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Definitions of Managed Objects for Source Routing Bridges

Status of this Memo

This RFC specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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1. Introduction

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in TCP/IP based internets. In particular, it defines objects for managing source routing and source routing transparent bridges. These bridges are also required to implement relevant groups in the Bridge MIB [6].

This MIB supersedes the dotldSr group of objects published in an earlier version of the Bridge MIB, RFC 1286. Changes have primarily been made to track changes in the IEEE 802.5M SRT Addendum to the IEEE 802.1D Standard for MAC Bridges.

2. The Network Management Framework

The Internet-standard Network Management Framework consists of three components. They are:

- o STD 16, RFC 1155 which defines the SMI, the mechanisms used for describing and naming objects for the purpose of management. STD 16, RFC 1212 defines a more concise description mechanism, which is wholly consistent with the SMI.
- o STD 17, RFC 1213 defines MIB-II, the core set of managed objects for the Internet suite of protocols.
- o STD 15, RFC 1157 which defines the SNMP, the protocol used for network access to managed objects.

The Framework permits new objects to be defined for the purpose of experimentation and evaluation.

2.1. Object Definitions

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. Objects in the MIB are defined using the subset of Abstract Syntax Notation One (ASN.1) defined in the SMI. In particular, each object object type is named by an OBJECT IDENTIFIER, an administratively assigned name. The object type together with an object instance serves to uniquely identify a specific instantiation of the object. For human convenience, we often use a textual string, termed the descriptor, to refer to the object type.

3. Overview

A common device present in many networks is the Bridge. This device is used to connect Local Area Network segments below the network

layer. There are two major modes defined for this bridging; transparent and source route. The transparent method of bridging is defined in the IEEE 802.1d MAC Bridge specification [11]. Source route bridging has been defined by I.B.M. and is described in the Token Ring Architecture Reference [12], as well as the IEEE 802.5M SRT Bridge Operations Addendum [14] to 802.1d. This memo defines objects needed for management of a source routing bridge, and is an extension to the SNMP Bridge MIB [6].

An explicit attempt was made to keep this MIB as simple as possible. This was accomplished by applying the following criteria to objects proposed for inclusion:

- (1) Start with a small set of essential objects and add only as further objects are needed.
- (2) Require objects be essential for either fault or configuration management.
- (3) Consider evidence of current use and/or utility.
- (4) Limit the total of objects.
- (5) Exclude objects which are simply derivable from others in this or other MIBs.
- (6) Avoid causing critical sections to be heavily instrumented. The guideline that was followed is one counter per critical section per layer.

3.1. Structure of MIB

Objects in this MIB are arranged into groups. Each group is organized as a set of related objects. The overall structure and assignment of objects to their groups is shown below. Where appropriate, the corresponding management object name found in IEEE 802.1d [11] and IEEE 802.5M [14] is also included.

SR Bridge MIB Name	IEEE Name
dot1dSr	
PortTable	
Port	
HopCount	SourceRoutingPort .PortHopCount
LocalSegment	.SegmentNumber
BridgeNum	.BridgeNumber
TargetSegment	

LargestFrame	.LargestFrameSize
STESpanMode	.LimitedBroadcastMode
SpecInFrames	BridgePort
	.ValidSRFramesReceived
SpecOutFrames	.ValidSRForwardedOutbound
ApeInFrames	
ApeOutFrames	.BroadcastFramesForwarded
SteInFrames	
SteOutFrames	.BroadcastFramesForwarded
SegmentMismatchDiscards	.DiscardInvalidRI
DuplicateSegmentDiscards	.LanIdMismatch
HopCountExceededDiscards	.FramesDiscardedHopCountExceeded

The following IEEE management objects have not been included in the SR Bridge MIB for the indicated reasons.

IEEE Object	Disposition
SourceRoutingPort	The following objects were NOT included in this MIB because they are redundant or not considered useful.
.LimitedBroadcastEnable	
.DiscardLackOfBuffers	
.DiscardErrorDetails	
.DiscardTargetLANInoperable	
.ValidSRDiscardedInbound	
.BroadcastBytesForwarded	
.NonBroadcastBytesForwarded	
.FramesNotReceivedDueToCongestion	
.FramesDiscardedDueToInternalError	

3.1.1. The dot1dSr Group

This group contains the objects that describe the entity's state with respect to source route bridging. If source routing is not supported, this group will not be implemented. This group is applicable to source route only, and SRT bridges.

