

# 对帧中继配置与故障排除的全面的指南

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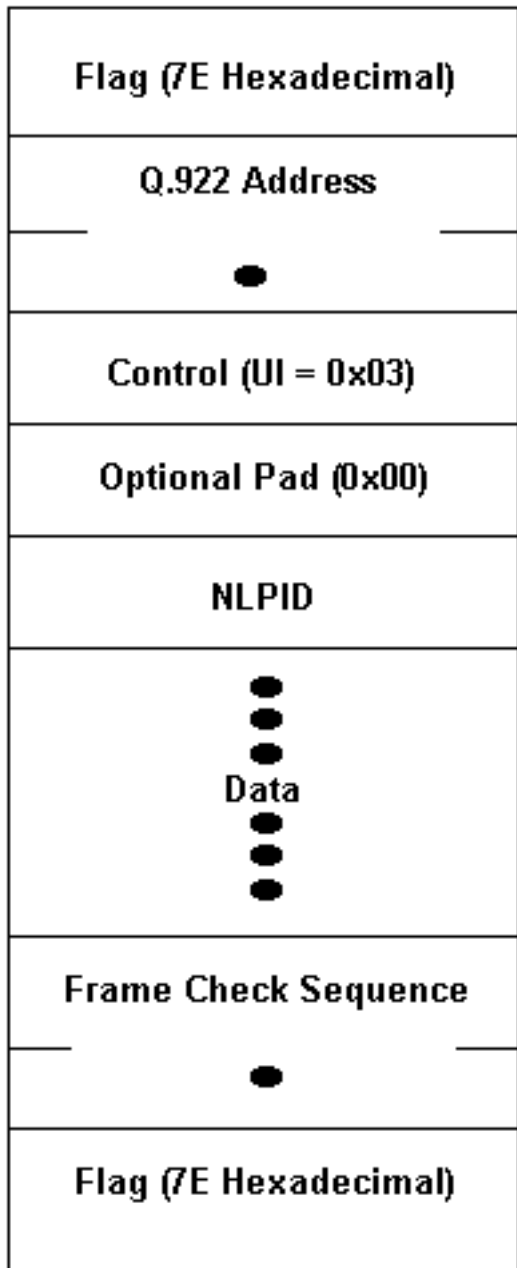
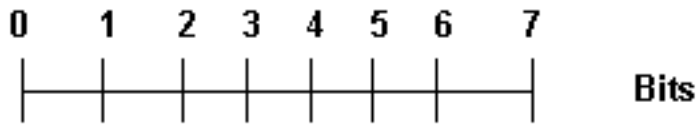
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## [简介](#)

帧中继是行业标准，交换数据链路层协议该把柄多个虚拟电路使用在连接的设备之间的高级数据链路控制(HDLC)封装。在许多情况下，帧中继比X.25更有效率，X.25是一般考虑替换的协议。以下图说明一个帧中继帧(ANSI T1.618)。



● = Octet

注意在上图中，Q.922地址（如当前定义）是2个八位字节，并包含10-bit数据链路连接标识符（DLCI）。在一些网络中，Q.922地址可能被随意增加到三个或四个八位位组。

“标志”领域分隔帧的开始处和结束。在主导的“flag”字段之后是两字节的地址信息。这两个字节的十位数组成了实际电路ID(称为DLCI，用于数据链路连接标识符)。

10位DLCI值是帧中继报头的重点。它识别多元化到物理信道的逻辑连接。在基本的(即不由本地管理接口[LMI]进行扩展)寻址模式中，DLCI有本地意义；即二个不同连接端的终端设备可以在相同连接上使用不同的DLCI。

# [开始使用前](#)

## [规则](#)

有关文档规则的详细信息，请参阅 [Cisco 技术提示规则](#)。

## [先决条件](#)

[欲知更多信息和本文所用术语的定义，请参见帧中继术语表。](#)

## [使用的组件](#)

本文档不限于特定的软件和硬件版本。

本文档中的信息都是基于特定实验室环境中的设备创建的。本文档中使用的所有设备最初均采用原始（默认）配置。如果您是在真实网络上操作，请确保您在使用任何命令前已经了解其潜在影响。

## [背景理论](#)

帧中继最初被设想为作为一份协议为在ISDN接口的使用。1984年，初步提议被提交到国际电信联盟电信标委会标准化部门(ITU-T) (以前的国际电报电话咨询委员会[CCITT])。帧中继的工作也可以在美国ANSI认可的T1S1标准委员会里执行。

1990年，思科系统、StrataCom、Northern Telecom和Digital Equipment Corporation组建了一个机构，专门从事帧中继技术的开发，加快可互操作的帧中继产品的推出。他们制定了一个规范，符合在T1S1和ITU-T中讨论的基本帧中继协议，但在功能方面进行了扩展，提供了一些适用于复杂联网环境的其他功能。这些帧中继扩展共同指LMI。这是在路由器的“cisco” LMI与“ansi”或“q933a” LMI相对。

帧中继提供了分组交换数据通信功能，可在用户设备(例如路由器、网桥、主机)和网络设备(例如交换节点)之间的接口上使用。用户设备经常称为数据终端设备(DTE)，连接到DTE的网络设备通常称为数据电路终端设备(DCE)。提供帧中继接口的网络可以是运营商提供的公共网络或为单个企业服务的专有设备网络。

帧中继与在其功能和格式的X.25极大有不同。特别是，帧中继是更多效率化的协议，实现高性能和更加了不起的效率。

作为用户和网络设备之间的一个接口，帧中继提供了一种在单个物理传输链路上统计复用很多逻辑数据会话(指虚拟电路)的方式。这与使用支持多数据流的仅Time Division Multiplexing (TDM)技术的系统形成对比。帧中继的统计复用提供可用的带宽灵活和有效利用。无需TDM技术它也可以使用，或者由TDM系统提供在信道顶部。

帧中继的另一个重要特性是它开发了广域网(WAN)传输技术的最新进展。当模拟传输传动系统和铜媒体是主要的，更早的广域网协议，例如X.25，开发。这些链路比光纤媒体/数字传输链路联机今天较不可靠。在这类链路上，链路层协议可以抛弃耗费时间长的错误改正算法，将这类算法留在更高协议层上执行。因此更加了不起的性能和效率是可能的，无需牺牲数据完整性。帧中继设计有此方法的念头。它包括循环冗余校验(CRC)算法，用于检测损坏的位(可能导致数据丢弃)，但不包括任何用于纠正坏数据(例如，在这个水平的协议上重新转发)的任何协议机制。

帧中继和X.25之间的另一个区别是帧中继中缺乏明确的每条虚拟电路的流控制。即然许多上层协议

能够有效执行它们自己的流控制算法，因此链路层对此功能的需求已经减少。帧中继，因此，不包括在更高层复制那些的明确流控制程序。相反地，使用非常简单的拥塞通知机制是为了使网络通知用户设备现在网络资源接近拥塞状态。此通知能警告更高层协议流量控制可能是需要的。

## 配置基本的帧中继

一旦您在永久虚拟电路(PVC)的两端具有到本地帧中继交换机的可靠连接，便需开始规划帧中继配置。在此第一示例中，对“cisco” LMI的本地管理接口(LMI)型的默认在Spicey。“接口被默认为”“多点”“接口，因此frame-relay inverse-arp 是打开的(对于点到点的应用而言，这里没有反向ARP)。”IP水平分割检查默认禁用帧中继封装，路由更新将从相同接口流入流出。路由器通过LMI更新，获取它们需要从帧中继交换机使用的数据链路连接标识符(DLCI)。路由器将反向ARP传输到远程IP地址上，并创建本地DLCI和相关远程IP地址的映射。

## 网络图



## 配置

- [Spicey](#)
- [Prasit](#)

### Spicey

```
Spicey#show running-config
Building configuration...

Current configuration : 1705 bytes
!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Spicey
!
!
!
interface Ethernet0
 ip address 124.124.124.1 255.255.255.0
!
interface Serial0
 ip address 3.1.3.1 255.255.255.0
 encapsulation frame-relay
 frame-relay interface-dlci 140
!
!
router rip
```

```
network 3.0.0.0
network 124.0.0.0
!
line con 0
  exec-timeout 0 0
  transport input none
line aux 0
line vty 0 4
  login
!
end
```

## Prasit

```
Prasit#show running-config
Building configuration...
Current configuration : 1499 bytes
!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Prasit
!
!
!
interface Ethernet0
  ip address 123.123.123.1 255.255.255.0
!
!
interface Serial1
  ip address 3.1.3.2 255.255.255.0
  encapsulation frame-relay
  frame-relay interface-dlci 150
!
!
router rip
  network 3.0.0.0
  network 123.0.0.0
!
!
!
line con 0
  exec-timeout 0 0
  transport input none
line aux 0
line vty 0 4
  login
!
end
```

## [debug 和 show 命令](#)

在发出 **debug** 命令之前，请参阅[有关 Debug 命令的重要信息](#)。

- **show frame-relay map**
- **show frame-relay pvc**
- **show frame-relay lmi**
- **ping <device name>**

- show ip route

## Spicey

```
Spicey#show frame-relay map
```

```
Serial0 (up): ip 3.1.3.2 dlci 140(0x8C,0x20C0), dynamic,  
             broadcast,, status defined, active
```

```
Spicey#show frame-relay pvc
```

```
PVC Statistics for interface Serial0 (Frame Relay DTE)
```

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

```
DLCI = 140, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0
```

```
input pkts 83          output pkts 87          in bytes 8144  
out bytes 8408        dropped pkts 0          in FECN pkts0  
in BECN pkts 0        out FECN pkts 0        out BECN pkts0  
in DE pkts 0          out DE pkts 0  
out bcast pkts 41     out bcast bytes 3652  
pvc create time 01:31:50, last time pvc status changed 01:28:28
```

```
Spicey#show frame-relay lmi
```

```
LMI Statistics for interface Serial0 (Frame Relay DTE) LMI TYPE = CISCO
```

```
Invalid Unnumbered info 0      Invalid Prot Disc 0  
Invalid dummy Call Ref 0      Invalid Msg Type 0  
Invalid Status Message 0      Invalid Lock Shift 0  
Invalid Information ID 0      Invalid Report IE Len 0  
Invalid Report Request 0      Invalid Keep IE Len 0  
Num Status Enq. Sent 550      Num Status msgs Rcvd 552  
Num Update Status Rcvd 0      Num Status Timeouts 0
```

```
Spicey#ping 123.123.123.1
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 123.123.123.1, timeout is 2 seconds:
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/40 ms
```

```
Spicey#show ip route
```

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
```

```
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
```

```
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
```

```
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
```

```
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
```

```
inter area
```

```
       * - candidate default, U - per-user static route, o - ODR
```

```
       P - periodic downloaded static route
```

```
Gateway of last resort is not set
```

```
 3.0.0.0/24 is subnetted, 1 subnets
```

```
 C    3.1.3.0 is directly connected, Serial0
```

```
124.0.0.0/24 is subnetted, 1 subnets
```

```
 C    124.124.124.0 is directly connected, Ethernet0
```

```
 R    123.0.0.0/8 [120/1] via 3.1.3.2, 00:00:08, Serial0
```

## Prasit

```
Prasit#show frame-relay map
```

```
Serial1 (up): ip 3.1.3.1 dlci 150(0x96,0x2460), dynamic,  
             broadcast,, status defined, active
```

```
Prasit#show frame-relay pvc
```

PVC Statistics for interface Serial1 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 150, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1

```
input pkts 87          output pkts 83          in bytes 8408
out bytes 8144        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 38     out bcast bytes 3464
pvc create time 01:34:29, last time pvc status changed 01:28:05
```

Prasit#show frame-relay lmi

LMI Statistics for interface Serial1 (Frame Relay DTE) LMI TYPE = CISCO

Invalid Unnumbered info	0	Invalid Prot Disc	0
Invalid dummy Call Ref	0	Invalid Msg Type	0
Invalid Status Message	0	Invalid Lock Shift	0
Invalid Information ID	0	Invalid Report IE Len	0
Invalid Report Request	0	Invalid Keep IE Len	0
Num Status Enq. Sent	569	Num Status msgs Rcvd	570
Num Update Status Rcvd	0	Num Status Timeouts	0

Prasit#ping 124.124.124.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/36 ms

Prasit#show ip route

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS

inter area

\* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is not set

3.0.0.0/24 is subnetted, 1 subnets

C 3.1.3.0 is directly connected, Serial1

R 124.0.0.0/8 [120/1] via 3.1.3.1, 00:00:19, Serial1

123.0.0.0/24 is subnetted, 1 subnets

C 123.123.123.0 is directly connected, Ethernet0

## 配置星形帧中继

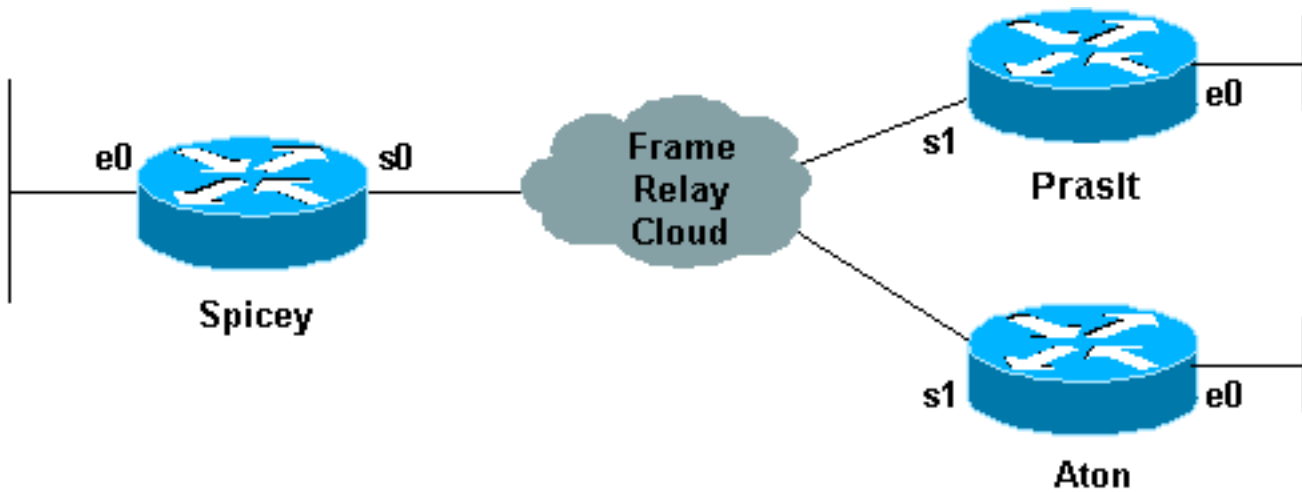
在本例中，路由器知道它使用了哪些来自帧中继交换机的数据链路连接标识符(DLCI)，并将它们分配到主接口。然后路由器远程IP地址的反向ARP。

**注意：**除非您在每个末端明确添加了帧中继映射，否则您不便不能够从Aton，ping通Prasit的串行IP地址。如果已经正确配置路由，在LAN上生成的数据流不会出现故障。如果在扩展的ping中将以太网IP地址用作源地址，您就能实现Ping操作。

当帧中继Inverse-arp启用，默认情况下广播IP流量在连接将出去。

## 网络图





## 配置

- [Spicey](#)
- [Prasit](#)
- [Aton](#)

### Spicey

```

spicey#show running-config
Building configuration...
!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname spicey
!
!
!
!
interface Ethernet0
 ip address 124.124.124.1 255.255.255.0
!
interface Serial0
 ip address 3.1.3.1 255.255.255.0
 encapsulation frame-relay
 frame-relay interface-dlci 130
 frame-relay interface-dlci 140
!
!
router rip
 network 3.0.0.0
 network 124.0.0.0
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
end

```

## Prasit

```
prasit#show running-config
Building configuration...

Current configuration : 1499 bytes
!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname prasit
!
!
!
interface Ethernet0
 ip address 123.123.123.1 255.255.255.0
!
interface Serial1
 ip address 3.1.3.2 255.255.255.0
 encapsulation frame-relay
 frame-relay interface-dlci 150
!
!
router rip
 network 3.0.0.0
 network 123.0.0.0
!
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
end
```

## Aton

```
aton#show running-config
Building configuration...
Current configuration:
!
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname aton
!
!
interface Ethernet0
 ip address 122.122.122.1 255.255.255.0
!
interface Serial1
 ip address 3.1.3.3 255.255.255.0
 encapsulation frame-relay
 frame-relay interface-dlci 160
!
!
router rip
 network 3.0.0.0
```

```

network 122.0.0.0
!
!
line con 0
  exec-timeout 0 0
  transport input none
line aux 0
line vty 0 4
  login
!
end

```

## 显示命令

- show frame-relay map
- show frame-relay pvc
- ping <device name>

## Spicey

spicey#**show frame-relay map**

```

Serial0 (up): ip 3.1.3.2 dlci 140(0x8C,0x20C0), dynamic,
              broadcast,, status defined, active
Serial0 (up): ip 3.1.3.3 dlci 130(0x82,0x2020), dynamic,
              broadcast,, status defined, active

```

spicey#**show frame-relay pvc**

PVC Statistics for interface Serial0 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	2	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 130, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0

```

input pkts 32          output pkts 40          in bytes 3370
out bytes 3928        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 30     out bcast bytes 2888
pvc create time 00:15:46, last time pvc status changed 00:10:42

```

DLCI = 140, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0

