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Definitions of Managed Objects for Bridges

Status of This Memo

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Abstract

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 MAC bridges based on the IEEE 802.1D-1998 standard between Local Area Network (LAN) segments. Provisions are made for the support of transparent bridging. Provisions are also made so that these objects apply to bridges connected by subnetworks other than LAN segments.

The MIB module presented in this memo is a translation of the BRIDGE-MIB defined in RFC 1493 to the SMIv2 syntax.

This memo obsoletes RFC 1493.

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1. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [RFC3410].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIv2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

2. Conventions

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL", when they appear in this document, are to be interpreted as described in BCP 14, RFC 2119 [RFC2119].

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 specification [IEEE8021D]. This memo defines those objects needed for the management of a bridging entity that operates in the transparent mode, as well as some objects that apply to all types of bridges.

To be consistent with IAB directives and good engineering practices, an explicit attempt was made to keep this MIB module 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 that objects be essential for either fault or configuration management.

3. Consider evidence of current use and/or utility.

4. Limit the total number of objects.

5. Exclude objects that are simply derivable from others in this or other MIB modules.

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 the MIB Module

Objects in this MIB module are arranged into subtrees. Each subtree is organized as a set of related objects. The overall structure and assignment of objects to their subtrees is shown below. Where appropriate, the corresponding IEEE 802.1D [IEEE8021D] management object name is also included.

```
   Bridge MIB Name                  IEEE 802.1D Name

   dot1dBridge
     dot1dBase
       BridgeAddress                Bridge.BridgeAddress
       NumPorts                     Bridge.NumberOfPorts
       Type
       PortTable
         Port                       BridgePort.PortNumber
         IfIndex
         Circuit
         DelayExceededDiscards        .DiscardTransitDelay
         MtuExceededDiscards          .DiscardOnError
     dot1dStp
       ProtocolSpecification
       Priority                     SpanningTreeProtocol
                                      .BridgePriority
       TimeSinceTopologyChange        .TimeSinceTopologyChange
       TopChanges                     .TopologyChangeCount
       DesignatedRoot                 .DesignatedRoot
       RootCost                       .RootCost
       RootPort                       .RootPort
       MaxAge                         .MaxAge
       HelloTime                      .HelloTime
       HoldTime                       .HoldTime
       ForwardDelay                   .ForwardDelay
       BridgeMaxAge                   .BridgeMaxAge
       BridgeHelloTime                .BridgeHelloTime
       BridgeForwardDelay             .BridgeForwardDelay
       PortTable
         Port                        SpanningTreeProtocolPort
                                       .PortNumber
         Priority                      .PortPriority
         State                         .SpanningTreeState
         Enable
         PathCost                      .PortPathCost
         DesignatedRoot                .DesignatedRoot
         DesignatedCost                .DesignatedCost
         DesignatedBridge              .DesignatedBridge
         DesignatedPort                .DesignatedPort
         ForwardTransitions
```

```
  dot1dTp
    LearnedEntryDiscards          BridgeFilter.DatabaseSize
                                    .NumDynamic,NumStatic
    AgingTime                     BridgeFilter.AgingTime
    FdbTable
      Address
      Port
      Status
    PortTable
      Port
      MaxInfo
      InFrames                    BridgePort.FramesReceived
      OutFrames                     .ForwardOutbound
      InDiscards                    .DiscardInbound
  dot1dStatic
    StaticTable
      Address
      ReceivePort
      AllowedToGoTo
      Status
```

The following IEEE 802.1D management objects have not been included in the BRIDGE-MIB module for the indicated reasons.

IEEE 802.1D Object	Disposition
Bridge.BridgeName	Same as sysDescr (SNMPv2-MIB)
Bridge.BridgeUpTime	Same as sysUpTime (SNMPv2-MIB)
Bridge.PortAddresses	Same as ifPhysAddress (IF-MIB)
BridgePort.PortName	Same as ifDescr (IF-MIB)
BridgePort.PortType	Same as ifType (IF-MIB)
BridgePort.RoutingType	Derivable from the implemented subtrees
SpanningTreeProtocol	
.BridgeIdentifier	Combination of dot1dStpPriority and dot1dBaseBridgeAddress
.TopologyChange	Since this is transitory, it is not considered useful.
SpanningTreeProtocolPort	
.Uptime	Same as ifLastChange (IF-MIB)
.PortIdentifier	Combination of dot1dStpPort and dot1dStpPortPriority
.TopologyChangeAcknowledged	Since this is transitory, it is not considered useful.
.DiscardLackOfBuffers	Redundant

Transmission Priority	These objects are not required as per the Pics Proforma and are not considered useful.
.TransmissionPriorityName	
.OutboundUserPriority	
.OutboundAccessPriority	

3.1.1 The dot1dBase Subtree

This subtree contains the objects that are applicable to all types of bridges.

3.1.2 The dot1dStp Subtree

This subtree contains the objects that denote the bridge's state with respect to the Spanning Tree Protocol. If a node does not implement the Spanning Tree Protocol, this subtree will not be implemented.

3.1.3 The dot1dSr Subtree

This subtree contains the objects that describe the entity's state with respect to source route bridging. This subtree described in RFC 1525 [RFC1525] is applicable only to source route bridging.

3.1.4 The dot1dTp Subtree

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

3.1.5 The dot1dStatic Subtree

This subtree contains objects that describe the entity's state with respect to destination-address filtering. If destination-address filtering is not supported, this subtree will not be implemented. This subtree is applicable to any type of bridge that performs destination-address filtering.

3.2 Relationship to Other MIB Modules

As described above, some IEEE 802.1D management objects have not been included in this MIB module because they overlap with objects in other MIB modules that are applicable to a bridge implementing this MIB module.

3.2.1 Relationship to the SNMPv2-MIB

The SNMPv2-MIB [RFC3418] defines objects that are generally applicable to managed devices. These objects apply to the device as a whole, irrespective of whether the device's sole functionality is bridging, or whether bridging is only a subset of the device's functionality.

As explained in Section 3.1, full support for the 802.1D management objects requires that the SNMPv2-MIB objects sysDescr and sysUpTime be implemented. Note that compliance with the current SNMPv2-MIB module requires additional objects and notifications to be implemented, as specified in RFC 3418 [RFC3418].

3.2.2 Relationship to the IF-MIB

The IF-MIB [RFC2863] defines managed objects for managing network interfaces. A network 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, whether it be an Ethernet segment, a 'ring', a WAN link, or even an X.25 virtual circuit.

As explained in Section 3.1, full support for the 802.1D management objects requires that the IF-MIB objects ifIndex, ifType, ifDescr, ifPhysAddress, and ifLastChange are implemented. Note that compliance to the current IF-MIB module requires additional objects and notifications to be implemented as specified in RFC 2863 [RFC2863].

Implicit in this BRIDGE-MIB is the notion of ports on a bridge. Each of these ports is associated with one interface of the 'interfaces' subtree, 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 that are 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. Port numbers are in the range (1..dot1dBaseNumPorts).

Some entities perform other functionalities as well as bridging through the sending and receiving of data on 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 that exclusively performs bridging, all protocols would be considered as bridged, whereas in an entity that performs IP routing on IP datagrams and only bridges other protocols, only the non-IP data would be considered as having been bridged.

