第18章 Novell Internet 包交换协议

本章主题

- IPX 技术概述
- 使用RIP/SAP的IPX配置
- 在IPX网络中配置EIGRP
- 静态SAP入口
- SAP 访问列表
- IPX 故障排除

18.1 引言

虽然Novell Internet包交换协议（IPX）已不如昔日流行，但它依然是一个广泛使用的网络协议。本章将讨论IPX协议以及Cisco IOS对IPX的支持。

18.2 Novell IPX 概述

Novell Netware是一个操作系统，也是一种网络协议。 Novell IPX是基于原先Xerox网络系统（XNS）协议开发的。当使用术语 IPX时，指的是整个Novell协议套，就像我们用IP来表示整个TCP/IP体系。

18.2.1 IPX 地址

Novell IPX网络的地址与IP网络的地址是不同的。 IPX地址的格式为：网络.节点.套接字，如图18-1所示。IPX地址的三个部分包括：

- 网络部分：每个IPX网络被分配给一个全球唯一的32比特网络号。
- 节点部分：各个IPX设备（通常为工作站、路由器或服务器）被分配一个长 48比特的节点地址，这个48比特的地址来自设备本身的 MAC地址。该地址是IPX一个具有吸引力的特点，因为 IPX的节点地址使用设备的 MAC地址意味着 IPX将不再需要地址解析协议（ARP）。在两个支持IPX的设备间发送数据报只需知道目的端的 IPX地址即可，因为其MAC地址就嵌在IPX地址之中，由于已经明确目的端 MAC地址，在发送端就拥有足够的信息来创建以太网帧或令牌环帧。在 IP网络中，如果已知某设备的 IP地址，还无法确定该设备的MAC地址，而它是创建以太网帧、令牌环帧或 FDDI数据链路帧所必须的。IP网络使用ARP协议以从目的设备的IP地址得知其MAC地址。
- 套接字部分：套接字是一个 16比特的数字，它用于识别在目的端使用 IPX的软件进程。某些套接字是保留的，某些可以供目的端使用。

从图18-1我们可以看出，网络地址长 32比特，节点地址为 48位，而套接字长16比特，所以一个完整的IPX地址长96比特，通常用12字节的十六进制数来表示。

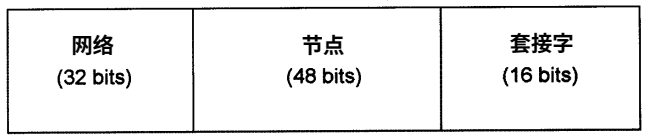

图18-1 IPX 寻址

18.2.2 IPX 协议栈

图18-2列出了IPX协议栈，其中的关键部分描述如下：

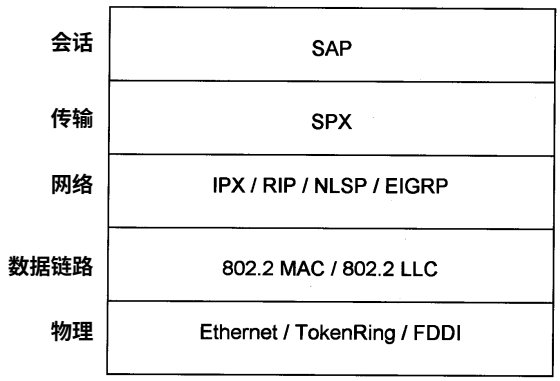

图18-2 IPX协议栈

(1) IPX网络层

IPX提供网络层进行无连接的数据报传输以支持 Novell Netware，最小的IPX包为30字节，最大为65 535字节，一个IPX包有30字节的报头，如图18-3所示。

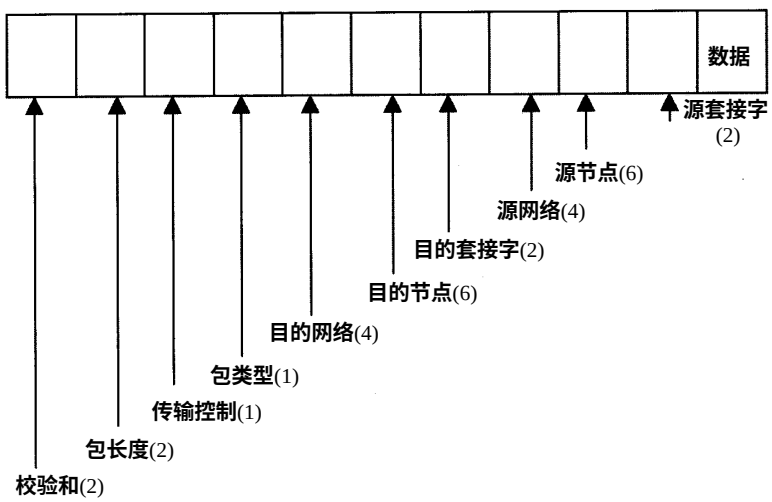

图18-3 IPX包结构

(2) IPX传输层

Novell IPX的传输层协议为SPX，SPX为面向连接的协议，在两个终端间只有建立连接后才能进行数据的传输。

(3) 服务通告协议（SAP）

SAP用于公告和发布Novell服务信息，Netware服务器和路由器每隔60秒广播一次SAP消息，该消息公告所能提供的服务。

共有三种类型的SAP包：

- 定期更新包：当服务器有某种服务需要通告时使用定期更新包。服务器发送的SAP广播包括服务名称、服务类型和完整的IPX地址（网络.节点.套接字），路由器侦听并存储这些广播信息，定期向直接连接的邻居广播更新信息。
- 服务查询包：Netware客户端使用服务查询包来定位服务器，这种查询通常是指获取最近服务器（GNS）查询。服务查询为本地广播，由存储有服务器所发送的定期更新包的路由器进行响应。
- 服务响应包：服务响应包是对服务查询包的回答，通常是来自路由器。

18.2.3 IPX路由协议

IPX使用三种不同的路由协议来传播路由信息：

- IPX RIP：它是一种基于距离矢量的协议，与IP RIP有许多相似之处。IPX RIP与IP RIP的不同之处在于IPX终端设备需要查询路由信息，而在IP网络中存在一条至最近的路由器的缺省路由。IPX更新包每60秒广播一次。IPX RIP有两种度量标准，一种为延迟，以嘀嗒表示；另一种为跳数。在确定最佳路由时，首先比较延迟值，在两条路由的延迟滴嗒值相同的情况下，具有最少跳数的路由为最佳路由。
- NLSP：NLSP是一种链路状态协议，它能够在具有相同开销的路由之间进行负载平衡，其特点是会聚速度比IPX RIP快得多。
- EIGRP：Cisco所专有的增强型IGRP，该路由协议的特点是可以在RIP/SAP和EIGRP之间进行路由的自动重分配。

1) RIP/SAP工作流程

在IPX网络中，RIP和SAP紧密地联系在一起的，图18-4表明了IPX工作站如何定位服务器和寻找到达服务器的路由。

图18-4 SAP工作流程

① 工作站A发送GNS查询请求以寻找服务器；

② 路由器A的缓存中存储了来自路由器B的SAP更新信息，这些更新信息包含服务器B发出的公告，路由器A向工作站A发送一个SAP响应；

③ 于是工作站A有了服务器B的IPX地址，知道服务器B位于网络3，现在工作站A需要寻找至网络3的路由；

④ 路由器A通过RIP更新信息知道至网络3的路由，它给工作站A发送RIP响应包。

2) IPX封装类型

图18-5给出了各种IPX以太网封装类型。

在局域网中，IPX可以在以太网、令牌环网和FDDI等网络拓扑上运行。由于IPX支持四种不同的以太网封装形式，这意味着在同一个IPX网络中可能会使用四种格式的MAC帧，如果Netware局域网中两台工作站使用不同的以太网封装形式，它们之间不能直接进行会话，所有流量必须经过一个中间路由器。

四种以太网封装形式为：

- Ethernet II：在Cisco设备中被描述为ARPA封装形式。
- 802.2：在Cisco设备中被称为SAP封装形式。
- 802.3：在Cisco设备中以Novell-Ether封装形式表示，它是Cisco的默认封装形式。
- SNAP：该封装形式在Cisco设备中以SNAP表示。

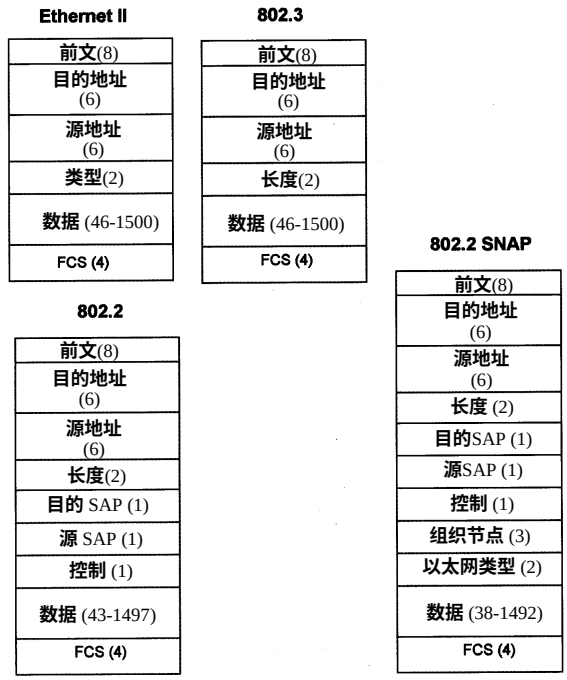

图18-5 IPX以太网封装类型

IPX支持两种不同的令牌环封装类型：

- Cisco SAP，这是缺省封装类型。
- Cisco SNAP。

IPX还支持三种不同类型的FDDI封装类型：

- Cisco SNAP
- Cisco SAP
- Novell-FDDI Raw

18.3 本章所讨论的命令

■ **access-list** *access-list-number* **[deny|permit]** *network*[.*node*] [*network-mask.node-mask*] [*service-type*[*server-name*]]

