QoS VoIP per Frame Relay su ATM Interworking con LLQ, PPP LFI e cRTP

Sommario

Introduzione

In questo documento viene fornita una configurazione di esempio per la funzionalità Voice over IP con Multilink PPP su ATM e Frame Relay Interworking (VoIP con MLPoATM / MLPoFR). Gli esempi di configurazione sono incentrati sulla fornitura di Quality of Service (QoS) per supportare correttamente la voce su una WAN interconnessa ATM/Frame Relay. Gli esempi di configurazione usano anche il protocollo compressed Real Time Protocol (cRTP), supportato su ATM dal software Cisco IOS® versione 12.2(2)T.

Il documento può essere letto come documento autonomo per le guide alla configurazione, gli esempi di configurazione e i comandi di verifica da utilizzare nella creazione della rete. Vengono inoltre fornite alcune informazioni preliminari per problemi specifici associati all'utilizzo dell'interoperabilità ATM/Frame Relay. Per ulteriori informazioni su QoS per VoIP su Frame Relay o PPP, consultare i seguenti documenti:

- Collegamenti VoIP over PPP con Quality of Service (priorità LLQ / IP RTP, LFI, cRTP)
- VoIP over Frame Relay con QoS (frammentazione, Traffic Shaping, priorità LLQ / IP RTP)

Prerequisiti

Requisiti

Prima di provare questa configurazione, accertarsi di soddisfare i seguenti requisiti:

Ènecessario avere familiarità con le seguenti aree tecnologiche:

- Access Control List
- Circuiti virtuali permanenti (PVC) ATM
- Circuiti virtuali permanenti Frame Relay (DLCI (Data-Link Connection Identifier))
- Gestione della larghezza di banda
- LLQ
- LFI
- Modelli virtuali e interfacce di accesso virtuale
- MLPPP
- cRTP

Componenti usati

Le informazioni fornite in questo documento si basano sulle seguenti versioni software e hardware:

- Cisco 3640 come router ATM
- Cisco 2620 come router Frame Relay
- Software Cisco IOS release 12.2(8)T (IP Plus)

Nota: Come regola generale, l'ultima versione di manutenzione della linea principale di Cisco IOS 12.2 è la versione consigliata del software Cisco IOS da utilizzare per MLPoATM/FR. Il software Cisco IOS release 12.2T è richiesto sul router ATM se si usa cRTP.

Le funzionalità rilevanti sono state introdotte nelle seguenti versioni del software Cisco IOS:

- La tecnologia LFI è stata introdotta nel software Cisco IOS versione 11.3.
- LLQ è stato introdotto nel software Cisco IOS versione 12.0(7)T.
- LLQ su Frame Relay e ATM per PVC è stato introdotto nel software Cisco IOS versione 12.1(2)T.
- La funzionalità LFI di Multilink PPP per Frame Relay e circuiti virtuali ATM è stata introdotta nel software Cisco IOS versione 12.1(5)T.
- Il protocollo cRTP over ATM è stato introdotto nel software Cisco IOS versione 12.2(2)T.

Le informazioni discusse in questo documento fanno riferimento a dispositivi usati in uno specifico ambiente di emulazione. Su tutti i dispositivi menzionati nel documento la configurazione è stata ripristinata ai valori predefiniti. Se la rete è operativa, valutare attentamente eventuali conseguenze derivanti dall'uso dei comandi.

Convenzioni

Per ulteriori informazioni sulle convenzioni usate, consultare il documento Cisco sulle convenzioni nei suggerimenti tecnici.

Premesse

I problemi chiave per ridurre al minimo il ritardo end-to-end e l'eliminazione dell'effetto jitter per il VoIP su una rete interconnessa ATM/Frame Relay sono:

- Priorità rigida per il traffico vocale (LLQ (Low-Latency Queueing))
- Link Fragmentation and Interleaving (LFI)
- Frame Relay Traffic Shaping (FRTS) per voce
- Traffic Shaping ATM

Questi documenti forniscono utili fonti di ulteriori informazioni generali:

- Quality of Service per Voice over IP
- Configurazione della frammentazione e dell'interfoliazione del collegamento per Frame Relay e circuiti virtuali ATM

