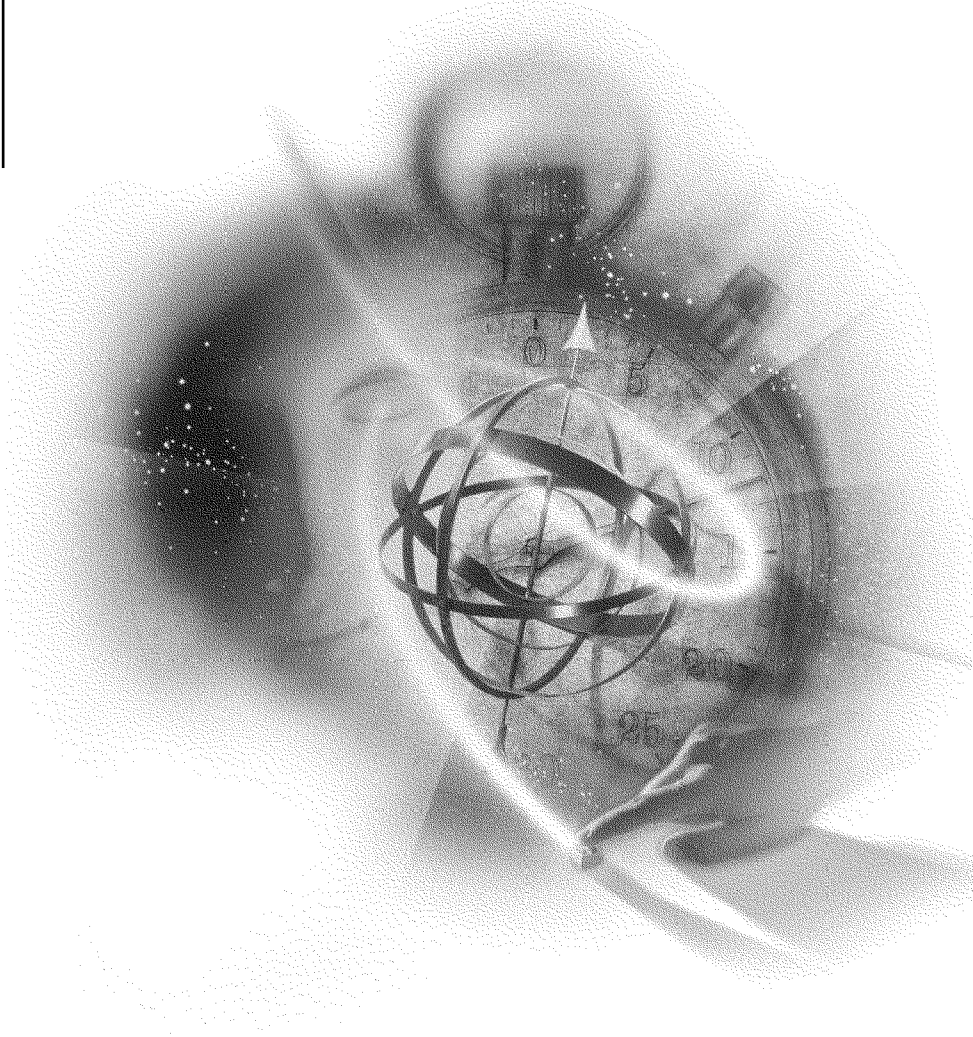


**Source Route Bridge**



**Connectivity Services**

**Novell®**

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# About This Guide

This guide provides the information you need to configure and manage the Novell Internet Access Server 4.1 source route bridge software. In addition to planning information, this guide provides troubleshooting tips, techniques, and tools, as well as the symptoms of and solutions to commonly occurring problems for the source route bridge components of Novell Internet Access Server 4.1.





# 1

## Understanding

This section describes the various functions and features of the Novell<sup>®</sup> implementation of source route bridging included in the Novell Internet Access Server 4.1 routing software. Many of the functions and features of the source route bridge software are described in terms of how the software can be configured to provide the most commonly required applications.

Novell source route bridge software enables you to link token ring networks and create an extended network. This functionality is compatible with the source route bridging mechanism used by IBM\* to handle the flow of data between token ring networks. Source route bridging allows supporting end stations to discover routes dynamically and determine which one to use when sending data to any particular destination.

Novell Internet Access Server 4.1 supports concurrent routing and bridging of all major protocols. Novell Internet Access Server 4.1 can be configured to route or bridge the Internetwork Packet Exchange<sup>™</sup> (IPX<sup>™</sup>) protocol, TCP/IP protocol, and AppleTalk protocol, and to bridge unroutable protocols such as IBM's NetBIOS and SNA. Because you cannot bridge and route the same protocol on the same interface, Novell Internet Access Server 4.1 also provides a mechanism for automatically disabling bridging for a given protocol, when routing of that protocol is enabled.

Novell Internet Access Server 4.1 can also bridge over point-to-point (PPP), X.25, and frame relay wide area telecommunications links. Multiple PPP links, X.25 virtual circuits, and frame relay virtual circuits can be used to connect multiple remote sites or to create backup links between two locations, providing fault tolerance if one link fails.

The use of source route bridging prevents packets sent between end stations on the same ring from passing on to other connected rings. Preventing extraneous traffic across networks increases the available bandwidth on all networks. Performance can be further enhanced by limiting traffic through the

use of custom filters that permit packets from certain stations to pass while blocking packets from other stations. The filter can also increase network security by not allowing users on one ring to access another ring that contains sensitive information.

As token ring networks have grown, they have become increasingly difficult to manage. The standards-based SNMP management protocol allows organizations to install equipment from multiple vendors and manage the entire network from one centralized monitoring console. Novell Internet Access Server 4.1 supports IBM LAN Network Manager and the SNMP MIB variables, as defined in RFC 1286, Bridging MIB. These MIB variables can be managed using the Novell ManageWise<sup>®</sup> product or any other SNMP-based management console.

## Route Discovery

Source route bridging provides end stations (clients and hosts) with the ability to discover routes dynamically and determine which one to use when sending data to a particular destination. Depending on your network configuration and the route selection algorithm used, several routes can be discovered for each destination. The source examines the available routes and then determines the best route to use when sending data.

For more information about route discovery, refer to:

- ◆ Explorer Frames
- ◆ Route End Station Implementation
- ◆ Spanning Tree Protocol

## Explorer Frames

An end station can be configured to begin the route discovery process using either of two general methods:

- ◆ Originating a single-route explorer frame
- ◆ Originating an all-routes explorer frame

**NOTE:** This guide uses the terms *all-routes explorer frame* and *single-route explorer frame*. In IBM literature, these frames are called *all-routes broadcast frame* and *single-route broadcast frame*, respectively. In RFCs, the term *spanning tree explorer frame* is equivalent to the term *single-route explorer frame*.

For more information about explorer frames, refer to:

- ◆ Originating a Single-Route Explorer Frame
- ◆ Originating an All-Routes Explorer Frame
- ◆ Advantages of Each Type of Explorer Frame

## Originating a Single-Route Explorer Frame

By default, the Novell end station implementation originates route discovery using single-route explorer frames. When the end station sends out a single-route explorer frame, it travels over a single route that is configured manually or determined automatically by the Spanning Tree Protocol. This protocol uses the configuration of each bridge in the network to determine a single route, as described in “Spanning Tree Protocol.”

With this method, the destination receives only one explorer frame, resulting in considerably less traffic than the use of all-routes explorer frames (as described in the next section).

When the destination receives an explorer frame, it can respond in one of three ways:

- ◆ With a specifically routed frame
- ◆ With an all-routes explorer frame
- ◆ With a single-route explorer frame

A specifically routed frame uses the information contained in the original explorer frame to take the same route back to the source. An all-routes explorer frame is propagated and takes all possible routes back to the source. Single-route explorer frames behave as described at the beginning of this section.

**NOTE:** The Novell implementation does not support a response with a single-route explorer frame. It responds with only a specifically routed frame or an all-routes explorer frame, the default being an all-routes explorer frame.

When the all-routes explorer frame is received by the destination, it chooses the best route based on one of the following criteria:

- ◆ Which frame is received first (the fastest route)
- ◆ Which route has the least number of hops (the shortest route)
- ◆ Which route uses the largest frame size (the widest route)

The criteria used to choose the route is determined by the end station implementation. Novell's implementation chooses the route traveled by the frame that is received first (the fastest route).

## Originating an All-Routes Explorer Frame

Route discovery begins when the source route end station generates an all-routes explorer frame and sends it to its local ring. As the process continues, each bridge examines the all-routes explorer frame to determine whether it has already been on any of the other rings attached to the bridge. If the frame has not been on one of the attached rings, it is forwarded to that ring. Because frames are not transmitted on rings on which they have previously traveled, no frame can follow the same route twice. With this mechanism, a frame is propagated in such a way that all possible routes to a destination are discovered, but no routes containing loops are received by the destination.

With this method, the destination receives one explorer frame for each possible route to the destination, resulting in considerably more traffic than the use of single-route explorer frames.

Depending on the implementation, the destination responds with one of three types of frames described earlier. The source then chooses the best route from all the frames it receives, based on the same criteria described in the previous section. As before, the criteria used are determined by the end station implementation.

## Advantages of Each Type of Explorer Frame

In comparing the two methods of route determination, using single-route explorer frames creates the least amount of traffic in the network. This method produces only one frame on the destination ring.

In contrast, the number of duplicate frames created by using all-routes explorer frames can increase route determination traffic to the point of significantly degrading network performance. However, if your network can handle the extra route discovery traffic, the use of all-routes explorer frames has two advantages:

- ♦ It allows for the discovery and use of alternate routes.
- ♦ It provides load sharing on bridges with two interfaces attached to the same bridged network.

**IMPORTANT:** If the destination responds with a single-route explorer frame or specifically routed frame to a single-route explorer frame, the source cannot choose the best route. For the source to choose the best route, the destination must respond with an all-routes explorer frame.

## Route End Station Implementation

For versions of Novell Internet Access Server 4.1 routing software and NetWare MultiProtocol Router™ software that provide end station support for source route bridging, the configuration of ROUTE.NLM determines how the end station responds to explorer frames. Any machine that is running both Novell Internet Access Server 4.1 routing software and NetWare server software is acting as an end station. ROUTE.NLM must be loaded on any bridged interface that allows bridged clients to access the server, as well as on the bridged clients themselves.