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

4. Definitions

```
BRIDGE-MIB DEFINITIONS ::= BEGIN

-- ------------------------------------------------------------ --
-- MIB for IEEE 802.1D devices
-- ------------------------------------------------------------ --
IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
    Counter32, Integer32, TimeTicks, mib-2
        FROM SNMPv2-SMI
    TEXTUAL-CONVENTION, MacAddress
        FROM SNMPv2-TC
    MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
        FROM SNMPv2-CONF
    InterfaceIndex FROM IF-MIB
    ;

dot1dBridge MODULE-IDENTITY
    LAST-UPDATED "200509190000Z"
    ORGANIZATION "IETF Bridge MIB Working Group"
    CONTACT-INFO
        "Email: bridge-mib@ietf.org

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```
        Send comments to <bridge-mib@ietf.org>"
    DESCRIPTION
        "The Bridge MIB module for managing devices that support
        IEEE 802.1D.

        Copyright (C) The Internet Society (2005). This version of
        this MIB module is part of RFC 4188; see the RFC itself for
        full legal notices."
    REVISION     "200509190000Z"
    DESCRIPTION
        "Third revision, published as part of RFC 4188.

        The MIB module has been converted to SMIv2 format.
        Conformance statements have been added and some
        description and reference clauses have been updated.

        The object dot1dStpPortPathCost32 was added to
        support IEEE 802.1t and the permissible values of
        dot1dStpPriority and dot1dStpPortPriority have been
        clarified for bridges supporting IEEE 802.1t or
        IEEE 802.1w.

        The interpretation of dot1dStpTimeSinceTopologyChange
        has been clarified for bridges supporting the Rapid
        Spanning Tree Protocol (RSTP)."
    REVISION     "199307310000Z"
    DESCRIPTION
        "Second revision, published as part of RFC 1493."
    REVISION     "199112310000Z"
    DESCRIPTION
        "Initial revision, published as part of RFC 1286."
    ::= { mib-2 17 }


-- ---------------------------------------------------------- --
-- Textual Conventions
-- ---------------------------------------------------------- --

BridgeId ::= TEXTUAL-CONVENTION
```

```
        STATUS      current
        DESCRIPTION
            "The Bridge-Identifier, as used in the Spanning Tree
            Protocol, to uniquely identify a bridge.  Its first two
            octets (in network byte order) contain a priority value,
            and its last 6 octets contain the MAC address used to
            refer to a bridge in a unique fashion (typically, the
            numerically smallest MAC address of all ports on the
            bridge)."
        SYNTAX      OCTET STRING (SIZE (8))

    Timeout ::= TEXTUAL-CONVENTION
        DISPLAY-HINT "d"
        STATUS      current
        DESCRIPTION
            "A Spanning Tree Protocol (STP) timer in units of 1/100
            seconds.  Several objects in this MIB module represent
            values of timers used by the Spanning Tree Protocol.
            In this MIB, these timers have values in units of
            hundredths of a second (i.e., 1/100 secs).

            These timers, when stored in a Spanning Tree Protocol's
            BPDU, are in units of 1/256 seconds.  Note, however, that
            802.1D-1998 specifies a settable granularity of no more
            than one second for these timers.  To avoid ambiguity,
            a conversion algorithm is defined below for converting
            between the different units, which ensures a timer's
            value is not distorted by multiple conversions.

            To convert a Timeout value into a value in units of
            1/256 seconds, the following algorithm should be used:

                b = floor( (n * 256) / 100)

            where:
                floor   =  quotient [ignore remainder]
                n is the value in 1/100 second units
                b is the value in 1/256 second units

            To convert the value from 1/256 second units back to
            1/100 seconds, the following algorithm should be used:

                n = ceiling( (b * 100) / 256)

            where:
                ceiling = quotient [if remainder is 0], or
                          quotient + 1 [if remainder is nonzero]
                n is the value in 1/100 second units
```

```
                b is the value in 1/256 second units

            Note: it is important that the arithmetic operations are
            done in the order specified (i.e., multiply first,
            divide second)."
        SYNTAX      Integer32

    -- ---------------------------------------------------------- --
    -- subtrees in the Bridge MIB
    -- ---------------------------------------------------------- --

    dot1dNotifications  OBJECT IDENTIFIER ::= { dot1dBridge 0 }

    dot1dBase           OBJECT IDENTIFIER ::= { dot1dBridge 1 }
    dot1dStp            OBJECT IDENTIFIER ::= { dot1dBridge 2 }

    dot1dSr             OBJECT IDENTIFIER ::= { dot1dBridge 3 }
    -- documented in RFC 1525

    dot1dTp             OBJECT IDENTIFIER ::= { dot1dBridge 4 }
    dot1dStatic         OBJECT IDENTIFIER ::= { dot1dBridge 5 }

    -- Subtrees used by Bridge MIB Extensions:
    --      pBridgeMIB  MODULE-IDENTITY   ::= { dot1dBridge 6 }
    --      qBridgeMIB  MODULE-IDENTITY   ::= { dot1dBridge 7 }
    -- Note that the practice of registering related MIB modules
    -- below dot1dBridge has been discouraged since there is no
    -- robust mechanism to track such registrations.

    dot1dConformance    OBJECT IDENTIFIER ::= { dot1dBridge 8 }

    -- ---------------------------------------------------------- --
    -- the dot1dBase subtree
    -- ---------------------------------------------------------- --
    -- Implementation of the dot1dBase subtree is mandatory for all
    -- bridges.
    -- ---------------------------------------------------------- --

    dot1dBaseBridgeAddress OBJECT-TYPE

        SYNTAX      MacAddress
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The MAC address used by this bridge when it must be
            referred to in a unique fashion.  It is recommended
            that this be the numerically smallest MAC address of
            all ports that belong to this bridge.  However, it is only
```

```
            required to be unique.  When concatenated with
            dot1dStpPriority, a unique BridgeIdentifier is formed,
            which is used in the Spanning Tree Protocol."
        REFERENCE
            "IEEE 802.1D-1998: clauses 14.4.1.1.3 and 7.12.5"
        ::= { dot1dBase 1 }

    dot1dBaseNumPorts OBJECT-TYPE
        SYNTAX      Integer32
        UNITS       "ports"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The number of ports controlled by this bridging
            entity."
        REFERENCE
            "IEEE 802.1D-1998: clause 14.4.1.1.3"
        ::= { dot1dBase 2 }

    dot1dBaseType OBJECT-TYPE
        SYNTAX      INTEGER {
                        unknown(1),
                        transparent-only(2),
                        sourceroute-only(3),
                        srt(4)
                    }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "Indicates what type of bridging this bridge can
            perform.  If a bridge is actually performing a
            certain type of bridging, this will be indicated by
            entries in the port table for the given type."
        ::= { dot1dBase 3 }

    -- ---------------------------------------------------------- --
    -- The Generic Bridge Port Table
    -- ---------------------------------------------------------- --
    dot1dBasePortTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF Dot1dBasePortEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "A table that contains generic information about every
            port that is associated with this bridge.  Transparent,
            source-route, and srt ports are included."
        ::= { dot1dBase 4 }
```

```
   dot1dBasePortEntry OBJECT-TYPE
       SYNTAX      Dot1dBasePortEntry
       MAX-ACCESS  not-accessible
       STATUS      current

       DESCRIPTION
           "A list of information for each port of the bridge."
       REFERENCE
           "IEEE 802.1D-1998: clause 14.4.2, 14.6.1"
       INDEX  { dot1dBasePort }
       ::= { dot1dBasePortTable 1 }

   Dot1dBasePortEntry ::=
       SEQUENCE {
           dot1dBasePort
               Integer32,
           dot1dBasePortIfIndex
               InterfaceIndex,
           dot1dBasePortCircuit
               OBJECT IDENTIFIER,
           dot1dBasePortDelayExceededDiscards
               Counter32,
           dot1dBasePortMtuExceededDiscards
               Counter32
       }

   dot1dBasePort OBJECT-TYPE
       SYNTAX      Integer32 (1..65535)
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "The port number of the port for which this entry
