

在具有PVP的Cisco Catalyst 8540 MSR增強型ARM(ARM 2)上配置MPLS

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簡介

本檔案將提供Catalyst 8540增強型ATM路由器模組(ARM)上的多重協定層交換(MPLS)的範例組態。ARM模組的主要功能是增強連線兩個不同世界的能力 — 分組/交換 (基於幀) 和ATM (基於信元)。此功能也可以擴展到MPLS。具有增強型ARM的Catalyst 8540 MSR可以安裝在基於資料包和信元的網路的邊緣，並在同一機箱中啟用兩種MPLS模式。Catalyst 8540 MSR上的增強型ARM(ARM2)對於ATM介面上的標籤邊緣路由(LER)功能是必需的 — 它充當標籤交換路徑(LSP)中每個傳入和傳出ATM介面的代理介面，以執行MPLS封包處理。Catalyst 8540非常適合於蜂窩模式到幀模式MPLS整合 (通過部署增強型ATM路由器模組來實現)。一個機箱中最多可使用兩個ARM2卡。

本文提供兩個不同配置的示例，說明ARM 2的使用。

- 將增強型ARM用於蜂窩模式 (在ARM 2上終止蜂窩模式MPLS)
- 將增強型ARM用於通過ATM over ATM VP隧道的幀模式MPLS。

必要條件

需求

本文件沒有特定需求。

採用元件

本文中的資訊係根據以下軟體和硬體版本：

- 兩個Cisco C8540 MSR，Cisco IOS® 版本12.1(10)EY(256 MB DRAM)
- Cisco C8510 MSR，Cisco IOS版本12.1(7a)EY1(64 MB DRAM)
- C8540-ARM2 (增強型ATM路由器模組)
- WAI-OC3-4MM (4埠OC-3線卡)
- C85MS-4F-OC12MM (4埠OC-12線卡)

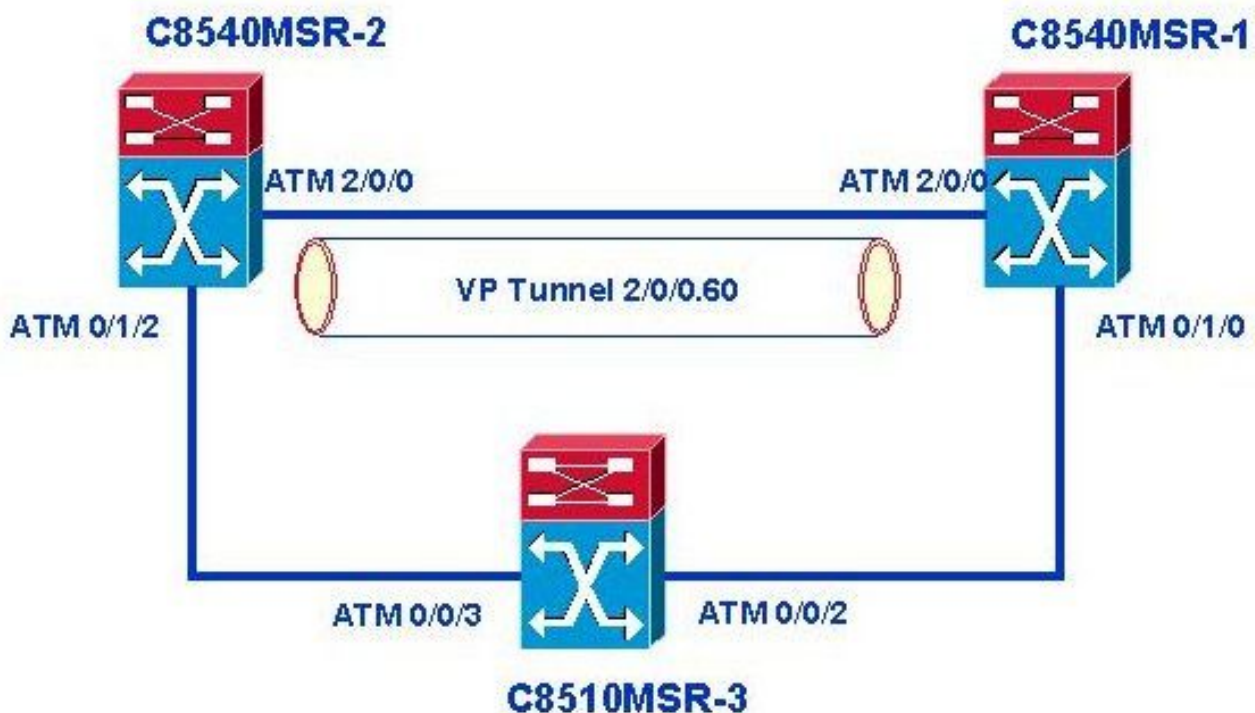
本文中的資訊是根據特定實驗室環境內的裝置所建立。文中使用到的所有裝置皆從已清除(預設)的組態來啟動。如果您在即時網路中工作，請確保在使用任何命令之前瞭解其潛在影響。

