適用於訊框中繼到ATM的VoIP QoS與LLQ、PPP LFI和cRTP互通

目錄

簡介

本檔案將提供使用ATM多重連結PPP和訊框中繼互通（使用MLPoATM/MLPoFR的VoIP）的IP語音的組態範例。 配置示例的核心重點是提供服務品質(QoS)，以便在ATM/幀中繼互通的WAN上正確支援語音。組態範例也使用壓縮即時通訊協定(cRTP)，自Cisco IOS®軟體版本12.2(2)T以來，ATM支援此通訊協定。

本文檔可獨立閱讀，瞭解配置指南、配置示例和驗證命令，以便用於構建網路。還提供與ATM/幀中繼互通相關的特定問題的一些背景資訊。有關使用訊框中繼或PPP的VoIP的QoS的詳細資訊，請參閱以下檔案：

- [使用服務品質（LLQ/IP RTP優先順序、LFI、cRTP）的PPP上的VoIP連結](#)
- [含QoS的訊框中繼VoIP（分段、流量調節、LLQ/IP RTP優先順序）](#)

必要條件

需求

嘗試此組態之前，請確保符合以下要求：

您應該熟悉以下技術領域：

- 訪問控制清單

- ATM永久虛擬電路(PVC)
- 訊框中繼永久虛擬電路(資料連結連線識別碼(DLCI))
- 頻寬管理
- LLQ
- LFI
- 虛擬模板和虛擬訪問介面
- MLPPP
- cRTP

採用元件

本文中的資訊係根據以下軟體和硬體版本：

- 用作ATM路由器的Cisco 3640
- 作為幀中繼路由器的Cisco 2620
- Cisco IOS軟體版本12.2(8)T(IP Plus)

附註： 作為一般指南，最新的Cisco IOS 12.2主線維護版本是推薦用於MLPoATM/FR的Cisco IOS軟體版本。如果使用cRTP，則ATM路由器上需要Cisco IOS軟體版本12.2T。

以下Cisco IOS軟體版本已加入相關功能：

- LFI是在Cisco IOS軟體版本11.3中匯入。
- LLQ是在Cisco IOS軟體版本12.0(7)T中匯入。
- 使用Frame Relay的LLQ和每PVC的ATM是在Cisco IOS軟體版本12.1(2)T中匯入。
- 適用於訊框中繼和ATM虛擬電路的多連結PPP LFI是在Cisco IOS軟體版本12.1(5)T中匯入。
- 使用ATM的cRTP是在Cisco IOS軟體版本12.2(2)T中匯入。