- **debug ipx routing activity**
- **debug ipx routing events**
- **debug ipx sap activity**
- **debug ipx sap events**
- **distribute-list in**
- **distribute-list out**
- **ipx network** *network* **[encapsulation** ***encapsulation-type*** **[secondary]]**
- **ipx output-sap-filter** *access-list-number*
- **ipx router [eigrp** *autonomous-system-number* **| nlsp [***tag***] | rip]**
- **ipx routing [***node***]**
- **ipx sap** *service-type name network.node socket hop-count*
- **network [***network-number***] |all]**
- **ping [ipx] [***network.node***]**
- **show access-list**
- **show ipx eigrp interfaces [***type number***] [***as-number***]**
- **show ipx eigrp neighbors [servers] [***autonomous-system-number* **|** *interface***]**
- **show ipx interface [***type number***]**
- **show ipx interface brief**
- **show ipx route [***network***] [default] [detailed]**
- **show ipx servers [unsorted | [sorted [name | net | type]] [regexp** *name***]**
- **show ipx traffic**

命令的定义

- access-list：**是一个全局配置命令，定义用于** SAP**过滤、路由过滤和** NLSP**过滤的访问列表。**
- debug ipx routing activity：**调试时用的命令，显示** IPX**路由活动的信息。**
- debug ipx routing events：**用于调试时显示** IPX**路由活动的信息。**
- debug ipx sap activity , debug ipx sap events：**这两条调试命令用于提供关于** IPX SAP**包的信息。**
- distribute-list in：**该命令使路由器过滤掉外界进入的有关** IPX**网络的信息。**
- distribute-list out：**该命令使有关** IPX**网络的信息不从本路由器发出。**
- ipx network：**是一项接口配置命令，在所选定接口激活** IPX**路由，该命令也可用于局域网接口上的封装类型选择。**
- ipx router：**该全局命令用于指定路由器所选用的路由协议，可供选择的有** RIP、EIGRP **和**NLSP**。**
- ipx routing：**该全局命令使路由器支持** IPX**路由，可以在该命令中为路由器设定节点号。**
- ipx sap：**该全局命令在路由器的** IPX**服务器列表中建立静态** SAP**入口。**
- network：**这条路由器配置命令指定在路由更新包中包含哪些网络。**

- ping ipx：是一条可执行命令，用于证实IPX网络是否工作。
- show access-list：该可执行命令显示路由器上定义的访问列表的信息。
- show ipx eigrp interfaces：该可执行命令显示所有激活了EIGRP路由协议的接口的信息。
- show ipx eigrp neighbor：执行该命令可以显示通过EIGRP协议发现的相邻路由器的信息。
- show ipx interface：执行该命令可以显示路由器中配置了IPX协议的某接口的有关信息。
- show ipx interface brief：该命令显示路由器中所有配置了IPX协议的接口的概要信息。
- show ipx route：是一可执行命令，显示该路由器的IPX路由表。
- show ipx servers：该可执行命令列出所有静态配置或通过SAP公告发现的IPX服务器。
- show ipx traffic：执行该命令可以给出接收/发送的IPX协议包的信息，执行结果根据IPX包类型分类列出，如RIP、EIGRP和SAP等。

18.4 IOS需求

本章实验中使用的是IOS 11.2版。

18.5 实验70：使用IPX RIP/SAP的IPX配置

18.5.1 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电缆相连接做成一条交叉电缆；

3) Cisco路由器控制口电缆；

4) 支持IPX协议的Cisco IOS。

18.5.2 配置概述

本实验将演示IPX协议的配置和监测。如图18-6所示，实验中定义了五个IPX网络，路由器A、B和C被分别配以IPX节点号a.a.a、b.b.b和c.c.c，三台路由器的连接方法如图18-6所示，路由器B作为DCE为路由器A和C提供时钟信号。

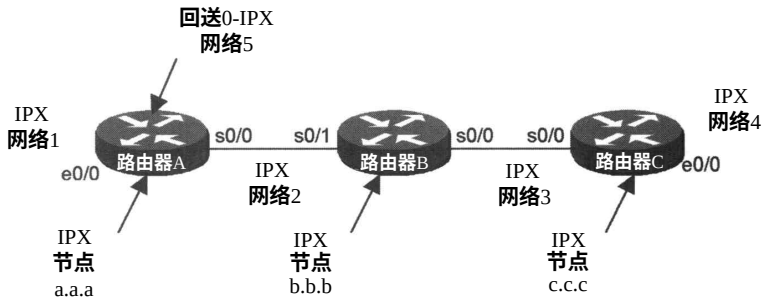

图18-6 使用RIP/SAP的IPX配置

18.5.3 路由器配置

本实验中三台路由器的配置情况如下(关键IPX命令黑体高亮显示)：

1. 路由器A

```
Current configuration:
!
version 11.2
no service password-encryption
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterA
!
!
ipx routing 000a.000a.000a←Enable IPX routing. Define the IPX node to be 000a.000a.000a.
!
interface Loopback0
 no ip address
 ipx network 5←Make this interface IPX network 5
!
interface Ethernet0/0
 no ip address
 no keepalive
 ipx network 1←Make this interface IPX network 1
!
interface Serial0/0
 no ip address
 encapsulation ppp
 ipx network 2←Make this interface IPX network 2
 no fair-queue
!
no ip classless
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

2. 路由器B

```
Current configuration:
!
version 11.2
no service password-encryption
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterB
!
!
ipx routing 000b.000b.000b←Enable IPX routing. Define the IPX node to be 000b.000b.000b
!
interface Serial0/0
 no ip address
 encapsulation ppp
 ipx network 3←Make this interface IPX network 3
 no fair-queue
 clockrate 64000
!
interface Serial0/1
 no ip address
 encapsulation ppp
 ipx network 2←Make this interface IPX network 2
```

```
 clockrate 64000
!
no ip classless
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

3. 路由器C

```
Current configuration:
!
version 11.2
no service password-encryption
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterC
!
!
ipx routing 000c.000c.000c←Enable IPX routing. Define the IPX node to be 000c.000c.000c
!
interface Ethernet0/0
 no ip address
 no keepalive
 ipx network 4←Make this interface IPX network 4
!
interface Serial0/0
 no ip address
 encapsulation ppp
 ipx network 3←Make this interface IPX network 3
 no fair-queue
!
no ip classless
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

注意到在三个路由器中，均没有显式地配置路由协议，因为 IPX**网络中，默认已经运行了** IPX RIP**路由协议。**

18.5.4 监测配置

我们先看路由器A**，执行**show ipx interface brief**命令以显示该路由器所有接口的状态信息，可以发现该路由器中有三个接口在运行** IPX**协议，这三个接口分别为：** IPX**网络**1**中的以太网口**e0/0**、**IPX**网络**2**中的串口**s0/0**和**IPX**网络**5**中的本地环路接口**0**，并且所有这些接口均为正常工作状态。另外，以太网口** e0/0**的封装形式被设定为**NOVELL-ETHER**，从前面部分的介绍我们知道这是**IPX**网络中以太网口的缺省封装形式。**

```
RouterA#show ipx interface brief
Interface          IPX Network Encapsulation Status                IPX State
Ethernet0/0        1           NOVELL-ETHER     up                 [up]
Serial0/0          2           PPP              up                 [up]
BRI0/0             unassigned  not config'd     administratively down n/a
BRI0/0:1           unassigned  not config'd     administratively down n/a
```

```
BRI0/0:2          unassigned    not config'd    administratively down   n/a
Ethernet1/0       unassigned    not config'd    administratively down   n/a
Serial1/0         unassigned    not config'd    administratively down   n/a
Serial1/1         unassigned    not config'd    administratively down   n/a
Loopback0         5             UNKNOWN         up                      [up]
```

执行show ipx route**命令来查看路由器**A**的路由表，我们可以看到有三个**IPX**网络是直接相连的：网络**1**与以太网口**e0/0**直连、网络**2**与串口**s0/0**直连、网络**5**与环路接口**0**直连。通过**IPX RIP**路由协议路由器**A**找到了另外两个网络：网络**3**，距离为**1**跳、**7**嘀嗒；网络**4**，距离为**2**跳、**13**嘀嗒。**

```
RouterA#show ipx route
Codes: C - Connected primary network,     c - Connected secondary network
       S - Static, F - Floating static, L - Local (internal), W - IPXWAN
       R - RIP, E - EIGRP, N - NLSP, X - External, A - Aggregate
       s - seconds, u - uses

5 Total IPX routes. Up to 1 parallel paths and 16 hops allowed.

No default route known.