設定

本節提供用於設定本文件中所述功能的資訊。OSPF用作內部路由協定。

網路圖表

本檔案會使用下圖所示的網路設定：



以上圖表適用於以下場景：

- 將增強型ARM用於蜂窩模式(在ARM 2上終止蜂窩模式MPLS)
- 將增強型ARM用於通過ATM over ATM VP隧道的幀模式MPLS。

請注意，單元模式的組態使用路徑C8540MSR-2到C8510MSR-3到C8540MSR-1，而本檔案所述的訊框模式的組態使用VP通道連線C8540MSR-2和C8540MSR-1。

將增強型ARM用於蜂窩模式MPLS

在Catalyst 8540 MSR上，所有ATM介面都支援MPLS，且與ATM訊號(例如ILMI)和ATM路由(PNNI)並行運作。當您新增mpls ip介面命令(或舊版Cisco IOS中的tag-switching ip)並要求為每個轉發等效類(FEC)或IP目標建立一個單向標籤虛擬電路(LVC)或標籤虛擬電路(TVC)時，會啟用蜂窩模

式MPLS。標籤虛擬電路在發起方LER處稱為**頭端LVC**，在目標LER處稱為**尾端LVC**，在LSR處稱為**transit LVC**。如果Cat8540 MSR充當純ATM LSR (MPLS P路由器)，CPU不會為ATM核心中獲知的路由建立頭端LVC。源自CPU且目的地為遠端LSR的流量通過MPLS控制VC傳送。ATM介面可以連結到ARM2埠，如果是，LVC將在ARM2埠終止。實際上，當您將ATM介面連結到ARM2連線埠時，ARM2會充當ATM LER (MPLS PE路由器)，並為在ATM核心中獲知的路由啟動頭端LVC (終止LVC)。

可以將ATM介面、ATM VP和分層VP隧道配置為在ARM2埠上終止 (僅在8540 MSR平台上可用)。出於負載均衡的目的，ATM介面可以連結到增強型ARM的兩個埠之一。要在ARM2埠上終止蜂窩模式MPLS，請使用**mpls-forwarding interface ATMx/y/z**介面配置命令，其中ATMx/y/z是增強型ARM埠)。該命令僅適用於主介面。

組態

- [C8540MSR-2](#)
- [C8510MSR-3](#)

C8540MSR-2(Catalyst 8540MSR)

```
C8540MSR-2#show hardware
```

```
C8540 named c8540MSR-2, Date: 04:46:41 UTC Mon Feb 10 2003
Slot Ctrlr-Type      Part No.  Rev Ser No  Mfg Date  RMA No.  Hw Vrs  Tst  EEP
-----
0/* Super Cam       73-2739-03 B0 03170SXG Apr 27 99 0          3.0
0/1 155MM PAM       73-1496-03 A0 09006167 Aug 01 95 00-00-00 3.1    0   2
2/* OCM Board       73-2833-06 A0 03210XWB May 26 99 0          6.0
2/0 QUAD 622 Gen    73-2852-05 A0 03210YN8 May 26 99 0          5.0
9/* ETHERNET PAM    73-3754-05 A0 03374A9K Mar 17 99 0          4.1
12/* CPM Card       73-3944-05 A0 04209EX0 Aug 29 00 0          5.0
12/0 ARM2 PAM      73-5533-01 A0 0424A160 Aug 29 00 0          5.1
12/1 ARM2 PAM      73-5533-01 A0 0424A183 Aug 29 00 0          5.1
C8540MSR-2#conf t
```

Enter configuration commands, one per line. End with CNTL/Z.

```
C8540MSR-2(config)#int atm 0/1/2
C8540MSR-2(config-if)#mpls ip
! Cell mode MPLS enabled
C8540MSR-2(config-if)#ip add 10.254.14.237 255.255.255.252
C8540MSR-2(config-if)#mpls label protocol ldp
! LDP enabled on the interface
C8540MSR-2(config-if)#end
```

```
C8540MSR-2#show atm vc int atm 0/1/2
```

