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Definitions of Managed Objects for the Ethernet-like Interface Types

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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 the Internet community. This memo obsoletes RFC 2665 ''Definitions of Managed Objects for the Ethernet-like Interface Types''. This memo updates that specification by including management information useful for the management of 10 Gigabit per second (Gb/s) Ethernet interfaces.

Ethernet technology, as defined by the 802.3 Working Group of the IEEE, continues to evolve, with scalable increases in speed, new types of cabling and interfaces, and new features. This evolution may require changes in the managed objects in order to reflect this new functionality. This document, as with other documents issued by this working group, reflects a certain stage in the evolution of Ethernet technology. In the future, this document might be revised, or new documents might be issued by the Ethernet Interfaces and Hub MIB Working Group, in order to reflect the evolution of Ethernet technology.

Distribution of this memo is unlimited. Please forward comments to hubmib@ietf.org.

Table of Contents

1. Introduction

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it defines objects for managing Ethernet-like interfaces.

This memo also includes a MIB module. This MIB module updates the list of managed objects specified in the earlier version of this MIB, RFC 2665 [26].

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [29].

2. The SNMP Management Framework

The SNMP Management Framework presently consists of five major components:

- An overall architecture, described in RFC 2571 [1].
- Mechanisms for describing and naming objects and events for the purpose of management. The first version of this Structure of Management Information (SMI) is called SMIv1 and described in STD 16, RFC 1155 [2], STD 16, RFC 1212 [3] and RFC 1215 [4]. The second version, called SMIv2, is described in STD 58, RFC 2578 [5], STD 58, RFC 2579 [6] and STD 58, RFC 2580 [7].

- Message protocols for transferring management information. The first version of the SNMP message protocol is called SNMPv1 and described in STD 15, RFC 1157 [8]. A second version of the SNMP message protocol, which is not an Internet standards track protocol, is called SNMPv2c and described in RFC 1901 [9] and RFC 1906 [10]. The third version of the message protocol is called SNMPv3 and described in RFC 1906 [10], RFC 2572 [11] and RFC 2574 [12].

- Protocol operations for accessing management information. The first set of protocol operations and associated PDU formats is described in STD 15, RFC 1157 [8]. A second set of protocol

operations and associated PDU formats is described in RFC 1905 [13].

- A set of fundamental applications described in RFC 2573 [14] and the view-based access control mechanism described in RFC 2575 [15].

A more detailed introduction to the current SNMP Management Framework can be found in RFC 2570 [16].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. Objects in the MIB are defined using the mechanisms defined in the SMI.

This memo specifies a MIB module that is compliant to the SMIv2. A MIB conforming to the SMIv1 can be produced through the appropriate translations. The resulting translated MIB must be semantically equivalent, except where objects or events are omitted because no translation is possible (use of Counter64). Some machine readable information in SMIv2 will be converted into textual descriptions in SMIv1 during the translation process. However, this loss of machine readable information is not considered to change the semantics of the MIB.

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 the value ethernetCsmacd(6) of the ifType object in the Interfaces MIB [28]. Some older implementations may return the values iso88023Csmacd(7) or starLan(11) for ifType for ethernet-like media.

The definitions presented here are based on Section 30, "10 Mb/s, 100 Mb/s 1000 Mb/s and 10 Gb/s Management", and Annex 30A, "GDMO Specification for 802.3 managed object classes" of IEEE Std. 802.3, 2000 Edition [17], ammended by IEEE Draft P802.3ae/D3.0 [18], as originally interpreted by Frank Kastenholz, then of Interlan in [19]. Implementors of these MIB objects should note that IEEE Std. 802.3 [17] 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 [17] are represented by previously defined objects in MIB-2 [27] or in the Interfaces MIB [28], 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.

3.1. Relation to MIB-2

This section applies only when this MIB is used in conjunction with the "old" (RFC 1213) [27] interface group.

The relationship between an ethernet-like interface and an interface in the context of MIB-2 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.

For agents which implement the (now deprecated) ifSpecific object, an instance of that object that is associated with an ethernet-like interface has the OBJECT IDENTIFIER value:

```
dot3    OBJECT IDENTIFER ::= { transmission 7 }
```

3.2. Relation to the Interfaces MIB

The Interface MIB [28] requires that any MIB which is an adjunct of the Interface MIB clarify specific areas within the Interface MIB. These areas were intentionally left vague in the Interface MIB to avoid over constraining the MIB, thereby precluding management of certain media-types.

Section 4 of [28] enumerates several areas which a media-specific MIB must clarify. Each of these areas is addressed in a following subsection. The implementor is referred to [28] in order to understand the general intent of these areas.

3.2.1. Layering Model

Ordinarily, there are no sublayers for an ethernet-like interface. However there may be implementation-specific requirements which require the use of sublayers. One example is the use of 802.3 link aggregation. In this case, Annex 30C of [17] describes the layering model and the use of the ifStackTable for representing aggregated links.

3.2.2. Virtual Circuits

This medium does not support virtual circuits and this area is not applicable to this MIB.

3.2.3. ifRcvAddressTable

This table contains all IEEE 802.3 addresses, unicast, multicast, and broadcast, for which this interface will receive packets and forward them up to a higher layer entity for local consumption. The format of the address, contained in ifRcvAddressAddress, is the same as for ifPhysAddress.

In the event that the interface is part of a MAC bridge, this table

does not include unicast addresses which are accepted for possible forwarding out some other port. This table is explicitly not intended to provide a bridge address filtering mechanism.

3.2.4. ifType

This MIB applies to interfaces which have the ifType value ethernetCsmacd(6). It is REQUIRED that all ethernet-like interfaces use an ifType of ethernetCsmacd(6) regardless of the speed that the interface is running or the link-layer encapsulation in use. Use of the ifType values iso88023Csmacd(7) and starLan(11) are deprecated, however some older implementations may return these values. Management applications should be prepared to receive these deprecated ifType values from older implementations.

There are three other interface types defined in the IANAifType-MIB for Ethernet. They are fastEther(62), fastEtherFX(69), and gigabitEthernet(117). These interface types were registered by individual vendors, not by any IETF working group. A requirement for compliance with this document is that all ethernet-like interfaces MUST return ethernetCsmacd(6) for ifType, and MUST NOT return fastEther(62), fastEtherFX(69), or gigabitEthernet(117). However, as there are fielded implementations that do return these obsolete ifType values, management applications SHOULD be prepared to receive them from older implementations.

Information on the particular flavor of Ethernet that an interface is running is available from ifSpeed in the Interfaces MIB, and ifMauType in the 802.3 MAU MIB [30]. Note that implementation of the 802.3 MAU MIB [30] is REQUIRED for all ethernet-like interfaces.

3.2.5. ifXxxOctets

The Interface MIB octet counters, ifInOctets, ifOutOctets, ifHCInOctets and ifHCOutOctets, MUST include all octets in valid frames sent or received on the interface, including the MAC header and FCS, but not the preamble, start of frame delimiter, or extension octets. This corresponds to the definition of frameSize/8 in section 4.2.7.1 of [17] (frameSize is defined in bits rather than octets, and

is defined as 2 x addressSize + lengthOrTypeSize + dataSize + crcSize). They do not include the number of octets in collided or failed transmit attempts, since the MAC layer driver typically does not have visibility to count these octets. They also do not include octets in received invalid frames, since this information is normally not passed to the MAC layer, and since non-promiscuous MAC implementations cannot reliably determine whether an invalid frame was actually addressed to this station.

Note that these counters do include octets in valid MAC control frames sent or received on the interface, as well as octets in otherwise valid received MAC frames that are discarded by the MAC layer for some reason (insufficient buffer space, unknown protocol, etc.).

Note that the octet counters in IF-MIB do not exactly match the definition of the octet counters in IEEE 802.3. aOctetsTransmittedOK and aOctetsReceivedOK count only the octets in the clientData and Pad fields, whereas ifInOctets and ifOutOctets include the entire MAC frame, including MAC header and FCS. However, the IF-MIB counters can be derived from the IEEE 802.3 counters as follows:

```
ifInOctets = aOctetsReceivedOK + (18 * aFramesReceivedOK)
ifOutOctets = aOctetsTransmittedOK + (18 * aFramesTransmittedOK)
```

Another difference to keep in mind between the IF-MIB counters and IEEE 802.3 counters is that in the IEEE 802.3 document, the frame counters and octet counters are always incremented together. aOctetsTransmittedOK counts the number of octets in frames that were counted by aFramesTransmittedOK. aOctetsReceivedOK counts the number of octets in frames that were counted by aFramesReceivedOK. This is not the case with the IF-MIB counters. The IF-MIB octet counters count the number of octets sent to or received from the layer below this interface, whereas the packet counters count the number of packets sent to or received from the layer above. Therefore, received MAC Control frames, ifInDiscards, and ifInUnknownProtos are counted by ifInOctets, but not ifInXcastPkts. Transmitted MAC Control frames are counted by ifOutOctets, but not ifOutXcastPkts. ifOutDiscards and ifOutErrors are counted by ifOutXcastPkts, but not ifOutOctets.