C           1 (NOVELL-ETHER),   Et0/0
C           2 (PPP),            Se0/0
C           5 (UNKNOWN),        Lo0

                Tick Count          Next hop address
                ↓                   ↓
R           3 [07/01] via         2.000b.000b.000b,    49s, Se0/0
                  ↑
                Hop Count to destination network

                Tick Count          Next hop address
                ↓                   ↓
R           4 [13/02] via         2.000b.000b.000b,    50s, Se0/0
                  ↑
                Hop Count to destination network
```

show interface s 0/0 **命令通常列出**IP**地址，由于路由器**A**中没有运行**IP**，该命令没有显示网络地址。可以看到**IPXCP**，即**IPX**网络控制协议已被开放。**

```
RouterA#show int 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
Open: CDPCP, IPXCP←No IP is enabled on this interface
Last input 00:00:01, output 00:00:01, 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
   99 packets input, 3888 bytes, 0 no buffer←Packets input
   Received 99 broadcasts, 0 runts, 0 giants, 0 throttles
   0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
   100 packets output, 3902 bytes, 0 underruns←Packets output
   0 output errors, 0 collisions, 16 interface resets
   0 output buffer failures, 0 output buffers swapped out
   31 carrier transitions
   DCD=up  DSR=up  DTR=up  RTS=up  CTS=up
```

具体某接口的IPX**信息可以通过**show ipx int**命令给出。**

```
RouterA#show ipx int s 0/0
Serial0/0 is up, line protocol is up
  IPX address is 2.000a.000a.000a [up]←IPX address

                                      A WAN interface has a default IPX
                                      delay of 6
                                        ↓
  Delay of this IPX network, in ticks is 6 throughput 0 link delay 0
  IPXWAN processing not enabled on this interface.
  IPX SAP update interval is 1 minute(s)
  IPX type 20 propagation packet forwarding is disabled
  Incoming access list is not set
  Outgoing access list is not set
  IPX helper access list is not set
  SAP GNS processing enabled, delay 0 ms, output filter list is not set
  SAP Input filter list is not set
  SAP Output filter list is not set
  SAP Router filter list is not set
  Input filter list is not set
  Output filter list is not set
  Router filter list is not set
  Netbios Input host access list is not set
  Netbios Input bytes access list is not set
  Netbios Output host access list is not set
  Netbios Output bytes access list is not set
  Updates each 60 seconds, aging multiples RIP: 3 SAP: 3
  SAP interpacket delay is 55 ms, maximum size is 480 bytes
  RIP interpacket delay is 55 ms, maximum size is 432 bytes
  Watchdog processing is disabled, SPX spoofing is disabled, idle time 60
  IPX accounting is disabled
  IPX fast switching is configured (enabled)
  RIP packets received 9, RIP packets sent 9←RIP is running on this interface
  SAP packets received 1, SAP packets sent 1←SAP is running on this interface
```

执行show interface e 0/0**可以显示路由器**A**的以太网口的信息，这里有两点值得注意：**

1) **该接口没有**IP**地址，因为路由器中没有配置**IP**协议。**

2) **该接口的**MAC**地址是**00e0.1e5b.2601**，而不是**000a.000a.000a，**尽管在路由器的配置中执行**IPX routing 000A.000A.000A**命令已指定其串口**S0**以该地址作为其**MAC**地址。**

```
RouterA#show int e 0/0
Ethernet0/0 is up, line protocol is up
  Hardware is AmdP2, address is 00e0.1e5b.2601 (bia 00e0.1e5b.2601)
  MTU 1500 bytes, BW 10000 Kbit, DLY 1000 usec, rely 128/255, load 1/255
  Encapsulation ARPA, loopback not set, keepalive not set
  ARP type: ARPA, ARP Timeout 04:00:00
  Last input never, output 00:00:54, 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 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     0 input packets with dribble condition detected
     576 packets output, 96038 bytes, 0 underruns
     576 output errors, 0 collisions, 1 interface resets
     0 babbles, 0 late collision, 0 deferred
     576 lost carrier, 0 no carrier
     0 output buffer failures, 0 output buffers swapped out
```

show ipx int e 0/0**命令可以显示以太网口的**IPX**信息。**

```
RouterA#show ipx int e 0/0
Ethernet0/0 is up, line protocol is up
```

```
  IPX address is 1.00e0.1e5b.2601, NOVELL-ETHER [up]←default IPX encapsulation

                                          A LAN interface has a default IPX
                                          delay of 1
                                            ↓
Delay of this IPX network, in ticks is 1 throughput 0 link delay 0
  IPXWAN processing not enabled on this interface.
  IPX SAP update interval is 1 minute(s)
  IPX type 20 propagation packet forwarding is disabled
  Incoming access list is not set
  Outgoing access list is not set
  IPX helper access list is not set
  SAP GNS processing enabled, delay 0 ms, output filter list is not set
  SAP Input filter list is not set
  SAP Output filter list is not set
  SAP Router filter list is not set
  Input filter list is not set
  Output filter list is not set
  Router filter list is not set
  Netbios Input host access list is not set
  Netbios Input bytes access list is not set
  Netbios Output host access list is not set
  Netbios Output bytes access list is not set
  Updates each 60 seconds, aging multiples RIP: 3 SAP: 3
  SAP interpacket delay is 55 ms, maximum size is 480 bytes
  RIP interpacket delay is 55 ms, maximum size is 432 bytes
  IPX accounting is disabled
  IPX fast switching is configured (enabled)
  RIP packets received 0, RIP packets sent 200
  SAP packets received 0, SAP packets sent 166
```

路由器B和C可以通过路由器A到达，但相对于IP网络，IPX网络的测试功能有限。只能ping另外一个IPX接口。

```
RouterA#ping ipx 2.b.b.b←ping RouterB

Type escape sequence to abort.
Sending 5, 100-byte IPX cisco Echoes to 2.000b.000b.000b, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/29/32 ms
```

可以使用IPX的ping命令来证实从路由器A可以到达路由器C。

```
RouterA#ping ipx 3.c.c.c←ping RouterC

Type escape sequence to abort.
Sending 5, 100-byte IPX cisco Echoes to 3.000c.000c.000c, timeout is 2 seconds
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/56/60 ms
```

现在连接路由器C。执行show ipx route命令显示路由器C的IPX路由表，我们可以看出有两个网络直接与路由器C相连：网络3和网络4，通过IPX RIP发现了三个网络：网络1、网络2和网络4，所有这些RIP路由的下一跳均为路由器B。

```
RouterC#show ipx route
Codes: C - Connected primary network,     c - Connected secondary network
       S - Static, F - Floating static, L - Local (internal), W - IPXWAN
       R - RIP, E - EIGRP, N - NLSP, X - External, A - Aggregate
       s - seconds, u - uses

5 Total IPX routes. Up to 1 parallel paths and 16 hops allowed.

No default route known.

C           3 (PPP),           Se0/0
C           4 (NOVELL-ETHER),  Et0/0
```

```
                                        The next hop address for all remote networks
                                        is RouterB
                                          ↓
R           1 [13/02] via          3.000b.000b.000b,    57s, Se0/0
R           2 [07/01] via          3.000b.000b.000b,    58s, Se0/0
R           5 [13/02] via          3.000b.000b.000b,    58s, Se0/0
```

执行show ipx interface brief**命令以显示路由器所有接口的状态信息，可以发现该路由器** C **中配置了两个**IPX**网络：与以太网口** e0/0**相连的**IPX**网络**4**和与串口** s0/0**相连的**IPX**网络**3**，两个网络均处于正常工作状态。**

```
RouterC#show ipx interface brief
Interface            IPX Network Encapsulation Status                IPX State
Ethernet0/0          4           NOVELL-ETHER  up                    [up]
Serial0/0            3           PPP           up                    [up]
BRI0/0               unassigned  not config'd  administratively down  n/a
BRI0/0:1             unassigned  not config'd  administratively down  n/a
BRI0/0:2             unassigned  not config'd  administratively down  n/a
```

在路由器C**上通过**IPX ping**可以到达路由器**A**和**B**，以**ping**路由器**B**上的网络**3**为例：**

```
RouterC#ping ipx 3.b.b.b

Type escape sequence to abort.
Sending 5, 100-byte IPX cisco Echoes to 3.000b.000b.000b, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/29/32 ms
```

可以确认IPX**网络**2**的两个接口都是能够到达的。**

```
RouterC#ping ipx 2.b.b.b←ping RouterB

Type escape sequence to abort.
Sending 5, 100-byte IPX cisco Echoes to 2.000b.000b.000b, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/29/32 ms

RouterC#ping ipx 2.a.a.a←ping RouterA

Type escape sequence to abort.
Sending 5, 100-byte IPX cisco Echoes to 2.000a.000a.000a, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 56/56/56 ms
```

另外一条实用的命令为 show ipx traffic**，它给出路由器接收/发送的**IPX**包数目的详细信息。**

```
RouterC#show ipx traffic
System Traffic for 0.0000.0000.0001 System-Name: RouterC
Rcvd:    36 total, 0 format errors, 0 checksum errors, 0 bad hop count,
         0 packets pitched, 36 local destination, 0 multicast
Bcast:   16 received, 29 sent
Sent:    50 generated, 0 forwarded
         0 encapsulation failed, 0 no route
SAP:     1 SAP requests, 0 SAP replies, 0 servers
         0 SAP Nearest Name requests, 0 replies
         0 SAP General Name requests, 0 replies
         5 SAP advertisements received, 4 sent
         2 SAP flash updates sent, 0 SAP format errors
RIP:     1 RIP requests, 0 RIP replies, 5 routes
         9 RIP advertisements received, 18 sent
         2 RIP flash updates sent, 0 RIP format errors
Echo:    Rcvd 5 requests, 15 replies
         Sent 15 requests, 5 replies
         0 unknown: 0 no socket, 0 filtered, 0 no helper
         0 SAPs throttled, freed NDB len 0
```

```
Watchdog:
        0 packets received, 0 replies spoofed
Queue lengths:
        IPX input: 0, SAP 0, RIP 0, GNS 0
        SAP throttling length: 0/(no limit), 0 nets pending lost route reply
        Delayed process creation: 0
EIGRP:  Total received 0, sent 0
        Updates received 0, sent 0
        Queries received 0, sent 0
        Replies received 0, sent 0
        SAPs received 0, sent 0
NLSP:   Level-1 Hellos received 0, sent 0
        PTP Hello received 0, sent 0
        Level-1 LSPs received 0, sent 0
        LSP Retransmissions: 0
        LSP checksum errors received: 0
        LSP HT=0 checksum errors received: 0
        Level-1 CSNPs received 0, sent 0
        Level-1 PSNPs received 0, sent 0
        Level-1 DR Elections: 0
        Level-1 SPF Calculations: 0
        Level-1 Partial Route Calculations: 0
```

现在，我们来观察路由器B，使用show ipx interface brief命令以显示路由器B所有接口的状态信息，可以发现该路由器的接口S0/0和S0/1各连接了一个IPX网络，这两个接口都处于正常工作状态。

```
RouterB#show ipx interface brief
Interface              IPX Network Encapsulation Status                IPX State
Ethernet0/0            unassigned  not config'd  administratively down n/a
Serial0/0              3           PPP           up                    [up]
Serial0/1              2           PPP           up                    [up]
```

执行show ipx route命令来查看路由器B的路由表信息，我们可以看到网络2和网络3与路由器B直接相连，通过IPX RIP路由协议该路由器发现了网络1、4和5。

```
RouterB#show ipx route
Codes: C - Connected primary network,     c - Connected secondary network
       S - Static, F - Floating static, L - Local (internal), W - IPXWAN
       R - RIP, E - EIGRP, N - NLSP, X - External, A - Aggregate
       s - seconds, u - uses

5 Total IPX routes. Up to 1 parallel paths and 16 hops allowed.

No default route known.

