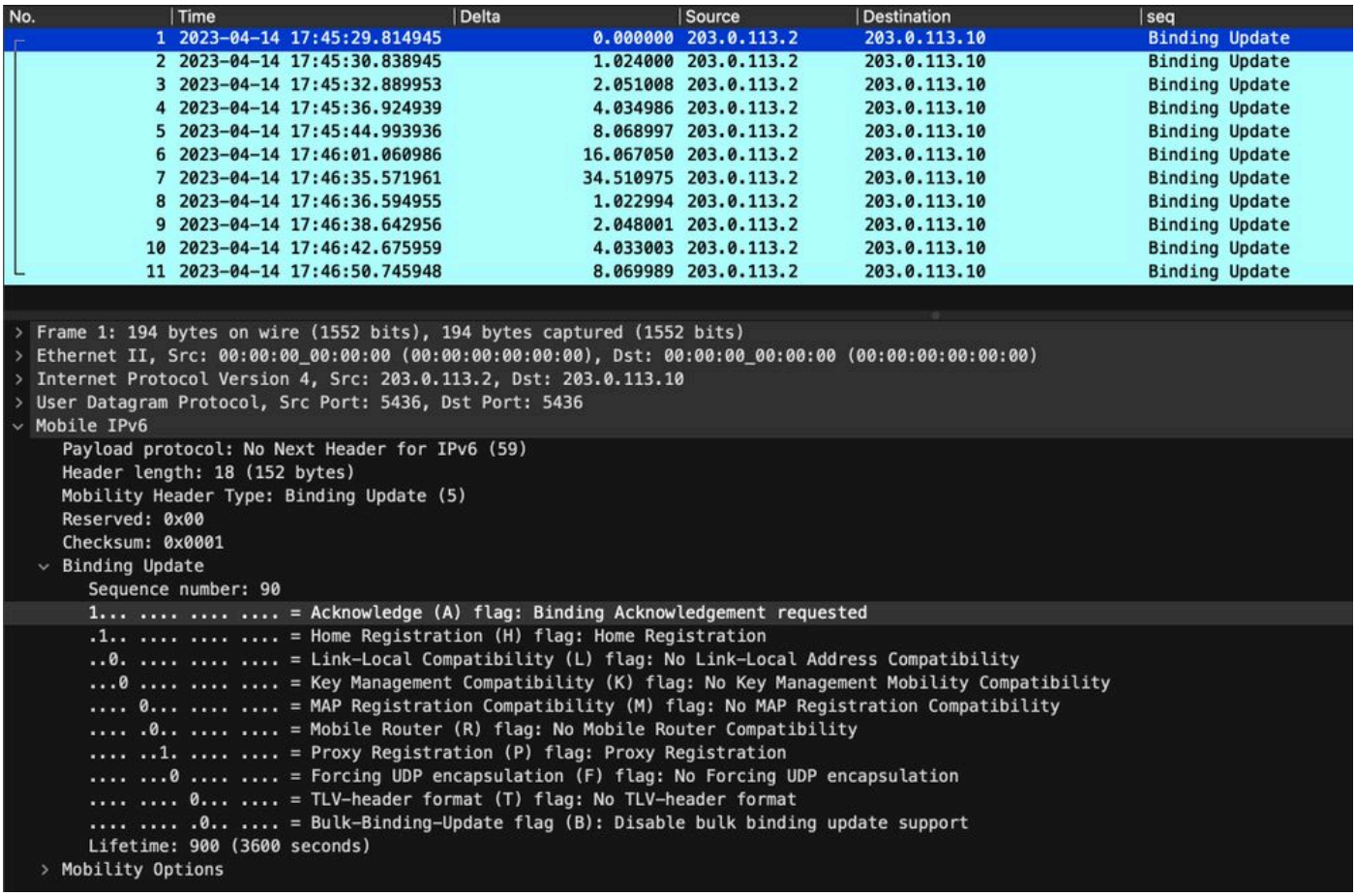
monitor capture cap start

```
< wait at least 3 minutes >

MAG#

show monitor capture cap buffer brief


 ----------------------------------------------------------------------------
 #   size   timestamp     source             destination      dscp    protocol
 ----------------------------------------------------------------------------
   0  194    0.000000   203.0.113.2      ->  203.0.113.10     0  BE   UDP
   1  194    1.024000   203.0.113.2      ->  203.0.113.10     0  BE   UDP
   2  194    3.075008   203.0.113.2      ->  203.0.113.10     0  BE   UDP
   3  194    7.109994   203.0.113.2      ->  203.0.113.10     0  BE   UDP
   4  194   15.178991   203.0.113.2      ->  203.0.113.10     0  BE   UDP
   5  194   31.246041   203.0.113.2      ->  203.0.113.10     0  BE   UDP
   6  194   65.757016   203.0.113.2      ->  203.0.113.10     0  BE   UDP
   7  194   66.780010   203.0.113.2      ->  203.0.113.10     0  BE   UDP
   8  194   68.828011   203.0.113.2      ->  203.0.113.10     0  BE   UDP
   9  194   72.861014   203.0.113.2      ->  203.0.113.10     0  BE   UDP
  10  194   80.931003   203.0.113.2      ->  203.0.113.10     0  BE   UDP
```

数据包捕获显示IP地址203.0.113.2（由ISP分配的地址）将PBU数据包发送到LMA IP地址203.0.113.10。

有关详细信息，可使用命令monitor capture cap export bootflash:<name>.pcap将捕获导出到bootflash并以.pcap文件的形式上传到tftp服务器。