3.2.6. ifXxxXcastPkts

The packet counters in the IF-MIB do not exactly match the definition of the frame counters in IEEE 802.3. aFramesTransmittedOK counts the number of frames successfully transmitted on the interface, whereas ifOutUcastPkts, ifOutMulticastPkts and ifOutBroadcastPkts count the number of transmit requests made from a higher layer, whether or not the transmit attempt was successful. This means that packets counted by ifOutErrors or ifOutDiscards are also be counted by ifOutXcastPkts, but are not be counted by aFramesTransmittedOK. This also means that, since MAC Control frames are generated by a sublayer internal to the interface layer rather than by a higher layer, they are not counted by ifOutXcastPkts, but are counted by aFramesTransmittedOK. Roughly:

```
aFramesTransmittedOK = ifOutUcastPkts + ifOutMulticastPkts +
                       ifOutBroadcastPkts + dot3OutPauseFrames -
                       (ifOutErrors + ifOutDiscards)
```

Similarly, aFramesReceivedOK counts the number of frames received successfully by the interface, whether or not they are passed to a higher layer, whereas ifInUcastPkts, ifInMulticastPkts and ifInBroadcastPkts count only the number of packets passed to a higher layer. This means that packets counted by ifInDiscards or ifInUnknownProtos are also counted by aFramesReceivedOK, but are not counted by ifInXcastPkts. This also means that, since MAC Control frames are consumed by a sublayer internal to the interface layer and not passed to a higher layer, they are not counted by ifInXcastPkts, but are counted by aFramesReceivedOK. Roughly:

```
aFramesReceivedOK = ifInUcastPkts + ifInMulticastPkts +
                    ifInBroadcastPkts + dot3InPauseFrames +
                    ifInDiscards + ifInUnknownProtos
```

This specification chooses to treat MAC control frames as being originated and consumed within the interface and not counted by the IF-MIB packet counters. MAC control frames are normally sent as multicast packets. In many network environments, MAC control frames can greatly outnumber multicast frames carrying actual data. If MAC control frames were included in the ifInMulticastPkts and ifOutMulticastPkts, the count of data-carrying multicast packets would tend to be drowned out by the count of MAC control frames, rendering those counters considerably less useful.

3.2.7. ifMtu

The defined standard MTU for ethernet-like interfaces is 1500 octets.

However, many implementations today support larger packet sizes than the IEEE 802.3 standard. The value of this object MUST reflect the actual MTU in use on the interface, whether it matches the standard MTU or not.

This value should reflect the value seen by the MAC client interface. When a higher layer protocol, like IP, is running over Ethernet framing, this is the MTU that will be seen by that higher layer protocol. However, most ethernet-like interfaces today run multiple protocols that use a mix of different framing types. For example, an IEEE 802.2 LLC type 1 client protocol will see an MTU of 1497 octets on an interface using the IEEE standard maximum packet size, and a protocol running over SNAP will see an MTU of 1492 octets on an interface using the IEEE standard maximum packet size. However, since specification mandates using the MTU as seen at the MAC client interface, the value of ifMtu would be reported as 1500 octets in these cases.

3.2.8. ifSpeed and ifHighSpeed

For ethernet-like interfaces operating at 1000 Megabits per second (Mb/s) or less, ifSpeed will represent the current operational speed of the interface in bits per second. For current interface types, this will be equal to 1,000,000 (1 million), 10,000,000 (10 million), 100,000,000 (100 million), or 1,000,000,000 (1 billion). ifHighSpeed will represent the current operational speed in millions of bits per second. For current ethernet-like interfaces, this will be equal to 1, 10, 100, or 1,000. If the interface implements auto-negotiation, auto-negotiation is enabled for this interface, and the interface has not yet negotiated to an operational speed, these objects SHOULD reflect the maximum speed supported by the interface.

For ethernet-like interfaces operating at greater than 1000 Mb/s, ifHighSpeed will represent the current operational speed of the interface in millions of bits per second. Note that for WAN implementations, this will be the payload data rate over the WAN interface sublayer. For current implementations, this will be equal to 10,000 for LAN implentations of 10 Gb/s, and 9,585 for WAN implementations of the 10 Gb/s MAC over an OC-192 PHY. For these speeds, ifSpeed should report a maximum unsigned 32-bit value of 4,294,967,295 as specified in [28].

Note that these object MUST NOT indicate a doubled value when operating in full-duplex mode. It MUST indicate the correct line speed regardless of the current duplex mode. The duplex mode of the

interface may be determined by examining either the dot3StatsDuplexStatus object in this MIB module, or the ifMauType

object in the 802.3 MAU MIB [30].

3.2.9. ifPhysAddress

This object contains the IEEE 802.3 address which is placed in the source-address field of any Ethernet, Starlan, or IEEE 802.3 frames that originate at this interface. Usually this will be kept in ROM on the interface hardware. Some systems may set this address via software.

In a system where there are several such addresses the designer has a tougher choice. The address chosen should be the one most likely to be of use to network management (e.g. the address placed in ARP responses for systems which are primarily IP systems).

If the designer truly can not chose, use of the factory- provided ROM address is suggested.

If the address can not be determined, an octet string of zero length should be returned.

The address is stored in binary in this object. The address is stored in "canonical" bit order, that is, the Group Bit is positioned as the low-order bit of the first octet. Thus, the first byte of a multicast address would have the bit 0x01 set.

3.2.10. Specific Interface MIB Objects

The following table provides specific implementation guidelines for applying the interface group objects to ethernet-like media.

Object	Guidelines
ifIndex	Each ethernet-like interface is represented by an ifEntry. The dot3StatsTable in this MIB module is

	indexed by dot3StatsIndex. The interface identified by a particular value of dot3StatsIndex is the same interface as identified by the same value of ifIndex.
ifDescr	Refer to [28].
ifType	Refer to section 3.2.4.

ifMtu	Refer to section 3.2.7.
ifSpeed	Refer to section 3.2.8.
ifPhysAddress	Refer to section 3.2.9.
ifAdminStatus	Write access is not required. Support for 'testing' is not required.
ifOperStatus	The operational state of the interface. Support for 'testing' is not required. The value 'dormant' has no meaning for an ethernet-like interface.
ifLastChange	Refer to [28].
ifInOctets	The number of octets in valid MAC frames received on this interface, including the MAC header and FCS. This does include the number of octets in valid MAC Control frames received on this interface. See section 3.2.5.
ifInUcastPkts	Refer to [28]. Note that this does not include MAC Control frames, since MAC Control frames are consumed by the interface layer and are not passed to any higher layer protocol. See section 3.2.6.
ifInDiscards	Refer to [28].

ifInErrors	The sum for this interface of dot3StatsAlignmentErrors, dot3StatsFCSErrors, dot3StatsFrameTooLongs, and dot3StatsInternalMacReceiveErrors.
ifInUnknownProtos	Refer to [28].
ifOutOctets	The number of octets transmitted in valid MAC frames on this interface, including the MAC header and FCS. This does include the number of octets in valid MAC Control frames transmitted on this interface. See section 3.2.5.
ifOutUcastPkts	Refer to [28]. Note that this does not include MAC Control frames, since MAC Control frames are generated by the interface layer, and are not passed from any higher layer protocol. See section 3.2.6.
ifOutDiscards	Refer to [28].
ifOutErrors	The sum for this interface of: dot3StatsSQETestErrors, dot3StatsLateCollisions, dot3StatsExcessiveCollisions, dot3StatsInternalMacTransmitErrors and dot3StatsCarrierSenseErrors.
ifName	Locally-significant textual name for the interface (e.g. lan0).
ifInMulticastPkts	Refer to [28]. Note that this does not include MAC Control frames, since MAC Control frames are consumed by the interface layer and are not passed to any higher layer protocol. See section 3.2.6.

ifInBroadcastPkts	Refer to [28]. Note that this does not include MAC Control frames, since MAC Control frames are generated by the interface layer, and are not passed from any higher layer protocol. See section 3.2.6.
ifOutMulticastPkts	Refer to [28]. Note that this does not include MAC Control frames, since MAC Control frames are consumed by the interface layer and are not passed to any higher layer protocol. See section 3.2.6.
ifOutBroadcastPkts	Refer to [28]. Note that this does not include MAC Control frames, since MAC Control frames are generated by the interface layer, and are not passed from any higher layer protocol. See section 3.2.6.
ifHCInOctets ifHCOutOctets	64-bit versions of counters. Required for ethernet-like interfaces that are

	capable of operating at 20 Mb/s or faster, even if the interface is currently operating at less than 20 Mb/s.
ifHCInUcastPkts ifHCInMulticastPkts ifHCInBroadcastPkts ifHCOutUcastPkts ifHCOutMulticastPkts ifHCOutBroadcastPkts	64-bit versions of packet counters. Required for ethernet-like interfaces that are capable of operating at 640 Mb/s or faster, even if the interface is currently operating at less than 640 Mb/s.
ifLinkUpDownTrapEnable	Refer to [28]. Default is 'enabled'
ifHighSpeed	Refer to section 3.2.8.
ifPromiscuousMode	Refer to [28].

ifConnectorPresent	This will normally be 'true'.
ifAlias	Refer to [28].
ifCounterDiscontinuityTime	Refer to [28]. Note that a discontinuity in the Interface MIB counters may also indicate a discontinuity in some or all of the counters in this MIB that are associated with that interface.
ifStackHigherLayer ifStackLowerLayer ifStackStatus	Refer to section 3.2.1.
ifRcvAddressAddress ifRcvAddressStatus ifRcvAddressType	Refer to section 3.2.3.

3.3. Relation to the 802.3 MAU MIB

Support for the mauModIfCompl2 compliance statement of the MAU-MIB [30] is REQUIRED for Ethernet-like interfaces. This MIB is needed in order to allow applications to determine the current MAU type in use by the interface, and to control autonegotiation and duplex mode for the interface. Implementing this MIB module without implementing the MAU-MIB would leave applications with no standard way to determine the media type in use, and no standard way to control the duplex mode of the interface.