           contains bridge management information."
       ::= { dot1dBasePortEntry 1 }

   dot1dBasePortIfIndex OBJECT-TYPE
       SYNTAX      InterfaceIndex
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "The value of the instance of the ifIndex object,
           defined in IF-MIB, for the interface corresponding
           to this port."
       ::= { dot1dBasePortEntry 2 }

   dot1dBasePortCircuit OBJECT-TYPE
       SYNTAX      OBJECT IDENTIFIER
       MAX-ACCESS  read-only
```

```
        STATUS      current
        DESCRIPTION
            "For a port that (potentially) has the same value of
            dot1dBasePortIfIndex as another port on the same bridge.
            This object contains the name of an object instance
            unique to this port.  For example, in the case where
            multiple ports correspond one-to-one with multiple X.25
            virtual circuits, this value might identify an (e.g.,
            the first) object instance associated with the X.25
            virtual circuit corresponding to this port.

            For a port which has a unique value of
            dot1dBasePortIfIndex, this object can have the value
            { 0 0 }."
        ::= { dot1dBasePortEntry 3 }

    dot1dBasePortDelayExceededDiscards OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The number of frames discarded by this port due
            to excessive transit delay through the bridge.  It
            is incremented by both transparent and source
            route bridges."
        REFERENCE
            "IEEE 802.1D-1998: clause 14.6.1.1.3"
        ::= { dot1dBasePortEntry 4 }

    dot1dBasePortMtuExceededDiscards OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The number of frames discarded by this port due
            to an excessive size.  It is incremented by both
            transparent and source route bridges."
        REFERENCE
            "IEEE 802.1D-1998: clause 14.6.1.1.3"
        ::= { dot1dBasePortEntry 5 }

    -- ---------------------------------------------------------- --
    -- the dot1dStp subtree
    -- ---------------------------------------------------------- --
    -- Implementation of the dot1dStp subtree is optional.  It is
    -- implemented by those bridges that support the Spanning Tree
    -- Protocol.
    -- ---------------------------------------------------------- --
```

```
   dot1dStpProtocolSpecification OBJECT-TYPE
       SYNTAX      INTEGER {
                       unknown(1),
                       decLb100(2),
                       ieee8021d(3)
                   }
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "An indication of what version of the Spanning Tree
           Protocol is being run.  The value 'decLb100(2)'
           indicates the DEC LANbridge 100 Spanning Tree protocol.
           IEEE 802.1D implementations will return 'ieee8021d(3)'.
           If future versions of the IEEE Spanning Tree Protocol
           that are incompatible with the current version
           are released a new value will be defined."
       ::= { dot1dStp 1 }

   dot1dStpPriority OBJECT-TYPE
       SYNTAX      Integer32 (0..65535)
       MAX-ACCESS  read-write
       STATUS      current
       DESCRIPTION
           "The value of the write-able portion of the Bridge ID
           (i.e., the first two octets of the (8 octet long) Bridge
           ID).  The other (last) 6 octets of the Bridge ID are
           given by the value of dot1dBaseBridgeAddress.
           On bridges supporting IEEE 802.1t or IEEE 802.1w,
           permissible values are 0-61440, in steps of 4096."
       REFERENCE
           "IEEE 802.1D-1998 clause 8.10.2, Table 8-4,
           IEEE 802.1t clause 8.10.2, Table 8-4, clause 14.3."
       ::= { dot1dStp 2 }

   dot1dStpTimeSinceTopologyChange OBJECT-TYPE
       SYNTAX      TimeTicks
       UNITS       "centi-seconds"
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "The time (in hundredths of a second) since the
           last time a topology change was detected by the
           bridge entity.
           For RSTP, this reports the time since the tcWhile
           timer for any port on this Bridge was nonzero."
       REFERENCE
           "IEEE 802.1D-1998 clause 14.8.1.1.,
           IEEE 802.1w clause 14.8.1.1."
```

```
        ::= { dot1dStp 3 }

    dot1dStpTopChanges OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The total number of topology changes detected by
            this bridge since the management entity was last
            reset or initialized."
        REFERENCE
            "IEEE 802.1D-1998 clause 14.8.1.1."
        ::= { dot1dStp 4 }

    dot1dStpDesignatedRoot OBJECT-TYPE
        SYNTAX      BridgeId
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The bridge identifier of the root of the spanning
            tree, as determined by the Spanning Tree Protocol,
            as executed by this node.  This value is used as
            the Root Identifier parameter in all Configuration
            Bridge PDUs originated by this node."
        REFERENCE
            "IEEE 802.1D-1998: clause 8.5.3.1"
        ::= { dot1dStp 5 }

    dot1dStpRootCost OBJECT-TYPE
        SYNTAX      Integer32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The cost of the path to the root as seen from
            this bridge."
        REFERENCE
            "IEEE 802.1D-1998: clause 8.5.3.2"
        ::= { dot1dStp 6 }

    dot1dStpRootPort OBJECT-TYPE
        SYNTAX      Integer32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The port number of the port that offers the lowest
            cost path from this bridge to the root bridge."
        REFERENCE
            "IEEE 802.1D-1998: clause 8.5.3.3"
```

```
        ::= { dot1dStp 7 }

    dot1dStpMaxAge OBJECT-TYPE
        SYNTAX      Timeout
        UNITS       "centi-seconds"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The maximum age of Spanning Tree Protocol information
            learned from the network on any port before it is
            discarded, in units of hundredths of a second.  This is
            the actual value that this bridge is currently using."
        REFERENCE
            "IEEE 802.1D-1998: clause 8.5.3.4"
        ::= { dot1dStp 8 }

    dot1dStpHelloTime OBJECT-TYPE
        SYNTAX      Timeout
        UNITS       "centi-seconds"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The amount of time between the transmission of
            Configuration bridge PDUs by this node on any port when
            it is the root of the spanning tree, or trying to become
            so, in units of hundredths of a second.  This is the
            actual value that this bridge is currently using."
        REFERENCE
            "IEEE 802.1D-1998: clause 8.5.3.5"
        ::= { dot1dStp 9 }

    dot1dStpHoldTime OBJECT-TYPE
        SYNTAX      Integer32
        UNITS       "centi-seconds"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "This time value determines the interval length
            during which no more than two Configuration bridge
            PDUs shall be transmitted by this node, in units
            of hundredths of a second."
        REFERENCE
            "IEEE 802.1D-1998: clause 8.5.3.14"
        ::= { dot1dStp 10 }

    dot1dStpForwardDelay OBJECT-TYPE
        SYNTAX      Timeout
        UNITS       "centi-seconds"
```

```
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "This time value, measured in units of hundredths of a
            second, controls how fast a port changes its spanning
            state when moving towards the Forwarding state.  The
            value determines how long the port stays in each of the
            Listening and Learning states, which precede the
            Forwarding state.  This value is also used when a
            topology change has been detected and is underway, to
            age all dynamic entries in the Forwarding Database.
            [Note that this value is the one that this bridge is
            currently using, in contrast to
            dot1dStpBridgeForwardDelay, which is the value that this
            bridge and all others would start using if/when this
            bridge were to become the root.]"
        REFERENCE
            "IEEE 802.1D-1998: clause 8.5.3.6"
        ::= { dot1dStp 11 }

    dot1dStpBridgeMaxAge OBJECT-TYPE
        SYNTAX      Timeout (600..4000)
        UNITS       "centi-seconds"
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
            "The value that all bridges use for MaxAge when this
            bridge is acting as the root.  Note that 802.1D-1998
            specifies that the range for this parameter is related
            to the value of dot1dStpBridgeHelloTime.  The
            granularity of this timer is specified by 802.1D-1998 to
            be 1 second.  An agent may return a badValue error if a
            set is attempted to a value that is not a whole number
