                   Definitions of Managed Objects for
                   the Ethernet-like Interface Types

Status of this Memo

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

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 ethernet-like objects.

Table of Contents

1. The Network Management Framework

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

      STD 16/RFC 1155 [3] which defines the SMI, the mechanisms used for
      describing and naming objects for the purpose of management. STD
      16/RFC 1212 [13] defines a more concise description mechanism,
      which is wholly consistent with the SMI.

RFC 1156 [4] which defines MIB-I, the core set of managed objects
for the Internet suite of protocols. STD 17/RFC 1213 [6] defines
MIB-II, an evolution of MIB-I based on implementation experience
and new operational requirements.

STD 15/RFC 1157 [5] 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. Objects

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) [7]
defined in the SMI. In particular, each object has a name, a syntax,
and an encoding. The name is an object identifier, an
administratively assigned name, which specifies an object type. 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 OBJECT
DESCRIPTOR, to also refer to the object type.

The syntax of an object type defines the abstract data structure
corresponding to that object type. The ASN.1 language is used for
this purpose. However, the SMI [3] purposely restricts the ASN.1
constructs which may be used. These restrictions are explicitly made
for simplicity.

The encoding of an object type is simply how that object type is
represented using the object type's syntax. Implicitly tied to the
notion of an object type's syntax and encoding is how the object type
is represented when being transmitted on the network.

The SMI specifies the use of the basic encoding rules of ASN.1 [8],
subject to the additional requirements imposed by the SNMP.

2.1. Format of Definitions

Section 4 contains contains the specification of all object types
contained in this MIB module. The object types are defined using the
conventions defined in the SMI, as amended by the extensions
specified in [13].

3. Overview

   Instances of these object types represent attributes of an interface
   to an ethernet-like communications medium. At present, ethernet-like
   media are identified by three values of the ifType object in the
   Internet-standard MIB:

           ethernet-csmacd(6)
           iso88023-csmacd(7)
           starLan(11)

   For these interfaces, the value of the ifSpecific variable in the
   MIB-II [6] has the OBJECT IDENTIFIER value:

           dot3   OBJECT IDENTIFER ::= { transmission 7 }

   The definitions presented here are based on the IEEE 802.3 Layer
   Management Specification [9], as originally interpreted by Frank
   Kastenholz of Interlan in [10]. Implementors of these MIB objects
   should note that the IEEE document explicitly describes (in the form
   of Pascal pseudocode) when, where, and how various MAC attributes are
   measured. The IEEE document also describes the effects of MAC
   actions that may be invoked by manipulating instances of the MIB
   objects defined here.

   To the extent that some of the attributes defined in [9] are
   represented by previously defined objects in the Internet- standard
   MIB or in the Generic Interface Extensions MIB [11], such attributes
   are not redundantly represented by objects defined in this memo.
   Among the attributes represented by objects defined in other memos
   are the number of octets transmitted or received on a particular
   interface, the number of frames transmitted or received on a
   particular interface, the promiscuous status of an interface, the MAC
   address of an interface, and multicast information associated with an
   interface.

   The relationship between an ethernet-like interface and an interface
   in the context of the Internet-standard MIB is one-to-one. As such,
   the value of an ifIndex object instance can be directly used to
   identify corresponding instances of the objects defined herein.

4. Definitions

          RFC1398-MIB DEFINITIONS ::= BEGIN

            IMPORTS
                Counter, Gauge
                    FROM RFC1155-SMI
                transmission
                    FROM RFC1213-MIB
                OBJECT-TYPE
                    FROM RFC-1212;

      -- This MIB module uses the extended OBJECT-TYPE macro as
      -- defined in RFC-1212.

      -- this is the MIB module for ethernet-like objects

      dot3   OBJECT IDENTIFIER ::= { transmission 7 }

      -- { dot3 1 } is obsolete and has been deleted.