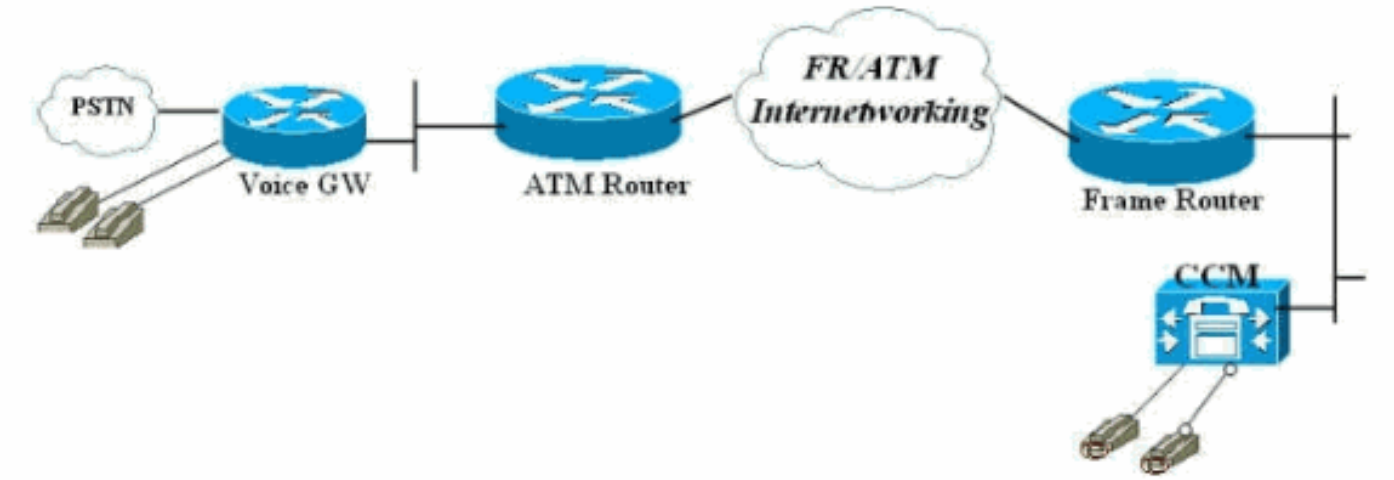
Configurazione

In questa sezione vengono presentate le informazioni necessarie per configurare le funzionalità descritte più avanti nel documento.

Nota: per ulteriori informazioni sui comandi menzionati in questo documento, usare lo strumento di ricerca dei comandi (solo utenti registrati).

Esempio di rete

Nel documento viene usata questa impostazione di rete:



Configurazioni

Nel documento vengono usate queste configurazioni:

- Frame Relay Connected Router
- Router connesso ATM

Nota: è importante notare che in questa configurazione, i due router sono connessi back-to-back su un Frame Relay a uno switch di interworking ATM. Nella maggior parte delle topologie, tuttavia, i router abilitati per la voce possono esistere ovunque. In genere, i router voce utilizzano la connettività LAN ad altri router, connessi a ATM/Frame WAN. In questi casi, i router connessi alla WAN, Frame Relay e ATM devono essere configurati per LLQ, LFI e MLPPP in modo da poter

fornire il QoS e non i gateway voce, come mostrato in queste configurazioni.

Frame Relay Connected Router

```
!--- 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
```

Router connesso ATM

```
!--- 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
```

Verifica

Per verificare che la configurazione funzioni correttamente, consultare questa sezione.

Lo strumento Output Interpreter (solo utenti registrati) (OIT) supporta alcuni comandi **show**. Usare l'OIT per visualizzare un'analisi dell'output del comando **show**.