            of seconds."
        REFERENCE
            "IEEE 802.1D-1998: clause 8.5.3.8"
        ::= { dot1dStp 12 }

    dot1dStpBridgeHelloTime OBJECT-TYPE
        SYNTAX      Timeout (100..1000)
        UNITS       "centi-seconds"
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
            "The value that all bridges use for HelloTime when this
            bridge is acting as the root.  The granularity of this
            timer is specified by 802.1D-1998 to be 1 second.  An
            agent may return a badValue error if a set is attempted
```

```
            to a value that is not a whole number of seconds."
        REFERENCE
            "IEEE 802.1D-1998: clause 8.5.3.9"
        ::= { dot1dStp 13 }

    dot1dStpBridgeForwardDelay OBJECT-TYPE
        SYNTAX      Timeout (400..3000)
        UNITS       "centi-seconds"
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
            "The value that all bridges use for ForwardDelay when
            this bridge is acting as the root.  Note that
            802.1D-1998 specifies that the range for this parameter
            is related to the value of dot1dStpBridgeMaxAge.  The
            granularity of this timer is specified by 802.1D-1998 to
            be 1 second.  An agent may return a badValue error if a
            set is attempted to a value that is not a whole number
            of seconds."
        REFERENCE
            "IEEE 802.1D-1998: clause 8.5.3.10"
        ::= { dot1dStp 14 }

    -- ------------------------------------------------------------ --
    -- The Spanning Tree Port Table
    -- ------------------------------------------------------------ --

    dot1dStpPortTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF Dot1dStpPortEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "A table that contains port-specific information
            for the Spanning Tree Protocol."
        ::= { dot1dStp 15 }

    dot1dStpPortEntry OBJECT-TYPE
        SYNTAX      Dot1dStpPortEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "A list of information maintained by every port about
            the Spanning Tree Protocol state for that port."
        INDEX   { dot1dStpPort }
        ::= { dot1dStpPortTable 1 }

    Dot1dStpPortEntry ::=
        SEQUENCE {
```

```
            dot1dStpPort
                Integer32,
            dot1dStpPortPriority
                Integer32,
            dot1dStpPortState
                INTEGER,
            dot1dStpPortEnable
                INTEGER,
            dot1dStpPortPathCost
                Integer32,
            dot1dStpPortDesignatedRoot
                BridgeId,
            dot1dStpPortDesignatedCost
                Integer32,
            dot1dStpPortDesignatedBridge
                BridgeId,
            dot1dStpPortDesignatedPort
                OCTET STRING,
            dot1dStpPortForwardTransitions
                Counter32,
            dot1dStpPortPathCost32
                Integer32
        }

    dot1dStpPort OBJECT-TYPE
        SYNTAX      Integer32 (1..65535)
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The port number of the port for which this entry
            contains Spanning Tree Protocol management information."
        REFERENCE
            "IEEE 802.1D-1998: clause 14.8.2.1.2"
        ::= { dot1dStpPortEntry 1 }

    dot1dStpPortPriority OBJECT-TYPE
        SYNTAX      Integer32 (0..255)
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
            "The value of the priority field that is contained in
            the first (in network byte order) octet of the (2 octet
            long) Port ID.  The other octet of the Port ID is given
            by the value of dot1dStpPort.
            On bridges supporting IEEE 802.1t or IEEE 802.1w,
            permissible values are 0-240, in steps of 16."
        REFERENCE
            "IEEE 802.1D-1998 clause 8.10.2, Table 8-4,
```

```
            IEEE 802.1t clause 8.10.2, Table 8-4, clause 14.3."
        ::= { dot1dStpPortEntry 2 }

    dot1dStpPortState OBJECT-TYPE
        SYNTAX      INTEGER {
                        disabled(1),
                        blocking(2),
                        listening(3),
                        learning(4),
                        forwarding(5),
                        broken(6)
                    }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The port's current state, as defined by application of
            the Spanning Tree Protocol.  This state controls what
            action a port takes on reception of a frame.  If the
            bridge has detected a port that is malfunctioning, it
            will place that port into the broken(6) state.  For
            ports that are disabled (see dot1dStpPortEnable), this
            object will have a value of disabled(1)."
        REFERENCE
            "IEEE 802.1D-1998: clause 8.5.5.2"
        ::= { dot1dStpPortEntry 3 }

    dot1dStpPortEnable OBJECT-TYPE
        SYNTAX      INTEGER {
                        enabled(1),
                        disabled(2)
                    }
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
            "The enabled/disabled status of the port."
        REFERENCE
            "IEEE 802.1D-1998: clause 8.5.5.2"
        ::= { dot1dStpPortEntry 4 }

    dot1dStpPortPathCost OBJECT-TYPE
        SYNTAX      Integer32 (1..65535)
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
            "The contribution of this port to the path cost of
            paths towards the spanning tree root which include
            this port.  802.1D-1998 recommends that the default
            value of this parameter be in inverse proportion to
```

```
            the speed of the attached LAN.

            New implementations should support dot1dStpPortPathCost32.
            If the port path costs exceeds the maximum value of this
            object then this object should report the maximum value,
            namely 65535.  Applications should try to read the
            dot1dStpPortPathCost32 object if this object reports
            the maximum value."
        REFERENCE "IEEE 802.1D-1998: clause 8.5.5.3"
            ::= { dot1dStpPortEntry 5 }

    dot1dStpPortDesignatedRoot OBJECT-TYPE
        SYNTAX      BridgeId
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The unique Bridge Identifier of the Bridge
            recorded as the Root in the Configuration BPDUs
            transmitted by the Designated Bridge for the
            segment to which the port is attached."
        REFERENCE
            "IEEE 802.1D-1998: clause 8.5.5.4"
        ::= { dot1dStpPortEntry 6 }

    dot1dStpPortDesignatedCost OBJECT-TYPE
        SYNTAX      Integer32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The path cost of the Designated Port of the segment
            connected to this port.  This value is compared to the
            Root Path Cost field in received bridge PDUs."
        REFERENCE
            "IEEE 802.1D-1998: clause 8.5.5.5"
        ::= { dot1dStpPortEntry 7 }

    dot1dStpPortDesignatedBridge OBJECT-TYPE
        SYNTAX      BridgeId
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The Bridge Identifier of the bridge that this
            port considers to be the Designated Bridge for
            this port's segment."
        REFERENCE
            "IEEE 802.1D-1998: clause 8.5.5.6"
        ::= { dot1dStpPortEntry 8 }
```

```
   dot1dStpPortDesignatedPort OBJECT-TYPE
       SYNTAX      OCTET STRING (SIZE (2))
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "The Port Identifier of the port on the Designated
           Bridge for this port's segment."
       REFERENCE
           "IEEE 802.1D-1998: clause 8.5.5.7"
       ::= { dot1dStpPortEntry 9 }

   dot1dStpPortForwardTransitions OBJECT-TYPE
       SYNTAX      Counter32
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "The number of times this port has transitioned
           from the Learning state to the Forwarding state."
       ::= { dot1dStpPortEntry 10 }

   dot1dStpPortPathCost32 OBJECT-TYPE
       SYNTAX      Integer32 (1..200000000)
       MAX-ACCESS  read-write
       STATUS      current
       DESCRIPTION
           "The contribution of this port to the path cost of
           paths towards the spanning tree root which include
           this port.  802.1D-1998 recommends that the default
           value of this parameter be in inverse proportion to
           the speed of the attached LAN.

           This object replaces dot1dStpPortPathCost to support
           IEEE 802.1t."
       REFERENCE
           "IEEE 802.1t clause 8.10.2, Table 8-5."
       ::= { dot1dStpPortEntry 11 }

   -- ---------------------------------------------------------- --
   -- the dot1dTp subtree
   -- ---------------------------------------------------------- --
   -- Implementation of the dot1dTp subtree is optional.  It is
   -- implemented by those bridges that support the transparent
