CHAPTER 25

Chapter Goals

- Describe when to use source-route bridging.
- Understand the difference between SRB and transparent bridging.
- Know the mechanism that end stations use to specify a source-route.
- Understand the basics of source-route frame formats.

Source-Route Bridging

Background

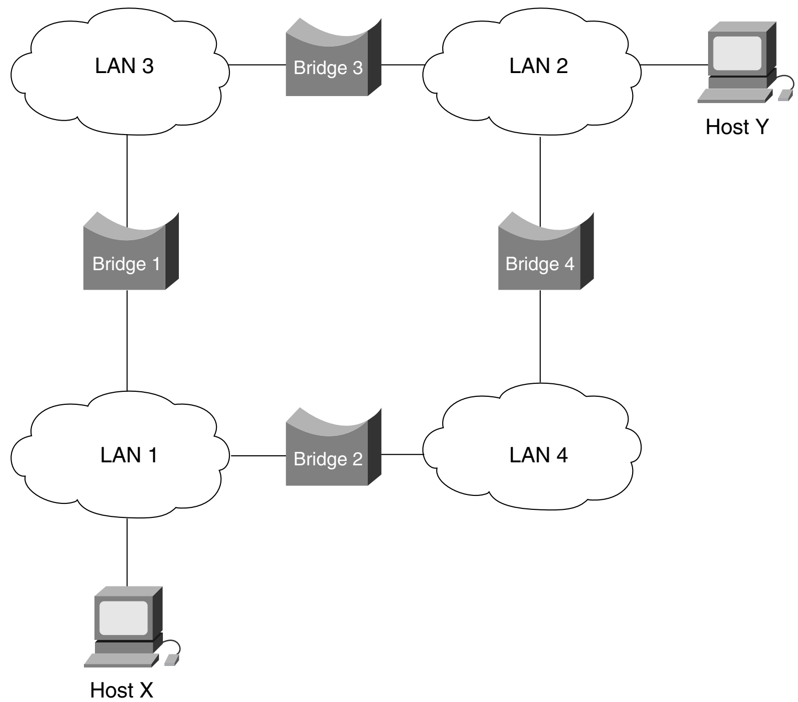
The source-route bridging (SRB) algorithm was developed by IBM and was proposed to the IEEE 802.5 committee as the means to bridge between all LANs. Since its initial proposal, IBM has offered a new bridging standard to the IEEE 802 committee: the source-route transparent (SRT) bridging solution. SRT bridging eliminates pure SRBs, proposing that the two types of LAN bridges be transparent bridges and SRT bridges. Although SRT bridging has achieved support, SRBs are still widely deployed. SRT is covered in Chapter 24, "Mixed-Media Bridging." This chapter summarizes the basic SRB frame-forwarding algorithm and describes SRB frame fields.

SRB Algorithm

SRBs are so named because they assume that the complete source-to-destination route is placed in all inter-LAN frames sent by the source. SRBs store and forward the frames as indicated by the route appearing in the appropriate frame field. Figure 25-1 illustrates a sample SRB network.

In Figure 25-1, assume that Host X wants to send a frame to Host Y. Initially, Host X does not know whether Host Y resides on the same LAN or a different LAN. To determine this, Host X sends out a test frame. If that frame returns to Host X without a positive indication that Host Y has seen it, Host X assumes that Host Y is on a remote segment.

Figure 25-1 An SRB Network Contains LANs and Bridges



To determine the exact remote location of Host Y, Host X sends an explorer frame. Each bridge receiving the explorer frame (Bridges 1 and 2, in this example) copies the frame onto all outbound ports. Route information is added to the explorer frames as they travel through the internetwork. When Host X's explorer frames reach Host Y, Host Y replies to each individually, using the accumulated route information. Upon receipt of all response frames, Host X chooses a path based on some predetermined criteria.

In the example in Figure 25-1, this process will yield two routes:

- LAN 1 to Bridge 1 to LAN 3 to Bridge 3 to LAN 2
- LAN 1 to Bridge 2 to LAN 4 to Bridge 4 to LAN 2

Host X must select one of these two routes. The IEEE 802.5 specification does not mandate the criteria that Host X should use in choosing a route, but it does make several suggestions, including the following:

- First frame received
- Response with the minimum number of hops
- Response with the largest allowed frame size
- Various combinations of the preceding criteria

In most cases, the path contained in the first frame received is used.

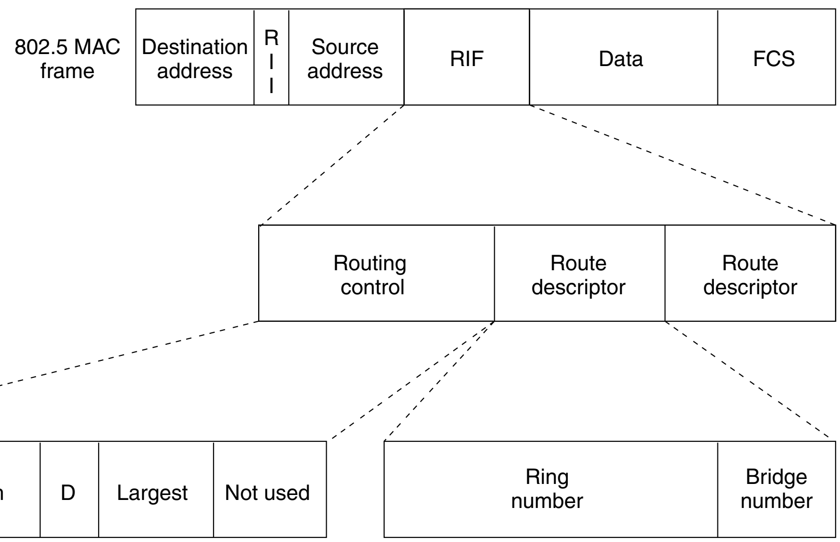
After a route is selected, it is inserted into frames destined for Host Y in the form of a *routing information field (RIF)*. A RIF is included only in those frames destined for other LANs. The presence of routing information within the frame is indicated by setting the most significant bit within the Source Address field, called the *routing information indicator (RII)* bit.