I comandi **show** sono utili per verificare lo stato operativo dell'ambiente di interworking ATM/Frame Relay, che include statistiche DLCI e PVC, lo stato dell'interfaccia fisica e virtuale, l'applicazione QoS (Policy) e informazioni cRTP:

- **show ppp multilink interface *interface-name*: verifica se il bundle è attivo/inattivo, quale interfaccia di accesso virtuale è il bundle (bundle MLPPP) e quali sono i membri (collegamento PPP).** Questo comando verifica anche se il vettore rilascia celle/fotogrammi (frammenti persi **<>** 0). L'unica perdita accettabile è causata da errori CRC (Cyclic Redundancy Check).
- **show user**: visualizza il numero associato all'interfaccia di accesso virtuale. È possibile utilizzare le informazioni di questo comando o del comando **show ppp multilink** per visualizzare le statistiche sull'interfaccia o cancellare il contenuto dell'interfaccia.
- show frame-relay pvc *dlci**: visualizza informazioni quali parametri di traffic shaping, valori di frammentazione e pacchetti ignorati.*** Questo comando mostra anche se l'interfaccia fisica è stata associata all'interfaccia virtuale.
- **show atm pvc *pvc*: visualizza tutti i PVC ATM attivi e le informazioni sul traffico.**
- **show policy-map interface *interface-name*: visualizza tutte le operazioni LLQ e le interruzioni nel PQ.** Per ulteriori informazioni sui vari campi del comando **show policy-map interface**, consultare il documento sulla descrizione dei contatori dei pacchetti nell'output del comando **show policy-map interface**.**Nota:** l'accodamento fantasia viene sempre applicato all'interfaccia virtual-access2. Le altre interfacce utilizzano l'accodamento FIFO.
- **show ip rtp header-compression**: visualizza le statistiche di compressione dell'intestazione RTP, se configurate. Le statistiche sono collegate all'interfaccia virtual-access2, che è l'interfaccia del bundle.

Di seguito sono riportati alcuni esempi di questi comandi:

```
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
```

Questo output visualizza il comando **show users** sul router Frame Relay.

```
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#
```

Questo output visualizza il comando **show users** sul router ATM.

```
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#
```

Questo output mostra il comando **show frame-relay pvc**.

```
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#
```

In questo output viene mostrato il comando **show atm pvc 10/100** sul router ATM.

```
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#
```

Questa è la **procedura show policy-map** sul router Frame Relay.

```
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
```

Questo output mostra il comando **show policy map** sul router ATM.

```
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#
```

Questo output mostra il comando **show ip rtp header-compression** sul router Frame Relay.

```
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
```

Questo output mostra il comando **show ip rtp header-compression** sul router ATM.

```
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
```

Risoluzione dei problemi

Consultare questa sezione per risolvere i problemi di configurazione.

In questa sezione vengono forniti alcuni debug di esempio per chiarire la configurazione LFI di

MLP e come esempi pratici per risolvere i problemi relativi alla configurazione.

Comandi per la risoluzione dei problemi

Lo strumento Output Interpreter (solo utenti registrati) (OIT) supporta alcuni comandi **show**. Usare l'OIT per visualizzare un'analisi dell'output del comando **show**.

Nota: consultare le informazioni importanti sui comandi di debug prima di usare i comandi di **debug**.

- **debug ppp negotiation**: illustra il processo di duplicazione delle due interfacce di accesso virtuale per rappresentare i collegamenti del bundle PPP e PPP. L'interfaccia di accesso virtuale 1 (Vi1) è il collegamento PPP a cui è associato il PVC (ATM o frame). L'interfaccia virtuale 2 (Vi2) è il collegamento al bundle PPP a cui sono allegati i criteri di coda.
- **debug ppp multilink fragment**: illustra il concetto di pacchetti di dati più grandi da interfogliare con pacchetti voce più piccoli. L'interfoliazione si verifica sull'interfaccia Vi2 (livello MLP) poiché all'interfaccia del bundle è stata assegnata una coda elaborata.

Questo è l'output del comando **debug ppp negotiation**.

```
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
```

Questo output del comando è il comando **debug ppp multilink fragment**.

```
*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
```

Informazioni correlate

- Progettazione e distribuzione di Multilink PPP su Frame Relay e ATM
- Collegamenti VoIP over PPP con Quality of Service (priorità LLQ / IP RTP, LFI, cRTP)
- VoIP over Frame Relay con QoS (frammentazione, Traffic Shaping, priorità LLQ / IP RTP)
- Supporto alla tecnologia vocale
- Supporto ai prodotti voce e Unified Communications
- Risoluzione dei problemi di Cisco IP Telephony
- Documentazione e supporto tecnico – Cisco Systems