   -- bridging mode.  A transparent or SRT bridge will implement
   -- this subtree.
   -- ---------------------------------------------------------- --

   dot1dTpLearnedEntryDiscards OBJECT-TYPE
       SYNTAX      Counter32
```

```
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The total number of Forwarding Database entries that
            have been or would have been learned, but have been
            discarded due to a lack of storage space in the
            Forwarding Database.  If this counter is increasing, it
            indicates that the Forwarding Database is regularly
            becoming full (a condition that has unpleasant
            performance effects on the subnetwork).  If this counter
            has a significant value but is not presently increasing,
            it indicates that the problem has been occurring but is
            not persistent."
        REFERENCE
            "IEEE 802.1D-1998: clause 14.7.1.1.3"
        ::= { dot1dTp 1 }

    dot1dTpAgingTime OBJECT-TYPE
        SYNTAX      Integer32 (10..1000000)
        UNITS       "seconds"
        MAX-ACCESS  read-write
        STATUS      current
        DESCRIPTION
            "The timeout period in seconds for aging out
            dynamically-learned forwarding information.
            802.1D-1998 recommends a default of 300 seconds."
        REFERENCE
            "IEEE 802.1D-1998: clause 14.7.1.1.3"
        ::= { dot1dTp 2 }


    -- ---------------------------------------------------------- --
    --  The Forwarding Database for Transparent Bridges
    -- ---------------------------------------------------------- --

    dot1dTpFdbTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF Dot1dTpFdbEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "A table that contains information about unicast
            entries for which the bridge has forwarding and/or
            filtering information.  This information is used
            by the transparent bridging function in
            determining how to propagate a received frame."
        ::= { dot1dTp 3 }

    dot1dTpFdbEntry OBJECT-TYPE
```

```
        SYNTAX      Dot1dTpFdbEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "Information about a specific unicast MAC address
            for which the bridge has some forwarding and/or
            filtering information."
        INDEX   { dot1dTpFdbAddress }
        ::= { dot1dTpFdbTable 1 }

    Dot1dTpFdbEntry ::=
        SEQUENCE {
            dot1dTpFdbAddress
                MacAddress,
            dot1dTpFdbPort
                Integer32,
            dot1dTpFdbStatus
                INTEGER
        }

    dot1dTpFdbAddress OBJECT-TYPE
        SYNTAX      MacAddress
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "A unicast MAC address for which the bridge has
            forwarding and/or filtering information."
        REFERENCE
            "IEEE 802.1D-1998: clause 7.9.1, 7.9.2"
        ::= { dot1dTpFdbEntry 1 }

    dot1dTpFdbPort OBJECT-TYPE
        SYNTAX      Integer32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "Either the value '0', or the port number of the port on
            which a frame having a source address equal to the value
            of the corresponding instance of dot1dTpFdbAddress has
            been seen.  A value of '0' indicates that the port
            number has not been learned, but that the bridge does
            have some forwarding/filtering information about this
            address (e.g., in the dot1dStaticTable).  Implementors
            are encouraged to assign the port value to this object
            whenever it is learned, even for addresses for which the
            corresponding value of dot1dTpFdbStatus is not
            learned(3)."
        ::= { dot1dTpFdbEntry 2 }
```

```
   dot1dTpFdbStatus OBJECT-TYPE
       SYNTAX      INTEGER {
                       other(1),
                       invalid(2),
                       learned(3),
                       self(4),
                       mgmt(5)
                   }
       MAX-ACCESS  read-only
       STATUS      current
       DESCRIPTION
           "The status of this entry.  The meanings of the
           values are:
               other(1) - none of the following.  This would
                   include the case where some other MIB object
                   (not the corresponding instance of
                   dot1dTpFdbPort, nor an entry in the
                   dot1dStaticTable) is being used to determine if
                   and how frames addressed to the value of the
                   corresponding instance of dot1dTpFdbAddress are
                   being forwarded.
               invalid(2) - this entry is no longer valid (e.g.,
                   it was learned but has since aged out), but has
                   not yet been flushed from the table.
               learned(3) - the value of the corresponding instance
                   of dot1dTpFdbPort was learned, and is being
                   used.
               self(4) - the value of the corresponding instance of
                   dot1dTpFdbAddress represents one of the bridge's
                   addresses.  The corresponding instance of
                   dot1dTpFdbPort indicates which of the bridge's
                   ports has this address.
               mgmt(5) - the value of the corresponding instance of
                   dot1dTpFdbAddress is also the value of an
                   existing instance of dot1dStaticAddress."
       ::= { dot1dTpFdbEntry 3 }

   -- ---------------------------------------------------------- --
   --  Port Table for Transparent Bridges
   -- ---------------------------------------------------------- --

   dot1dTpPortTable OBJECT-TYPE
       SYNTAX      SEQUENCE OF Dot1dTpPortEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "A table that contains information about every port that
           is associated with this transparent bridge."
```

```
        ::= { dot1dTp 4 }

    dot1dTpPortEntry OBJECT-TYPE
        SYNTAX      Dot1dTpPortEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION
            "A list of information for each port of a transparent
            bridge."
        INDEX   { dot1dTpPort }
        ::= { dot1dTpPortTable 1 }

    Dot1dTpPortEntry ::=
        SEQUENCE {
            dot1dTpPort
                Integer32,
            dot1dTpPortMaxInfo
                Integer32,
            dot1dTpPortInFrames
                Counter32,
            dot1dTpPortOutFrames
                Counter32,
            dot1dTpPortInDiscards
                Counter32
        }

    dot1dTpPort OBJECT-TYPE
        SYNTAX      Integer32 (1..65535)
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The port number of the port for which this entry
            contains Transparent bridging management information."
        ::= { dot1dTpPortEntry 1 }

    -- It would be nice if we could use ifMtu as the size of the
    -- largest INFO field, 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).

    dot1dTpPortMaxInfo OBJECT-TYPE
        SYNTAX      Integer32
        UNITS       "bytes"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The maximum size of the INFO (non-MAC) field that
```

```
            this port will receive or transmit."
        ::= { dot1dTpPortEntry 2 }

    dot1dTpPortInFrames OBJECT-TYPE
        SYNTAX      Counter32
        UNITS       "frames"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The number of frames that have been received by this
            port from its segment.  Note that a frame received on the
            interface corresponding to this port is only counted by
            this object if and only if it is for a protocol being
            processed by the local bridging function, including
            bridge management frames."
        REFERENCE
            "IEEE 802.1D-1998: clause 14.6.1.1.3"
        ::= { dot1dTpPortEntry 3 }

    dot1dTpPortOutFrames OBJECT-TYPE
        SYNTAX      Counter32
        UNITS       "frames"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "The number of frames that have been transmitted by this
            port to its segment.  Note that a frame transmitted on
            the interface corresponding to this port is only counted
            by this object if and only if it is for a protocol being
            processed by the local bridging function, including
            bridge management frames."
        REFERENCE
            "IEEE 802.1D-1998: clause 14.6.1.1.3"
        ::= { dot1dTpPortEntry 4 }

    dot1dTpPortInDiscards OBJECT-TYPE
        SYNTAX      Counter32
        UNITS       "frames"
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION
            "Count of received valid frames that were discarded
            (i.e., filtered) by the Forwarding Process."
        REFERENCE
            "IEEE 802.1D-1998: clause 14.6.1.1.3"
        ::= { dot1dTpPortEntry 5 }

