第19章 Appletalk

本章主题

- Appletalk技术概述
- Cisco对Appletalk的支持
- Appletalk EIGRP配置
- Appletalk GRE隧道
- Appletalk流量过滤
- Appletalk区域过滤
- Appletalk网络故障排除

19.1 引言

Appletalk是苹果计算机公司为其 Macintosh计算机提供网络服务而开发的一种网络协议，它是桌面协议中自动化程度最高的协议，但同时也是最繁琐的。例如， Appletalk的缺省路由协议是RTMP，而RTMP每10秒定时向所有直接相邻路由器发送路由更新信息。

19.1.1 Appletalk术语

Appletalk节点可以是与Appletalk网络相连的任一设备，每个节点都被分配给一个 Appletalk地址。节点可能是Macintosh计算机或打印机或网络中任何其他可以分配地址的设备。

Appletalk网络可以理解为一个物理的局域网或广域网，其中包括一个或多个Appletalk节点。

Appletalk区域是网络上的一个逻辑组，通常由物理上位于不同地方的多个 Appletalk节点组成，它与虚拟局域网的概念非常相近。图 19-1可以说明Appletalk区域的工作方式，图中给

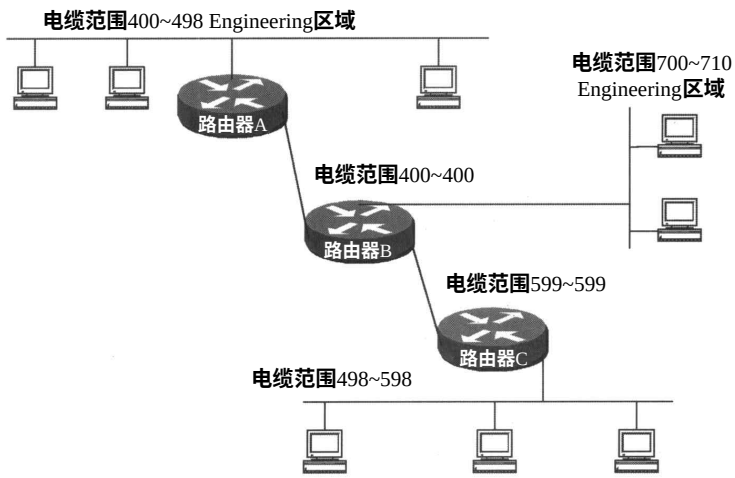

图19-1 不正确的Appletalk地址范围

出了一个分为三个以太网段的 Appletalk网络、路由器A和路由器B上的以太网段都在名为工程的区域内。当路由器 C连接的以太局域网中的一个 Macintosh用户访问工程区域内的资源时，他可以访问与路由器 A和B相连的两个局域网。利用 Appletalk区域可以对网络资源进行方便的分组而无须考虑其实际的物理位置。

19.1.2 Appletalk寻址

早期的Appletalk网络被称为第一阶段或非扩展的网络，第一阶段网络的地址空间有限，一个局域网段或广域网段最多拥有 127台主机和127台服务器，每个局域网段或广域网段只能分配一个Appletalk网络号。

第二阶段 Appletalk网络在网络寻址方面要灵活得多。它允许在单个网段中分配多个Appletalk网络号，这意味着一个局域网可以包含多个 Appletalk网络。网段中网络号的范围通常以线缆范围来表示，线缆范围必须唯一且不能与其它线缆范围重叠。图 19-1是一个不正确的线缆范围分配示例，因为其中存在地址冲突，网络 498被分配给了两个以太局域网。图 19-2则是一个正确的线缆范围分配方案，其中没有地址重叠。

设计Appletalk节点地址是为了减少在Macintosh计算机上的配置工作量。当Macintosh计算机加电启动时，它会向在同一网段内的所有路由器发送广播，询问该网段的线缆范围。一旦有某个路由器给出响应，计算机便在线缆范围内选择一个网络号，接着它再选择节点号。在选好节点号后，Macintosh计算机会向网络查询该地址组合（网络.节点）是否已经被使用，如果被使用，它就会继续选择一个新的节点号，直至找到一个未被使用的地址。

如图19-3所示，Appletalk地址长24比特，以“网络.节点”的形式表示。前16位是网络号，后8位是节点号。这说明Appletalk网络号必须小于65 536，而节点号必须小于256，且节点号0和255是保留的（255用于网络广播地址）。因此一个Appletalk网络最多只能有254个节点。

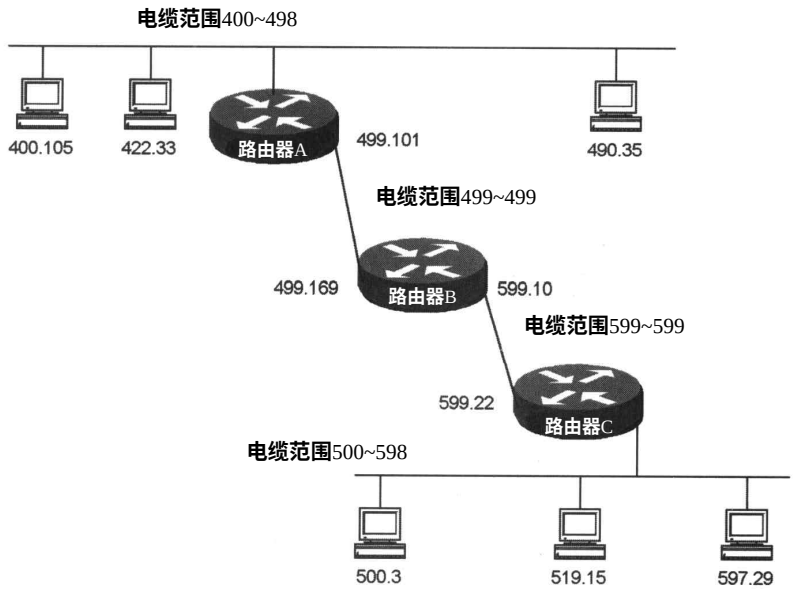

图19-2 正确的Appletalk寻址分配

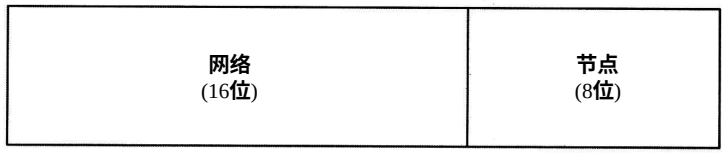

图19-3 Appletalk寻址结构

19.1.3 Appletalk协议栈

图19-4描述了Appletalk协议栈及与OSI协议栈的对应关系。

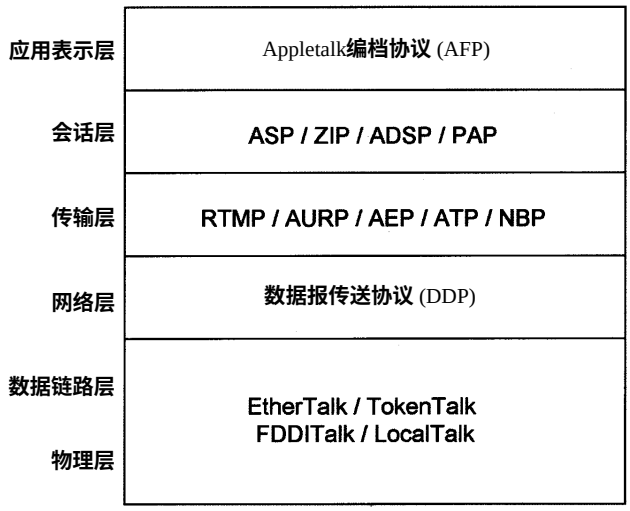

图19-4 Appletalk协议栈及其与OSI栈的对应关系

(1) 物理层和数据链路层

除了广域网连接如帧中继和ISDN支持Appletalk协议外，Appletalk也可以运行在四种主要的局域网平台之上：

- EtherTalk —— 苹果公司的以太网版本
- TokenTalk —— 苹果公司的令牌环网版本
- FDDITalk —— 苹果公司的FDDI版本
- Appletalk —— 苹果公司专有的串行链路方式，速率为230Kbps

(2) 网络层

Appletalk使用数据报传送协议（ DDP）作为其网络层数据传输和路由的包协议。Appletalk是一个可路由协议，因为对应于每个Appletalk节点它都有相应的网络层地址。 DDP是一种无连接的网络协议，图19-5中给出了DDP包头的详细内容。

(3) 传输层

Appletalk传输层中存在几种协议：

- 路由表维护协议（RTMP） —— RTMP是一种距离矢量路由协议，与IP RIP相似，它非常烦琐，每10秒向所有相连的邻居发送路由更新信息。
- Appletalk回波响应协议（AEP） —— AEP是一种简单的协议，生成数据包用于测试网络

节点是否可连通。

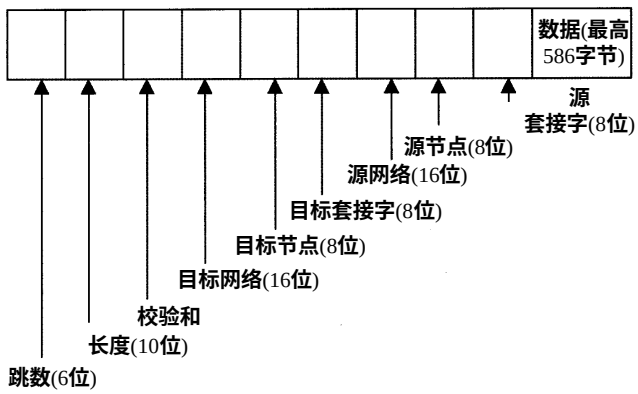

图19-5 DDP包

- Appletalk事务协议（ATP）—— ATP提供Appletalk传输的基于连接的数据传输方式。它与IP网络中的TCP功能相似，也有数据确认、重传、数据包排序、分段和重装。
- NBP —— 命名联编协议（NBP）将一个Appletalk命名与地址关联起来。

(4) 会话层

Appletalk支持多种上层协议：

- Appletalk会话协议（ASP）—— ASP建立和维持Appletalk服务器与客户机之间的会话。
- 区域信息协议（ZIP）—— 区域信息协议维护在区域信息表中网络号与区域名的映射。ZIP使用RTMP路由表来跟踪网络拓扑结构的变化，当 ZIP在路由表中发现原先所没有的项时，便增加一个新的ZIP项。
- Appletalk打印机访问协议（PAP）—— PAP是面向连接的协议，它建立和维护客户机与打印机之间的连接。

(5) 应用层/表示层

Appletalk文件编档协议（AFP）帮助客户机通过网络共享服务器的文件。

19.1.4 Appletalk路由协议

Cisco支持三种Appletalk网络路由协议：

- 路由维护协议(RTMP)—— RTMP是Appletalk网络的缺省路由协议，它是一种距离矢量路由协议，以跳数作为度量单位。 RTMP的更新发布周期为10秒，而不管网络中的路由是否有变化，这种频繁的发布使得在Appletalk网络中产生了大量的路由信息流量。
- AURP —— Appletalk基于更新的路由协议（AURP）与RTMP一样都是距离矢量协议，最大跳数为15跳，它区别于RTMP之处在于它只当网络中的路由有所变化时才发送路由更新信息。 AURP同时是一种隧道协议，可以在 TCP/IP中建立Appletalk隧道，使两个Appletalk网络基于 TCP/IP网络之上进行连接。这样的 TCP/IP连接称为隧道，被Appletalk理解为1跳。连接Appletalk网络和隧道的路由器叫外部路由器。
- EIGRP —— Appletalk EIGRP主要用于Appletalk网络的广域网连接，它与IP/IPX EIGRP一样使用复合度量方式，及相同的DUAL路由算法，只当网络中的路由改变时才发送路由更新信息。与IP/IPX EIGRP不同的是，Appletalk EIGRP中每个路由器必须设置唯一