在导出的捕获中，MAG向LMA请求确认，但LMA不发送PBA数据包。



7.此问题与ISP无关。联系您当地的ISP，询问是否启用了PMIP服务。

MAG未建立指向LMA的PMIPv6隧道（PBU和PBA数据包交换）。

诊断问题

1.检查移动接入网关(MAG)上的配置。

2.检查MAG和LMA之间的关联。

<#root>

MAG

#sh ipv6 mobile pmipv6 mag binding

MAG#

3.验证PBU和PBA消息。

<#root>

MAG#

show ipv6 mobile pmipv6 mag stats

```
----------------------------------------
[MAG819]: Total Bindings    : 0

[MAG819]: PBU Sent        : 48
[MAG819]: PBA Rcvd        : 36

[MAG819]: PBRI Sent        : 0
[MAG819]: PBRI Rcvd        : 0
[MAG819]: PBRA Sent        : 0
[MAG819]: PBRA Rcvd        : 0
[MAG819]: No Of handoff    : 0
-----------------------------------------------

<snip>

Trigger Sent Stats
Response to DHCP DISCOVER     : 0    Response to DHCP REQUEST      : 0
Response to ARP REQUEST       : 0
Response to GARP              : 0    Response to Rtr Solicitation  : 0
ATTACH QUERY Sent             : 0

CLEANUP INDICATION Sent       : 37

Resp to MCSA CREATE REQ       : 62

Resp to MCSA UPD REQ          : 0
Resp to MCSA DEL REQ          : 0
```

A)RESP to MCSA CREATE REQ表示MAG请求连接到LMA。当LMA拒绝PBU时，MAG以清除指示消息开始。

4.启用debug ipv6 mobile mag events以验证MAG上显示的错误代码。

<#root>

```
*Apr 17 18:13:22.885: [PMIPV6_LMN_EVENT]: Attach Timer expired
*Apr 17 18:13:22.885: [PMIPV6_LMN_EVENT]: Event received Attach timer expiry in state: LMN_READY, new s
*Apr 17 18:13:22.885: [PMIPV6_LMN_EVENT]: Logical MN (310410901877700@13511.mcs) sending Attach trigger
*Apr 17 18:13:22.885: [PMIPV6_LMN_EVENT]: Starting Logical MN attach timer, period (5000)
*Apr 17 18:13:22.885: [PMIPV6_MAG_EVENT]: Trigger request received (Session create trigger) from (31041
*Apr 17 18:13:22.885: [PMIPV6_MAG_EVENT]: Trigger attach request received
*Apr 17 18:13:22.885: [PMIPV6_MAG_EVENT]:

Event received New MN intf attached for Nai: 310410901877700@13511.mcs in path state machine, path: Cell

*Apr 17 18:13:22.885: [PMIPV6_MAG_EVENT]: Starting Retx timer, period (1000)
*Apr 17 18:13:22.885: [PMIPV6_MM_EVENT]:  Allocated packet of size 160 with tlv length 148
*Apr 17 18:13:22.885: [PMIPV6_MAG_EVENT]:

PBU message sent for Nai: 310410901877700@13511.mcs

*Apr 17 18:13:22.885: [PMIPV6_MAG_EVENT]: Event received First path created for Nai: 310410901877700@13
*Apr 17 18:13:22.886: [PMIPV6_MAG_EVENT]:

message received: PBA


*Apr 17 18:13:22.886: [PMIPV6_MAG_EVENT]:
```

PBU rejected by LMA, NAI:310410901877700@13511.mcs, status: 130

*Apr 17 18:13:22.886: [PMIPV6_MAG_EVENT]:

PBA: nai(310410901877700@13511.mcs),nai len: 26, lli (310410901877700@135), ll len: 21, att:4, lifetime:

*Apr 17 18:13:22.886: [PMIPV6_MAG_EVENT]:

Event received PBA reject for Nai: 310410901877700@13511.mcs in path state machine, path: Cellular0/1/0,

<snip>
*Apr 17 18:13:22.886: [PMIPV6_MAG_EVENT]: S

ending cleanup ind reason Last path Down, orig_event PBA reject

*Apr 17 18:13:22.886: [PMIPV6_LMN_EVENT]:

Event received Cleanup request from MAG in state: LMN_READY, new state: LMN_READY

*Apr 17 18:13:22.886: [PMIPV6_MAG_EVENT]:

Nai: 310410901877700@13511.mcs, Sending IPv4 address cleanup indication for address (0.0.0.0)

*Apr 17 18:13:22.886: [PMIPV6_MAG_EVENT]: Nai: 310410901877700@13511.mcs, Binding Removed

要考虑的重要日志：

A)MAG启动与LMA的连接。
*Apr 17 18:13:22.885:[PMIPV6_MAG_EVENT]:事件已收到为Nai附加的新MN intf:310410901877700@13511.mcs在路径状态机中，路径：Cellular0/1/0，状态：PATH_NULL，新状态：PATH_INIT

B)PBU从MAG发送到LMA。

*Apr 17 18:13:22.885:[PMIPV6_MAG_EVENT]:为Nai发送的PBU消息：310410901877700@13511.mcs

C)从LMA收到的PBA。

*Apr 17 18:13:22.886:[PMIPV6_MAG_EVENT]:收到的消息：PBA

D)由于代码130,LMA拒绝了PBU消息

*Apr 17 18:13:22.886:[PMIPV6_MAG_EVENT]:PBU被LMA拒绝，NAI:310410901877700@13511.mcs，状态：130