```

input pkts 282        output pkts 291        in bytes 25070
out bytes 27876       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 223    out bcast bytes 20884
pvc create time 02:28:36, last time pvc status changed 02:25:14

```

spicey#

spicey#**ping 3.1.3.2**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 3.1.3.2, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 32/35/36 ms

spicey#**ping 3.1.3.3**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 3.1.3.3, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 32/35/36 ms

## Prasit

prasit#show frame-relay map

Serial1 (up): ip 3.1.3.1 dlci 150(0x96,0x2460), dynamic,  
broadcast,, status defined, active

prasit#show frame-relay pvc

PVC Statistics for interface Serial1 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 150, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1

input pkts 311	output pkts 233	in bytes 28562
out bytes 22648	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 162	out bcast bytes 15748	

pvc create time 02:31:39, last time pvc status changed 02:25:14

prasit#ping 3.1.3.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 3.1.3.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/36 ms

prasit#ping 3.1.3.3

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 3.1.3.3, timeout is 2 seconds:

.....

Success rate is 0 percent (0/5)

## Aton

aton#show frame-relay map

Serial1 (up): ip 3.1.3.1 dlci 160(0xA0,0x2800), dynamic,  
broadcast,, status defined, active

aton#show frame-relay pvc

PVC Statistics for interface Serial1 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 160, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1

input pkts 35	output pkts 32	in bytes 3758
out bytes 3366	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 27	out bcast bytes 2846	

pvc create time 00:10:53, last time pvc status changed 00:10:53

aton#ping 3.1.3.1

Type escape sequence to abort.

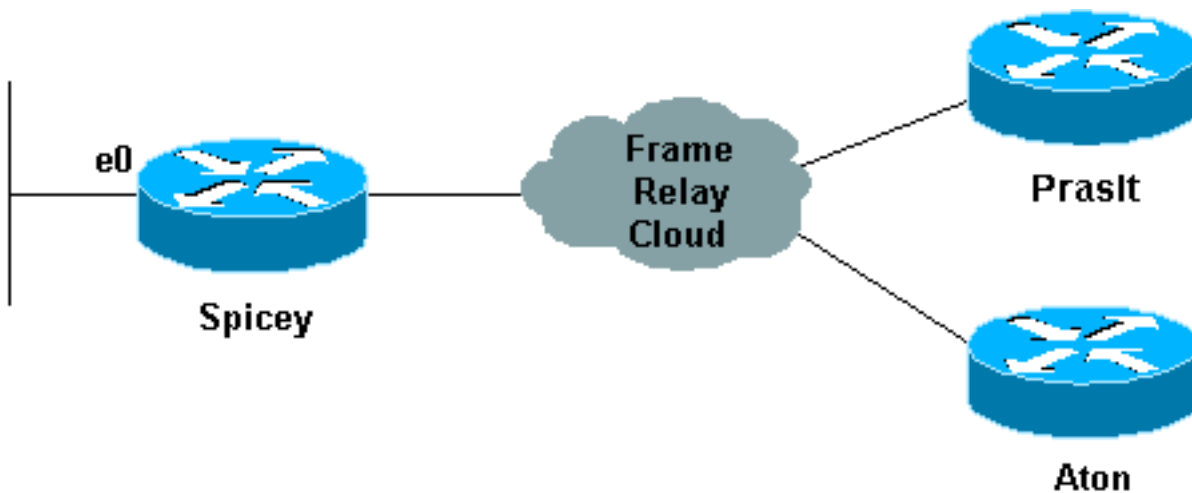
```
Sending 5, 100-byte ICMP Echos to 3.1.3.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/35/36 ms

aton#ping 3.1.3.2
```

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.1.3.2, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

## 分支间连接

在使用多点接口的星型结构中，您不能从一个支路ping通另一个支路，因为没有其他支路的IP地址映射。仅集线器地址通过反向地址解析协议(IARP)了解。如果您使用frame-relay map命令，将远程支路的IP地址配置静态映射，以使用本地的数据链路连接标识符(DLCI)，您也能够ping其他支路的地址。



## 配置

```
Prasit

prasit#show running-config
interface Ethernet0
 ip address 123.123.123.1 255.255.255.0
!
interface Serial
 ip address 3.1.3.2 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 3.1.3.3 150
 frame-relay interface-dlci 150
```

## 显示命令

- show frame-relay map
- ping <device name>
- show running-config

## Prasit

```
prasit#show frame-relay map
Serial1 (up): ip 3.1.3.1 dlci 150(0x96,0x2460), dynamic,
              broadcast,, status defined, active
Serial1 (up): ip 3.1.3.3 dlci 150(0x96,0x2460), static,
              CISCO, status defined, active

prasit#ping 3.1.3.3
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.1.3.3, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 68/70/80 ms

prasit#ping 122.122.122.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 122.122.122.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 64/67/76 ms
```

## Aton

```
aton#show running-config
interface Ethernet0
ip address 122.122.122.1 255.255.255.0
!
interface Serial1
ip address 3.1.3.3 255.255.255.0
no ip directed-broadcast
encapsulation frame-relay
frame-relay map ip 3.1.3.2 160
frame-relay interface-dlci 160

aton#show frame-relay map
Serial1 (up): ip 3.1.3.1 dlci 160(0xA0,0x2800), dynamic,
              broadcast,, status defined, active
Serial1 (up): ip 3.1.3.2 dlci 160(0xA0,0x2800), static,
              CISCO, status defined, active

aton#ping 3.1.3.2
Type escape sequence to abort
Sending 5, 100-byte ICMP Echos to 3.1.3.2, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 68/68/68 ms

aton#ping 123.123.123.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 123.123.123.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 64/67/80 ms
```

## 配置帧中继子接口

帧中继子接口提供了一种机制，支持部分网状帧中继网络。多数协议假设在逻辑网络的及物性;也就是说，如果A站能与B站通话，B站能与C站通话，则A站应该能够与C站直接通话。实际上传输在LAN上而不在帧中继网络上进行，除非A直接连接到C。

此外，部分网状网络不支持某些协议，例如AppleTalk、透明桥接和IPX，因为它们需要"水平分割"。在这些网络中，在一个接口上收到的信息包不能通过同一接口发出，即使信息包在不同的虚拟电路上接收和传输。

配置帧中继接口可将单个物理接口用作多个虚拟接口。此功能允许我们解决水平分割规则。虚拟接口收到的信息包现在可以转发给另一个虚拟接口，即使它们配置在同一个物理接口。

子接口通过将部分网状帧中继网络划分为许多较小的完全网状（或点对点）子网，为帧中继网络的限制问题提供了一种解决方法。每个子网络分配了它自己的网络编号，并且协议看起来好象可以通过独立接口达到。（注意，点到点子接口可能没有分配IP地址，以降低编址的负担）

## 点到点子接口

### 网络图



### 配置

- [Spicey](#)
- [Prasit](#)

#### Spicey

```
Spicey#show running-config
Building configuration...

Current configuration : 1338 bytes
!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Spicey
!
enable password ww
!
!
!
interface Ethernet0
 ip address 124.124.124.1 255.255.255.0
!
interface Serial0
 no ip address
 encapsulation frame-relay
!
interface Serial0.1 point-to-point
 ip address 3.1.3.1 255.255.255.0
 frame-relay interface-dlci 140
!
!
```

```
router igrp 2
 network 3.0.0.0
 network 124.0.0.0
!
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
end
```

## Prasit

```
Prasit#show running-config
Building configuration...

Current configuration : 1234 bytes
!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Prasit
!
!
!
interface Ethernet0
 ip address 123.123.123.1 255.255.255.0
!
 interface Serial1
 no ip address
 encapsulation frame-relay
!
interface Serial1.1 point-to-point
 ip address 3.1.3.2 255.255.255.0
 frame-relay interface-dlci 150
!
router igrp 2
 network 3.0.0.0
 network 123.0.0.0
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
end
```

## 显示命令

- show frame-relay map
- show frame-relay pvc



Spicey#show frame-relay map

Serial0.1 (up): point-to-point dlci, dlci 140(0x8C,0x20C0), broadcast  
status defined, active

Spicey#show frame-relay pvc

PVC Statistics for interface Serial0 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 140, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0.1

```
input pkts 193          output pkts 175          in bytes 20450
out bytes 16340        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 50     out bcast bytes 3786
pvc create time 01:11:27, last time pvc status changed 00:42:32
```

Spicey#ping 123.123.123.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 123.123.123.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/36 ms

## [Prasit](#)

Prasit#show frame-relay map

Serial1.1 (up): point-to-point dlci, dlci 150(0x96,0x2460), broadcast  
status defined, active

Prasit#show frame-relay pvc

PVC Statistics for interface Serial1 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 150, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE =  
Serial1.1

```
input pkts 74          output pkts 89          in bytes 7210
out bytes 10963        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 24     out bcast bytes 4203
pvc create time 00:12:25, last time pvc status changed 00:12:25
```

Prasit#ping 124.124.124.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:

!!!!!

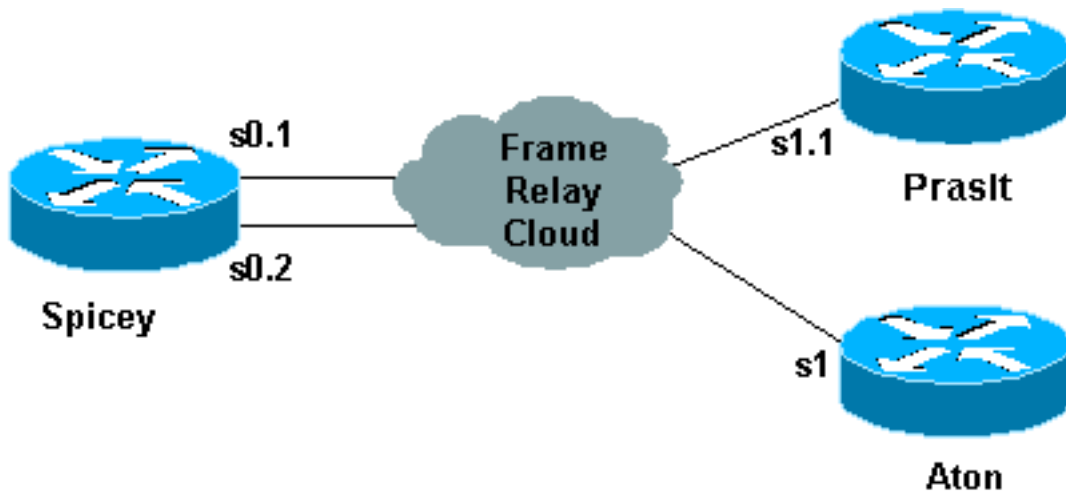
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/36 ms

## [星型连接子接口](#)

以下星型网配置示例显示两个点对点子接口并且使用在一个远程站点的动态地址解析。每个子接口带有单个协议地址和子网掩码，并且interface-dlci命令将子接口与一个指定的数据链路连接标识符

(DLCI)关联起来。每个点到点子接口的远程目的地地址没有被解析，因为它们是点到点接口，流量必须发送到另一端的对等接口。远程终端(Aton)使用反向ARP进行映射，中心相应地回复子接口的IP地址。默认情况下，因为帧中继反向ARP打开为多点接口，这发生。

## 网络图



## 配置

- [Spicey](#)
- [Prasit](#)
- [Aton](#)

### Spicey

```
Spicey#show running-config
Building configuration...
!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Spicey
!
!
!
!
interface Ethernet0
 ip address 124.124.124.1 255.255.255.0
!
interface Serial0
 no ip address
 encapsulation frame-relay
!
interface Serial0.1 point-to-point
 ip address 4.0.1.1 255.255.255.0
 frame-relay interface-dlci 140
!
interface Serial0.2 point-to-point
 ip address 3.1.3.1 255.255.255.0
 frame-relay interface-dlci 130
```

```
!  
router igrp 2  
  network 3.0.0.0  
  network 4.0.0.0  
  network 124.0.0.0  
!  
line con 0  
  exec-timeout 0 0  
  transport input none  
line aux 0  
line vty 0 4  
  login  
!  
end
```

## Prasit

```
Prasit#show running-config  
Building configuration...  
  
version 12.1  
service timestamps debug datetime msec  
service timestamps log datetime msec  
no service password-encryption  
!  
hostname Prasit  
!  
interface Ethernet0  
  ip address 123.123.123.1 255.255.255.0  
!  
interface Serial1  
  no ip address  
  encapsulation frame-relay  
!  
interface Serial1.1 point-to-point  
  ip address 4.0.1.2 255.255.255.0  
  frame-relay interface-dlci 150  
!  
router igrp 2  
  network 4.0.0.0  
  network 123.0.0.0  
!  
!  
line con 0  
  exec-timeout 0 0  
  transport input none  
line aux 0  
line vty 0 4  
  login  
!  
end
```

## Aton

```
Aton#show running-config  
Building configuration...  
  
Current configuration:  
!  
version 12.0  
service timestamps debug uptime  
service timestamps log uptime  
!  
end
```

```

hostname Aton
!
!
!
interface Ethernet0
 ip address 122.122.122.1 255.255.255.0
!
interface Serial1
 ip address 3.1.3.3 255.255.255.0
 encapsulation frame-relay
 frame-relay interface-dlci 160
!
router igrp 2
 network 3.0.0.0
 network 122.0.0.0
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
end

```

## 显示命令

- **show frame-relay map**
- **show frame-relay pvc**

## Spicey

Spicey#**show frame-relay map**

```

Serial0.2 (up): point-to-point dlci, dlci 130(0x82,0x2020), broadcast
 status defined, active
Serial0.1 (up): point-to-point dlci, dlci 140(0x8C,0x20C0), broadcast
 status defined, active

```

Spicey#**show frame-relay pvc**

PVC Statistics for interface Serial0 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	2	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 130, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0.2

```

input pkts 11          output pkts 22          in bytes 1080
out bytes 5128         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 17     out bcast bytes 4608
pvc create time 00:06:36, last time pvc status changed 00:06:36

```

DLCI = 140, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0.1

```

input pkts 33          output pkts 28          in bytes 3967
out bytes 5445         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 17      out bcast bytes 4608
pvc create time 00:06:38, last time pvc status changed 00:06:38
```

Spicey#**ping 122.122.122.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 122.122.122.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 32/35/36 ms

Spicey#**ping 123.123.123.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 123.123.123.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/36 ms

## Prasit

Prasit#**show frame-relay map**

```
Serial1.1 (up): point-to-point dlci, dlci 150(0x96,0x2460), broadcast
                status defined, active
```

Prasit#**show frame-relay pvc**

PVC Statistics for interface Serial1 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 150, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1.1

```
input pkts 45          output pkts 48          in bytes 8632
out bytes 6661         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 31     out bcast bytes 5573
pvc create time 00:12:16, last time pvc status changed 00:06:23
```

Prasit#**ping 124.124.124.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/36 ms

## Aton

Aton#**show frame-relay map**

```
Serial1 (up): ip 3.1.3.1 dlci 160(0xA0,0x2800), dynamic,
                broadcast,, status defined, active
```

Aton#**show frame-relay pvc**

PVC Statistics for interface Serial1 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 160, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1

```

input pkts 699          output pkts 634          in bytes 81290
out bytes 67008        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 528    out bcast bytes 56074
pvc create time 05:46:14, last time pvc status changed 00:05:57

```

Aton#ping 124.124.124.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/36 ms

## 配置多点子接口的动态和静态映射

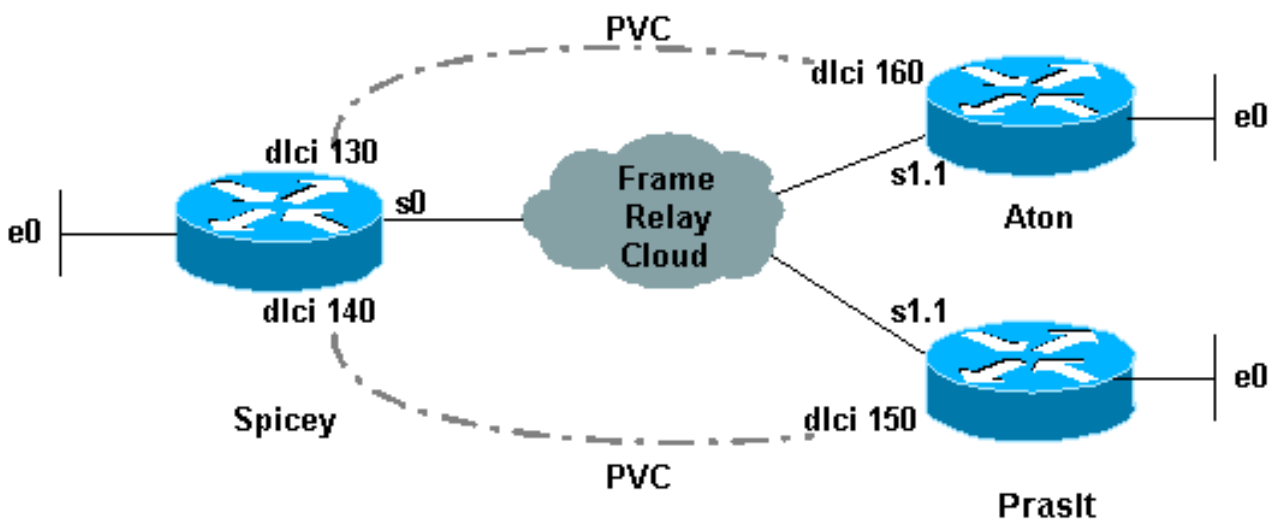
在给定了数据链路连接标识符(DLCI)的情况下，动态地址映射使用帧中继逆向ARP，以请求实现特殊连接的下一跳协议地址。反向ARP请求的回应被输入到路由器或接入服务器上的地址到DLCI的映射表中。然后表可以为流出的数据流提供下一跳协议地址或DLCI。

由于物理接口现在配置为多个子接口，您必须提供一些信息，以区分子接口和物理接口，将特定子接口与特定DLCI关联。

在默认情况下，所有支持协议都能使用反向ARP，而但在某些特殊协议DLCI对中则可能被限制使用。结果是，您可以把动态映射用于某些协议，把静态映射用于相同DLCI上的其他协议。如果您知道连接的另一端不支持协议，您就能明确地禁用协议DLCI对的反向ARP。由于反向ARP默认在它支持的所有协议上都是启动的，因此不需要使用其他命令在子接口上配置动态地址映射。静态映射连接对指定的DLCI的指定的下一跳地址协议地址。静态映射取消对反向ARP请求的需要;在您提供静态映射时，特定DLCI上的指定的协议将自动禁用反向ARP。如果路由器在另一端完全不支持反向ARP，或者不支持您要在帧中继上使用的特定协议的反向ARP，您必须使用静态映射。

## 网络图

我们已经看见如何配置Cisco路由器执行反向ARP。下例显示的是如何在您需要用于多点接口或子接口的情况下配置静态映射：



## 配置

- [Aton](#)

- [Spicey](#)
- [Prasit](#)

## Aton

```
Aton#show running-config
Building configuration...
Current configuration:
!
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Aton
!
!
interface Ethernet0
 ip address 122.122.122.1 255.255.255.0
!
interface Serial1
 no ip address
 encapsulation frame-relay
!
interface Serial1.1 multipoint
 ip address 4.0.1.3 255.255.255.0
 frame-relay map ip 4.0.1.1 160 broadcast
!
router igrp 2
 network 4.0.0.0
 network 122.0.0.0
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
end
```

## Spicey

```
Spicey#show running-config
Building configuration...Current configuration : 1652
bytes!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Spicey
!
!
interface Ethernet0
 ip address 124.124.124.1 255.255.255.0
!
interface Serial0
 ip address 4.0.1.1 255.255.255.0
 encapsulation frame-relay
 frame-relay map ip 4.0.1.2 140 broadcast
 frame-relay map ip 4.0.1.3 130 broadcast
```

```
!  
router igrp 2  
network 4.0.0.0  
network 124.0.0.0  
!  
!  
line con 0  
exec-timeout 0 0  
transport input none  
line aux 0  
line vty 0 4  
login  
!  
end
```

## Prasit