的自治系统（AS）号。Appletalk EIGRP的特点是对RTMP路由协议进行自动重分配。

19.1.5 Appletalk区域

Appletalk区域与虚拟局域网（VLAN）的概念非常相近，把性质相似的资源分为一组。每个Appletalk网络必须定义为一个或多个区域的成员。Appletalk ZIP拥有一张整个网络内所有区域名称和相应Appletalk网络号的表，某个区域的成员在整个网络内可以很容易的被定位。例如，当一个Appletalk节点像Macintosh计算机需要打印服务时，该过程为：

- Macintosh机向本地路由器发送请求，需要所有区域的清单。
- Macintosh机在区域清单中寻找合适的服务；
- 如果找到所需要的服务，Macintosh机将向该区域内的所有线缆号发送请求；
- 本地路由器把该请求向所选定的区域进行广播；
- 选定区域内的服务提供者将给发送此服务请求的路由器一个响应；
- 发送此服务请求的路由器把响应传递给源节点 Macintosh计算机；
- 于是Macintosh节点可以得到所需的服务。

19.2 本章所讨论的命令

- **access-list** *access-list-number* **[deny|permit] cable-range | zones | additional-zones | other-access**
- **appletalk access-group** *access-list-number*
- **appletalk cable-range** *cable-range* [*network.node*]
- **appletalk distribute list** *access-list-number* **out**
- **appletalk protocol [aurp|eigrp|rmp]**
- **appletalk route-redistribution**
- **appletalk routing [eigrp** *route-number* **]**
- **appletalk zip-reply-filter** *access-list-number*
- **appletalk zone** *zone-name*
- **debug apple zip**
- **ping appletalk** *[network.node]*
- **show appletalk access-lists**
- **show appletalk eigrp interfaces** *[type number]*
- **show appletalk eigrp neighbors** *[interface]*
- **show appletalk eigrp traffic**
- **show appletalk globals**
- **show appletalk interface [brief]** *[type number]*
- **show appletalk neighbors** *[neighbor-address]*
- **show appletalk route** *[network | type number]*
- **show appletalk traffic**
- **show appletalk zone** *[zone-name]*
- **tunnel destination**
- **tunnel source** [*ip-address | type number*]

命令的定义

- access-list: **是一个全局配置命令，它用于定义在路由器对不同的数据、路由、区域和其他**Appletalk**访问列表应采取的行动。**
- appletalk access-group: **该命令用于在接口上配置访问列表。**
- appletalk cable-range: **这是一个接口配置命令，用来定义一个扩展的** Appletalk**网络。**
- appletalk distribute list: **可以用该接口配置命令来过滤路由更新信息。**
- appletalk protocol: **用该接口配置命令来指定在某一接口上运行的路由协议。如果不明确指定，系统默认为使用** RTMP**。**
- appletalk route-redistribution: **该全局配置命令用于实现** RTMP**和**EIGRP**路由之间的重分配。**
- appletalk routing: **该全局配置命令使路由器支持** Appletalk**路由协议，该命令还有一个选项允许激活**EIGRP**路由协议。**
- appletalk zip-reply-filter: **这是一个接口命令，与访问列表一起使用以限制在** Appletalk**网络上可以看到的区域的数目。**
- appletalk zone: **用该接口命令设置**Appletalk**网络的区域名称。**
- debug apple zip: **此调试命令用于打开** Appletalk ZIP**的调试。**
- ping appletalk: **执行该命令可以证实主机是否连通。**
- show appletalk access-lists: **执行该命令以显示路由器上定义的所有** Appletalk**访问列表。**
- show appletalk eigrp interfaces: **该命令显示配置成**EIGRP**路由协议的路由器接口信息。**
- show appletalk eigrp neighbors: **该命令显示所有相邻的**EIGRP**路由器的信息。**
- show appletalk globals: **该命令显示路由器上是如何配置** Appletalk**的。**
- show appletalk interface: **该命令显示路由器上所有运行** Appletalk**的接口状态。**
- show appletalk neighbors: **该命令显示运行**Appletalk**的直连接路由器信息。**
- show appletalk route: **该命令显示** Appletalk**路由表的所有项。**
- show appletalk traffic: **该命令显示路由器上通过的** Appletalk**流量信息。**
- show appletalk zone: **用该命令可以列出** Appletalk ZIP**表的内容。**
- tunnel destination: **使用该接口配置命令设置** Appletalk**隧道的目标**IP**地址。**
- tunnel source: **使用该接口配置命令设置** Appletalk**隧道的源接口。**

19.3 IOS需求

本章实验中使用的是IOS 11.1**版。**

19.4 实验73：基本Appletalk配置

19.4.1 所需设备

为完成本实验需要下列设备：

1) **三台**Cisco**路由器，其中一台有两个串口，另外两台路由器各有一个串口和一个以太网口；**

2) 两条Cisco DTE/DCE交叉电缆，如果没有可用的交叉电缆，可以将标准的 Cisco DTE电缆与标准的Cisco DCE电缆相连接做成一条交叉电缆；

3) 用于连接控制台端口和路由器的扁平电缆；

4) 支持Appletalk协议的Cisco IOS映像。

19.4.2 配置概述

本实验将演示Appletalk协议的基本配置和监测。实验中将建立一个三节点的 Appletalk网络，使用RTMP动态路由协议来获取网络中的所有路由。

三台路由器的连接方法如图 19-6所示，路由器B作为DCE设备为路由器A和C提供时钟信号。

注意 有时对Appletalk路由参数的修改需要路由器进行重启，在重启路由器之前务必保存所作的配置。

图19-6 基本Appletalk连接

19.4.3 路由器配置

本实验中三台路由器的配置情况如下 (Appletalk命令以粗体高亮显示)：

1. 路由器A

```
Current configuration:
!
version 11.1
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterA
!
appletalk routing←Enable Appletalk routing on this router
!
interface Ethernet0/0
 no ip address
 no keepalive
 appletalk cable-range 400-499 410.1←Define a cable range for this interface
                                     and an address of 410.1
 appletalk zone accounting←Define the primary Appletalk zone to be accounting
 appletalk zone service←Define the secondary Appletalk zone to be service
!
interface Serial0/0
 no ip address
 encapsulation ppp
 appletalk cable-range 600-600 600.1←Define a cable range for this interface
                                     and an address of 600.1
 appletalk zone wan1←Define the primary Appletalk zone to be wan1
!
no ip classless
logging buffered
!
```

```
line con 0
line aux 0
line vty 0 4
 login
!
end
```

2. 路由器B

```
Current configuration:
!
version 11.1
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterB
!
enable password cisco
!
appletalk routing←Enable Appletalk routing on this router
!
interface Serial0/0
 no ip address
 encapsulation ppp
 appletalk cable-range 600-600 600.2←Define a cable range for this interface
                                     and an address of 600.2
 appletalk zone wan1←Define the Appletalk zone to be wan1
 no fair-queue
!
interface Serial0/1
 no ip address
 encapsulation ppp
 appletalk cable-range 700-700 700.1←Define a cable range for this interface
                                     and an address of 700.1
 appletalk zone wan2←Define the Appletalk zone to be wan2
 clockrate 64000←Provide clocking to neighbor router
!
no ip classless
logging buffered
!
line con 0
line aux 0
line vty 0 4
 password cisco
 login
!
end
```

3. 路由器C

```
Current configuration:
!
version 11.1
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterC
!
!
appletalk routing←Enable Appletalk routing on this router
!
interface Ethernet0/0
 no ip address
 no keepalive
 appletalk cable-range 500-599 599.1←Define a cable range for this interface
                                     and an address of 599.1
 appletalk zone sales←Define the primary Appletalk zone to be sales
 appletalk zone service←Define the secondary Appletalk zone to be service
!
```

```
interface Serial0/0
 no ip address
 encapsulation ppp
 appletalk cable-range 700-700 700.2←Define a cable range for this interface
                                     and an address of 700.2.
 appletalk zone wan2←Define the primary Appletalk zone to be wan2
 no fair-queue
!
no ip classless
logging buffered
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

19.4.4 监测配置

连接到路由器A，执行show appletalk route命令以显示该路由器的Appletalk路由表，可以发现该路由器中有两个直接相连的 Appletalk网络：与接口e0/0相连的网络400-499和与S0/0相连的网络600-600。通过Appletalk RTMP路由协议，路由器A发现了另外两个网络，分别为与路由器C的接口E0/0相连的网络500-599和网络600-600（即路由器B和路由器C之间的串行链路）。在Appletalk路由表中还给出了与各网络相关联的区域。

```
RouterA#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static  P - proxy
4 routes in internet

The first zone listed for each entry is its default (primary) zone.

C Net 400-499 directly connected, Ethernet0/0, zone accounting
                Additional zones: 'service'
R Net 500-599 [2/G] via 600.2, 8 sec, Serial0/0, zone sales
                Additional zones: 'service'
C Net 600-600 directly connected, Serial0/0, zone wan1
R Net 700-700 [1/G] via 600.2, 8 sec, Serial0/0, zone wan2
```

利用show appletalk zone命令可以显示网络中的所有区域。注意区域“服务”同时存在于路由器A和路由器C上。

```
RouterA#show appletalk zone
Name                 Network(s)
wan1                 600-600
wan2                 700-700
accounting           400-499
service              500-599 400-499←This zone exists on two different
                                     Appletalk networks
sales                500-599
Total of 5 zones
```

另外一个有用的命令是show appletalk globals，该命令可以提供整个Appletalk网络的概要信息。从下面的输出我们可以知道：网络中共有四个路由、五个区域。 RTMP路由协议每10秒发送路由更新信息，20秒后将路由标识为无效，60秒后清除。

```
RouterA#show appletalk globals
Appletalk global information:
  Internet is incompatible with older, AT Phase1, routers.
  There are 4 routes in the internet.
  There are 5 zones defined.
```

```
Logging of significant Appletalk events is disabled.
ZIP resends queries every 10 seconds.
RTMP updates are sent every 10 seconds.
RTMP entries are considered BAD after 20 seconds.
RTMP entries are discarded after 60 seconds.
AARP probe retransmit count: 10, interval: 200 msec.
AARP request retransmit count: 5, interval: 1000 msec.
DDP datagrams will be checksummed.
RTMP datagrams will be strictly checked.
RTMP routes may not be propagated without zones.
Routes will not be distributed between routing protocols.
Routing between local devices on an interface will not be performed.
IPTalk uses the udp base port of 768 (Default).
Appletalk EIGRP is not enabled.
Alternate node address format will not be displayed.
Access control of any networks of a zone hides the zone.
```

show appletalk traffic**命令显示路由器接收/发送的**Appletalk**信息流量大小，其流量统计信息是根据具体**Appletalk**协议来分别统计的，如路由协议、** Appletalk**回波响应协议（与**IP ping**相似）及**ZIP**协议等。**

```
RouterA#show appletalk traffic
Appletalk statistics:
  Rcvd:      74 total, 0 checksum errors, 0 bad hop count
       74 local destination, 0 access denied
       0 for MacIP, 0 bad MacIP, 0 no client
       7 port disabled, 0 no listener
       0 ignored, 0 martians
  Bcast:     0 received, 143 sent
  Sent:      145 generated, 0 forwarded, 0 fast forwarded, 0 loopback
       0 forwarded from MacIP, 0 MacIP failures
       0 encapsulation failed, 0 no route, 0 no source
  DDP: 74 long, 0 short, 0 macip, 0 bad size
  NBP: 15 received, 0 invalid, 0 proxies
          0 replies sent, 20 forwards, 15 lookups, 0 failures
  RTMP:      60 received, 0 requests, 0 invalid, 0 ignored
       127 sent, 0 replies
  AURP:      0 Open Requests, 0 Router Downs
       0 Routing Information sent, 0 Routing Information received
       0 Zone Information sent, 0 Zone Information received
       0 Get Zone Nets sent, 0 Get Zone Nets received
       0 Get Domain Zone List sent, 0 Get Domain Zone List received
       0 bad sequence
  ATP: 0 received
  ZIP: 9 received, 8 sent, 0 netinfo
Appletalk statistics:
  Echo:      0 received, 0 discarded, 0 illegal
       0 generated, 0 replies sent
  Responder: 0 received, 0 illegal, 0 unknown
          0 replies sent, 0 failures
  AARP:      0 requests, 0 replies, 0 probes
       0 martians, 0 bad encapsulation, 0 unknown
       10 sent, 0 failures, 0 delays, 0 drops
  Lost:      0 no buffers
  Unknown: 0 packets
  Discarded: 0 wrong encapsulation, 0 bad SNAP discriminator
```

需要注意的是，show interface e 0/0**命令并不给出明确的**Appletalk**信息，它只显示接口的**MAC**地址及高级输入/输出流量信息。**