E)由于代码130,MAG拒绝了PBA消息。

*Apr 17 18:13:22.886:[PMIPV6_MAG_EVENT]:PBA:nai(310410901877700@13511.mcs)、nai len:26, lli(310410901877700@135), ll len:21、att:4、lifetime:0、status:130

F)由于PBU和PBA数据包被拒绝，因此MAG回退到NULL状态。

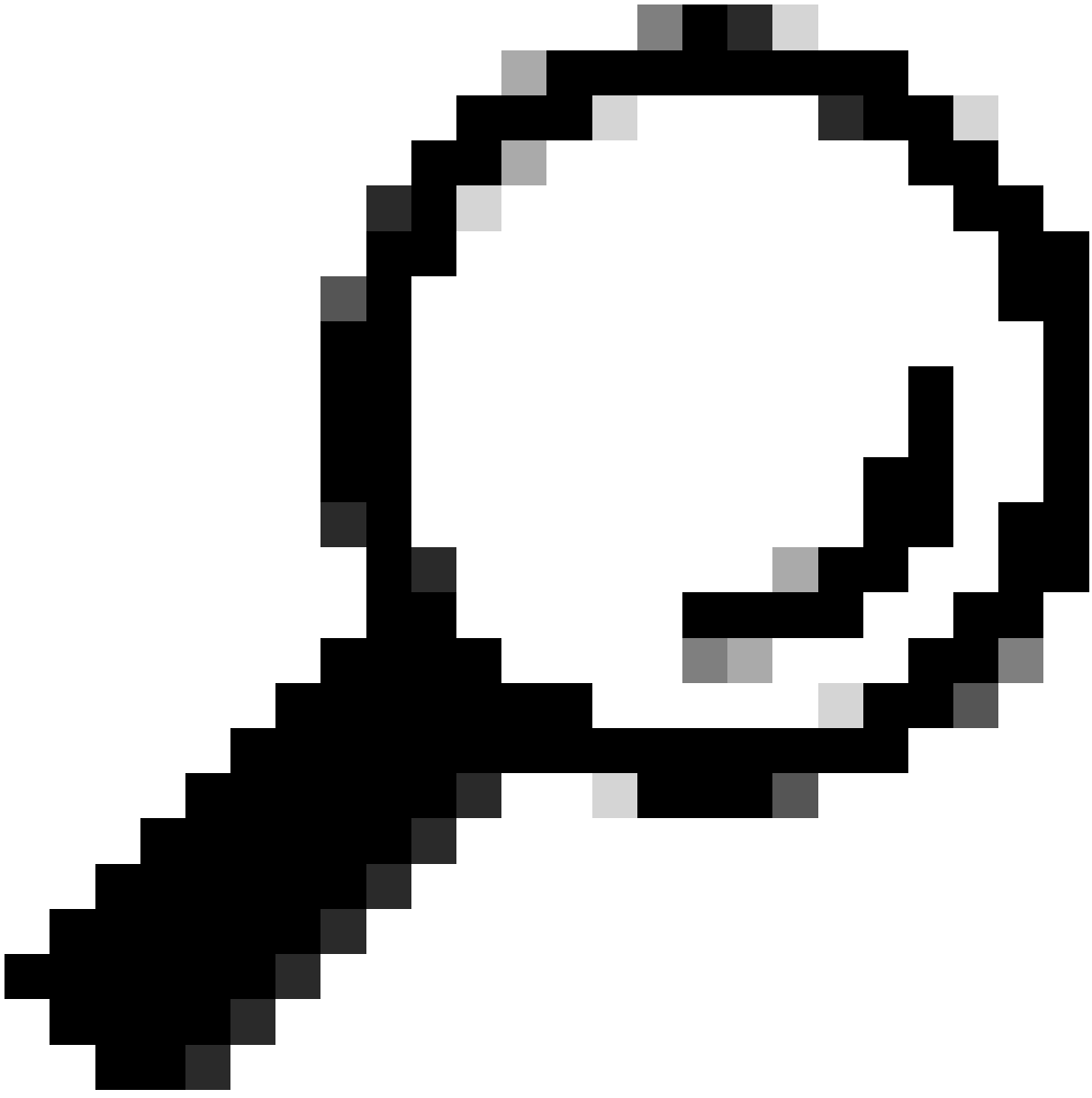
*Apr 17 18:13:22.886:[PMIPV6_MAG_EVENT]:事件收到的Nai PBA拒绝：310410901877700@13511.mcs在路径状态机中，路径：Cellular0/1/0，状态：PATH_INIT，新状态：PATH_NULL

G)Clean消息表示需要重新建立通向LMA的隧道。

*Apr 17 18:13:22.886:[PMIPV6_MAG_EVENT]:正在发送清理查找原因最后一个路径关闭，orig_event PBA拒绝

*Apr 17 18:13:22.886:[PMIPV6_LMN_EVENT]:事件已收到来自MAG的清理请求，处于以下状态：LMN_READY，新状态：LMN_READY

*Apr 17 18:13:22.886:[PMIPV6_MAG_EVENT]:Nai:310410901877700@13511.mcs，正在发送地址(0.0.0.0)的IPv4地址清除指示



提示:调试的状态由LMA发送，以接受或拒绝隧道建立。当MAG收到PBA时，可以看到这些

代码

PBA:nai(310410901877700@13511.mcs)、nai len:26, lli(310410901877700@135), ll len:21、att:4、lifetime:0、status:130