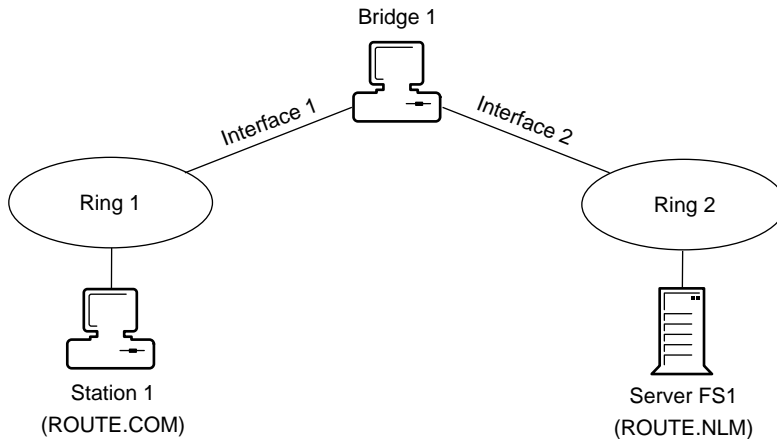
Because the SRBRIDGE.LAN driver (used for logical boards) is also required when the system running Novell Internet Access Server 4.1 routing software provides print and file services for bridged clients, ROUTE.NLM is loaded automatically when a board using the SRBRIDGE.LAN driver is configured in the Novell Internet Access Server Configuration utility (NIASCFG). For physical boards, load ROUTE.NLM by setting the Source Route Status option to Enabled in NIASCFG (parameter path: Select Configure NIAS > Protocols and Routing > Protocols > Source Route End Station ).

Although the functionality of ROUTE.NLM can be configured on a per-interface (board) basis, we recommend that you use the default functionality. For more information about the options available for each ROUTE.NLM parameter using, refer to “Setting Up” in the routing documentation for Source Route Bridge.

Any client node that will be attaching to a bridged server must load ROUTE.COM, the file that provides client support, as shown in Figure 1.

By default, the source route client (ROUTE.COM) begins the route discovery process by originating a single-route explorer frame. ROUTE.COM can be configured to use all-routes explorer frames as well, but this can degrade network performance by creating more traffic on the network.

**Figure 1** ROUTE.COM and ROUTE.NLM in a Bridged Token Ring Network



When a single-route explorer frame is sent by the client, it travels along a single-route (of forwarding interfaces) determined by the Spanning Tree Protocol. When this frame is received by the destination file server, the server responds with one of the following types of frames:

- ◆ All-routes explorer frame
- ◆ Specifically routed frame

The most efficient response is a specifically routed frame. A specifically routed frame travels along the single route that was discovered by the explorer frame sent from the client. This is possible because all explorer frames sent from the source keep track of the ID numbers of all the bridges and rings they traversed to reach the destination node.

By default, the Novell source route server end station software responds to a single-route explorer frame with an all-routes explorer frame. Although you can configure your network to respond to an explorer frame with a specifically routed frame, we recommend that you use the default settings.

**NOTE:** Before the 1994 release of the source route server end station software, the defaults were different. In the earlier releases, the source route server software responded with a specifically routed explorer frame and could also be configured to respond to an explorer frame with an all-routes explorer frame. We recommend that you use matching versions of ROUTE.NLM and ROUTE.COM throughout your source route bridge topology to maintain a consistent mode of operation.

When the source receives responses from the destination, the source route end station software determines which one of the three criteria described on Which

frame is received first (the fastest route) it uses to choose the best route. ROUTE.COM chooses the best route based on which frame is received first.

If the DEF (default) option is used, ROUTE.NLM responds in one of two ways:

- ◆ If the route between two nodes has already been determined and stored in the destination's routing table, resetting the source node causes it to issue a new single-route explorer frame to reestablish the route, and the destination responds with an all-routes explorer frame (because the route is already known).
- ◆ If the route is not in the routing table, a new single-route explorer frame from the source causes the destination to respond with an all-routes explorer frame (because the route is not already known).

When the destination responds with an all-routes explorer frame, the frame is propagated, as explained previously, and the (original) source receives one explorer frame for each route. Because each bridge encountered by the explorer frame records the bridge number and next ring number in the explorer frame's information field, each frame contains its own routing information. The fastest route is chosen.

## Spanning Tree Protocol

The Spanning Tree Protocol automatically discovers the route that single-route explorer frames use. By definition, a single-route explorer frame travels a single route to the destination. As well as being determined automatically by using the Spanning Tree Protocol, this single route can be set manually by configuring each bridge interface on the network to forward or block single-route explorer frames.

**IMPORTANT:** We strongly recommend that you use the Spanning Tree Protocol to configure your bridge interfaces automatically.

A forwarding interface passes the following types of frames:

- ◆ All-routes explorer frame
- ◆ Single-route explorer frame
- ◆ Specifically routed frame

A blocking interface passes the following types of frames:

- ◆ All-routes explorer frame

- ♦ Specifically routed frame

The Spanning Tree Protocol does not set all bridged interfaces automatically on a single Novell router to blocking mode. For clients and administrators to have access to bridged print/file services, network management, or other applications, at least one interface to each source route bridge must be able to forward packets.

For more information about spanning tree protocol, refer to:

- ♦ Advantages of Using the Spanning Tree Protocol
- ♦ Factors that Affect the Selection of the Best Route
- ♦ Setting Parameters for Automatic Mode

## **Advantages of Using the Spanning Tree Protocol**

By default, Novell Internet Access Server 4.1 uses the Spanning Tree Protocol. This automatic mode provides the most efficient and dynamic way to determine a single route because bridge interfaces reconfigure themselves automatically when other bridges fail. By configuring source route bridge interfaces in this way, they can automatically take advantage of the best available single route as other bridges go down or come up.

If you configure your network manually, you must ensure that there are no loops in the topology and that there is only one single-route path to any particular ring. It is also important to ensure that at least one single-route path is configured for each ring to maintain connectivity. Therefore, a great deal of effort is needed to effectively place each bridge and know its bridging mode. However, by carefully configuring the bridge interfaces in the network, you can create preferred routes for route determination, freeing those rings whose operation is most sensitive from most explorer frame traffic.

## **Factors that Affect the Selection of the Best Route**

One risk of using the Spanning Tree Protocol is that the single route between two rings that are physically close together might not be the most direct path between those rings. This risk can be reduced by designing your network with backbones. It can also be reduced by having stations respond to single-route explorer frames with all-routes explorer frames. The use of all-routes explorer frames allows the stations that have been separated logically to determine the faster, more direct paths; however, in larger networks with multiple paths, the all-routes explorer frames' responses increase network traffic. The types of



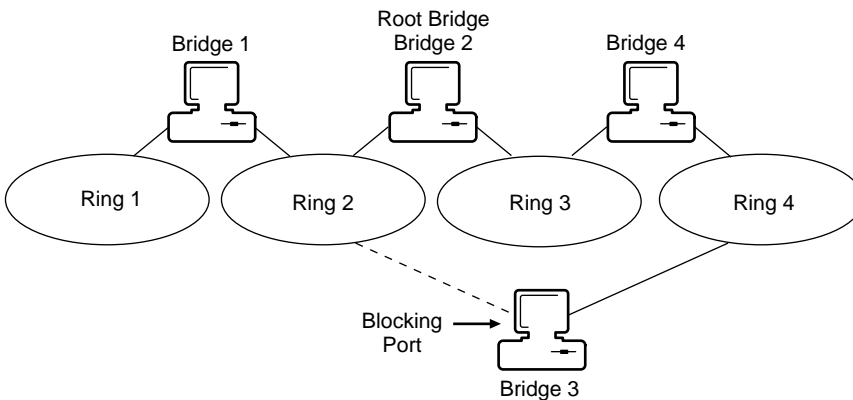
responses that are sent depend on how your software is configured. Refer to “Route End Station Implementation” on page 13 for a complete discussion of these issues.

Another way of ensuring that the most direct or most desirable route is selected by the Spanning Tree Protocol is to carefully select which bridge is assigned to maintain and forward network configuration information to all other bridges. This bridge is called the root bridge.

## Setting Parameters for Automatic Mode

The Spanning Tree Protocol uses a hierarchical control structure to determine which bridge interfaces are allowed to forward single-route explorer frames. Using the Spanning Tree Protocol ensures that there is only a single data path between any two end stations and eliminates data loops, as shown in Figure 2.

**Figure 2** Eliminating a Data Loop with the Spanning Tree Protocol



In this hierarchy, the root bridge receives topology change information (for example, if certain bridges have been disabled) and automatically forwards this information throughout the network.

For best results, all bridges (including other vendors' bridges) should have the same Spanning Tree mode enabled (either IEEE or IBM) for all interfaces. This mode allows the bridge to communicate with other bridges to determine whether it should set its interfaces to forward single-route explorer frames.

If you set any bridge interface to forward or block frames manually, you might cause loops or other problems. Therefore, you should not manually configure

any bridge unless you are extremely familiar with your network and the Spanning Tree Protocol.

The Bridge Label/Priority and Path Cost Increment parameters determine which paths on the network are used as the logical single route or spanning tree. These parameters are usually adjusted by an administrator, but a single path can be determined even if the default values are used.

The Bridge Label/Priority parameter has a default value of 8000. The default path cost is shown as zero at bridge startup time. In actual operation, this parameter changes depending on the microcode version of the interface board or, for remote bridges, the baud rate of the line that is connected to the bridge. If you change this parameter to a nonzero value, this value overrides the values that the bridge program otherwise calculates, and the nonzero value is inserted automatically.

## Bridge Roles and Port States

Depending on how the bridge interface parameters are configured (automatically or manually), a bridge assumes one of the following roles:

- ◆ Root bridge
- ◆ Designated bridge

The root bridge is at the top of the single-path hierarchy and should be assigned manually to ensure efficient network layout. It maintains and forwards network configuration information to all other bridges. The root bridge is centrally located in the single data path defined by the spanning tree configuration information exchanged. In Figure 2, Bridge 2 is the root bridge.

A designated bridge is one that has been designated to be on the single-path route and forward frames. In Figure 2, Bridge 1 and Bridge 4 are designated bridges.

