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

Contents

Introduction

本文为基于IP的语音提供一配置示例使用在ATM和帧中继相互作用(VoIP的多链路PPP使用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。一些背景信息为与使用产生关联的特定问题也被提供ATM/帧中继相互作用。请参见这些文件关于基于帧中继的VoIP或PPP的QoS的更多信息：

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

Prerequisites

Requirements

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区域：

- 访问控制列表

- ATM永久虚拟电路(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

Components Used

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 Software Release 12.2(8)T (IP Plus)

Note: 作为总指导大纲，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 Software Release 12.2T需要在ATM路由器cRTP。

相关功能在这些Cisco IOS软件版本被介绍了：

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

The information in this document was created from the devices in a specific lab environment.All of the devices used in this document started with a cleared (default) configuration.If your network is live, make sure that you understand the potential impact of any command.

Conventions

Refer to Cisco Technical Tips Conventions for more information on document conventions.

背景信息

在提供减到最小的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(低延时队列严格优先级(LLQ))
- 链路分段和交织(LFI)
- 语音的帧中继流量整形(FRTS)
- ATM流量整形

这些文件提供背景信息的有用的来源：

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

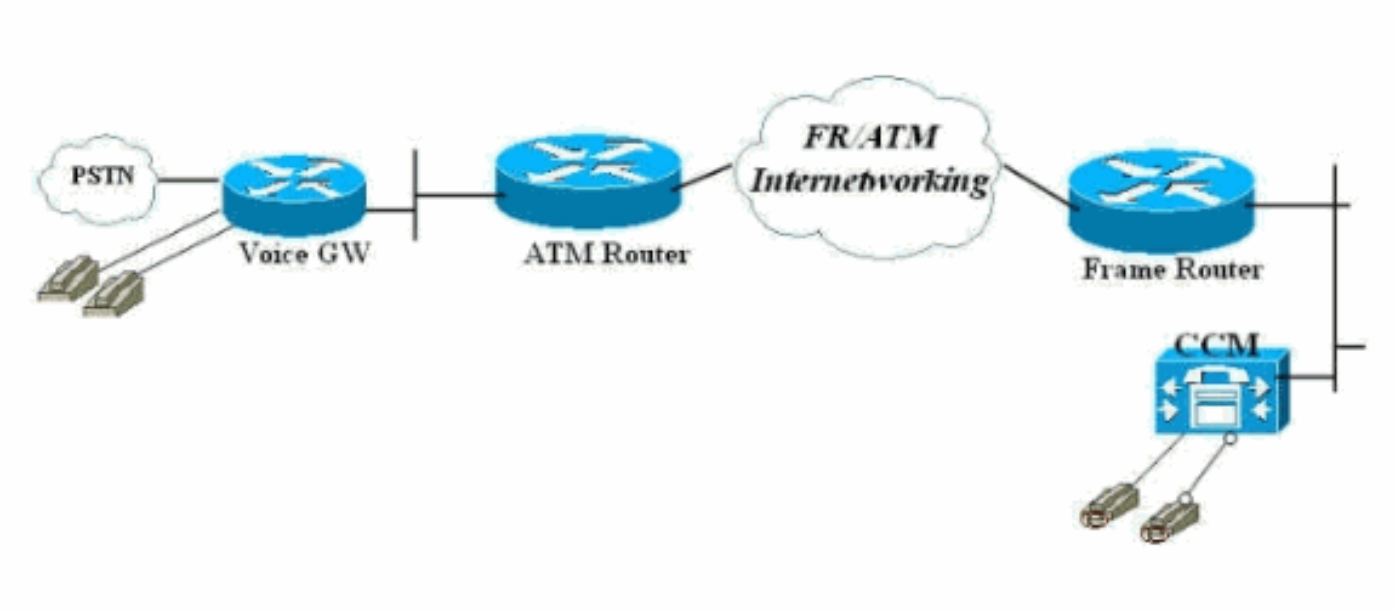
Configure

本部分提供有关如何配置本文档所述功能的信息。

Note: 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。

Network Diagram

本文档使用以下网络设置：



配置

本文档使用以下配置：

- 帧中继连接的路由器
- ATM的路由器

Note: 请注意在此配置，两路由器在帧中继紧接被联络到ATM互通交换机。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连接到其他路由器，被联络到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被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。

帧中继连接的路由器

```
!--- 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
```

Verify

Use this section to confirm that your configuration works properly.

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操作状态的验证，包括DLCI和PVC统计数据、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** —验证套件是否up/down，虚拟访问接口是套件(MLPPP套件)，并且是成员(PPP链接)。此命令是否也验证载波丢弃信元/帧(丢失的片段<> 0)。唯一的可接受片段损失是循环冗余校验(CRC)错误造成的一个。
- **显示用户**—显示与虚拟访问接口产生关联的编号。您能使用从此命令或**show ppp multilink命令的**信息，因此您能显示关于接口的统计数据或清除接口。
- **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。此命令也显示物理接口是否一定对虚拟接口。
- **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**输出中关于此命令的更多信息多种字段。**Note:** 理想的排队机制总是适用于virtual-access2接口。其他接口使用先进先出排队。
- **show ip rtp header-compression** —若被设定显示RTP报头压缩统计数据。注意统计数据附有virtual-access2接口，是套件接口。

这些命令示例显示得这里：

```
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**显示用户**。

```
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**显示用户**。

```
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
```

Troubleshoot

使用本部分可排除配置的故障。

此部分提供打算的一些示例调试澄清MLP LFI和担当运行示例排除您的配置故障。

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。

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

- **debug ppp协商**—说明克隆两个虚拟访问接口的进程表示PPP和PPP捆绑链路。虚拟访问接口1 (Vi1)是的PPP链接(ATM或帧) PVC一定。虚拟接口2 (Vi2)是排队策略附有的PPP捆绑链路。
- **debug ppp multilink fragment** —说明用更小的语音数据包被插入的更大的数据包的概念。交叉在Vi2接口(MLP级别)发生，因为套件接口有分配的理想的排队机制。

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

Related Information

- 设计和配置在帧中继和ATM的多链路PPP
- 带有服务质量控制的VoIP-over-PPP (LLQ /IP RTP优先级、LFI， cRTP)
- 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
- Technical Support & Documentation - Cisco Systems