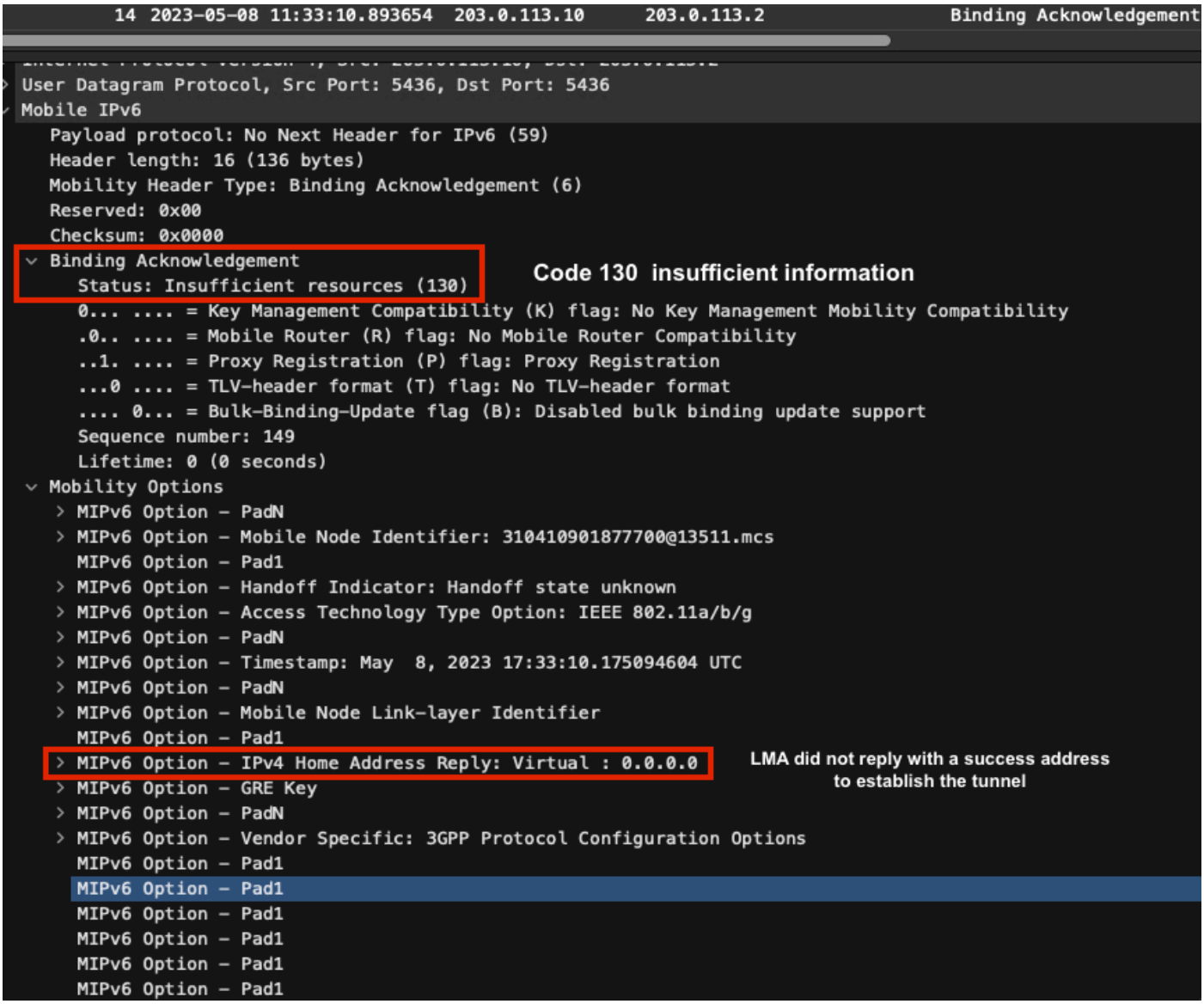
请参阅值代码。

值代码	描述
0	已接受绑定更新
1	已接受，但需要前缀发现
128	原因未指定
129	管理性禁止
130	资源不足
131	不支持家庭注册
132	非主子网
133	此移动节点的非本地代理
134	重复地址检测失败
135	序列号超出窗口
136	失效的主节点索引
137	过期的nonce索引
138	过期的nonces
139	不允许更改注册类型