3.1.2. The dot1dPortPair Group

Implementation of this group is optional. This group is implemented by those bridges that support the port-pair multipoint model of the source route bridging mode as defined in the IEEE 802.5M SRT Addendum to 802.1d.

3.2. Relationship to Other MIBs

As described above, some IEEE 802.1d management objects have not been included in this MIB because they overlap with objects in other MIBs applicable to a bridge implementing this MIB. In particular, it is assumed that a bridge implementing this MIB will also implement (at least) the Bridge MIB and the 'system' group and the 'interfaces' group defined in MIB-II [4].

3.2.1. Relationship to the Bridge MIB

The Bridge MIB [6] must be implemented by all bridges, including transparent, SR and SRT bridges. The SR bridge MIB is an extension to the Bridge MIB.

3.2.2. Relationship to the 'system' group

In MIB-II, the 'system' group is defined as being mandatory for all systems such that each managed entity contains one instance of each object in the 'system' group. Thus, those objects apply to the entity as a whole irrespective of whether the entity's sole functionality is bridging, or whether bridging is only a subset of the entity's functionality.

3.2.3. Relationship to the 'interfaces' group

In MIB-II, the 'interfaces' group is defined as being mandatory for all systems and contains information on an entity's interfaces, where each interface is thought of as being attached to a 'subnetwork'. (Note that this term is not to be confused with 'subnet' which refers to an addressing partitioning scheme used in the Internet suite of protocols.) The term 'segment' is used in this memo to refer to such a subnetwork.

Implicit in this MIB is the notion of ports on a bridge. Each of these ports is associated with one interface of the 'interfaces' group, and in most situations, each port is associated with a different interface. However, there are situations in which multiple ports are associated with the same interface. An example of such a situation would be several ports, each corresponding one-to-one with several X.25 virtual circuits, but all on the same interface.

Each port is uniquely identified by a port number. A port number has no mandatory relationship to an interface number, but in the simple case, a port number will have the same value as the corresponding interface's interface number.

Some entities provide other services in addition to bridging with respect to the data sent and received by their interfaces. In such situations, only a subset of the data sent/received on an interface is within the domain of the entity's bridging functionality. This subset is considered to be delineated according to a set of protocols, with some protocols being bridged, and other protocols not being bridged. For example, in an entity which exclusively performed bridging, all protocols would be considered as being bridged, whereas in an entity which performed IP routing on IP datagrams and only bridged other protocols, only the non-IP data would be considered as being bridged.

Thus, this MIB (and in particular, its counters) are applicable only to that subset of the data on an entity's interfaces which is sent/received for a protocol being bridged. All such data is sent/received via the ports of the bridge.

4. Changes from RFC 1286

In addition to being separated from the Bridge MIB into a separate document, the following changes were implemented as a result of feedback from IEEE 802.5M:

- (1) Changed syntax of dot1dSrPortLargestFrame to INTEGER in order to allow for having 64 possible values as described in draft 7 of the SR Addendum. Listed all legal values in description.
- (2) Updated syntax of dot1dSrPort, used to index into dot1dSrPortTable, to use the range (1..65535).
- (3) Added a counter to dot1dSrPortTable to count occurrences of duplicate LAN IDs or Tree errors.
- (4) Added a counter to dot1dSrPortTable to count LAN ID mismatches.
- (5) Added text to dot1dSrPortSpecInFrames and dot1dSrPortSpecOutFrames clarifying that they are also referred to as Source Routed Frames.
- (6) Added text to dot1dSrPortApeInFrames and dot1dSrPortApeOutFrames clarifying that they are also referred to as All Routes Explorer frames.
- (7) Added a scalar variable to the dot1dSr group to indicate whether the bridge uses 3 bit or 6 bit length negotiation fields.

- (8) Added dotldPortPairGroup to allow representation of port pairs as defined in the IEEE 802.5M SRT Addendum.