Interface	VPI	VCI	Type	X-Interface	X-VPI	X-VCI	Encap	Status
ATM0/1/2	0	5	PVC	ATM0	0	57	QSAAL	UP
ATM0/1/2	0	16	PVC	ATM0	0	37	ILMI	UP
ATM0/1/2	0	18	PVC	ATM0	0	202	PNNI	UP
ATM0/1/2	0	32	PVC	ATM0	0	256	SNAP	UP

```
C8540MSR-2#show mpls int atm 0/1/2
```

Interface	IP	Tunnel	Operational
ATM0/1/2	Yes (ldp)	No	Yes (ATM labels)

```
C8540MSR-2#show mpls int atm 0/1/2 det
```

```
Interface ATM0/1/2:
```

```

IP labeling enabled (ldp)
LSP Tunnel labeling not enabled
MPLS operational
MTU = 4470
ATM tagging: Label VPI = 1
Label VCI range = 33 - 65535
Control VC = 0/32

```

```

C8540MSR-2#conf t
Enter configuration commands, one per line. End with CNTL/Z.
C8540MSR-2(config)#int atm 0/1/2
C8540MSR-2(config-if)#mpls-forwarding int atm 12/0/1
! Terminate Cell mode MPLS on ARM2
C8540MSR-2(config-if)#end
C8540MSR-2#show atm vc int atm 0/1/2

```

Interface	VPI	VCI	Type	X-Interface	X-VPI	X-VCI	Encap	Status
ATM0/1/2	0	5	PVC	ATM0	0	57	QSAAL	UP
ATM0/1/2	0	16	PVC	ATM0	0	37	ILMI	UP
ATM0/1/2	0	18	PVC	ATM0	0	202	PNNI	UP
ATM0/1/2	0	32	PVC	ATM12/0/1	2	120	SNAP	UP
ATM0/1/2	1	35	TVC(O)	ATM12/0/1	2	121	MUX	UP
ATM0/1/2	1	36	TVC(O)	ATM12/0/1	2	122	MUX	UP
ATM0/1/2	1	37	TVC(O)	ATM12/0/1	2	123	MUX	UP
ATM0/1/2	1	41	TVC(O)	ATM12/0/1	2	124	MUX	UP

```

C8540MSR-2#show mpls int

```

Interface	IP	Tunnel	Operational
FastEthernet9/0/0	Yes (ldp)	No	Yes
ATM0/1/2	Yes (ldp)	No	Yes (ATM labels)
<i>! Note: ATM labels -> Cell mode</i>			
ATM12/0/0.60	Yes(ldp)	No	Yes

附註：在第二個8540 MSR(C8540MSR-1)上應該使用前面顯示的相同配置過程。此處不顯示此配置，因為若要使MPLS啟動並運行，需要相同的步驟。

C8510MSR-3(Catalyst 8510MSR)

```

C8510MSR-1#show running-config
Building configuration...

!
interface Loopback0
ip address 10.254.231.1 255.255.255.255
! interface ATM0/0/2
ip address 10.254.14.245 255.255.255.252
logging event subif-link-status
no atm ilmi-keepalive
mpls label protocol ldp
tag-switching ip
!
interface ATM0/0/3
ip address 10.254.14.238 255.255.255.252
logging event subif-link-status
load-interval 30
no atm ilmi-keepalive
mpls label protocol ldp
tag-switching ip
!
router ospf 1
log-adjacency-changes

```

```
network 10.0.0.0 0.255.255.255 area 0.0.0.0
```

將增強型ARM用於通過ATM VP隧道的幀模式MPLS

具有增強型ARM線路卡的Catalyst 8540 MSR還可以在ATM上運行幀模式MPLS。為了說明增強型ARM在幀模式MPLS中的使用情況，請檢視本文檔中的「使用增強型ARM實現通過ATM隧道的MPLS」配置示例。ATM VP通道有時用於連線兩個站點。可以使用大型「管道」VP隧道而不是配置單個VC。為了說明該選項（通常在遠端站點之間需要大量虛電路的公司使用），在C8540MSR-1和C8540MSR-2之間建立了VP隧道。兩個8540MSR通過ATM2/0/0直接連線（OC-12，已使用分層VP隧道ATM2/0/0.60）。兩個增強型ARM模組在ATM子介面上運行幀模式MPLS。因此，已配置資料PVC/aal5snap。