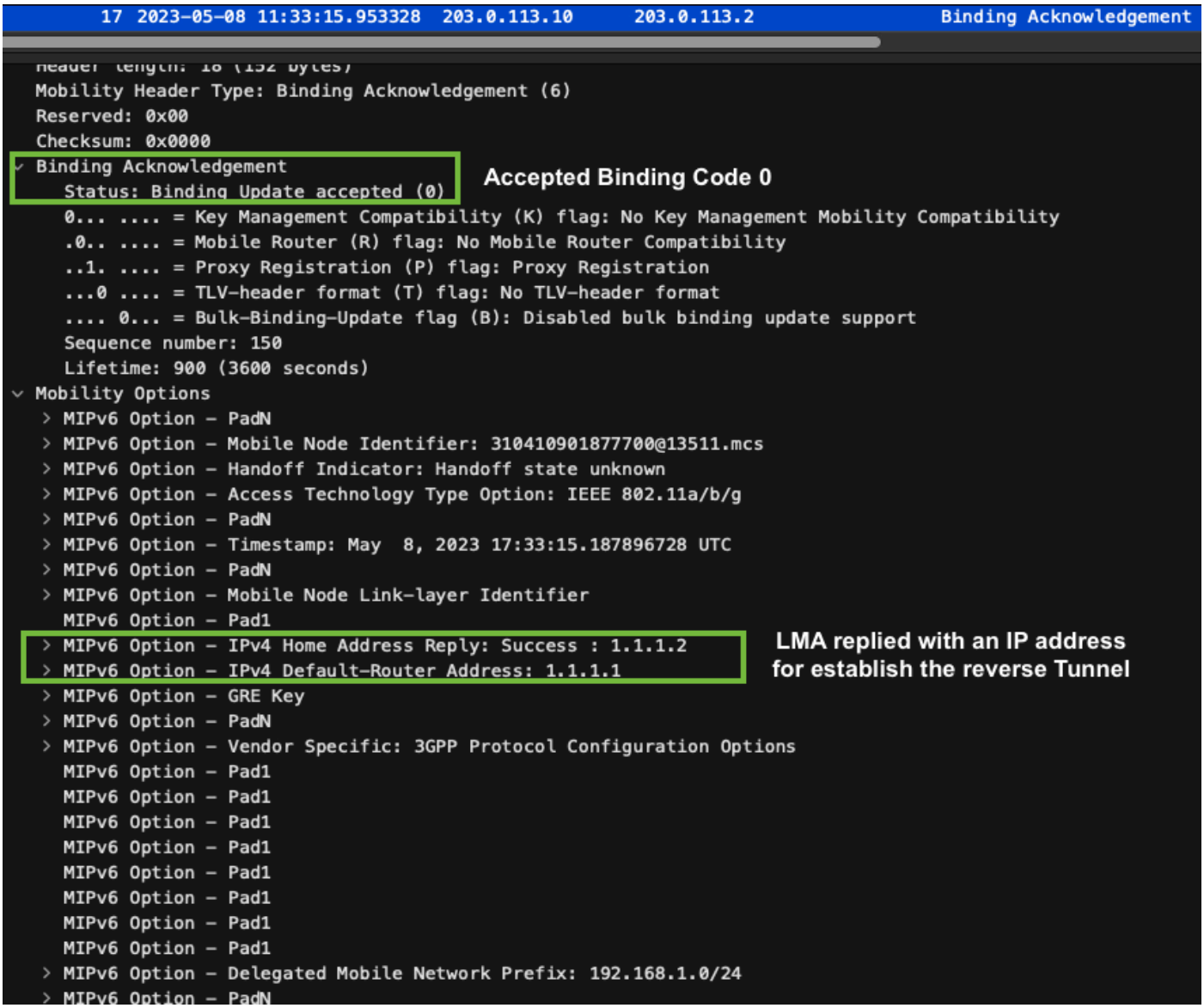
5.继续捕获路由器上的控制平面，并验证确认数据包中的移动IPv6报头。

比较捕获

报头有错误


14 2023-05-08 11:33:10.893654 203.0.113.10 203.0.113.2 Binding Acknowledgement
User Datagram Protocol, Src Port: 5436, Dst Port: 5436
Mobile IPv6
Payload protocol: No Next Header for IPv6 (59)
Header length: 16 (136 bytes)
Mobility Header Type: Binding Acknowledgement (6)
Reserved: 0x00
Checksum: 0x0000
Binding Acknowledgement
Status: Insufficient resources (130)
Code 130 insufficient information
0... .... = Key Management Compatibility (K) flag: No Key Management Mobility Compatibility
.0.. .... = Mobile Router (R) flag: No Mobile Router Compatibility
..1. .... = Proxy Registration (P) flag: Proxy Registration
...0 .... = TLV-header format (T) flag: No TLV-header format
.... 0... = Bulk-Binding-Update flag (B): Disabled bulk binding update support
Sequence number: 149
Lifetime: 0 (0 seconds)
Mobility Options
MIPv6 Option - PadN
MIPv6 Option - Mobile Node Identifier: 310410901877700@13511.mcs
MIPv6 Option - Pad1
MIPv6 Option - Handoff Indicator: Handoff state unknown
MIPv6 Option - Access Technology Type Option: IEEE 802.11a/b/g
MIPv6 Option - PadN
MIPv6 Option - Timestamp: May 8, 2023 17:33:10.175094604 UTC
MIPv6 Option - PadN
MIPv6 Option - Mobile Node Link-layer Identifier
MIPv6 Option - Pad1
MIPv6 Option - IPv4 Home Address Reply: Virtual : 0.0.0.0
LMA did not reply with a success address to establish the tunnel
MIPv6 Option - GRE Key
MIPv6 Option - PadN
MIPv6 Option - Vendor Specific: 3GPP Protocol Configuration Options
MIPv6 Option - Pad1
MIPv6 Option - Pad1
MIPv6 Option - Pad1
MIPv6 Option - Pad1
MIPv6 Option - Pad1
MIPv6 Option - Pad1