5. Definitions

```

SOURCE-ROUTING-MIB DEFINITIONS ::= BEGIN

IMPORTS
    Counter, Gauge
        FROM RFC1155-SMI
    dotldBridge, dotldSr
        FROM BRIDGE-MIB
    OBJECT-TYPE
        FROM RFC-1212;

-- groups in the SR MIB

-- dotldSr is imported from the Bridge MIB

dotldPortPair OBJECT IDENTIFIER ::= { dotldBridge 10 }

-- the dotldSr group

-- this group is implemented by those bridges that
-- support the source route bridging mode, including Source
-- Routing and SRT bridges.

dotldSrPortTable OBJECT-TYPE
    SYNTAX SEQUENCE OF DotldSrPortEntry
    ACCESS not-accessible
    STATUS mandatory
    DESCRIPTION
        "A table that contains information about every
        port that is associated with this source route
        bridge."
    ::= { dotldSr 1 }

dotldSrPortEntry OBJECT-TYPE
    SYNTAX DotldSrPortEntry
    ACCESS not-accessible
    STATUS mandatory
    DESCRIPTION
        "A list of information for each port of a source
        route bridge."
    INDEX { dotldSrPort }

```

```
::= { dot1dSrPortTable 1 }
```

```
Dot1dSrPortEntry ::=
```

```
SEQUENCE {
    dot1dSrPort
        INTEGER,
    dot1dSrPortHopCount
        INTEGER,
    dot1dSrPortLocalSegment
        INTEGER,
    dot1dSrPortBridgeNum
        INTEGER,
    dot1dSrPortTargetSegment
        INTEGER,
    dot1dSrPortLargestFrame
        INTEGER,
    dot1dSrPortSTESpanMode
        INTEGER,
    dot1dSrPortSpecInFrames
        Counter,
    dot1dSrPortSpecOutFrames
        Counter,
    dot1dSrPortApeInFrames
        Counter,
    dot1dSrPortApeOutFrames
        Counter,
    dot1dSrPortSteInFrames
        Counter,
    dot1dSrPortSteOutFrames
        Counter,
    dot1dSrPortSegmentMismatchDiscards
        Counter,
    dot1dSrPortDuplicateSegmentDiscards
        Counter,
    dot1dSrPortHopCountExceededDiscards
        Counter,
    dot1dSrPortDupLanIdOrTreeErrors
        Counter,
    dot1dSrPortLanIdMismatches
        Counter
}
```

```
dot1dSrPort OBJECT-TYPE
```

```
SYNTAX INTEGER (1..65535)
```

```
ACCESS read-only
```

```
STATUS mandatory
```

```
DESCRIPTION
```

```
"The port number of the port for which this entry
```

```
        contains Source Route management information."
 ::= { dot1dSrPortEntry 1 }

dot1dSrPortHopCount OBJECT-TYPE
    SYNTAX  INTEGER
    ACCESS  read-write
    STATUS  mandatory
    DESCRIPTION
        "The maximum number of routing descriptors allowed
         in an All Paths or Spanning Tree Explorer frames."
 ::= { dot1dSrPortEntry 2 }

dot1dSrPortLocalSegment OBJECT-TYPE
    SYNTAX  INTEGER
    ACCESS  read-write
    STATUS  mandatory
    DESCRIPTION
        "The segment number that uniquely identifies the
         segment to which this port is connected. Current
         source routing protocols limit this value to the
         range: 0 through 4095. (The value 0 is used by
         some management applications for special test
         cases.) A value of 65535 signifies that no segment
         number is assigned to this port."
 ::= { dot1dSrPortEntry 3 }

dot1dSrPortBridgeNum OBJECT-TYPE
    SYNTAX  INTEGER
    ACCESS  read-write
    STATUS  mandatory
    DESCRIPTION
        "A bridge number uniquely identifies a bridge when
         more than one bridge is used to span the same two
         segments. Current source routing protocols limit
         this value to the range: 0 through 15. A value of
         65535 signifies that no bridge number is assigned
         to this bridge."
 ::= { dot1dSrPortEntry 4 }

dot1dSrPortTargetSegment OBJECT-TYPE
    SYNTAX  INTEGER
    ACCESS  read-write
    STATUS  mandatory
    DESCRIPTION
        "The segment number that corresponds to the target
         segment this port is considered to be connected to
         by the bridge. Current source routing protocols
         limit this value to the range: 0 through 4095."
```