There are two port states: *forwarding* and *blocking*. When a bridge interface has been configured for forwarding, the port forwards single-route explorer frames to the attached network segment. An interface that has been configured for blocking does not forward single-route explorer frames to the attached network segment. The Spanning Tree Protocol automatically assigns port states to create a single data path and eliminate loops. As shown in Figure 2, one port of Bridge 3 has been placed in a blocking state (the port connected to Ring 2). The designated bridges for Ring 2 are Bridge 1 and Bridge 2 (the root bridge).

## Factors Affecting Role Assignments

The main parameter that determines the role of a bridge is the Bridge Number parameter. This number is a hexadecimal value that is formed by appending the Bridge Label/Priority parameter value to the beginning of the MAC address of the interface board connected to the lowest-numbered ring. (The Bridge Label/Priority parameter value is the most significant bit of the Bridge Number parameter.) The bridge that has the lowest Bridge Number value is assigned the role of root bridge.

Because the root bridge should be centrally located on the network, its selection should not be left to chance. Because the Bridge Label/Priority parameter value is the most significant part of the Bridge Number parameter value, the most efficient way to determine the root bridge is to adjust the value of the Bridge Label/Priority parameter.

Once the root bridge is determined, all the other bridges negotiate with each other to determine which is assigned the role of designated bridge. The role of designated bridge is assumed by the bridge with the lowest path cost to the root bridge, or by the bridge with the lowest bridge ID (if the path costs are equal).

All path cost calculations are made from the root bridge outward. You can manually assign a path cost to a bridge, or the bridge software can calculate a path cost. The path cost is calculated as the sum of the costs of all the bridges between a given bridge and the root bridge. The path cost of the root bridge is always zero.

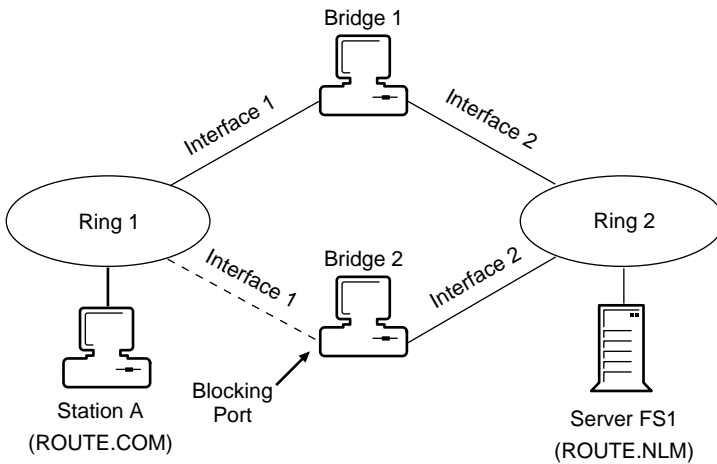
The root bridge keeps itself apprised of any changes in the network by sending out a Bridge Protocol Data Unit (BPDU). The BPDU contains the bridge ID of the root bridge, a path cost of zero, and some timing information. The BPDU is then received by any designated bridges on the rings directly connected to the root bridge.

Each designated bridge updates the path cost and timing information in the BPDU and transmits the updated BPDU to the other ring. As the BPDU travels through the network, the bridges use this information to determine whether they need to change roles. Whenever a bridge that is not a designated bridge does not receive a BPDU from the designated bridge within the maximum age timeout, it assumes the designated bridge is down, transmits a Topology Change BPDU, and begins the transition to a forwarding state.

For example, in Figure 3, Bridge 1 is the designated bridge connecting Ring 1 and Ring 2. If Bridge 1 fails, Bridge 2 becomes the designated bridge connecting Ring 1 and Ring 2 and its ports are changed to the forwarding state.

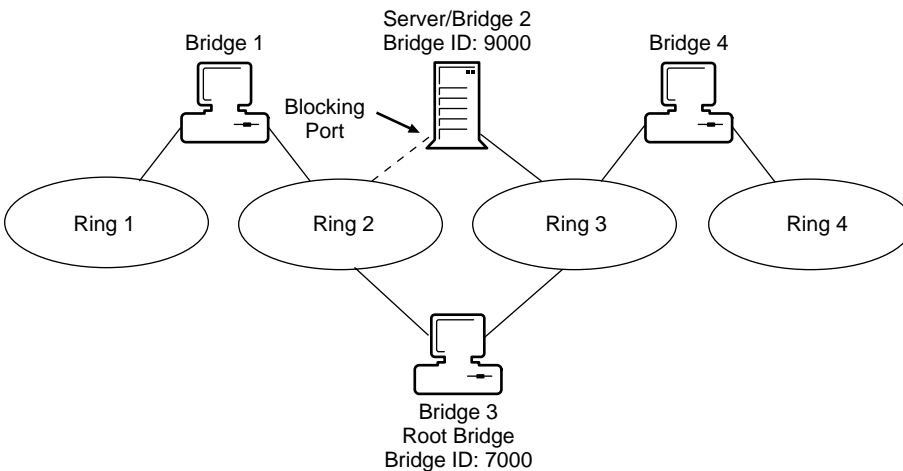
This reconfiguration occurs automatically when ports are configured with the Spanning Tree Mode option set to Automatic .

**Figure 3 Assigning a Designated Bridge**



Heavily used NetWare servers should be assigned a high Bridge Label/Priority parameter value so that they are less likely to be designated as a root bridge. For example, in Figure 4, Bridge 3 has been assigned the lowest Bridge Label/Priority parameter value so that it is likely to be designated as a root bridge.

**Figure 4 Determining the Root Bridge Based on the Bridge Number Parameter Value**



In addition, if Bridge 2 were a remote bridge (connected to the network with WAN links), you should assign the Bridge Label/Priority parameter a higher number (9000) to ensure that it is not selected as the root bridge. This ensures that the Spanning Tree Protocol does not cause the lower-cost link, such as a LAN link, to be blocked in favor of a higher-cost WAN link. In Figure 4, Bridge 1 and Bridge 4 have the Bridge Label/Priority parameter set to the default (8000) and the root bridge is assigned a lower Bridge Label/Priority parameter value (7000).

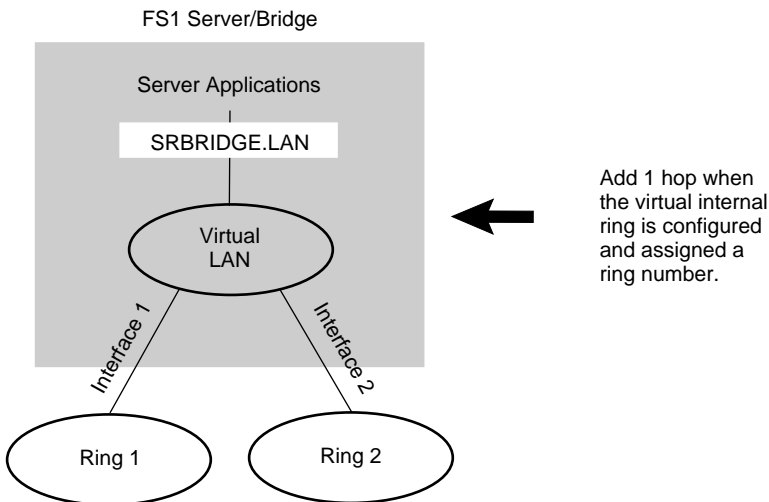
## Hop Count Limitations

Although the source route bridge can be configured for up to 13 entries in the hop count field, typical hardware limitations of seven hops currently exist. Follow these rules and limitations when you are setting up your network:

- ◆ The path between two end stations should contain no more than seven bridges (eight rings).
- ◆ The use of the virtual internal ring (when assigned a ring number) or virtual WAN ring adds one hop to the path.

Figure 5 shows a virtual internal ring without a ring number and the virtual board driver (SRBRIDGE.LAN).

**Figure 5** Adding to the Hop Count with the Virtual Internal Ring



**NOTE:** A virtual ring number is *not* required for server-based bridging.

## Novell LAN Network Manager Agent

Novell LAN Network Manager (LNM) Agent is network management software that supports communication with the IBM LAN Network Manager (LNM) program. Concurrent communication with up to four IBM LNM programs is supported.

**NOTE:** The product *IBM LAN Manager* is an earlier version of IBM LAN Network Manager. Both versions of this product, although they have slightly different names, are abbreviated *LNM*.

You should use IBM LNM to monitor and control source route bridge functions. IBM LNM programs receive events and can set and read the values of the source route bridge operational parameters.

For more information about Novell LAN Network Manager Agent, refer to:

- ◆ Management Servers
- ◆ NetView Support
- ◆ Novell LNM Agent Configuration

## Management Servers

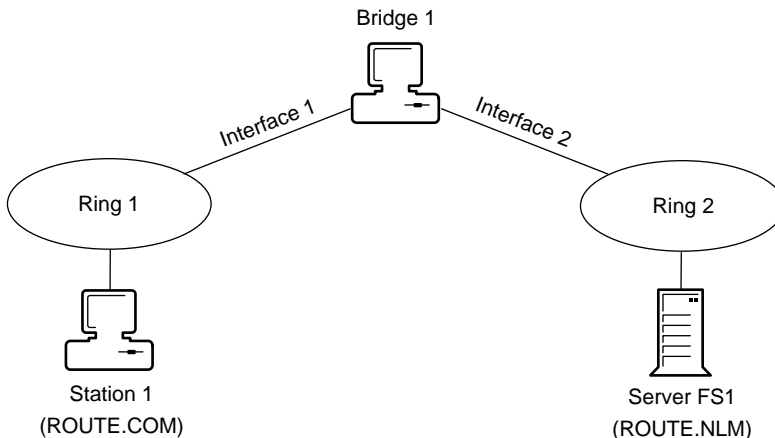
Novell LNM Agent software is divided into five different functional areas, or *management servers*. These management servers collect data from the network, analyze it, and forward that information to one or more IBM LNMs (consoles). IBM LNM can then forward alerts to an IBM network host. The management server functions are as follows:

- ◆ **LAN Reporting Mechanism (LRM)**—Distributes reports generated by other management servers to each interested LAN manager.
- ◆ *Ring Error Monitor (REM)*—Collects ring error data from ring stations, analyzes the data, and forwards the result of the analysis to a network manager through LRM.
- ◆ *Configuration Report Server (CRS)*—Collects ring configuration change data from ring stations and forwards this information to a LAN manager through LRM.