    -- ---------------------------------------------------------- --
```

```
   -- The Static (Destination-Address Filtering) Database
   -- ------------------------------------------------------- --
   -- Implementation of this subtree is optional.
   -- ------------------------------------------------------- --

   dot1dStaticTable OBJECT-TYPE
       SYNTAX      SEQUENCE OF Dot1dStaticEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "A table containing filtering information configured
           into the bridge by (local or network) management
           specifying the set of ports to which frames received
           from specific ports and containing specific destination
           addresses are allowed to be forwarded.  The value of
           zero in this table, as the port number from which frames
           with a specific destination address are received, is
           used to specify all ports for which there is no specific
           entry in this table for that particular destination
           address.  Entries are valid for unicast and for
           group/broadcast addresses."
       REFERENCE
           "IEEE 802.1D-1998: clause 14.7.2"
       ::= { dot1dStatic 1 }

   dot1dStaticEntry OBJECT-TYPE
       SYNTAX      Dot1dStaticEntry
       MAX-ACCESS  not-accessible
       STATUS      current
       DESCRIPTION
           "Filtering information configured into the bridge by
           (local or network) management specifying the set of
           ports to which frames received from a specific port and
           containing a specific destination address are allowed to
           be forwarded."
       REFERENCE
           "IEEE 802.1D-1998: clause 14.7.2"
       INDEX   { dot1dStaticAddress, dot1dStaticReceivePort }
       ::= { dot1dStaticTable 1 }

   Dot1dStaticEntry ::=
       SEQUENCE {
           dot1dStaticAddress       MacAddress,
           dot1dStaticReceivePort   Integer32,
           dot1dStaticAllowedToGoTo OCTET STRING,
           dot1dStaticStatus        INTEGER
       }
```

```
   dot1dStaticAddress OBJECT-TYPE
       SYNTAX      MacAddress
       MAX-ACCESS  read-create
       STATUS      current
       DESCRIPTION
           "The destination MAC address in a frame to which this
           entry's filtering information applies.  This object can
           take the value of a unicast address, a group address, or
           the broadcast address."
       REFERENCE
           "IEEE 802.1D-1998: clause 7.9.1, 7.9.2"
       ::= { dot1dStaticEntry 1 }

   dot1dStaticReceivePort OBJECT-TYPE
       SYNTAX      Integer32 (0..65535)
       MAX-ACCESS  read-create
       STATUS      current
       DESCRIPTION
           "Either the value '0', or the port number of the port
           from which a frame must be received in order for this
           entry's filtering information to apply.  A value of zero
           indicates that this entry applies on all ports of the
           bridge for which there is no other applicable entry."
       ::= { dot1dStaticEntry 2 }

   dot1dStaticAllowedToGoTo OBJECT-TYPE
       SYNTAX      OCTET STRING (SIZE (0..512))
       MAX-ACCESS  read-create
       STATUS      current
       DESCRIPTION
           "The set of ports to which frames received from a
           specific port and destined for a specific MAC address,
           are allowed to be forwarded.  Each octet within the
           value of this object specifies a set of eight ports,
           with the first octet specifying ports 1 through 8, the
           second octet specifying ports 9 through 16, etc.  Within
           each octet, the most significant bit represents the
           lowest numbered port, and the least significant bit
           represents the highest numbered port.  Thus, each port
           of the bridge is represented by a single bit within the
           value of this object.  If that bit has a value of '1',
           then that port is included in the set of ports; the port
           is not included if its bit has a value of '0'.  (Note
           that the setting of the bit corresponding to the port
           from which a frame is received is irrelevant.)  The
           default value of this object is a string of ones of
           appropriate length.
```

```
            The value of this object may exceed the required minimum
            maximum message size of some SNMP transport (484 bytes,
            in the case of SNMP over UDP, see RFC 3417, section 3.2).
            SNMP engines on bridges supporting a large number of
            ports must support appropriate maximum message sizes."
        ::= { dot1dStaticEntry 3 }

    dot1dStaticStatus OBJECT-TYPE
        SYNTAX      INTEGER {
                        other(1),
                        invalid(2),
                        permanent(3),
                        deleteOnReset(4),
                        deleteOnTimeout(5)
                    }
        MAX-ACCESS  read-create
        STATUS      current
        DESCRIPTION
            "This object indicates the status of this entry.
            The default value is permanent(3).
                other(1) - this entry is currently in use but the
                    conditions under which it will remain so are
                    different from each of the following values.
                invalid(2) - writing this value to the object
                    removes the corresponding entry.
                permanent(3) - this entry is currently in use and
                    will remain so after the next reset of the
                    bridge.
                deleteOnReset(4) - this entry is currently in use
                    and will remain so until the next reset of the
                    bridge.
                deleteOnTimeout(5) - this entry is currently in use
                    and will remain so until it is aged out."
        ::= { dot1dStaticEntry 4 }

    -- ---------------------------------------------------------- --
    -- Notifications for use by Bridges
    -- ---------------------------------------------------------- --
    -- Notifications for the Spanning Tree Protocol
    -- ---------------------------------------------------------- --

    newRoot NOTIFICATION-TYPE
        -- OBJECTS     { }
        STATUS      current
        DESCRIPTION
            "The newRoot trap indicates that the sending agent has
            become the new root of the Spanning Tree; the trap is
            sent by a bridge soon after its election as the new
```

```
            root, e.g., upon expiration of the Topology Change Timer,
            immediately subsequent to its election.  Implementation
            of this trap is optional."
        ::= { dot1dNotifications 1 }

    topologyChange NOTIFICATION-TYPE
        -- OBJECTS     { }
        STATUS      current
        DESCRIPTION
            "A topologyChange trap is sent by a bridge when any of
            its configured ports transitions from the Learning state
            to the Forwarding state, or from the Forwarding state to
            the Blocking state.  The trap is not sent if a newRoot
            trap is sent for the same transition.  Implementation of
            this trap is optional."
        ::= { dot1dNotifications 2 }

    -- ------------------------------------------------------------ --
    -- IEEE 802.1D MIB - Conformance Information
    -- ------------------------------------------------------------ --

    dot1dGroups         OBJECT IDENTIFIER ::= { dot1dConformance 1 }
    dot1dCompliances    OBJECT IDENTIFIER ::= { dot1dConformance 2 }

    -- ------------------------------------------------------------ --
    -- units of conformance
    -- ------------------------------------------------------------ --

    -- ------------------------------------------------------------ --
    -- the dot1dBase group
    -- ------------------------------------------------------------ --

    dot1dBaseBridgeGroup OBJECT-GROUP
        OBJECTS {
            dot1dBaseBridgeAddress,
            dot1dBaseNumPorts,
            dot1dBaseType
        }
        STATUS      current
        DESCRIPTION
            "Bridge level information for this device."
        ::= { dot1dGroups 1 }

    dot1dBasePortGroup OBJECT-GROUP
        OBJECTS {
            dot1dBasePort,
            dot1dBasePortIfIndex,
            dot1dBasePortCircuit,
```

```
            dot1dBasePortDelayExceededDiscards,
            dot1dBasePortMtuExceededDiscards
        }
        STATUS      current
        DESCRIPTION
            "Information for each port on this device."
        ::= { dot1dGroups 2 }

    -- ---------------------------------------------------------- --
    -- the dot1dStp group
    -- ---------------------------------------------------------- --

    dot1dStpBridgeGroup OBJECT-GROUP
        OBJECTS {
            dot1dStpProtocolSpecification,
            dot1dStpPriority,