3.4. dot3StatsEtherChipSet

This document defines an object called dot3StatsEtherChipSet, which is used to identify the MAC hardware used to communicate on an interface. Previous versions of this document contained a number of OID assignments for some existing Ethernet chipsets. Maintaining that list as part of this document has proven to be problematic, so the OID assignments contained in prevous versions of this document have now been moved to a separate document [31].

The dot3StatsEtherChipSet object has now been deprecated.

Implementation feedback indicates that this object is much more useful in theory than in practice. The object's utility in debugging network problems in the field appears to be limited. In those cases where it may be useful, it is not sufficient, since it identifies only the MAC chip, and not the PHY, PMD, or driver. The administrative overhead involved in maintaining a central registry of chipset OIDs cannot be justified for an object whose usefulness is questionable at best.

Implementations which continue to support this object for the purpose of backwards compatability may continue to use the values defined in [31]. For chipsets not listed in [31], implementors that wish to support this object and return a valid OBJECT IDENTIFIER value may assign OBJECT IDENTIFIERS within that part of the registration tree delegated to individual enterprises.

3.5. Mapping of IEEE 802.3 Managed Objects

IEEE 802.3 Managed Object	Corresponding SNMP Object
oMacEntity	
.aMACID	dot3StatsIndex or IF-MIB - ifIndex
.aFramesTransmittedOK	IF-MIB - ifOutUCastPkts + ifOutMulticastPkts + ifOutBroadcastPkts*
.aSingleCollisionFrames	dot3StatsSingleCollisionFrames
.aMultipleCollisionFrames	dot3StatsMultipleCollisionFrames
.aFramesReceivedOK	IF-MIB - ifInUcastPkts + ifInMulticastPkts + ifInBroadcastPkts*
.aFrameCheckSequenceErrors	dot3StatsFCSErrors
.aAlignmentErrors	dot3StatsAlignmentErrors
.aOctetsTransmittedOK	IF-MIB - ifOutOctets*
.aFramesWithDeferredXmissions	dot3StatsDeferredTransmissions
.aLateCollisions	dot3StatsLateCollisions

.aFramesAbortedDueToXSColls	dot3StatsExcessiveCollisions
.aFramesLostDueToIntMACXmitError	dot3StatsInternalMacTransmitErrors
.aCarrierSenseErrors	dot3StatsCarrierSenseErrors
.aOctetsReceivedOK	IF-MIB - ifInOctets*

```
 .aFramesLostDueToIntMACRcvError  dot3StatsInternalMacReceiveErrors
 .aPromiscuousStatus              IF-MIB - ifPromiscuousMode
 .aReadMulticastAddressList       IF-MIB - ifRcvAddressTable
 .aMulticastFramesXmittedOK       IF-MIB - ifOutMulticastPkts*
 .aBroadcastFramesXmittedOK       IF-MIB - ifOutBroadcastPkts*
 .aMulticastFramesReceivedOK      IF-MIB - ifInMulticastPkts*
 .aBroadcastFramesReceivedOK      IF-MIB - ifInBroadcastPkts*
 .aFrameTooLongErrors             dot3StatsFrameTooLongs
 .aReadWriteMACAddress            IF-MIB - ifPhysAddress
 .aCollisionFrames                dot3CollFrequencies
 .aDuplexStatus                   dot3StatsDuplexStatus
 .aRateControlAbility             dot3StatsRateControlAbility
 .aRateControlStatus              dot3StatsRateControlStatus
 .acAddGroupAddress               IF-MIB - ifRcvAddressTable
 .acDeleteGroupAddress            IF-MIB - ifRcvAddressTable
 .acExecuteSelfTest               dot3TestLoopBack

oPHYEntity
 .aPHYID                          dot3StatsIndex or
                                  IF-MIB - ifIndex
 .aSQETestErrors                  dot3StatsSQETestErrors
 .aSymbolErrorDuringCarrier       dot3StatsSymbolErrors

oMACControlEntity
 .aMACControlID                   dot3StatsIndex or
                                  IF-MIB - ifIndex
 .aMACControlFunctionsSupported   dot3ControlFunctionsSupported and
                                  dot3ControlFunctionsEnabled
 .aUnsupportedOpcodesReceived     dot3ControlInUnknownOpcodes

oPAUSEEntity
 .aPAUSEMACCtrlFramesTransmitted  dot3OutPauseFrames
 .aPAUSEMACCtrlFramesReceived     dot3InPauseFrames
```

* Note that the octet counters in IF-MIB do not exactly match the definition of the octet counters in IEEE 802.3. See section 3.2.5 for details.

Also note that the packet counters in the IF-MIB do not exactly match the definition of the frame counters in IEEE 802.3. See section 3.2.6 for details.

The following IEEE 802.3 managed objects have been removed from this

MIB module as a result of implementation feedback:

```
oMacEntity
  .aFramesWithExcessiveDeferral
  .aInRangeLengthErrors
  .aOutOfRangeLengthField
  .aMACEnableStatus
  .aTransmitEnableStatus
  .aMulticastReceiveStatus
  .acInitializeMAC
```

Please see [21] for the detailed reasoning on why these objects were removed.

In addition, the following IEEE 802.3 managed objects have not been included in this MIB for the following reasons.

IEEE 802.3 Managed Object	Disposition
oMACEntity	
.aMACCapabilities	Can be derived from MAU-MIB - ifMauTypeListBits
.aStretchRatio	Implementation constant.
oPHYEntity	
.aPhyType	Can be derived from MAU-MIB - ifMauType
.aPhyTypeList	Can be derived from MAU-MIB - ifMauTypeListBits
.aMIIDetect	Not considered useful.
.aPhyAdminState	Can already obtain interface state from IF-MIB - ifOperStatus and MAU state from MAU-MIB - ifMauStatus. Providing an additional state for the PHY was not considered useful.
.acPhyAdminControl	Can already control interface state from IF-MIB - ifAdminStatus and MAU state from MAU-MIB - ifMauStatus. Providing separate admin control of the PHY was not considered useful.

oMACControlEntity	
.aMACControlFramesTransmitted	Can be determined by summing the OutFrames counters for the individual control functions
.aMACControlFramesReceived	Can be determined by summing the InFrames counters for the individual control functions
oPAUSEEntity	
.aPAUSELinkDelayAllowance	Not considered useful.

4. Definitions

```
EtherLike-MIB DEFINITIONS ::= BEGIN

    IMPORTS
        MODULE-IDENTITY, OBJECT-TYPE, OBJECT-IDENTITY,
        Counter32, Counter64, mib-2, transmission
            FROM SNMPv2-SMI
        MODULE-COMPLIANCE, OBJECT-GROUP
            FROM SNMPv2-CONF
        TruthValue
            FROM SNMPv2-TC
        ifIndex, InterfaceIndex
            FROM IF-MIB;

    etherMIB MODULE-IDENTITY
        LAST-UPDATED "200106260024Z"  -- June 26, 2001
        ORGANIZATION "IETF Ethernet Interfaces and Hub MIB
                      Working Group"
        CONTACT-INFO
            "WG E-mail: hubmib@ietf.org
          To subscribe: hubmib-request@ietf.org

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```
        DESCRIPTION "The MIB module to describe generic objects for
                     ethernet-like network interfaces.

                     The following reference is used throughout this
                     MIB module:

                     [IEEE 802.3 Std] refers to:
                        IEEE Std 802.3, 2000 Edition: 'IEEE Standard
                        for Information technology -
                        Telecommunications and information exchange
                        between systems - Local and metropolitan
                        area networks - Specific requirements -
                        Part 3: Carrier sense multiple access with
                        collision detection (CSMA/CD) access method
                        and physical layer specifications', as
                        ammended by IEEE Draft P802.3ae/D3.0:
                        'Supplement to Carrier Sense Multiple Access
                        with Collision Detection (CSMA/CD) Access
                        Method & Physical Layer Specifications -
                        Media Access Control (MAC) Parameters,
                        Physical Layer, and Management Parameters
                        for 10 Gb/s Operation', March, 2001.

                     Of particular interest is Clause 30, '10 Mb/s,
                     100 Mb/s, 1000 Mb/s, and 10 Gb/s Management'."

        REVISION    "200106260024Z"  -- June 26, 2001
        DESCRIPTION "Updated to include support for 10 Gb/sec
```

```
                    interfaces.
                    This version published as RFC XXXX."

        REVISION    "9908240400Z"  -- August 24, 1999
        DESCRIPTION "Updated to include support for 1000 Mb/sec
                    interfaces and full-duplex interfaces.
                    This version published as RFC 2665."

        REVISION    "9806032150Z"  -- June 3, 1998
        DESCRIPTION "Updated to include support for 100 Mb/sec
                    interfaces.
                    This version published as RFC 2358."

        REVISION    "9402030400Z"  -- February 3, 1994
        DESCRIPTION "Initial version, published as RFC 1650."
```



```
        ::= { mib-2 35 }

    etherMIBObjects OBJECT IDENTIFIER ::= { etherMIB 1 }

    dot3    OBJECT IDENTIFIER ::= { transmission 7 }

    -- the Ethernet-like Statistics group

    dot3StatsTable OBJECT-TYPE
        SYNTAX     SEQUENCE OF Dot3StatsEntry
        MAX-ACCESS not-accessible
        STATUS     current
        DESCRIPTION "Statistics for a collection of ethernet-like
                    interfaces attached to a particular system.
                    There will be one row in this table for each
                    ethernet-like interface in the system."
        ::= { dot3 2 }

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