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。

慣例

如需文件慣例的詳細資訊，請參閱思科技術提示慣例。

背景資訊

在ATM/幀中繼互通網路中為VoIP提供最小端到端延遲和抖動避免的關鍵問題是：

- 語音流量的嚴格優先順序(低延遲佇列(LLQ))
- 連結分割和交錯(LFI)
- 適用於語音的訊框中繼流量調節(FRTS)
- ATM流量調節

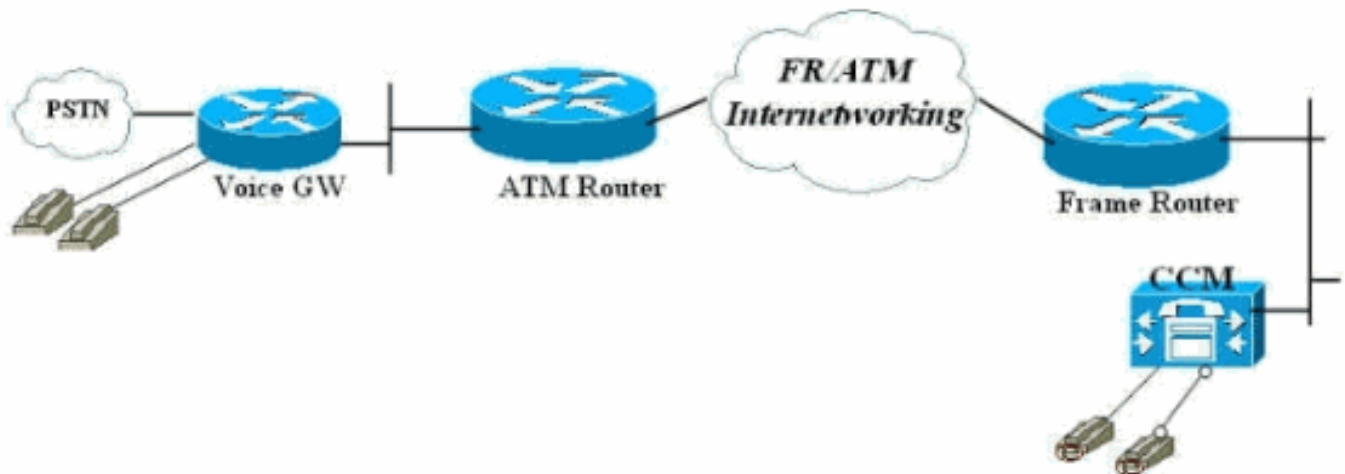這些檔案提供了進一步的背景資訊的有用來源：

- IP語音的服務品質
- 為訊框中繼和ATM虛擬電路設定連結分散和交錯

設定

本節提供用於設定本文件中所述功能的資訊。

註：使用Command Lookup Tool(僅限註冊客戶)可以查詢有關本文檔中使用的命令的詳細資訊。

網路圖表

本檔案會使用以下網路設定：

組態

本檔案會使用以下設定：

- 訊框中繼連線路由器
- ATM連線路由器

注意：必須注意的是，在此配置中，兩台路由器通過幀中繼背對背連線到ATM互通交換機。但是，在大多數拓撲中，支援語音的路由器可以位於任何位置。通常，語音路由器使用到連線到ATM/幀WAN的其他路由器的LAN連線。在這些情況下，連線到WAN、幀中繼和ATM的路由器必須配置為LLQ、LFI和MLPPP，以便它們可以提供QoS，而不是這些配置中所示的語音網關。