C           2 (PPP),              Se0/1
C           3 (PPP),              Se0/0
R           1 [07/01] via          2.000a.000a.000a,    30s, Se0/1←RIP route
R           4 [07/01] via          3.000c.000c.000c,    31s, Se0/0←RIP route
R           5 [07/01] via          2.000a.000a.000a,    31s, Se0/1←RIP route
```

使用IPX的ping命令证实从路由器B是可以到达路由器A和C的。

```
RouterB#ping ipx 3.c.c.c←ping RouterC

Type escape sequence to abort.
Sending 5, 100-byte IPX cisco Echoes to 3.000c.000c.000c, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/29/32 ms

RouterB#ping ipx 2.a.a.a←ping RouterA

Type escape sequence to abort.
```

```
Sending 5, 100-byte IPX cisco Echoes to 2.000a.000a.000a, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/29/32 ms
```

我们可以尝试登录到路由器C上，执行telnet命令，当提示主机地址时，输入3.c.c.c，可以看到路由器B会显示出错信息，提示它不能找到计算机地址。这是由于 telnet是IP协议应用，IPX不使用telnet，也没有相应的命令，在IPX网络中唯一的测试工具就是IPX ping，因此在网络中总是运行IP协议是非常重要的。

```
RouterB#telnet
Host: ?3.c.c.c←try to telnet to an IPX address
Translating "3.c.c.c"...domain server (255.255.255.255)
% Unknown command or computer name, or unable to find computer address
        ↑
        Telnet can only be used with the IP protocol. IPX does not support
        telnet
```

下面我们来看IPX RIP路由协议的工作原理。在路由器B上执行debug ipx routing activity和debug ipx routing events以进行IPX RIP协议工作调试，如果你的设备没有与路由器的控制口相连，则需用terminal monitor命令来将所有调试结果发送到调试终端上。

```
RouterB#debug ipx routing activity
IPX routing debugging is on

RouterB#debug ipx routing events
IPX routing events debugging is on
```

IPX RIP与IP RIP在发送和接收路由更新信息方面有许多相似之处，路由器每 60秒向直连的邻居发送更新信息，路由更新信息包括该路由器所能到达的路由器及距离。在 IP RIP中只有一种度量方法（跳数），而在IPX RIP中有两种度量方法，分别是跳数和时延。缺省情况下，广域网接口的时延为6，局域网接口的时延为1。以下为对路由器的以太网口和串口分别执行show ipx interface命令的输出结果。

```
RouterA#show ipx int e 0/0
Ethernet0/0 is up, line protocol is up
  IPX address is 1.00e0.1e5b.2601, NOVELL-ETHER [up]

                                        A LAN interface has a default IPX delay
                                        of 1
                                         ↓
Delay of this IPX network, in ticks is 1 throughput 0 link delay 0
RouterA#show ipx int s 0/0
Serial0/0 is up, line protocol is up
  IPX address is 2.000a.000a.000a [up]

                                          A WAN interface has a default IPX
                                          delay of 6
                                           ↓
  Delay of this IPX network, in ticks is 6 throughput 0 link delay 0
```

IPX RIP在判断路由时，优先根据时延值来选择。

执行show ipx routing，可以显示路由器B发出或接收到的路由更新信息。首先，路由器 B向路由器C发送路由更新信息，表明路由器B有到IPX网络1、网络2和网络5的路由。

```
RouterB sends an update to RouterC
↓
IPXRIP: positing full update to 3.ffff.ffff.ffff via Serial0/0 (broadcast)
IPXRIP: src=3.000b.000b.000b, dst=3.ffff.ffff.ffff, packet sent
     network 5, hops 2,  delay 13
     network 1, hops 2,  delay 13
     network 2, hops 1,  delay 7
```

接着，路由器B接收来自路由器C的路由更新信息，路由器C表明自身有到IPX网络4的路由。

```
RouterB receives an update from RouterC
↓
IPXRIP: update from 3.000c.000c.000c
     4 in 1 hops, delay 7
```

然后，路由器B给路由器A发送信息，表明它可以到达IPX网络3和4。

```
RouterB sends an update to RouterA
↓
IPXRIP: positing full update to 2.ffff.ffff.ffff via Serial0/1 (broadcast)
IPXRIP: src=2.000b.000b.000b, dst=2.ffff.ffff.ffff, packet sent
     network 4, hops 2,  delay 13
     network 3, hops 1,  delay 7
```

最后，路由器B接收来自A的更新，称路由器A有到达IPX网络1和网络5的路由。

```
RouterB receives an update from RouterA
↓
IPXRIP: update from 2.000a.000a.000a
     1 in 1 hops, delay 7
     5 in 1 hops, delay 7
```

上述过程每60秒重复一次。

18.6 实验71：IPX EIGRP

18.6.1 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电缆相连接做成一条交叉电缆；

3) Cisco路由器控制口电缆；

4) 支持IPX协议的Cisco IOS。

18.6.2 配置概述

本实验主要讨论IPX网络的路由协议。在缺省情况下，IPX网络中所有接口运行的是IPX RIP协议，但也可以为其指定使用EIGRP路由协议。EIGRP相对于RIP具有诸多优点，如：

- 快速会聚（convergence）。
- 路由更新信息所占用的网络资源少（EIGRP只发送其路由表的更新部分）。
- 更低的CPU利用率。
- 更适合于大型网络。
- 对IPX RIP进行自动重分配。

本实验中，我们在局域网接口上运行IPX RIP，在其它接口上运行EIGRP。由于默认在所有接口都已运行了IPX RIP协议，为了运行EIGRP，需要显式地在相应接口上关闭IPX RIP协议。

如图18-7所示，本实验中一共定义了五个IPX网络，路由器A、B和C被分别配以IPX节点号a.a.a、b.b.b和c.c.c，三台路由器的连接方法如图所示，路由器 B作为DCE为路由器A和C提供时钟信号。

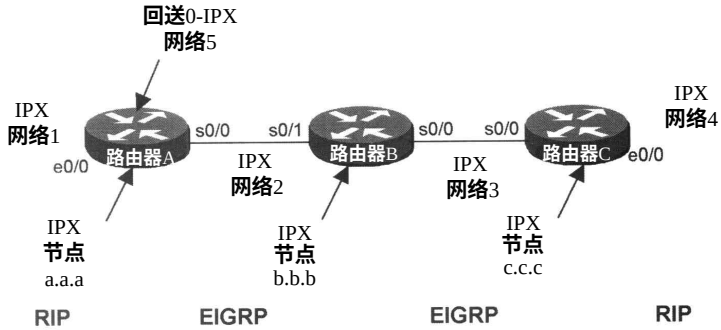

图18-7 IPX EIGRP

18.6.3 路由器配置

本实验中三台路由器的配置情况如下：

1. 路由器A

```
Current configuration:
!
version 11.2
no service password-encryption
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterA
!
!
ipx routing 000a.000a.000a←Enable IPX routing. Define the IPX node to be 000a.000a.000a
!
interface Loopback0
 no ip address
 ipx network 5←Make this interface IPX network 5
!
interface Ethernet0/0
 no ip address
 no keepalive
 ipx network 1
!
interface Serial0/0
 no ip address
 encapsulation ppp
 ipx network 2←Make this interface IPX network 2
 no fair-queue
!
no ip classless
!
!
ipx router eigrp 1←Enable IPX EIGRP autonomous system 1
 network 2←Include IPX network 2 in EIGRP updates
!
!
ipx router rip←Enable IPX RIP on this router
 no network 2←Do not advertise IPX network 2 in RIP updates
!
```

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

2. 路由器B

```
Current configuration:
!
version 11.2
no service password-encryption
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterB
!
!
ipx routing 000b.000b.000b←Enable IPX routing. Define the IPX node to be 000b.000b.000b
!
interface Serial0/0
 no ip address
 encapsulation ppp
 ipx network 3←Make this interface IPX network 3
no fair-queue
 clockrate 64000
!
interface Serial0/1
 no ip address
 encapsulation ppp
 ipx network 2←Make this interface IPX network 2
clockrate 64000
!
no ip classless
!
!
ipx router eigrp 1←Enable IPX EIGRP autonomous system 1
 network all←Advertise all IPX networks on this router in EIGRP updates
!
!
no ipx router rip←Do not enable IPX RIP on this router
!
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

3. 路由器C

```
Current configuration:
!
version 11.2
no service password-encryption
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterC
!
!
ipx routing 000c.000c.000c←Enable IPX routing. Define the IPX node to be 000c.000c.000c
!
interface Ethernet0/0
 no ip address
 no keepalive
```

```
 ipx network 4←Make this interface IPX network 4
!
interface Serial0/0
 no ip address
 encapsulation ppp
 ipx network 3←Make this interface IPX network 3
 no fair-queue
!
no ip classless
!
!
ipx router eigrp 1←Enable IPX EIGRP autonomous system 1
 network 3←Include IPX network 3 in EIGRP updates
!
!
ipx router rip←Enable IPX RIP on this router
 no network 3←Do not advertise IPX network 3 in RIP updates
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

注意到在不希望运行IPX RIP协议的接口，使用了显式的命令将其关闭。

18.6.4 监测配置

连接路由器A，通过show ipx interface brief命令证实该路由器所有IPX接口处于激活状态。

```
RouterA#show ipx interface brief
Interface              IPX Network Encapsulation Status                IPX State
Ethernet0/0            1           NOVELL-ETHER  up                    [up]
Serial0/0              2           PPP           up                    [up]
BRI0/0                 unassigned  not config'd  administratively down n/a
BRI0/0:1               unassigned  not config'd  administratively down n/a
BRI0/0:2               unassigned  not config'd  administratively down n/a
Ethernet1/0            unassigned  not config'd  administratively down n/a
Serial1/0              unassigned  not config'd  administratively down n/a
Serial1/1              unassigned  not config'd  administratively down n/a
Loopback0              5           UNKNOWN       up                    [up]
```

执行show ipx route命令查看路由器A的路由表，我们可以看到有三个直接相连的IPX网络（网络1、网络2和网络5），通过EIGRP路由协议找到了两个远端网络：网络3和4。注意在路由表中没有通过RIP发现的路由。

```
RouterA#show ipx route
Codes: C - Connected primary network,     c - Connected secondary network
       S - Static, F - Floating static, L - Local (internal), W - IPXWAN
       R - RIP, E - EIGRP, N - NLSP, X - External, A - Aggregate
       s - seconds, u - uses

5 Total IPX routes. Up to 1 parallel paths and 16 hops allowed.

No default route known.