            dot1dStpTimeSinceTopologyChange,
            dot1dStpTopChanges,
            dot1dStpDesignatedRoot,
            dot1dStpRootCost,
            dot1dStpRootPort,
            dot1dStpMaxAge,
            dot1dStpHelloTime,
            dot1dStpHoldTime,
            dot1dStpForwardDelay,
            dot1dStpBridgeMaxAge,
            dot1dStpBridgeHelloTime,
            dot1dStpBridgeForwardDelay
        }
        STATUS      current
        DESCRIPTION
            "Bridge level Spanning Tree data for this device."
        ::= { dot1dGroups 3 }

    dot1dStpPortGroup OBJECT-GROUP
        OBJECTS {
            dot1dStpPort,
            dot1dStpPortPriority,
            dot1dStpPortState,
            dot1dStpPortEnable,
            dot1dStpPortPathCost,
            dot1dStpPortDesignatedRoot,
            dot1dStpPortDesignatedCost,
            dot1dStpPortDesignatedBridge,
            dot1dStpPortDesignatedPort,
            dot1dStpPortForwardTransitions
        }
        STATUS      current
```

```
        DESCRIPTION
            "Spanning Tree data for each port on this device."
        ::= { dot1dGroups 4 }

    dot1dStpPortGroup2 OBJECT-GROUP
        OBJECTS {
            dot1dStpPort,
            dot1dStpPortPriority,
            dot1dStpPortState,
            dot1dStpPortEnable,
            dot1dStpPortDesignatedRoot,
            dot1dStpPortDesignatedCost,
            dot1dStpPortDesignatedBridge,
            dot1dStpPortDesignatedPort,
            dot1dStpPortForwardTransitions,
            dot1dStpPortPathCost32
        }
        STATUS      current
        DESCRIPTION
            "Spanning Tree data for each port on this device."
        ::= { dot1dGroups 5 }

    dot1dStpPortGroup3 OBJECT-GROUP
        OBJECTS {
            dot1dStpPortPathCost32
        }
        STATUS      current
        DESCRIPTION
            "Spanning Tree data for devices supporting 32-bit
             path costs."
        ::= { dot1dGroups 6 }

    -- ---------------------------------------------------------- --
    -- the dot1dTp group
    -- ---------------------------------------------------------- --

    dot1dTpBridgeGroup OBJECT-GROUP
        OBJECTS {
            dot1dTpLearnedEntryDiscards,
            dot1dTpAgingTime
        }
        STATUS      current
        DESCRIPTION
            "Bridge level Transparent Bridging data."
        ::= { dot1dGroups 7 }

    dot1dTpFdbGroup OBJECT-GROUP
        OBJECTS {
```

```
            dot1dTpFdbAddress,
            dot1dTpFdbPort,
            dot1dTpFdbStatus
        }

        STATUS      current
        DESCRIPTION
            "Filtering Database information for the Bridge."
        ::= { dot1dGroups 8 }

    dot1dTpGroup OBJECT-GROUP
        OBJECTS {
            dot1dTpPort,
            dot1dTpPortMaxInfo,
            dot1dTpPortInFrames,
            dot1dTpPortOutFrames,
            dot1dTpPortInDiscards
        }
        STATUS      current
        DESCRIPTION
            "Dynamic Filtering Database information for each port of
            the Bridge."
        ::= { dot1dGroups 9 }

    -- ---------------------------------------------------------- --
    -- The Static (Destination-Address Filtering) Database
    -- ---------------------------------------------------------- --

    dot1dStaticGroup OBJECT-GROUP
        OBJECTS {
            dot1dStaticAddress,
            dot1dStaticReceivePort,
            dot1dStaticAllowedToGoTo,
            dot1dStaticStatus
        }
        STATUS      current
        DESCRIPTION
            "Static Filtering Database information for each port of
            the Bridge."
        ::= { dot1dGroups 10 }

    -- ---------------------------------------------------------- --
    -- The Trap Notification Group
    -- ---------------------------------------------------------- --

    dot1dNotificationGroup NOTIFICATION-GROUP
        NOTIFICATIONS {
            newRoot,
```

```
            topologyChange
        }
        STATUS      current
        DESCRIPTION
            "Group of objects describing notifications (traps)."
        ::= { dot1dGroups 11 }

    -- ---------------------------------------------------------- --
    -- compliance statements
    -- ---------------------------------------------------------- --

    bridgeCompliance1493 MODULE-COMPLIANCE
        STATUS      current
        DESCRIPTION
            "The compliance statement for device support of bridging
            services, as per RFC1493."

        MODULE
            MANDATORY-GROUPS {
                dot1dBaseBridgeGroup,
                dot1dBasePortGroup
            }

        GROUP   dot1dStpBridgeGroup
        DESCRIPTION
            "Implementation of this group is mandatory for bridges
            that support the Spanning Tree Protocol."

        GROUP   dot1dStpPortGroup
        DESCRIPTION
            "Implementation of this group is mandatory for bridges
            that support the Spanning Tree Protocol."

        GROUP   dot1dTpBridgeGroup
        DESCRIPTION
            "Implementation of this group is mandatory for bridges
            that support the transparent bridging mode.  A
            transparent or SRT bridge will implement this group."

        GROUP   dot1dTpFdbGroup
        DESCRIPTION
            "Implementation of this group is mandatory for bridges
            that support the transparent bridging mode.  A
            transparent or SRT bridge will implement this group."

        GROUP   dot1dTpGroup
        DESCRIPTION
            "Implementation of this group is mandatory for bridges
```

```
            that support the transparent bridging mode.  A
            transparent or SRT bridge will implement this group."

        GROUP   dot1dStaticGroup
        DESCRIPTION
            "Implementation of this group is optional."

        GROUP dot1dNotificationGroup
        DESCRIPTION
            "Implementation of this group is optional."
        ::= { dot1dCompliances 1 }

    bridgeCompliance4188 MODULE-COMPLIANCE
        STATUS      current
        DESCRIPTION
            "The compliance statement for device support of bridging
            services.  This supports 32-bit Path Cost values and the
            more restricted bridge and port priorities, as per IEEE
            802.1t.

            Full support for the 802.1D management objects requires that
            the SNMPv2-MIB [RFC3418] objects sysDescr, and sysUpTime, as
            well as the IF-MIB [RFC2863] objects ifIndex, ifType,
            ifDescr, ifPhysAddress, and ifLastChange are implemented."

        MODULE
            MANDATORY-GROUPS {
                dot1dBaseBridgeGroup,
                dot1dBasePortGroup
            }

        GROUP   dot1dStpBridgeGroup
        DESCRIPTION
            "Implementation of this group is mandatory for
            bridges that support the Spanning Tree Protocol."

        OBJECT dot1dStpPriority
        SYNTAX Integer32 (0|4096|8192|12288|16384|20480|24576
                         |28672|32768|36864|40960|45056|49152
                         |53248|57344|61440)
        DESCRIPTION
            "The possible values defined by IEEE 802.1t."

        GROUP   dot1dStpPortGroup2
        DESCRIPTION
            "Implementation of this group is mandatory for
            bridges that support the Spanning Tree Protocol."
```

```
        GROUP   dot1dStpPortGroup3
        DESCRIPTION
            "Implementation of this group is mandatory for bridges
             that support the Spanning Tree Protocol and 32-bit path
             costs.  In particular, this includes devices supporting
             IEEE 802.1t and IEEE 802.1w."

        OBJECT dot1dStpPortPriority
        SYNTAX Integer32 (0|16|32|48|64|80|96|112|128
                         |144|160|176|192|208|224|240)
        DESCRIPTION
            "The possible values defined by IEEE 802.1t."

        GROUP   dot1dTpBridgeGroup
        DESCRIPTION
            "Implementation of this group is mandatory for
            bridges that support the transparent bridging
            mode.  A transparent or SRT bridge will implement
            this group."

        GROUP   dot1dTpFdbGroup
        DESCRIPTION
            "Implementation of this group is mandatory for
            bridges that support the transparent bridging
            mode.  A transparent or SRT bridge will implement
            this group."

        GROUP   dot1dTpGroup
        DESCRIPTION
            "Implementation of this group is mandatory for
            bridges that support the transparent bridging
            mode.  A transparent or SRT bridge will implement
            this group."

        GROUP   dot1dStaticGroup
        DESCRIPTION
            "Implementation of this group is optional."

        GROUP dot1dNotificationGroup
        DESCRIPTION
            "Implementation of this group is optional."

        ::= { dot1dCompliances 2 }

    END
```

