Token Ring Switching

This appendix provides an overview of Token Ring transparent, source route bridging, and source route transparent switching. It contains the following sections:

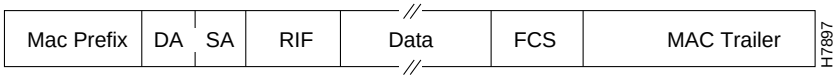
- MAC Frames
- Transparent Switching
- Source Routing
- Source Route Transparent Switching
- Source Routing Broadcast Reduction

MAC Frames

Figure A-1 shows the format of a MAC-level frame. The frame is composed of a MAC Prefix (header), a Destination (DA) and Source Address (SA), a Routing Information Field (RIF) for source routing, a Data field, an FCS and a MAC Trailer. The RIF is not present for non-Source-Routed frames.

The Routing Information Indicator (RII) bit (Global Address, bit 47) in the Source Address field is used to denote the presence or absence of a RIF header.

Figure A-1 MAC Frame



Transparent Switching

Transparent switching operates on the address portion of MAC frames. The source MAC address of each frame is stored by the Cisco Catalyst 1800 Token Ring switch along with the port number that the frame arrived on. This learned information is used by the Catalyst 1800 switch to determine which port(s) shall transmit the received frame. Note that the transmit port must be a member of the receiving port's logical ring group. If an arriving frame is destined for a MAC address that has not yet been learned by the switch, the frame is flooded to all ports on the switch (excluding the port that received the frame) that are part of the same logical ring group or that are part of the same SRT group. The Catalyst 1800 switch does not flood a transparent frame to other logical rings that are part of an SR group only.

The term *transparent* is derived from the perspective of the end-node. Each end-node needs to know only the destination MAC address when transmitting a transparent network frame.

To reduce flooding in a redundant network topology, the Catalyst 1800 switch implements a forwarding algorithm known as the spanning-tree algorithm. This algorithm works by blocking switch ports from transmitting if the algorithm determines that a loop is found in the interconnection of LANs.

Note that the spanning-tree algorithm is not available for TB mode for either single rings or for logical segment groups. Spanning tree is only available for bridge port pairs.

Source Routing

Source routing operates on the routing information field (RIF) of network frames. Source routing requires that the RII field in the source address of the MAC header be set to one.

Figure A-2 shows the format of the RIF. The RIF portion of the MAC header is present only for source-routed frames. The field is composed of the frame routing type (RT), the RIF frame size (LTH) field, the direction flag (D), the largest frame size that can be passed between two end stations (LF), and route descriptor fields (RD*n*).

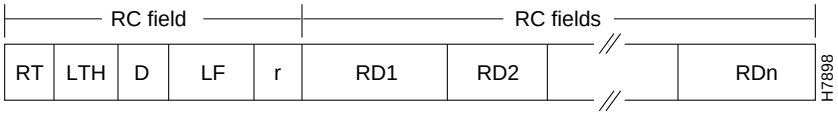
The routing type field designates the type of source routed frame: Specifically routed (SRF) frame, all routes explorer (ARE) frame or spanning-tree explorer (STE) frame.

The LTH field specifies the length of the route descriptor field plus the routing control (RC) field. The legal values for this field are between two and 18 (inclusive). The LTH value must be an even number (2 bytes per RD).

The D field specifies the direction in which the Route Descriptor fields should be read interpreted. If D = 0, the route descriptors are read from left to right. If D = 1, the route descriptors are read right to left.

The LF field designates the largest size frame that can be passed across the path connecting two end stations. This field is set to the smallest maximum frame size that can be passed across any LAN segment in the path.

Figure A-2 Routing Information Field



The following table describes the notations on this frame.

Table A-1 Routing Information Field

Notation	Description	Size (in bits)
RC	Routing Control	16
LTH	Length	5
RD*n*	Route Descriptor *n*	16
D	Direction bit	1
RT	Routing Type	3
LF	Largest Frame	6
r	reserved	1

Source routing requires that the end-nodes determine the path between themselves. Each end-node needs to know the destination MAC address and the path that the frame must take (that is, the list of rings and switches) to reach the destination MAC address. Each source routed frame contains a route information field between the source MAC address and the data portion of the MAC frame. The actual path that a frame can traverse can be composed of up to eight routing descriptors (RD), allowing a maximum of *seven* hops per route. Each RD (segment number/switch number) pair is two octets long, plus there are two additional octets of route control for a total of 18 octets.

The end node determines the route that a frame travels through the network. To determine the route, the end node sends an explorer frame, which is an LLC (Class 1) frame with a TEST/XID command or a protocol specific explorer (for example, NetBIOS NAME_QUERY). As explorer frames traverse the network, each switch that receives an explorer frame, places its RD (segment number /switch number) into the source routing information field (RIF) and forwards the frame out its other source routing ports to other rings/switches. As explorers traverse the network, each end-station looks at the MAC DA or a protocol-specific request to determine if the explorer is intended for itself. If the destination information matches the end station, it responds by returning the frame to the originating end-node by reversing the collected routing information, or via another explorer.

A direction bit in the routing control field of the RIF determines the direction for processing RDs. If the direction bit is set, the RDs are read last to first. An SRF is returned from its destination to its source with the RD read last-to-first. The end node originating an explorer frame saves the returned RDs and sends future frames indicating that the RD is to be read first to last.

Source Route Transparent Switching

Source Route Transparent (SRT) switching supports passing both source routed (frames with a RIF) and transparently switched (no RIF) frames over the same MAC interface. To differentiate each frame type, the routing-information indicator (RII) is used to indicate a frame is source routed or transparently switched. Source routing allows two types of explorer frames: All route explorers (ARE) and spanning-tree explorers (STE). AREs are sent on all rings to all switches in search of a destination MAC address. STEs are sent only on forwarding state spanning-tree ports. Spanning tree frames are only transmitted on SRT and transparent interfaces. Source route only interfaces do not support the reception or transmission of Spanning-tree bridge protocol data units (BPDU). All SR ports use the user-specified STE mode to determine whether an SR port should forward or block STE frames on input and output.

Source Routing Broadcast Reduction

One function of an SR switch is to forward all route explorer frames to all of its ports. Protocols such as Net BIOS make use of the ARE function extensively when issuing a NAME_QUERY command to locate service providers on a network. In redundant networks where looping topologies exist, the same frame can be sent out the same ports more than once. This may result in broadcast storms that halt the network.

The method to reduce broadcast storms in an SR network is defined by the IEEE 802.1d specification. It specifies that the RDs in an ARE frame must be checked to see if the frame has been previously sent on any potential outgoing port. This is performed by checking each LAN ID in the RDs looking for the outgoing port LAN ID. If the outgoing LAN ID exists in any of the RDs, that frame is dropped by the incoming port.

Cisco Systems supports the IEEE standard for the looped topology checking policy. In this policy, each frame is not only checked for its outgoing LAN ID in the RD list, but all LAN IDs in the switch are checked against the RD list of the incoming frame, and if a previously forwarded frame is detected, the frame is dropped.