C           1 (NOVELL-ETHER),   Et0/0
C           2 (PPP),            Se0/0
C           5 (UNKNOWN),        Lo0

EIGRP learned route
↓
E           3 [2681856/0] via         2.000b.000b.000b, age 02:08:01,
```

```
EIGRP learned route
↓
E           4 [2707456/1] via          2.000b.000b.000b, age 02:07:52,
                      385u, Se0/0
```

使用show ipx eigrp neighbor命令可以显示与该路由器相邻的EIGRP路由器的信息。

```
RouterA#show ipx eigrp neigh

IPX EIGRP Neighbors for process 1
H    Address                  Interface     Hold Uptime    SRTT       RTO     Q  Seq
                                            (sec)          (ms)           Cnt Num
0    2.000b.000b.000b         Se0/0          13 02:10:19    53         318     0   38
     ↑
       RouterB, interface S0/1 is an EIGRP neighbor
```

通过show ipx eigrp interfaces命令可以知道哪些接口在运行EIGRP协议。在路由器A上只有接口S0/0是EIGRP接口，接口e0/0仍然运行IPX RIP路由协议。

```
RouterA#show ipx eigrp interfaces

IPX EIGRP Interfaces for process 1

                        Xmit Queue    Mean    Pacing Time    Multicast     Pending
Interface     Peers     Un/Reliable   SRTT    Un/Reliable    Flow Timer    Routes
Se0/0           1         0/0         53        0/15           263         0
↑
Only interface S0/0 is running EIGRP. Interface E0/0 is still running EIGRP.
```

下面我们连接到路由器B上，show ipx interface brief命令表明该路由器所有IPX接口都处于激活状态。

```
RouterB#show ipx interface brief
Interface            IPX Network Encapsulation Status                IPX State
Ethernet0/0          unassigned  not config'd  administratively down n/a
Serial0/0            3           PPP           up                    [up]
Serial0/1            2           PPP           up                    [up]
```

show ipx route命令显示路由器B通过EIGRP发现了至网络1、4和5的路由。

```
RouterB#show ipx route
Codes: C - Connected primary network,     c - Connected secondary network
       S - Static, F - Floating static, L - Local (internal), W - IPXWAN
       R - RIP, E - EIGRP, N - NLSP, X - External, A - Aggregate
       s - seconds, u - uses
5 Total IPX routes. Up to 1 parallel paths and 16 hops allowed.

No default route known.

C           2 (PPP),            Se0/1
C           3 (PPP),            Se0/0
E           1 [2195456/1] via          2.000a.000a.000a, age 02:08:28,
                      392u, Se0/1
E           4 [2195456/1] via          3.000c.000c.000c, age 02:08:28,
                      3u, Se0/0
E           5 [2297856/1] via          2.000a.000a.000a, age 02:08:28,
                      1u, Se0/1
```

同时，路由器B应当通过EIGRP发现了两个相邻路由器，分别属于IPX网络2和IPX网络3。可以通过show ipx eigrp neighbor命令来证实这一点。

```
RouterB#show ipx eigrp neigh

IPX EIGRP Neighbors for process 1
H    Address                  Interface     Hold Uptime    SRTT       RTO     Q  Seq
                                            (sec)          (ms)           Cnt Num
```

```
        EIGRP neighbor RouterA
        ↓
1   2.000a.000a.000a          Se0/1          10 02:11:10    22    200     0   20

        EIGRP neighbor RouterC
        ↓
0   3.000c.000c.000c          Se0/0          14 02:11:41    43    258     0   22
```

执行show ipx eigrp interfaces**可以得知在路由器**B**的两个串口上运行的都是** EIGRP**路由协议。**

```
RouterB#show ipx eigrp interfaces

IPX EIGRP Interfaces for process 1

                        Xmit Queue    Mean    Pacing Time    Multicast     Pending
Interface     Peers     Un/Reliable   SRTT    Un/Reliable    Flow Timer    Routes
Se0/0           1         0/0         43        0/15           207           0
Se0/0           1         0/0         22        0/15           103           0
↑
Both serial interfaces on RouterB are using EIGRP for their routing protocol.
```

show ipx eigrp traffic**是一条有用的命令，它给出路由器接收 /发送的**EIGRP**流量大小的信息。**

```
RouterB#show ipx eigrp traffic
IP-EIGRP Traffic Statistics for process 1
  Hellos sent/received: 3433/3430
  Updates sent/received: 11/11
  Queries sent/received: 10/7
  Replies sent/received: 7/10
  Acks sent/received: 37/33
  Input queue high water mark 2, 0 drops
```

最后，连接路由器C**，执行**show ipx interface brief**命令证实该路由器所有** IPX**接口处于激活状态。**

```
RouterC#show ipx interface brief
Interface             IPX Network Encapsulation Status                IPX State
Ethernet0/0           4           NOVELL-ETHER  up                    [up]
Serial0/0             3           PPP           up                    [up]
BRI0/0                unassigned  not config'd  administratively down  n/a
BRI0/0:1              unassigned  not config'd  administratively down  n/a
BRI0/0:2              unassigned  not config'd  administratively down  n/a
```

通过show ipx route**命令我们得知路由器**C**通过**EIGRP**发现了三个网络：网络** 1、2**和**5。

```
RouterC#show ipx route
Codes: C - Connected primary network,     c - Connected secondary network
       S - Static, F - Floating static, L - Local (internal), W - IPXWAN
       R - RIP, E - EIGRP, N - NLSP, X - External, A - Aggregate
       s - seconds, u - uses

5 Total IPX routes. Up to 1 parallel paths and 16 hops allowed.

No default route known.

C           3 (PPP),           Se0/0
C           4 (NOVELL-ETHER),  Et0/0
E           1 [2707456/1] via          3.000b.000b.000b, age 02:09:47,
                    4u, Se0/0
E           2 [2681856/0] via          3.000b.000b.000b, age 02:09:47,
                    1u, Se0/0
E           5 [2809856/1] via          3.000b.000b.000b, age 02:09:47,
                    1u, Se0/0
```

执行show ipx eigrp interfaces可以发现在路由器C上串口S0/0运行的是EIGRP路由协议。

```
RouterC#show ipx eigrp interfaces

IPX EIGRP Interfaces for process 1

                    Xmit Queue     Mean    Pacing Time  Multicast    Pending
Interface     Peers Un/Reliable    SRTT    Un/Reliable  Flow Timer   Routes
Se0/0           1       0/0         20        0/15          95          0
```

18.7 实验72：静态SAP入口和SAP访问列表

18.7.1 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电缆相连接做成一条交叉电缆；

3) Cisco路由器控制口电缆；

4) 支持IPX协议的Cisco IOS。

18.7.2 配置概述

本实验主要探讨Cisco路由器中SAP公告的工作原理。我们将在路由器上静态配置服务公告协议项，研究它是如何工作的。在 IPX网络中，SAP公告占用较宽的带宽资源， Cisco IOS允许静态设定SAP入口。另外，还将讨论Cisco路由器是如何过滤SAP更新公告的。

三台路由器的连接方法如图 18-8所示，本实验定义了五个 IPX网络，路由器A、B和C被分别配以IPX节点号a.a.a、b.b.b和c.c.c。

在本实验中，路由器B作为DCE为路由器A和C提供时钟信号。

注意 虽然在WAN中没有运行IPX RIP/SAP，但仍然可以看到在网络中传播了SAP更新公告。

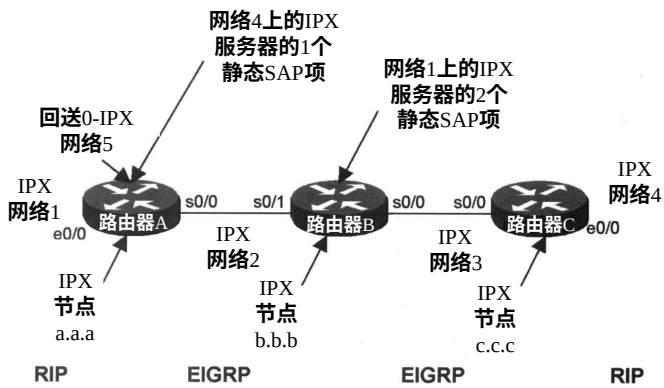

图18-8 IPX SAP

18.7.3 路由器配置

本实验中三台路由器的配置情况如下：

1. 路由器A