```
Prasit#show running-config  
Building configuration...  
Current configuration : 1162 bytes  
!  
version 12.1  
service timestamps debug datetime msec  
service timestamps log datetime msec  
no service password-encryption  
!  
hostname Prasit  
!  
!  
!  
interface Ethernet0  
 ip address 123.123.123.1 255.255.255.0  
!  
interface Serial1  
 no ip address  
 encapsulation frame-relay  
!  
interface Serial1.1 multipoint  
 ip address 4.0.1.2 255.255.255.0  
 frame-relay map ip 4.0.1.1 150 broadcast  
!  
router igrp 2  
 network 4.0.0.0  
 network 123.0.0.0  
!  
line con 0  
 exec-timeout 0 0  
 transport input none  
line aux 0  
line vty 0 4  
 login  
!  
end
```

## [debug 和 show 命令](#)

- show frame-relay map
- show frame-relay pvc

## [Aton](#)



Aton#show frame-relay map

Serial1.1 (up): ip 4.0.1.1 dlci 160(0xA0,0x2800), static, broadcast, CISCO, status defined, active

Aton#show frame-relay pvc

PVC Statistics for interface Serial1 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 160, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1.1

input pkts 16	output pkts 9	in bytes 3342
out bytes 450	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 9	out bcast bytes 450	
pvc create time 00:10:02, last time pvc status changed 00:10:02		

Aton#ping 124.124.124.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 32/35/36 ms

[Spicey](#)

Spicey#show frame-relay map

Serial0 (up): ip 4.0.1.2 dlci 140(0x8C,0x20C0), static, broadcast, CISCO, status defined, active

Serial0 (up): ip 4.0.1.3 dlci 130(0x82,0x2020), static, broadcast, CISCO, status defined, active

Spicey#show frame-relay pvc

PVC Statistics for interface Serial0 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	2	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 130, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0

input pkts 9	output pkts 48	in bytes 434
out bytes 11045	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 48	out bcast bytes 11045	
pvc create time 00:36:25, last time pvc status changed 00:36:15		

DLCI = 140, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0

input pkts 17	output pkts 26	in bytes 1390
out bytes 4195	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 16	out bcast bytes 3155	
pvc create time 00:08:39, last time pvc status changed 00:08:39		

```
Spicey#ping 122.122.122.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 122.122.122.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/40 ms
```

```
Spicey#ping 123.123.123.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 123.123.123.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/35/36
```

## [Prasit](#)

```
Prasit#show frame-relay map
Serial1.1 (up): ip 4.0.1.1 dlci 150(0x96,0x2460), static,
                broadcast,
                CISCO, status defined, active
```

```
Prasit#show frame-relay pvc
PVC Statistics for interface Serial1 (Frame Relay DTE)

```

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

```
DLCI = 150, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1.1
input pkts 28          output pkts 19          in bytes 4753
out bytes 1490        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 9      out bcast bytes 450
pvc create time 00:11:00, last time pvc status changed 00:11:00
```

```
Prasit#ping 124.124.124.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/36 ms
```

关于这些命令的更多信息，请参阅[帧中继命令](#)。

## [配置 IP 无编号帧中继](#)

如果您没有IP地址空间来使用许多子接口，您可以在每个子接口上使用未编号的IP。如果出现这种情况，您需要使用静态路由或动态路由，以便您的数据流照常被路由，并且您必须使用点到点子接口。

### [网络图](#)

下面的示例说明此：



## 配置

- [Spicey](#)
- [Prasit](#)

### Spicey

```
Spicey#show running-config
Building configuration...
Current configuration : 1674 bytes
!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Spicey
!
!
!
interface Ethernet0
 ip address 124.124.124.1 255.255.255.0
!
interface Serial0
 no ip address
 encapsulation frame-relay
!
interface Serial0.1 point-to-point
 ip unnumbered Ethernet0
 frame-relay interface-dlci 140
!
router igrp 2
 network 124.0.0.0
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
end
```

### Prasit

```
Prasit#show running-config
Building configuration...

Current configuration : 1188 bytes
!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Prasit
!
!
interface Ethernet0
 ip address 123.123.123.1 255.255.255.0
!
```

```

interface Serial11
  no ip address
  encapsulation frame-relay
  !
interface Serial11.1 point-to-point
  ip unnumbered Ethernet0
  frame-relay interface-dlci 150
  !
router igrp 2
  network 123.0.0.0
  !
line con 0
  exec-timeout 0 0
  transport input none
line aux 0
line vty 0 4
  login
  !
end

```

## 显示命令

- **show frame-relay map**
- **show frame-relay pvc**

## Spicey

Spicey#**show frame-relay map**

Serial0.1 (up): point-to-point dlci, dlci 140(0x8C,0x20C0), broadcast  
status defined, active

Spicey#**show frame-relay pvc**

PVC Statistics for interface Serial0 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 140, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE =  
Serial0.1

```

input pkts 23          output pkts 24          in bytes 3391
out bytes 4952        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 bcst pkts 14      out bcst bytes 3912
pvc create time 00:04:47, last time pvc status changed 00:04:47

```

Spicey#**show ip route**

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS  
inter area  
\* - candidate default, U - per-user static route, o - ODR  
P - periodic downloaded static route

```
Gateway of last resort is not set
  124.0.0.0/24 is subnetted, 1 subnets
C    124.124.124.0 is directly connected, Ethernet0
  123.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
I    123.0.0.0/8 [100/8576] via 123.123.123.1, 00:01:11, Serial0.1
I    123.123.123.0/32 [100/8576] via 123.123.123.1, 00:01:11,
Serial0.1
```

Spicey#**ping 123.123.123.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 123.123.123.1, timeout is 2 seconds:  
!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/36 ms

[Prasit](#)

Prasit#**show frame-relay map**

```
Serial1.1 (up): point-to-point dlci, dlci 150(0x96,0x2460), broadcast
      status defined, active
```

Prasit#**show frame-relay pvc**

PVC Statistics for interface Serial1 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 150, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1.1

```
input pkts 24          output pkts 52          in bytes 4952
out bytes 10892        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 41     out bcast bytes 9788
pvc create time 00:10:54, last time pvc status changed 00:03:51
```

Prasit#**show ip route**

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route
```

```
Gateway of last resort is not set
  124.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
I    124.0.0.0/8 [100/8576] via 124.124.124.1, 00:00:18, Serial1.1
I    124.124.124.0/32 [100/8576] via 124.124.124.1, 00:00:18,
Serial1.1
  123.0.0.0/24 is subnetted, 1 subnets
C    123.123.123.0 is directly connected, Ethernet0
```

Prasit#**ping 124.124.124.1**

Type escape sequence to abort.

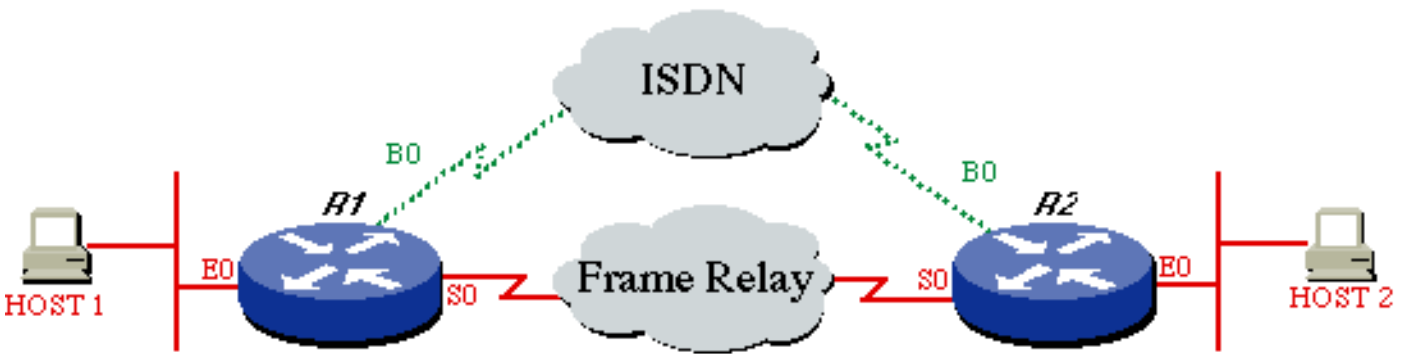
Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:  
!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 36/120/436 ms

# 配置帧中继备份

## ISDN 上的帧中继备份

使用ISDN，您可以希望到备用帧中继电路。实现的方式有几种。第一个，也很可能是最佳一个，使用浮动静态路由，将流量路由到基本速率接口(BRI) IP地址，并使用适当的路由度量指标。您也可以主要接口上或根据每个数据链接的连接标识符(DLCI)使用备份接口。对于备份主要接口，它的作用可能不大，因为您可能丢失永久虚拟电路(PVC)，而主要接口不会断开。切记，协议用本地帧中继交换机交换，不是远程路由器。



### 配置

- [路由器 1](#)
- [路由器 2](#)

```
路由器 1

Prasit#show frame-relay map
Serial1.1 (up): point-to-point dlci, dlci
150(0x96,0x2460), broadcast
        status defined, active

Prasit#show frame-relay pvc

PVC Statistics for interface Serial1 (Frame Relay DTE)

          Active      Inactive      Deleted
Static
  Local          1           0           0
0
  Switched       0           0           0
0
  Unused         0           0           0
0
DLCI = 150, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE,
INTERFACE =
Serial1.1

  input pkts 24          output pkts 52          in
bytes 4952
  out bytes 10892       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 41    out bcast bytes 9788
```

```
pvc create time 00:10:54, last time pvc status changed
00:03:51
```

```
Prasit#show ip route
```

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M -
mobile, B - BGP
```

```
    D - EIGRP, EX - EIGRP external, O - OSPF, IA -
OSPF inter area
```

```
    N1 - OSPF NSSA external type 1, N2 - OSPF NSSA
external type 2
```

```
    E1 - OSPF external type 1, E2 - OSPF external
type 2, E - EGP
```

```
    i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-
2, ia - IS-IS
```

```
inter area
```

```
    * - candidate default, U - per-user static route,
o - ODR
```

```
    P - periodic downloaded static route
```

```
Gateway of last resort is not set
```

```
    124.0.0.0/8 is variably subnetted, 2 subnets, 2
masks
```

```
    I      124.0.0.0/8 [100/8576] via 124.124.124.1,
00:00:18, Serial1.1
```

```
    I      124.124.124.0/32 [100/8576] via 124.124.124.1,
00:00:18,
Serial1.1
```

```
    123.0.0.0/24 is subnetted, 1 subnets
```

```
    C      123.123.123.0 is directly connected, Ethernet0
```

```
Prasit#ping 124.124.124.1
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout
is 2 seconds:
```

```
!!!!!
```

```
Success rate is 100 percent (5/5), round-trip
```

```
min/avg/max = 36/120/436 ms
```

## 路由器 2

```
Prasit#show frame-relay map
```

```
Serial1.1 (up): point-to-point dlci, dlci
```

```
150(0x96,0x2460), broadcast
```

```
    status defined, active
```

```
Prasit#show frame-relay pvc
```

```
PVC Statistics for interface Serial1 (Frame Relay DTE)
```

```
          Active      Inactive      Deleted
```

```
Static
```

```
  Local          1          0          0
```

```
0
```

```
  Switched       0          0          0
```

```
0
```

```
  Unused         0          0          0
```

```
0
```

```
DLCI = 150, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE,
```

```
INTERFACE =
```

```
Serial1.1
```

```
    input pkts 24          output pkts 52          in
```

```
bytes 4952
```

```
    out bytes 10892        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 41      out bcast bytes 9788
  pvc create time 00:10:54, last time pvc status changed
00:03:51

Prasit#show ip route
Codes: C - connected, S - static, I - IGRP, R - RIP, M -
mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA -
OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA
external type 2
       E1 - OSPF external type 1, E2 - OSPF external
type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-
2, ia - IS-IS
inter area
       * - candidate default, U - per-user static route,
o - ODR
       P - periodic downloaded static route

Gateway of last resort is not set
 124.0.0.0/8 is variably subnetted, 2 subnets, 2
masks
I      124.0.0.0/8 [100/8576] via 124.124.124.1,
00:00:18, Serial1.1
I      124.124.124.0/32 [100/8576] via 124.124.124.1,
00:00:18,
Serial1.1
      123.0.0.0/24 is subnetted, 1 subnets
C      123.123.123.0 is directly connected, Ethernet0

Prasit#ping 124.124.124.1
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout
is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip
min/avg/max = 36/120/436 ms

```

## 显示命令

要验证，如果ISDN工作，请使用以下调试指令。在发出 **debug** 命令之前，请参阅[有关 Debug 命令的重要信息](#)。

- **debug isdn q931**
- **debug ppp neg**
- **debug ppp auth**

设法由主叫方做ISDN呼叫到中心端，不用备份命令。如果这是成功的，请添加备份命令到主叫方。

**注意：**要测试备份，请不要在串行接口使用shutdown命令，但可以从串联线拔出电缆，模拟真正串联线问题。

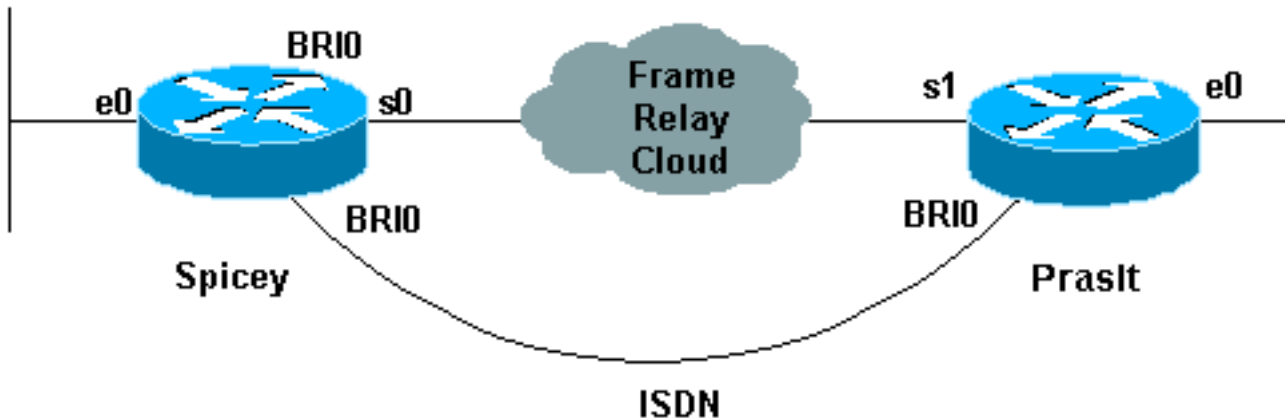
## 配置每个 DLCI 备份



我们现在假设Spicey是中心端，Prasit是与中心端(Spicey)建立连接的端。注意您只能将backup命令添加到呼叫中心端上。

**注意：**子接口不支持备份负载。因为你不跟踪在子接口的数据流级别，负载没有计算。

## 网络图



## 配置

- [Spicey](#)
- [Prasit](#)

### Spicey

```
Spicey#show running-config
Building configuration...

Current configuration : 1438 bytes
!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Spicey
!
!
username Prasit password 0 cisco
!
!
!
isdn switch-type basic-net3
!
!
!
interface Ethernet0
 ip address 124.124.124.1 255.255.255.0
!
interface Serial0
 no ip address
 encapsulation frame-relay
!
interface Serial0.1 point-to-point
 ip address 4.0.1.1 255.255.255.0
```

```
frame-relay interface-dlci 140
!
interface BRI0
 ip address 3.1.6.1 255.255.255.0
 encapsulation ppp
 dialer map ip 3.1.6.2 name Prasit broadcast
 dialer-group 1
 isdn switch-type basic-net3
 no peer default ip address
 no cdp enable
 ppp authentication chap
!
router igrp 2
 network 3.0.0.0
 network 4.0.0.0
 network 124.0.0.0
!
ip classless
 ip route 123.123.123.0 255.255.255.0 3.1.6.2 250
!
access-list 101 deny igrp any any
access-list 101 permit ip any any
dialer-list 1 protocol ip list 101
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
end
```

## Prasit

```
Prasit#show running-config
Building configuration...

Current configuration : 1245 bytes
!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Prasit
!
username Spicey password 0 cisco
!
!
isdn switch-type basic-net3
!
!
!
interface Ethernet0
 ip address 123.123.123.1 255.255.255.0
!
interface Serial1
 no ip address
 encapsulation frame-relay
!
interface Serial1.1 point-to-point
 backup delay 5 10
```

```

backup interface BRI0
ip address 4.0.1.2 255.255.255.0
frame-relay interface-dlci 150
!
interface BRI0
ip address 3.1.6.2 255.255.255.0
encapsulation ppp
dialer map ip 3.1.6.1 name Spicely broadcast 6106
dialer-group 1
isdn switch-type basic-net3
ppp authentication chap
!
router igrp 2
network 3.0.0.0
network 4.0.0.0
network 123.0.0.0
!
ip route 124.124.124.0 255.255.255.0 3.1.6.1 250
!
access-list 101 deny igrp any any
access-list 101 permit ip any any
dialer-list 1 protocol ip list 101
!
line con 0
exec-timeout 0 0
transport input none
line aux 0
line vty 0 4
login
!
end

```

## [显示命令](#)

- **show frame-relay map**
- **show ip route**
- **show isdn history**
- **show isdn status**
- **show interface bri 0**
- **show isdn active**

## [Spicely](#)

Spicely#**show frame-relay map**

Serial0.2 (up): point-to-point dlci, dlci 130(0x82,0x2020), broadcast  
status defined, active

Serial0.1 (up): point-to-point dlci, dlci 140(0x8C,0x20C0), broadcast  
status defined, active

Spicely#**show ip route**

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP

D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area

N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2

E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP

i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS

inter area

\* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is not set

3.0.0.0/24 is subnetted, 2 subnets C  
3.1.3.0 is directly connected, Serial0.2 C  
3.1.6.0 is directly connected, BRI0  
4.0.0.0/24 is subnetted, 1 subnets C  
4.0.1.0 is directly connected, Serial0.1  
124.0.0.0/24 is subnetted, 1 subnets C  
124.124.124.0 is directly connected, Ethernet0  
123.0.0.0/8 is variably subnetted, 2 subnets, 2 masks I  
123.0.0.0/8 [100/8576] via 4.0.1.2, 00:00:00, Serial0.1 S  
123.123.123.0/24 [250/0] via 3.1.6.2 I  
122.0.0.0/8 [100/8576] via 3.1.3.3, 00:00:37, Serial0.2

Spicey#

\*Mar 1 00:59:12.527: %LINK-3-UPDOWN: Interface BRI0:1, changed state to up  
\*Mar 1 00:59:13.983: %LINEPROTO-5-UPDOWN: Line protocol on Interface  
BRI0:1, changed state to up  
\*Mar 1 00:59:18.547: %ISDN-6-CONNECT: Interface BRI0:1 is now connected to 6105 Prasit

Spicey#**show isdn history**

-----  
ISDN CALL HISTORY  
-----  
Call History contains all active calls, and a maximum of 100 inactive calls.  
Inactive call data will be retained for a maximum of 15 minutes.  
-----  
Call      Calling      Called      Remote    Seconds   Seconds   Seconds  
Charges  
Type      Number      Number      Name      Used      Left      Idle      Units/Currency  
-----  
In            6105            6106      Prasit      31      90      29  
-----

Spicey#

\*Mar 1 01:01:14.547: %ISDN-6-DISCONNECT: Interface BRI0:1 disconnected  
from 6105 Prasit, call lasted 122 seconds  
\*Mar 1 01:01:14.663: %LINK-3-UPDOWN: Interface BRI0:1, changed state to down  
\*Mar 1 01:01:15.663: %LINEPROTO-5-UPDOWN: Line protocol on Interface  
BRI0:1, changed state to down

## [Prasit](#)

Prasit#**show frame-relay map**

Serial1.1 (up): point-to-point dlci, dlci 150(0x96,0x2460), broadcast  
status defined, active

Prasit#**ping 124.124.124.1**

Type escape sequence to abort.  
Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:  
!!!!  
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/40 ms

Prasit#**show ip route**

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS  
inter area  
\* - candidate default, U - per-user static route, o - ODR

P - periodic downloaded static route

Gateway of last resort is not set