(The value 0 is used by some management applications for special test cases.) A value of 65535 signifies that no target segment is assigned to this port."

```
::= { dot1dSrPortEntry 5 }
```

```
-- It would be nice if we could use ifMtu as the size of the
-- largest frame, but we can't because ifMtu is defined to be
-- the size that the (inter-)network layer can use which can
-- differ from the MAC layer (especially if several layers of
-- encapsulation are used).
```

```
dot1dSrPortLargestFrame OBJECT-TYPE
```

```
SYNTAX INTEGER
ACCESS read-write
STATUS mandatory
DESCRIPTION
```

"The maximum size of the INFO field (LLC and above) that this port can send/receive. It does not include any MAC level (framing) octets. The value of this object is used by this bridge to determine whether a modification of the LargestFrame (LF, see [14]) field of the Routing Control field of the Routing Information Field is necessary.

64 valid values are defined by the IEEE 802.5M SRT Addendum: 516, 635, 754, 873, 993, 1112, 1231, 1350, 1470, 1542, 1615, 1688, 1761, 1833, 1906, 1979, 2052, 2345, 2638, 2932, 3225, 3518, 3812, 4105, 4399, 4865, 5331, 5798, 6264, 6730, 7197, 7663, 8130, 8539, 8949, 9358, 9768, 10178, 10587, 10997, 11407, 12199, 12992, 13785, 14578, 15370, 16163, 16956, 17749, 20730, 23711, 26693, 29674, 32655, 35637, 38618, 41600, 44591, 47583, 50575, 53567, 56559, 59551, and 65535.

An illegal value will not be accepted by the bridge."

```
::= { dot1dSrPortEntry 6 }
```

```
dot1dSrPortSTESpanMode OBJECT-TYPE
```

```
SYNTAX INTEGER {
    auto-span(1),
    disabled(2),
    forced(3)
}
ACCESS read-write
```

STATUS mandatory

DESCRIPTION

"Determines how this port behaves when presented with a Spanning Tree Explorer frame. The value 'disabled(2)' indicates that the port will not accept or send Spanning Tree Explorer packets; any STE packets received will be silently discarded. The value 'forced(3)' indicates the port will always accept and propagate Spanning Tree Explorer frames. This allows a manually configured Spanning Tree for this class of packet to be configured. Note that unlike transparent bridging, this is not catastrophic to the network if there are loops. The value 'auto-span(1)' can only be returned by a bridge that both implements the Spanning Tree Protocol and has use of the protocol enabled on this port. The behavior of the port for Spanning Tree Explorer frames is determined by the state of dot1dStpPortState. If the port is in the 'forwarding' state, the frame will be accepted or propagated. Otherwise, it will be silently discarded."

::= { dot1dSrPortEntry 7 }

dot1dSrPortSpecInFrames OBJECT-TYPE

SYNTAX Counter

ACCESS read-only

STATUS mandatory

DESCRIPTION

"The number of Specifically Routed frames, also referred to as Source Routed Frames, that have been received from this port's segment."

::= { dot1dSrPortEntry 8 }

dot1dSrPortSpecOutFrames OBJECT-TYPE

SYNTAX Counter

ACCESS read-only

STATUS mandatory

DESCRIPTION

"The number of Specifically Routed frames, also referred to as Source Routed Frames, that this port has transmitted on its segment."

::= { dot1dSrPortEntry 9 }

dot1dSrPortApeInFrames OBJECT-TYPE

SYNTAX Counter

ACCESS read-only

STATUS mandatory

DESCRIPTION

"The number of All Paths Explorer frames, also referred to as All Routes Explorer frames, that have been received by this port from its segment."

::= { dot1dSrPortEntry 10 }

dot1dSrPortApeOutFrames OBJECT-TYPE

SYNTAX Counter

ACCESS read-only

STATUS mandatory

DESCRIPTION

"The number of all Paths Explorer Frames, also referred to as All Routes Explorer frames, that have been transmitted by this port on its segment."

::= { dot1dSrPortEntry 11 }

dot1dSrPortSteInFrames OBJECT-TYPE

SYNTAX Counter

ACCESS read-only

STATUS mandatory

DESCRIPTION

"The number of spanning tree explorer frames that have been received by this port from its segment."