- ◆ *Ring Parameter Server (RPS)* —Sets and maintains a consistent set of operational parameters in ring stations on a particular ring.
- ◆ *LAN Bridge Server (LBS)* —Keeps statistical counters of frames forwarded between two rings through a bridge.

Figure 6 shows a two-port source route bridge configuration using IBM LNM and the Novell LNM Agent.

**Figure 6 Two-Port Source Route Bridge**



**NOTE:** In this example, IBM LNM monitors and controls source route bridge functions. IBM LNM can be anywhere on the network within the hop count limit.

IBM LNM assumes that the bridge supports exactly two physical interfaces, particularly token rings (although you can also use IBM LNM to manage the 8209 token ring/Ethernet bridge). The bridge implementation enables the Novell LNM Agent when two token ring interfaces are bound to the bridge with no virtual ring number assigned.

**NOTE:** The Novell LNM Agent does not SUPPORT either the virtual WAN ring or virtual internal ring implementations described earlier in this section.

After the Novell LNM Agent (BRGLANM.NLM) is loaded, it registers with the source route bridge NetWare Loadable Module™ (NLM™) file. It communicates across the bound physical interfaces through the LLC8022 NLM, because communication between the Novell LNM Agent and IBM LNM occurs over the connection-oriented LLC type 2 across the source route bridged network. For the Novell LNM Agent to work, ROUTE.NLM must be loaded for the two token ring interfaces. The token ring MAC control frames

must also be accessible to the Novell LNM Agent, which is supported by LLC8022 NLM.

## NetView Support

IBM LNM and LNM protocols also provide the ability to communicate between a Novell LNM Agent and an IBM NetView host, using the SNA communication services provided by OS/2\* Extended Services/Extended Edition. With this type of communication, the management servers send NetView alerts from the Novell LNM Agent to IBM LNM, which, in turn, forwards the alerts to the IBM NetView host. Conversely, support configuration information from the IBM NetView host is communicated through IBM LNM to the Novell LNM Agent.

## Novell LNM Agent Configuration

The Novell LNM Agent is configurable through the NIASCFG source route bridge configuration screens.

The Novell LNM Agent function is implemented as a single NLM, although it requires support from many other parts of the system (notably BRIDGE.NLM, which requires support from SNMP and NIASCFG and their required supporting modules).

The Configure LAN Network Management Agent parameters can be used to support the Novell LNM Agent. For more information about these parameters, refer to “Setting Up” in the routing documentation for Source Route Bridge.

The Link Password parameters are used to establish an LLC Type 2 connection between the Novell LNM Agent and IBM LNM. Up to four IBM LNMs can establish a communication link to the Novell LNM Agent concurrently.

There can be only one controlling IBM LNM linked to the bridge at any given time. Three observing LNMs can be linked to the bridge. A controlling LNM can issue any LNM command for the local segment, including commands that change the way LAN components operate and commands that change the topology of the segment. Only the controlling IBM LNMs log and transport alerts from application programs, using the IBM Alert Transport facility. An observing LNM is restricted to query and status commands and, therefore, cannot reconfigure bridges.



Any configuration changes through SNMP or through IBM LNM take effect immediately.

The Novell LNM Agent is activated as soon as the source route bridge software recognizes two token ring interfaces and is deactivated when the source route bridge software detects that it no longer has exactly two active ports (it has just one active port or more than two active ports).



# 2 Planning

This section explains what decisions must be made before you can configure the Novell<sup>®</sup> Internet Access Server 4.1 includes source route bridging software.

## Configuration Decisions

Configuration decisions for source route bridging are determined by which of the applications described in this section you need to implement. Each application of the source route bridge requires that certain configuration decisions must be made. Once you choose an application, the configuration instructions describe the decisions that are required for that application. All decisions about the virtual WAN ring, internal virtual ring, and SRBRIDGE.LAN driver are determined by the applications you choose.

It is likely that you will need to implement more than one application. To determine which applications to use, read the introductory information provided for each application. This information describes the benefits and uses of the applications.



# 3

## Setting Up

Novell<sup>®</sup> Internet Access Server 4.1 includes source route bridging software that enables you to link token ring networks and create an extended network. This functionality is compatible with the source route bridging mechanism used by IBM to handle the flow of data between token ring networks. Source route bridging allows end stations to discover routes dynamically and determine which one to use when sending data to a destination.

Novell Internet Access Server 4.1 supports concurrent routing and bridging of all major protocols. Novell Internet Access Server 4.1 can be configured to route or bridge the TCP/IP, AppleTalk, and Internetwork Packet Exchange<sup>™</sup> (IPX<sup>™</sup>) protocols, and to bridge unroutable protocols such as IBM's NetBIOS and SNA. Because you cannot bridge and route the same protocol on the same interface, Novell Internet Access Server 4.1 also provides a mechanism for automatically disabling bridging when routing is enabled.

Novell Internet Access Server 4.1 can also bridge over Point-to-Point Protocol (PPP), frame relay, and X.25 wide area telecommunications links. Multiple WAN links can be used to connect multiple remote sites or to create backup links between two locations, providing fault tolerance if one link fails.

The use of source route bridging prevents packets sent between end stations on the same ring from passing on to other connected rings. This prevents extraneous traffic across networks, increasing the available bandwidth on all networks. Performance can be further enhanced by limiting traffic through the use of custom filters that permit packets from certain stations to pass while blocking packets from others. Filters can also increase network security by not allowing users on one ring to access another ring that contains sensitive information.

As token ring networks have grown, they have become increasingly difficult to manage; the Novell source route bridge software supports the bridging Management Information Base (MIB) defined in RFC 1286. The standards-

based Simple Network Management Protocol (SNMP) allows organizations to install equipment from multiple vendors and manage the entire network from one centralized monitoring console. Novell Internet Access Server 4.1 supports the SNMP MIB variables as defined in RFC 1219, which can be managed using the Novell ManageWise<sup>®</sup> product or any other SNMP-based management console. When configured as a two-port local bridge, it can also be managed by IBM LAN Manager or IBM LAN Network Manager (which are different versions of the same product, both abbreviated as LNM).

## Configuring Local Two-Port Bridging

When configured as a standalone two-port token ring bridge, Novell Internet Access Server 4.1 works like an IBM bridge. Local two-port bridging enables you to perform the following services:

- ◆ Replace existing bridges while adding a migration path to an environment with simultaneous bridging, routing, and NetWare<sup>®</sup> print and file services.
- ◆ Physically extend the length of a network or increase the number of users a network can support.

Token ring LANs are limited in the network's physical length and the number of supported nodes. Source route bridging limits only the size of the network by the maximum number of allowed bridges (hops) between any given source and destination nodes. Novell supports the IBM and IEEE 802.5 bridging standards for a seven-hop limitation and allows you to extend a Novell-bridged network up to a 13-hop limit.

- ◆ Partition your network into segments so that most traffic remains local to the segment.

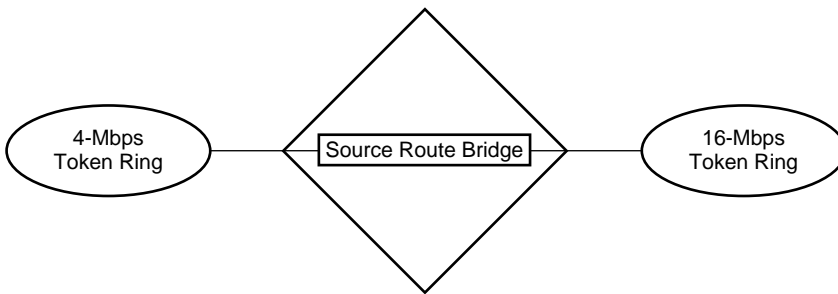
This reduces the overall bandwidth used on all segments of the network while still providing access to the rest of the bridged network. Segmentation can also be used to control access to certain rings or departments.

- ◆ Connect PC users on both 4-Mbps and 16-Mbps token ring networks, as shown in Figure 7 .

PC users on the same network segment must operate at the same speed. Linking LANs operating at different speeds is especially important when organizations install newer 16-Mbps token ring networks but still have a large number of 4-Mbps token ring networks.

- ◆ Enable the Novell LAN Network Manager (LNM) Agent to support the following management server functions:
  - ◆ LAN Reporting Mechanism (LRM)
  - ◆ Ring Error Monitor (REM)
  - ◆ Configuration Report Server (CRS)
  - ◆ Ring Parameter Server (RPS)
  - ◆ LAN Bridge Server (LBS)

**Figure 7 Local Bridging Between 4-Mbps and 16-Mbps Token Ring Networks**



For more information about two-port bridging, refer to “Understanding.”

## How to Configure Local Two-Port Bridging

Before you begin, you must configure two token ring boards.

To configure local two-port bridging, complete the following steps:

- 1** Load NIASCFG, then select the following parameter path:  
 Select Configure NIAS > Protocols and Routing > Protocols > Source Route Bridge
- 2** Set the Bridge Status parameter to Enabled .
- 3** Assign a value to the Bridge Number parameter, press Enter , then press Esc to return to the Internetworking Configuration menu.
- 4** Bind the source route bridge software to each interface.
  - 4a** Select Bindings and do one of the following:  
 If you are adding a new binding:

- ◆ Press Ins .
- ◆ Select Source Route Bridge .
- ◆ Select the interface to which you are binding the protocol.

**If you are modifying an existing binding, select the interface to which you are binding the protocol.**

- 4b** Set the Ring Number parameter to the correct value for the token ring connected to the interface.
- 5** Press Esc to return to the Internetworking Configuration menu; save your changes when prompted.
- 6** If you want these changes to take effect immediately, restart the router.  
If you want to configure other parameters, do so now, then restart the router when you are finished.

## Configuring Remote Bridging

Novell Internet Access Server 4.1 supports WAN bridging over PPP, frame relay, or X.25, allowing you to connect geographically dispersed LANs and further extend the distances over which devices can communicate.

Novell Internet Access Server 4.1 provides two methods of attaching to another bridge over a WAN link:

- ◆ Configuring the WAN link to function like a token ring network (virtual WAN ring). This approach is used for the following reasons:
  - ◆ To ensure interoperability of Novell Internet Access Server 4.1 with another vendor's bridge over a WAN link
  - ◆ To avoid configuring two half-bridges when both bridges run Novell Internet Access Server 4.1 software

The use of the virtual WAN ring in this case is optional, but it is easier to configure than two half-bridges. Half-bridges must share the same bridge number.