訊框中繼連線路由器

```
!--- Note: This configuration is commented and numbered
!--- in the order that commands should be entered.


version 12.2
service timestamps debug datetime msec
service timestamps log uptime
no service password-encryption
!
hostname FR
!
enable password cisco
!
username ATM password 0 cisco
voice-card 0
```

```
dspfarm
!
ip subnet-zero
!
!
!
!


!--- access-list 105 permit ip any any dscp ef specifies
!--- that all traffic with Differentiated Services Code
Point (DSCP) !--- are set to 40 falls into this access-
list. !--- This class-map command defines a class of
traffic called "voice".

access-list 105 permit ip any any dscp ef
access-list 105 permit udp any any  range 16384 32767
access-list 105 permit ip any any precedence critical
!
class-map match-all voice
match access-group 105
!


!
!
 !--- This policy-map command defines a policy for LLQ
called "VoIP" and !--- maps the "voice" class to the
"VOIP" policy. !--- "priority" defines the amount of
bandwidth reserved for the priority queue. !--- "class-
default" specifies that the default class is also mapped
to this policy. !--- "fair-queue" specifies that all
other traffic is served in the WFQ.



policy-map VOIP
  class voice
    priority 48
  class class-default
    fair-queue

 !--- Note: Although it is possible to queue various
types of !--- real-time traffic to the priority queue,
!--- Cisco recommends that you direct only voice traffic
!--- to it. Real-time traffic such as video or voice !--
- could introduce variations in delay. Please note voice
and !--- video should not be combined in the same PVC.
!--- (the priority queue is a First In First Out (FIFO)
!--- queue). Voice traffic requires that delay be !---
nonvariable in order to avoid jitter. !--- Note: The sum
of the values for priority and !--- bandwidth statements
needs to be less !--- than or equal to 75% of the link
bandwidth. !--- Otherwise service-policy cannot be !---
assigned to the link. When configuring VoIP over a !---
64 Kbps link to support two !--- voice calls, it is
common to allocate more than 75% !--- (48 Kbps) of the
link bandwidth to !--- the priority queue. In such
cases, you can use the !--- max-reserved-bandwidth <#%>
command in order to raise !--- available bandwidth to a
value more than 75%.



!
!
!
fax interface-type fax-mail
```

```
mta receive maximum-recipients 0
!
interface Loopback0
 ip address 10.1.1.2 255.255.255.0
!
!
interface FastEthernet0/0
 ip address 172.17.111.16 255.255.255.224
 duplex auto
 speed auto
!
interface Serial0/0
 no ip address
 encapsulation frame-relay IETF
 no ip route-cache
 no ip mroute-cache
 frame-relay traffic-shaping
!
!--- Choose the frame relay interface to be !---
associated with the virtual interface. The !--- virtual
template could equally have been associated !--- with
the physical interface. !--- The "class mlp" associates
the virtual template interface !--- defined in
"interface Virtual-Template1" with a Frame Relay DLCI.
!--- Associates a Frame Relay map class with a DLCI.
interface Serial0/0.1 point-to-point no ip route-cache
no ip mroute-cache frame-relay interface-dlci 16 ppp
Virtual-Template1 class mlp !--- The interface command
creates a virtual !--- template called Virtual-
Template1. !--- A bandwidth of 64 Kbps is assigned to
this !--- template interface. This bandwidth is used !--
- by Cisco IOS to calculate the data fragment size as
noted regarding !--- interleaving of PPP segments. !---
"ip rtp header-compression"—cRTP is supported in an
ATM/Frame Relay Interworking !--- environment. It
requires Cisco IOS Software Release 12.2(2)T on the !---
ATM router. !--- "service-policy output VOIP"—The VoIP
policy created earlier is assigned !--- to this
interface in the outbound direction. !--- PPP multilink
is enabled and the !--- maximum delay per segment is
specified. This bandwidth is !--- used by Cisco IOS to
calculate the data fragment size as noted. !---
Interleaving of PPP segments is enabled, which allows !-
-- voice packets to be expedited. Voice !--- packets
need only wait behind a single segment of !--- a
previously queued data packet (for example, 10 ms !---
delay) rather than wait until the end of the !--- entire
data packet. Cisco IOS calculates the !--- data fragment
size using the following formula: !--- fragment size =
delay x bandwidth/8

!
interface Virtual-Template1
 bandwidth 64
 ip unnumbered loopback0
 ip rtp header-compression
 no ip route-cache
 load-interval 30
 max-reserved-bandwidth 99
 service-policy output VOIP
 ppp multilink
 ppp multilink fragment-delay 10
 ppp multilink interleave
!
```

```
!
ip classless
ip route 0.0.0.0 0.0.0.0 172.17.111.1
no ip http server
ip pim bidir-enable
!
!
!
```

```
map-class frame-relay mlp

 no frame-relay adaptive-shaping
 frame-relay cir 64000
 frame-relay bc 640
 frame-relay be 0


!
call rsvp-sync
!
voice-port 1/0/0
!
voice-port 1/0/1
!
!
mgcp profile default
!
dial-peer cor custom
!
!
!
dial-peer voice 123 voip
 destination-pattern 123
 session target ipv4:10.1.1.1
 ip qos dscp cs5 media
 ip qos dscp cs5 signaling
 no vad
!
dial-peer voice 456 pots
 destination-pattern 456
 port 1/0/0
!
!
```

```
line con 0
line aux 0
line vty 0 4
 exec-timeout 0 0
 password cisco
 login
!
!
end
```