信头无错误



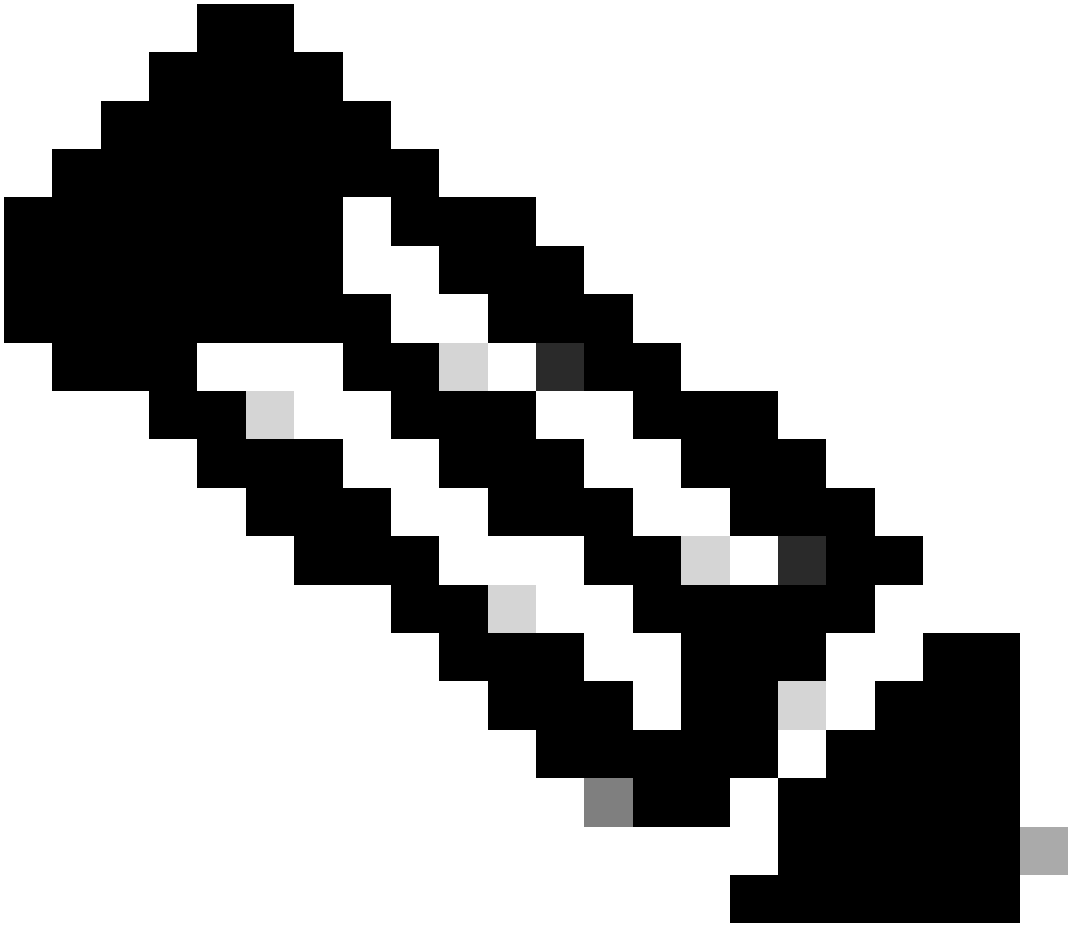
6.与您的本地ISP进行验证。在这种情况下，为了建立反向隧道，LMA应答不包含主地址。

PMIPv6退回至LMA

```
*May  8 23:09:33.631: %LINEPROTO-5-UPDOWN: Line protocol on Interface Tunnel0, changed state to up
*May  8 23:09:33.632: %PMIPV6-5-TUNNELUP: Bringing up the Proxy Mobile IPv6 tunnel Tunnel0
*May  8 23:15:39.067: %PMIPV6-5-TUNNELDELETE: Deleting the Proxy Mobile IPv6 tunnel Tunnel0
*May  8 23:17:16.655: %LINEPROTO-5-UPDOWN: Line protocol on Interface Tunnel0, changed state to up
*May  8 23:17:16.656: %PMIPV6-5-TUNNELUP: Bringing up the Proxy Mobile IPv6 tunnel Tunnel0
```

诊断问题

1.验证天线是否具有良好信号。



备注:蜂窝网故障排除超出本文档的范围。

2.激活debug ipv6 mobile以验证设备是否将PBU数据包发送到LMA。

<#root>

```
*May  9 20:28:26.784: [PMIPV6_LMN_EVENT]:

Attach Timer expired

*May  9 20:28:26.784: [PMIPV6_LMN_EVENT]:

 Event received Attach timer expiry in state: LMN_READY, new state: LMN_READY

*May  9 20:28:26.784: [PMIPV6_LMN_EVENT]: Logical MN (310410901877700@13511.mcs) sending Attach trigger
*May  9 20:28:26.784: [PMIPV6_LMN_EVENT]: Starting Logical MN attach timer, period (5000)
*May  9 20:28:26.784: [PMIPV6_MAG_EVENT]: Trigger request received (Session create trigger) from (31041
*May  9 20:28:26.784: [PMIPV6_MAG_EVENT]: Trigger attach request received
*May  9 20:28:26.784: [PMIPV6_MAG_EVENT]:

 Event received Old MN intf attached for Nai: 310410901877700@13511.mcs in path state machine, path: Cel
```

*May 9 20:28:26.784: [PMIPV6_MAG_EVENT]:

Event received First path created for Nai: 310410901877700@13511.mcs in state: INIT, new state: INIT

At this point the MAG waits for a reply from the LMA to establish the tunnel. Since the timer expires,

*May 9 20:28:39.523: [PMIPV6_MAG_EVENT]:

Event received Last path Down for Nai: 310410901877700@13511.mcs in state: INIT, new state: NULL