4.1. The Ethernet-like Statistics Group

      -- the Ethernet-like Statistics group

      -- Implementation of this group is mandatory

      dot3StatsTable   OBJECT-TYPE
          SYNTAX   SEQUENCE OF Dot3StatsEntry
          ACCESS   not-accessible
          STATUS   mandatory
          DESCRIPTION
                  "Statistics for a collection of ethernet-like
                  interfaces attached to a particular system."
          ::= { dot3 2 }

      dot3StatsEntry   OBJECT-TYPE
          SYNTAX   Dot3StatsEntry
          ACCESS   not-accessible
          STATUS   mandatory
          DESCRIPTION
                  "Statistics for a particular interface to an
                  ethernet-like medium."
          INDEX   { dot3StatsIndex }
          ::= { dot3StatsTable 1 }

```
         Dot3StatsEntry ::= SEQUENCE {
             dot3StatsIndex
                  INTEGER,
             dot3StatsAlignmentErrors
                  Counter,
             dot3StatsFCSErrors
                  Counter,
             dot3StatsSingleCollisionFrames
                  Counter,
             dot3StatsMultipleCollisionFrames
                  Counter,
             dot3StatsSQETestErrors
                  Counter,
             dot3StatsDeferredTransmissions
                  Counter,
             dot3StatsLateCollisions
                  Counter,
             dot3StatsExcessiveCollisions
                  Counter,
             dot3StatsInternalMacTransmitErrors
                  Counter,
             dot3StatsCarrierSenseErrors
                  Counter,
             dot3StatsFrameTooLongs
                  Counter,
             dot3StatsInternalMacReceiveErrors
                  Counter
         }

         dot3StatsIndex    OBJECT-TYPE
             SYNTAX    INTEGER
             ACCESS    read-only
             STATUS    mandatory
             DESCRIPTION
                     "An index value that uniquely identifies an
                     interface to an ethernet-like medium.  The
                     interface identified by a particular value of
                     this index is the same interface as identified
                     by the same value of ifIndex."
             ::= { dot3StatsEntry 1 }


         dot3StatsAlignmentErrors    OBJECT-TYPE
             SYNTAX    Counter
             ACCESS    read-only
             STATUS    mandatory
             DESCRIPTION
                     "A count of frames received on a particular
```

                    interface that are not an integral number of
                    octets in length and do not pass the FCS check.

                    The count represented by an instance of this
                    object is incremented when the alignmentError
                    status is returned by the MAC service to the
                    LLC (or other MAC user). Received frames for
                    which multiple error conditions obtain are,
                    according to the conventions of IEEE 802.3
                    Layer Management, counted exclusively according
                    to the error status presented to the LLC."
            REFERENCE
                    "IEEE 802.3 Layer Management"
            ::= { dot3StatsEntry 2 }

        dot3StatsFCSErrors   OBJECT-TYPE
            SYNTAX   Counter
            ACCESS   read-only
            STATUS   mandatory
            DESCRIPTION
                    "A count of frames received on a particular
                    interface that are an integral number of octets
                    in length but do not pass the FCS check.

                    The count represented by an instance of this
                    object is incremented when the frameCheckError
                    status is returned by the MAC service to the
                    LLC (or other MAC user). Received frames for
                    which multiple error conditions obtain are,
                    according to the conventions of IEEE 802.3
                    Layer Management, counted exclusively according
                    to the error status presented to the LLC."
            REFERENCE
                    "IEEE 802.3 Layer Management"
            ::= { dot3StatsEntry 3 }

        dot3StatsSingleCollisionFrames   OBJECT-TYPE
            SYNTAX   Counter
            ACCESS   read-only
            STATUS   mandatory
            DESCRIPTION
                    "A count of successfully transmitted frames on
                    a particular interface for which transmission
                    is inhibited by exactly one collision.

                    A frame that is counted by an instance of this

                    object is also counted by the corresponding
                    instance of either the ifOutUcastPkts or
                    ifOutNUcastPkts object and is not counted by
                    the corresponding instance of the
                    dot3StatsMultipleCollisionFrames object."
            REFERENCE
                    "IEEE 802.3 Layer Management"
            ::= { dot3StatsEntry 4 }

        dot3StatsMultipleCollisionFrames   OBJECT-TYPE
            SYNTAX   Counter
            ACCESS   read-only
            STATUS   mandatory
            DESCRIPTION
                    "A count of successfully transmitted frames on
                    a particular interface for which transmission
                    is inhibited by more than one collision.