```
I 3.0.0.0/8 [100/10476] via 4.0.1.1, 00:00:55, Serial1.1
  4.0.0.0/24 is subnetted, 1 subnets
C 4.0.1.0 is directly connected, Serial1.1
  124.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
S 124.124.124.0/24 [250/0] via 3.1.6.1
I 124.0.0.0/8 [100/8576] via 4.0.1.1, 00:00:55, Serial1.1
  123.0.0.0/24 is subnetted, 1 subnets
C 123.123.123.0 is directly connected, Ethernet0
I 122.0.0.0/8 [100/10576] via 4.0.1.1, 00:00:55, Serial1.1
```

串行线路断开。

Prasit#

```
*Mar 1 01:23:50.531: %LINK-3-UPDOWN: Interface Serial1, changed state to down
*Mar 1 01:23:51.531: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial1, changed state to down
*Mar 1 01:23:53.775: %LINK-3-UPDOWN: Interface BRI0:1, changed state to down
*Mar 1 01:23:53.791: %LINK-3-UPDOWN: Interface BRI0:2, changed state to down
*Mar 1 01:23:53.827: %LINK-3-UPDOWN: Interface BRI0, changed state to up
*Mar 1 01:23:57.931: %ISDN-6-LAYER2UP: Layer 2 for Interface BR0, TEI 64 changed to up
```

Prasit#show ip route

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route
```

Gateway of last resort is not set

```
3.0.0.0/24 is subnetted, 1 subnets
C 3.1.6.0 is directly connected, BRI0
  124.0.0.0/24 is subnetted, 1 subnets
S 124.124.124.0 [250/0] via 3.1.6.1
  123.0.0.0/24 is subnetted, 1 subnets
C 123.123.123.0 is directly connected, Ethernet0
```

Prasit#show isdn status

```
Global ISDN Switchtype = basic-net3
ISDN BRI0 interface
  dsl 0, interface ISDN Switchtype = basic-net3
Layer 1 Status:
  ACTIVE
Layer 2 Status:
  TEI = 64, Ces = 1, SAPI = 0, State = MULTIPLE_FRAME_ESTABLISHED
Layer 3 Status:
  0 Active Layer 3 Call(s)
Active dsl 0 CCBs = 0
The Free Channel Mask: 0x80000003
Total Allocated ISDN CCBs = 0
```

Prasit#ping 124.124.124.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:

!

```
*Mar 1 01:25:47.383: %LINK-3-UPDOWN: Interface BRI0:1, changed state to up!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 36/36/36 ms
Prasit#
*Mar 1 01:25:48.475: %LINEPROTO-5-UPDOWN: Line protocol on Interface
BRI0:1, changed state to up
```

Prasit#

```
*Mar 1 01:25:53.407: %ISDN-6-CONNECT: Interface BRI0:1 is now connected
to 6106 Spicey
```

Prasit#**show isdn status**

Global ISDN Switchtype = basic-net3

ISDN BRI0 interface

dsl 0, interface ISDN Switchtype = basic-net3

Layer 1 Status:

ACTIVE

Layer 2 Status:

TEI = 64, Ces = 1, SAPI = 0, State = MULTIPLE\_FRAME\_ESTABLISHED

Layer 3 Status:

1 Active Layer 3 Call(s)

CCB:callid=8003, sapi=0, ces=1, B-chan=1, calltype=DATA

Active dsl 0 CCBs = 1

The Free Channel Mask: 0x80000002

Total Allocated ISDN CCBs = 1

Prasit#**show isdn active**

-----  
ISDN ACTIVE CALLS  
-----

Call Type	Calling Number	Called Number	Remote Name	Seconds Used	Seconds Left	Seconds Idle	Charges Units/Currency
Out		6106	Spicey	21	100	19	0

-----

Prasit#

```
*Mar 1 01:27:49.027: %ISDN-6-DISCONNECT: Interface BRI0:1 disconnected
from 6106 Spicey, call lasted 121 seconds
```

```
*Mar 1 01:27:49.131: %LINK-3-UPDOWN: Interface BRI0:1, changed state to down
```

```
*Mar 1 01:27:50.131: %LINEPROTO-5-UPDOWN: Line protocol on Interface
BRI0:1, changed state to down
```

```
*Mar 1 01:28:09.215: %LINK-3-UPDOWN: Interface Serial1, changed state to up
```

```
*Mar 1 01:28:10.215: %LINEPROTO-5-UPDOWN: Line protocol on Interface
Serial1, changed state to up
```

```
*Mar 1 01:28:30.043: %ISDN-6-LAYER2DOWN: Layer 2 for Interface BRI0,
TEI 64 changed to down
```

```
*Mar 1 01:28:30.047: %ISDN-6-LAYER2DOWN: Layer 2 for Interface BR0, TEI
64 changed to down
```

```
*Mar 1 01:28:30.371: %LINK-5-CHANGED: Interface BRI0, changed state to standby mode
```

```
*Mar 1 01:28:30.387: %LINK-3-UPDOWN: Interface BRI0:1, changed state to down
```

```
*Mar 1 01:28:30.403: %LINK-3-UPDOWN: Interface BRI0:2, changed state to down
```

Prasit#

串行连接再回到。

Prasit#**show isdn status**

Global ISDN Switchtype = basic-net3

ISDN BRI0 interface

dsl 0, interface ISDN Switchtype = basic-net3

Layer 1 Status:

DEACTIVATED

Layer 2 Status:

Layer 2 NOT Activated

```
Layer 3 Status:
  0 Active Layer    3 Call(s)
Active dsl 0 CCBs = 0
The Free Channel Mask: 0x80000003
Total Allocated ISDN CCBs = 0
```

Prasit#**show interface bri 0**

```
BRI0 is standby mode, line protocol is down
Hardware is BRI
Internet address is 3.1.6.2/24
MTU 1500 bytes, BW 64 Kbit, DLY 20000 usec,
  reliability 255/255, txload 1/255, rxload 1/255
Encapsulation PPP, loopback not set
Last input 00:01:00, output 00:01:00, output hang never
Last clearing of "show interface" counters 01:28:16
Input queue: 0/75/0/0 (size/max/drops/flushes); Total output drops: 0
Queueing strategy: weighted fair
Output queue: 0/1000/64/0 (size/max total/threshold/drops)
  Conversations 0/1/16 (active/max active/max total)
  Reserved Conversations 0/0 (allocated/max allocated)
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
  128 packets input, 601 bytes, 0 no buffer
  Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
  0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
  132 packets output, 687 bytes, 0 underruns
  0 output errors, 0 collisions, 10 interface resets
  0 output buffer failures, 0 output buffers swapped out
  14 carrier transitions
```

Prasit#**ping 124.124.124.1**

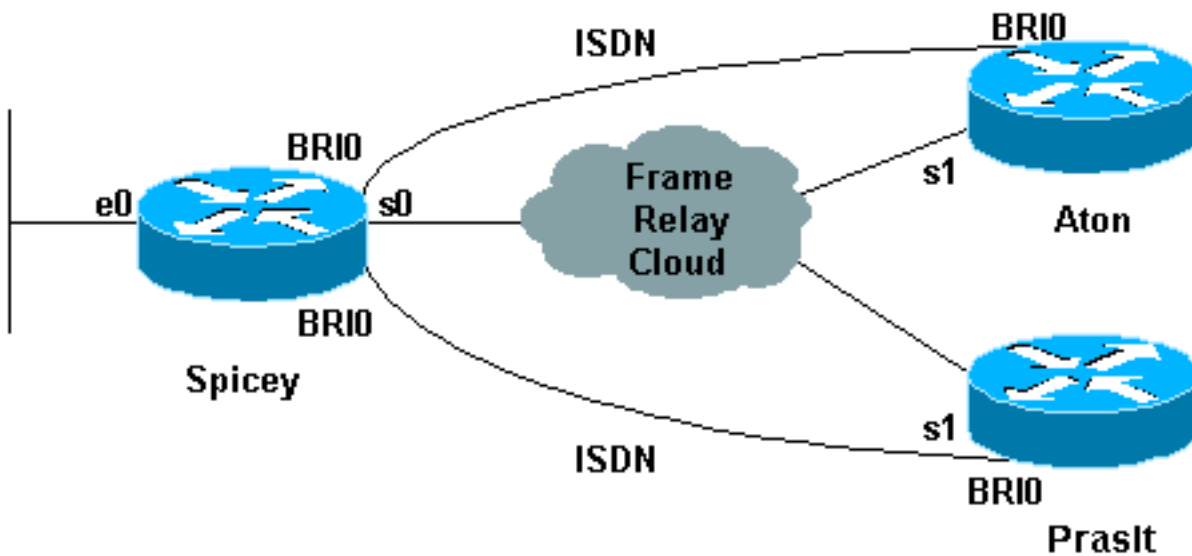
```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/36 ms
```

## [带有拨号程序配置文件的星型网](#)

这是星型网的示例每个DLCI备份配置。分支路由器呼叫中心路由器。您可以看到，我们在中心端的拨号池上使用max-link选项，每端只允许一条B信道。

**注意：**子接口不支持备份负载。因为我们不跟踪在子接口的数据流级别，负载没有计算。

## [网络图](#)



## 配置

- [Aton](#)
- [Spicey](#)
- [Prasit](#)

### Aton

```
Aton#show running-config
Building configuration...

Current configuration:
!
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Aton
!
!
username Spicey password 0 cisco
!
isdn switch-type basic-net3
!
!
!
interface Ethernet0
 ip address 122.122.122.1 255.255.255.0
!
!
interface Serial1
 no ip address
 encapsulation frame-relay
!
interface Serial1.1 point-to-point
 ip address 3.1.3.3 255.255.255.0
 backup delay 5 10
 backup interface BRI0
 frame-relay interface-dlci 160
```



```
!  
interface BRI0  
  ip address 155.155.155.3 255.255.255.0  
  encapsulation ppp  
  no ip route-cache  
  no ip mroute-cache  
  dialer map ip 155.155.155.2 name Spicey broadcast 6106  
  dialer-group 1  
  isdn switch-type basic-net3  
  ppp authentication chap  
!  
router igrp 2  
  network 3.0.0.0  
  network 122.0.0.0  
  network 155.155.0.0  
!  
ip route 124.124.124.0 255.255.255.0 155.155.155.2 250  
!  
access-list 101 deny   igrp any any  
  access-list 101 permit ip any any  
  dialer-list 1 protocol ip list 101  
!  
line con 0  
  exec-timeout 0 0  
  transport input none  
line aux 0  
line vty 0 4  
  login  
!  
end
```

## Spicey

```
Spicey#show running-config  
Building configuration...  
Current configuration : 1887 bytes  
!  
version 12.1  
service timestamps debug datetime msec  
service timestamps log datetime msec  
no service password-encryption  
!  
hostname Spicey  
!  
username Prasit password 0 cisco  
username Aton password 0 cisco  
!  
isdn switch-type basic-net3  
!  
!  
!  
interface Ethernet0  
  ip address 124.124.124.1 255.255.255.0  
!  
interface Serial0  
  no ip address  
  encapsulation frame-relay  
!  
interface Serial0.1 point-to-point  
  ip address 4.0.1.1 255.255.255.0  
  frame-relay interface-dlci 140  
!  
interface Serial0.2 point-to-point
```

```
ip address 3.1.3.1 255.255.255.0
frame-relay interface-dlci 130
!
interface BRI0
no ip address
encapsulation ppp
no ip route-cache
no ip mroute-cache
dialer pool-member 2 max-link 1
dialer pool-member 1 max-link 1
isdn switch-type basic-net3
no peer default ip address
no cdp enable
ppp authentication chap
!
interface Dialer1
ip address 160.160.160.1 255.255.255.0
encapsulation ppp
no ip route-cache
no ip mroute-cache
dialer pool 1
dialer remote-name Prasit
dialer-group 1
ppp authentication chap
!
interface Dialer2
ip address 155.155.155.2 255.255.255.0
encapsulation ppp
no ip route-cache
no ip mroute-cache
dialer pool 2
dialer remote-name Aton
dialer-group 1
ppp authentication chap
!
router igrp 2
network 3.0.0.0
network 4.0.0.0
network 124.0.0.0
network 155.155.0.0
network 160.160.0.0
!
access-list 101 deny igrp any any
access-list 101 permit ip any any
dialer-list 1 protocol ip list 101
!
line con 0
exec-timeout 0 0
transport input none
line aux 0
line vty 0 4
login
!
end
```

## Prasit

```
Prasit#show running-config
Building configuration...

Current configuration : 1267 bytes
!
version 12.1
```

```
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Prasit
!
username Spicey password 0 cisco
!
isdn switch-type basic-net3
!
!
!
interface Ethernet0
 ip address 123.123.123.1 255.255.255.0
!
interface Serial1
 no ip address
 encapsulation frame-relay
!
interface Serial1.1 point-to-point
 backup delay 5 10
 backup interface BRI0
 ip address 4.0.1.2 255.255.255.0
 frame-relay interface-dlci 150
!
interface BRI0
 ip address 160.160.160.2 255.255.255.0
 encapsulation ppp
 dialer map ip 160.160.160.1 name Spicey broadcast 6106
 dialer-group 1
 isdn switch-type basic-net3
 ppp authentication chap
!
router igrp 2
 network 4.0.0.0
 network 123.0.0.0
 network 160.160.0.0
!
ip route 124.124.124.0 255.255.255.0 160.160.160.1 250
!
access-list 101 deny igrp any any
access-list 101 permit ip any any
dialer-list 1 protocol ip list 101
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
end
```

## [显示命令](#)

- **show frame-relay map**
- **show ip route**
- **show frame map**
- **show frame-relay pvc**

## Aton

Aton#show frame-relay map

```
Serial1.1 (up): point-to-point dlci, dlci 160(0xA0,0x2800), broadcast
status defined, active
```

Aton#ping 124.124.124.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/36 ms

Aton#show ip route

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
        N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
        E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
        i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
        U - per-user static route, o - ODR, P - periodic downloaded static route
        T - traffic engineered route
```

Gateway of last resort is not set

```
I 155.155.0.0/16 [100/182571] via 3.1.3.1, Serial1.1
  3.0.0.0/24 is subnetted, 1 subnets
C 3.1.3.0 is directly connected, Serial1.1
I 4.0.0.0/8 [100/10476] via 3.1.3.1, Serial1.1
I 160.160.0.0/16 [100/182571] via 3.1.3.1, Serial1.1
  124.0.0.0/8 is variably subnetted, 2 subnets, 2 masks
S 124.124.124.0/24 [250/0] via 155.155.155.2
I 124.0.0.0/8 [100/8576] via 3.1.3.1, Serial1.1
I 123.0.0.0/8 [100/10576] via 3.1.3.1, Serial1.1
  122.0.0.0/24 is subnetted, 1 subnets
C 122.122.122.0 is directly connected, Ethernet0
```

Aton#

Serial1断开。

Aton#

```
01:16:33: %LINK-3-UPDOWN: Interface Serial1, changed state to down
01:16:34: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1,
changed state to down
01:16:37: %LINK-3-UPDOWN: Interface BRI0:1, changed state to down
01:16:37: %LINK-3-UPDOWN: Interface BRI0:2, changed state to down
01:16:37: %LINK-3-UPDOWN: Interface BRI0, changed state to up
01:16:41: %ISDN-6-LAYER2UP: Layer 2 for Interface BR0, TEI 64 changed to up
```

Aton#show ip route

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
        D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
        N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
        E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
        i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, * - candidate default
        U - per-user static route, o - ODR, P - periodic downloaded static route
        T - traffic engineered route
```

Gateway of last resort is not set

```
155.155.0.0/24 is subnetted, 1 subnets
C 155.155.155.0 is directly connected, BRI0
  124.0.0.0/24 is subnetted, 1 subnets
S 124.124.124.0 [250/0] via 155.155.155.2
```

```
122.0.0.0/24 is subnetted, 1 subnets
C 122.122.122.0 is directly connected, Ethernet0
```

```
Aton#ping 124.124.124.1
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:
```

```
01:21:33: %LINK-3-UPDOWN: Interface BRI0:1, changed state to up!!!!
Success rate is 80 percent (4/5), round-trip min/avg/max = 36/36/36 ms
Aton#
```

```
01:21:34: %LINEPROTO-5-UPDOWN: Line protocol on Interface BRI0:1,
changed state to up
```

```
01:21:39: %ISDN-6-CONNECT: Interface BRI0:1 is now connected to 6106
Spicey
```

```
Aton#ping 124.124.124.1
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:
```

```
!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/123/296 ms
```

```
Aton#
```

## Serial1再变得激活

```
Aton#
```

```
01:24:02: %ISDN-6-DISCONNECT: Interface BRI0:1 disconnected from 6106
Spicey, call lasted 149 seconds
```

```
01:24:02: %LINK-3-UPDOWN: Interface BRI0:1, changed state to down
```

```
01:24:03: %LINEPROTO-5-UPDOWN: Line protocol on Interface BRI0:1,
changed state to down
```

```
Aton#show frame map
```

```
Serial1.1 (down): point-to-point dlci, dlci 160(0xA0,0x2800), broadcast
status deleted
```

```
Aton#
```

```
01:26:35: %LINK-3-UPDOWN: Interface Serial1, changed state to up
```

```
01:26:36: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1,
changed state to up
```

```
01:26:56: %ISDN-6-LAYER2DOWN: Layer 2 for Interface BRI0, TEI 64 changed
to down
```

```
01:26:56: %ISDN-6-LAYER2DOWN: Layer 2 for Interface BR0, TEI 64 changed
to down
```

```
01:26:56: %LINK-5-CHANGED: Interface BRI0, changed state to standby mode
```

```
01:26:56: %LINK-3-UPDOWN: Interface BRI0:1, changed state to down
```

```
01:26:56: %LINK-3-UPDOWN: Interface BRI0:2, changed state to down
```

```
Aton#show frame map
```

```
Serial1.1 (up): point-to-point dlci, dlci 160(0xA0,0x2800), broadcast
status defined, active
```

```
Aton#ping 124.124.124.1
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:
```

```
!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/36 ms
```

```
Aton#ping 124.124.124.1
```

```
Aton#show frame-relay pvc
```

```
PVC Statistics for interface Serial1 (Frame Relay DTE)
```