::= { dot1dSrPortEntry 12 }

dot1dSrPortSteOutFrames OBJECT-TYPE

SYNTAX Counter

ACCESS read-only

STATUS mandatory

DESCRIPTION

"The number of spanning tree explorer frames that have been transmitted by this port on its segment."

::= { dot1dSrPortEntry 13 }

dot1dSrPortSegmentMismatchDiscards OBJECT-TYPE

SYNTAX Counter

ACCESS read-only

STATUS mandatory

DESCRIPTION

"The number of explorer frames that have been discarded by this port because the routing descriptor field contained an invalid adjacent segment value."

::= { dot1dSrPortEntry 14 }

dot1dSrPortDuplicateSegmentDiscards OBJECT-TYPE

```
SYNTAX Counter
ACCESS read-only
STATUS mandatory
DESCRIPTION
    "The number of frames that have been discarded by
    this port because the routing descriptor field
    contained a duplicate segment identifier."
 ::= { dot1dSrPortEntry 15 }

dot1dSrPortHopCountExceededDiscards OBJECT-TYPE
SYNTAX Counter
ACCESS read-only
STATUS mandatory
DESCRIPTION
    "The number of explorer frames that have been
    discarded by this port because the Routing
    Information Field has exceeded the maximum route
    descriptor length."
 ::= { dot1dSrPortEntry 16 }

dot1dSrPortDupLanIdOrTreeErrors OBJECT-TYPE
SYNTAX Counter
ACCESS read-only
STATUS mandatory
DESCRIPTION
    "The number of duplicate LAN IDs or Tree errors.
    This helps in detection of problems in networks
    containing older IBM Source Routing Bridges."
 ::= { dot1dSrPortEntry 17 }

dot1dSrPortLanIdMismatches OBJECT-TYPE
SYNTAX Counter
ACCESS read-only
STATUS mandatory
DESCRIPTION
    "The number of ARE and STE frames that were
    discarded because the last LAN ID in the routing
    information field did not equal the LAN-in ID.
    This error can occur in implementations which do
    only a LAN-in ID and Bridge Number check instead
    of a LAN-in ID, Bridge Number, and LAN-out ID
    check before they forward broadcast frames."
 ::= { dot1dSrPortEntry 18 }

-- scalar object in dot1dSr

dot1dSrBridgeLfMode OBJECT-TYPE
```

```
SYNTAX  INTEGER {
            mode3(1),
            mode6(2)
        }
ACCESS  read-write
STATUS  mandatory
DESCRIPTION
    "Indicates whether the bridge operates using older
     3 bit length negotiation fields or the newer 6 bit
     length field in its RIF."
 ::= { dot1dSr 2 }

-- The Port-Pair Database

-- Implementation of this group is optional.

-- This group is implemented by those bridges that support
-- the direct multipoint model of the source route bridging
-- mode as defined in the IEEE 802.5 SRT Addendum to
-- 802.1d.

-- Bridges implementing this group may report 65535 for
-- dot1dSrPortBridgeNumber and dot1dSrPortTargetSegment,
-- indicating that those objects are not applicable.

dot1dPortPairTableSize OBJECT-TYPE
    SYNTAX  Gauge
    ACCESS  read-only
    STATUS  mandatory
    DESCRIPTION
        "The total number of entries in the Bridge Port
         Pair Database."
    ::= { dot1dPortPair 1 }

-- the Bridge Port-Pair table

-- this table represents port pairs within a bridge forming
-- a unique bridge path, as defined in the IEEE 802.5M SRT
-- Addendum.

dot1dPortPairTable OBJECT-TYPE
    SYNTAX  SEQUENCE OF Dot1dPortPairEntry
    ACCESS  not-accessible
    STATUS  mandatory
    DESCRIPTION
        "A table that contains information about every
```

```

        port pair database entity associated with this
        source routing bridge."
 ::= { dot1dPortPair 2 }

dot1dPortPairEntry OBJECT-TYPE
SYNTAX  Dot1dPortPairEntry
ACCESS  not-accessible
STATUS  mandatory
DESCRIPTION
        "A list of information for each port pair entity
        of a bridge."
INDEX   { dot1dPortPairLowPort, dot1dPortPairHighPort }
 ::= { dot1dPortPairTable 1 }

Dot1dPortPairEntry ::=
SEQUENCE {
    dot1dPortPairLowPort
        INTEGER,
    dot1dPortPairHighPort
        INTEGER,
    dot1dPortPairBridgeNum
        INTEGER,
    dot1dPortPairBridgeState
        INTEGER
}

dot1dPortPairLowPort OBJECT-TYPE
SYNTAX  INTEGER (1..65535)
ACCESS  read-write
STATUS  mandatory
DESCRIPTION
        "The port number of the lower numbered port for
        which this entry contains port pair database
        information."
 ::= { dot1dPortPairEntry 1 }

dot1dPortPairHighPort OBJECT-TYPE
SYNTAX  INTEGER (1..65535)
ACCESS  read-write
STATUS  mandatory
DESCRIPTION
        "The port number of the higher numbered port for
        which this entry contains port pair database
        information."
 ::= { dot1dPortPairEntry 2 }

dot1dPortPairBridgeNum OBJECT-TYPE
SYNTAX  INTEGER