ATM連線路由器

```
!--- Note: This configuration is commented only !---
where additional consideration is required from the !---
above configuration of the Frame Relay router.


version 12.2
service timestamps debug datetime msec
service timestamps log uptime
no service password-encryption
!
hostname ATM
!
enable password cisco
!
username FR password 0 cisco
memory-size iomem 25
ip subnet-zero
!
!
!
access-list 105 permit ip any any dscp ef
access-list 105 permit udp any any  range 16384 32767
access-list 105 permit ip any any precedence critical
!
class-map match-all voice
 match access-group 105
!
!
!--- Note: Matching commands to the Frame Relay !---
router side of the network.


!
!
policy-map VOIP
  class voice
    priority 48
  class class-default
   fair-queue

!--- Note: Matching commands to the Frame Relay !---
router side of the network.



!
!
fax interface-type fax-mail
mta receive maximum-recipients 0
!
controller T1 2/0
```

```
 framing sf
 linecode ami
!
!
!
!
interface ATM0/0
 no ip address
 ip route-cache
 no atm ilmi-keepalive
!
```
!--- "interface ATM0/0.1 point-to-point" chooses the ATM subinterface. !--- The physical interface could equally have been used. !--- "pvc 10/100" creates an ATM PVC. !--- "cbr 64"—A VBR PVC has been defined on this example. !--- This exapmle uses VBR non-realtime and the sustained !--- cell rate (SCR) should be equal to the peak !--- cell rate (PCR) in order to avoid bursting. !--- ATM cell tax and the possibility !--- of ATM bandwidth expansion due to poor !--- fragment/cell alignment, means that it !--- cannot be assumed that the PCR/SCR on the ATM !--- side should equal the CIR of the Frame Relay side. !--- Maintain the value of CIR on the Frame-Relay side to define !--- our SCR, in this case, 64 kbps. This value may in some networks !--- require some fine-tuning as the CIR on the Frame side does not !--- exactly match the SCR on the ATM but makes for a good-enough estimation !--- for most purposes. !--- Refer to <u>*Designing and Deploying*</u> *!---* <u>*Multilink PPP over Frame Relay and ATM*</u> *!--- for more information. !--- "encapsulation aal5snap" is required. !--- "protocol ppp Virtual-Template1" associates the virtual !--- template with the ATM PVC.* interface ATM0/0.1 point-to-point ip route-cache pvc 10/100 cbr 64 encapsulation aal5snap protocol ppp Virtual-Template1 ! ! interface loopback0 ip address 10.1.1.1 255.255.255.0 ! interface Ethernet3/0 ip address 172.17.111.15 255.255.255.224 half-duplex ! interface Ethernet3/1 no ip address shutdown half-duplex ! interface Virtual-Template1 bandwidth 64 ip unnumbered loopback0 ip rtp header-compression no ip route-cache load-interval 30 max-reserved-bandwidth 99 service-policy output VOIP ppp multilink ppp multilink fragment-delay 10 ppp multilink interleave *!---* **Note**: The virtual template is created in !--- exactly the same way as for the !--- Frame Relay router side of the network. !--- An additional consideration for !--- the ATM router is that the fragment size !--- should be optimized to fit into !--- an integral number of ATM cells. !--- Refer to <u>Designing and Deploying</u> !--- <u>Multilink PPP over Frame Relay and ATM</u> !--- for more information on this issue. ! ip classless ip route 0.0.0.0 0.0.0.0 172.17.111.1 ip http server ip pim bidir-enable ! ! call rsvp-sync ! voice-port 1/0/0 description FXS ! voice-port 1/0/1 ! voice-port 1/1/0 description FXO ! voice-port 1/1/1 ! ! mgcp profile default ! dial-peer cor custom ! ! ! dial-peer voice 456 voip destination-pattern 456 session target ipv4:10.1.1.2 ip qos dscp cs5 media ip qos dscp cs5 signaling no vad ! dial-peer voice 123 pots destination-pattern 123 port 1/1/0 ! ! line con 0 line aux 0 line vty 0 4 exec-timeout 0 0 password cisco login ! ! end

驗證

使用本節內容，確認您的組態是否正常運作。

[輸出直譯器工具](僅供[已註冊](客戶使用)(OIT)支援某些show命令。使用OIT檢視show命令輸出的分析。

以下show命令可用於驗證ATM/訊框中繼互通環境的操作狀態，其中包括DLCI和PVC統計資訊、實體和虛擬介面狀態、原則(QoS)應用和cRTP資訊：

- show ppp multilink interface *interface-name* — ***驗證捆綁包是否為up/down、哪個虛擬訪問介面是捆綁包（MLPPP捆綁包）以及哪些是成員（PPP鏈路）。*** 此命令還驗證載體是否丟棄單元/幀（丟失片段<> 0）。 唯一可接受的片段丟失是由循環冗餘校驗(CRC)錯誤導致的。
- show user — 顯示與虛擬訪問介面關聯的編號。您可以使用來自此命令或show ppp multilink命令的資訊，以便顯示有關介面的統計資訊，或清除介面。
- show frame-relay pvc *dlci* — ***顯示流量整形引數、分段值和丟棄的資料包等資訊。***此命令還顯示物理介面是否已繫結到虛擬介面。
- show atm pvc *pvc* — ***顯示所有作用中ATM PVC和流量資訊。***
- show policy-map interface *interface-name* — ***顯示所有LLQ操作和PQ中的任何丟包。***有關此命令各個欄位的詳細資訊，請參閱show policy-map interface命令輸出中的瞭解資料包計數器。**注意：**花式隊列始終應用於virtual-access2介面。其他介面使用FIFO隊列。
- show ip rtp header-compression — 顯示RTP報頭壓縮統計資訊（如果已配置）。請注意，統計資訊附加到了作為捆綁介面的virtual-access2介面。

