Network Working Group
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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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