                    A frame that is counted by an instance of this
                    object is also counted by the corresponding
                    instance of either the ifOutUcastPkts or
                    ifOutNUcastPkts object and is not counted by
                    the corresponding instance of the
                    dot3StatsSingleCollisionFrames object."
            REFERENCE
                    "IEEE 802.3 Layer Management"
            ::= { dot3StatsEntry 5 }

        dot3StatsSQETestErrors   OBJECT-TYPE
            SYNTAX   Counter
            ACCESS   read-only
            STATUS   mandatory
            DESCRIPTION
                    "A count of times that the SQE TEST ERROR
                    message is generated by the PLS sublayer for a
                    particular interface. The SQE TEST ERROR
                    message is defined in section 7.2.2.2.4 of
                    ANSI/IEEE 802.3-1985 and its generation is
                    described in section 7.2.4.6 of the same
                    document."
            REFERENCE
                    "ANSI/IEEE Std 802.3-1985 Carrier Sense
                    Multiple Access with Collision Detection Access
                    Method and Physical Layer Specifications"
            ::= { dot3StatsEntry 6 }

```
        dot3StatsDeferredTransmissions   OBJECT-TYPE
            SYNTAX    Counter
            ACCESS    read-only
            STATUS    mandatory
            DESCRIPTION
                    "A count of frames for which the first
                    transmission attempt on a particular interface
                    is delayed because the medium is busy.

                    The count represented by an instance of this
                    object does not include frames involved in
                    collisions."
            REFERENCE
                    "IEEE 802.3 Layer Management"
            ::= { dot3StatsEntry 7 }


        dot3StatsLateCollisions   OBJECT-TYPE
            SYNTAX    Counter
            ACCESS    read-only
            STATUS    mandatory
            DESCRIPTION
                    "The number of times that a collision is
                    detected on a particular interface later than
                    512 bit-times into the transmission of a
                    packet.

                    Five hundred and twelve bit-times corresponds
                    to 51.2 microseconds on a 10 Mbit/s system. A
                    (late) collision included in a count
                    represented by an instance of this object is
                    also considered as a (generic) collision for
                    purposes of other collision-related
                    statistics."
            REFERENCE
                    "IEEE 802.3 Layer Management"
            ::= { dot3StatsEntry 8 }


        dot3StatsExcessiveCollisions   OBJECT-TYPE
            SYNTAX    Counter
            ACCESS    read-only
            STATUS    mandatory
            DESCRIPTION
                    "A count of frames for which transmission on a
                    particular interface fails due to excessive
                    collisions."
```

        REFERENCE
                "IEEE 802.3 Layer Management"
        ::= { dot3StatsEntry 9 }

     dot3StatsInternalMacTransmitErrors   OBJECT-TYPE
        SYNTAX   Counter
        ACCESS   read-only
        STATUS   mandatory
        DESCRIPTION
                "A count of frames for which transmission on a
                particular interface fails due to an internal
                MAC sublayer transmit error. A frame is only
                counted by an instance of this object if it is
                not counted by the corresponding instance of
                either the dot3StatsLateCollisions object, the
                dot3StatsExcessiveCollisions object, or the
                dot3StatsCarrierSenseErrors object.

                The precise meaning of the count represented by
                an instance of this object is implementation-
                specific. In particular, an instance of this
                object may represent a count of transmission
                errors on a particular interface that are not
                otherwise counted."
        REFERENCE
                "IEEE 802.3 Layer Management"
        ::= { dot3StatsEntry 10 }

     dot3StatsCarrierSenseErrors   OBJECT-TYPE
        SYNTAX   Counter
        ACCESS   read-only
        STATUS   mandatory
        DESCRIPTION
                "The number of times that the carrier sense
                condition was lost or never asserted when
                attempting to transmit a frame on a particular
                interface.