5. IANA Considerations

The MIB module in this document uses the following IANA-assigned OBJECT IDENTIFIER values that are recorded in the SMI Numbers registry:

Descriptor	OBJECT IDENTIFIER value
dot1dBridge	{ mib-2 17 }

6. Security Considerations

There are a number of management objects defined in this MIB module that have a MAX-ACCESS clause of read-write and/or read-create. Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations.

Some of the readable objects in this MIB module (i.e., objects with a MAX-ACCESS other than not-accessible) may be considered sensitive or vulnerable in some network environments. It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP.

These are the tables and objects and their sensitivity/vulnerability:

- The writable objects dot1dStpPriority, dot1dStpBridgeMaxAge, dot1dStpBridgeHelloTime, dot1dStpBridgeForwardDelay, dot1dStpPortPriority, dot1dStpPortEnable, dot1dStpPortPathCost, and dot1dStpPortPathCost32 influence the spanning tree protocol. Unauthorized write access to these objects can cause the spanning tree protocol to compute other default topologies or it can change the speed in which the spanning tree protocol reacts to failures.

- The writable object dot1dTpAgingTime controls how fast dynamically-learned forwarding information is aged out. Setting this object to a large value may simplify forwarding table overflow attacks.

- The writable dot1dStaticTable provides a filtering mechanism controlling to which ports frames originating from a specific source may be forwarded. Write access to this table can be used to turn provisioned filtering off or to add filters to prevent rightful use of the network.

- The readable objects defined in the BRIDGE-MIB module provide information about the topology of a bridged network and the attached active stations. The addresses listed in the dot1dTpFdbTable usually reveal information about the manufacturer of the MAC hardware, which can be useful information for mounting other specific attacks.

- The two notifications newRoot and topologyChange are emitted during spanning tree computation and may trigger management systems to inspect the status of bridges and to recompute internal topology information. Hence, forged notifications may cause management systems to perform unnecessary computations and to generate additional SNMP traffic directed to the bridges in a network. Therefore, forged notifications may be part of a denial of service attack.

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPSec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB module.

It is RECOMMENDED that implementers consider the security features as provided by the SNMPv3 framework (see [RFC3410], section 8), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy).

Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

7. Acknowledgements

The MIB module presented in this memo is a translation of the BRIDGE-MIB defined in [RFC1493] to the SMIv2 syntax. The original authors of the SMIv1 module were E. Decker, P. Langille, A. Rijsinghani, and K. McCloghrie. Further acknowledgement is given to the members of the original Bridge Working Group in [RFC1493].

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effort. Juergen Schoenwaelder helped in finalizing the document for publication.

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9. Changes from RFC 1493

The following changes have been made from RFC 1493.

1. Translated the MIB definitions to use SMIv2. This includes the introduction of conformance statements. ASN.1 type definitions have been converted into textual-conventions and several UNITS clauses were added.

2. The object dot1dStpPortPathCost32 was added to support IEEE 802.1t.

3. Permissible values for dot1dStpPriority and dot1dStpPortPriority have been clarified for bridges supporting IEEE 802.1t or IEEE 802.1w.

4. Interpretation of dot1dStpTimeSinceTopologyChange has been clarified for bridges supporting the rapid spanning tree protocol (RSTP).

5. Updated the introductory boilerplate text, the security considerations section, and the references to comply with the current IETF standards and guidelines.

6. Updated references to point to newer IEEE 802.1d documents.

7. Additions and clarifications in various description clauses.

10. References

10.1 Normative References

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[RFC3418] Presuhn, R., "Management Information Base (MIB) for the Simple Network Management Protocol (SNMP)", STD 62, RFC 3418, December 2002.

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[IEEE8021D] IEEE Project 802 Local and Metropolitan Area Networks, "ANSI/IEEE Standard 802.1D-1998 MAC Bridges", March 1998.

10.2 Informative References

[RFC3410] Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework", RFC 3410, December 2002.

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