以下是這些命令的示例：

```
FR#show ppp multilink interface virtual-access 2
Virtual-Access2, bundle name is ATM
Bundle up for 00:22:42
0 lost fragments, 0 reordered, 0 unassigned
0 discarded, 0 lost received, 231/255 load
0x2E5 received sequence, 0x10C31 sent sequence
Member links: 1 (max not set, min not set)
Virtual-Access1, since 00:22:42, last rcvd seq 0002E4 160 weight
```
此輸出顯示了幀中繼路由器上的show users。

```
FR#show users
Line User Host(s) Idle Location
67 vty 1 idle 00:00:00 10.1.1.1
Interface User Mode Idle Peer Address
Vi1 Virtual PPP (FR ) -
Vi2 Virtual PPP (Bundle) 00:00:00 10.1.1.1
FR#
```
此輸出顯示ATM路由器上的show users。

```
ATM#show users
Line User Host(s) Idle Location
131 vty 1 idle 00:00:00 64.104.207.95
Interface User Mode Idle Peer Address
Vi1 Virtual PPP (ATM ) -
Vi2 Virtual PPP (Bundle) 00:00:02 10.1.1.2
ATM#
```

此輸出顯示show frame-relay pvc命令。

```
FR#show frame-relay pvc 16
 PVC Statistics for interface Serial0/0 (Frame Relay DTE)
 DLCI = 16, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0/0.1

      input pkts 2301 output pkts 2295 in bytes 152266
      out bytes 151891 dropped pkts 0 in FECN pkts 0
      in BECN pkts 0 out FECN pkts 0 out BECN pkts 0
      in DE pkts 0 out DE pkts 0
      out bcast pkts 0 out bcast bytes 0
      5 minute input rate 9000 bits/sec, 9 packets/sec
      5 minute output rate 9000 bits/sec, 9 packets/sec
      pvc create time 23:46:56, last time pvc status changed 00:22:56
      Bound to Virtual-Access1 (up, cloned from Virtual-Template1)
      !--- PPP link interface. cir 64000 bc 640 be 0 byte limit 80 interval 10 mincir 64000 byte
increment 80 Adaptive Shaping none pkts 2296 bytes 152053 pkts delayed 9 bytes delayed 375
shaping active traffic shaping drops 0 Queueing strategy: fifo Output queue 0/40, 0 drop, 0
dequeued FR#
```

此輸出顯示ATM路由器上的show atm pvc 10/100命令。

```
ATM#show atm pvc 10/100
      ATM0/0.1: VCD: 1, VPI: 10, VCI: 100
      CBR, SusRate: 128
      AAL5-LLC/SNAP, etype:0x0, Flags: 0x820, VCmode: 0x0
      OAM frequency: 0 second(s), OAM retry frequency: 1 second(s)
      OAM up retry count: 3, OAM down retry count: 5
      OAM Loopback status: OAM Disabled
      OAM VC state: Not Managed
      ILMI VC state: Not Managed
      InARP frequency: 15 minutes(s)
      Transmit priority 1
      InPkts: 729, OutPkts: 729, InBytes: 49700, OutBytes: 51158
      InPRoc: 0, OutPRoc: 729
      InFast: 729, OutFast: 0, InAS: 0, OutAS: 0
      InPktDrops: 0, OutPktDrops: 0/0/0 (holdq/outputq/total)
      CrcErrors: 0, SarTimeOuts: 0, OverSizedSDUs: 0, LengthViolation: 0,
      CPIErrors: 0
      OAM cells received: 0
      F5 InEndloop: 0, F5 InSegloop: 0, F5 InAIS: 0, F5 InRDI: 0
      F4 InEndloop: 0, F4 InSegloop: 0, F4 InAIS: 0, F4 InRDI: 0
      OAM cells sent: 0
      F5 OutEndloop: 0, F5 OutSegloop: 0, F5 OutRDI: 0
      F4 OutEndloop: 0, F4 OutSegloop: 0, F4 OutRDI: 0
      OAM cell drops: 0
      Status: UP
   PPP: Virtual-Access2 from Virtual-Template1
    !--- MLPPP bundle interface. ATM#
```