	Active	Inactive	Deleted	Static
Local	1	0	0	0

```
Switched      0          0          0          0
Unused        0          0          0          0
```

```
DLCI = 160, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE =
Serial1.1
  input pkts 60          output pkts 69          in    bytes 9694
  out bytes 10811       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 44    out    bcast bytes 7565
  pvc create time 01:28:35, last time pvc status changed 00:02:19
```

## Spicey

### Spicey#show frame-relay map

```
Serial0.1 (up): point-to-point dlci, dlci 140(0x8C,0x20C0), broadcast
  status defined, active
Serial0.2 (up): point-to-point dlci, dlci 130(0x82,0x2020), broadcast
  status defined, active
```

### Spicey#ping 122.122.122.1

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 122.122.122.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 32/35/36 ms
```

### Spicey#ping 123.123.123.1

```
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 123.123.123.1, timeout is 2 seconds:
!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/36 ms
```

### Spicey#show ip route

```
Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP
       D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS
inter area
       * - candidate default, U - per-user static route, o - ODR
       P - periodic downloaded static route
Gateway of last resort is not set
 155.155.0.0/24 is subnetted, 1 subnets
C    155.155.155.0 is directly connected, Dialer2
 3.0.0.0/24 is subnetted, 1 subnets
C    3.1.3.0 is directly connected, Serial0.2
 4.0.0.0/24 is subnetted, 1 subnets
C    4.0.1.0 is directly connected, Serial0.1
 160.160.0.0/24 is subnetted, 1 subnets
C    160.160.160.0 is directly connected, Dialer1
 124.0.0.0/24 is subnetted, 1 subnets
C    124.124.124.0 is directly connected, Ethernet0
I    123.0.0.0/8 [100/8576] via 4.0.1.2, 00:00:55, Serial0.1
I    122.0.0.0/8 [100/8576] via 3.1.3.3, 00:00:35, Serial0.2
```

从主叫方的两串行线路断开。

### Spicey#

```
*Mar 1 01:21:30.171: %LINK-3-UPDOWN: Interface BRI0:1, changed state toup
*Mar 1 01:21:30.627: %DIALER-6-BIND: Interface BR0:1 bound to profile Di2
*Mar 1 01:21:31.647: %LINEPROTO-5-UPDOWN: Line protocol on Interface
```

```

BRI0:1, changed state to up
*Mar 1 01:21:36.191: %ISDN-6-CONNECT: Interface BRI0:1 is now connected
to 6104 Aton
*Mar 1 01:21:40.923: %LINK-3-UPDOWN: Interface BRI0:2, changed state to up
*Mar 1 01:21:41.359: %DIALER-6-BIND: Interface BR0:2 bound to profile Di1
*Mar 1 01:21:42.383: %LINEPROTO-5-UPDOWN: Line protocol on Interface
BRI0:2, changed state to up
*Mar 1 01:21:46.943: %ISDN-6-CONNECT: Interface BRI0:2 is now connected
to 6105 Prasit
*Mar 1 01:23:59.819: %DIALER-6-UNBIND: Interface BR0:1 unbound from
profile Di2
*Mar 1 01:23:59.831: %ISDN-6-DISCONNECT: Interface BRI0:1 disconnected
from 6104 Aton, call lasted 149 seconds
*Mar 1 01:23:59.927: %LINK-3-UPDOWN: Interface BRI0:1, changed state to down
*Mar 1 01:24:00.923: %LINEPROTO-5-UPDOWN: Line protocol on Interface
BRI0:1, changed state to down
*Mar 1 01:24:03.015: %DIALER-6-UNBIND: Interface BR0:2 unbound from
profile Di1
*Mar 1 01:24:03.023: %ISDN-6-DISCONNECT: Interface BRI0:2 disconnected
from 6105 Prasit, call lasted 142 seconds
*Mar 1 01:24:03.107: %LINK-3-UPDOWN: Interface BRI0:2, changed state to down
*Mar 1 01:24:04.107: %LINEPROTO-5-UPDOWN: Line protocol on Interface
BRI0:2, changed state to down

```

Spicey#show frame map

```

Serial0.1 (down): point-to-point dlci, dlci 140(0x8C,0x20C0), broadcast
status defined, inactive
Serial0.2 (down): point-to-point dlci, dlci 130(0x82,0x2020), broadcast
status defined, inactive

```

Spicey#

两串行线路再是可用的。

Spicey#show frame pvc

PVC Statistics for interface Serial0 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	2	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 130, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0.2

```

input pkts 54          output pkts 61          in   bytes 7014
out bytes 9975         dropped pkts 3          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 40     out   bcast bytes 7803
pvc create time 01:28:14, last time pvc status changed 00:02:38

```

DLCI = 140, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0.1

```

input pkts 56          output pkts 60          in   bytes 7604
out bytes 10114        dropped pkts 2          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 39     out   bcast bytes 7928
pvc create time 01:28:15, last time pvc status changed 00:02:29

```

[Prasit](#)

Prasit#show frame-relay map

Serial1.1 (up): point-to-point dlci, dlci 150(0x96,0x2460), broadcast  
status defined, active

Prasit#ping 124.124.124.1

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:

!!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/40 ms

Prasit#show ip route

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS  
inter area  
\* - candidate default, U - per-user static route, o - ODR  
P - periodic downloaded static route

Gateway of last resort is not set

I 155.155.0.0/16 [100/182571] via 4.0.1.1, 00:00:41, Serial1.1  
I 3.0.0.0/8 [100/10476] via 4.0.1.1, 00:00:41, Serial1.1  
4.0.0.0/24 is subnetted, 1 subnets  
C 4.0.1.0 is directly connected, Serial1.1  
I 160.160.0.0/16 [100/182571] via 4.0.1.1, 00:00:41, Serial1.1  
124.0.0.0/8 is variably subnetted, 2 subnets, 2 masks  
S 124.124.124.0/24 [250/0] via 160.160.160.1  
I 124.0.0.0/8 [100/8576] via 4.0.1.1, 00:00:41, Serial1.1  
123.0.0.0/24 is subnetted, 1 subnets  
C 123.123.123.0 is directly connected, Ethernet0  
I 122.0.0.0/8 [100/10576] via 4.0.1.1, 00:00:42, Serial1.1

Prasit#

Serial1断开。

Prasit#

\*Mar 1 01:16:08.287: %LINK-3-UPDOWN: Interface Serial1, changed state to down  
\*Mar 1 01:16:09.287: %LINEPROTO-5-UPDOWN: Line protocol on Interface  
Serial1, changed state to down  
\*Mar 1 01:16:11.803: %LINK-3-UPDOWN: Interface BRI0:1, changed state to down  
\*Mar 1 01:16:11.819: %LINK-3-UPDOWN: Interface BRI0:2, changed state to down  
\*Mar 1 01:16:11.855: %LINK-3-UPDOWN: Interface BRI0, changed state to up  
\*Mar 1 01:16:15.967: %ISDN-6-LAYER2UP: Layer 2 for Interface BR0, TEI  
64 changed to up

Prasit#show ip route

Codes: C - connected, S - static, I - IGRP, R - RIP, M - mobile, B - BGP  
D - EIGRP, EX - EIGRP external, O - OSPF, IA - OSPF inter area  
N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2  
E1 - OSPF external type 1, E2 - OSPF external type 2, E - EGP  
i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS  
inter area  
\* - candidate default, U - per-user static route, o - ODR  
P - periodic downloaded static route

Gateway of last resort is not set

160.160.0.0/24 is subnetted, 1 subnets  
C 160.160.160.0 is directly connected, BRI0  
124.0.0.0/24 is subnetted, 1 subnets  
S 124.124.124.0 [250/0] via 160.160.160.1



```
123.0.0.0/24 is subnetted, 1 subnets
C 123.123.123.0 is directly connected, Ethernet0
```

```
Prasit#ping 124.124.124.1
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:
```

```
*Mar 1 01:21:38.967: %LINK-3-UPDOWN: Interface BRI0:1, changed state to up!!!!
```

```
Success rate is 80 percent (4/5), round-trip min/avg/max = 36/36/36 ms
```

```
Prasit#
```

```
*Mar 1 01:21:40.063: %LINEPROTO-5-UPDOWN: Line protocol on Interface BRI0:1, changed state to up
```

```
*Mar 1 01:21:44.991: %ISDN-6-CONNECT: Interface BRI0:1 is now connected to 6106 Spicey
```

```
Prasit#ping 124.124.124.1
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:
```

```
!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/36/36 ms
```

```
Prasit#
```

Serial1再变得激活。

```
Prasit#
```

```
*Mar 1 01:26:40.579: %LINK-3-UPDOWN: Interface Serial1, changed state to up
```

```
*Mar 1 01:26:41.579: %LINEPROTO-5-UPDOWN: Line protocol on Interface Serial1, changed state to up
```

```
*Mar 1 01:27:01.051: %ISDN-6-LAYER2DOWN: Layer 2 for Interface BRI0, TEI 64 changed to down
```

```
*Mar 1 01:27:01.055: %ISDN-6-LAYER2DOWN: Layer 2 for Interface BR0, TEI 64 changed to down
```

```
*Mar 1 01:27:01.363: %LINK-5-CHANGED: Interface BRI0, changed state to standby mode
```

```
*Mar 1 01:27:01.379: %LINK-3-UPDOWN: Interface BRI0:1, changed state to down
```

```
*Mar 1 01:27:01.395: %LINK-3-UPDOWN: Interface BRI0:2, changed state to down
```

```
Prasit#show frame map
```

```
Serial1.1 (up): point-to-point dlci, dlci 150(0x96,0x2460), broadcast status defined, active
```

```
Prasit#ping 124.124.124.1
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:
```

```
!!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 36/116/432 ms
```

```
Prasit#show frame-relay pvc
```

```
PVC Statistics for interface Serial1 (Frame Relay DTE)
```

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

```
DLCI = 150, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1.1
```

input pkts 58	output pkts 66	in bytes 9727
out bytes 10022	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 46      out   bcast bytes 7942
pvc create time 01:27:37, last time pvc status changed 00:01:59
```

## 配置帧中继交换

帧中继交换是根据数据链路连接标识符(DLCI)的交换信息包方法。我们在此能查找作为MAC控制(MAC)地址的帧中继等同。您通过配置您的Cisco路由器或接入服务器执行交换到帧中继网络。有两部分对帧中继网络：

- 帧中继数据终端设备(DTE) -路由器或接入服务器。
- 帧中继数据电路终端的设备(DCE)交换机。

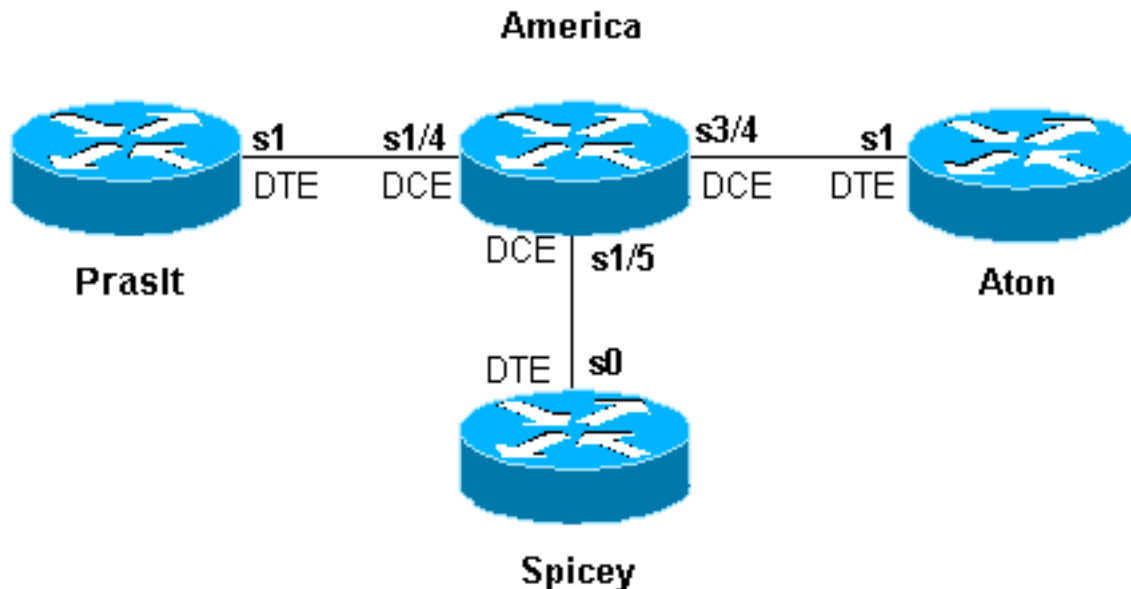
**注意：**在Cisco IOS软件release 12.1(2)T及以上版本，**frame route**命令由**连接**命令替换了。

请查看配置示例。在下面的配置中，我们使用路由器美国作为帧中继交换机。我们使用Spicey作为中心路由器和Prasit和Aton作为分支路由器。我们连接他们如下：

- Prasit序列1 (s1) DTE连接对美国序列1/4 (s1/4) DCE。
- Spicey serial0 (s0) DTE连接对美国序列1/5 (s1/5) DCE。
- Aton序列1 (s1) DTE连接对美国序列3/4 (s3/4) DCE。

## 网络图

本文根据以下配置：



## 配置

- [Spicey](#)
- [Prasit](#)
- [Aton](#)
- [美国](#)

## Spicey

```
Spicey#show running-config
Building configuration...

!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Spicey
!
!
!
interface Ethernet0
 ip address 124.124.124.1 255.255.255.0
!
interface Serial0
 ip address 3.1.3.1 255.255.255.0
 encapsulation frame-relay
 frame-relay interface-dlci 130
 frame-relay interface-dlci 140
!
!
router rip
 network 3.0.0.0
 network 124.0.0.0
!
line con 0
!
exec-timeout 0 0
 transport input none
 line aux 0
 line vty 0 4
 login
!
end
```

## Prasit

```
Prasit#show running-config
Building configuration...
Current configuration : 1499 bytes
!
 version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname Prasit
!
!
!
interface Ethernet0
 ip address 123.123.123.1 255.255.255.0
!
interface Serial1
 ip address 3.1.3.2 255.255.255.0
 encapsulation frame-relay
 frame-relay interface-dlci 150
!
!
```

```
router rip
 network 3.0.0.0
 network 123.0.0.0
!
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
end
```

## Aton

```
Aton#show running-config
Building configuration...
Current configuration:
!
version 12.0
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname Aton
!
!
!
interface Ethernet0
 ip address 122.122.122.1 255.255.255.0
!
interface Serial1
 ip address 3.1.3.3 255.255.255.0
 encapsulation frame-relay
 frame-relay interface-dlci 160
!
router rip
 network 3.0.0.0
 network 122.0.0.0
!
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
end
```

## 美国

```
america#show running-config
Building configuration...
Current configuration:
!
!
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname america
```

```

!
frame-relay switching
!
!
interface Serial1/4
  description *** static DCE connection to s1 Prasit
  no ip address
  encapsulation frame-relay
  clockrate 2000000
  frame-relay intf-type dce
  frame-relay route 150 interface Serial1/5 140
!
interface Serial1/5
  description *** static DCE connection to s0 spicy
  no ip address
  encapsulation frame-relay
  bandwidth 1000000
  tx-queue-limit 100
  frame-relay intf-type dce
  frame-relay route 130 interface Serial3/4 160
  frame-relay route 140 interface Serial1/4 150
  transmitter-delay 10
!
interface Serial3/4
  description *** static DCE connection to s1 Aton
  encapsulation frame-relay
  no ip mroute-cache
  clockrate 2000000
  frame-relay intf-type dce
  frame-relay route 160 interface Serial1/5 130
!

```

## [显示命令](#)

请使用以下显示命令测试您的网络适当地操作：

- **show frame-relay map**
- **show frame-relay pvc**

以下所示的输出是在我们在此示例配置中使用的设备上输入这些命令的结果。

## [Spicey](#)

Spicey#**show frame-relay map**

```

Serial0 (up): ip 3.1.3.2 dlci 140(0x8C,0x20C0), dynamic,
              broadcast,, status defined, active
Serial0 (up): ip 3.1.3.3 dlci 130(0x82,0x2020), dynamic,
              broadcast,, status defined, active

```

Spicey#**show frame-relay pvc**

PVC Statistics for interface Serial0 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	2	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 130, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0

```

input pkts 32          output pkts 40          in bytes 3370
out bytes 3928        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 30     out bcast bytes 2888
pvc create time 00:15:46, last time pvc status changed 00:10:42

```

DLCI = 140, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0

```

input pkts 282          output pkts 291          in bytes 25070
out bytes 27876        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 223     out bcast bytes 20884
pvc create time 02:28:36, last time pvc status changed 02:25:14

```

## Prasit

Prasit#show frame-relay map

```

Serial1 (up): ip 3.1.3.1 dlci 150(0x96,0x2460), dynamic,
              broadcast,, status defined, active

```

Prasit#show frame-relay pvc

PVC Statistics for interface Serial1 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	

DLCI = 150, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1

```

input pkts 311          output pkts 233          in bytes 28562
out bytes 22648        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 162     out bcast bytes 15748
pvc create time 02:31:39, last time pvc status changed 02:25:14

```

## Aton

Aton#show frame-relay map

```

Serial1 (up): ip 3.1.3.1 dlci 160(0xA0,0x2800), dynamic, broadcast, status defined, active

```

Aton#show frame-relay pvc

PVC Statistics for interface Serial1 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 160, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial

```

input pkts 35          output pkts 32          in bytes 3758
out bytes 3366        dropped pkts 0          in FECN pkt 0
in BECN pkts 0        out FECN pkts 0        out BECN pkts 0
in DE pkts 0          out DE pkts 0
out bcast pkts 27 out bcast bytes 2846
pvc create time 00:10:53, last time pvc status changed 00:10:53

```

## 配置帧中继 DLCI 优先级

通过数据链路连接标识符(DLCI)优先级排列很多不同的业务类型能够放置在独立的DLCI上，以便帧中继网络能为每个业务类型提供不同的承诺信息速率。它可以与自定义排队或优先级排队结合使用