```
RouterA#show interface e 0/0←There is no Appletalk specific information shown
                              in this commands output
Ethernet0/0 is up, line protocol is up
  Hardware is AmdP2, address is 00e0.1e5b.0d21 (bia 00e0.1e5b.0d21)
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec, rely 164/255, load 1/255
  Encapsulation ARPA, loopback not set, keepalive not set
```

```
ARP type: ARPA, ARP Timeout 04:00:00
Last input never, output 00:00:06, output hang never
Last clearing of "show interface" counters never
Queueing strategy: fifo
Output queue 0/40, 0 drops; input queue 0/75, 0 drops
5 minute input rate 0 bits/sec, 0 packets/sec
5 minute output rate 0 bits/sec, 0 packets/sec
   0 packets input, 0 bytes, 0 no buffer
   Received 0 broadcasts, 0 runts, 0 giants
   0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
   0 input packets with dribble condition detected
   77 packets output, 7574 bytes, 0 underruns
   77 output errors, 0 collisions, 3 interface resets
   0 babbles, 0 late collision, 0 deferred
   77 lost carrier, 0 no carrier
   0 output buffer failures, 0 output buffers swapped out
```

为了查看某接口具体的Appletalk信息，需要使用show appletalk interface命令。如在路由器A的端口e0/0上输入show appletalk interface e 0/0，就可以得到Appletalk接口的重复信息，包括接口的线缆范围、接口地址和区域信息等。

```
RouterA#show appletalk interface e 0/0
Ethernet0/0 is up, line protocol is up
  Appletalk cable range is 400-499←Network cable range information
  Appletalk address is 410.1, Valid←Interface address information
  Appletalk primary zone is "accounting"←Primary zone
  Appletalk additional zones: "service"←Secondary zone
  Appletalk address gleaning is disabled
  Appletalk route cache is enabled
```

关于运行Appletalk的串口的信息同样也可以利用两个命令来得到。 show interface s 0/0列出接口的总体信息。该接口正在运行 Appletalk的唯一表示是atalkcp LCP已被打开。这种状态作为PPP协商过程的一部分而产生，并告诉我们在该串行链路上可以传输 Appletalk流量。

```
RouterA#show interface s 0/0
Serial0/0 is up, line protocol is up
  Hardware is QUICC Serial
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation PPP, loopback not set, keepalive set (10 sec)
  LCP Open

Appletalk control protocol has been negotiated and open
                ↓
  Open: atalkcp, cdp
  Last input 00:00:02, output 00:00:02, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/64/0 (size/threshold/drops)
     Conversations  0/1 (active/max active)
     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
     185 packets input, 7207 bytes, 0 no buffer
     Received 185 broadcasts, 0 runts, 0 giants
     5 input errors, 0 CRC, 5 frame, 0 overrun, 0 ignored, 0 abort
     185 packets output, 6968 bytes, 0 underruns
     0 output errors, 0 collisions, 14 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
     DCD=up  DSR=up  DTR=up  RTS=up  CTS=up
```

串口上具体的Appletalk信息可以由命令show appletalk interface s 0/0得知。与在以太网接口的情况一样，它将给出该路由器串口的 Appletalk具体信息。

```
RouterA#show appletalk interface s 0/0
Serial0/0 is up, line protocol is up
  Appletalk cable range is 600-600
  Appletalk address is 600.1, Valid
  Appletalk zone is "wan1"
  Appletalk port configuration verified by 600.2
  Appletalk address gleaning is not supported by hardware
  Appletalk route cache is enabled
```

使用show appletalk neighbors命令可以证实你正与合适的邻居相连。如在路由器 A上运行该命令可以得知与你相连的邻居 Appletalk地址为600.2，也就是路由器B的s0/0接口。

```
RouterA#show appletalk neighbors
Appletalk neighbors:
  600.2          Serial0/0, uptime 00:08:10, 0 secs
            Neighbor is reachable as a RTMP peer
```

Appletalk支持ping命令以测试网络的连通性。如为确认路由器 C的s0/0口处于正常工作状态，可以输入命令ping appletalk 700.2。该命令将会向路由器C上Appletalk地址为700.2的节点发送回应请求。本例中ping应当成功，如下所示。

```
RouterA#ping appletalk 700.2

Type escape sequence to abort.
Sending 5, 100-byte Appletalk Echoes to 700.2, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/56/60 ms
```

确认路由器C的Ethernet接口也是可达的。用ping appletalk 599.1命令证明接口是激活的。

```
RouterA#ping appletalk 599.1

Type escape sequence to abort.
Sending 5, 100-byte Appletalk Echoes to 599.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/58/60 ms
```

在Appletalk网络中唯一的网络连通性 /可达性辅助测试工具就是 ping命令。如果试着远程登录路由器C上Appletalk地址为599.1的节点，将不会成功的，因为 telnet是一个TCP/IP应用。网络访问和 SNMP对于成功实施一个网络来说是至关重要的，而 TCP/IP是这些功能的关键因素，因此应当总在网络中运行 TCP/IP协议。

```
RouterA#telnet 599.1
% Unknown command or computer name, or unable to find computer address
```

接着连接到路由器B，检查其Appletalk状态。输入show appletalk route命令以显示该路由器的Appletalk路由表，可以发现该路由器有两个直接相连的 Appletalk网络：网络600~600（与路由器A串行连接）和网络 700~700（与路由器C串行连接）。通过Appletalk RTMP路由协议，路由器B发现了另外两个网络，分别为网络 400~499（与路由器 A的以太网口相连）和网络500~599（与路由器C的以太网口相连）。

```
RouterB#sh appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static  P - proxy
4 routes in internet

The first zone listed for each entry is its default (primary) zone.
R Net 400-499 [1/G] via 600.1, 9 sec, Serial0/0, zone accounting
              Additional zones: 'service'
R Net 500-599 [1/G] via 700.2, 7 sec, Serial0/1, zone sales
```

```
                Additional zones: 'service'
C Net 600-600 directly connected, Serial0/0, zone wan1
C Net 700-700 directly connected, Serial0/1, zone wan2
```

运行show appletalk zone命令显示区域表，它与在路由器A的区域表一样。假设没有设置区域过滤的话，则在网络中的所有路由器上显示的区域表都是完全相同的。

```
RouterB#show appletalk zone
Name                                    Network(s)
wan1                                    600-600
wan2                                    700-700
accounting                              400-499
service                                 400-499 500-599
sales                                   500-599
Total of 5 zones
```

最后连接至路由器C。用show appletalk route命令查看其Appletalk路由表，可以发现该路由器有两个直接相连的Appletalk网络，一个是网络500~599（路由器C的以太网接口），另一个是网络700-700（路由器C与路由器A的串行连接）。

```
RouterC#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static  P - proxy
4 routes in internet

The first zone listed for each entry is its default (primary) zone.

R Net 400-499 [2/G] via 700.1, 3 sec, Serial0/0, zone accounting
                Additional zones: 'service'
C Net 500-599 directly connected, Ethernet0/0, zone sales
                Additional zones: 'service'
R Net 600-600 [1/G] via 700.1, 3 sec, Serial0/0, zone wan1
C Net 700-700 directly connected, Serial0/0, zone wan2
```

路由器C的区域表信息与路由器A的区域表信息是完全一致的。

```
RouterC#show appletalk zone
Name                                    Network(s)
wan1                                    600-600
wan2                                    700-700
accounting                              400-499
service                                 400-499 500-599
sales                                   500-599
Total of 5 zones
```

利用ping命令证实路由器C与路由器A是连通的，处于正常工作状态。

```
RouterC#ping appletalk 410.1

Type escape sequence to abort.
Sending 5, 100-byte Appletalk Echoes to 410.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/58/60 ms
```

19.5 实验74：Appletalk EIGRP配置

19.5.1 所需设备

为完成本实验需要下列设备：

- 三台Cisco路由器，其中一台有两个串口，另外两台路由器各有一个串口和一个以太网口；

- 两根Cisco DTE/DCE交叉电缆。如果没有可用的交叉电缆，可以将标准的 Cisco DTE电缆与标准的Cisco DCE电缆相连接做成一条交叉电缆；
- Cisco路由器控制台端口扁平电缆；
- 支持Appletalk协议的Cisco IOS映像。

19.5.2 配置概述

本实验将讨论Appletalk EIGRP。与IP EIGRP一样，Appletalk EIGRP相对Appletalk RTMP有许多优点，如更少的传输开销及快速会聚等。如图 19-7所示，三台路由器中的每一台将配置为在所测试的广域网部分使用 Appletalk EIGRP，而路由器A和路由器C的以太网接口仍运行RTMP。Appletalk 能够在RTMP和EIGRP之间进行自动路由重分配。

注意 有时对Appletalk路由参数的修改需要路由器进行重启，在重启路由器之前务必保存所作的配置。

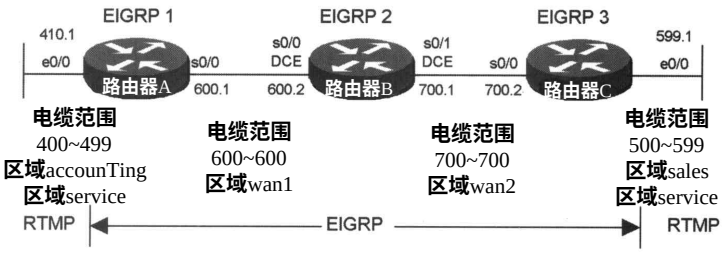

图19-7 Appletalk EIGRP

三台路由器的连接如图19-7所示，路由器B作为DCE设备为路由器A和C提供时钟信号。

注意 每台运行Appletalk EIGRP的路由器都必须拥有一个唯一的EIGRP处理号，这是与IP EIGRP所不同的，在IP EIGRP中，所有路由器必须使用相同的EIGRP处理号。

19.5.3 路由器配置

本实验中三台路由器的配置情况如下 (主要Appletalk命令以粗体高亮显示)：

1. 路由器A

```
Current configuration:
!
version 11.1
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterA
!
appletalk routing eigrp 1←Enable EIGRP Routing. Each Appletalk router must
                          have a different EIGRP process number
appletalk route-redistribution←This command is automatically added when
                               Appletalk EIGRP is enabled
!
interface Ethernet0/0
 no ip address
 no keepalive
 appletalk cable-range 400-499 410.1←Define a cable range for this interface
                                     and an address of 410.1
```

```
 appletalk zone accounting←Define the primary Appletalk zone to be accounting
 appletalk zone service←Define the secondary Appletalk zone to be service
!
interface Serial0/0
 no ip address
 encapsulation ppp
 appletalk cable-range 600-600 600.1←Define a cable range for this interface
                                     and an address of 600.1

 appletalk zone wan1←Define the primary Appletalk zone to be wan1
 appletalk protocol eigrp←Enable EIGRP on this interface
 no appletalk protocol rtmp←Disable RTMP on this interface
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

2. 路由器B

```
Current configuration:
!
version 11.1
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterB
!
enable password cisco
!
appletalk routing eigrp 2←Enable EIGRP Routing. Each Appletalk router must
                          have a different EIGRP process number
appletalk route-redistribution←This command is automatically added when
                               Appletalk EIGRP is enabled
!
interface Serial0/0
 no ip address
 encapsulation ppp
 appletalk cable-range 600-600 600.2←Define a cable range for this interface
                                     and an address of 600.1
 appletalk zone wan1←Define the primary Appletalk zone to be wan1
 appletalk protocol eigrp←Enable EIGRP on this interface
 no appletalk protocol rtmp←Disable RTMP on this interface
 no fair-queue
 clockrate 64000←Provide clocking to neighbor router
!
interface Serial0/1
 no ip address
 encapsulation ppp
 appletalk cable-range 700-700 700.1←Define a cable range for this interface
                                     and an address of 700.1
 appletalk zone wan2←Define the primary Appletalk zone to be wan2
 appletalk protocol eigrp←Enable EIGRP on this interface
 no appletalk protocol rtmp←Disable RTMP on this interface
 clockrate 64000←Provide clocking to neighbor router
!
no ip classless
logging buffered
!
line con 0
line aux 0
line vty 0 4
 password cisco
 login
!
end
```