```
Dot3StatsEntry ::=
    SEQUENCE {
        dot3StatsIndex                      InterfaceIndex,
        dot3StatsAlignmentErrors            Counter32,
        dot3StatsFCSErrors                  Counter32,
        dot3StatsSingleCollisionFrames      Counter32,
        dot3StatsMultipleCollisionFrames    Counter32,
        dot3StatsSQETestErrors              Counter32,
        dot3StatsDeferredTransmissions      Counter32,
        dot3StatsLateCollisions             Counter32,
        dot3StatsExcessiveCollisions        Counter32,
        dot3StatsInternalMacTransmitErrors  Counter32,
        dot3StatsCarrierSenseErrors         Counter32,
        dot3StatsFrameTooLongs              Counter32,
        dot3StatsInternalMacReceiveErrors   Counter32,
        dot3StatsEtherChipSet               OBJECT IDENTIFIER,
        dot3StatsSymbolErrors               Counter32,
        dot3StatsDuplexStatus               INTEGER,
        dot3StatsRateControlAbility         TruthValue,
        dot3StatsRateControlStatus          INTEGER
    }
```



```
dot3StatsIndex OBJECT-TYPE
    SYNTAX      InterfaceIndex
    MAX-ACCESS  read-only
    STATUS      current
    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."
    REFERENCE   "RFC 2863, ifIndex"
    ::= { dot3StatsEntry 1 }

dot3StatsAlignmentErrors OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    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 pertain are,
                    according to the conventions of IEEE 802.3
                    Layer Management, counted exclusively according
                    to the error status presented to the LLC.

                    This counter does not increment for group
                    encoding schemes greater than 4 bits per group.

                    For interfaces operating at 10 Gb/s, this
                    counter can roll over in less than 5 minutes if
                    it is incrementing at its maximum rate.  Since
                    that amount of time could be less than a
                    management station's poll cycle time, in order
                    to avoid a loss of information, a management
                    station is advised to poll the
                    dot3HCStatsAlignmentErrors object for 10 Gb/s
                    or faster interfaces.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
        REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.7,
                    aAlignmentErrors"
```



```
        ::= { dot3StatsEntry 2 }

    dot3StatsFCSErrors OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        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.  This
                    count does not include frames received with
                    frame-too-long or frame-too-short error.
```

```
                    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 pertain are,
                    according to the conventions of IEEE 802.3
                    Layer Management, counted exclusively according
                    to the error status presented to the LLC.

                    Note:  Coding errors detected by the physical
                    layer for speeds above 10 Mb/s will cause the
                    frame to fail the FCS check.

                    For interfaces operating at 10 Gb/s, this
                    counter can roll over in less than 5 minutes if
                    it is incrementing at its maximum rate.  Since
                    that amount of time could be less than a
                    management station's poll cycle time, in order
                    to avoid a loss of information, a management
                    station is advised to poll the
                    dot3HCStatsFCSErrors object for 10 Gb/s or
                    faster interfaces.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
        REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.6,
                    aFrameCheckSequenceErrors."
        ::= { dot3StatsEntry 3 }

    dot3StatsSingleCollisionFrames OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION "A count of frames that are involved in a single
```



```
                    collision, and are subsequently transmitted
                    successfully.

                    A frame that is counted by an instance of this
                    object is also counted by the corresponding
```

```
                    instance of either the ifOutUcastPkts,
                    ifOutMulticastPkts, or ifOutBroadcastPkts,
                    and is not counted by the corresponding
                    instance of the dot3StatsMultipleCollisionFrames
                    object.

                    This counter does not increment when the
                    interface is operating in full-duplex mode.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
        REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.3,
                    aSingleCollisionFrames."
        ::= { dot3StatsEntry 4 }


    dot3StatsMultipleCollisionFrames OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION "A count of frames that are involved in more
                    than one collision and are subsequently
                    transmitted successfully.

                    A frame that is counted by an instance of this
                    object is also counted by the corresponding
                    instance of either the ifOutUcastPkts,
                    ifOutMulticastPkts, or ifOutBroadcastPkts,
                    and is not counted by the corresponding
                    instance of the dot3StatsSingleCollisionFrames
                    object.

                    This counter does not increment when the
                    interface is operating in full-duplex mode.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
        REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.4,
                    aMultipleCollisionFrames."
```

```
    ::= { dot3StatsEntry 5 }


dot3StatsSQETestErrors OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION "A count of times that the SQE TEST ERROR
                is received on a particular interface. The
                SQE TEST ERROR is set in accordance with the
                rules for verification of the SQE detection
                mechanism in the PLS Carrier Sense Function as
                described in IEEE Std. 802.3, 2000 Edition,
                section 7.2.4.6.

                This counter does not increment on interfaces
                operating at speeds greater than 10 Mb/s, or on
                interfaces operating in full-duplex mode.

                Discontinuities in the value of this counter can
                occur at re-initialization of the management
                system, and at other times as indicated by the
                value of ifCounterDiscontinuityTime."
    REFERENCE   "[IEEE 802.3 Std.], 7.2.4.6, also 30.3.2.1.4,
                aSQETestErrors."
    ::= { dot3StatsEntry 6 }

dot3StatsDeferredTransmissions OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS  read-only
    STATUS      current
    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.

                This counter does not increment when the
                interface is operating in full-duplex mode.

                Discontinuities in the value of this counter can
                occur at re-initialization of the management
                system, and at other times as indicated by the
                value of ifCounterDiscontinuityTime."
    REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.9,
                aFramesWithDeferredXmissions."
```

```
        ::= { dot3StatsEntry 7 }

    dot3StatsLateCollisions OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION "The number of times that a collision is
                    detected on a particular interface later than
                    one slotTime into the transmission of a packet.

                    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.

                    This counter does not increment when the
                    interface is operating in full-duplex mode.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
        REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.10,
                    aLateCollisions."
        ::= { dot3StatsEntry 8 }

    dot3StatsExcessiveCollisions OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION "A count of frames for which transmission on a
                    particular interface fails due to excessive
                    collisions.

                    This counter does not increment when the
                    interface is operating in full-duplex mode.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
```

```
            REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.11,
                        aFramesAbortedDueToXSColls."
            ::= { dot3StatsEntry 9 }

        dot3StatsInternalMacTransmitErrors OBJECT-TYPE
            SYNTAX      Counter32
```



```
            MAX-ACCESS  read-only
            STATUS      current
            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.

                        For interfaces operating at 10 Gb/s, this
                        counter can roll over in less than 5 minutes if
                        it is incrementing at its maximum rate.  Since
                        that amount of time could be less than a
                        management station's poll cycle time, in order
                        to avoid a loss of information, a management
                        station is advised to poll the
                        dot3HCStatsInternalMacTransmitErrors object for
                        10 Gb/s or faster interfaces.

                        Discontinuities in the value of this counter can
                        occur at re-initialization of the management
                        system, and at other times as indicated by the
                        value of ifCounterDiscontinuityTime."
            REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.12,
                        aFramesLostDueToIntMACXmitError."
            ::= { dot3StatsEntry 10 }
```

```
        dot3StatsCarrierSenseErrors OBJECT-TYPE
            SYNTAX      Counter32
            MAX-ACCESS  read-only
            STATUS      current
            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.

                        This counter does not increment when the
                        interface is operating in full-duplex mode.

                        Discontinuities in the value of this counter can
                        occur at re-initialization of the management
                        system, and at other times as indicated by the
                        value of ifCounterDiscontinuityTime."
            REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.13,
                        aCarrierSenseErrors."
            ::= { dot3StatsEntry 11 }

        -- { dot3StatsEntry 12 } is not assigned

        dot3StatsFrameTooLongs OBJECT-TYPE
            SYNTAX      Counter32
            MAX-ACCESS  read-only
            STATUS      current
            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 pertain are, according to the conventions of IEEE 802.3 Layer Management, counted exclusively according to the error status presented to the LLC.

For interfaces operating at 10 Gb/s, this counter can roll over in less than 5 minutes if it is incrementing at its maximum rate. Since that amount of time could be less than a management station's poll cycle time, in order to avoid a loss of information, a management station is advised to poll the dot3HCStatsFrameTooLongs object for 10 Gb/s or faster interfaces.

Discontinuities in the value of this counter can occur at re-initialization of the management system, and at other times as indicated by the value of ifCounterDiscontinuityTime."

REFERENCE "[IEEE 802.3 Std.], 30.3.1.1.25,

aFrameTooLongErrors."

::= { dot3StatsEntry 13 }

-- { dot3StatsEntry 14 } is not assigned

-- { dot3StatsEntry 15 } is not assigned

dot3StatsInternalMacReceiveErrors OBJECT-TYPE

SYNTAX Counter32

MAX-ACCESS read-only

STATUS current

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.

                    For interfaces operating at 10 Gb/s, this
                    counter can roll over in less than 5 minutes if
                    it is incrementing at its maximum rate.  Since
                    that amount of time could be less than a
                    management station's poll cycle time, in order
                    to avoid a loss of information, a management
                    station is advised to poll the
                    dot3HCStatsInternalMacReceiveErrors object for
                    10 Gb/s or faster interfaces.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
        REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.15,
                    aFramesLostDueToIntMACRcvError."
        ::= { dot3StatsEntry 16 }

    dot3StatsEtherChipSet OBJECT-TYPE
        SYNTAX      OBJECT IDENTIFIER
        MAX-ACCESS  read-only
```



```
        STATUS      deprecated
        DESCRIPTION "******** THIS OBJECT IS DEPRECATED ********

                    This object contains an OBJECT IDENTIFIER
                    which identifies the chipset used to
                    realize the interface. Ethernet-like
                    interfaces are typically built out of
                    several different chips. The MIB implementor
                    is presented with a decision of which chip
                    to identify via this object. The implementor
                    should identify the chip which is usually
                    called the Medium Access Control chip.
                    If no such chip is easily identifiable,
                    the implementor should identify the chip
```

```
                    which actually gathers the transmit
                    and receive statistics and error
                    indications. This would allow a
                    manager station to correlate the
                    statistics and the chip generating
                    them, giving it the ability to take
                    into account any known anomalies
                    in the chip."
        ::= { dot3StatsEntry 17 }

    dot3StatsSymbolErrors OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION "For an interface operating at 100 Mb/s, the
                    number of times there was an invalid data symbol
                    when a valid carrier was present.