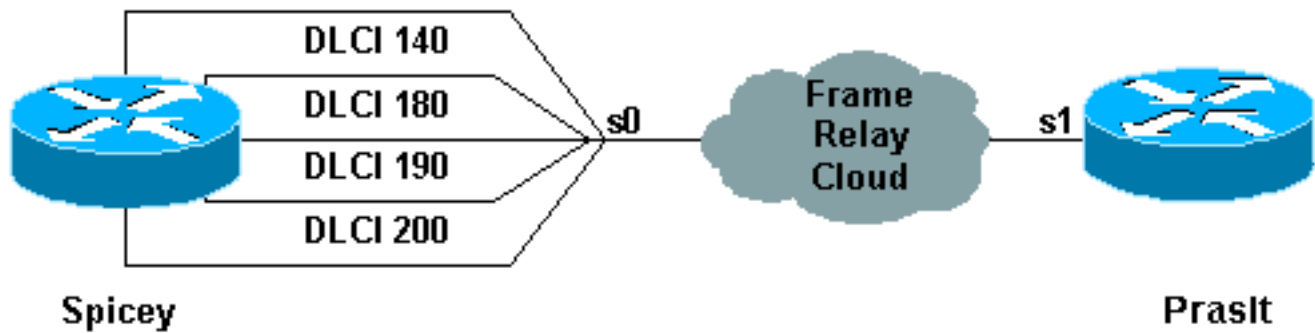
，提供帧中继网络的接入链路的带宽管理控制。另外，一些帧中继服务提供商和帧中继交换机(例如 Stratacom 互连网络信息包交换[IPX]、IGX、BPX或AXIS交换机)可根据优先级设置，在帧中继网云中提供优先级排列。

### 实施注意事项

当实现DLCI优先级划分，请注意下列问题：

- 如果附属DLCI断开，您将丢失定向到该队列的数据流。
- 如果您丢失主要DLCI，那么子接口断开并且丢失所有数据流。

### 网络图



为了使用此设置，您需为使用DLCI优先级划分的一端提供四个DLCI。在本例中，我们配置优先级队列的Spicey如下：

- Ping在高优先级队列。
- Telnet在优先级队列。
- 文件传输协议(FTP)在normal-priority队列。
- 其他IP数据流在低优先级队列。

**注意：** 确保您配置的DLCI与优先级列表匹配，或者系统不能使用正确队列。

### 配置

- [Spicey](#)
- [Prasit](#)

```
Spicey
-----
Spicey#show running-config
Building configuration...

Current configuration : 1955 bytes
!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
!
hostname Spicey
!
!
interface Ethernet0
```

```
ip address 124.124.124.1 255.255.255.0
!
interface Serial0
  no ip address
  encapsulation frame-relay
  priority-group 1
!
interface Serial0.1 point-to-point
  ip address 4.0.1.1 255.255.255.0
  frame-relay priority-dlci-group 1 140 180 190 200
  frame-relay interface-dlci 140
!
router igrp 2
  network 4.0.0.0
  network 124.0.0.0
!
access-list 102 permit icmp any any
  priority-list 1 protocol ip high list 102
  priority-list 1 protocol ip medium tcp telnet
  priority-list 1 protocol ip normal tcp ftp
  priority-list 1 protocol ip low
!
line con 0
  exec-timeout 0 0
  transport input none
line aux 0
line vty 0 4
  login
!
end
```

## Prasit

```
Prasit#show running-config
Building configuration...

!
version 12.1
service timestamps debug datetime msec
service timestamps log datetime msec
!
hostname Prasit
!
!
!
interface Ethernet0
  ip address 123.123.123.1 255.255.255.0
!
interface Serial1
  ip address 4.0.1.2 255.255.255.0
  encapsulation frame-relay
!
router igrp 2
  network 4.0.0.0
  network 123.0.0.0
!
line con 0
  exec-timeout 0 0
  transport input none
line aux 0
line vty 0 4
  login
!
```



```
end
```

## debug 和 show 命令

请使用以下显示和调试指令测试您的网络适当地操作。在发出 **debug** 命令之前，请参阅[有关 Debug 命令的重要信息](#)。

- **show frame-relay pvc**
- **show frame-relay map**
- **show queueing priority**
- **debug priority**

以下所示的输出是在我们在此示例配置中使用的设备上输入这些命令的结果。

## Spicey

```
Spicey#show frame-relay pvc
```

```
PVC Statistics for interface Serial0 (Frame Relay DTE)
```

	Active	Inactive	Deleted	Static
Local	4	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

```
DLCI = 140, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0.1
```

```
input pkts 106          output pkts 15          in bytes 6801
out bytes 1560          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
pvc create time 00:29:22, last time pvc status changed 00:20:37
Priority DLCI Group 1, DLCI 140 (HIGH), DLCI 180 (MEDIUM)
DLCI 190 (NORMAL), DLCI 200 (LOW)
```

```
DLCI = 180, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0.1
```

```
input pkts 0            output pkts 51          in bytes 0
out bytes 2434          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
pvc create time 00:29:23, last time pvc status changed 00:14:48
```

```
DLCI = 190, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0.1
```

```
input pkts 0            output pkts 13          in bytes 0
out bytes 3653          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 13      out bcast bytes 3653
pvc create time 00:29:23, last time pvc status changed 00:14:28
```

```
DLCI = 200, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0.1
```

```
input pkts 0            output pkts 42          in bytes 0
out bytes 2554          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 10          out bcast bytes 500
pvc create time 00:29:24, last time pvc status changed 00:14:09
```

Spicey#**show frame-relay map**

```
Serial0.1 (up): point-to-point dlci, dlci 140(0x8C,0x20C0), broadcast
status defined, active
Priority DLCI Group 1, DLCI 140 (HIGH), DLCI 180 (MEDIUM)
DLCI 190 (NORMAL), DLCI 200 (LOW)
```

Spicey#**show queueing priority**

Current priority queue configuration:

```
List  Queue  Args
1     high   protocol ip          list 102
1     medium protocol ip          tcp port telnet
1     normal protocol ip          tcp port ftp
1     low    protocol ip
```

要验证优先级队列，请使用**debug priority**命令。

Spicey#**debug priority**

Priority output queueing debugging is on

Spicey#**ping 123.123.123.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 123.123.123.1, timeout is 2 seconds:

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 44/45/48 ms

Spicey#

```
*Mar 1 00:32:30.391: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.395: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.399: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:32:30.439: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.443: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.447: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:32:30.487: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.491: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.495: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:32:30.535: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.539: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.543: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:32:30.583: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.587: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.587: PQ: Serial0 output (Pk size/Q 104/0)Spicey#
```

Spicey#**telnet 123.123.123.1**

Trying 123.123.123.1 ... Open

User Access Verification

Password:

```
*Mar 1 00:32:59.447: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.451: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.451: PQ: Serial0 output (Pk size/Q 48/1)
*Mar 1 00:32:59.475: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.479: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.483: PQ: Serial0 output (Pk size/Q 44/1)
*Mar 1 00:32:59.487: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.487: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.491: PQ: Serial0 output (Pk size/Q 53/1)
*Mar 1 00:32:59.495: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.499: PQ: Serial0: ip (tcp 23) -> medium
```

```
*Mar 1 00:32:59.499: PQ: Serial0 output (Pk size/Q 44/1)
*Mar 1 00:32:59.511: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.511: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.515: PQ: Serial0 output (Pk size/Q 47/1)
*Mar 1 00:32:59.519: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.519: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.523: PQ: Serial0 output (Pk size/Q 47/1)
*Mar 1 00:32:59.527: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.527: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.531: PQ: Serial0 output (Pk size/Q 53/1)
*Mar 1 00:32:59.539: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.543: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.547: PQ: Serial0 output (Pk size/Q 47/1)
*Mar 1 00:32:59.751: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.755: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.755: PQ: Serial0 output (Pk size/Q 44/1)
```

Password:

其他IP数据流通过低队列。

Spicey#**debug priority**

Priority output queueing debugging is on

Spicey#**ping 123.123.123.1**

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 123.123.123.1, timeout is 2 seconds:

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 44/45/48 ms

Spicey#

```
*Mar 1 00:32:30.391: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.395: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.399: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:32:30.439: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.443: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.447: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:32:30.487: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.491: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.495: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:32:30.535: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.539: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.543: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:32:30.583: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.587: PQ: Serial0: ip (s=4.0.1.1, d=123.123.123.1) ->high
*Mar 1 00:32:30.587: PQ: Serial0 output (Pk size/Q 104/0)Spicey#
```

Spicey#**telnet 123.123.123.1**

Trying 123.123.123.1 ... Open

User Access Verification

Password:

```
*Mar 1 00:32:59.447: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.451: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.451: PQ: Serial0 output (Pk size/Q 48/1)
*Mar 1 00:32:59.475: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.479: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.483: PQ: Serial0 output (Pk size/Q 44/1)
*Mar 1 00:32:59.487: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.487: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.491: PQ: Serial0 output (Pk size/Q 53/1)
*Mar 1 00:32:59.495: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.499: PQ: Serial0: ip (tcp 23) -> medium
```

```

*Mar 1 00:32:59.499: PQ: Serial0 output (Pk size/Q 44/1)
*Mar 1 00:32:59.511: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.511: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.515: PQ: Serial0 output (Pk size/Q 47/1)
*Mar 1 00:32:59.519: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.519: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.523: PQ: Serial0 output (Pk size/Q 47/1)
*Mar 1 00:32:59.527: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.527: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.531: PQ: Serial0 output (Pk size/Q 53/1)
*Mar 1 00:32:59.539: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.543: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.547: PQ: Serial0 output (Pk size/Q 47/1)
*Mar 1 00:32:59.751: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.755: PQ: Serial0: ip (tcp 23) -> medium
*Mar 1 00:32:59.755: PQ: Serial0 output (Pk size/Q 44/1)

```

Password:

## Prasit

```
Prasit#show frame-relay pvc
```

PVC Statistics for interface Serial11 (Frame Relay DTE)

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

DLCI = 150, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial11

```

input pkts 134          output pkts 119          in bytes 12029
out bytes 7801          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 18       out bcast bytes 1260
pvc create time 00:21:15, last time pvc status changed 00:21:15

```

```
Prasit#show frame-relay map
```

```
Serial11 (up): ip 4.0.1.1 dlci 150(0x96,0x2460), dynamic,
                broadcast, status defined, active
```

```
Prasit#ping 124.124.124.1
```

Type escape sequence to abort.

Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:

!!!!

Success rate is 100 percent (5/5), round-trip min/avg/max = 44/45/48

Here is the debug output shown on Spicey when you use the command above to ping to Spicey from Prasit.

```
Spicey#
```

```

*Mar 1 00:33:26.755: PQ: Serial0 output (Pk size/Q 13/0)
*Mar 1 00:33:28.535: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.539: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.543: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:33:28.583: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.587: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.587: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:33:28.631: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.635: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.635: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:33:28.679: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high

```

```
*Mar 1 00:33:28.683: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.683: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:33:28.723: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.727: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.731: PQ: Serial0 output (Pk size/Q 104/0)
```

```
Prasit#telnet 124.124.124.1
Trying 124.124.124.1 ... Open
```

```
User Access Verification
Password:
Spicey>exit
```

```
[Connection to 124.124.124.1 closed by foreign host]
Prasit#
```

当您使用调试命令从Prasit远程登录到Spicey时，这便是Spicey上显示的调试输出。

```
Prasit#show frame-relay pvc
```

```
PVC Statistics for interface Serial1 (Frame Relay DTE)
```

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

```
DLCI = 150, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1
```

```
input pkts 134          output pkts 119          in bytes 12029
out bytes 7801          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 18      out bcast bytes 1260
pvc create time 00:21:15, last time pvc status changed 00:21:15
```

```
Prasit#show frame-relay map
```

```
Serial1 (up): ip 4.0.1.1 dlci 150(0x96,0x2460), dynamic,
              broadcast, status defined, active
```

```
Prasit#ping 124.124.124.1
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 44/45/48
```

```
Here is the debug output shown on Spicey when you use the command above to ping to Spicey from
Prasit.
```

```
Spicey#
```

```
*Mar 1 00:33:26.755: PQ: Serial0 output (Pk size/Q 13/0)
*Mar 1 00:33:28.535: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.539: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.543: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:33:28.583: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.587: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.587: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:33:28.631: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.635: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.635: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:33:28.679: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.683: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.683: PQ: Serial0 output (Pk size/Q 104/0)
```

```
*Mar 1 00:33:28.723: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.727: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.731: PQ: Serial0 output (Pk size/Q 104/0)
```

```
Prasit#telnet 124.124.124.1
Trying 124.124.124.1 ... Open
```

```
User Access Verification
Password:
Spicey>exit
```

```
[Connection to 124.124.124.1 closed by foreign host]
Prasit#
```

## 帧中继广播队列

广播队列是在中型到大型IP或IPX网络中使用的一种主要功能，在这些网络中，路由和服务接入点(SAP)广播必须在帧中继网络上传送。广播队列在正常接口队列中进行独立管理，有它自己的缓冲区、可配置大小和服务速率。此广播队列没有使用桥接生成树更新(BPDU)由于时钟灵敏度。这些数据流将流经正常队列。interface命令启用广播队列跟随：

### 帧中继广播队列大小字节速率信息包费率

广播队列被指定最大传输速率(吞吐量)限额，该限额按每秒字节数和每秒信息包数测量。队列被服务保证提供仅此最大数量。传输速率低于配置的最大速率时，广播队列会有优先级，并且保证有最小带宽分配。两个传输速率限额打算避免充斥接口与广播。实际限制在所有秒钟是达到的第一个速率限制。给传输速率限制，另外的缓冲要求存储广播包。广播队列是可配置存储很大数量的广播包。应该设置队列大小避免广播路由更新数据包损耗。确切大小取决于正在使用的协议和每次更新所需的信息包数量。为安全起见，队列大小的设置应该确保来自每个协议的、每个数据链路连接标识符(DLCI)的完整路由更新能够存储。通常，请从每个DLCI 20数据包开始。比特率比两个应该是较少的下列：

- $N/4$ 乘以最低远程访问速率(以字节/秒为单位)，其中的N是广播必须复制到的DLCI的数量。
- $1/4$ 本地访问存取速率(测量在字节每秒)

如果比特率适当地，设置数据包速率不是关键。一般来说，应该设置数据包速率假设250-byte数据包。默认串行接口为64个队列大小、每秒256,000个字节(2,048,000 bps)和36 pps。高速串行接口(HSSI)的默认值为256个队列大小、1,024,000字节/秒(8,192,000 bps)和144 pps。

## 流量整形

流量整形使用呼叫令牌桶过滤器的一个速率控制控制机制。此令牌桶过滤器设置如下：

### 超额突发加上承诺突发量( $Bc+Be$ ) = 虚拟电路的最大速度

超出最大速度的数据流在流量整形队列中缓冲，该队列的大小与加权公平排队(WFQ)相等。令牌桶过滤器不过滤数据流，但控制出局接口上的数据流发送速率。关于令牌桶过滤器的更多信息，请参阅[监管与整形概述](#)。

本文提供通用流量整形和帧中继流量整形概述。

## 流量整形参数

我们能使用以下流量整形参数：

- CIR = 承诺信息速率(=平均时间)
- EIR = 过大信息速率
- TB = 令牌桶(=  $B_c + B_e$ )
- BC = 承诺突发流量大小(=持续的突发流量大小)
- 是 = 超额突发大小
- DE = 丢弃资格
- $T_c$  = 测量间隔
- AR = 与物理接口速率对应的接入速率(如果您使用T1，AR约为1.5 Mbps)。

请较详细地查看其中一些参数：

### [存取速率\(AR\)](#)

终端站到网络的最高传输速度(比特/秒)受到用户网络接口的接入速率的限制。客户网络连接的线路速度限制接入速率。您在您的订阅能设立此到服务提供商。

### [承诺突发流量大小\(BC\)](#)

您能提供到网络的最大承诺量数据定义作为BC。Bc是保证网络正常情况下交付的数据量的测量。在承诺速率 $T_c$ 期间，它被测量。

### [超额突发大小\(Be\)](#)

仍被帧中继交换机接受、但被标志为符合丢弃条件(DE)的非承诺位(CIR以外)的数量。

令牌桶是‘虚拟’缓冲区。它包含一定数量的令牌，启用您发送有限的数据每个时间间隔。令牌桶充满BC位每个 $T_c$ 。桶的最大大小是 $B_c + B_e$ 。如果 $B_e$ 非常大，在 $T_0$ 时段，令牌桶填满了 $B_c + B_e$ 令牌，则您能够以接入速率发送 $B_c + B_e$ 位。这不是通过 $T_c$ 而是通过发送 $B_e$ 的时间限制的。这是接入速率的功能。

### [承诺信息速率 \(CIR\)](#)

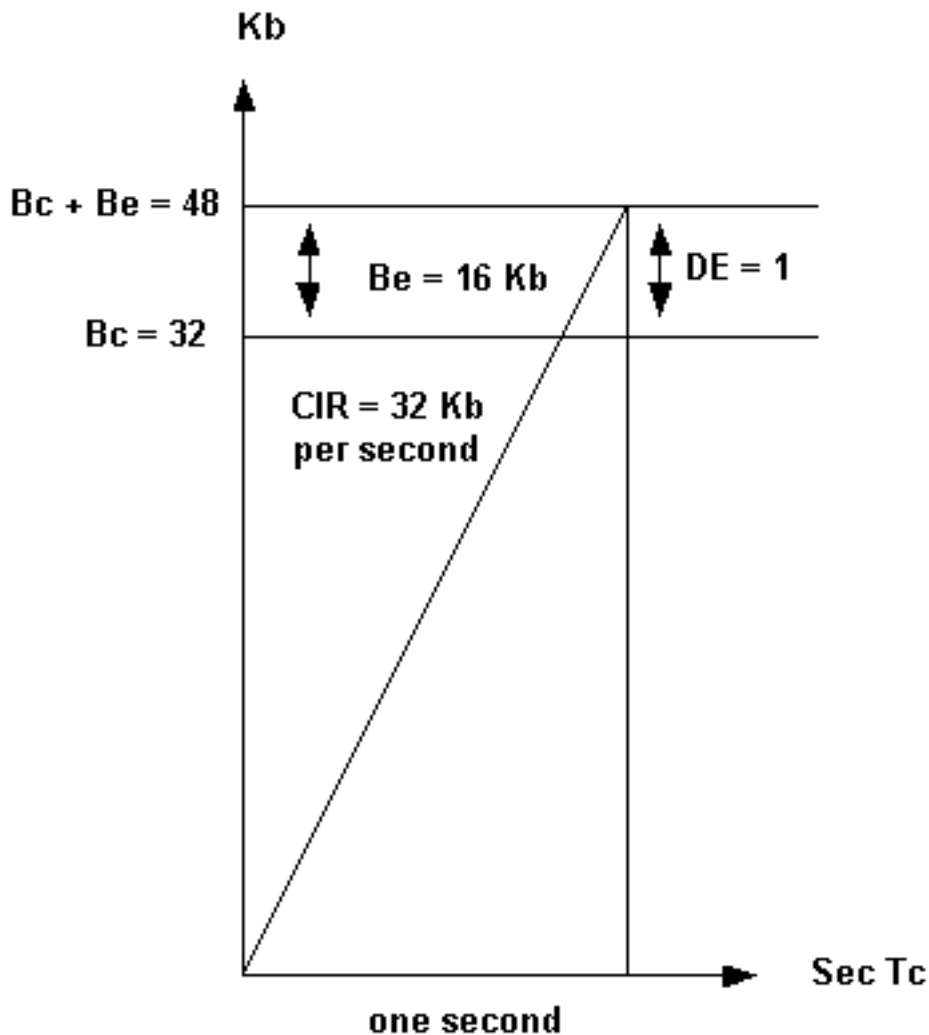
CIR是网络承诺在通常情况下传输的允许数据流量。速率在时间被平均 $T_c$ 的增量。CIR也指最低的可接受吞吐量。Bc和 $B_e$ 以位为单位、 $T_c$ 以秒为单位、接入速率和CIR以比特/秒为单位。