這是幀中繼路由器上的show policy-map。

```
FR#show policy-map interface Virtual-Access2
Service-policy output: VoIP
Class-map: voice (match-all)
15483 packets, 959502 bytes
30 second offered rate 24000 bps, drop rate 0 bps
Match: ip dscp 40
Weighted Fair Queueing
Strict Priority
!--- LLQ Strict Priority Queue for voice. Output Queue: Conversation 24 Bandwidth 48(kbps) Burst
```

1500 (Bytes) (pkts matched/bytes matched) 15536/962784 **(total drops/bytes drops) 0/0**
!--- No drops in the voice queue. Class-map: **class-default** (match-any)
139 packets, 19481 bytes
30 second offered rate 1000 bps, drop rate 0 bps
Match: any
Weighted Fair Queueing
Flow Based Fair Queueing
Maximum Number of Hashed Queues 16
(total queued/total drops/no-buffer drops) 0/0/0
此輸出顯示ATM路由器上的show policy map命令。

ATM#**show policy-map interface Virtual-Access2**
Service-policy output: VOIP
Class-map: voice (match-all)
11293 packets, 699718 bytes
30 second offered rate 24000 bps, drop rate 0 bps
Match: ip dscp 40
Weighted Fair Queueing
Strict Priority
!--- LLQ Strict Priority Queue for voice. Output Queue: Conversation 24 Bandwidth 48 (kbps)
Burst 1500 (Bytes) (pkts matched/bytes matched) 11352/703376 (total drops/bytes drops) 0/0 *!---
No drops in the voice queue.* Class-map: class-default (match-any) 63 packets, 9772 bytes 30
second offered rate 0 bps, drop rate 0 bps Match: any Weighted Fair Queueing Flow Based Fair
Queueing Maximum Number of Hashed Queues 16 (total queued/total drops/no-buffer drops) 0/0/0
ATM#
此輸出顯示了幀中繼路由器上的show ip rtp header-compression命令。

FR#**show ip rtp header-compression**
RTP/UDP/IP header compression statistics:
Interface Virtual-Access1:
Rcvd: 0 total, 0 compressed, 0 errors
0 dropped, 0 buffer copies, 0 buffer failures
Sent: 0 total, 0 compressed,
0 bytes saved, 0 bytes sent
Connect: 16 rx slots, 16 tx slots,
0 long searches, 0 misses 0 collisions

Interface Virtual-Template1:
Rcvd: 0 total, 0 compressed, 0 errors
0 dropped, 0 buffer copies, 0 buffer failures
Sent: 0 total, 0 compressed,
0 bytes saved, 0 bytes sent
Connect: 16 rx slots, 16 tx slots,
0 long searches, 0 misses 0 collisions

Interface Virtual-Access2:
Rcvd: 23682 total, 23681 compressed, 0 errors
0 dropped, 0 buffer copies, 0 buffer failures
Sent: 327 total, 233 compressed,
8821 bytes saved, 5159 bytes sent
2.70 efficiency improvement factor
Connect: 16 rx slots, 16 tx slots,
0 long searches, 94 misses 0 collisions
71% hit ratio, five minute miss rate 0 misses/sec, 0 max
此輸出顯示ATM路由器上的show ip rtp header-compression命令。