此範例顯示在C8540MSR-1中執行的步驟，其目的是為使用ATM VP通道的訊框模式MPLS設定增強型ARM。

C8540MSR-1(Catalyst 8540MSR)

```
C8540MSR-1#show hardware
```

```
C8540 named c8540-r6-1, Date: 04:46:41 UTC Mon Feb 10 2003
```

Slot	Ctrlr-Type	Part No.	Rev	Ser No	Mfg Date	RMA No.	Hw Vrs	Tst	EEP
0/*	Super Cam	73-2739-03	B0	03170SUQ	Apr 27 99	0		3.0	
0/1	155MM PAM	73-1496-03	A6	03199939	Aug 01 95	00-00-00		3.1	0 2
2/*	OCM Board	73-2833-06	A0	03210XWB	May 26 99	0		6.0	
2/0	QUAD 622 Gen	73-2852-05	A0	03210YN8	May 26 99	0		5.0	
9/*	ETHERNET PAM	73-3754-05	A0	031111EO	Mar 17 99	0		4.1	
11/*	CMPM Card	73-3944-05	A0	04209F5E	Aug 29 00	0		5.0	
11/0	ARM2 PAM	73-5533-01	A0	0424A162	Aug 29 00	0		5.1	
11/1	ARM2 PAM	73-5533-01	A0	0424A17C	Aug 29 00	0		5.1	

```
C8540MSR-1#conf t
```

```
Enter configuration commands, one per line. End with CNTL/Z.
```

```
C8540MSR-1(config)#atm hierarchical-tunnel
```

```
C8540MSR-1(config)#atm connection-traffic-table-row index 60 cbr pbr 120000
```

```
C8540MSR-1(config)#int atm 2/0/0
```

```
C8540MSR-1(config-if)#atm pvp 6 hierarchical rx-cttr 60 tx-cttr 60
```

```
C8540MSR-1(config-if)#int atm 2/0/0.60
```

```
C8540MSR-1(config-subif)#exit
```

```
C8540MSR-1(config)#int atm 11/0/0.60 point-to-point
```

```
C8540MSR-1(config-subif)#ip address 10.254.14.10 255.255.255.252
```

```
C8540MSR-1(conf-sif)#atm pvc 2 60 pd on encap aal5snap int atm 2/0/0.60 60 60
```

```
C8540MSR-1(config-subif)#mpls label protocol ldp
```

```
C8540MSR-1(config-subif)#mpls ip
```

```
C8540MSR-1(config-subif)#end
```

```
C8540MSR-1#show atm vc int atm 11/0/0.60 | include ATM2/
```

```
ATM11/0/0 2 60 PVC ATM2/0/0.60 60 60 SNAP UP
```

```
C8540MSR-1#show mpls int
```

Interface	IP	Tunnel	Operational
ATM0/0/1	Yes (ldp)	No	Yes (ATM labels)
ATM0/0/2	Yes	No	No (ATM labels)
FastEthernet9/0/4	Yes	No	No
ATM0/1/0	Yes (ldp)	No	No (ATM labels)
ATM11/0/1	Yes	No	No
ATM11/0/0.5	Yes (tdp)	No	Yes
ATM11/0/0.60	Yes (ldp)	No	Yes

! Note: no ATM labels -> Frame mode

```
C8540MSR-1#show mpls int atm 11/0/0.60 det
```

```
Interface ATM11/0/0.60:
```

```
    IP labeling enabled (ldp)          LSP Tunnel labeling not enabled
    MPLS operational                   MTU = 4470
```

```
C8540MSR-1#show atm vp
```

```
Interface      VPI  Type  X-Interface      X-VPI  Status
ATM2/0/0       60   PVP                    HIE. TUNNEL
```

組態

下面顯示了網路圖中MSR配置的相關部分：

- [C8540MSR-2](#)
- [C8540MSR-1](#)
- [C8510MSR-3](#)(此組態與使用增強型ARM進行細胞模式MPLS的組態相同。)