3. 路由器C

```
Current configuration:
!
version 11.1
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterC
!
!
appletalk routing eigrp 3←Enable EIGRP Routing. Each Appletalk router must
                          have a different EIGRP process number
appletalk route-redistribution←This command is automatically added when
                               Appletalk EIGRP is enabled
!
interface Ethernet0/0
 no ip address
 no keepalive
 appletalk cable-range 500-599 599.1←Define a cable range for this interface
                                     and an address of 599.1

 appletalk zone sales←Define the primary Appletalk zone to be sales
 appletalk zone service←Define the primary Appletalk zone to be service
!
interface Serial0/0
no ip address
encapsulation ppp
appletalk cable-range 700-700 700.2←Define a cable range for this interface
                                    and an address of 700.2

 appletalk zone wan2←Define the primary Appletalk zone to be wan2
 appletalk protocol eigrp←Enable EIGRP on this interface
 no appletalk protocol rtmp←Disable RTMP on this interface
 no fair-queue
!
no ip classless
logging buffered
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

19.5.4 监测配置

连接到路由器A，执行show appletalk route命令以显示该路由器的Appletalk路由表，可以发现该路由器有两个直接相连的 Appletalk网络并通过EIGRP路由协议发现了另外两个网络。对照前面的实验可知，通过EIGRP发现的这两个网络也即前面通过RTMP路由协议所发现的网络。

```
RouterA#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static  P - proxy
4 routes in internet

The first zone listed for each entry is its default (primary) zone.

C Net 400-499 directly connected, Ethernet0/0, zone accounting
              Additional zones: 'service'
E Net 500-599 [2/G] via 600.2, 2153 sec, Serial0/0, zone sales
              Additional zones: 'service'
```

```
C Net 600-600 directly connected, Serial0/0, zone wan1
E Net 700-700 [1/G] via 600.2, 2200 sec, Serial0/0, zone wan2
```

验证路由器A与路由器C的以太网接口是否处于连通状态，可以输入命令 ping appletalk 599.1，其结果显示应当为100%成功，说明整个网络状态正常。

```
RouterA#ping appletalk 599.1

Type escape sequence to abort.
Sending 5, 100-byte Appletalk Echoes to 599.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/56/56 ms
```

有几个重要的EIGRP命令值得注意。利用show appletalk eigrp interface命令可以显示路由器A上所有运行EIGRP的接口。在路由器A中，只有串口s0/0是运行EIGRP，而以太网口e0/0仍然运行Appletalk RTMP路由协议。

```
RouterA#show appletalk eigrp interface
AT/EIGRP Neighbors for process 1, router id 1

                    Xmit Queue     Mean     Pacing Time     Multicast    Pending
Interface    Peers  Un/Reliable    SRTT     Un/Reliable     Flow Timer   Routes
Se0/0          1        0/0          21         0/10            98          0
```

用show appletalk eigrp neighbor命令可以显示路由器A当前所有相邻的EIGRP路由器，路由器B（Appletalk地址600.2）是路由器A唯一的EIGRP邻居。

```
RouterA#show appletalk eigrp neighbor
AT/EIGRP Neighbors for process 1, router id 1
H    Address                  Interface    Hold Uptime    SRTT    RTO  Q  Seq
                                           (sec)          (ms)        Cnt Num
0    600.2                    Se0/0          14 00:37:29  21    200  0    8
```

show appletalk eigrp traffic命令显示通过路由器接收/发送的EIGRP信息流量大小。从路由器A的输出信息来看，目前它正在传送的是 EIGRP Hello信息。

```
RouterA#show appletalk eigrp traffic
AT-EIGRP Traffic Statistics
  Hellos sent/received: 499/488
  Updates sent/received: 6/4
  Queries sent/received: 0/2
  Replies sent/received: 2/0
  Acks sent/received: 5/6
  Input queue high water mark 1, 0 drops
```

查看某一特定接口正在运行EIGRP协议的另一种方法是使用show appletalk interface命令。在路由器A上输入show appletalk interface s 0/0，从输出结果可以得知该接口目前正在运行EIGRP路由协议。

```
RouterA#show appletalk interface s 0/0
Serial0/0 is up, line protocol is up
  Appletalk cable range is 600-600
  Appletalk address is 600.1, Valid
  Appletalk zone is "wan1"
  Routing protocols enabled: EIGRP
  Appletalk port configuration verified by 600.2
  Appletalk address gleaning is not supported by hardware
  Appletalk route cache is enabled
```

接着连接到路由器B。利用show appletalk route命令，从该路由器的Appletalk路由表可以得知，它有两个直接相连的 Appletalk网络并通过EIGRP路由协议发现了另外两个网络，但路

由器B上没有通过RTMP协议发现的路由。

```
RouterB#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static  P - proxy
4 routes in internet

The first zone listed for each entry is its default (primary) zone.

E Net 400-499 [1/G] via 600.1, 2299 sec, Serial0/0, zone accounting
              Additional zones: 'service'
E Net 500-599 [1/G] via 700.2, 2240 sec, Serial0/1, zone sales
              Additional zones: 'service'
C Net 600-600 directly connected, Serial0/0, zone wan1
C Net 700-700 directly connected, Serial0/1, zone wan2
```

执行show appletalk interface命令可以证实路由器B的两个串口运行的都是EIGRP协议。

```
RouterB#show appletalk interface s 0/0
Serial0/0 is up, line protocol is up
  Appletalk cable range is 600-600
  Appletalk address is 600.2, Valid
  Appletalk zone is "wan1"
  Routing protocols enabled: EIGRP
  Appletalk port configuration verified by 600.1
  Appletalk address gleaning is not supported by hardware
  Appletalk route cache is enabled


RouterB#show appletalk interface s 0/1
Serial0/1 is up, line protocol is up
  Appletalk cable range is 700-700
  Appletalk address is 700.1, Valid
  Appletalk zone is "wan2"
  Routing protocols enabled: EIGRP
  Appletalk port configuration verified by 700.2
  Appletalk address gleaning is not supported by hardware
  Appletalk route cache is enabled
```

路由器B两个串口的EIGRP路由状态信息也可以通过show appletalk eigrp interface命令来得知。

```
RouterB#show appletalk eigrp interface
AT/EIGRP Neighbors for process 1, router id 2

                    Xmit Queue     Mean     Pacing Time     Multicast    Pending
Interface    Peers  Un/Reliable    SRTT     Un/Reliable     Flow Timer   Routes
Se0/0            1        0/0      285          0/10           1418          0
Se0/1            1        0/0       28          0/10             50          0
```

show appletalk eigrp neighbor命令显示路由器B相邻的EIGRP路由器，其中邻居700.2是路由器C的串口，而邻居600.1则是路由器A的串口。

```
RouterB#show appletalk eigrp neighbor
AT/EIGRP Neighbors for process 1, router id 2
H    Address                 Interface    Hold Uptime    SRTT    RTO  Q  Seq
                                           (sec)          (ms)       Cnt Num
1    700.2                   Se0/1          14 00:37:41    28    200  0  2
0    600.1                   Se0/0          12 00:38:39   285   1710  0  8
```

最后连接至路由器C。用show appletalk route命令查看其Appletalk路由表，可看出该路由器通过EIGRP路由协议发现了两个Appletalk网络。

```
RouterC#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static  P - proxy
4 routes in internet
```

```
The first zone listed for each entry is its default (primary) zone.

E Net 400-499 [2/G] via 700.1, 2299 sec, Serial0/0, zone accounting
               Additional zones: 'service'
C Net 500-599 directly connected, Ethernet0/0, zone sales
               Additional zones: 'service'
E Net 600-600 [1/G] via 700.1, 2299 sec, Serial0/0, zone wan1
C Net 700-700 directly connected, Serial0/0, zone wan2
```

利用show appletalk eigrp interface命令可以显示路由器C上所有运行EIGRP的接口。在路由器C中，只有串口s0/0运行EIGRP。

```
RouterC#show appletalk eigrp interface
AT/EIGRP Neighbors for process 1, router id 3

                    Xmit Queue     Mean     Pacing Time     Multicast     Pending
Interface    Peers  Un/Reliable    SRTT     Un/Reliable     Flow Timer    Routes
Se0/0          1        0/0          24         0/10            50           0
```

用show appletalk eigrp neighbor命令可以显示与路由器C相邻的EIGRP路由器。路由器B（Appletalk地址700.1）是路由器C唯一的EIGRP邻居。

```
RouterC#show appletalk eigrp neighbor
AT/EIGRP Neighbors for process 1, router id 3
H    Address                  Interface    Hold Uptime    SRTT    RTO  Q  Seq
                                           (sec)   (ms)        Cnt  Num
0    700.1                    Se0/0          13 00:38:46    24    200  0   7
```

我们可以看看如果两个邻居路由器使用同一个 Appletalk EIGRP处理号将会发生什么样的情况。连接至路由器B，进入路由器配置模式，输入命令 appletalk routing eigrp 3。

```
RouterB#config term
Enter configuration commands, one per line. End with CNTL/Z.
RouterB(config)#appletalk routing eigrp 3
RouterB(config)#exit
RouterB#
```

在输入下面的命令后，路由器 B和路由器C将拥有相同的EIGRP处理号。将会看到下面的显示结果，路由器B提示路由器C（Appletalk地址700.2）与自己的路由器ID号相同。

```
%AT-5-COMPATERR4: Appletalk EIGRP neighbor incompatibility; 700.2 has same route
r ID (3)
%AT-5-COMPATERR4: Appletalk EIGRP neighbor incompatibility; 700.2 has same route
r ID (3)
%AT-5-COMPATERR4: Appletalk EIGRP neighbor incompatibility; 700.2 has same route
r ID (3)
%AT-5-COMPATERR4: Appletalk EIGRP neighbor incompatibility; 700.2 has same route
r ID (3)
%AT-5-COMPATERR4: Appletalk EIGRP neighbor incompatibility; 700.2 has same route
r ID (3)

RouterB#config term
Enter configuration commands, one per line. End with CNTL/Z.
RouterB(config)#appletalk routing eigrp 2
RouterB(config)#exit
```

19.6 实验75：Appletalk GRE隧道

19.6.1 所需设备

为完成本实验需要下列设备：

1) 三台Cisco路由器，其中一台有两个串口，另外两台路由器各有一个串口和一个以太网口；

2) 两根Cisco DTE/DCE交叉电缆，如果没有可用的交叉电缆，可以将标准的 Cisco DTE电缆与标准的Cisco DCE电缆相连接做成一根交叉电缆；

3) 控制台端口连接Cisco的扁平电缆；

4) 支持Appletalk协议的Cisco IOS映像。

19.6.2 配置概述

本实验讨论如何配置Appletalk GRE隧道。Cisco设备允许在两个末端路由器节点上运行Appletalk协议栈，连接Appletalk末端节点的路由器运行GRE隧道，在IP包中建立Appletalk信息流隧道。

图19-8是本实验的一个逻辑示意图。就 Appletalk而言，路由器 A和路由器 C是通过网络600直接连接的，隧道使得中间路由器（路由器 B）对于两个 Appletalk末端路由器（路由器 A和C）来说是不可见的。

三台路由器的连接方式如图 19-9所示。路由器 A和路由器 C在各自的接口上同时运行Appletalk和IP，路由器B只配置了IP协议，它作为DCE设备为路由器A和C提供时钟信号。

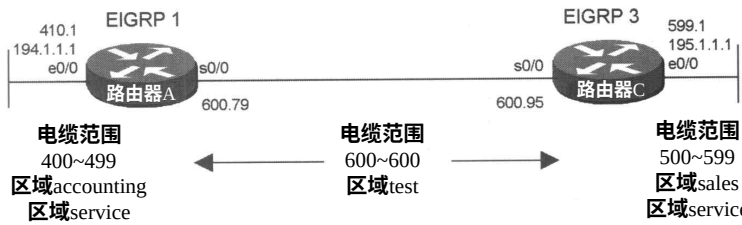

图19-8 Appletalk GRE/IP隧道逻辑示意图

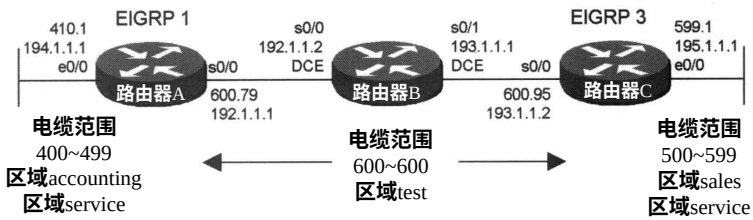

图19-9 Appletalk GRE/IP隧道

注意 注意路由器B只运行TCP/IP，没有Appletalk路由协议。路由器A和路由器C上的所有Appletalk流量都被封装成TCP/IP的格式。另外，有时对Appletalk路由参数的修改需要路由器进行重启，在重启路由器之前务必保存所作的配置。

19.6.3 路由器配置

本实验中三台路由器的配置情况如下 (主要Appletalk命令以粗体高亮显示)：

1. 路由器A