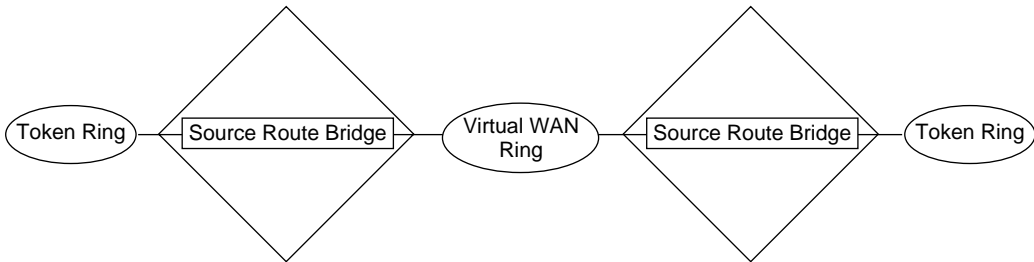
When a virtual WAN ring is used, both sides of the link must be configured with the same ring number. NIASCFG displays this manually configured parameter. The main disadvantage of the virtual WAN ring is that it adds one hop to the route (half-bridges do not add a hop). Figure 8 shows this extra hop.



- ◆ Configuring each side of the WAN link to operate as a half-bridge.

Because there is no standard for half-bridges, each vendor's implementation is proprietary. Therefore, Novell's half-bridge configuration option can be used only when both bridges run Novell Internet Access Server 4.1 software.

**Figure 8 Remote Bridging Using the Virtual WAN Ring**



For more information about remote bridging, refer to “Understanding.”

This topic contains the following sections:

- ◆ Connecting a Bridge to Another Vendor's Bridge
- ◆ Connecting a Bridge to Another Novell Source Route Bridge

## Connecting a Bridge to Another Vendor's Bridge

You can also use this procedure when both bridges run Novell Internet Access Server 4.1 software, but you do not want to configure two half-bridges.

### How to Configure a Connection to Another Vendor's Bridge

Before you begin, you must complete the following tasks:

- ◆ Configure a WAN board and interface.
- ◆ Configure and bind LAN interfaces as needed (refer to “How to Configure Local Two-Port Bridging” on page 31 ).

To configure bridging over a WAN to another vendor's bridge, complete the following steps:

- 1 Load NIASCFG, then select the following parameter path:

Select Configure NIAS > Protocols and Routing > Protocols > Source Route Bridge

- 2** Set the Bridge Status parameter to Enabled .
- 3** Assign a value for the Bridge Number parameter, press Enter , then press Esc to return to the Internetworking Configuration menu.
- 4** Bind the source route bridge software to the WAN interface.
  - 4a** Select Bindings and do one of the following:
    - If you are adding a new binding:**
      - ◆ Press Ins .
      - ◆ Select Source Route Bridge .
      - ◆ Select the interface to which you are binding the protocol.
    - If you are modifying an existing binding, select the interface to which you are binding the protocol.**
  - 4b** Set the Ring Number parameter to the correct value for the virtual WAN ring connected to the bridge.
  - 4c** Set Virtual WAN Ring to On .
  - 4d** Select the WAN call destination that connects the bridge to the other bridge (through the virtual WAN ring).

For information about defining WAN call destinations, refer to *Configuring a Permanent PPP Connection in the NetWare Link/PPP* documentation.
- 5** Press Esc to return to the Internetworking Configuration menu; save your changes when prompted.
- 6** If you want these changes to take effect immediately, restart the router.

If you want to configure other parameters, do so now, then restart the router when you are finished.

## Connecting a Bridge to Another Novell Source Route Bridge

To configure bridging over a WAN to another system running Novell source route bridge software, it is usually easier to use half-bridges.

**NOTE:** Because there is no standard for half-bridges, each vendor's implementation is proprietary. Therefore, Novell's half-bridge configuration option can only be used when both bridges run Novell source route bridge software.

## How to Configure a Connection to Another Novell Source Route Bridge

Before you begin, you must complete the following tasks:

- ◆ Configure a WAN board and interface for each bridge.
- ◆ Configure and bind LAN interfaces as needed (refer to “How to Configure Local Two-Port Bridging” on page 31 ).

To configure bridging over a WAN to another Novell source route bridge, complete the following steps for each bridge:

**1** Load NIASCFG, then select the following parameter path:

Select Configure NIAS > Protocols and Routing > Protocols > Source Route Bridge

**2** Set the Bridge Status parameter to Enabled .

**3** Assign a value to the Bridge Number parameter, press Enter , then press Esc to return to the Internetworking Configuration menu.

Both half-bridges must have the same bridge number.

**4** Bind the source route bridge software to the WAN interface.

**4a** Select Bindings and do one of the following:

**If you are adding a new binding:**

- ◆ Press Ins .
- ◆ Select Source Route Bridge .
- ◆ Select the interface to which you are binding the protocol.

**If you are modifying an existing binding, select the interface to which you are binding the protocol.**

**4b** Set the Ring Number parameter to the correct value for the virtual WAN ring connected to the bridge.

**4c** Set Virtual WAN Ring to On .

**4d** Select the WAN call destination that connects the bridge to the other bridge.

For information about defining WAN call destinations, refer to Configuring a Permanent PPP Connection in the *NetWare Link/PPP* documentation.

**5** Press Esc to return to the Internetworking Configuration menu; save your changes when prompted.

**6** If you want these changes to take effect immediately, restart the router.

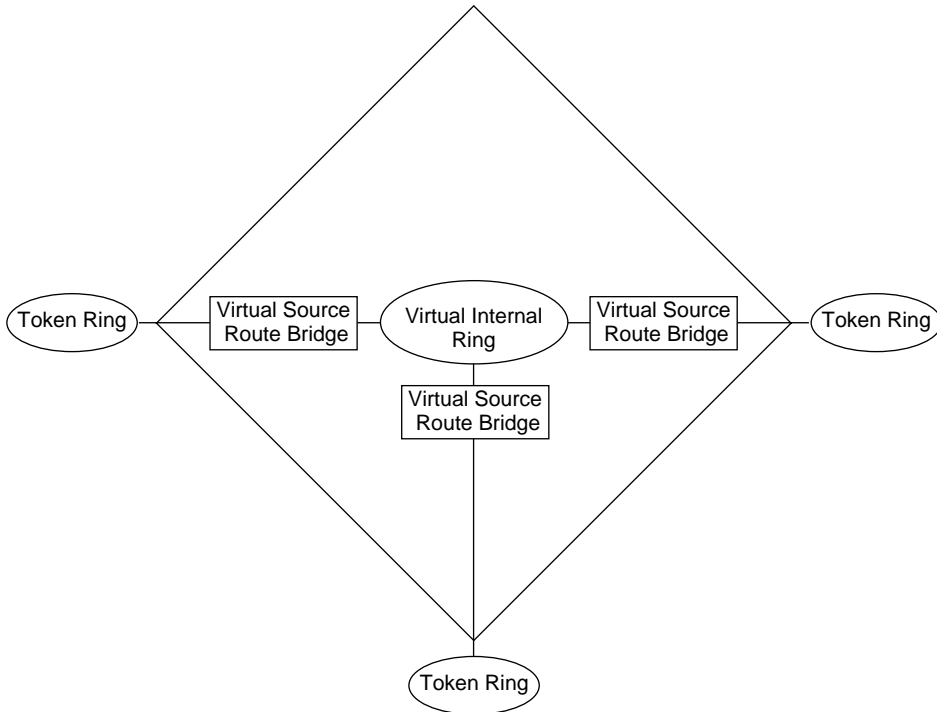
If you want to configure other parameters, do so now, then restart the router when you are finished.

## Configuring Multiport Bridging

Presently, most source route bridges support only two-port bridging. The reason is that the interface boards that specifically support source route bridging typically provide only for two-way bridging. In other words, they can bridge from only one source ring to a single destination ring. In source route bridging, each bridge hop is specified by a source ring number, bridge number, and destination ring number. Because more than one destination ring is possible in a multiport bridge, the hardware cannot be configured to support multiport bridging directly. To overcome this limitation, Novell Internet Access Server 4.1 supports the use of a virtual internal ring, as shown in Figure 9 .

**NOTE:** Some vendors might provide boards without this limitation. If this is the case, and as long as all boards are from the same vendor, the source route bridge does not require the virtual internal ring.

Figure 9 Using the Virtual Internal Ring to Support Three or More Interfaces



With the internal ring, any receiving interface has a *virtual internal bridge* associated with it (labeled virtual source route bridge in Figure 9). Each virtual internal bridge can pass packets from the external source ring to one destination ring (the virtual internal ring). Each forwarding interface can then bridge from the virtual internal ring to a single external destination.

Although virtual internal rings and virtual internal bridges have no corresponding physical devices, they appear in the routes specified in a frame's routing information field. From the point of view of the software, they are treated as if they were actual rings and bridges. The additional logic needed to implement the virtual internal ring with multiple virtual internal bridges does not impact performance. In fact, by using the virtual internal ring, the bridging logic can take advantage of the hardware support on the interface boards and significantly improve overall bridge performance. However, configuring a virtual internal ring adds one hop to the route.

For more information about multiport bridging, refer to "Understanding."

## How to Configure Multiport Bridging

Before you begin, you must complete the following tasks:

- ◆ Configure some combination of three or more token ring boards or WAN interfaces.
- ◆ Configure a WAN call destination if you are using a WAN interface. For more information, refer to "Setting Up" in the documentation for the WAN protocol that you are using.

To load the virtual internal ring, complete the following steps:

- 1** Load NIASCFG, then select the following parameter path:

Select Configure NIAS > Protocols and Routing > Protocols > Source Route Bridge

- 2** Set the Bridge Status parameter to Enabled .
- 3** Assign a value to the Bridge Number parameter.
- 4** Assign a value to the Virtual Ring Number parameter to enable the internal virtual ring, press Enter , then press Esc to return to the Internetworking Configuration menu.

**WARNING:** If no ring number is configured for the virtual internal ring, binding to the board has no effect. Although NIASCFG allows you to bind to the board, the binding does not actually occur.

- 5** Bind the source route bridge software to each interface.

- 5a** Select Bindings and do one of the following:

**If you are adding a new binding:**

- ◆ Press Ins .
- ◆ Select Source Route Bridge .
- ◆ Select the interface to which you are binding the protocol.