                The count represented by an instance of this
                object is incremented at most once per
                transmission attempt, even if the carrier sense
                condition fluctuates during a transmission
                attempt."
        REFERENCE
                "IEEE 802.3 Layer Management"
        ::= { dot3StatsEntry 11 }

```
         -- { dot3StatsEntry 12 } is not assigned

         dot3StatsFrameTooLongs   OBJECT-TYPE
             SYNTAX    Counter
             ACCESS    read-only
             STATUS    mandatory
             DESCRIPTION
                     "A count of frames received on a particular
                     interface that exceed the maximum permitted
                     frame size.

                     The count represented by an instance of this
                     object is incremented when the frameTooLong
                     status is returned by the MAC service to the
                     LLC (or other MAC user). Received frames for
                     which multiple error conditions obtain are,
                     according to the conventions of IEEE 802.3
                     Layer Management, counted exclusively according
                     to the error status presented to the LLC."
             REFERENCE
                     "IEEE 802.3 Layer Management"
             ::= { dot3StatsEntry 13 }



         -- { dot3StatsEntry 14 } is not assigned


         -- { dot3StatsEntry 15 } is not assigned

         dot3StatsInternalMacReceiveErrors   OBJECT-TYPE
             SYNTAX    Counter
             ACCESS    read-only
             STATUS    mandatory
             DESCRIPTION
                     "A count of frames for which reception on a
                     particular interface fails due to an internal
                     MAC sublayer receive error. A frame is only
                     counted by an instance of this object if it is
                     not counted by the corresponding instance of
                     either the dot3StatsFrameTooLongs object, the
                     dot3StatsAlignmentErrors object, or the
                     dot3StatsFCSErrors object.

                     The precise meaning of the count represented by
                     an instance of this object is implementation-
                     specific.  In particular, an instance of this
                     object may represent a count of receive errors
```

```
                    on a particular interface that are not
                    otherwise counted."
            REFERENCE
                    "IEEE 802.3 Layer Management"
            ::= { dot3StatsEntry 16 }
```

4.2. The Ethernet-like Collision Statistics Group


```
      -- the Ethernet-like Collision Statistics group

      -- Implementation of this group is optional; it is appropriate
      -- for all systems which have the necessary metering

      dot3CollTable   OBJECT-TYPE
          SYNTAX     SEQUENCE OF Dot3CollEntry
          ACCESS     not-accessible
          STATUS     mandatory
          DESCRIPTION
                    "A collection of collision histograms for a
                    particular set of interfaces."
          ::= { dot3 5 }


      dot3CollEntry   OBJECT-TYPE
          SYNTAX     Dot3CollEntry
          ACCESS     not-accessible
          STATUS     mandatory
          DESCRIPTION
                    "A cell in the histogram of per-frame
                    collisions for a particular interface.  An
                    instance of this object represents the
                    frequency of individual MAC frames for which
                    the transmission (successful or otherwise) on a
                    particular interface is accompanied by a
                    particular number of media collisions."
          INDEX     { dot3CollIndex, dot3CollCount }
          ::= { dot3CollTable 1 }



      Dot3CollEntry ::= SEQUENCE {
          dot3CollIndex
              INTEGER,
          dot3CollCount
              INTEGER,
          dot3CollFrequencies
              Counter
```

```
        }


        dot3CollIndex    OBJECT-TYPE
            SYNTAX    INTEGER
            ACCESS    read-only
            STATUS    mandatory
            DESCRIPTION
                    "The index value that uniquely identifies the
                    interface to which a particular collision
                    histogram cell pertains.  The interface
                    identified by a particular value of this index
                    is the same interface as identified by the same
                    value of ifIndex."
            ::= { dot3CollEntry 1 }


        dot3CollCount    OBJECT-TYPE
            SYNTAX    INTEGER (1..16)
            ACCESS    read-only
            STATUS    mandatory
            DESCRIPTION
                    "The number of per-frame media collisions for
                    which a particular collision histogram cell
                    represents the frequency on a particular
                    interface."
            ::= { dot3CollEntry 2 }


        dot3CollFrequencies    OBJECT-TYPE
            SYNTAX    Counter
            ACCESS    read-only
            STATUS    mandatory
            DESCRIPTION
                    "A count of individual MAC frames for which the
                    transmission (successful or otherwise) on a
                    particular interface is accompanied by a
                    particular number of media collisions."
            ::= { dot3CollEntry 3 }
```

4.3. 802.3 Tests

    -- 802.3 Tests

    -- The ifExtnsTestTable defined in RFC 1229 provides a common
    -- means for a manager to test any interface corresponding to

    -- a value of ifIndex.

