# 帧中继到 ATM 与LLQ 、PPP LFI 和cRTP 互工作的 VoIP QoS

## 目录



## 简介

本文为VoIP提供了示例配置，使用了PATM的多链路PPP和帧中继互联(VoIP使用了MLPoATM/MLPoFR)。配置示例的中央焦点是服务质量(QoS)提供为了适当地支持在ATM/帧中继相互作用的广域网间的语音。配置示例也利用压缩实时协议(CRTP)， ATM支持从Cisco IOS软件版本12.2(2)T。

本文可以是读的独立配置指导、配置示例和验证命令的为了用于建立网络。提供部分背景信息，供与ATM/帧中继互联相关的特殊事件使用。参考这些文档关于基于帧中继的VoIP或PPP的QoS的更多信息：

- 带有服务质量控制（ LLQ/IP RTP 优先级、LFI、cRTP ）的 VoIP-over-PPP
- 与QoS (分段、流量整形， LLQ /IP RTP优先级)的基于帧中继的VoIP

## 先决条件

### 要求

尝试进行此配置之前，请确保满足以下要求：

您应该熟悉这些技术领域：

- 访问控制列表

- ATM永久虚电路(PVC)
- 帧中继永久虚拟电路(数据链路连接标识符(DLCI))
- 带宽管理
- LLQ
- LFI
- 虚拟模板和虚拟访问接口
- MLPPP
- cRTP

## 使用的组件

本文档中的信息基于以下软件和硬件版本：

- Cisco 3640作为ATM路由器
- Cisco 2620作为帧中继路由器
- Cisco IOS软件版本12.2(8)T (IP Plus)

**注意：** 作为一般使用指南，如果使用，最新的Cisco IOS 12.2主线维护版是使用的推荐的Cisco IOS软件版本MLPoATM/帧Cisco IOS软件版本12.2T要求在ATM路由器cRTP。

相关功能在这些Cisco IOS软件版本介绍：

- LFI在Cisco IOS软件版本11.3介绍。
- LLQ在Cisco IOS软件版本12.0(7)T介绍。
- 基于帧中继的LLQ和ATM每个PVC在Cisco IOS软件版本12.1(2)T介绍。
- 帧中继和ATM虚拟电路的多链路PPP LFI在Cisco IOS软件版本12.1(5)T介绍。
- 在ATM的cRTP在Cisco IOS软件版本12.2(2)T介绍。

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。

## 规则

有关文档规则的详细信息，请参阅 Cisco 技术提示规则。

# 背景信息

在提供最小化端到端延迟和抖动避免的重要问题为在间ATM/帧中继相互作用的网络的VoIP是：

- 语音流量的(低延迟队列(LLQ))严格优先级
- Link Fragmentation and Interleaving (LFI)
- 语音的帧中继流量整形(FRTS)
- ATM 流量整形

这些文档提供背景信息有用的来源：

- IP 语音的服务质量
- 配置帧中继和ATM虚拟电路的Link Fragmentation and Interleaving

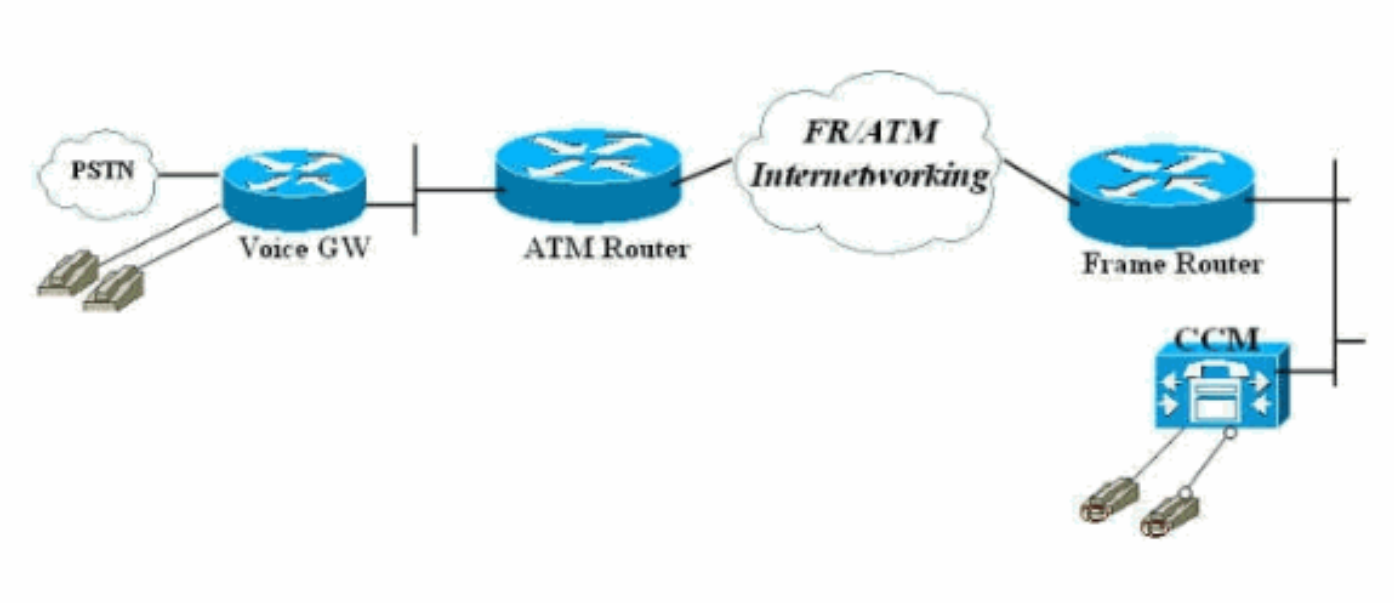
# 配置

本部分提供有关如何配置本文档所述功能的信息。

**注意：** 使用命令查找工具（仅限注册用户）查找有关本文档所使用命令的详细信息。

## 网络图

本文档使用以下网络设置：




## 配置

本文档使用以下配置：

- 连接帧中继的路由器
- ATM的路由器

**注意：** 请注意在此配置方面，两路由器在对ATM互联交换机的一帧中继连接背对背。然而在多数拓扑方面，语音可用的路由器能任何地方存在。通常，语音路由器使用LAN连通性到其他路由器，连接对ATM/帧广域网。在那些情况下，对广域网的路由器连接，帧中继和ATM必须为LLQ、LFI和MLPPP配置如这些配置所显示，因此他们能提供QoS而不是语音网关。