                    For an interface operating in half-duplex mode
                    at 1000 Mb/s, the number of times the receiving
                    media is non-idle (a carrier event) for a period
                    of time equal to or greater than slotTime, and
                    during which there was at least one occurrence
                    of an event that causes the PHY to indicate
                    'Data reception error' or 'carrier extend error'
                    on the GMII.

                    For an interface operating in full-duplex mode
                    at 1000 Mb/s, the number of times the receiving
                    media is non-idle (a carrier event) for a period
                    of time equal to or greater than minFrameSize,
                    and during which there was at least one
                    occurrence of an event that causes the PHY to
                    indicate 'Data reception error' on the GMII.
```



```
                    For an interface operating at 10 Gb/s, the
                    number of times the receiving media is non-idle
                    (a carrier event) for a period of time equal to
                    or greater than minFrameSize, and during which
                    there was at least one occurrence of an event
                    that causes the PHY to indicate 'Receive Error'
                    on the XGMII.
```

```
                    The count represented by an instance of this
                    object is incremented at most once per carrier
                    event, even if multiple symbol errors occur
                    during the carrier event.  This count does
                    not increment if a collision is present.

                    This counter does not increment when the
                    interface is operating at 10 Mb/s.

                    For interfaces operating at 10 Gb/s, this
                    counter can roll over in less than 5 minutes if
                    it is incrementing at its maximum rate.  Since
                    that amount of time could be less than a
                    management station's poll cycle time, in order
                    to avoid a loss of information, a management
                    station is advised to poll the
                    dot3HCStatsSymbolErrors object for 10 Gb/s
                    or faster interfaces.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
        REFERENCE   "[IEEE 802.3 Std.], 30.3.2.1.5,
                    aSymbolErrorDuringCarrier."
        ::= { dot3StatsEntry 18 }

    dot3StatsDuplexStatus OBJECT-TYPE
        SYNTAX      INTEGER {
                        unknown(1),
                        halfDuplex(2),
                        fullDuplex(3)
                    }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION "The current mode of operation of the MAC
                    entity.  'unknown' indicates that the current
                    duplex mode could not be determined.

                    Management control of the duplex mode is
```

```
                accomplished through the MAU MIB.  When
                an interface does not support autonegotiation,
                or when autonegotiation is not enabled, the
                duplex mode is controlled using
                ifMauDefaultType.  When autonegotiation is
                supported and enabled, duplex mode is controlled
                using ifMauAutoNegAdvertisedBits.  In either
                case, the currently operating duplex mode is
                reflected both in this object and in ifMauType.

                Note that this object provides redundant
                information with ifMauType.  Normally, redundant
                objects are discouraged.  However, in this
                instance, it allows a management application to
                determine the duplex status of an interface
                without having to know every possible value of
                ifMauType.  This was felt to be sufficiently
                valuable to justify the redundancy."
    REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.32,
                aDuplexStatus."
    ::= { dot3StatsEntry 19 }

dot3StatsRateControlAbility OBJECT-TYPE
    SYNTAX      TruthValue
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION "'true' for interfaces operating at speeds above
                1000 Mb/s that support Rate Control through
                lowering the average data rate of the MAC
                sublayer, with frame granularity, and 'false'
                otherwise."
    REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.33,
                aRateControlAbility."
    ::= { dot3StatsEntry 20 }

dot3StatsRateControlStatus OBJECT-TYPE
    SYNTAX      INTEGER {
                    rateControlOff(1),
                    rateControlOn(2),
                    unknown(3)
                }
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION "The current Rate Control mode of operation of
                the MAC sublayer of this interface."
    REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.34,
                aRateControlStatus."
    ::= { dot3StatsEntry 21 }
```

```
       -- 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
           MAX-ACCESS  not-accessible
           STATUS      current
           DESCRIPTION "A collection of collision histograms for a
                       particular set of interfaces."
           REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.30,
                       aCollisionFrames."
           ::= { dot3 5 }


       dot3CollEntry OBJECT-TYPE
           SYNTAX      Dot3CollEntry
           MAX-ACCESS  not-accessible
           STATUS      current
           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       { ifIndex, dot3CollCount }
           ::= { dot3CollTable 1 }

       Dot3CollEntry ::=
           SEQUENCE {
               dot3CollCount        INTEGER,
               dot3CollFrequencies  Counter32
           }

       -- { dot3CollEntry 1 } is no longer in use

       dot3CollCount OBJECT-TYPE
           SYNTAX      INTEGER (1..16)
           MAX-ACCESS  not-accessible
           STATUS      current
           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      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION "A count of individual MAC frames for which the
                    transmission (successful or otherwise) on a
                    particular interface occurs after the
                    frame has experienced exactly the number
                    of collisions in the associated
                    dot3CollCount object.

                    For example, a frame which is transmitted
                    on interface 77 after experiencing
                    exactly 4 collisions would be indicated
                    by incrementing only dot3CollFrequencies.77.4.
                    No other instance of dot3CollFrequencies would
                    be incremented in this example.

                    This counter does not increment when the
                    interface is operating in full-duplex mode.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
        ::= { dot3CollEntry 3 }


    dot3ControlTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF Dot3ControlEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION "A table of descriptive and status information
                    about the MAC Control sublayer on the
                    ethernet-like interfaces attached to a
                    particular system.  There will be one row in
```

```
                    this table for each ethernet-like interface in
                    the system which implements the MAC Control
                    sublayer.  If some, but not all, of the
                    ethernet-like interfaces in the system implement
                    the MAC Control sublayer, there will be fewer
                    rows in this table than in the dot3StatsTable."
        ::= { dot3 9 }

    dot3ControlEntry OBJECT-TYPE
        SYNTAX      Dot3ControlEntry
        MAX-ACCESS  not-accessible
        STATUS      current
```



```
        DESCRIPTION "An entry in the table, containing information
                    about the MAC Control sublayer on a single
                    ethernet-like interface."
        INDEX       { dot3StatsIndex }
        ::= { dot3ControlTable 1 }

    Dot3ControlEntry ::=
        SEQUENCE {
            dot3ControlFunctionsSupported       BITS,
            dot3ControlInUnknownOpcodes         Counter32,
            dot3HCControlInUnknownOpcodes       Counter64
        }

    dot3ControlFunctionsSupported OBJECT-TYPE
        SYNTAX      BITS {
                        pause(0)   -- 802.3 flow control
                    }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION "A list of the possible MAC Control functions
                    implemented for this interface."
        REFERENCE   "[IEEE 802.3 Std.], 30.3.3.2,
                    aMACControlFunctionsSupported."
        ::= { dot3ControlEntry 1 }

    dot3ControlInUnknownOpcodes OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
```

```
            DESCRIPTION "A count of MAC Control frames received on this
                        interface that contain an opcode that is not
                        supported by this device.

                        For interfaces operating at 10 Gb/s, this
                        counter can roll over in less than 5 minutes if
                        it is incrementing at its maximum rate.  Since
                        that amount of time could be less than a
                        management station's poll cycle time, in order
                        to avoid a loss of information, a management
                        station is advised to poll the
                        dot3HCControlInUnknownOpcodes object for 10 Gb/s
                        or faster interfaces.

                        Discontinuities in the value of this counter can
                        occur at re-initialization of the management
                        system, and at other times as indicated by the
                        value of ifCounterDiscontinuityTime."
            REFERENCE   "[IEEE 802.3 Std.], 30.3.3.5,
```



```
                        aUnsupportedOpcodesReceived"
            ::= { dot3ControlEntry 2 }

        dot3HCControlInUnknownOpcodes OBJECT-TYPE
            SYNTAX      Counter64
            MAX-ACCESS  read-only
            STATUS      current
            DESCRIPTION "A count of MAC Control frames received on this
                        interface that contain an opcode that is not
                        supported by this device.

                        This counter is a 64 bit version of
                        dot3ControlInUnknownOpcodes.  It should be used
                        on interfaces operating at 10 Gb/s or faster.