**If you are modifying an existing binding, select the interface to which you are binding the protocol.**

- 5b** For LAN interfaces, set the Ring Number parameter to the correct value for the token ring connected to the interface.
- 5c** For WAN interfaces, select the WAN call destination that connects the bridge to the other bridge.

For information about defining WAN call destinations, refer to *Configuring a Permanent PPP Connection in the NetWare Link/PPP* documentation.

- 6** Press Esc to return to the Internetworking Configuration menu; save your changes when prompted.
- 7** If you want these changes to take effect immediately, restart the router.  
If you want to configure other parameters, do so now, then restart the router when you are finished.

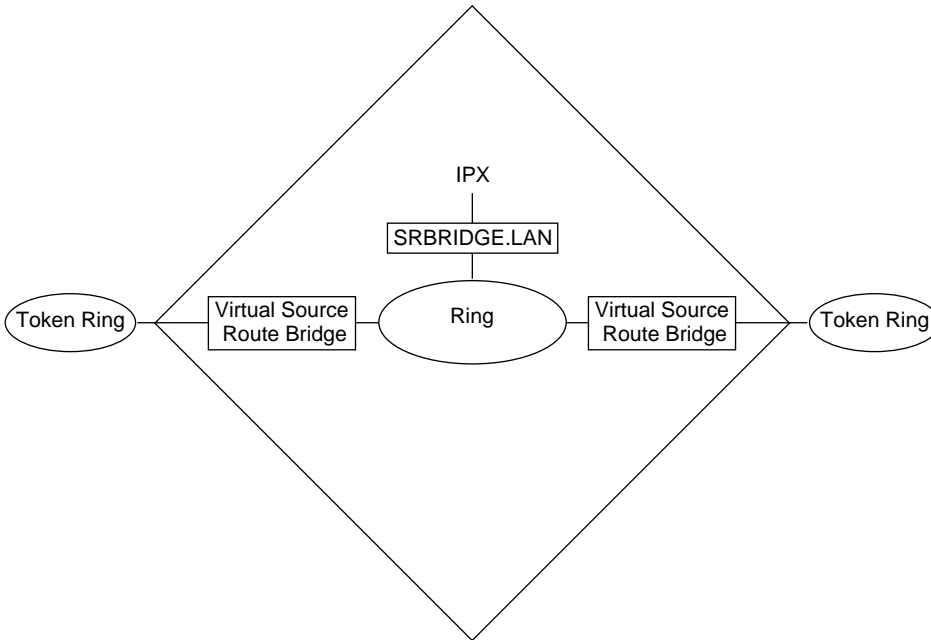
When the bridge protocol is attached to a LAN or WAN interface, the virtual internal ring is automatically attached to the bridge. Each attachment of the bridge protocol to an interface essentially causes the creation of a virtual internal bridge for that interface.

## Configuring Server-Based Bridging

Access to a NetWare application, such as print or file services or network management, usually requires that the appropriate protocol is routed on each interface that provides access to use that application. However, when a protocol is bridged on an interface, it cannot be routed on that interface. Therefore, when bridging is used, alternate access to the application is provided through a virtual internal ring. This principle applies to all NetWare applications and services, including RCONSOLE, SNMP, NetWare for Macintosh, NetWare for SAA\*, and NetWare for NFS\*.

The virtual internal ring is attached to each bridged interface through a separate virtual internal bridge (as described in “Configuring Multiport Bridging” on page 36 ). In this case, the required protocol must be attached to the virtual internal ring through a virtual token ring board that uses the SRBRIDGE.LAN driver. The virtual board is then attached to the virtual internal ring automatically. Figure 10 shows an example of this configuration using IPX. Note that the two token rings might be part of a larger looped topology.

**Figure 10 Server-Based Bridging**



Ensure that the necessary frame types are configured in NIASCFG when making attachments (bindings). The virtual token ring board uses the same two frame types that physical boards use:

- ◆ TOKEN\_RING for IPX, NetWare for SAA, and NetBIOS
- ◆ TOKEN\_RING-SNAP for TCP/IP, AppleTalk, and IPX

For more information about server-based bridging, refer to “Understanding.”

## How to Configure Server-Based Bridging

Before you begin, you must complete one of the following tasks:

- ◆ Configure any required token ring boards.
- ◆ Configure a WAN call destination if you are using a WAN interface.

To configure bridging with access to applications, complete the following steps:

- 1 Load NIASCFG and configure the SRBRIDGE.LAN driver.



**1a** Select Configure NIAS > Protocols and Routing > Boards and do one of the following:

**If you are adding a new virtual board:**

- ◆ Press Ins .
- ◆ Select SRBRIDGE from the Available Drivers list.

**If you are modifying an existing virtual board, select the interface to which you are binding the protocol.**

**NOTE:** The SRBRIDGE.LAN driver replaces the VBRIDGE.LAN driver from previous NetWare routing software releases.

**1b** Enter a name in the Board Name field that identifies the network interface, press Enter , then press Esc to return to the Internetworking Configuration menu.

**NOTE:** Use of a SRBRIDGE virtual board adds only one node address to the source route bridge node table.

**2** Select the following parameter path:

Select Protocols > Source Route Bridge

**3** Set the Bridge Status parameter to Enabled .

**4** Assign a value to the Bridge Number parameter.

**5** If necessary, assign a value to the Virtual Ring Number to enable the internal virtual ring, press Enter , then press Esc to return to the Internetworking Configuration menu.

The internal virtual ring does not need a number unless more than two interfaces are attached.

**6** Bind each protocol you need to access applications to the SRBRIDGE driver by selecting Bindings and doing one of the following for each protocol:

**If you are adding a new binding:**

- ◆ Press Ins .
- ◆ Select the protocol.
- ◆ Select the SRBRIDGE driver from the list of configured network interfaces.

**If you are modifying an existing binding, select the SRBRIDGE driver to which you are binding the protocol.**

**NOTE:** SRBRIDGE automatically configures source route end station support.

**7** Bind the source route bridge software to each LAN interface.

**7a** Select Bindings and do one of the following:

**If you are adding a new binding:**

- ◆ Press Ins .
- ◆ Select Source Route Bridge .
- ◆ Select the interface to which you are binding the protocol.

**If you are modifying an existing binding, select the interface to which you are binding the protocol.**

**7b** For LAN interfaces, set the Ring Number parameter to the correct value for the token ring connected to the interface.

**7c** For WAN interfaces, select the WAN call destination that connects the interface to the token ring network.

For information about defining WAN call destinations, refer to Configuring a Permanent PPP Connection in the *NetWare Link/PPP* documentation.

**8** Press Esc to return to the Internetworking Configuration menu; save your changes when prompted.

**9** If you want these changes to take effect immediately, restart the router.

If you want to configure other parameters, do so now, then restart the router when you are finished.

## Configuring the Spanning Tree Protocol

The Spanning Tree Protocol is used only when single-route explorer frames are used for route discovery. Novell's default end station implementation originates a route discovery session by issuing a single-route explorer frame. When a bridge sends out a single-route explorer frame, it travels over a single route that is manually configured or automatically determined by the Spanning Tree Protocol.

The automatic mode provides the most efficient and dynamic way to determine a single route, because bridge interfaces reconfigure themselves automatically when other bridges fail. By configuring source route bridge interfaces in this way, they can automatically take advantage of the best available single route as other bridges go down or come up.

If you configure your network manually, you must ensure that there are no loops in the topology and that there is only one single-route path to any particular ring. Also, at least one single-route path must be configured for each ring to maintain connectivity. However, by carefully configuring the bridge interfaces in the network, you can create preferred routes for route determination, freeing rings whose operation is most sensitive from most explorer frame traffic.

By definition, a single-route explorer frame travels a single route to the destination. A forwarding interface passes all-routes explorer frames, single-route explorer frames, and specifically routed frames. A blocking interface passes all-routes explorer frames and specifically routed frames.

We strongly recommend that you use the Spanning Tree Protocol to configure your bridge interfaces automatically. For more information about the Spanning Tree Protocol, refer to “Understanding.”

## How to Configure the Spanning Tree Protocol

Before you begin, you must configure one of the source route bridge application scenarios described in this section.

To configure the Spanning Tree Protocol, complete the following steps:

- 1** Load NIASCFG and configure the Spanning Tree Protocol for each source route bridge as follows:
  - 1a** Select the following parameter path:

Select Bindings > an existing binding to a source route bridged interface
  - 1b** From the Binding Source Route Bridge to an Interface menu, configure the Spanning Tree Mode parameter by selecting one of the following modes:
    - ◆ Select Automatic to configure your bridge interfaces automatically. This is the recommended and default setting.
    - ◆ Select Manual (Block) to disable the forwarding of single-route explorer frames.
    - ◆ Select Manual (Forward) to enable the forwarding of single-route explorer frames.

- ♦ Select **No Bridging** to disable bridging between an interface and other interfaces. This is relevant only when the **SRBRIDGE** driver is loaded.
- 2** Press **Esc** to return to the **Internetworking Configuration** menu; save your changes when prompted.
  - 3** If you want these changes to take effect immediately, restart the router.  
If you want to configure other parameters, do so now, then restart the router when you are finished.

## Configuring Source Route End Stations

Source route end stations are used when Novell Internet Access Server 4.1 is also used as a server to which source route clients are attached and the virtual ring is not used. They are also used with a two-port bridge and IBM LNM support.

Source route bridging enables end stations to discover routes dynamically and determine which one to use when sending data to a particular destination. Depending on your network configuration and the route selection algorithm used, several routes can be discovered for each destination. The source examines the available routes and then determines the best route to use when sending data.

An end station can be configured to begin the route discovery process using either of the following methods:

- ♦ **Originating an all-routes explorer frame**

When the source device sends out an all-routes explorer frame, the frame records the numbers of all the rings and bridges it passes through on its way to the destination.

When a bridge receives an all-routes explorer frame, it examines it to determine whether the frame has already been on any of the rings attached to the bridge. If the frame has not been on one of the attached rings, it is forwarded to that ring.

Because frames are not transmitted on rings on which they have previously traveled, no frame can follow the same route twice. With this mechanism, a frame is propagated in such a way that all possible routes to a destination are discovered, but no routes containing loops are received by the destination.

For more information about all-routes explorer frames, refer to “Understanding.”