    -- At this time, one well known test (testFullDuplexLoopBack) is
    -- defined in RFC 1229. For ethernet-like interfaces, this test
    -- configures the MAC chip and executes an internal loopback
    -- test of memory and the MAC chip logic. This loopback test can
    -- only be executed if the interface is offline. Once the test
    -- has completed, the MAC chip should be reinitialized for network
    -- operation, but it should remain offline.

    -- If an error occurs during a test, the object ifExtnsTestResult
    -- (defined in RFC 1229) will be set to failed(7). The following
    -- two OBJECT IDENTIFIERs may be used to provided more
    -- information as values for the object ifExtnsTestCode in
    -- RFC 1229:

        dot3Errors   OBJECT IDENTIFIER ::= { dot3 7 }

                            -- couldn't initialize MAC chip for test
        dot3ErrorInitError   OBJECT IDENTIFIER ::= { dot3Errors 1 }

                            -- expected data not received (or not
                            -- received correctly) in loopback test
        dot3ErrorLoopbackError OBJECT IDENTIFIER ::= { dot3Errors 2 }

    -- Tests
     -- TDR Test

    -- Another test, specific to ethernet-like interfaces with the
    -- exception of 10BaseT and 10BaseF, is Time-domain Reflectometry
       (TDR).
    -- The TDR value may be useful in determining the approximate
       distance
    -- to a cable fault. It is advisable to repeat this test to
       check for
    -- a consistent resulting TDR value, to verify that there is a
       fault.

        dot3Tests   OBJECT IDENTIFIER ::= { dot3 6 }
        dot3TestTdr OBJECT IDENTIFIER ::= { dot3Tests 1 }

    -- A TDR test returns as its result the time interval, measured
    -- in 10 MHz ticks or 100 nsec units, between the start of
    -- TDR test transmission and the subsequent detection of a
    -- collision or deassertion of carrier. On successful completion
    -- of a TDR test, the appropriate instance of ifExtnsTestResult
    -- contains the OBJECT IDENTIFIER of the MIB object which
    -- contains the value of this time interval.

4.4. 802.3 Hardware Chipsets

        -- 802.3 Hardware Chipsets

        -- The object ifExtnsChipSet is provided in RFC 1229 to identify
        -- the MAC hardware used to communcate on an interface. The
        -- following hardware chipsets are provided for 802.3:

```
 dot3ChipSets          OBJECT IDENTIFIER ::= { dot3 8 }
 dot3ChipSetAMD        OBJECT IDENTIFIER ::= { dot3ChipSets 1 }
 dot3ChipSetAMD7990    OBJECT IDENTIFIER ::= { dot3ChipSetAMD 1 }
 dot3ChipSetAMD79900   OBJECT IDENTIFIER ::= { dot3ChipSetAMD 2 }

 dot3ChipSetIntel      OBJECT IDENTIFIER ::= { dot3ChipSets 2 }
 dot3ChipSetIntel82586 OBJECT IDENTIFIER ::= { dot3ChipSetIntel 1 }
 dot3ChipSetIntel82596 OBJECT IDENTIFIER ::= { dot3ChipSetIntel 2 }
 dot3ChipSetSeeq       OBJECT IDENTIFIER ::= { dot3ChipSets 3 }
 dot3ChipSetSeeq8003   OBJECT IDENTIFIER ::= { dot3ChipSetSeeq 1 }

 dot3ChipSetNational     OBJECT IDENTIFIER ::= { dot3ChipSets 4 }
 dot3ChipSetNational8390 OBJECT IDENTIFIER ::=
                                     { dot3ChipSetNational 1 }
 dot3ChipSetNationalSonic OBJECT IDENTIFIER ::=
                                     { dot3ChipSetNational 2 }

 dot3ChipSetFujitsu      OBJECT IDENTIFIER ::= { dot3ChipSets 5 }
 dot3ChipSetFujitsu86950 OBJECT IDENTIFIER ::=
                                     { dot3ChipSetFujitsu 1 }
 dot3ChipSetFujitsu86960 OBJECT IDENTIFIER ::=
                                     { dot3ChipSetFujitsu 2 }
```

        -- For those chipsets not represented above, OBJECT IDENTIFIER
        -- assignment is required in other documentation, e.g., assignment
        -- within that part of the registration tree delegated to
        -- individual enterprises (see RFC 1155).

            END

5. Change Log

   (1) Replace old "Historical Perspective" boilerplate with the
        new "The Network Management Framework" boilerplate.