                        Discontinuities in the value of this counter can
                        occur at re-initialization of the management
                        system, and at other times as indicated by the
                        value of ifCounterDiscontinuityTime."
            REFERENCE   "[IEEE 802.3 Std.], 30.3.3.5,
                        aUnsupportedOpcodesReceived"
            ::= { dot3ControlEntry 3 }
```

```
    dot3PauseTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF Dot3PauseEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION "A table of descriptive and status information
                     about the MAC Control PAUSE function on the
                     ethernet-like interfaces attached to a
                     particular system. There will be one row in
                     this table for each ethernet-like interface in
                     the system which supports the MAC Control PAUSE
                     function (i.e., the 'pause' bit in the
                     corresponding instance of
                     dot3ControlFunctionsSupported is set).  If some,
                     but not all, of the ethernet-like interfaces in
                     the system implement the MAC Control PAUSE
                     function (for example, if some interfaces only
                     support half-duplex), there will be fewer rows
                     in this table than in the dot3StatsTable."
        ::= { dot3 10 }

    dot3PauseEntry OBJECT-TYPE
        SYNTAX      Dot3PauseEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION "An entry in the table, containing information
```



```
                     about the MAC Control PAUSE function on a single
                     ethernet-like interface."
        INDEX       { dot3StatsIndex }
        ::= { dot3PauseTable 1 }

    Dot3PauseEntry ::=
        SEQUENCE {
            dot3PauseAdminMode                  INTEGER,
            dot3PauseOperMode                   INTEGER,
            dot3InPauseFrames                   Counter32,
            dot3OutPauseFrames                  Counter32,
            dot3HCInPauseFrames                 Counter64,
            dot3HCOutPauseFrames                Counter64
        }
```

```
dot3PauseAdminMode OBJECT-TYPE
    SYNTAX      INTEGER {
                    disabled(1),
                    enabledXmit(2),
                    enabledRcv(3),
                    enabledXmitAndRcv(4)
                }
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION "This object is used to configure the default
                administrative PAUSE mode for this interface.

                This object represents the
                administratively-configured PAUSE mode for this
                interface.  If auto-negotiation is not enabled
                or is not implemented for the active MAU
                attached to this interface, the value of this
                object determines the operational PAUSE mode
                of the interface whenever it is operating in
                full-duplex mode.  In this case, a set to this
                object will force the interface into the
                specified mode.

                If auto-negotiation is implemented and enabled
                for the MAU attached to this interface, the
                PAUSE mode for this interface is determined by
                auto-negotiation, and the value of this object
                denotes the mode to which the interface will
                automatically revert if/when auto-negotiation is
                later disabled.  Note that when auto-negotiation
                is running, administrative control of the PAUSE
                mode may be accomplished using the
                ifMauAutoNegCapAdvertisedBits object in the
```



```
                MAU-MIB.

                Note that the value of this object is ignored
                when the interface is not operating in
                full-duplex mode.

                An attempt to set this object to
                'enabledXmit(2)' or 'enabledRcv(3)' will fail
```

```
                    on interfaces that do not support operation
                    at greater than 100 Mb/s."
        ::= { dot3PauseEntry 1 }

    dot3PauseOperMode OBJECT-TYPE
        SYNTAX      INTEGER {
                        disabled(1),
                        enabledXmit(2),
                        enabledRcv(3),
                        enabledXmitAndRcv(4)
                    }
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION "This object reflects the PAUSE mode currently
                    in use on this interface, as determined by
                    either (1) the result of the auto-negotiation
                    function or (2) if auto-negotiation is not
                    enabled or is not implemented for the active MAU
                    attached to this interface, by the value of
                    dot3PauseAdminMode.  Interfaces operating at
                    100 Mb/s or less will never return
                    'enabledXmit(2)' or 'enabledRcv(3)'.  Interfaces
                    operating in half-duplex mode will always return
                    'disabled(1)'.  Interfaces on which
                    auto-negotiation is enabled but not yet
                    completed should return the value
                    'disabled(1)'."
        ::= { dot3PauseEntry 2 }

    dot3InPauseFrames OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION "A count of MAC Control frames received on this
                    interface with an opcode indicating the PAUSE
                    operation.

                    This counter does not increment when the
                    interface is operating in half-duplex mode.
```



```
                    For interfaces operating at 10 Gb/s, this
```

```
                    counter can roll over in less than 5 minutes if
                    it is incrementing at its maximum rate.  Since
                    that amount of time could be less than a
                    management station's poll cycle time, in order
                    to avoid a loss of information, a management
                    station is advised to poll the
                    dot3HCInPauseFrames object for 10 Gb/s or
                    faster interfaces.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
        REFERENCE   "[IEEE 802.3 Std.], 30.3.4.3,
                    aPAUSEMACCtrlFramesReceived."
        ::= { dot3PauseEntry 3 }

    dot3OutPauseFrames OBJECT-TYPE
        SYNTAX      Counter32
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION "A count of MAC Control frames transmitted on
                    this interface with an opcode indicating the
                    PAUSE operation.

                    This counter does not increment when the
                    interface is operating in half-duplex mode.

                    For interfaces operating at 10 Gb/s, this
                    counter can roll over in less than 5 minutes if
                    it is incrementing at its maximum rate.  Since
                    that amount of time could be less than a
                    management station's poll cycle time, in order
                    to avoid a loss of information, a management
                    station is advised to poll the
                    dot3HCOutPauseFrames object for 10 Gb/s or
                    faster interfaces.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
        REFERENCE   "[IEEE 802.3 Std.], 30.3.4.2,
                    aPAUSEMACCtrlFramesTransmitted."
        ::= { dot3PauseEntry 4 }

    dot3HCInPauseFrames OBJECT-TYPE
```

```
            SYNTAX      Counter64
            MAX-ACCESS  read-only
            STATUS      current
            DESCRIPTION "A count of MAC Control frames received on this
                        interface with an opcode indicating the PAUSE
                        operation.

                        This counter does not increment when the
                        interface is operating in half-duplex mode.

                        This counter is a 64 bit version of
                        dot3InPauseFrames.  It should be used on
                        interfaces operating at 10 Gb/s or faster.

                        Discontinuities in the value of this counter can
                        occur at re-initialization of the management
                        system, and at other times as indicated by the
                        value of ifCounterDiscontinuityTime."
            REFERENCE   "[IEEE 802.3 Std.], 30.3.4.3,
                        aPAUSEMACCtrlFramesReceived."
            ::= { dot3PauseEntry 5 }

        dot3HCOutPauseFrames OBJECT-TYPE
            SYNTAX      Counter64
            MAX-ACCESS  read-only
            STATUS      current
            DESCRIPTION "A count of MAC Control frames transmitted on
                        this interface with an opcode indicating the
                        PAUSE operation.

                        This counter does not increment when the
                        interface is operating in half-duplex mode.

                        This counter is a 64 bit version of
                        dot3OutPauseFrames.  It should be used on
                        interfaces operating at 10 Gb/s or faster.

                        Discontinuities in the value of this counter can
                        occur at re-initialization of the management
                        system, and at other times as indicated by the
                        value of ifCounterDiscontinuityTime."
            REFERENCE   "[IEEE 802.3 Std.], 30.3.4.2,
                        aPAUSEMACCtrlFramesTransmitted."
            ::= { dot3PauseEntry 6 }
```

```
    dot3HCStatsTable OBJECT-TYPE
        SYNTAX      SEQUENCE OF Dot3HCStatsEntry
```



```
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION "A table containing 64-bit versions of error
                    counters from the dot3StatsTable.  The 32-bit
                    versions of these counters may roll over quite
                    quickly on higher speed ethernet interfaces.
                    The counters that have 64-bit versions in this
                    table are the counters that apply to full-duplex
                    interfaces, since 10 Gb/s and faster
                    ethernet-like interfaces do not support
                    half-duplex, and very few 1000 Mb/s
                    ethernet-like interfaces support half-duplex.

                    Entries in this table are recommended for
                    interfaces capable of operating at 1000 Mb/s or
                    faster, and are required for interfaces capable
                    of operating at 10 Gb/s or faster.  Lower speed
                    ethernet-like interfaces do not need entries in
                    this table, in which case there may be fewer
                    entries in this table than in the
                    dot3StatsTable. However, implementations
                    containing interfaces with a mix of speeds may
                    choose to implement entries in this table for
                    all ethernet-like interfaces."
        ::= { dot3 11 }

    dot3HCStatsEntry OBJECT-TYPE
        SYNTAX      Dot3HCStatsEntry
        MAX-ACCESS  not-accessible
        STATUS      current
        DESCRIPTION "An entry containing 64-bit statistics for a
                    single ethernet-like interface."
        INDEX       { dot3StatsIndex }
        ::= { dot3HCStatsTable 1 }

    Dot3HCStatsEntry ::=
        SEQUENCE {
            dot3HCStatsAlignmentErrors          Counter64,
            dot3HCStatsFCSErrors                Counter64,
```

```
            dot3HCStatsInternalMacTransmitErrors Counter64,
            dot3HCStatsFrameTooLongs             Counter64,
            dot3HCStatsInternalMacReceiveErrors  Counter64,
            dot3HCStatsSymbolErrors              Counter64
        }

    dot3HCStatsAlignmentErrors OBJECT-TYPE
        SYNTAX      Counter64
        MAX-ACCESS  read-only
```



```
        STATUS      current
        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 pertain are,
                    according to the conventions of IEEE 802.3
                    Layer Management, counted exclusively according
                    to the error status presented to the LLC.

                    This counter does not increment for group
                    encoding schemes greater than 4 bits per group.

                    This counter is a 64 bit version of
                    dot3StatsAlignmentErrors.  It should be used
                    on interfaces operating at 10 Gb/s or faster.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
        REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.7,
                    aAlignmentErrors"
        ::= { dot3HCStatsEntry 1 }

    dot3HCStatsFCSErrors OBJECT-TYPE
        SYNTAX      Counter64
        MAX-ACCESS  read-only
```

```
            STATUS      current
            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.  This
                        count does not include frames received with
                        frame-too-long or frame-too-short error.

                        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 pertain are,
                        according to the conventions of IEEE 802.3
                        Layer Management, counted exclusively according
                        to the error status presented to the LLC.
```



```
                        Note:  Coding errors detected by the physical
                        layer for speeds above 10 Mb/s will cause the
                        frame to fail the FCS check.