- ◆ Originating a single-route explorer frame

By default, Novell's end station implementation originates route discovery using single-route explorer frames. When the bridge sends out a single-route explorer frame, the frame travels over a single route that is manually configured or automatically determined by the Spanning Tree Protocol. This protocol uses the configuration of each bridge in the network to determine a single route.

With this method, the destination receives only one explorer frame, resulting in considerably less traffic than the use of all-routes explorer frames. The destination replies with an all-routes explorer frame, and the source then chooses the best route from all the frames it receives. The criteria used are determined by the end station implementation.

For more information about single-route explorer frames, refer to “Understanding.”

For more information about source route end stations, refer to “Understanding.”

## How to Configure Source Route End Stations

Before you begin, you must configure any required token ring boards.

To configure a source route end station, complete the following steps:

- 1** Load NIASCFG, then select the following parameter path:

Select Configure NIAS > Protocols and Routing > Protocols > Source Route End Stn

- 2** Select Enabled to enable the source route end station, press Enter, then press Esc to return to the Internetworking Configuration menu.

- 3** Bind the source route end station software to each interface.

- 3a** Select Bindings and do one of the following:

**If you are adding a new binding:**

- ◆ Press Ins.
- ◆ Select Source Route End Station.
- ◆ Select the interface to which you are binding the protocol.

**If you are modifying an existing binding, select the interface to which you are binding the protocol.**

- 3b** Select the type of route explorer frames (single or all) for the Send Frames with Unknown Address parameter.  
Select Single Route Explorer Frame to limit explorer frame traffic.
  - 3c** Select the type of route explorer frames (single or all) for the Send Broadcast Frames parameter.  
Select Single Route Explorer Frame to limit explorer frame traffic.
  - 3d** Select the type of route explorer frames (single or all) for the Send Multicast Frames parameter.  
Select Single Route Explorer Frame to limit explorer frame traffic.
  - 3e** Select the type of frame (all-routes explorer or specifically routed) for the Respond to Broadcast Request parameter.  
Select Specifically Routed Frame to limit explorer frame traffic.
- 4** Press Esc to return to the Internetworking Configuration menu; save your changes when prompted.
  - 5** If you want these changes to take effect immediately, restart the router.  
If you want to configure other parameters, do so now, then restart the router when you are finished.

## Configuring the Novell LNM Agent

IBM LAN Network Manager and IBM LAN Manager (which are different versions of the same product, both abbreviated as LNM) are IBM's proprietary network management solution for token ring source route bridges. The Novell LAN Network Manager (LNM) Agent supports the use of IBM LNM. The Novell LNM Agent supports the following functions:

- ◆ Source route bridge management through IBM LNM
- ◆ Communication between a Novell LNM Agent and an IBM NetView host
- ◆ SNMP support using the bridging MIB defined in RFC 1286

You can link controlling and observing IBM LNMs to a bridge. A controlling IBM LNM, or IBM NetView host through the IBM LNM, can issue any IBM LNM command for the local segment, including commands to reconfigure the

bridge. Only controlling IBM LNMs log and transport alerts from application programs.

An observing IBM LNM can issue only query and status commands, and therefore cannot reconfigure bridges.

**NOTE:** Only one controlling IBM LNM can be linked to the bridge at any time. Up to three observing IBM LNMs can be linked to the bridge as well.

The source route bridge enables the Novell LNM Agent as soon as the bridge recognizes two token ring interfaces. If the bridge detects that it has more or less than two active ports, it deactivates the Novell LNM Agent.

For more information about the Novell LNM Agent, refer to “Understanding.”

## How to Configure the Novell LNM Agent

Before you begin, you must configure one of the source route bridge application scenarios described in this section.

To configure the Novell LNM Agent, complete the following steps:

- 1** Load NIASCFG, then select the following parameter path:  
Select Configure NIAS > Protocols and Routing > Protocols > Source Route Bridge
- 2** Set the LAN Network Management Status parameter to Enabled .
- 3** Press Esc to return to the Internetworking Configuration menu; save your changes when prompted.
- 4** If you want these changes to take effect immediately, restart the router.  
If you want to configure other parameters, do so now, then restart the router when you are finished.





# 4 Troubleshooting

This section contains source route bridge troubleshooting information that is divided into three categories:

- ◆ Troubleshooting tools
- ◆ Troubleshooting checkpoints
- ◆ Common problems

If a problem that is general in nature occurs, the procedure described in “Troubleshooting Checkpoints” on page 50 will help you isolate and resolve the problem. If a problem with a specific symptom occurs, refer to “Common Problems.”

## Troubleshooting Tools

BRGCON is the primary tool used to troubleshoot source route bridging. This utility uses SNMP to provide the following capabilities:

- ◆ Basic bridge configuration information
- ◆ Spanning tree per bridge information
- ◆ Ports table
- ◆ Spanning tree port configuration information and statistics
- ◆ Source route bridge port configuration information and statistics
- ◆ Interfaces table

# Troubleshooting Checkpoints

To isolate and resolve problems with source route bridging, complete the following steps:

- 1** Load BRGCON and check the value of the Number of Ports field displayed on the main window to verify that it matches the number of interfaces configured.

If the value of the Number of Ports field is incorrect, load NIASCFG and use the Boards option to add or configure network interface boards (parameter path: Configure NIAS > Protocols and Routing > Boards). Reinitialize the system and continue with Step 2 .

If the value of the Number of Ports field is correct, go to Step 3 .

- 2** Load BRGCON and check the value of the Number of Ports field.

If the value of the Number of Ports is still incorrect, load NIASCFG. Inspect the Boards option to make sure that the correct network boards and hardware parameters are selected. Verify that the source route bridge software is bound to the appropriate boards under Bindings. Reinitialize the system.

**NOTE:** The BRGCON Interfaces option gives information about all the boards, whether or not they are bound to the source route bridge. For information about any token ring port associated with the source route bridge software, look under the Ports option.

- 3** Load BRGCON and inspect the following parameters under the Ports option for token ring interfaces:

*Hop Counts* (Range: 1-13)

This field indicates the maximum number of hops (bridges) allowed for all routes or spanning tree explorer frames.

If this field is incorrect, load NIASCFG. Check the Protocols option for the source route bridge software (parameter path: Select Configure NIAS > Protocols and Routing > Protocols). Change the following parameters:

- ◆ All Routes Explorer Frame Hop Count Limit (1-13)
- ◆ Single Route Explorer Frame Hop Count Limit (1-13)

*Local Ring* (Range: 1-FFF)

This field identifies the ring (*ring number* and *segment number* are the same) that uniquely identifies the segment to which this port is connected.

All source route bridges on a given ring must assign the same value to the Ring Number option for that ring. If this field is incorrect, load NIASCFG. Check the bindings for the source route bridge software (parameter path: Select Configure NIAS > Protocols and Routing > Bindings). Change the Ring Number value.

*Bridge Number* (Range: 0-F)

This field identifies a bridge. When more than one bridge is used to span the same two segments, each bridge must have a unique number.

If this field is incorrect, load NIASCFG. Check the Protocols option for the source route bridge software and inspect the Bridge Number option of the source route bridge configuration. If the Bridge Number is incorrect, change it to reflect the correct value.

*Target Ring* (Range: 0-FFF)

This field displays a nonzero value only when the bridge is configured with a virtual ring. The Virtual Ring Number is required only when more than two interfaces are bound to the bridge.

*Largest Frame* (valid frame sizes are 512, 1500, 2052, 4472, 8144, 11407, and 17800)

This field indicates the maximum size of the frame's INFO field (Logical Link Control [LLC] and higher) that this port can send and receive. The value is the smallest number of the following values:

- ◆ The value configured is the Largest Frame Size option in NIASCFG
- ◆ The maximum receive buffer size of the server
- ◆ The maximum packet size the driver can forward

If the value is larger than the smallest of these three parameters, load NIASCFG and check the bindings for the source route bridge software. Change the Largest Frame Size option in NIASCFG.

*Spanning Tree Mode* (valid options are Auto, Manual Blocking, Manual Forwarding, and No Bridging)

This field determines how this port responds when it is presented with a spanning tree explorer frame.

If this field is incorrect, load NIASCFG. Check the bindings for the source route bridge software and change the Spanning Tree Mode field.

Unless you are an expert user, keep the default mode of Auto.

- 4 Use NIASCFG to check the Protocols and Bindings options for the source route bridge software and inspect additional fields that cannot be viewed through BRGCON.

If any of the information displayed under these options is incorrect, load NIASCFG and select the Protocols or Bindings option (parameter path: Select Configure NIAS > Protocols and Routing > Protocols or Bindings). Change the following parameters, as needed:

*Bridge Status* (valid options are Enabled or Disabled)

You must enable the source route bridge software to configure the other bridging parameters.

*Virtual Ring Number* (Range: 0-FFF)

The Virtual Ring Number is required only when more than two interfaces are bound to the source route bridge.

*Frame Type*

This field identifies the frame type of the LAN board to which the source route bridge is bound. If you are not an expert user, use NIASCFG to bind the bridge to all the known frame types.

*Path Cost Increment* (Range: 0-65535)

This field specifies the path cost increment for the source route bridge. The lower the value, the more likely that the Spanning Tree Protocol will select the source route bridge as the root of the spanning tree. Only source route bridges determined to be in the spanning tree will forward all the single-route explorer frames.

- 5 Load BRGCON and inspect the Source Route Port Statistics option under Ports.

The various counters might identify some of the problems that are related to source route bridge configurations and source route bridge frame forwarding functions.

*Specifically Routed Frames Received Counter*

This field indicates the number of specifically routed frames that have been received by this port. If this value is zero, the wrong frame type might have been selected (or not all required frame types were selected). Load NIASCFG and check the frame type for the source route bridge software. If the frame type is incorrect, select the appropriate frame type.

*All Routes Explorer Frames Received Counter*

This field indicates the number of all-routes explorer frames that have been received by this port. If this value is zero, the wrong frame type might have been selected. Load NIASCFG and check the frame type for the source route bridge software. If the frame type is incorrect, select the appropriate frame type. This counter might also remain zero when no end stations are using all-routes explorer frames.

#### *Spanning Tree Explorer Frames Received Counter*

This field indicates the number of spanning tree explorer frames that have been received by this port from its segment. If this value is zero, the Spanning Tree Protocol for the source route bridge software might be disabled. Load NIASCFG and check whether the Spanning Tree Protocol is enabled for the source route bridge software.