```
Current configuration:
!
version 11.2
no service password-encryption
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterA
!
!
ipx routing 000a.000a.000a←Enable IPX routing. Define the IPX node to be 000a.000a.000a
!
interface Loopback0
 no ip address
 ipx network 5←Make this interface IPX network 5
!
interface Ethernet0/0
 no ip address
 no keepalive
 ipx network 1←Make this interface IPX network 1
!
interface Serial0/0
 no ip address
 encapsulation ppp
 ipx network 2←Make this interface IPX network 2
 no fair-queue
!
no ip classless
!
!
ipx router eigrp 1←Enable IPX EIGRP autonomous system 1
 network 2←Include IPX network 2 in EIGRP updates
!
!
ipx router rip←Enable IPX RIP on this router
 no network 2←Do not advertise IPX network 2 in RIP updates
!
!
ipx sap 4 Server4 4.00e0.1e5b.0a81 451 2←Define a static SAP entry on this
                                          router
!
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

2. 路由器B

```
Current configuration:
!
version 11.2
no service password-encryption
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterB
!
!
```

```
ipx routing 000b.000b.000b←Enable IPX routing. Define the IPX node to be 000b.000b.000b
!
interface Serial0/0
 no ip address
 encapsulation ppp
 ipx network 3←Make this interface IPX network 3
 no fair-queue
 clockrate 64000
!
interface Serial0/1
 no ip address
 encapsulation ppp
 ipx network 2
 clockrate 64000
!
no ip classless
!
!
ipx router eigrp 1←Enable IPX EIGRP autonomous system 1
 network all←Include all IPX networks in EIGRP advertisements
!
!
no ipx router rip←Do not enable IPX RIP on this router
!
ipx sap 4 Server1 1.00e0.1e5b.2601 451 1←Define a static SAP entry on this
                                         router
ipx sap 7 Server2 1.00e0.1e5b.2601 451 1←Define a static SAP entry on this
                                         router
!
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

3. 路由器C

```
Current configuration:
!
version 11.2
no service password-encryption
no service udp-small-servers
no service tcp-small-servers
!
hostname RouterC
!
!
ipx routing 000c.000c.000c←Enable IPX routing. Define the IPX node to be 000c.000c.000c
!
interface Ethernet0/0
 no ip address
 no keepalive
 ipx network 4←Make this interface IPX network 4
!
interface Serial0/0
 no ip address
 encapsulation ppp
 ipx network 3←Make this interface IPX network 3
 no fair-queue
!
no ip classless
!
!
ipx router eigrp 1←Enable IPX EIGRP autonomous system 1
 network 3←Include IPX network 3 in EIGRP updates
!
```

```
!
ipx router rip←Enable IPX RIP on this router
 no network 3←Do not advertise IPX network 3 in RIP updates
!
line con 0
line aux 0
line vty 0 4
 login
!
end
```

18.7.4 监测配置

从三台路由器的配置我们可以看出一共定义了三项静态 SAP入口：

1) 路由器A至位于IPX网络4上的服务器（服务器4）的静态SAP入口。

2) 路由器B至位于IPX网络1上的服务器（服务器1）的静态SAP入口。

3) 路由器B至位于IPX网络1上的另一台服务器（服务器2）的静态SAP入口。

连接到路由器A。用show ipx servers命令可以显示已知的IPX服务器，路由器A只知道一个IPX服务器即服务器4，这是我们在路由器A上静态设定的。为什么路由器A不知道我们在路由器B上静态设定的另外两个IPX服务器（服务器1和2）呢？为了弄清这一点，我们首先需理解RIP/SAP水平分割（split-horizon）的概念。RIP/SAP水平分割（split-horizon）就是路由器不会向它接收RIP路由或SAP服务公告信息的接口又发送 RIP路由或SAP公告。因此，由于在路由器B上静态配置的SAP入口分别指向路由器 A上的两个服务器，它就不会将这一信息再向路由器A发送，故路由器A并不知道我们在路由器B上静态设定的两个IPX服务器。

```
RouterA#show ipx servers
Codes: S - Static, P - Periodic, E - EIGRP, N - NLSP, H - Holddown, + = detail
1 Total IPX Servers

Table ordering is based on routing and server info

   Type    Name                    Net      Address      Port    Route Hops    Itf
S    4     Server4                 4.00e0.1e5b.0a81:0451        2707456/01     2
Se0/0
```

对于路由器B，show ipx servers命令显示路由器已知的IPX服务器为服务器1和2，这是我们在路由器B上静态设定的。为什么路由器 B不知道我们在路由器 A上静态设定的IPX服务器（服务器4）？这同样是由于水平分割（ split-horizon）的缘故。路由器 A的静态SAP入口指向IPX网络4，由于从路由器A到IPX网络4的下一跳为路由器B，在路由器A看来SAP公告信息是来自路由器B。因此它不会向路由器B发送SAP服务公告。

```
RouterB#show ipx servers
Codes: S - Static, P - Periodic, E - EIGRP, N - NLSP, H - Holddown, + = detail
2 Total IPX Servers

Table ordering is based on routing and server info

   Type  Name                    Net      Address      Port    Route Hops    Itf
S    4    Server1                 1.00e0.1e5b.2601:0451        2195456/01    1 Se0/1
S      7  Server2                 1.00e0.1e5b.2601:0451        2195456/01    1 Se0/1
```

对于路由器C，show ipx servers命令显示该路由器已知两个IPX服务器（服务器1和服务器2），这两个服务器就是我们在路由器 B上静态设定的。由于路由器 B对这些静态入口可以看成是从路由器A中学到的，因此路由器 B可以向路由器C传播其静态SAP入口，这不违反水平分割（split-horizon）规则。

```
RouterC#show ipx servers
Codes: S - Static, P - Periodic, E - EIGRP, N - NLSP, H - Holddown, + = detail
2 Total IPX Servers

Table ordering is based on routing and server info

   Type  Name                    Net      Address      Port    Route Hops   Itf
E     4  Server1                 1.00e0.1e5b.2601:0451        2707456/01   2 Se0/0
E     7  Server2                 1.00e0.1e5b.2601:0451        2707456/01   2 Se0/0
```

在路由器C上执行debug ipx sap activity和debug ipx sap events以进行SAP调试，如果设备没有与路由器的控制口相连，则需用term mon命令来将所有调试结果发送到调试终端上。

```
RouterC#debug ipx sap activity
IPX service debugging is on

RouterC#debug ipx sap events
IPX service events debugging is on
```

下面的输出每60秒重复一次。注意路由器C向IPX网络4发送SAP更新信息，公告两个IPX服务器（服务器1和2），而路由器B没有向路由器C发送任何SAP更新公告，因为路由器B和路由器C之间的广域网链路运行的是EIGRP路由协议，而不是RIP/SAP。

```
                                    RouterC broadcasts the SAP updates to the Ethernet
                                    LAN on Ethernet0/0
                                              ↓
IPXSAP: positing update to 4.ffff.ffff.ffff via Ethernet0/0 (broadcast) (full)
IPXSAP: Update type 0x2 len 160 src:4.00e0.1e5b.0a81 dest:4.ffff.ffff.ffff(452)
 type 0x4, "Server1", 1.00e0.1e5b.2601(451), 2 hops←RouterC advertises two IPX
                                                    servers to IPX network 4
 type 0x7, "Server2", 1.00e0.1e5b.2601(451), 2 hops
```

Cisco支持扩展的IPX过滤功能，Cisco IPX的一个特点就是能够过滤进入或出去的SAP更新信息，当为了安全目的不希望某些用户或网络知道具体的服务器时经常使用这一特性。我们可以修改路由器B的配置使得它只向路由器C发送关于服务器1（注意：不是服务器2）的IPX SAP服务公告信息。用config term命令进入路由器B的配置模式，输入全局命令access-list 1000 deny -1 7 Server2和access-list 1000 permit -1，接着由int s0/0进入端口配置模式，输入命令ipx output-sap-filter 1000，至此我们已经在路由器B上配置了访问列表，使得它发送的SAP更新信息中不包括SAP类型为7的IPX服务器，即服务器2。

```
RouterB#config term
Enter configuration commands, one per line. End with CNTL/Z.
RouterB(config)#access-list 1000 deny -1 7 Server2
RouterB(config)#access-list 1000 permit -1
RouterB(config)#
RouterB(config)#int s 0/0
RouterB(config-if)#ipx output-sap-filter 1000
RouterB(config-if)#exit
RouterB(config)#exit
RouterB#
```

在路由器B中输入上述访问列表的相关命令后，立即连接至路由器C，对它进行IPX SAP调试，可以得到如下的输出结果。注意，路由器C先是宣布服务器2不能到达（将该服务器的跳数设为16），接着才是将其删去，不再公告有关该服务器的SAP信息。

```
IPXEIGRP: Sending EIGRP SAP flash
IPXEIGRP: Received EIGRP SAP from 3.000b.000b.000b←EIGRP update received from
                                                    RouterB

IPXSAP: positing update to 4.ffff.ffff.ffff via Ethernet0/0 (broadcast) (full)
IPXSAP: Update type 0x2 len 160 src:4.00e0.1e5b.0a81 dest:4.ffff.ffff.ffff(452)
```

```
 type 0x4, "Server1", 1.00e0.1e5b.2601(451), 2 hops
 type 0x7, "Server2", 1.00e0.1e5b.2601(451), 16 hops←RouterC advertises
                                                      Server2 as being 16 hops
                                                      away. This means that it
                                                      is unreachable.
IPXSAP: server type 7 named Server2 metric 255 being deleted
IPX: SAP queue-hash deleted for type 7, count 2

IPXSAP: positing update to 4.ffff.ffff.ffff via Ethernet0/0 (broadcast) (full)
IPXSAP: Update type 0x2 len 96 src:4.00e0.1e5b.0a81 dest:4.ffff.ffff.ffff(452)
 type 0x4, "Server1", 1.00e0.1e5b.2601(451), 2 hops←RouterC no longer
                                                     advertises Server2