```

```

ACCESS read-write
STATUS mandatory
DESCRIPTION
    "A bridge number that uniquely identifies the path
    provided by this source routing bridge between the
    segments connected to dotldPortPairLowPort and
    dotldPortPairHighPort. The purpose of bridge
    number is to disambiguate between multiple paths
    connecting the same two LANs."
 ::= { dotldPortPairEntry 3 }

dotldPortPairBridgeState OBJECT-TYPE
SYNTAX INTEGER {
    enabled(1),
    disabled(2),
    invalid(3)
}
ACCESS read-write
STATUS mandatory
DESCRIPTION
    "The state of dotldPortPairBridgeNum. Writing
    'invalid(3)' to this object removes the
    corresponding entry."
 ::= { dotldPortPairEntry 4 }

```

END

6. Acknowledgments

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7. References

- [1] Cerf, V., "IAB Recommendations for the Development of Internet Network Management Standards", RFC 1052, NRI, April 1988.
- [2] Cerf, V., "Report of the Second Ad Hoc Network Management Review Group", RFC 1109, NRI, August 1989.
- [3] Rose M., and K. McCloghrie, "Structure and Identification of Management Information for TCP/IP-based internets", STD 16, RFC

- 1155, Performance Systems International, Hughes LAN Systems, May 1990.
- [4] McCloghrie K., and M. Rose, Editors, "Management Information Base for Network Management of TCP/IP-based internets", STD 17, RFC 1213, Performance Systems International, March 1991.
 - [5] Case, J., Fedor, M., Schoffstall, M., and J. Davin, "Simple Network Management Protocol", STD 15, RFC 1157, SNMP Research, Performance Systems International, Performance Systems International, MIT Laboratory for Computer Science, May 1990.
 - [6] Decker, E., Langille, P., Rijsinghani, A., and McCloghrie, K., "Definitions of Managed Objects for Bridges", RFC 1493, cisco Systems, Digital Equipment Corporation, Digital Equipment Corporation, Hughes LAN Systems, July 1993.
 - [7] Information processing systems - Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1), International Organization for Standardization, International Standard 8824, December 1987.
 - [8] Information processing systems - Open Systems Interconnection - Specification of Basic Encoding Rules for Abstract Notation One (ASN.1), International Organization for Standardization, International Standard 8825, December 1987.
 - [9] Rose, M., and K. McCloghrie, Editors, "Concise MIB Definitions", STD 16, RFC 1212, Performance Systems International, Hughes LAN Systems, March 1991.
 - [10] Rose, M., Editor, "A Convention for Defining Traps for use with the SNMP", RFC 1215, Performance Systems International, March 1991.
 - [11] ANSI/IEEE Standard 802.1D-1990 MAC Bridges, IEEE Project 802 Local and Metropolitan Area Networks, (March 8, 1991).
 - [12] I.B.M. Token Ring Architecture Reference.
 - [13] ISO DIS 10038 MAC Bridges.
 - [14] ANSI/IEEE P802.5M-Draft 7, "Source Routing Transparent Bridge Operation", IEEE Project 802 (1991).
 - [15] ANSI/IEEE 802.1y, "Source Routing Tutorial for End System Operation", (September, 1990).

Security Considerations

Security issues are not discussed in this memo.

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