**连接帧中继的路由器**

```
!--- 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 fragement 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 ! ! !
!--- A map class called mlp is created. !--- With "no
frame-relay adaptive-shaping", adaptive !--- shaping is
disabled. You do not !--- want to exceed CIR and have
voice packets !--- possibly queued within the Frame
Relay network. !--- Waiting for a BECN to resolve this
!--- situation could result in poor voice quality. !---
The frame-relay cir 64000 command forces the router to
transmit !--- at the desired CIR rate rather than line
!--- rate for the port. !--- "frame-relay bc 640"
configures the Bc value to force the desired !--- Tc
(shaping interval) value is 10 ms. !--- This formula
should be used to determine !--- the Bc value to use: Tc
= Bc/CIR. A !--- smaller Tc value reduces the interval a
voice !--- packet has to wait to be sent. !--- As in
"frame-relay be 0", the Be value should be set to zero
!--- in order to avoid voice being sent as part of a
burst !--- that is not guaranteed by the Frame Relay
network. 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的路由器

```
!--- 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
Designing and Deploying !--- Multilink PPP over Frame
Relay and ATM !--- 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 Designing
and Deploying !--- Multilink PPP over Frame Relay and
ATM !--- 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
```

# 验证

使用本部分可确认配置能否正常运行。

命令输出解释程序（仅限注册用户）(OIT) 支持某些 **show** 命令。使用 OIT 可查看对 show 命令输出的分析。

这些**显示**命令是有用的在ATM/帧中继相互作用环境的运行状态的验证，包括DLCI和PVC统计信息、物理和虚拟接口状态、策略(QoS)应用程序和cRTP信息：

- show ppp multilink interface interface-name命令---验证捆绑是否处于up/down状态，哪个虚拟访问接口处于捆绑状态(MLPPP捆绑)，而哪些虚拟访问接口则是成员(PPP链路)。此命令也验证，如果载波丢弃信元/帧(丢失的片段<> 0)。唯一的可接受片段损失是循环冗余冗余校验(CRC)错误造成的一个。
- **show users** —显示编号关联与虚拟访问接口。您可以使用此命令或show ppp multilink命令输出中的信息，这样您便可以显示接口的统计数据或者清除接口。

- **show frame-relay PVC dlci** —显示信息例如流量整形参数、分段值和丢弃的数据包。如果物理接口一定对虚拟接口，此命令也显示。
- **show atm pvc pvc** —显示所有活动ATM PVC和数据流信息。
- **show policy-map interface interface-name** —显示所有LLQ操作和所有丢包在PQ。参考了解信息包计数器在**show policy-map interface命令**输出中关于此的多种字段的更多信息请发出命令。**注意：** 理想的排队机制总是应用对virtual-access2接口。其他接口使用FIFO队列。
- **show ip rtp header-compression** —若被设定显示RTP报头压缩统计信息。注意统计信息附加对virtual-access2接口，是捆绑接口。

这些命令示例显示此处：

```
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
```

此输出显示帧中继路由器的**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#
```

此输出显示ATM路由器的**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#
```

此输出显示**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#
```

此输出显示**show atm pvc 10/100命令**在ATM路由器。

```
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#
```

这是在帧中继路由器的**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
```

此输出显示**show policy map命令**在ATM路由器。

```
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#
```

此输出显示**show ip rtp header-compression命令**在帧中继路由器。

```
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
```

此输出显示**show ip rtp header-compression命令**在ATM路由器。

```
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
```

# 故障排除

使用本部分可排除配置的故障。

此部分提供部分澄清MLP LFI的示例调试，它同时充当您排除配置故障的操作示例。

## 故障排除命令

命令输出解释程序（仅限注册用户）(OIT) 支持某些 **show** 命令。使用 OIT 可查看对 show 命令输出的分析。

**注意：** 使用 **debug** 命令之前，请参阅有关 Debug 命令的重要信息。

- debug ppp negotiation——说明克隆二个虚拟访问接口，以代表PPP和PPP捆绑链路的过程。虚拟访问接口1 (Vi1)是的PPP链路，其中绑定了PVC (ATM或帧)。虚拟接口2 (Vi2)是排队策略附加的PPP捆绑链路。
- **debug ppp multilink fragment** —说明用更加小的语音数据包被插入的更加大的数据包的概念。交叉发生在Vi2接口(MLP级别)，因为捆绑接口被分配了的理想的排队。

这是**debug ppp negotiation命令的**命令输出。

```
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
```

此命令输出是从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
```

# 相关信息

- 在帧中继与 ATM 上设计与部署多链路 PPP
- 带有服务质量控制（LLQ/IP RTP 优先级、LFI、cRTP）的 VoIP-over-PPP
- 与QoS (分段、流量整形， LLQ /IP RTP优先级)的基于帧中继的VoIP
- 语音技术支持
- 语音和统一通信产品支持
- Cisco IP 电话故障排除
- 技术支持和文档 - Cisco Systems