#### *Specifically Routed Frames Transmitted Counter*

This field indicates the number of specifically routed frames that this port has transmitted on its segment.

If this value is zero, filters might be discarding all data or data using a certain frame type, or the receiving port might not be bound to the source route bridge.

#### *All Routes Explorer Frames Transmitted Counter*

This field indicates the number of all-routes explorer frames that this port has transmitted on its segment.

If this value is zero, filters might be discarding all data or data using a certain frame type, or the receiving port might not be bound to the source route bridge.

#### *Spanning Tree Explorer Frames Transmitted Counter*

This field indicates the number of spanning tree explorer frames that this port has transmitted on its segment. If this value is zero, the Spanning Tree Protocol for the source route bridge software might be disabled. Load NIASCFG and check whether the Spanning Tree Protocol is enabled for the source route bridge software.

#### *Frames Discarded Due to an Invalid Adjacent Ring Value*

This field indicates the number of frames that have been discarded by this port because the frame's routing information field contained an invalid adjacent segment value. A nonzero value usually indicates a configuration problem with the Ring Number NIASCFG option of this or another source route bridge on the ring.

### *Frames Discarded Due to a Duplicate Ring Identifier*

This field indicates the number of frames that have been discarded by this port because the frame's routing information field contained a duplicate ring number.

A nonzero value usually indicates that more than one ring in the source route topology has been assigned the same ring number.

### *Frames Discarded Due to Too Many Hops*

This field indicates the number of explorer frames that have been discarded by this port because the frame's routing information field has exceeded the maximum descriptor length.

If this counter is nonzero, the source route topology contains more sequential bridges than the maximum hop count supported by this bridge. This condition does not present a problem as long as no servers are separated from their clients by more than seven hops.

## **6** Check the following miscellaneous items in NIASCFG:

- ◆ Verify that all source route bridges on a given token ring have been assigned the same Ring Number value for the interfaces to that ring.
- ◆ Make sure that all token rings in a source route topology have been assigned a unique Ring Number value.
- ◆ If you are employing two or more parallel bridges between the same two token rings, make sure that each parallel bridge has been assigned a unique Bridge Number value.
- ◆ If a given bridge uses more than two interfaces (either token rings or WAN ports), you might need a Virtual Ring Number value. You receive a warning message when three or more interfaces are bound to the bridge and a virtual ring is required. When a virtual ring is required, make sure that the Virtual Ring Number value is also unique across the source route topology.
- ◆ When configuring a bridged WAN link using the Virtual WAN Ring option (between the two bridges), make sure that the Ring Number value is the same on both ends.
- ◆ When configuring a bridged WAN link without using the Virtual WAN Ring option (half-bridges), make sure that the Bridge Numbers values of both bridges are the same and that the Ring Numbers values are the remote target rings.

- ◆ If you use parallel half-bridges, make sure that the WAN Link Identifier fields match.
- ◆ Verify that the defined speeds of the token ring interface cards match the speed of the rings.

## Common Problems

This section discusses various symptoms of common problems and their associated solutions.

- ◆ Source route bridge software is not bridging one or more protocols.
  - ◆ Verify that all frame types for the LAN interfaces that are attached to the source route bridge are loaded and bound individually. For example, when bridging over a given token ring LAN interface, make sure that both the TOKEN-RING and the TOKEN-RING\_SNAP frame types for that interface are loaded and bound to the source route bridge.
  - ◆ When a protocol is routed on a LAN interface or WAN port, bridging of that protocol is blocked automatically on that interface or port. Bridging cannot occur unless routing of that protocol is disabled.
  - ◆ Load FILTCFG and select Configure Source Route Bridge Filters to view the filter table. Verify that no filter exists for the protocol that you want to bridge.
- ◆ End stations cannot make a connection.
  - ◆ If you have loaded upgraded server software that has been modified to support buffer sizes larger than 4202, verify that the LAN drivers you are using support this size (some have been found to set the largest frame size allowed to 4202).
  - ◆ Check for duplicate ring numbers or for bridges on the same ring that have different ring numbers assigned to the interfaces. Load BRGCON and select Source Route Port Statistics. If duplicate ring numbers exist, the appropriate error counter increments.
  - ◆ Make sure that all Novell end stations on the source route bridge topology have loaded ROUTE.COM (for clients) and ROUTE.NLM (for servers).
  - ◆ If you loaded ROUTE.NLM or ROUTE.COM and modified some of its parameters, use version 1.12 (dated May 1, 1991) or later. We

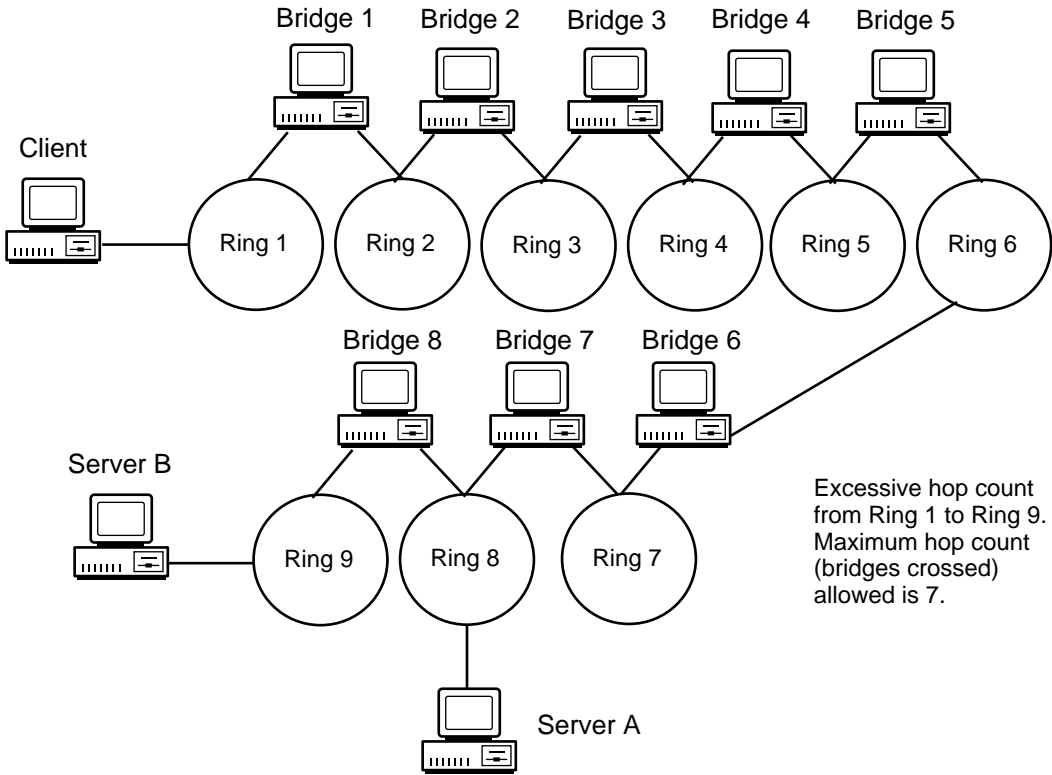
recommend that you use ROUTE.NLM and ROUTE.COM 4.11 (dated February 4, 1994) or later.

- ◆ Check how often the hop count limit is being reached. Load BRGCON and select Source Route Port Statistics.
- ◆ In a relatively large source route topology, it might be advisable to design the spanning tree root bridge in the center of the topology so that the spanning tree (single-route) explorer frames are less likely to reach a hop count limit.
- ◆ You cannot log in to a server that is more than the maximum number of hops that you configured for the source route bridge software.

For example, in Figure 11 , Server A is seven hops away from the client, but Server B is more than seven hops away from the client. IPX RIP lets the client from Ring 1 log in to Server A and see Server B through the SLIST command. However, because the bridges are configured to discard packets more than seven hops away, the client cannot log in to Server B.



Figure 11 Hop Count Limitation



- ◆ A protocol seems to be routed and bridged.
  - ◆ Router and bridge configuration was not done through NIASCFG. Because NIASCFG informs the bridge about which protocols are routed, the bridge does not receive this information if NIASCFG is bypassed. Therefore, the bridge does not block routed traffic.
  - ◆ When the bridge was bound to a WAN interface, the Plan to Route IPX option was set to No when, in fact, routing is configured.
- ◆ SRBRIDGE clients do not work.
  - ◆ Load MONITOR and display the LAN/WAN Information for the SRBRIDGE LANs. The information under the Custom Statistics option might indicate the source of the problem. The solution might be as simple as assigning a Virtual Ring Number value in NIASCFG or loading the correct ROUTE.NLM version (1.12 or later).

- ◆ If the following messages appear frequently, this indicates that one or more of the clients cannot use the SRBRIDGE driver:

Send Packet Too Many Fragments

Send Packet Raw Transmit Attempts

**NOTE:** All Novell router clients have been validated to operate with the SRBRIDGE driver (IPX, TCP/IP, and AppleTalk).

- ◆ If the following message appears frequently, then the hop count of a peer connection is greater than seven:

Receive Packet Route Too Long

Use ROUTE.NLM and ROUTE.COM 4.11 or later to correct the problem.

- ◆ Verify that the frame type is correct for the protocol. For example, IP and AppleTalk require TOKEN-RING\_SNAP, whereas IPX, NetBIOS, and SNA require TOKEN-RING.
- ◆ Connection to an X.25 network cannot be established.

Verify that the local DTE address matches the remote DTE address at the other end of the WAN link.

- ◆ Incorrect spanning tree parameters are configured.
  - ◆ When implementing standby (parallel) bridges, the value of the IPX RETRY COUNT parameter, specified in the NET.CFG file on the client, should be changed from the default (20) to 40 or greater. This change allows the workstation to recover successfully from a bridge failure.
  - ◆ On NetWare servers, use the default value for the source route update interval (when configured through NIASCFG), or equivalently, the default TIME parameter for ROUTE.NLM (when configured through the AUTOEXEC.NCF file). The default is 3 seconds.
- ◆ Incorrect frame types are configured.
  - ◆ IP and AppleTalk require TOKEN-RING\_SNAP.
  - ◆ IPX, Spanning Tree Protocol, NetBIOS, and SNA require TOKEN-RING.
  - ◆ If you are using the virtual internal ring with SRBRIDG.LAN, IP and AppleTalk require TOKEN-RING\_SNAP, whereas IPX, NetBIOS, and SNA require TOKEN-RING.