C8540MSR-2(Catalyst 8540MSR)

```
C8540MSR-2#show running-config
```

```
Building configuration...
```

```
!
mpls label protocol ldp
atm hierarchical-tunnel
atm connection-traffic-table-row index 60 cbr pcr 120000

!
interface Loopback0
 ip address 10.254.225.1 255.255.255.255
!
interface ATM0/1/2
 description IP subnet 10.254.14.236
 ip address 10.254.14.237 255.255.255.252
 ip ospf cost 4
 no atm ilmi-keepalive
 mpls label protocol ldp
 tag-switching ip
 mpls-forwarding interface ATM12/0/1
 ! terminates cell mode MPLS on the ARM module
interface ATM2/0/0
 no ip address
 no atm ilmi-keepalive
 atm pvp 60 hierarchical rx-cttr 60 tx-cttr 60
!
interface ATM2/0/0.60 point-to-point
 description Hierarchical VP Tunnel for frame mode MPLS over ATM
!
interface FastEthernet9/0/0
 ip address 10.64.0.2 255.255.255.252
 load-interval 30
 duplex full
 speed 100
 tag-switching ip
 mpls-forwarding interface ATM12/0/0
 ! EPIF based FE line cards do not support MPLS natively
 ! link to ARM2 (ATM 12/0/0) enables MPLS on those cards
interface ATM12/0/0
```

```
description Enhanced ARM - ARM2
no ip address
```

```
!
interface ATM12/0/0.60 point-to-point
```

```
description ARM2 subinterface used for Frame mode MPLS over HVPT 60
```

```
ip address 10.254.14.9 255.255.255.252
```

```
atm pvc 2 60 pd on encap
```

```
aal5snap interface ATM2/0/0.60 60 60
```

```
mpls label protocol ldp tag-switching ip
```

```
! an ARM2 point-to-point subinterface (point-to-point) supported as of
```

```
! Cisco IOS release 12.1(10)EY only
```

```
! router ospf 1
```

```
router-id 10.254.225.1
```

```
log-adjacency-changes network 10.0.0.0 0.255.255.255 area 0.0.0.0
```

```
!
```

```
C8540MSR-1(Catalyst 8540MSR)
```

```
C8540MSR-1#show running-config
```

```
Building configuration...
```

```
sdm sram Label 32768
```

```
sdm sram Tag-Cos 32768
```

```
! tag-switching tdp router-id Loopback0
```

```
!
```

```
atm hierarchical-tunnel
```

```
atm connection-traffic-table-row index 60 cbr pcr 120000
```

```
!
```

```
interface Loopback0
```

```
ip address 10.254.232.1 255.255.255.255
```

```
!
```

```
interface ATM0/1/0
```

```
ip address 10.254.14.246 255.255.255.252
```

```
ip ospf cost 100
```

```
logging event subif-link-status
```

```
no atm ilmi-keepalive
```

```
mpls label protocol ldp
```

```
tag-switching ip
```

```
mpls-forwarding interface ATM11/0/0
```

```
!
```

```
interface ATM2/0/0
```

```
no ip address
```

```
no atm ilmi-keepalive
```

```
atm pvp 60 hierarchical rx-cttr 60 tx-cttr 60
```

```
!
```

```
interface ATM2/0/0.60 point-to-point
```

```
no atm ilmi-keepalive
```

```
!
```

```
interface FastEthernet9/0/4
```

```
ip address 10.177.1.1 255.255.255.252
```

```
tag-switching ip
```

```
mpls-forwarding interface ATM11/0/0
```

```
!
```

```
interface ATM11/0/0
```

```
no ip address
```

```
!
```

```
interface ATM11/0/0.60 point-to-point
```

```
ip address 10.254.14.10 255.255.255.252
```

```
atm pvc 2 60 pd on encap aal5snap interface ATM2/0/0.60 60 60
```

```
mpls label protocol ldp
```

```
tag-switching ip
```

```
!
```

```
router ospf 1
router-id 10.254.232.1
log-adjacency-changes
network 10.177.1.0 0.0.0.3 area 0.0.0.0
network 10.254.0.0 0.0.255.255 area 0.0.0.0
!
end
```

驗證

使用以下命令以驗證MPLS是否已啟動並正常工作：

- **show mpls interfaces [detail]** — 驗證標籤分發協定是否在請求的介面上運行
- **show mpls ldp neighbors** — 顯示LDP會話/鄰居連線的狀態
- **show mpls ldp discovery** — 確定介面的LDP識別符號和LDP hello交換狀態
- **show mpls forwarding-table** - 檢查MPLS轉發資訊庫(FIB)表
- **show mpls ip binding** - 檢查MPLS IP標籤資訊庫(LIB)表

C8540MSR-1#show mpls interfaces

Interface	IP	Tunnel	Operational
ATM0/0/1	Yes (ldp)	No	Yes (ATM labels)
ATM0/1/0	Yes (ldp)	No	Yes (ATM labels)
ATM11/0/0.60	Yes (ldp)	No	Yes