```
Current configuration:
!
version 11.1
no service udp-small-servers
no service tcp-small-servers
!
```

```
hostname RouterA
!
appletalk routing eigrp 1←Enable EIGRP Routing. Each Appletalk router must
                          have a different EIGRP process number
appletalk route-redistribution←This command is automatically added when
                               Appletalk EIGRP is enabled
!
interface Tunnel1
 no ip address
 appletalk cable-range 600-600 600.79←Define a cable range for this interface
                                      and an address of 600.79

 appletalk zone test←Define the primary Appletalk zone to be tested
 appletalk protocol eigrp←Enable EIGRP on this interface
 tunnel source Ethernet0/0←Define a tunnel source interface
 tunnel destination 195.1.1.1←Define a tunnel destination address
!
interface Ethernet0/0
 ip address 194.1.1.1 255.255.255.0
 no keepalive
 appletalk cable-range 400-499 410.1←Define a cable range for this interface
                                     and an address of 410.1

 appletalk zone accounting←Define the primary Appletalk zone to be accounting
 appletalk zone service←Define the secondary Appletalk zone to be service
!
interface Serial0/0
 ip address 192.1.1.1 255.255.255.0
 encapsulation ppp
!
router rip
 network 192.1.1.0
 network 194.1.1.0
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

2. 路由器B

```
Current configuration:
!
version 11.1
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterB
!
enable password cisco
!
interface Serial0/0
 ip address 192.1.1.2 255.255.255.0
 encapsulation ppp
 no fair-queue
 clockrate 64000←Provide clocking to neighbor router
!
interface Serial0/1
 ip address 193.1.1.1 255.255.255.0
 encapsulation ppp
 clockrate 64000←Provide clocking to neighbor router
!
router rip
 network 193.1.1.0
 network 192.1.1.0
```

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

3. 路由器C

```
Current configuration:
!
version 11.1
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterC
!
!
appletalk routing eigrp 3←Enable EIGRP Routing. Each Appletalk router must
                          have a different EIGRP process number
appletalk route-redistribution←This command is automatically added when
                               Appletalk EIGRP is enabled
!
interface Tunnel1
 no ip address
 appletalk cable-range 600-600 600.95←Define a cable range for this interface
                                      and an address of 600.95
 appletalk zone test←Define the primary Appletalk zone to be tested
 appletalk protocol eigrp←Enable EIGRP on this interface
 tunnel source Ethernet0/0←Define a tunnel source interface
 tunnel destination 194.1.1.1←Define a tunnel destination address
!
interface Ethernet0/0
 ip address 195.1.1.1 255.255.255.0
 no keepalive
 appletalk cable-range 500-599 599.1←Define a cable range for this interface
                                     and an address of 599.1
 appletalk zone sales←Define the primary Appletalk zone to be sales
 appletalk zone service←Define the secondary Appletalk zone to be service
!
interface Serial0/0
 ip address 193.1.1.2 255.255.255.0
 encapsulation ppp
 no fair-queue
!
router rip
 network 193.1.1.0
 network 195.1.1.0
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

19.6.4 监测配置

连接到路由器A，执行show appletalk route命令以显示该路由器的Appletalk路由表。注意到Appletalk网络中共计有三条路由。在路由器 A和路由器C之间的隧道被视为一个单独的Appletalk网络。在前面的两个实验中当我们没有设置隧道接口之前，一共有四条路由。另外，隧道中运行的是EIGRP路由协议，路由器C上的网络500~599是通过EIGRP路由协议发现的。

```
RouterA#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static  P - proxy
3 routes in internet

The first zone listed for each entry is its default (primary) zone.

C Net 400-499 directly connected, Ethernet0/0, zone accounting
              Additional zones: 'service'
E Net 500-599 [1/G] via 600.95, 523 sec, Tunnel1, zone sales
              Additional zones: 'service'
C Net 600-600 directly connected, Tunnel1, zone test
```

用show appletalk zone命令显示网络中的所有区域，我们看到隧道区域被显示为网络600~600的区域“ test ”。

```
RouterA#show appletalk zone
Name                                    Network(s)
test                                    600-600
accounting                              400-499
service                                 500-599 400-499
sales                                   500-599
Total of 4 zones
```

路由器A的EIGRP接口信息可以通过show appletalk eigrp interface命令来得知。可以看出路由器A只有一个激活的EIGRP接口，即隧道接口。

```
RouterA#show appletalk eigrp interface
AT/EIGRP Neighbors for process 1, router id 1

                    Xmit Queue     Mean     Pacing Time     Multicast    Pending
Interface    Peers  Un/Reliable    SRTT     Un/Reliable     Flow Timer   Routes
Tu1              1        0/0       436        58/1100           3212        0
```

验证网络端到端的连通状态可以输入命令 ping appletalk 599.1，它将发送ping数据包到路由器C的以太网口，其结果显示应当为 100%成功。

```
RouterA#ping appletalk 599.1

Type escape sequence to abort.
Sending 5, 100-byte Appletalk Echoes to 599.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 72/72/72 ms
```

隧道接口的状态可以用命令show interface tunnel1命令来查看，该命令将显示通过隧道的流量大小、隧道的源端和目的端，以及隧道协议和传输方式（分别为 GRE和IP）。

```
RouterA#show interface tunnel1
Tunnel1 is up, line protocol is up
  Hardware is Tunnel
  MTU 1500 bytes, BW 9 Kbit, DLY 500000 usec, rely 255/255, load 1/255
  Encapsulation TUNNEL, loopback not set, keepalive set (10 sec)
  Tunnel source 194.1.1.1 (Ethernet0/0), destination 195.1.1.1
  Tunnel protocol/transport GRE/IP, key disabled, sequencing disabled
  Checksumming of packets disabled,  fast tunneling enabled
  Last input 00:00:00, output 00:00:04, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/0, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     250 packets input, 14254 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     5298 packets output, 284287 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
```

由于在路由器A和路由器C的以太网口之间建立的是IP隧道，在路由器A的串口上将不会运行Appletalk协议。这可以通过show appletalk interface s 0/0命令来证实，输出结果如下所示。

```
RouterA#show appletalk interface s 0/0
Serial0/0 is up, line protocol is up
  Appletalk protocol processing disabled
```

执行show appletalk interface e 0/0命令可以证实路由器A的以太网接口运行的是Appletalk协议。

```
RouterA#show appletalk interface e 0/0
Ethernet0/0 is up, line protocol is up
  Appletalk cable range is 400-499
  Appletalk address is 410.1, Valid
  Appletalk primary zone is "accounting"
  Appletalk additional zones: "service"
  Appletalk address gleaning is disabled
  Appletalk route cache is enabled
```

连接路由器B，它没有一个接口运行Appletalk协议。从路由器A到路由器C的隧道只是以路由器B作为一个TCP/IP传输节点使用。利用show appletalk global，show appletalk route和show appletalk zone等命令都可以证实路由器B的所有节点都没有运行Appletalk协议。

```
RouterB#show appletalk global
% Appletalk not running


RouterB#show appletalk route
% Appletalk not running


RouterB#show appletalk zone
% Appletalk not running
```

在路由器B上执行show ip route命令显示其IP路由表，可以发现该路由器有两个直接相连的网络并通过RIP路由协议发现了另外两个网络。本实验中所有路由器都开启了IP协议，IP路由表说明整个网络，从路由器A的以太网口（194.1.1.1）到路由器C的以太网口（195.1.1.1），都是连通的。

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

     192.1.1.0/24 is variably subnetted, 2 subnets, 2 masks
C       192.1.1.0/24 is directly connected, Serial0/0
C       192.1.1.1/32 is directly connected, Serial0/0
     193.1.1.0/24 is variably subnetted, 2 subnets, 2 masks
C       193.1.1.0/24 is directly connected, Serial0/1
C       193.1.1.2/32 is directly connected, Serial0/1
R    194.1.1.0/24 [120/1] via 192.1.1.1, 00:00:24, Serial0/0
R    195.1.1.0/24 [120/1] via 193.1.1.2, 00:00:13, Serial0/1
```

最后连接至路由器C，用ping appletalk 410.1命令可以证实从路由器C能够到达路由器A。

```
RouterC#ping appletalk 410.1

Type escape sequence to abort.
Sending 5, 100-byte Appletalk Echoes to 410.1, timeout is 2 seconds:
```

```
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 72/83/108 ms
```

执行show appletalk route命令以显示该路由器的Appletalk路由表。与在路由器A上看到的情况一样，整个Appletalk网络中只有三条路由。

```
RouterC#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static   P - proxy
3 routes in internet

The first zone listed for each entry is its default (primary) zone.

E Net 400-499 [1/G] via 600.79, 652 sec, Tunnel1, zone accounting
              Additional zones: 'service'
C Net 500-599 directly connected, Ethernet0/0, zone sales
              Additional zones: 'service'
C Net 600-600 directly connected, Tunnel1, zone test
```

执行show appletalk zone命令所显示的网络中的Appletalk区域与在路由器A的结果是相同的，而且如果没有设置区域过滤的话， Appletalk网络中任意路由器的区域列表都应当是完全一致的。

```
RouterC#show appletalk zone
Name                                    Network(s)
test                                    600-600
accounting                              400-499
service                                 400-499 500-599
sales                                   500-599
Total of 4 zones
```

show appletalk interface s 0/0命令说明路由器C的串口上没有运行Appletalk路由协议，Appletalk流量在离开路由器C的以太网口之后立即被输送到IP隧道中。

```
RouterC#show appletalk interface s 0/0
Serial0/0 is up, line protocol is up
  Appletalk protocol processing disabled
```

执行show appletalk interface e 0/0命令可以证实路由器C的以太网口运行的是Appletalk协议。

```
RouterC#show appletalk interface e 0/0
Ethernet0/0 is up, line protocol is up
  Appletalk cable range is 500-599
  Appletalk address is 599.1, Valid
  Appletalk primary zone is "sales"
  Appletalk additional zones: "service"
  Appletalk address gleaning is disabled
  Appletalk route cache is enabled
```

路由器C上IP隧道的状态信息可以用命令show interface tunnel1命令来查看。隧道应处于正常工作状态。值得注意的是输出中描述隧道源端和目的端的方式。

```
RouterC#show interface tunnel1
Tunnel1 is up, line protocol is up
  Hardware is Tunnel
  MTU 1500 bytes, BW 9 Kbit, DLY 500000 usec, rely 255/255, load 1/255
  Encapsulation TUNNEL, loopback not set, keepalive set (10 sec)
  Tunnel source 195.1.1.1 (Ethernet0/0), destination 194.1.1.1
  Tunnel protocol/transport GRE/IP, key disabled, sequencing disabled
  Checksumming of packets disabled,  fast tunneling enabled
  Last input 00:00:01, output 00:00:00, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/0, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
```

```
5 minute output rate 0 bits/sec, 0 packets/sec
   250 packets input, 14459 bytes, 0 no buffer
   Received 0 broadcasts, 0 runts, 0 giants
   0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
   5386 packets output, 289355 bytes, 0 underruns
   0 output errors, 0 collisions, 0 interface resets
   0 output buffer failures, 0 output buffers swapped out
```