ATM#**show ip rtp header-compression**
RTP/UDP/IP header compression statistics:

```
Interface Virtual-Access1:
Rcvd: 0 total, 0 compressed, 0 errors
0 dropped, 0 buffer copies, 0 buffer failures
Sent: 0 total, 0 compressed,
0 bytes saved, 0 bytes sent
Connect: 16 rx slots, 16 tx slots,
0 long searches, 0 misses 0 collisions, 0 negative cache hits

Interface Virtual-Template1:
Rcvd: 0 total, 0 compressed, 0 errors
0 dropped, 0 buffer copies, 0 buffer failures
Sent: 0 total, 0 compressed,
0 bytes saved, 0 bytes sent
Connect: 16 rx slots, 16 tx slots,
0 long searches, 0 misses 0 collisions, 0 negative cache hits

Interface Virtual-Access2:
Rcvd: 283 total, 233 compressed, 0 errors
0 dropped, 0 buffer copies, 0 buffer failures
Sent: 25341 total, 25340 compressed,
955537 bytes saved, 564463 bytes sent
2.69 efficiency improvement factor
Connect: 16 rx slots, 16 tx slots,
0 long searches, 1 misses 0 collisions, 100 negative cache hits
99% hit ratio, five minute miss rate 0 misses/sec, 0 max
```

疑難排解

使用本節內容，對組態進行疑難排解。

本節提供一些澄清MLP LFI的示例調試，它同時充當排除配置故障的工作示例。

疑難排解指令

輸出直譯器工具(僅供已註冊客戶使用)(OIT)支援某些show命令。使用OIT檢視show命令輸出的分析。

附註：使用 debug 指令之前，請先參閱有關 Debug 指令的重要資訊。

- debug ppp negotiation — 說明克隆兩個虛擬訪問介面以表示PPP和PPP捆綁鏈路的過程。虛擬接入介面1(Vi1)是PVC（ATM或幀）繫結到的PPP鏈路。虛擬介面2(Vi2)是連線了隊列策略的PPP捆綁鏈路。
- debug ppp multilink fragment — 說明與較小語音資料包交織的較大資料包的概念。交織在Vi2介面（MLP級別）上發生，因為捆綁介面已分配了花式隊列。

以下是debug ppp negotiation命令的**命令輸**出。

```
FR(config-if)#no shut
FR(config-if)#^Z
FR#
FR#
6d23h: %LINK-3-UPDOWN: Interface Virtual-Access1, changed state to up
*Mar 7 23:20:42.842: Vi1 PPP: Treating connection as
a dedicated line
!--- Vi1 is the PPP link to which the PVC is bound. *Mar 7 23:20:42.842: Vi1 PPP: Phase is
ESTABLISHING, Active Open *Mar 7 23:20:42.842: Vi1 LCP: O CONFREQ [Closed] id 197 len 19 *Mar 7
23:20:42.842: Vi1 LCP: MagicNumber 0xF44128D2 (0x0506F44128D2) *Mar 7 23:20:42.842: Vi1 LCP:
MRRU 1524 (0x110405F4) *Mar 7 23:20:42.842: Vi1 LCP: EndpointDisc 1 FR (0x1305014652)
```

!--- Router FR at one end of PPP discovery. `*Mar 7 23:20:42.858: Vi1 LCP: I CONFREQ [REQsent] id 14 len 20 *Mar 7 23:20:42.858: Vi1 LCP: MagicNumber 0x294819D4 (0x0506294819D4) *Mar 7 23:20:42.858: Vi1 LCP: MRRU 1524 (0x110405F4) *Mar 7 23:20:42.858: Vi1 LCP:` **EndpointDisc 1 ATM (0x13060141544D)**

!--- Router ATM at the other end of PPP discovery. `*Mar 7 23:20:42.858: Vi1 LCP: O CONFACK [REQsent] id 14 len 20 *Mar 7 23:20:42.862: Vi1 LCP: MagicNumber 0x294819D4 (0x0506294819D4) *Mar 7 23:20:42.862: Vi1 LCP: MRRU 1524 (0x110405F4) *Mar 7 23:20:42.862: Vi1 LCP: EndpointDisc 1 ATM (0x13060141544D) *Mar 7 23:20:42.870: Vi1 LCP: I CONFACK [ACKsent] id 197 len 19 *Mar 7 23:20:42.870: Vi1 LCP: MagicNumber 0xF44128D2 (0x0506F44128D2) *Mar 7 23:20:42.870: Vi1 LCP: MRRU 1524 (0x110405F4) *Mar 7 23:20:42.870: Vi1 LCP: EndpointDisc 1 FR (0x1305014652) *Mar 7 23:20:42.870: Vi1 LCP: State is Open *Mar 7 23:20:42.870: Vi1 PPP: Phase is FORWARDING, Attempting Forward *Mar 7 23:20:42.874: Vi1 PPP: Phase is ESTABLISHING, Finish LCP *Mar 7 23:20:42.874: Vi1 PPP: Phase is VIRTUALIZED *Mar 7 23:20:42.942: Vi2 PPP: Phase is DOWN, Setup *Mar 7 23:20:43.222: Vi1 IPCP:` **Packet buffered while building MLP bundle interface** `6d23h: %LINK-3-UPDOWN:` **Interface Virtual-Access2, changed state to up**