BC，是， $T_c$ 和CIR每数据链路连接标识符(DLCI)定义。由于此，令牌桶过滤器控制速率每个DLCI。接入速率每个用户网络接口是有效。对于Bc， $B_e$ 及CIR流入和流出的值可以是著名的。如果连接是对称的，在两个方向的值是相同的。对于永久虚电路，我们定义了流入和流出的Bc， $B_e$ 及CIR在订阅时间。

- 高峰 = DLCI的最大速度。那的带宽特定DLCI。
- $T_c = B_c / CIR$
- 高峰 =  $CIR + B_e / T_c = CIR (1 + B_e / B_c)$

如果 $T_c$ 是一秒钟然后：

- 高峰 = CIR + 是 =  $B_c + B_e$
- EIR = 是



在我们的示例中，路由器根据网络中的拥塞情况，选择使用48 Kbps还是32 Kbps的速率发送数据流。网络可能在BC上用DE标记帧，但是仍有大量空闲容量可以用来传输帧。反向也是可能的：他们能立即限制了产能，丢弃额外的帧。网络可能在Bc+Be上的帧标记DE，可能传输这个帧，或者根据国际电信联盟电信标准化部门规范ITU-T I.370丢弃它。流量整形抑制根据从交换网络的后向显式拥塞通知(BECN)标记信息包的流量。如果您收到50%的BECN，路由器将把特定DLCI减少到当前传输带宽的八分之一。

### 示例

已发送速度是42 Kb。路由器将速度降低到 $42 - 42/8$ ，为36.75千字节。如果更改后拥塞减少，路由器将进一步减少流量，从而使当前传输带宽下降至原来的八分之一。减少流量，直到达到配置的CIR值。然而，当我们仍然能看见BECN时，速度可以降至CIR以下。您能指定一底下限制，例如CIR/2。当从网络中收到的所有帧，在给定的时间间隔中不再有BECN位时，网络便不再拥塞。200毫秒是此间隔的默认值。

### 一般流量整形

通用流量整形功能是一种独立于媒体和封装的流量整形工具，当网云、链路和接受终端路由器发生拥塞时，它可以减少出局流量。我们在接口或子接口能设置它在路由器内。

通用流量整形在以下情况下是有用的：



- 当您的网络拓扑由中心站点的高速连接(T1线路速度)、分支机构或远程办公人员站点的低速连接(低于56kbps)组成时。由于速度不匹配，当中心站点发送数据的速度高于远程站点能够接收的速度时，分支机构或远程办公人员站点的流量通常存在瓶颈。这导致在最后交换机的一瓶颈在远程点路由器前。
- 如果您是提供子速率服务的服务提供商，此功能将使您能够使用路由器，将您的T1或T3链路分为更小的信道。您可以为每个子接口配置令牌过滤器桶，使之与用户订购的服务匹配。

在帧中继连接上，您可能希望路由器抑制数据流，而不是将数据流发送到网络中。限制流量将限制在服务提供商的网云的包丢失。基于BECN的控制功能，使您能够根据从网络中收到的BECN标记数据包，让路由器动态控制数据流。这种控制将信息包保留在路由器的缓冲区，以便减少从路由器到帧中继网络的数据流。路由器控制子接口上的数据流，当少量的BECN标记的信息包收到时，速率也会增加。

## 通用流量整形的命令

要定义速率控制，请使用此命令：

```
traffic-shape rate 位元速率 [burst-size [excess-burst-size]] [group access-list]
```

要节流在帧中继接口的BECN使用此命令：

```
traffic-shape.adaptive [bit-rate]
```

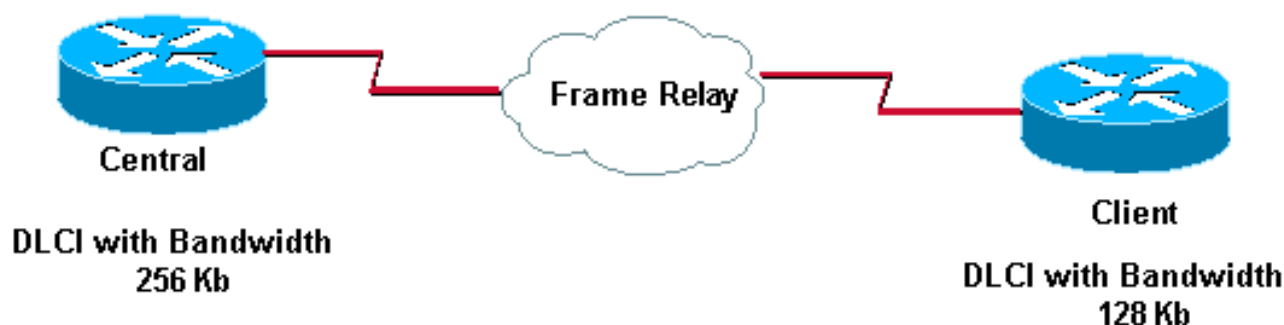
如果要配置帧中继子接口来评估接收BECN的可用带宽，请使用traffic-shape adaptive命令。

**注意：** 在您能够使用traffic-shape adaptive命令之前，您必须在带有traffic-shape rate命令的接口上启用流量整形。

为traffic-shape rate命令指定的比特率是上限，为traffic-shape adaptive命令指定的比特率是下限(通常为CIR值)，当接口接收BECN时，数据流整形的比特率在此范围之内。实际上使用的速率通常在这两速率之间。您应该在链路两端配置traffic-shape adaptive命令，因为该命令也会配置流末端的设备，将转发显式拥塞通知(FECN)信号作为反映为BECN。即使数据流主要在一个方向，这也能使高速端的路由器发现和适应拥塞。

## 示例

以下示例配置了接口0.1上的流量整形，上限为(通常为Bc + Be)128 kbps，下限为64 kbps。这允许链路运行速率从64kbps到128kbps，具体取决于拥塞程度。如果中心侧有一个256 kbps的上限，您应该使用最低的上限值。



这是什么我们在这些路由器配置：

```
Prasit#show frame-relay pvc
```

```
PVC Statistics for interface Serial1 (Frame Relay DTE)
```

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

```
DLCI = 150, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1
```

```
input pkts 134          output pkts 119          in bytes 12029
out bytes 7801          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 18      out bcast bytes 1260
pvc create time 00:21:15, last time pvc status changed 00:21:15
```

```
Prasit#show frame-relay map
```

```
Serial1 (up): ip 4.0.1.1 dlci 150(0x96,0x2460), dynamic,
              broadcast, status defined, active
```

```
Prasit#ping 124.124.124.1
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 44/45/48
```

```
Here is the debug output shown on Spicey when you use the command above to ping to Spicey from Prasit.
```

```
Spicey#
```

```
*Mar 1 00:33:26.755: PQ: Serial0 output (Pk size/Q 13/0)
*Mar 1 00:33:28.535: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.539: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.543: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:33:28.583: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.587: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.587: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:33:28.631: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.635: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.635: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:33:28.679: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.683: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.683: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:33:28.723: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.727: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.731: PQ: Serial0 output (Pk size/Q 104/0)
```

```
Prasit#telnet 124.124.124.1
```

```
Trying 124.124.124.1 ... Open
```

```
User Access Verification
```

```
Password:
```

```
Spicey>exit
```

```
[Connection to 124.124.124.1 closed by foreign host]
```

```
Prasit#
```

[帧中继流量整形](#)

在通用流量整形中，您只能为每个物理接口的指定一个峰值速率(上限)，为每个子接口指定一个 CIR (下限)。使用帧中继流量整形，您启动一个令牌桶过滤器每条虚拟电路。

在帧中继功能的流量整形提供以下功能：

- 在逐个VC的速率强制：您可以配置峰值速率，把出局流量限制为CIR或某些其他定义值，例如突发信息速率(EIR)。
- 在逐个VC的概括的BECN支持：路由器能监控BECN，并从帧中继网络限制根据BECN标记的信息包反馈的流量。
- 优先级排队(PQ)、客户排队(CQ)或者WFQ支持在VC级别。这使数据流的优先级排列和排队能够有好的间隔，使您能够更多地控制单个VC上的数据流。在帧中继功能的流量整形适用于帧中继永久虚拟电路(PVC)和交换虚拟电路(SVC)。

## 示例

```
Prasit#show frame-relay pvc
```

```
PVC Statistics for interface Serial1 (Frame Relay DTE)
```

	Active	Inactive	Deleted	Static
Local	1	0	0	0
Switched	0	0	0	0
Unused	0	0	0	0

```
DLCI = 150, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial1
```

```
input pkts 134          output pkts 119          in bytes 12029
out bytes 7801          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 18      out bcast bytes 1260
pvc create time 00:21:15, last time pvc status changed 00:21:15
```

```
Prasit#show frame-relay map
```

```
Serial1 (up): ip 4.0.1.1 dlci 150(0x96,0x2460), dynamic,
              broadcast, status defined, active
```

```
Prasit#ping 124.124.124.1
```

```
Type escape sequence to abort.
```

```
Sending 5, 100-byte ICMP Echos to 124.124.124.1, timeout is 2 seconds:
```

```
!!!!
```

```
Success rate is 100 percent (5/5), round-trip min/avg/max = 44/45/48
```

```
Here is the debug output shown on Spicey when you use the command above to ping to Spicey from Prasit.
```

```
Spicey#
```

```
*Mar 1 00:33:26.755: PQ: Serial0 output (Pk size/Q 13/0)
*Mar 1 00:33:28.535: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.539: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.543: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:33:28.583: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.587: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.587: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:33:28.631: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.635: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.635: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:33:28.679: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.683: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
```

```
*Mar 1 00:33:28.683: PQ: Serial0 output (Pk size/Q 104/0)
*Mar 1 00:33:28.723: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.727: PQ: Serial0: ip (s=124.124.124.1, d=4.0.1.2) ->high
*Mar 1 00:33:28.731: PQ: Serial0 output (Pk size/Q 104/0)
```

```
Prasit#telnet 124.124.124.1
Trying 124.124.124.1 ... Open
```

```
User Access Verification
Password:
Spicey>exit
```

```
[Connection to 124.124.124.1 closed by foreign host]
Prasit#
```

在本例中路由器添加两令牌时段。

- 一运行在64000个(CIR之间), 并且128000(Bc +是)。
- 其他运行在16000 (CIR)和64000之间(Bc+Be)。

如果从以太网流入的流量大于令牌桶过滤器, 流量会被缓冲在帧中继流量队列。

要查看显示数据包流的流程图, 当您实现帧中继流量整形时, 请参阅[帧中继流量整形流程图](#)。使用令牌桶过滤器, 特别地要查看流程图, 请参阅[帧中继流量整形-令牌桶流程图](#)。

## 常用帧中继命令

本章节描述了两个在配置帧中继时特别有用的Cisco IOS命令。

### show frame-relay pvc

该命令可显示永久虚拟电路(PVC)的状态、进入和流出的信息包。如果线路上有拥塞, 它还可以通过前向显式拥塞通知(FECN)和后向显式拥塞通知(BECN), 显示丢弃的数据包。对于字段的详细说明与**show frame-relay pvc**命令一起使用, 请点击此处。

如果有输出一**show frame-relay pvc**命令从您的Cisco设备, 您能使用[Output Interpreter \(仅限注册用户\)](#)显示潜在问题和修正。

### Output Interpreter仅限注册用户

输出示例如下所示:

```
RouterA#show frame-relay pvc
PVC Statistics for interface Serial0 (Frame Relay DTE)
DLCI = 666, DLCI USAGE = UNUSED, PVC STATUS = DELETED, INTERFACE = Serial0
  input pkts 0                output pkts 0                in bytes 0
  out bytes 0                 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
  pvc create time 0:03:18    last time pvc status changed 0:02:27
  Num Pkts Switched 0
DLCI = 980, DLCI USAGE = LOCAL, PVC STATUS = ACTIVE, INTERFACE = Serial0
  input pkts 19               output pkts 87               in bytes 2787
  out bytes 21005             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
```

```
pvc create time 1:17:47 last time pvc status changed 0:58:27
```

DLCI USAGE字段包含以下条目之一：

- 交换式-路由器或接入服务器使用作为交换机。
- 本地-路由器或接入服务器使用作为数据终端设备(DTE)。
- 未使用-数据链路连接标识符(DLCI)没有由在路由器的用户输入的配置命令参考。

PVC能有四可能的状态。这些由PVC STATUS字段显示如下：

- 激活- PVC是上和通常作用。
- 非激活- PVC不是端到端。这可能是因为在帧中继网云中没有本地DLCI的映射(或不正确映射)，或者PVC的远程终端被删除。
- 删除-或者本地管理接口(LMI)没有交换在路由器和本地交换机之间，或者交换机没有在本本地交换机配置的DLCI。
- 静态-在路由器的帧中继接口配置的no keepalive。

## [show frame-relay map](#)

请使用此命令确定帧中继Inverse-arp是否解决了一个远程IP地址对本地DLCI。此命令没有为点对点子接口启用。为仅多点接口和子接口是有用的。输出示例如下所示：

```
RouterA#show frame-relay map
Serial0 (up): ip 157.147.3.65 dlci 980(0x3D4,0xF440), dynamic,
             broadcast,, status defined, active
```

[欲知使用show frame-relay map命令的字段详细说明，请参见“帧中继命令的说明文档”。](#)

如果有输出一show frame-relay map命令从您的Cisco设备，您能使用[Output Interpreter \(仅限注册用户\)](#)显示潜在问题和修正。

[Output Interpreter仅限注册用户](#)

## [帧中继和桥接](#)

称为网桥协议数据单元(BPDU)的配置消息用于Cisco网桥和路由器支持的生成树协议。这些定期流在网桥之间并且构成巨大数量的流量由于他们的频繁发生。有生成树协议的两种类型在透明桥接的。算法最先由Digital Equipment Corporation (DEC)引入，随后被IEEE 802委员会修正，并发布在IEEE 802.1d规格中。DEC生成树协议在一秒钟的间隔发出BPDU，而IEEE在2秒钟的间隔发出BPDU。每个数据包为41个字节，其中包括35字节的配置BPDU消息、2字节的帧中继报头、2字节的以太网类型和2字节的FCS。

## [帧中继和内存](#)

帧中继资源的内存消耗量在四个区域中发生：

1. 每数据链路连接标识符(DLCI)：216个字节
2. 每个映射语句：96个字节(或动态建立的地图)
3. 每个IDB (硬件接口+ ENCAP FRAME中继)：5040个+ 8346个= 13,386个字节
4. 每个IDB (软件子接口)：2260个字节

例如，Cisco 2501使用二个帧中继接口，每个接口带有四个子接口，总共有八个DLCI，关联映射需

要以下：

- 2接口硬件IDB x 13,386 = 26,772
- 8子接口IDB x 2260 = 18,080子接口
- 8 DLCI x 216 = 1728 DLCI
- 8个映射语句x 96 = 768映射语句或Dynamics

总计与使用的47,348字节是相等的RAM。

**注意：** 使用的值这里为Cisco IOS版本11.1，12.0和12.1软件是有效。

## 帧中继的故障排查

此部分包含您可以遇到，当排除故障时可能的**show interface**命令输出的部分。提供输出的说明。

### "Serial0 is down, line protocol is down"

此输出意味着您的电缆、信道服务单元/数据服务单元(CSU/DSU)或串行线路发生了问题。您需要排除故障与环回测试的问题。要进行环回测试，请遵从下面步骤：

1. 设置串联线封装为HDLC和Keepalive为10秒。执行如此，发出encapsulation hdlc命令和 **keepalive 10**在serial interfaces下。
2. 安置CSU/DSU或调制解调器在本地环路模式。如果线路通信协议出来，当CSU，DSU或调制解调器在本地回环模式(表示由"line protocol is up (looped)"消息)，建议问题在本地CSU/DSU之外发生。如果状态行没有更改状态，则可能路由器、连接电缆、CSU/DSU或调制解调器存在问题。在大多数情况下，问题出在CSU/DSU或调制解调器上。
3. ping您自己的IP地址用循环的CSU/DSU或调制解调器。命令应该全部成功。0x0000的扩展ping有助于解决线路问题，因为T1或E1从数据获取时钟，需要每8位进行转换。B8ZS保证那重零数据模式帮助确定中继上实现的转换是否正确实施。路径中如果有一对数据变换器，将使用重一模式适当模拟高零负荷。交替的模式(0x5555)代表“典型的”数据模式。如果ping失败，或者收到循环冗余校验(CRC)错误，则您需要一个带有电信公司提供的相应分析器的误码率测试器(BERT)。
4. 当您是完成的测试时，请确保您返回封装到帧中继。

### "Serial0 is up, line protocol is down"

输出中的此线路意味着路由器正从CSU/DSU或调制解调器获取载波信号。检查确定帧中继提供商是否已经激活了他们的端口，您的本地管理接口(LMI)是否设置了匹配。一般来说，帧中继交换机会忽略数据终端设备(DTE)，除非看到正确的LMI(使用Cisco默认的"cisco" LMI)。检查确保Cisco路由器传送数据。您很可能需要使用环路测试来检查线路完整性，从本地CSU开始进行，直到您到达提供商的帧中继交换机。请参阅前面部分关于如何执行环回测试。

### "Serial0 is up, line protocol is up"

如果没有关闭Keepalive，此输出线路则意味着路由器正与帧中继提供商的交换机进行对话。您应该看到双向数据流成功的交换在serial interfaces的没有CRC错误。"Keepalive(保活)在帧中继中是必要的，因为它们是路由器""学习""到提供商提供了哪些数据链路连接标识符(DLCI)的机制。"要观看交换，您能在任何情况下安全使用**debug frame-relay lmi**。debug frame-relay lmi命令生成非常少量消息，并且能提供回答问题例如：