19.7 实验76：Appletalk 流量和区域过滤

19.7.1 所需设备

为完成本实验需要下列设备：

1) **三台**Cisco**路由器，其中一台有两个串口，另外两台路由器各有一个串口和一个以太网口；**

2) **两根**Cisco DTE/DCE**交叉电缆，如果没有可用的交叉电缆，可以将标准的** Cisco DTE**电缆与标准的**Cisco DCE**电缆相连接做成一根交叉电缆；**

3) **用于控制台端口连接路由器的** Cisco**扁平电缆；**

4) **支持**Appletalk**协议的**Cisco IOS**映像。**

19.7.2 配置概述

本实验研究几种类型的 Appletalk**过滤：**

1) Appletalk**区域过滤 —— 区域过滤是某些区域不在路由器的区域列表中出现。**

2) Appletalk**数据包过滤 —— 这类过滤阻止数据流量到达指定的** Appletalk**节点。**

3) Appletalk**路由过滤 —— 它使路由器不发送** Appletalk**路由更新信息。**

三台路由器的连接方式如图 19-10**所示，路由器** B**作为** DCE**设备为路由器** A**和** C**提供时钟信号。**

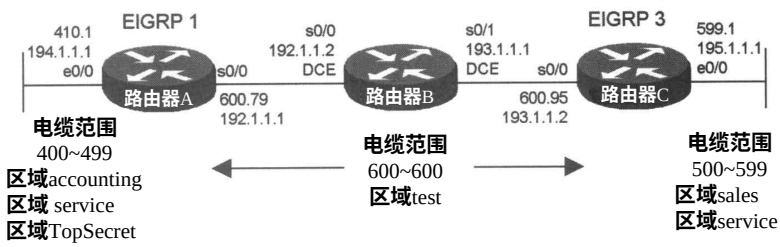

图19-10 Appletalk过滤

19.7.3 路由器配置

本实验中三台路由器的配置情况如下 (主要 Appletalk**命令以粗体高亮显示)：**

1. 路由器A

```
Current configuration:
!
version 11.1
no service udp-small-servers
no service tcp-small-servers
!
```

```
hostname RouterA
!
appletalk routing eigrp 1←Enable EIGRP Routing. Each Appletalk router must
                          have a different EIGRP process number
appletalk route-redistribution←This command is automatically added when
                               Appletalk EIGRP is enabled
!
interface Tunnel1
 no ip address
 appletalk cable-range 600-600 600.79←Define a cable range for this interface
                                      and an address of 600.79
 appletalk zone test←Define the primary Appletalk zone to be tested
 appletalk protocol eigrp←Enable EIGRP on this interface
 tunnel source Ethernet0/0←Define a tunnel source interface
 tunnel destination 195.1.1.1←Define a tunnel destination address
!
interface Ethernet0/0
 ip address 194.1.1.1 255.255.255.0
 no keepalive
 appletalk cable-range 400-499 410.1←Define a cable range for this interface
                                     and an address of 410.1
 appletalk zone accounting←Define the primary Appletalk zone to be accounting
 appletalk zone service←Define the secondary Appletalk zone to be service
 appletalk zone TopSecret←Define the secondary Appletalk zone to be TopSecret
!
interface Serial0/0
 ip address 192.1.1.1 255.255.255.0
 encapsulation ppp
!
router rip
 network 192.1.1.0
 network 194.1.1.0
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

2. 路由器B

```
Current configuration:
!
version 11.1
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterB
!
enable password cisco
!
interface Serial0/0
 ip address 192.1.1.2 255.255.255.0
 encapsulation ppp
 no fair-queue
 clockrate 64000←Provide clocking to neighbor router
!
interface Serial0/1
 ip address 193.1.1.1 255.255.255.0
 encapsulation ppp
 clockrate 64000←Provide clocking to neighbor router
!
router rip
 network 193.1.1.0
 network 192.1.1.0
!
line con 0
```

```
line aux 0
line vty 0 4
 password cisco
 login
!
end
```

3. 路由器C

```
Current configuration:
!
version 11.1
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterC
!
!
appletalk routing eigrp 3←Enable EIGRP Routing. Each Appletalk router must
                          have a different EIGRP process number
appletalk route-redistribution←This command is automatically added when
                               Appletalk EIGRP is enabled
!
interface Tunnel1
 no ip address
 appletalk cable-range 600-600 600.95←Define a cable range for this interface
                                      and an address of 600.95
 appletalk zone test←Define the primary Appletalk zone to be test
 appletalk protocol eigrp←Enable EIGRP on this interface
 tunnel source Ethernet0/0←Define a tunnel source interface
 tunnel destination 194.1.1.1←Define a tunnel destination address
!
interface Ethernet0/0
 ip address 195.1.1.1 255.255.255.0
 no keepalive
 appletalk cable-range 500-599 599.1←Define a cable range for this interface
                                     and an address of 599.1
 appletalk zone sales←Define the primary Appletalk zone to be sales
 appletalk zone service←Define the secondary Appletalk zone to be service
!
interface Serial0/0
 ip address 193.1.1.2 255.255.255.0
 encapsulation ppp
 no fair-queue
!
router rip
 network 193.1.1.0
 network 195.1.1.0
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

19.7.4 监测配置

连接路由器A，执行show appletalk route命令以显示该路由器的路由表。可以发现路由器A有两个直接相连的网络并通过EIGRP路由协议发现了一个网络。

```
RouterA#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static  P - proxy
3 routes in internet

The first zone listed for each entry is its default (primary) zone.
```

```
C Net 400-499 directly connected, Ethernet0/0, zone accounting
              Additional zones: 'TopSecret','service'
E Net 500-599 [1/G] via 600.95, 1958 sec, Tunnel1, zone sales
              Additional zones: 'service'
C Net 600-600 directly connected, Tunnel1, zone test
```

执行show appletalk zone**命令显示网络中所有的**Appletalk**区域。**

```
RouterA#show appletalk zone
Name                                    Network(s)
TopSecret                               400-499
test                                    600-600
accounting                              400-499
service                                 500-599 400-499
sales                                   500-599
Total of 5 zones
```

连接至路由器C**，用**show appletalk route**命令查看其路由表。可以看到网络** 400~499**在路由表中。**

```
RouterC#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static  P - proxy
3 routes in internet

The first zone listed for each entry is its default (primary) zone.

E Net 400-499 [1/G] via 600.79, 2010 sec, Tunnel1, zone accounting
              Additional zones: 'service','TopSecret'
C Net 500-599 directly connected, Ethernet0/0, zone sales
              Additional zones: 'service'
C Net 600-600 directly connected, Tunnel1, zone test
```

在路由器C**上执行**show appletalk zone**命令，路由器**C**上的区域列表应与路由器**A**上的区域列表相匹配。事实也如此。路由器**C**和路由器**A**的，区域表中都列出了五个区域。**

```
RouterC#show appletalk zone
Name                                    Network(s)
TopSecret                               400-499
test                                    600-600
accounting                              400-499
service                                 400-499 500-599
sales                                   500-599
Total of 5 zones
```

如果还没有保存路由器C**的配置，那么现在就用** write mem**命令保存配置。**

重新连接至路由器 A**，在重启路由器**C**的同时监视路由器** A**上**Appletalk ZIP**协议的运行，将看到路由器**C**在重新启动时是如何向路由器** A**发送查询区域列表请求的。用** debug apple zip **命令进入**Appletalk ZIP**调试，同时确认与路由器**A**的控制台端口相连。如果设备没有与路由器的控制台端口相连，则需用** term mon**命令将所有调试结果发送到屏幕显示。**

```
RouterA#debug apple zip
Appletalk ZIP Packets debugging is on
```

与路由器A**连接好后，关掉路由器**C**的电源并重新加电。当路由器**C**启动和装载完**IOS**后，将会在路由器**A**上看到如下调试输出：**

```
1  AT: Recvd ZIP cmd 5 from 600.95-6
2  AT: Answering ZIP GetNetInfo rcvd from 600.95 via Tunnel1
3  AT: Sent GetNetInfo reply to 600.95 via Tunnel1
4  AT: Recvd ZIP cmd 1 from 600.95-6
5  AT: 1 networks in ZIPquery pkt from 600.95
6  AT: Sent ZIP answer with 3 nets to 600.95
7  AT: NextNbrZipQuery: [500-599] zoneupdate 0 gw: 600.95 n: 600.95
8  AT: NextNbrZipQuery: r->rpath.gwptr: 606BA174, n: 606BA174
```

```
9  AT: maint_SendNeighborQueries, sending 1 queries to 600.95
10 AT: 1 query packet sent to neighbor 600.95
11 AT: Recvd ZIP cmd 2 from 600.95-6
12 AT: 2 zones in ZIPreply pkt, src 600.95
13 AT: net 500, zonelen 5, name sales
14 AT: net 500, zonelen 7, name service
15 AT: in CancelZoneRequest, cancelling req on 500-599...succeeded
16 AT: atZip_GC() called.
```

上面调试输出的第1行说明路由器A收到路由器C的ZIP请求（600.95是路由器C的隧道接口的Appletalk地址）。第2行表明该请求信息为ZIP GetNetInfo请求。第6行（AT: Sent ZIP answer with 3 nets to 600.95）表示路由器A发送给路由器C关于三个Appletalk网络的区域信息。第10行的内容为路由器A向路由器C上的Appletalk地址600.95发送ZIP查询包。第12行为路由器C给路由器A发回一个ZIP响应，其中有两个区域的信息。第13行和第14行分别为路由器C发给路由器A的有关两个区域（区域“sales”和区域“service”）的信息。

可以再连接到路由器C上用show appletalk zone命令验证区域表信息，其中在与路由器A相连的网络400~499上定义了三个区域（TopSecret，accounting和service），它们就是路由器A向路由器C发送的ZIP响应中所包含的三个区域。

```
RouterC#show appletalk zone
Name                                    Network(s)
TopSecret                               400-499
test                                    600-600
accounting                              400-499
service                                 500-599 400-499
sales                                   500-599
Total of 5 zones
```

下面我们再连接到路由器A，在路由器A上增加区域访问列表。该访问列表使得路由器A不向外发送关于区域TopSecret的区域响应包。

用config term命令进入路由器A的配置模式。输入如下全局access-list命令，接着进入tunnel1接口配置模式，输入appletalk zip-reply-filter 600语句。

```
RouterA#config term
Enter configuration commands, one per line. End with CNTL/Z.
RouterA(config)#access-list 600 deny zone TopSecret
RouterA(config)#access-list 600 permit additional-zones
RouterA(config)#access-list 600 permit other-access
RouterA(config)#int tunnel1
RouterA(config-if)#appletalk zip-reply-filter 600
RouterA(config-if)#exit
RouterA(config)#exit
RouterA#
```

使用命令show apple access 600可以看到刚才在路由器A上输入的访问列表。

```
RouterA#sh apple access 600
Appletalk access list 600:
  deny zone TopSecret
  permit additional-zones
  permit other-access
```

路由器A现在有一个限制任何从参考区域TopSecret的隧道接口发出的任意ZIP应答包。先用show debug命令证实调试功能已被开启。

```
RouterA#sh debug
Appletalk:
  Appletalk ZIP Packets debugging is on
```