   (2) Remove the "slime text".

   (3) Updated the reference to the Interface Extensions mib to
        reflect its new RFC status.

(4) Change the status of the memo section to hold the new
     suggested text.

(5) References in ASN.1 comments were changed from the [#]
     form to name the actual document being referred to. These
     references are now meaningful when the ASN.1 is read
     outside of the RFC.

(6) The IMPORTS section of the ASN.1 has been updated to
     reflect that the OBJECT-TYPE macro is imported from RFC-
     1212.

(7) The the Generic Ethernet-like group, containing
     dot3Index, dot3InitializeMac, dot3MacSubLayerStatus,
     dot3MulticastReceiveStatus, dot3TxEnabled, and
     dot3TestTdrValue has been deprecated as a result of the
     implementation experience presented at the San Diego IETF
     meeting.

(8) dot3StatsInRangeLengthErrors and
     dot3StatsOutOfRangeLengthFields have been deprecated as a
     result of the implementation experience presented at the
     San Diego IETF meeting.

(9) Update the acknowledgements section to reflect this
     document's history, etc.

(10) REFERENCE clauses have been added to all of the MIB
     objects which are being retained.

12 August 1992

(1) Removed all deprecated objects.

(2) Rephrased the description of the TDR test OID to reflect
     the fact that dot3TestTdrValue is no more.
     ifExtnsTestResult still points to the object containing
     the result, the text simply does not refer to
     dot3TestTdrValue. I could have deleted the Test, but the
     OID should then remain reserved. I figured that it would
     be just as easy to rephrase the definition of the test.

13 august 1992

(1) Add fuji. 86960

6. Acknowledgements

   This document was produced by the Ethernet MIB Working Group.

   This document is based on the Proposed Standard Ethernet MIB, RFC
   1284 [14], of which John Cook of Chipcom was the editor. The
   Ethernet MIB Working Group gathered implementation experience of the
   variables specified in RFC 1284 and used that information to develop
   this revised MIB.

   RFC 1284, in turn, is based on a document written by Frank Kastenholz
   of Interlan entitled IEEE 802.3 Layer Management Draft M compatible
   MIB for TCP/IP Networks [10]. This document has been modestly
   reworked, initially by the SNMP Working Group, and then by the
   Transmission Working Group, to reflect the current conventions for
   defining objects for MIB interfaces. James Davin, of the MIT
   Laboratory for Computer Science, and Keith McCloghrie of Hughes LAN
   Systems, contributed to later drafts of this memo. Marshall Rose of
   Performance Systems International, Inc. converted the document into
   its current concise format. Anil Rijsinghani of DEC contributed text
   that more adequately describes the TDR test. Thanks to Frank
   Kastenholz of Interlan and Louis Steinberg of IBM for their
   experimentation.

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, "Management Information Base for
       Network Management of TCP/IP-based internets", RFC 1156, Hughes
       LAN Systems, Performance Systems International, May 1990.

   [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] Rose M., Editor, "Management Information Base for Network
       Management of TCP/IP-based internets: MIB-II", STD 17, RFC 1213,

         Performance Systems International, March 1991.

     [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] IEEE, "IEEE 802.3 Layer Management", November 1988.

    [10] Kastenholz, F., "IEEE 802.3 Layer Management Draft compatible MIB
          for TCP/IP Networks", electronic mail message to mib-
          wg@nnsc.nsf.net, 9 June 1989.

    [11] McCloghrie, K., Editor, Extensions to the Generic-Interface MIB,
          RFC 1229, Hughes LAN Systems, Inc., May 1991.

    [12] IEEE, "Carrier Sense Multiple Access with Collision Detection
          (CSMA/CD) Access Method and Physical Layer Specifications",
          ANSI/IEEE Std 802.3-1985.

    [13] Rose, M., and K. McCloghrie, Editors, "Concise MIB Definitions",
          STD 16, RFC 1212, Performance Systems International, Hughes LAN
          Systems, March 1991.

    [14] Cook, J., Editor, "Definitions of Managed Objects for Ethernet-
          Like Interface Types", RFC 1284, Chipcom Corporation, December
          1991.

8. Security Considerations

     Security issues are not discussed in this memo.

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