                        This counter is a 64 bit version of
                        dot3StatsFCSErrors.  It should be used on
                        interfaces operating at 10 Gb/s or faster.

                        Discontinuities in the value of this counter can
                        occur at re-initialization of the management
                        system, and at other times as indicated by the
                        value of ifCounterDiscontinuityTime."
            REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.6,
                        aFrameCheckSequenceErrors."
            ::= { dot3HCStatsEntry 2 }

        dot3HCStatsInternalMacTransmitErrors OBJECT-TYPE
            SYNTAX      Counter64
            MAX-ACCESS  read-only
            STATUS      current
            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.

                    This counter is a 64 bit version of
                    dot3StatsInternalMacTransmitErrors.  It should
                    be used on interfaces operating at 10 Gb/s or
                    faster.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
        REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.12,
                    aFramesLostDueToIntMACXmitError."
        ::= { dot3HCStatsEntry 3 }
```



```
    dot3HCStatsFrameTooLongs OBJECT-TYPE
        SYNTAX      Counter64
        MAX-ACCESS  read-only
        STATUS      current
        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 pertain are,
                    according to the conventions of IEEE 802.3
                    Layer Management, counted exclusively according
                    to the error status presented to the LLC.

                    This counter is a 64 bit version of
```

```
                    dot3StatsFrameTooLongs.  It should be used on
                    interfaces operating at 10 Gb/s or faster.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
        REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.25,
                    aFrameTooLongErrors."
        ::= { dot3HCStatsEntry 4 }

    dot3HCStatsInternalMacReceiveErrors OBJECT-TYPE
        SYNTAX      Counter64
        MAX-ACCESS  read-only
        STATUS      current
        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.
```



```
                    This counter is a 64 bit version of
                    dot3StatsInternalMacReceiveErrors.  It should be
                    used on interfaces operating at 10 Gb/s or
                    faster.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
        REFERENCE   "[IEEE 802.3 Std.], 30.3.1.1.15,
                    aFramesLostDueToIntMACRcvError."
```

```
        ::= { dot3HCStatsEntry 5 }

    dot3HCStatsSymbolErrors OBJECT-TYPE
        SYNTAX      Counter64
        MAX-ACCESS  read-only
        STATUS      current
        DESCRIPTION "For an interface operating at 100 Mb/s, the
                    number of times there was an invalid data symbol
                    when a valid carrier was present.

                    For an interface operating in half-duplex mode
                    at 1000 Mb/s, the number of times the receiving
                    media is non-idle (a carrier event) for a period
                    of time equal to or greater than slotTime, and
                    during which there was at least one occurrence
                    of an event that causes the PHY to indicate
                    'Data reception error' or 'carrier extend error'
                    on the GMII.

                    For an interface operating in full-duplex mode
                    at 1000 Mb/s, the number of times the receiving
                    media is non-idle (a carrier event) for a period
                    of time equal to or greater than minFrameSize,
                    and during which there was at least one
                    occurrence of an event that causes the PHY to
                    indicate 'Data reception error' on the GMII.

                    For an interface operating at 10 Gb/s, the
                    number of times the receiving media is non-idle
                    (a carrier event) for a period of time equal to
                    or greater than minFrameSize, and during which
                    there was at least one occurrence of an event
                    that causes the PHY to indicate 'Receive Error'
                    on the XGMII.

                    The count represented by an instance of this
                    object is incremented at most once per carrier
```



```
                    event, even if multiple symbol errors occur
                    during the carrier event.  This count does
                    not increment if a collision is present.
```

```
                    This counter is a 64 bit version of
                    dot3StatsSymbolErrors.  It should be used on
                    interfaces operating at 10 Gb/s or faster.

                    Discontinuities in the value of this counter can
                    occur at re-initialization of the management
                    system, and at other times as indicated by the
                    value of ifCounterDiscontinuityTime."
    REFERENCE       "[IEEE 802.3 Std.], 30.3.2.1.5,
                    aSymbolErrorDuringCarrier."
    ::= { dot3HCStatsEntry 6 }


--  802.3 Tests

dot3Tests   OBJECT IDENTIFIER ::= { dot3 6 }

dot3Errors  OBJECT IDENTIFIER ::= { dot3 7 }


--  TDR Test

dot3TestTdr OBJECT-IDENTITY
    STATUS      current
    DESCRIPTION "The Time-Domain Reflectometry (TDR) test is
                specific to ethernet-like interfaces of type
                10Base5 and 10Base2.  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.

                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 result
                is stored as the value of an appropriate
                instance of an appropriate vendor specific MIB
                object, and the OBJECT IDENTIFIER of that
                instance is stored in the appropriate instance
                of the appropriate test result code object
                (thereby indicating where the result has been
```

```
                    stored)."
        ::= { dot3Tests 1 }

    -- Loopback Test

    dot3TestLoopBack OBJECT-IDENTITY
        STATUS      current
        DESCRIPTION "This test configures the MAC chip and executes
                    an internal loopback test of memory, data paths,
                    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
                    appropriate test result object will be set
                    to indicate a failure.  The two OBJECT
                    IDENTIFIER values dot3ErrorInitError and
                    dot3ErrorLoopbackError may be used to provided
                    more information as values for an appropriate
                    test result code object."
        ::= { dot3Tests 2 }

    dot3ErrorInitError OBJECT-IDENTITY
        STATUS      current
        DESCRIPTION "Couldn't initialize MAC chip for test."
        ::= { dot3Errors 1 }

    dot3ErrorLoopbackError OBJECT-IDENTITY
        STATUS      current
        DESCRIPTION "Expected data not received (or not received
                    correctly) in loopback test."
        ::= { dot3Errors 2 }


    -- { dot3 8 }, the dot3ChipSets tree, is defined in [31]


    -- conformance information

    etherConformance OBJECT IDENTIFIER ::= { etherMIB 2 }

    etherGroups      OBJECT IDENTIFIER ::= { etherConformance 1 }
    etherCompliances OBJECT IDENTIFIER ::= { etherConformance 2 }
```

```
        -- compliance statements
```



```
        etherCompliance MODULE-COMPLIANCE
            STATUS      deprecated
            DESCRIPTION "******** THIS COMPLIANCE IS DEPRECATED ********

                        The compliance statement for managed network
                        entities which have ethernet-like network
                        interfaces.

                        This compliance is deprecated and replaced by
                        dot3Compliance."

            MODULE  -- this module
                MANDATORY-GROUPS { etherStatsGroup }

                GROUP       etherCollisionTableGroup
                DESCRIPTION "This group is optional. It is appropriate
                             for all systems which have the necessary
                             metering. Implementation in such systems is
                             highly recommended."
            ::= { etherCompliances 1 }

        ether100MbsCompliance MODULE-COMPLIANCE
            STATUS      deprecated
            DESCRIPTION "******** THIS COMPLIANCE IS DEPRECATED ********

                        The compliance statement for managed network
                        entities which have 100 Mb/sec ethernet-like
                        network interfaces.

                        This compliance is deprecated and replaced by
                        dot3Compliance."

            MODULE  -- this module
                MANDATORY-GROUPS { etherStats100MbsGroup }

                GROUP       etherCollisionTableGroup
                DESCRIPTION "This group is optional. It is appropriate
                             for all systems which have the necessary
                             metering. Implementation in such systems is
                             highly recommended."
```

```
        ::= { etherCompliances 2 }

    dot3Compliance MODULE-COMPLIANCE
        STATUS      deprecated
        DESCRIPTION "******** THIS COMPLIANCE IS DEPRECATED ********

                    The compliance statement for managed network
                    entities which have ethernet-like network
```



```
                    interfaces."

        MODULE  -- this module
            MANDATORY-GROUPS { etherStatsBaseGroup }

            GROUP       etherDuplexGroup
            DESCRIPTION "This group is mandatory for all
                        ethernet-like network interfaces which are
                        capable of operating in full-duplex mode.
                        It is highly recommended for all
                        ethernet-like network interfaces."

            GROUP       etherStatsLowSpeedGroup
            DESCRIPTION "This group is mandatory for all
                        ethernet-like network interfaces which are
                        capable of operating at 10 Mb/s or slower in
                        half-duplex mode."

            GROUP       etherStatsHighSpeedGroup
            DESCRIPTION "This group is mandatory for all
                        ethernet-like network interfaces which are
                        capable of operating at 100 Mb/s or faster."

            GROUP       etherControlGroup
            DESCRIPTION "This group is mandatory for all
                        ethernet-like network interfaces that
                        support the MAC Control sublayer."

            GROUP       etherControlPauseGroup
            DESCRIPTION "This group is mandatory for all
                        ethernet-like network interfaces that
                        support the MAC Control PAUSE function."
```

```
            GROUP       etherCollisionTableGroup
            DESCRIPTION "This group is optional. It is appropriate
                        for all ethernet-like network interfaces
                        which are capable of operating in
                        half-duplex mode and have the necessary
                        metering. Implementation in systems with
                        such interfaces is highly recommended."
        ::= { etherCompliances 3 }

    dot3Compliance2 MODULE-COMPLIANCE
        STATUS      current
        DESCRIPTION "The compliance statement for managed network
                    entities which have ethernet-like network
                    interfaces."
```



```
        MODULE  -- this module
            MANDATORY-GROUPS { etherStatsBaseGroup2 }

            GROUP       etherDuplexGroup
            DESCRIPTION "This group is mandatory for all
                        ethernet-like network interfaces which are
                        capable of operating in full-duplex mode.
                        It is highly recommended for all
                        ethernet-like network interfaces."