!--- MLP level queuing. `*Mar 7 23:20:43.226: Vi2 PPP: Treating connection as a dedicated line *Mar 7 23:20:43.226: Vi2 PPP: Phase is ESTABLISHING, Active Open *Mar 7 23:20:43.226: Vi2 LCP: O CONFREQ [Closed] id 1 len 19 *Mar 7 23:20:43.226: Vi2 LCP: MagicNumber 0xF4412A53 (0x0506F4412A53) *Mar 7 23:20:43.226: Vi2 LCP: MRRU 1524 (0x110405F4) *Mar 7 23:20:43.230: Vi2 LCP: EndpointDisc 1 FR (0x1305014652) *Mar 7 23:20:43.230:` **Vi2 MLP:** **Added first link Vi1 to bundle ATM**

!--- PVCs make up the bundle. `*Mar 7 23:20:43.230: Vi2 PPP: Phase is UP *Mar 7 23:20:43.230: Vi2 IPCP: O CONFREQ [Closed] id 1 len 10 *Mar 7 23:20:43.234: Vi2 IPCP: Address 10.1.1.2 (0x03060A010102) *Mar 7 23:20:43.234: Vi2 PPP: Pending ncpQ size is 1 *Mar 7 23:20:43.234: Vi1 IPCP: Redirect packet to Vi1 *Mar 7 23:20:43.234: Vi2 IPCP: I CONFREQ [REQsent] id 1 len 10 *Mar 7 23:20:43.234: Vi2 IPCP: Address 10.1.1.1 (0x03060A010101) *Mar 7 23:20:43.234: Vi2 IPCP: O CONFACK [REQsent] id 1 len 10 *Mar 7 23:20:43.234: Vi2 IPCP: Address 10.1.1.1 (0x03060A010101) *Mar 7 23:20:43.266: Vi2 IPCP: I CONFACK [ACKsent] id 1 len 10 *Mar 7 23:20:43.266: Vi2 IPCP: Address 10.1.1.2 (0x03060A010102) *Mar 7 23:20:43.266: Vi2 IPCP: State is Open *Mar 7 23:20:43.266: Vi2 IPCP: Install route to 10.1.1.1 *Mar 7 23:20:43.270: Vi2 IPCP: Add link info for cef entry 10.1.1.1`

此命令輸出來自debug ppp multilink fragment命令。

```
*Mar 7 23:16:08.034: Vi2 MLP:
Packet interleaved from queue 24
*Mar 7 23:16:08.038: Vi1 MLP: O ppp UNKNOWN(0x0000) (0000) size 64
*Mar 7 23:16:08.038: Vi2 MLP: Packet interleaved from queue 24
*Mar 7 23:16:08.038: Vi1 MLP: O ppp UNKNOWN(0x0000) (0000) size 64
*Mar 7 23:16:08.038: Vi2 MLP: Packet interleaved from queue 24
*Mar 7 23:16:08.038: Vi1 MLP: O ppp UNKNOWN(0x0000) (0000) size 64
*Mar 7 23:16:08.038: Vi1 MLP: O frag 0000829B size 160
*Mar 7 23:16:08.042: Vi1 MLP: I ppp IP (0021) size 64 direct
*Mar 7 23:16:08.046: Vi1 MLP: I ppp IP (0021) size 64 direct
```

相關資訊

- 設計和部署通過幀中繼和ATM的多鏈路PPP
- 使用服務品質（LLQ/IP RTP優先順序、LFI、cRTP）的PPP上的VoIP連結
- 含QoS的訊框中繼VoIP（分段、流量調節、LLQ/IP RTP優先順序）
- 語音技術支援
- 語音和整合通訊產品支援
- Cisco IP電話故障排除
- 技術支援與文件 - Cisco Systems