IPXSAP: positing update to 4.ffff.ffff.ffff via Ethernet0/0 (broadcast) (full)
IPXSAP: Update type 0x2 len 96 src:4.00e0.1e5b.0a81 dest:4.ffff.ffff.ffff(452)
 type 0x4, "Server1", 1.00e0.1e5b.2601(451), 2 hops←RouterC no longer
                                                     advertises Server2
```

用undebug all命令可以将所有调试功能全部关闭。

```
RouterC#undebug all
All possible debugging has been turned off
```

这时在路由器C上执行show ipx server命令将只能看到一个IPX服务器即服务器1。

```
RouterC#show ipx server
Codes: S - Static, P - Periodic, E - EIGRP, N - NLSP, H - Holddown, + = detail
1 Total IPX Servers

Table ordering is based on routing and server info

   Type  Name                  Net      Address      Port   Route Hops   Itf
E     4  Server1               1.00e0.1e5b.2601:0451     2707456/01   2   Se0/0
```

再连接至路由器B，运行show ipx sever命令显示所有已知服务器。可以发现尽管它过滤掉了发向路由器C的关于服务器2的更新信息，路由器B仍然知道两个服务器——服务器1和服务器2。

```
RouterB#show ipx server
Codes: S - Static, P - Periodic, E - EIGRP, N - NLSP, H - Holddown, + = detail
2 Total IPX Servers
Table ordering is based on routing and server info

   Type  Name                  Net      Address      Port   Route Hops   Itf
S     4  Server1               1.00e0.1e5b.2601:0451     2195456/01   1   Se0/1
S     7  Server2               1.00e0.1e5b.2601:0451     2195456/01   1   Se0/1
```

可以用show access-list命令来证实在路由器B上有一个被激活的访问列表。

```
RouterB#show access-list
IPX SAP access list 1000←Access List 1000
    deny FFFFFFFF 7 Server2←Do not send any updates to any network regarding
                            IPX Server2 with a server type of 7
    permit FFFFFFFF←Permit SAP updates to all other networks
```

现在去掉路由器B上的SAP过滤功能。进入到该路由器端口S0/0的配置模式，输入命令no ipx output-sap-filter 1000。

```
RouterB#config term
Enter configuration commands, one per line. End with CNTL/Z.
RouterB(config)#int s 0/0
RouterB(config-if)#no ipx output-sap-filter 1000
RouterB(config-if)#exit
RouterB(config)#exit
```

再连接至路由器C，几秒钟之后，就可以用show ipx server命令重新看到关于服务器2的信息。

```
RouterC#show ipx server
Codes: S - Static, P - Periodic, E - EIGRP, N - NLSP, H - Holddown, + = detail
2 Total IPX Servers

Table ordering is based on routing and server info

   Type  Name                          Net      Address     Port    Route Hops  Itf
E      4  Server1                       1.00e0.1e5b.2601:0451       2707456/01  2 Se0/0
E      7  Server2                       1.00e0.1e5b.2601:0451       2707456/01  2 Se0/0
                ↑
              The entry for Server2 will now be back in the IPX server list
```

下面在路由器C上设置SAP输入过滤，它将过滤掉进入该路由器的 SAP更新信息。进入路由器配置模式并输入相应access-list和ipx input-sap-filter语句。

```
RouterC#config term
Enter configuration commands, one per line. End with CNTL/Z.
RouterC(config)#access-list 1000 deny -1 4 Server1
RouterC(config)#access-list 1000 permit -1
RouterC(config)#exit
RouterC(config)#int s 0/0
RouterC(config-if)#ipx input-sap-filter 1000←Deny any incoming SAP advertisements
                                             that are for server type 4 and for a
                                             server named Server1.
RouterC(config-if)#exit
RouterC#
```

几分钟之后在路由器C上执行show ipx server命令，将看不到关于服务器1的SAP信息，因为它已经被路由器C过滤掉了。

```
RouterC#sh ipx server
Codes: S - Static, P - Periodic, E - EIGRP, N - NLSP, H - Holddown, + = detail
1 Total IPX Servers

Table ordering is based on routing and server info

   Type  Name                          Net      Address     Port    Route Hops  Itf
E      7  Server2                       1.00e0.1e5b.2601:0451       2707456/01  2 Se0/0
```

Cisco IOS也支持扩展的路由过滤功能，输出路由过滤使到某些网络的路由不被发送到其它路由器，输入路由过滤使外部路由不进入到本地路由器的 IPX路由表。我们先来看输出路由过滤，在路由器C上执行show ipx route查看其IPX路由表，可以看出它通过EIGRP路由协议发现了IPX网络1、2和5。

```
RouterC#show ipx route
Codes: C - Connected primary network,     c - Connected secondary network
       S - Static, F - Floating static, L - Local (internal), W - IPXWAN
       R - RIP, E - EIGRP, N - NLSP, X - External, A - Aggregate
       s - seconds, u - uses

5 Total IPX routes. Up to 1 parallel paths and 16 hops allowed.

No default route known.

C           3 (PPP),           Se0/0
C           4 (NOVELL-ETHER),  Et0/0

Routes to networks 1, 2, and 5 are learned via EIGRP
↓
E           1 [2707456/1] via          3.000b.000b.000b, age 00:03:23,
                                       4u, Se0/0
E           2 [2681856/0] via          3.000b.000b.000b, age 00:03:24,
                                       1u, Se0/0
E           5 [2809856/1] via          3.000b.000b.000b, age 00:03:24,
                                       1u, Se0/0
```

连接到路由器A，进入配置模式，输入下面的access-list和distribute-list命令。distribute-list随EIGRP一起使用以过滤路由，而access-list将使得路由器A不发送有关IPX网络5的任何信息。

```
RouterA#config term
Enter configuration commands, one per line. End with CNTL/Z.
RouterA(config)#access-list 810 deny 5←Do not advertise IPX network 5
RouterA(config)#access-list 810 permit -1←Advertise all other IPX networks
RouterA(config)#
RouterA(config)#router eigrp 1
RouterA(config-ipx-router)#distribute-list 810 out
RouterA(config-ipx-router)#exit
RouterA(config)#exit
```

连接到路由器C，稍过一段时间执行命令show ipx route就会发现至IPX网络5的路由在其路由表中已经不存在了。

```
RouterC#sh ipx route
Codes: C - Connected primary network,     c - Connected secondary network
       S - Static, F - Floating static, L - Local (internal), W - IPXWAN
       R - RIP, E - EIGRP, N - NLSP, X - External, A - Aggregate
       s - seconds, u - uses

4 Total IPX routes. Up to 1 parallel paths and 16 hops allowed.

No default route known.

C           3 (PPP),           Se0/0
C           4 (NOVELL-ETHER),  Et0/0
E           1 [2707456/1] via        3.000b.000b.000b, age 00:00:34,
                                2u, Se0/0
E           2 [2681856/0] via        3.000b.000b.000b, age 00:09:09,
                                1u, Se0/0
```

连接到路由器B。用show ipx route同样可以发现至IPX网络5的路由在该路由器的路由表中也已经被删去了，说明路由器A对路由器B或C都已经不再公告至IPX网络5的路由。

```
RouterB#sh ipx route
Codes: C - Connected primary network,     c - Connected secondary network
       S - Static, F - Floating static, L - Local (internal), W - IPXWAN
       R - RIP, E - EIGRP, N - NLSP, X - External, A - Aggregate
       s - seconds, u - uses

4 Total IPX routes. Up to 1 parallel paths and 16 hops allowed.

No default route known.

C           2 (PPP),           Se0/1
C           3 (PPP),           Se0/0
E           1 [2195456/1] via        2.000a.000a.000a, age 00:01:52,
                      15u, Se0/1
E           4 [2195456/1] via        3.000c.000c.000c, age 00:01:53,
                      7u, Se0/0
```

接着我们在路由器C上设置输入路由过滤。进入路由器C配置模式，输入下面的access-list和distribute-list命令，其中access-list将使得路由器C过滤掉进入的任何有关IPX网络1的公告信息。

```
RouterC#config term
Enter configuration commands, one per line. End with CNTL/Z.
RouterC(config)#access-list 820 deny 1←Filter out any routing updates for IPX
                                        network 1
RouterC(config)#access-list 820 permit -1
RouterC(config)#
RouterC(config)#ipx router eigrp 1
```

```
RouterC(config-ipx-router)#distribute-list 820 in
RouterC(config-ipx-router)#exit
RouterC(config)#exit
```

这时在路由器C上执行show ipx route命令，可以发现至IPX网络1的路由在该路由器的路由表中已经被删去了。

```
RouterC#sh ipx route
Codes: C - Connected primary network,     c - Connected secondary network
       S - Static, F - Floating static, L - Local (internal), W - IPXWAN
       R - RIP, E - EIGRP, N - NLSP, X - External, A - Aggregate
       s - seconds, u - uses

3 Total IPX routes. Up to 1 parallel paths and 16 hops allowed.

No default route known.

C           3 (PPP),           Se0/0
C           4 (NOVELL-ETHER),  Et0/0
E           2 [2681856/0] via         3.000b.000b.000b, age 00:00:08,
                  1u, Se0/0
```

而对于路由器B，执行show ipx route命令查看路由表。可以得知，在该路由器的路由表中至IPX网络1的路由仍然存在，这是因为只是当这条路由信息进入路由器 C时才将其过滤掉，而在路由器B上并不对其进行过滤。

```
RouterB#sh ipx route
Codes: C - Connected primary network,     c - Connected secondary network
       S - Static, F - Floating static, L - Local (internal), W - IPXWAN
       R - RIP, E - EIGRP, N - NLSP, X - External, A - Aggregate
       s - seconds, u - uses

4 Total IPX routes. Up to 1 parallel paths and 16 hops allowed.

No default route known.