1. Cisco路由器与本地帧中继交换机对话？
2. 路由器正可以从帧中继提供商获取预订的永久虚拟电路(PVC)的全部LMI状态消息吗？
3. 正确的DLCI？

这是从成功的连接输出的某示例debug frame-relay lmi：

```
*Mar 1 01:17:58.763: Serial0(out): StEnq, myseq 92, yourseen 64, DTE up
*Mar 1 01:17:58.763: datagramstart = 0x20007C, datagramsize = 14
*Mar 1 01:17:58.763: FR encap = 0x0001030800 75 95 01 01 01 03 02 5C 40
*Mar 1 01:17:58.767:
*Mar 1 01:17:58.815: Serial0(in): Status, myseq 92
*Mar 1 01:17:58.815: RT IE 1, length 1, type 1
*Mar 1 01:17:58.815: KA IE 3, length 2, yourseq 65, myseq 92
*Mar 1 01:18:08.763: Serial0(out): StEnq, myseq 93, yourseen 65, DTE up
*Mar 1 01:18:08.763: datagramstart = 0x20007C, datagramsize = 14
*Mar 1 01:18:08.763: FR encap = 0x0001030800 75 95 01 01 01 03 02 5D 41
*Mar 1 01:18:08.767:
*Mar 1 01:18:08.815: Serial0(in): Status, myseq 93
*Mar 1 01:18:08.815: RT IE 1, length 1, type 1
*Mar 1 01:18:08.815: KA IE 3, length 2, yourseq 66, myseq 93
*Mar 1 01:18:18.763: Serial0(out): StEnq, myseq 94, yourseen 66, DTE up
*Mar 1 01:18:18.763: datagramstart = 0x20007C, datagramsize = 14
*Mar 1 01:18:18.763: FR encap = 0x0001030800 75 95 01 01 00 03 02 5E 42
*Mar 1 01:18:18.767:
*Mar 1 01:18:18.815: Serial0(in): Status, myseq 94
*Mar 1 01:18:18.815: RT IE 1, length 1, type 0
*Mar 1 01:18:18.819: KA IE 3, length 2, yourseq 67, myseq 94
*Mar 1 01:18:18.819: PVC IE 0x7 , length 0x3 , dlci 980, status 0x2
```

注意状态“在以上输出的DLCI 980”。Status字段的可能的值如下解释：

1. 0x0-Added/inactive意味着交换机为该DLCI进行了编程，但由于某种原因(例如PVC的另一端发生故障)，它无法使用。
2. 0x2-Added/active含义帧中继交换机有DLCI，并且一切是可操作的。您能开始发送它与此DLCI的流量在报头。
3. 0x3-0x3是有效状态(0x2)与被设置为(0x1)的RNR (或r-bit) 的组合。这意味着这个PVC的交换机(或交换机上的一个特定队列)进行了备份，您中止了传输，以防帧溢出。
4. 0x4-Deleted表明帧中继交换机没有为路由器提供DLCI编程。但是它被编程了得过去在某些程度上。这可能是由于在路由器上倒转的DLCI导致的，或者是由在帧中继网云中删除的PVC导致。配置DLCI ( 交换机没有)将显示为0x4。
5. 0x8-New/inactive
6. 0x0a-New/active

## 帧中继特性

此部分说明您应该知道的几个帧中继特性。

### IP 分界检查

IP水平分割检查默认禁用帧中继封装，路由更新将从相同接口流入流出。路由器通过本地管理接口(LMI)更新，获取它们需要从帧中继交换机使用的数据链路连接标识符(DLCI)。然后路由器向远程IP地址使用反向ARP，并创建本地DLCI和相关远程IP地址的映射。此外，部分网状网络不支持某些协议，例如AppleTalk、透明桥接和IPX，因为它们需要“水平分割”。在这些网络中，在一个接口上

收到的信息包不能通过同一接口发出，即使信息包在不同的虚拟电路上接收和传输。配置帧中继子接口可将单个物理接口用作多个虚拟接口。此功能允许我们解决水平分割规则。虚拟接口收到的信息包现在可以转发给另一个虚拟接口，即使它们配置在同一个物理接口。

## [Ping 多点帧中继上您自己的 IP 地址](#)

您不能ping您在多点帧中继接口的自己的IP地址。这是因为帧中继多点(子)接口是非广播的(不同于以太网和点对点接口高级数据链路控制[HDLC])，以及帧中继点对点接口。

此外，您不能在星型结构从一个分支ping到另一个分支。这是因为您自己的IP地址没有映射(没有通过反向ARP学到任何地址)。但如果您为自己的IP地址(或远程辐射点)配置了静态映射(使用frame-relay map命令)，以使用本地DLCI，您就能够ping通您的设备。

```
aton#ping 3.1.3.3
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.1.3.3, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)

aton#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
aton(config)#interface serial 1
aton(config-if)#frame-relay map ip 3.1.3.3 160
aton(config-if)#

aton#show frame-relay map
Serial1 (up): ip 3.1.3.1 dlci 160(0xA0,0x2800), dynamic,
              broadcast,, status defined, active
Serial1 (up): ip 3.1.3.2 dlci 160(0xA0,0x2800), static,
              CISCO, status defined, active
Serial1 (up): ip 3.1.3.3 dlci 160(0xA0,0x2800), static,
              CISCO, status defined, active
aton#ping 3.1.3.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.1.3.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 64/68/76 ms
aton#
aton#show running-config
!
interface Serial1
ip address 3.1.3.3 255.255.255.0
no ip directed-broadcast
encapsulation frame-relay
frame-relay map ip 3.1.3.2 160
frame-relay map ip 3.1.3.3 160
frame-relay interface-dlci 160
!
```

## [关键字广播](#)

广播关键字提供两个功能：当组播没有启用时，它会转发广播，并简化使用帧中继的非广播网络的开放式最短路径优先 (OSPF) 配置。

广播关键字也许为一些路由协议也要求--例如，AppleTalk--它取决于定期路由表更新，特别是在添加路由之前，远程终端的路由器在等待路由更新数据包到达时。



通过请求选择指定路由器，OSPF可以处理非广播的多路访问网络(例如帧中继)，处理方法与广播网络非常相似。在早先的版本中，OSPF配置必需的手工分配使用 `neighbor interface router`命令。当带有广播关键字的配置包括`frame-relay map`命令，并且配置了`ip ospf network`命令(带有广播关键字)配置时，不需要手工配置任何邻居。OSPF自动地当前运行帧中继网络作为广播网络。(请参阅`ip ospf network interface`命令以获得详情。)

**注意：**OSPF广播机制假设D类IP地址从不在帧中继上正常的数据流上使用。

## 示例

以下示例映射目的IP地址172.16.123.1到DLCI 100：

```
aton#ping 3.1.3.3
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.1.3.3, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)

aton#configure terminal
Enter configuration commands, one per line. End with CNTL/Z.
aton(config)#interface serial 1
aton(config-if)#frame-relay map ip 3.1.3.3 160
aton(config-if)#

aton#show frame-relay map
Serial1 (up): ip 3.1.3.1 dlci 160(0xA0,0x2800), dynamic,
              broadcast,, status defined, active
Serial1 (up): ip 3.1.3.2 dlci 160(0xA0,0x2800), static,
              CISCO, status defined, active
Serial1 (up): ip 3.1.3.3 dlci 160(0xA0,0x2800), static,
              CISCO, status defined, active
aton#ping 3.1.3.3

Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 3.1.3.3, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 64/68/76 ms
aton#
aton#show running-config
!
interface Serial1
ip address 3.1.3.3 255.255.255.0
no ip directed-broadcast
encapsulation frame-relay
frame-relay map ip 3.1.3.2 160
frame-relay map ip 3.1.3.3 160
frame-relay interface-dlci 160
!
```

OSPF广播更新的用途DLCI 100。

## 重新配置子接口

一旦您创建了特殊类型的子接口，您就不能在不重新加载的情况下进行更改。例如，您不能创建一个多点子接口`serial0.2`，然后更改它到点对点。如果要更改它，您需要重新加载路由器或创建另一个子接口。这是帧中继代码在Cisco IOS软件方面工作的方式。

## [DLCI 限制](#)

### [DLCI地址空间](#)

假如提供10位地址，单个物理链路上大约可以配置1000个 DLCI。由于某DLCI保留(根据vendor-implementation)，最大数量约为1000。Cisco LMI的范围是16-1007。ANSI/ITU的陈述的范围是16-992。这些是传送用户数据的DLCI。

然而，在子接口上配置帧中继VC时，您需要考虑被称为IDB限制的实际限制。每个系统的接口和子接口的总数受到您的Cisco IOS版本支持的接口描述符块(IDB)的数量的限制。IDB是存储关于接口的信息(例如计数器、接口状态等)的存储器的一部分。IOS为每个平台上出现的每个接口维护IDB，为每个子接口维护IDB。更高的速度接口比低速度接口要求更多的内存。每个平台包含不同最大数量的IDB，这些限制可能会随每个Cisco IOS版本改变。

欲知更多信息，请参阅[最大接口数和子接口关于Cisco IOS软件平台：IDB 限制](#)。

### [LMI状态更新](#)

LMI协议要求所有永久虚拟电路(PVC)状态报告符合单个数据包，一般会将DLCI的数量限制到少于800，取决于最大传输单位 ( MTU ) 的大小。

$$\text{Max DLCIs} \cong \frac{\text{MTU bytes} - 20 \text{ bytes}}{5 \frac{\text{bytes}}{\text{DLCI}}}$$

MTU = 4000 bytes

$$\frac{4000 - 20}{5} \cong 796$$

**DLCIs, where 20 = Frame Relay and LMI Header**

在serial interfaces的默认MTU是1500个字节，产生最多每个接口296 DLCI。您能增加MTU支持从帧中继交换机的一个更加大的完整状态更新消息。如果完整状态更新消息大于接口MTU，那么丢失信息包，并且增加接口大型计数器。更改MTU时，保证远程路由器和相关网络设备上配置了相同值。

请注意:这些编号根据LMI类型稍有变化。根据Cisco 7000路由器平台上的经验数据得出的每个路由器(不是接口)平台的推荐最大DLCI值如下所示：

- Cisco2500 : 1条X T1/E1链路@每个接口60 DLCI = 60个总计
- Cisco4000 : 1条X T1/E1链路@每个接口120 DLCI = 120个总计
- Cisco4500 : 3条X T1/E1链路@每个接口120 DLCI = 360个总计
- Cisco 4700 : 4条X T1/E1链路@每个接口120 DLCI = 480个总计
- Cisco 7000 : 4条X T1/E1/T3/E3链路@每个接口120 DLCI = 480个总计

- Cisco7200 : 5条X T1/E1/T3/E3链路@每个接口120 DLCI = 600个总计
- Cisco 7500 : 6倍T1/E1/T3/E3链路@每个接口120 DLCI = 720个总计

注意：这些编号是仅指南，并且假设，所有流量快速交换。

## 其他注意事项

一个实际的DLCI限制也取决于VC是否运行动态或静态路由协议。动态路由协议和其他协议(如IPX SAP)交换数据库表将发送hello包，以及CPU必须识别和处理的转发信息消息。作为通用规则，使用静态路由使您能在单个帧中继接口配置大量VC。

## IP/IPX/AT 地址

如果您正在使用子接口，请不要将IP、IPX或AT地址放置在主要接口。在启用主要接口之前，请将DLCI分配到它们的子接口上，以确保帧中继反向ARP正常工作。万一它发生故障，请遵从下面步骤：

1. 使用no frame-relay inverse-arp ip 16和clear frame-relay-inarp命令，关闭该DLCI的反向地址解析协议(ARP)。
2. 修复您的配置。
3. 再打开frame-relay inverse-arp命令。

## RIP 和 IGRP

路由信息协议(RIP)更新流每30秒。每个RIP数据包可以包含25个路由条目，共536个字节。36字节的此总计是报头信息，并且每路由条目是20个字节。所以，如果您通过为50 DLCI配置的帧中继链路通告1000个路由，路由更新数据速度将为每30秒1MB，消耗285kbps的带宽。在T1链路上，此带宽表示18.7%的带宽，每一次更新的持续时间为5.6秒。开销相当高，并且处于可接受的边缘，但承诺信息速率(CIR)必须在这个接入速率范围内。明显地，任何较少比T1将导致许多笔开销。例如：

- $1000/25 = 40$ 数据包x 36个= 1440个报头字节
- 1000个x 20个字节= 20,000字节的路由条目
- 总计21,440字节x 50 RIP DLCI = 1072 MB更新每30秒
- $1,072,000$ 个字节/30秒x 8个位= 285 Kbps

增强型内部网关路由协议(EIGRP)更新流每90秒(此间隔可配置)。每个IGRP信息包能够包含104个路由条目，总共1492个字节，其中38个字节是报头信息，每个路由条目为14个字节。如果您在为配置了50个DLCI的帧中继链路上通告1000个路由，则请求每90秒将进行大约720 KB的路由更新，即消耗58.4 kbps的带宽。在T1链路上，此带宽表示4.2%的带宽，每一次更新的持续时间为3.7秒。此开销是一可接受数量：

- $1000/104 = 9$ 数据包x 38个= 342个报头字节
- $1000 \times 14 = 14,000$ 字节的路由条目
- 托塔尔=  $14,342$ 个字节x 50 DLCI = IGRP更新717 KB每90秒
- $717,000$ 个字节/90 x 8位= 63.7 Kbps

路由表维护协议(RTMP)路由更新发生每10秒(此间隔可配置)。每个RTMP信息包最多可包含94个扩大路由条目，总共为564个字节，23个字节的报头信息，并且每个路由条目为6个字节。如果您在为配置了50个DLCI的帧中继链路上通告1000个AppleTalk网络，每10秒将进行大约313 KB的RTMP更新，即消耗250kbps带宽。要使开销保持在可接受的开销程度内(15%或更低)，则必须提供T1速率。例如：

- $1000/94 = 11$ 数据包x 23个字节= 253个报头字节
- $1000 \times 6 = 6000$ 字节的路由条目
- 托塔尔=  $6253 \times 50$  DLCI = RTMP 313 KB更新每10秒
- $313,000/10$ 秒x 8个位= 250 Kbps

IPX RIP数据包更新发生每60秒(此间隔可配置)。每个IPX RIP数据包最多可包含50个路由条目，总共为536个字节，38个字节的报头信息，每个路由条目为8个字节。如果您在为配置50个DLCI的帧中继链路上通告1000个IPX路由，每60秒将进行大约536 KB的IPX更新，即消耗58.4 kbps的带宽。要维持在可接受的开销程度内(15%或更少)，应该达到512 kbps的速率。例如：

- $1000/50 = 20$ 数据包x 38个字节= 760个报头字节
- $1000 \times 8 = 8000$ 字节的路由条目
- 托塔尔=  $8760 \times 50$  DLCI = 438,000字节的IPX更新每60秒
- $438,000/60$ 秒x 8个位= 58.4 Kbps

IPX服务接入点(SAP)信息包更新发生每60秒(此间隔可配置)。每个IPX SAP数据包最多可包含7个通告条目，总共为536个字节，38个字节的报头信息，每个通告条目为64个字节。如果您在为50个DLCI配置的帧中继链路上广播1000个IPX通告，您将以IPX每60秒将进行536 KB的更新而告终，或者消耗58.4 kbps的带宽。要维持在可接受的开销程度内(15%或更少)，应该达到高于2 Mbps的速率。明显地，SAP过滤在此方案要求。与本章节提及的所有其他协议相比，IPX SAP 新需要最大带宽：

- $1000/7 = 143$ 数据包x 38个字节= 5434个报头字节
- $1000 \times 64 = 64,000$ 字节的路由条目
- 托塔尔=  $69,434 \times 50$  DLCI = 3,471,700字节的IPX服务广告每60秒
- $3,471,700/60$ 秒x 8个位= 462 Kbps

## Keepalive

在某些情况下，Cisco设备上的Keepalive需要设置成比交换机上的Keepalive稍短(大约短8秒)。如果接口保持忽开/忽关状态，您应查看此需求。

## 串行接口

Serial interfaces，默认情况下多点，是非广播媒介，而点对点接口广播。如果您使用静态路由，您可以指向下一跳或串行子接口。对于多点，您需要指向下一跳。当执行帧中继上的OSPF时，此概念是非常重要的。路由器需知道这是为OSPF操作提供的广播接口。

## OSPF 和多点

OSPF和多点可以是非常麻烦的。OSPF需要指定路由器(DR)。如果开始丢失的PVC，一些路由器可能丢失连接和设法变为DR，即使其他路由器仍然看到旧有DR。这造成OSPF程序发生故障。

OSPF相关的开销不象传统距离矢量路由协议那样明显和可预测。不可预料来自OSPF网络链路是否稳定的。如果帧中继路由器的所有邻接设备都是稳定的，只有邻居hello数据包(Keepalive)通过，其开销低于距离矢量协议(例如RIP和IGRP)中的开销。然而，如果路由(邻接)不稳定，则会发生连接状态泛洪，并且带宽可能迅速被消耗。在运行Dijkstra算法时(用来计算路由)，OSPF非常占用处理器。

在Cisco IOS软件的早期版本中，当您在多路接入非广播媒介上(帧中继、x.25和ATM)配置OSPF时，应该特别注意。OSPF协议考虑这些媒体类似所有其他广播介质例如以太网。非广播多路访问(NBMA)网云在一星型网拓扑里典型地被建立。PVC或交换虚拟电路(SVC)在部分网状拓扑中，这种

物理拓扑不提供OSPF认为存在的多通道。对于盒点对点串行接口，OSPF总是形成在邻居之间的一邻接。OSPF邻接交换数据库信息。为将在特定网段上交换的信息量减到最小，OSPF在每个多路访问网段上选择一台路由器作为DR，另一台路由器作为备份指定路由器(BDR)。BDR选择作为DR停机时的备用机制。

在此设置后的想法是路由器有信息交换的中心联络点。由于DR和BDR需要与网云上的所有路由器有全网状物理连接，这就使DR的选择成为一个问题。并且，由于缺乏广播功能，DR和BDR需要附在网云上的其他所有路由器的静态列表。使用**neighbor命令**，此设置达到：

**neighbor ip-address [priority number] [poll-interval seconds]**

在Cisco IOS软件最新版本中，您可以使用不同的方法，避免静态地配置邻居和指定特定路由器成为非广播网络上的DR或BDR的复杂性。使用哪种方法取决于网络是否是新型网络，或者现有网络设计是否需要修改。

子接口是定义接口的逻辑方法。同一个物理接口可以被分离成多个逻辑接口，每个子接口被定义为点对点的接口。此方案最初创建的目的是更好地处理NBMA的水平分离和基于路由协议的向量引起的问题。

点对点子接口具有任何物理点对点接口的属性。就OSPF而言，邻接始终在不进行DR或BDR选择的点对点子接口上形成。OSPF考虑网云一组点对点链接而不是一个多路访问网络。点到点应用的唯一缺点是每个分段属于不同子网。由于一些管理员已经为全部网云分配一个IP子网，所以此方案可能无法实施。另一个解决方法是在网云上使用IP不编号的接口。此方案也可能成为根据串联线的IP地址管理WAN的某些管理员面临的一个问题。

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9. [RFC 1315帧中继MIB](#)
10. [RFC 1293帧中继反向ARP](#)
11. [RFC 1144-TCP/IP报头压缩](#)
12. 帧中继论坛(FRF) 1.1用户网络接口(UNI)
13. FRF 2.1帧中继网络之间的接口
14. FRF 3.1多协议封装
15. FRF 4 SVCS
16. FRF 6帧中继服务客户网络管理(MIB)

17. 四LMI的帮会
18. Q.922附件A
19. ANSI T1.617 Annex D
20. ANSI T1.618 , T1.606
21. ITU-T Q.933 , Q.922
22. [OSPF 设计指南](#)
23. [高级IGRP增强实施的配置说明](#)

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