Frame Format

The IEEE 802.5 RIF is structured as shown in Figure 25-2.

The RIF illustrated in Figure 25-2 consists of two main fields: Routing Control and Routing Designator. These fields are described in the summaries that follow.

Figure 25-2 An IEEE 802.5 RIF Is Present in Frames Destined for Other LANs



Routing Control Field

The Routing Control field consists of four subfields: Type, Length, D Bit, and Largest Frame. The fields are summarized in the following list:

- **Type**—Consists of three possible types of routing controls:
  - **Specifically routed**—Used when the source node supplies the route in the RIF header. The bridges route the frame by using the route designator field(s).
  - **All paths explorer**—Used to find a remote node. The route is collected as the frame traverses the network. Bridges add to the frame their bridge number and the ring number onto which the frame is forwarded. (The first bridge also adds the ring number of the first ring.) The target destination will receive as many frames as routes to that destination.
  - **Spanning-tree explorer**—Used to find a remote node. Only bridges in the spanning tree forward the frame, adding their bridge number and attached ring number as it is forwarded. The spanning-tree explorer reduces the number of frames sent during the discovery process.
- **Length**—Indicates the total length (in bytes) of the RIF. The value can range from 2 to 30 bytes.
- **D Bit**—Indicates and controls the direction (forward or reverse) that the frame traverses. The D bit affects whether bridges read the ring number/bridge number combinations in the route designators from right to left (forward) or from left to right (reverse).
- **Largest Frame**—Indicates the largest frame size that can be handled along a designated route. The source initially sets the largest frame size, but bridges can lower it if they cannot accommodate the requested size.

Routing Designator Fields

Each routing designator field consists of two subfields:

- **Ring Number (12 bits)**—Assigns a value that must be unique within the bridged network.
- **Bridge Number (4 bits)**—Assigns a value that follows the ring number. This number does not have to be unique unless it is parallel with another bridge connecting two rings.

Bridges add to the frame their bridge number and the ring number onto which the frame is forwarded. (The first bridge also adds the ring number of the first ring.)

Routes are alternating sequences of ring and bridge numbers that start and end with ring numbers. A single RIF can contain more than one routing designator field. The IEEE specifies a maximum of 14 routing designator fields (a maximum of 13 bridges or hops because the last bridge number always equals zero).

Until recently, IBM specified a maximum of eight routing designator fields (a maximum of seven bridges or hops), and most bridge manufacturers followed IBM's implementation. Newer IBM bridge software programs combined with new LAN adapters support 13 hops.

Review Questions

Q—*Describe a basic difference between transparent bridges and source-route bridges relative to the forwarding processes.*

A—In a transparent bridged environment, bridges determine whether a frame needs to be forwarded, and through what path based upon local bridge tables. In an SRB network, the source device prescribes the route to the destination and indicates the desired path in the RIF.

Q—*Recall that the SRB standards do not specify how a source selects a path to the destination whenever multiple choices exist. The chapter listed four methods that a source could use to make the decision and said that the first received frame (path) was the most commonly used method. What assumptions might the source make about the network when using this method?*

A—The source may assume that the frame arrived first because of more bandwidth on the links, less congestion in the system, and less latency in the bridge equipment. Therefore, this may be a preferred route over the other choices.

Q—*How do stations and bridges know if there is a source route defined in the frame?*

A—By the value of the RII bit. The RII is set if there is a RIF included in the frame.

Q—*What problems might you anticipate in a large SRB network with many alternate paths?*

A—With this network topology, many explorer frames may propagate throughout the network. Because explorers are broadcast frames, they consume bandwidth throughout the entire broadcast domain and consume CPU cycles within end stations.

Q—*Because only 4 bits are used to define bridge numbers, does this mean that there can be only 16 bridges (2^4=16)? Why or why not?*

A—No. This means only that there can be no more than 16 bridges in parallel between the same two adjacent rings.

Q—*Can you have a large number of bridges attached to a central ring, all with the same bridge value?*

A—Yes, as long as none of the bridges directly interconnects the same two rings.

Q—*A 12-bit value defines ring numbers. Can you have more than 4096 rings in the network (2^{12}=4096)? Why or why not?*

A—No, you cannot, because this value defines the total number of rings. Each ring number must be unique in the network.

For More Information

Computer Technology Research Corporation. *The IBM Token Ring Network*. New York: Prentice Hall, 1990.

IEEE. "IEEE Standard for Local Area Networks: Token Ring Physical Layer Specifications." June 1989.

Although not directly related to source-route bridging, an effort to define a high-speed Token Ring standard for IEEE 802.5 is underway. Details may be monitored at the Web site http://www.hstra.com/.