*May 9 20:28:39.523: [PMIPV6_MAG_EVENT]: Trigger Reply sent in Bul Null state entry for Nai: 3104109014
*May 9 20:28:39.523: [PMIPV6_LMN_EVENT]: Event received Trigger Attach Failure in state: LMN_READY, new
< snip >
*May 9 20:28:39.523: [PMIPV6_MAG_EVENT]:

sending cleanup ind reason Last path Down, orig_event ReTx timer exhausted

*May 9 20:28:39.523: [PMIPV6_LMN_EVENT]:

Event received Cleanup request from MAG in state: LMN_READY, new state: LMN_READY

*May 9 20:28:39.523: [PMIPV6_MAG_EVENT]:

Nai: 310410901877700@13511.mcs, Sending IPv4 address cleanup indication for address (0.0.0.0)

*May 9 20:28:39.523: [PMIPV6_MAG_EVENT]:

Nai: 310410901877700@13511.mcs, Binding Removed

< Snip >

*May 9 20:28:41.955: [PMIPV6_MAG_EVENT]: Event received New MN intf attached for Nai: 310410901877700@1
*May 9 20:28:41.955: [PMIPV6_MAG_EVENT]: Starting Retx timer, period (1000)
*May 9 20:28:41.955: [PMIPV6_MM_EVENT]: Allocated packet of size 160 with tlv length 148
*May 9 20:28:41.955: [PMIPV6_MAG_EVENT]:

PBU message sent for Nai: 310410901877700@13511.mcs

*May 9 20:28:41.956: [PMIPV6_MAG_EVENT]: Event received First path created for Nai: 310410901877700@13
*May 9 20:28:42.979: [PMIPV6_MAG_EVENT]: Retx Timer expired for Nai: 310410901877700@13511.mcs
*May 9 20:28:42.979: [PMIPV6_MAG_EVENT]: Event received PBU Retx timer expired for Nai: 31041090187770
*May 9 20:28:42.979: [PMIPV6_MM_EVENT]: Allocated packet of size 160 with tlv length 148
*May 9 20:28:42.979: [PMIPV6_MAG_EVENT]:

PBU message sent for Nai: 310410901877700@13511.mcs

*May 9 20:28:42.979: [PMIPV6_MAG_EVENT]: Starting Retx timer for Nai: 310410901877700@13511.mcs,period
*May 9 20:28:42.979: [PMIPV6_MAG_EVENT]: Event received First path created for Nai: 310410901877700@13
*May 9 20:28:45.027: [PMIPV6_MAG_EVENT]: Retx Timer expired for Nai: 310410901877700@13511.mcs
*May 9 20:28:45.027: [PMIPV6_MAG_EVENT]: Event received PBU Retx timer expired for Nai: 31041090187770
*May 9 20:28:45.027: [PMIPV6_MM_EVENT]: Allocated packet of size 160 with tlv length 148
*May 9 20:28:45.027: [PMIPV6_MAG_EVENT]: PBU message sent for Nai: 310410901877700@13511.mcs

```
*May  9 20:28:45.027: [PMIPV6_MAG_EVENT]: Starting Retx timer for Nai: 310410901877700@13511.mcs,period
*May  9 20:28:45.027: [PMIPV6_MAG_EVENT]: Event received First path created for Nai: 310410901877700@13
*May  9 20:28:45.228: [PMIPV6_MAG_EVENT]:

message received: PBA


*May  9 20:28:45.228: [PMIPV6_MAG_EVENT]: P

BA: nai(310410901877700@13511.mcs),nai len: 26, lli (310410901877700@135), ll len: 21, att:4, lifetime:3

*May  9 20:28:45.228: [PMIPV6_MAG_EVENT]:

Event received PBA accept for Nai: 310410901877700@13511.mcs in path state machine, path: Cellular0/1/0,

*May  9 20:28:45.228: [PMIPV6_MAG_EVENT]: Starting Refresh timer, period (300000)
*May  9 20:28:45.229: PMIPV6_LMN_EVENT]: Received event (20)
*May  9 20:28:45.229: [PMIPV6_LMN_EVENT]:

Address change event received for Tunnel0

*May  9 20:28:45.229: %LINEPROTO-5-UPDOWN:

Line protocol on Interface Tunnel0, changed state to up

*May  9 20:28:45.230: %PMIPV6-5-TUNNELUP:

 Bringing up the Proxy Mobile IPv6 tunnel Tunnel0

*May  9 20:28:45.230: [PMIPV6_MAG_EVENT]: Adding V4 Tunnel, Handle (Tunnel0), mode: (GRE_IN_IPV4)
*May  9 20:28:45.230: [PMIPV6_MAG_EVENT]: Populating Reverse V4 Tunnel entry, l2 address (0x3104109018
*May  9 20:28:45.230: [PMIPV6_MAG_EVENT]: Populating Reverse V4 Tunnel entry, l2 address (0x3104109018
*May  9 20:28:45.230: [PMIPV6_MAG_EVENT]: Stopping Retx timer for Nai: 310410901877700@13511.mcs
*May  9 20:28:45.230: [PMIPV6_MAG_EVENT]: Event received First path UP for Nai: 310410901877700@13511.m
*May  9 20:28:45.230: [PMIPV6_MAG_EVENT]: Nai: 310410901877700@13511.mcs, Updating binding succeeded
```

要考虑的重要日志：

A)MAG使与LMA的连接到期并等待响应。

*5月9日20:28:26.784:[PMIPV6_LMN_EVENT]:附加计时器已过期
*5月9日20:28:26.784:[PMIPV6_LMN_EVENT]:事件已收到附加计时器到期状态：LMN_READY，新状态：LMN_READY