现在ZIP访问列表在路由器A上，关掉路由器C的电源并重新加电。在路由器C的重启动过

程中，监视路由器A的调试情况，将会看到如下调试输出：

```
RouterA#

1  AT: Recvd ZIP cmd 5 from 600.95-6
2  AT: Answering ZIP GetNetInfo rcvd from 600.95 via Tunnel1
3  AT: Sent GetNetInfo reply to 600.95 via Tunnel1
4  AT: Recvd ZIP cmd 1 from 600.95-6
5  AT: 1 networks in ZIPquery pkt from 600.95
6  AT: Sent ZIP answer with 2 nets to 600.95
7  AT: NextNbrZipQuery: [500-599] zoneupdate 0 gw: 600.95 n: 600.95
8  AT: NextNbrZipQuery: r->rpath.gwptr: 606BA174, n: 606BA174
9  AT: maint_SendNeighborQueries, sending 1 queries to 600.95
10 AT: 1 query packet sent to neighbor 600.95
11 AT: Recvd ZIP cmd 2 from 600.95-6
12 AT: 2 zones in ZIPreply pkt, src 600.95
13 AT: net 500, zonelen 5, name sales
14 AT: net 500, zonelen 7, name service
15 AT: in CancelZoneRequest, cancelling req on 500-599.succeeded
16 AT: atzip_GC() called
```

其中第1、第2两行为路由器C发送给路由器A的ZIP GetNetInfo查询请求，第6行中显示路由器A的响应中只包括两个网络区域信息，而前面的实验中没有 ZIP响应过滤，路由器 A的响应中包含了三个网络区域信息。

在路由器A上执行show appletalk zone命令，所有区域都是可见的。

```
RouterA#show appletalk zone
Name                                    Network(s)
TopSecret                               400-499
test                                    600-600
accounting                              400-499
service                                 500-599 400-499
sales                                   500-599
Total of 5 zones
```

连接到路由器C并用show appletalk zone命令显示区域列表，在路由器 A上可以看到5个区域，而在路由器 C上只能看到 4个区域。对比二者的区域列表可知，路由器 C中没有区域TopSecret，这是由于在路由器A上所加的ZIP响应过滤使它不发送关于该区域信息的缘故。

```
RouterC#show appletalk zone
Name                                    Network(s)
test                                    600-600
accounting                              400-499
service                                 500-599 400-499
sales                                   500-599
Total of 4 zones
```

在路由器C上ping路由器A上的以太网口Appletalk地址410.1，结果应当成功。尽管存在区域过滤，使得区域列表中没有与网络 410相关联的区域信息，但 Appletalk网络400~499与路由器C仍然是连通的。

```
RouterC#ping apple 410.1

Type escape sequence to abort.
Sending 5, 100-byte Appletalk Echoes to 410.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 72/72/72 ms
```

现在再在路由器A上增加Appletalk数据包过滤，限制流向与区域 TopSecret对应的网络的所有数据流。如下所示，在路由器 A的配置中还是定义了访问列表600。

```
access-list 600 deny zone TopSecret
access-list 600 permit additional-zones
access-list 600 permit other-access
```

用config term命令进入路由器 A的配置模式，接着进入 tunnel1的接口配置模式，输入appletalk access-group 600命令。该命令将访问列表600应用为路由器A上的数据包过滤。任何从具有与区域TopSecret相关的Appletalk源地址的路由器A的tunnel 1接口发出的数据流都将被丢弃。

```
RouterA#config term
Enter configuration commands, one per line. End with CNTL/Z.
RouterA(config)#
RouterA(config)#interface tunnel1
RouterA(config-if)#appletalk access-group 600
RouterA(config-if)#exit
RouterA(config)#exit
```

现在再连接到路由器 C上ping路由器A的 Appletalk地址410.1节点，结果将不成功，这是由于在路由器A所设置的数据包过滤的缘故。

```
RouterC#ping 410.1

Type escape sequence to abort.
Sending 5, 100-byte Appletalk Echoes to 410.1, timeout is 2 seconds:
.....
Success rate is 0 percent (0/5)
```

重新连接至路由器A，进入路由器接口配置模式，用 no appletalk access-group 600命令取消先前设置的数据包过滤。

```
RouterA#config term
Enter configuration commands, one per line. End with CNTL/Z.
RouterA(config)#int tunnel 1
RouterA(config-if)#no appletalk access-group 600
RouterA(config-if)#exit
RouterA(config)#exit
```

这时再连接到路由器C上ping路由器A的 Appletalk地址410.1节点，结果成功。

```
RouterC#ping 410.1

Type escape sequence to abort.
Sending 5, 100-byte Appletalk Echoes to 410.1, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 72/72/72 ms
```

下面尝试在路由器A上增加输出路由表更新过滤。路由表更新过滤将控制路由器 A向路由器C发送哪些路由。首先将路由器 A与路由器C之间的路由协议从EIGRP改为RTMP。RTMP每10秒发送路由更新信息，使得更容易观察实验中的工作情况。

在路由器A上增加访问列表并关闭EIGRP路由协议，但这时并不激活访问列表。

```
RouterA#config term
Enter configuration commands, one per line. End with CNTL/Z.
RouterA(config)#access-list 601 deny cable-range 400-499
RouterA(config)#access-list 601 deny other-access
RouterC(config)#int tunnel1
RouterC(config-if)#no appletalk protocol eigrp
RouterC(config-if)#exit
RouterA(config)#exit
```

刚才在路由器A上配置的访问列表可以使用命令 show apple access 601进行查看。

```
RouterA#sh apple access 601
Appletalk access list 601:
  deny cable-range 400-499
  deny other-access
```

进入路由器C的配置模式，取消tunnel1接口所运行的EIGRP路由协议。

```
RouterC#config term
Enter configuration commands, one per line. End with CNTL/Z.
RouterC(config)#int tunnel1
RouterC(config-if)#no appletalk protocol eigrp
RouterC(config-if)#exit
RouterC(config)#exit
```

再连接至路由器A，用show appletalk route命令查看其路由表。可以看到路由表中网络500~599是通过RTMP协议发现的，而不是EIGRP。RTMP的更新周期为10秒。下面的输出告诉我们从路由器C发送过来的最后一个RTMP更新包是9秒钟前接收到的。

```
RouterA#sh appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static  P - proxy
3 routes in internet

The first zone listed for each entry is its default (primary) zone.

C Net 400-499 directly connected, Ethernet0/0, zone accounting
              Additional zones: 'TopSecret','service'
R Net 500-599 [1/G] via 600.95, 9 sec, Tunnel1, zone sales
              Additional zones: 'service'
C Net 600-600 directly connected, Tunnel1, zone test
```

多执行几次show appletalk route命令，就可以观察到RTMP的10秒计数器每10秒钟清零一次，这说明路由器A正在接收路由器C的RTMP更新包。

```
RouterA#sh appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static  P - proxy
3 routes in internet

The first zone listed for each entry is its default (primary) zone.

C Net 400-499 directly connected, Ethernet0/0, zone accounting
              Additional zones: 'TopSecret','service'
R Net 500-599 [1/G] via 600.95, 2 sec, Tunnel1, zone sales
              Additional zones: 'service'
C Net 600-600 directly connected, Tunnel1, zone test
```

在路由器C上，同样可以证实路由器C通过RTMP协议发现路由器A，且RTMP的更新周期为10秒。执行show appletalk route命令显示路由器C的路由表。下面的输出说明从路由器A发送过来的最后一个RTMP更新包是9秒钟前接收到的。

```
RouterC#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static  P - proxy
3 routes in internet

The first zone listed for each entry is its default (primary) zone.

R Net 400-499 [1/G] via 600.79, 9 sec, Tunnel1, zone accounting
              Additional zones: 'service','TopSecret'
C Net 500-599 directly connected, Ethernet0/0, zone sales
              Additional zones: 'service'
C Net 600-600 directly connected, Tunnel1, zone test
```

多执行几次show appletalk route命令，就可以观察到RTMP的C0秒计数器每10秒钟清零一次，这说明路由器C正在接收来自路由器A的RTMP更新包。

```
RouterC#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
```

```
        S - static   P - proxy
3 routes in internet

The first zone listed for each entry is its default (primary) zone.

R Net 400-499 [1/G] via 600.79, 0 sec, Tunnel1, zone accounting
                Additional zones: 'service','TopSecret'
C Net 500-599 directly connected, Ethernet0/0, zone sales
                Additional zones: 'service'
C Net 600-600 directly connected, Tunnel1, zone test
```

回到路由器A激活路由表更新访问列表。用 config term**命令进入路由器A的配置模式、在** tunnel1**的接口配置模式中输入** appletalk distribute-list 601 out**命令。**

```
RouterA#config term
Enter configuration commands, one per line. End with CNTL/Z.
RouterA(config)#int tunnel1
RouterA(config-if)#appletalk distribute-list 601 out
RouterA(config-if)#exit
RouterA(config)#exit
```

在路由器C上多执行几次 show appletalk route**命令，很快就会发现路由器A已经不再向路由器C发送**RTMP**更新包了。从下面的输出显示可以看出路由器C接收的最后一个来自路由器A的**RTMP**包是**15**秒钟以前发送的。**

```
RouterC#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static   P - proxy
3 routes in internet

The first zone listed for each entry is its default (primary) zone.

R Net 400-499 [1/G] via 600.79, 15 sec, Tunnel1, zone accounting
                Additional zones: 'service','TopSecret'
C Net 500-599 directly connected, Ethernet0/0, zone sales
                Additional zones: 'service'
C Net 600-600 directly connected, Tunnel1, zone test
```

而下面的输出则说明来自路由器A的最后一个RTMP**包是**76**秒以前发送的。**

```
RouterC#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static   P - proxy
3 routes in internet

The first zone listed for each entry is its default (primary) zone.

R Net 400-499 [31/B] via 600.79, 76 sec, zone accounting
                Additional zones: 'service','TopSecret'
C Net 500-599 directly connected, Ethernet0/0, zone sales
                Additional zones: 'service'
C Net 600-600 directly connected, Tunnel1, zone test
```

路由器C到路由器A的RTMP**路由最后将从路由表中删除掉。如下所示，在路由表中不再有路由该路由表中只有直接与路由器C相连的两个网络。**

```
RouterC#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static   P - proxy
2 routes in internet

The first zone listed for each entry is its default (primary) zone.

C Net 500-599 directly connected, Ethernet0/0, zone sales
                Additional zones: 'service'
C Net 600-600 directly connected, Tunnel1, zone test
```

重新连接至路由器A并取消其上的路由表更新访问列表。先用config term命令进入路由器A的配置模式，然后在tunnel1的接口配置模式中输入no appletalk distribute-list 601 out命令。

```
RouterA#config term
Enter configuration commands, one per line. End with CNTL/Z.
RouterA(config)#int tunnel1
RouterA(config-if)#no appletalk distribute-list 601 out
RouterA(config-if)#exit
RouterA(config)#exit
```

这时再回到路由器C用show appletalk route命令查看其路由表。可以看到其路由表中再次出现通过RTMP协议找到的网络400-499。

```
RouterC#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static  P - proxy
3 routes in internet

The first zone listed for each entry is its default (primary) zone.

R Net 400-499 [1/G] via 600.79, 9 sec, Tunnel1, zone accounting
                Additional zones: 'service','TopSecret'
C Net 500-599 directly connected, Ethernet0/0, zone sales
                Additional zones: 'service'
C Net 600-600 directly connected, Tunnel1, zone test
```

过几秒钟之后执行show appletalk route命令，可以观察到RTMP的计数器又每10秒钟清零一次。

```
RouterC#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static  P - proxy
3 routes in internet

The first zone listed for each entry is its default (primary) zone.

R Net 400-499 [1/G] via 600.79, 0 sec, Tunnel1, zone accounting
                Additional zones: 'service','TopSecret'
C Net 500-599 directly connected, Ethernet0/0, zone sales
                Additional zones: 'service'
C Net 600-600 directly connected, Tunnel1, zone test
```