C8540MSR-1#show mpls interfaces atm 0/1/0 detail

```
Interface ATM0/1/0:
  IP labeling enabled (ldp)
  LSP Tunnel labeling not enabled
MPLS operational
  MTU = 4470
  ATM tagging: Label VPI = 1
                Label VCI range = 33 - 65535
                Control VC = 0/32
```

C8540MSR-1#show mpls ldp neighbor

```
Peer LDP Ident: 10.254.225.1:0; Local LDP Ident 10.254.232.1:0
TCP connection: 10.254.225.1.646 - 10.254.232.1.11016
State: Oper; Msgs sent/rcvd: 106/93; Downstream
Up time: 00:56:36
LDP discovery sources:
  ATM11/0/0.60, Src IP addr: 10.254.14.9
Addresses bound to peer LDP Ident:
  2.2.2.1      10.64.4.190    10.254.225.1    1.254.8.1
  10.254.14.221 10.254.14.225 10.254.14.237 10.254.14.9
Peer LDP Ident: 10.254.231.1:4; Local LDP Ident 10.254.232.1:2
TCP connection: 10.254.14.245.646 - 10.254.14.246.11017
State: Oper; Msgs sent/rcvd: 45/45; Downstream on demand
Up time: 00:38:27
LDP discovery sources:
  ATM0/1/0, Src IP addr: 10.254.14.245
```

C8540MSR-1#show mpls ldp discovery

```
Local LDP Identifier:      10.254.232.1:0
Discovery Sources:
Interfaces:

ATM0/1/0 (ldp): xmit/rcv          LDP Id: 10.254.231.1:4; IP addr:      10.254.14.245
ATM11/0/0.60 (ldp): xmit/rcv     LDP Id: 10.254.225.1:0
```


C8540MSR-1#show mpls forwarding-table

Local tag	Outgoing tag or VC	Prefix or Tunnel Id	Bytes switched	tag	Outgoing interface	Next Hop
16	Untagged	10.254.14.220/30	0		AT11/0/0.60	point2point
17	27	10.254.247.1/32	0		AT11/0/0.60	
point2point						
20	22	10.254.14.240/30	0		AT11/0/0.60	
point2point						
21	26	10.254.231.1/32	0		AT11/0/0.60	
point2point						
24	Untagged	10.254.14.224/30	0		AT11/0/0.60	
point2point						
25	24	10.254.227.1/32	0		AT11/0/0.60	
point2point						
26	Pop tag	10.254.14.236/30	0		AT11/0/0.60	
point2point						
33	Untagged	10.254.221.1/32	0		AT11/0/0.60	
point2point						
45	18	10.254.14.12/30	0		AT11/0/0.60	point2point

SORBRCV0(c8540-r6-1)#show mpls ip bind

```
...
10.254.221.1/32
  in label: 33
10.254.222.1/32
  in label: 36
  out vc label: 1/53      lsr: 10.254.233.1:2  ATM0/0/1
  Active      ingress 4 hops (vcd 49)
10.254.223.1/32
  in label: 34
  out vc label: 1/54      lsr: 10.254.233.1:2  ATM0/0/1
  Active      ingress 3 hops (vcd 43)
10.254.225.1/32
  in label: 28
  out label: imp-null    lsr: 10.254.225.1:0
10.254.227.1/32
  in label: 25
  out label: 24          lsr: 10.254.225.1:0
10.254.232.1/32
  in label: imp-null
  in vc label: 1/34      lsr: 10.254.233.1:2  ATM0/0/1
  Active      egress (vcd 59)
  out label: 33          lsr: 10.254.225.1:0
10.254.233.1/32
  in label: 29
  out label: 34          lsr: 10.254.225.1:0
  out vc label: 1/60      lsr: 10.254.233.1:2  ATM0/0/1
  Active      ingress 2 hops (vcd 38)
10.254.242.1/32
  in label: 19
  out vc label: 1/61      lsr: 10.254.233.1:2  ATM0/0/1
  Active      ingress 5 hops (vcd 50)
10.254.247.1/32
  in label: 17
  out label: 27          lsr: 10.254.225.1:0
```

疑難排解

有關MPLS故障排除的其他資訊，請參閱[MPLS故障排除](#)一般故障排除文檔，其中詳細介紹了MPLS故障排除。

相關資訊

- [MPLS技術支援](#)
- [ATM技術支援](#)
- [工具與資源 — Cisco Systems](#)
- [技術支援與文件 - Cisco Systems](#)