C           2 (PPP),           Se0/1
C           3 (PPP),           Se0/0
E           1 [2195456/1] via         2.000a.000a.000a, age 00:03:40,
                  27u, Se0/1
E           4 [2195456/1] via         3.000c.000c.000c, age 00:00:23,
                  2u, Se0/0
```

18.8 IPX故障查找

本节将讨论主要的IPX监测和故障排除命令。

show ipx interface brief 该命令可以用于获取路由器上所有运行IPX协议的端口状态的概要信息。

```
RouterA#show ipx interface brief
Interface             IPX Network Encapsulation Status                IPX State
Ethernet0/0           1           NOVELL-ETHER  up                    [up]
Serial0/0             2           PPP           up                    [up]
BRI0/0                unassigned  not config'd  administratively down n/a
BRI0/0:1              unassigned  not config'd  administratively down n/a
BRI0/0:2              unassigned  not config'd  administratively down n/a
Ethernet1/0           unassigned  not config'd  administratively down n/a
Serial1/0             unassigned  not config'd  administratively down n/a
Serial1/1             unassigned  not config'd  administratively down n/a
Loopback0             5           UNKNOWN       up                    [up]
```

show ipx route 该命令用于显示路由器的路由表。例如，从路由器 A的路由表可以看到有

三个直接相连的IPX网络：网络1与以太网接口e0/0直连、网络2与串口S0/0直连、网络5与环路接口0直连。该路由器还通过IPX RIP路由协议找到了两个远端网络：网络3，距离为1跳、7嘀嗒；网络4，距离为2跳、13嘀嗒。

```
RouterA#show ipx route
Codes: C - Connected primary network,     c - Connected secondary network
       S - Static, F - Floating static, L - Local (internal), W - IPXWAN
       R - RIP, E - EIGRP, N - NLSP, X - External, A - Aggregate
       s - seconds, u - uses

5 Total IPX routes. Up to 1 parallel paths and 16 hops allowed.

No default route known.

C           1 (NOVELL-ETHER),   Et0/0
C           2 (PPP),            Se0/0
C           5 (UNKNOWN),        Lo0

                Tick Count          Next hop address
                    ↓                   ↓
R           3 [07/01] via               2.000b.000b.000b,    49s, Se0/0
                          ↑
                          Hop Count to destination network

                Tick Count          Next hop address
                    ↓                   ↓
R           4 [13/02] via               2.000b.000b.000b,    50s, Se0/0
                          ↑
                          Hop Count to destination network
```

show interface**该命令列出哪些链路控制协议已经开放，以及有关流量和线路电气状态的一些信息。**

```
RouterA#show int 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
  Open: CDPCP, IPXCP←No IP is enabled on this interface
  Last input 00:00:01, output 00:00:01, 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
     99 packets input, 3888 bytes, 0 no buffer←Packets input
  Received 99 broadcasts, 0 runts, 0 giants, 0 throttles
  0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
  100 packets output, 3902 bytes, 0 underruns←Packets output
  0 output errors, 0 collisions, 16 interface resets
  0 output buffer failures, 0 output buffers swapped out
  31 carrier transitions
  DCD=up   DSR=up   DTR=up   RTS=up   CTS=up
```

show ipx interface**使用该命令可以知道运行IPX协议的某接口的具体信息，包括端口的IPX地址以及IPX路由、过滤和SAP信息。**

```
RouterA#show ipx int s 0/0
Serial0/0 is up, line protocol is up
  IPX address is 2.000a.000a.000a [up]←IPX address

                                      A WAN interface has a default IPX
                                      delay of 6.
                                       ↓
```

```
Delay of this IPX network, in ticks is 6 throughput 0 link delay 0
IPXWAN processing not enabled on this interface.
IPX SAP update interval is 1 minute(s)
IPX type 20 propagation packet forwarding is disabled
Incoming access list is not set
Outgoing access list is not set
IPX helper access list is not set
SAP GNS processing enabled, delay 0 ms, output filter list is not set
SAP Input filter list is not set
SAP Output filter list is not set
SAP Router filter list is not set
Input filter list is not set
Output filter list is not set
Router filter list is not set
Netbios Input host access list is not set
Netbios Input bytes access list is not set
Netbios Output host access list is not set
Netbios Output bytes access list is not set
Updates each 60 seconds, aging multiples RIP: 3 SAP: 3
SAP interpacket delay is 55 ms, maximum size is 480 bytes
RIP interpacket delay is 55 ms, maximum size is 432 bytes
Watchdog processing is disabled, SPX spoofing is disabled, idle time 60
IPX accounting is disabled
IPX fast switching is configured (enabled)
RIP packets received 9, RIP packets sent 9←RIP is running on this interface
SAP packets received 1, SAP packets sent 1←SAP is running on this interface
```

ping ipx IPX　**在诊断功能方面比IP网络要受限得多，唯一一个可用于检查网络连接性的测试工具是**ping ipx**命令。**

```
RouterA#ping ipx 2.b.b.b←ping RouterB

Type escape sequence to abort.
Sending 5, 100-byte IPX cisco Echoes to 2.000b.000b.000b, timeout is 2 seconds:
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 28/29/32 ms
```

show ipx traffic　**该命令显示路由器上所有接口的流量信息以及用户数据流量、路由协议和**SAP**统计信息。**

```
RouterC#show ipx traffic
System Traffic for 0.0000.0000.0001 System-Name: RouterC
Rcvd:     36 total, 0 format errors, 0 checksum errors, 0 bad hop count,
          0 packets pitched, 36 local destination, 0 multicast
Bcast:    16 received, 29 sent
Sent:     50 generated, 0 forwarded
          0 encapsulation failed, 0 no route
SAP:      1 SAP requests, 0 SAP replies, 0 servers
          0 SAP Nearest Name requests, 0 replies
          0 SAP General Name requests, 0 replies
          5 SAP advertisements received, 4 sent
          2 SAP flash updates sent, 0 SAP format errors
RIP:      1 RIP requests, 0 RIP replies, 5 routes
          9 RIP advertisements received, 18 sent
          2 RIP flash updates sent, 0 RIP format errors
Echo:     Rcvd 5 requests, 15 replies
          Sent 15 requests, 5 replies
          0 unknown: 0 no socket, 0 filtered, 0 no helper
          0 SAPs throttled, freed NDB len 0
Watchdog:
          0 packets received, 0 replies spoofed
Queue     lengths:
          IPX input: 0, SAP 0, RIP 0, GNS 0
          SAP throttling length: 0/(no limit), 0 nets pending lost route reply
          Delayed process creation: 0
EIGRP:    Total received 0, sent 0
```

```
            Updates received 0, sent 0
            Queries received 0, sent 0
            Replies received 0, sent 0
            SAPs received 0, sent 0
NLSP:       Level-1 Hellos received 0, sent 0
            PTP Hello received 0, sent 0
            Level-1 LSPs received 0, sent 0
            LSP Retransmissions: 0
            LSP checksum errors received: 0
            LSP HT=0 checksum errors received: 0
            Level-1 CSNPs received 0, sent 0
            Level-1 PSNPs received 0, sent 0
            Level-1 DR Elections: 0
            Level-1 SPF Calculations: 0
            Level-1 Partial Route Calculations: 0
```

show ipx eigrp neighbor **执行该命令将显示通过**EIGRP**路由协议所发现的相邻路由器的信息。**

```
RouterA#show ipx eigrp neigh

IPX EIGRP Neighbors for process 1
H    Address                 Interface     Hold Uptime    SRTT       RTO     Q  Seq
                                           (sec)          (ms)           Cnt Num
0    2.000b.000b.000b        Se0/0           13 02:10:19    53    318     0  38
```

show ipx eigrp interfaces **该命令将列出路由器上运行**EIGRP**的所有接口。**

```
RouterA#show ipx eigrp interfaces

IPX EIGRP Interfaces for process 1

                      Xmit Queue    Mean    Pacing Time    Multicast      Pending
Interface     Peers   Un/Reliable   SRTT    Un/Reliable    Flow Timer     Routes
Se0/0           1       0/0          53       0/15           263            0
↑
Interface S0/0 is running EIGRP.
```

show ipx eigrp traffic **该命令显示路由器上接收/发送的**EIGRP**流量的大小。**

```
RouterB#show ipx eigrp traffic
IP-EIGRP Traffic Statistics for process 1
  Hellos sent/received: 3433/3430
  Updates sent/received: 11/11
  Queries sent/received: 10/7
  Replies sent/received: 7/10
  Acks sent/received: 37/33
  Input queue high water mark 2, 0 drops
```

show ipx servers **该可执行命令列出所有静态配置或通过** SAP**公告发现的**IPX**服务器。**

```
RouterA#show ipx servers
Codes: S - Static, P - Periodic, E - EIGRP, N - NLSP, H - Holddown, + = detail
1 Total IPX Servers

Table ordering is based on routing and server info

   Type  Name                          Net      Address      Port    Route Hops  Itf
S      4  Server4                       4.00e0.1e5b.0a81:0451       2707456/01  2
Se0/0
```

show access-list **该可执行命令显示路由器上定义的访问列表的信息。**

```
RouterB#show access-list
IPX SAP access list 1000←Access List 1000
     deny FFFFFFFF 7 Server2←Do not send any updates to any network regarding
                             IPX Server2 with a server type of 7
     permit FFFFFFFF←Permit SAP updates to all other networks
```

debug ipx routing activity

debug ipx routing events **这两条命令用于调试时显示IPX RIP路由活动的信息。**

```
RouterB#debug ipx routing activity
IPX routing debugging is on

RouterB#debug ipx routing events
IPX routing events debugging is on
```

debug ipx sap activity

debug ipx sap events **这两条调试命令用于提供路由器接收/发送的SAP包的信息。**

```
RouterC#debug ipx sap activity
IPX service debugging is on

RouterC#debug ipx sap events
IPX service events debugging is on
```

18.9 结论

本章讨论了Novell IPX网络协议。虽然Novell IPX的流行程度正在下降，但它依然被广泛使用。本章的动手实验覆盖了Novell IPX网络协议的核心内容，如：

- **基本的IPX配置和监测；**
- IPX EIGRP**配置；**
- **静态IPX SAP入口；**
- IPX SAP**和路由的过滤。**