19.8 Appletalk监测与故障查找

本节将讨论主要的Appletalk监测和故障排除命令。

show appletalk route 该命令显示Appletalk路由表的内容。在下面的例子中可以看出，路由器A有两个直接相连的Appletalk网络：网络400-499（与以太网口e0/0连接）和网络600-600（与串口s0/0连接）。通过Appletalk RTMP路由协议，该路由器发现了另外两个网络，分别为网络500-599和网络700-700。Appletalk路由表还列出了与每个网络相关联的区域。

```
RouterA#show appletalk route
Codes: R - RTMP derived, E - EIGRP derived, C - connected, A - AURP
       S - static  P - proxy
4 routes in internet

The first zone listed for each entry is its default (primary) zone.

C Net 400-499 directly connected, Ethernet0/0, zone accounting
                Additional zones: 'service'
R Net 500-599 [2/G] via 600.2, 8 sec, Serial0/0, zone sales
                Additional zones: 'service'
C Net 600-600 directly connected, Serial0/0, zone wan1
```

```
R Net 700-700 [1/G] via 600.2, 8 sec, Serial0/0, zone wan2
```

show appletalk zone 用该命令可以列出网络中的所有区域。注意下面的显示中区域“service”在两个不同的Appletalk网络上存在。

```
RouterA#show appletalk zone
Name                                    Network(s)
wan1                                    600-600
wan2                                    700-700
accounting                              400-499
service                                 500-599 400-499←This zone exists on
                                                        two different Appleta
                                                        networks
sales                                   500-599
Total of 5 zones
```

show appletalk globals 该命令提供整个Appletalk网络的概要信息。在下例显示中提供的信息包括：网络中共计有四条路由和五个区域，RTMP路由协议每10秒发送更新包，20秒后将路由标记为无效路由，60秒后清除该路由信息。

```
RouterA#show appletalk globals
Appletalk global information:
  Internet is incompatible with older, AT Phase1, routers.
  There are 4 routes in the internet.
  There are 5 zones defined.
  Logging of significant Appletalk events is disabled.
  ZIP resends queries every 10 seconds.
  RTMP updates are sent every 10 seconds.
  RTMP entries are considered BAD after 20 seconds.
  RTMP entries are discarded after 60 seconds.
  AARP probe retransmit count: 10, interval: 200 msec.
  AARP request retransmit count: 5, interval: 1000 msec.
  DDP datagrams will be checksummed.
  RTMP datagrams will be strictly checked.
  RTMP routes may not be propagated without zones.
  Routes will not be distributed between routing protocols.
  Routing between local devices on an interface will not be performed.
  IPTalk uses the udp base port of 768 (Default).
  Appletalk EIGRP is not enabled.
  Alternate node address format will not be displayed.
  Access control of any networks of a zone hides the zone.
```

show appletalk access 该命令显示路由器上定义的所有Appletalk访问列表。如果该命令中带有具体的访问列表号，则只提供这一条访问列表的内容。

```
RouterA#sh appletalk access
Appletalk access list 600:
  deny zone TopSecret
  permit additional-zones
  permit other-access
Appletalk access list 601:
  deny cable-range 400-499
  deny other-access

RouterA#sh apple access 600
Appletalk access list 600:
  deny zone TopSecret
  permit additional-zones
  permit other-access
```

show appletalk traffic 该命令显示路由器接收/发送的Appletalk流量信息。流量信息是根据具体Appletalk协议来分别统计的，如路由协议、Appletalk响应协议及ZIP协议等。

```
RouterA#show appletalk traffic
Appletalk statistics:
```

```
    Rcvd: 74 total, 0 checksum errors, 0 bad hop count
          74 local destination, 0 access denied
          0 for MacIP, 0 bad MacIP, 0 no client
          7 port disabled, 0 no listener
          0 ignored, 0 martians
    Bcast: 0 received, 143 sent
    Sent: 145 generated, 0 forwarded, 0 fast forwarded, 0 loopback
           0 forwarded from MacIP, 0 MacIP failures
           0 encapsulation failed, 0 no route, 0 no source
    DDP: 74 long, 0 short, 0 macip, 0 bad size
    NBP: 15 received, 0 invalid, 0 proxies
          0 replies sent, 20 forwards, 15 lookups, 0 failures
    RTMP: 60 received, 0 requests, 0 invalid, 0 ignored
          127 sent, 0 replies
    AURP:    0 Open Requests, 0 Router Downs
             0 Routing Information sent, 0 Routing Information received
             0 Zone Information sent, 0 Zone Information received
             0 Get Zone Nets sent, 0 Get Zone Nets received
             0 Get Domain Zone List sent, 0 Get Domain Zone List received
             0 bad sequence
    ATP: 0 received
    ZIP: 9 received, 8 sent, 0 netinfo
  Appletalk statistics:
    Echo:     0 received, 0 discarded, 0 illegal
              0 generated, 0 replies sent
    Responder: 0 received, 0 illegal, 0 unknown
          0 replies sent, 0 failures
    AARP:     0 requests, 0 replies, 0 probes
              0 martians, 0 bad encapsulation, 0 unknown
              10 sent, 0 failures, 0 delays, 0 drops
    Lost: 0 no buffers
    Unknown: 0 packets
    Discarded: 0 wrong encapsulation, 0 bad SNAP discriminator
```

show interface　**标准的**show interface**命令并不提供明确的**Appletalk**信息。下例中的**show interface e 0/0**命令只显示了该端口的**MAC**地址和一些高层输入/输出流量信息。**

```
RouterA#show interface e 0/0←There is no Appletalk specific information sho
                             in this command's output
Ethernet0/0 is up, line protocol is up
  Hardware is AmdP2, address is 00e0.1e5b.0d21 (bia 00e0.1e5b.0d21)
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec, rely 164/255, load 1/255
  Encapsulation ARPA, loopback not set, keepalive not set
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output 00:00:06, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     0 packets input, 0 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 input packets with dribble condition detected
     77 packets output, 7574 bytes, 0 underruns
     77 output errors, 0 collisions, 3 interface resets
     0 babbles, 0 late collision, 0 deferred
     77 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
```

show appletalk interface　**用该命令可以得到路由器上某接口与** Appletalk**相关的信息。它能够提供一些重要的信息，如接口的电缆范围、接口地址和区域信息。**

```
RouterA#show appletalk interface e 0/0
Ethernet0/0 is up, line protocol is up
  Appletalk cable range is 400-499←Network cable range information
```

```
  Appletalk address is 410.1, Valid←Interface address information
  Appletalk primary zone is "accounting"←Primary zone
  Appletalk additional zones: "service"←Secondary zone
  Appletalk address gleaning is disabled
  Appletalk route cache is enabled
```

关于运行Appletalk的串口的信息同样也可以利用两个命令来得到。show interface命令列出接口的总体信息。说明该接口与运行Appletalk的唯一提示是atalkcp LCP已被开启。这种情况是PPP协商过程的一部分表明在该串行链路上可以传输Appletalk流量。

```
RouterA#show interface s 0/0
Serial0/0 is up, line protocol is up
  Hardware is QUICC Serial
  MTU 1500 bytes, BW 1544 Kbit, DLY 20000 usec, rely 255/255, load 1/255
  Encapsulation PPP, loopback not set, keepalive set (10 sec)
  LCP Open

Appletalk control protocol has been negotiated and open
          ↓
  Open: atalkcp, cdp
  Last input 00:00:02, output 00:00:02, output hang never
  Last clearing of "show interface" counters never
  Input queue: 0/75/0 (size/max/drops); Total output drops: 0
  Queueing strategy: weighted fair
  Output queue: 0/64/0 (size/threshold/drops)
     Conversations  0/1 (active/max active)
     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
     185 packets input, 7207 bytes, 0 no buffer
     Received 185 broadcasts, 0 runts, 0 giants
     5 input errors, 0 CRC, 5 frame, 0 overrun, 0 ignored, 0 abort
     185 packets output, 6968 bytes, 0 underruns
     0 output errors, 0 collisions, 14 interface resets
     0 output buffer failures, 0 output buffers swapped out
     0 carrier transitions
     DCD=up  DSR=up  DTR=up  RTS=up  CTS=up
```

串口上具体的Appletalk信息可以由命令show appletalk interface得知。与在以太网口的情况一样，它将给出该路由器串口具体的Appletalk信息。

```
RouterA#show appletalk interface s 0/0
Serial0/0 is up, line protocol is up
  Appletalk cable range is 600-600
  Appletalk address is 600.1, Valid
  Appletalk zone is "wan1"
  Appletalk port configuration verified by 600.2
  Appletalk address gleaning is not supported by hardware
  Appletalk route cache is enabled
```

show appletalk neighbors 使用show appletalk neighbors命令可以证实你正与合适的路由器相连。如在路由器A上运行该命令可以得知与它相连的邻居Appletalk地址为600.2。

```
RouterA#show appletalk neighbors
Appletalk neighbors:
  600.2          Serial0/0, uptime 00:08:10, 0 secs
              Neighbor is reachable as a RTMP peer
```

show appletalk eigrp interface 当运行Appletalk EIGRP时，有几条重要的命令用于监测网络状态。利用show appletalk eigrp interface命令可以显示路由器上所有运行EIGRP的接口。

```
RouterA#show appletalk eigrp interface
AT/EIGRP Neighbors for process 1, router id 1

                    Xmit Queue     Mean     Pacing Time     Multicast     Pending
```

```
Interface    Peers   Un/Reliable    SRTT    Un/Reliable    Flow Timer    Routes
Se0/0          1         0/0         21         0/10            98          0
```

show appletalk eigrp neighbor **该命令显示所有相邻的**EIGRP**路由器的信息。下例中，路由器**A**的**EIGRP**邻居**Appletalk**地址为**600.2。

```
RouterA#show appletalk eigrp neighbor
AT/EIGRP Neighbors for process 1, router id 1
H    Address                  Interface    Hold Uptime    SRTT    RTO  Q  Seq
                                           (sec)          (ms)       Cnt Num
0    600.2                    Se0/0          14 00:37:29  21      200  0   8
```

show appletalk eigrp traffic **该命令用于显示通过路由器接收/发送的**EIGRP**流量大小。从路由器**A**的输出信息来看，目前它正在传送** EIGRP Hello**信息。**

```
RouterA#show appletalk eigrp traffic
AT-EIGRP Traffic Statistics
  Hellos sent/received: 499/488
  Updates sent/received: 6/4
  Queries sent/received: 0/2
  Replies sent/received: 2/0
  Acks sent/received: 5/6
  Input queue high water mark 1, 0 drops
```

另一种证实某接口是否运行 EIGRP**的方法是利用** show appletalk interface**命令。从下面的输出结果可以知道该接口的路由协议是** EIGRP**。**

```
RouterA#show appletalk interface s 0/0
Serial0/0 is up, line protocol is up
  Appletalk cable range is 600-600
  Appletalk address is 600.1, Valid
  Appletalk zone is "wan1"
  Routing protocols enabled: EIGRP
  Appletalk port configuration verified by 600.2
  Appletalk address gleaning is not supported by hardware
  Appletalk route cache is enabled
```

show interface tunnel1 Appletalk GRE/IP**隧道接口的状态可以用命令** show interface tunnel1 **命令来查看。该命令将显示通过隧道的流量大小、隧道的源端和目的端，以及隧道协议和传输方式（分别为**GRE**和**IP**）。**

```
RouterA#show interface tunnel1
Tunnel1 is up, line protocol is up
  Hardware is Tunnel
  MTU 1500 bytes, BW 9 Kbit, DLY 500000 usec, rely 255/255, load 1/255
  Encapsulation TUNNEL, loopback not set, keepalive set (10 sec)
  Tunnel source 194.1.1.1 (Ethernet0/0), destination 195.1.1.1
  Tunnel protocol/transport GRE/IP, key disabled, sequencing disabled
  Checksumming of packets disabled,  fast tunneling enabled
  Last input 00:00:00, output 00:00:04, output hang never
  Last clearing of "show interface" counters never
  Queueing strategy: fifo
  Output queue 0/0, 0 drops; input queue 0/75, 0 drops
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
     250 packets input, 14254 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     5298 packets output, 284287 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out
```

19.9 结论

本章讨论了Appletalk网络协议。Appletalk是桌面协议中自动化程度最高的，且在末端系统所需进行的配置工作最少，但缺点是它同时也是桌面协议中最繁琐的。我们尝试了几种减少Appletalk网络中开销的方法，例如在广域网中运行 EIGRP协议或者采用GRE隧道。本章中还演示了Cisco IOS对Appletalk路由访问列表、数据访问列表和 ZIP访问列表的支持。