*5月9日20:28:26.784:[PMIPV6_MAG_EVENT]:事件收到为Nai附加的旧MN intf:310410901877700@13511.mcs在路径状态机中，路径：Cellular0/1/0，状态：PATH_INIT，新状态：PATH_INIT
*5月9日20:28:26.784:[PMIPV6_MAG_EVENT]:收到事件为Nai创建的第一个路径：310410901877700@13511.mcs状态：初始，新状态：初始

B)系统会发送一条清除消息，以删除之前的绑定并建立新的隧道。

*5月9日20:28:39.523:[PMIPV6_MAG_EVENT]:事件接收到Nai的最后路径关闭：310410901877700@13511.mcs状态：初始，新状态：NULL

*5月9日20:28:39.523:[PMIPV6_MAG_EVENT]:发送清理查找原因上次路径关闭，源_事件ReTx计时器已耗尽

*5月9日20:28:39.523:[PMIPV6_LMN_EVENT]:事件已收到来自MAG的清理请求，处于以下状态：LMN_READY，新状态：LMN_READY
*5月9日20:28:39.523:[PMIPV6_MAG_EVENT]:Nai:310410901877700@13511.mcs，正在发送地址(0.0.0.0)的IPv4地址清除指示
*5月9日20:28:39.523:[PMIPV6_MAG_EVENT]:Nai:310410901877700@13511.mcs，已删除绑定

C)向LMA发送PBU消息以建立新的隧道0。MAG收到后，PBA将启动隧道。

*5月9日20:28:41.955:[PMIPV6_MAG_EVENT]：为Nai发送的PBU消息：310410901877700@13511.mcs

D)MAG和LMA接收并接受PBA。

*5月9日20:28:45.228:[PMIPV6_MAG_EVENT]:收到的消息：PBA
*5月9日20:28:45.228:[PMIPV6_MAG_EVENT]:PBA:nai(310410901877700@13511.mcs)、nai len:26, lli(310410901877700@135), ll len:21、att:4、lifetime:3600、status:0
*5月9日20:28:45.228:[PMIPV6_MAG_EVENT]:为Nai接收的事件PBA接受：310410901877700@13511.mcs在路径状态机中，路径：Cellular0/1/0，状态：PATH_INIT，新状态：PATH_ACTIVE

E)隧道0已建立。

*5月9日20:28:45.229:[PMIPV6_LMN_EVENT]:收到的Tunnel0地址更改事件
*5月9日20:28:45.229:%LINEPROTO-5-UPDOWN:接口Tunnel0上的线路协议，状态更改为up
*5月9日20:28:45.230:%PMIPV6-5-TUNNELUP:启用代理移动IPv6隧道Tunnel0

3.继续捕获路由器上的控制平面，并验证数据包是否在MAG和LMA之间共享。

No.	Time	Source	Destination	seq
3	2023-05-08 17:39:27.111994	203.0.113.2	203.0.113.10	Binding Update
5	2023-05-08 17:39:30.184528	203.0.113.2	203.0.113.10	Binding Update
11	2023-05-08 17:39:42.285758	203.0.113.2	203.0.113.10	Binding Update
19	2023-05-08 17:39:58.357894	203.0.113.2	203.0.113.10	Binding Update
20	2023-05-08 17:39:58.368576	203.0.113.10	203.0.113.2	Binding Acknowledgement
66	2023-05-08 17:44:59.532368	203.0.113.2	203.0.113.10	Binding Update
69	2023-05-08 17:45:13.679442	203.0.113.2	203.0.113.10	Binding Update
76	2023-05-08 17:45:44.998085	203.0.113.2	203.0.113.10	Binding Update
77	2023-05-08 17:45:48.062409	203.0.113.2	203.0.113.10	Binding Update
79	2023-05-08 17:45:48.083544	203.0.113.10	203.0.113.2	Binding Acknowledgement

在导出的捕获中，MAG请求确认LMA。LMA回复此消息；但是，由于传输出现问题，MAG无法一致地接收这些消息。
一旦传输稳定，隧道就会变得稳定。

4.与您的本地ISP验证这两台设备之间的传输是否稳定。

Additional Information

PMIP预计不会从ISP收到默认路由。为了获得连接和建立隧道，需要有一条指向LMA的IP的主机路由，并将蜂窝接口添加为下一跳。

示例：
ip route 203.0.113.10 255.255.255.255 cellular0/1/0

术语	描述
国际移动用户身份(IMSI)	为SIM卡分配的15位数字代码编号
国际移动设备标识(IMEI)	分配给移动设备的15位代码
集成电路卡标识符(ICCID)	为硬件SIM卡指定了19到20位代码
移动站国际用户目录号码(MSISDN)	ISP分配的移动设备编号。这包括国家/地区代码和分配的编号。
网络访问标识符(NAI)	网络访问身份验证期间客户端提交的用户身份
接入点名称(APN)	与移动网络数据连接的移动设备的信息（漫游过程）
移动节点(MN)	参与任何与IP移动性相关的PMIP所需的IP主机或路由器
移动接入网关(MAG)	管理与ISP连接的接入设备
本地移动锚点(LMA)	代理移动IPv6域(PMIP)中移动节点的家乡代理
家庭地址(HoA)	LMA池分配的动态IP地址
代理绑定更新(PBU)	来自MAG的请求，以建立LMA之间的隧道。此请求包括移动节点标识符选项。
代理绑定确认(PBA)	从LMA发送到MAG的消息，其中包括HoA网络前缀并触发建立双向隧道

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