            GROUP       etherRateControlGroup
            DESCRIPTION "This group is mandatory for all
                        ethernet-like network interfaces which are
                        capable of operating at speeds faster than
                        1000 Mb/s. It is highly recommended for all
                        ethernet-like network interfaces."

            GROUP       etherStatsLowSpeedGroup
            DESCRIPTION "This group is mandatory for all
                        ethernet-like network interfaces which are
                        capable of operating at 10 Mb/s or slower in
                        half-duplex mode."

            GROUP       etherStatsHighSpeedGroup
            DESCRIPTION "This group is mandatory for all
                        ethernet-like network interfaces which are
```

```
                    capable of operating at 100 Mb/s or faster."

                GROUP       etherStatsHalfDuplexGroup
                DESCRIPTION "This group is mandatory for all
                            ethernet-like network interfaces which are
                            capable of operating in half-duplex mode."

                GROUP       etherHCStatsGroup
                DESCRIPTION "This group is mandatory for all
                            ethernet-like network interfaces which are
                            capable of operating at 10 Gb/s or faster.
                            It is recommended for all ethernet-like
                            network interfaces which are capable of
                            operating at 1000 Mb/s or faster."

                GROUP       etherControlGroup
                DESCRIPTION "This group is mandatory for all
                            ethernet-like network interfaces that
                            support the MAC Control sublayer."

                GROUP       etherHCControlGroup
                DESCRIPTION "This group is mandatory for all
```



```
                            ethernet-like network interfaces that
                            support the MAC Control sublayer and are
                            capable of operating at 10 Gb/s or faster."

                GROUP       etherControlPauseGroup
                DESCRIPTION "This group is mandatory for all
                            ethernet-like network interfaces that
                            support the MAC Control PAUSE function."

                GROUP       etherHCControlPauseGroup
                DESCRIPTION "This group is mandatory for all
                            ethernet-like network interfaces that
                            support the MAC Control PAUSE function and
                            are capable of operating at 10 Gb/s or
                            faster."

                GROUP       etherCollisionTableGroup
                DESCRIPTION "This group is optional. It is appropriate
                            for all ethernet-like network interfaces
```

```
                        which are capable of operating in
                        half-duplex mode and have the necessary
                        metering. Implementation in systems with
                        such interfaces is highly recommended."
        ::= { etherCompliances 4 }

    -- units of conformance

    etherStatsGroup OBJECT-GROUP
        OBJECTS     { dot3StatsIndex,
                      dot3StatsAlignmentErrors,
                      dot3StatsFCSErrors,
                      dot3StatsSingleCollisionFrames,
                      dot3StatsMultipleCollisionFrames,
                      dot3StatsSQETestErrors,
                      dot3StatsDeferredTransmissions,
                      dot3StatsLateCollisions,
                      dot3StatsExcessiveCollisions,
                      dot3StatsInternalMacTransmitErrors,
                      dot3StatsCarrierSenseErrors,
                      dot3StatsFrameTooLongs,
                      dot3StatsInternalMacReceiveErrors,
                      dot3StatsEtherChipSet
                    }
        STATUS      deprecated
        DESCRIPTION "********* THIS GROUP IS DEPRECATED **********

                    A collection of objects providing information
                    applicable to all ethernet-like network
```



```
                    interfaces.

                    This object group has been deprecated and
                    replaced by etherStatsBaseGroup and
                    etherStatsLowSpeedGroup."
        ::= { etherGroups 1 }

    etherCollisionTableGroup OBJECT-GROUP
        OBJECTS     { dot3CollFrequencies
                    }
        STATUS      current
        DESCRIPTION "A collection of objects providing a histogram
```

```
                    of packets successfully transmitted after
                    experiencing exactly N collisions."
        ::= { etherGroups 2 }

    etherStats100MbsGroup OBJECT-GROUP
        OBJECTS     { dot3StatsIndex,
                      dot3StatsAlignmentErrors,
                      dot3StatsFCSErrors,
                      dot3StatsSingleCollisionFrames,
                      dot3StatsMultipleCollisionFrames,
                      dot3StatsDeferredTransmissions,
                      dot3StatsLateCollisions,
                      dot3StatsExcessiveCollisions,
                      dot3StatsInternalMacTransmitErrors,
                      dot3StatsCarrierSenseErrors,
                      dot3StatsFrameTooLongs,
                      dot3StatsInternalMacReceiveErrors,
                      dot3StatsEtherChipSet,
                      dot3StatsSymbolErrors
                    }
        STATUS      deprecated
        DESCRIPTION "********* THIS GROUP IS DEPRECATED **********

                    A collection of objects providing information
                    applicable to 100 Mb/sec ethernet-like network
                    interfaces.

                    This object group has been deprecated and
                    replaced by etherStatsBaseGroup and
                    etherStatsHighSpeedGroup."
        ::= { etherGroups 3 }

    etherStatsBaseGroup OBJECT-GROUP
        OBJECTS     { dot3StatsIndex,
                      dot3StatsAlignmentErrors,
                      dot3StatsFCSErrors,
```



```
                      dot3StatsSingleCollisionFrames,
                      dot3StatsMultipleCollisionFrames,
                      dot3StatsDeferredTransmissions,
                      dot3StatsLateCollisions,
                      dot3StatsExcessiveCollisions,
```

```
                    dot3StatsInternalMacTransmitErrors,
                    dot3StatsCarrierSenseErrors,
                    dot3StatsFrameTooLongs,
                    dot3StatsInternalMacReceiveErrors
                  }
        STATUS      deprecated
        DESCRIPTION "********* THIS GROUP IS DEPRECATED **********

                    A collection of objects providing information
                    applicable to all ethernet-like network
                    interfaces."
        ::= { etherGroups 4 }

    etherStatsLowSpeedGroup OBJECT-GROUP
        OBJECTS     { dot3StatsSQETestErrors }
        STATUS      current
        DESCRIPTION "A collection of objects providing information
                    applicable to ethernet-like network interfaces
                    capable of operating at 10 Mb/s or slower in
                    half-duplex mode."
        ::= { etherGroups 5 }

    etherStatsHighSpeedGroup OBJECT-GROUP
        OBJECTS     { dot3StatsSymbolErrors }
        STATUS      current
        DESCRIPTION "A collection of objects providing information
                    applicable to ethernet-like network interfaces
                    capable of operating at 100 Mb/s or faster."
        ::= { etherGroups 6 }

    etherDuplexGroup OBJECT-GROUP
        OBJECTS     { dot3StatsDuplexStatus }
        STATUS      current
        DESCRIPTION "A collection of objects providing information
                    about the duplex mode of an ethernet-like
                    network interface."
        ::= { etherGroups 7 }

    etherControlGroup OBJECT-GROUP
        OBJECTS     { dot3ControlFunctionsSupported,
                      dot3ControlInUnknownOpcodes
                    }
        STATUS      current
```

```
    DESCRIPTION "A collection of objects providing information
                about the MAC Control sublayer on ethernet-like
                network interfaces."
    ::= { etherGroups 8 }

etherControlPauseGroup OBJECT-GROUP
    OBJECTS     { dot3PauseAdminMode,
                  dot3PauseOperMode,
                  dot3InPauseFrames,
                  dot3OutPauseFrames
                }
    STATUS      current
    DESCRIPTION "A collection of objects providing information
                about and control of the MAC Control PAUSE
                function on ethernet-like network interfaces."
    ::= { etherGroups 9 }

etherStatsBaseGroup2 OBJECT-GROUP
    OBJECTS     { dot3StatsIndex,
                  dot3StatsAlignmentErrors,
                  dot3StatsFCSErrors,
                  dot3StatsInternalMacTransmitErrors,
                  dot3StatsFrameTooLongs,
                  dot3StatsInternalMacReceiveErrors
                }
    STATUS      current
    DESCRIPTION "A collection of objects providing information
                applicable to all ethernet-like network
                interfaces."
    ::= { etherGroups 10 }

etherStatsHalfDuplexGroup OBJECT-GROUP
    OBJECTS     { dot3StatsSingleCollisionFrames,
                  dot3StatsMultipleCollisionFrames,
                  dot3StatsDeferredTransmissions,
                  dot3StatsLateCollisions,
                  dot3StatsExcessiveCollisions,
                  dot3StatsCarrierSenseErrors
                }
    STATUS      current
    DESCRIPTION "A collection of objects providing information
                applicable only to half-duplex ethernet-like
                network interfaces."
    ::= { etherGroups 11 }

etherHCStatsGroup OBJECT-GROUP
    OBJECTS     { dot3HCStatsAlignmentErrors,
                  dot3HCStatsFCSErrors,
```

```
                        dot3HCStatsInternalMacTransmitErrors,
                        dot3HCStatsFrameTooLongs,
                        dot3HCStatsInternalMacReceiveErrors,
                        dot3HCStatsSymbolErrors
                      }
        STATUS      current
        DESCRIPTION "A collection of objects providing high-capacity
                    statistics applicable to higher-speed
                    ethernet-like network interfaces."
        ::= { etherGroups 12 }

    etherHCControlGroup OBJECT-GROUP
        OBJECTS     { dot3HCControlInUnknownOpcodes }
        STATUS      current
        DESCRIPTION "A collection of objects providing high-capacity
                    statistics for the MAC Control sublayer on
                    higher-speed ethernet-like network interfaces."
        ::= { etherGroups 13 }

    etherHCControlPauseGroup OBJECT-GROUP
        OBJECTS     { dot3HCInPauseFrames,
                      dot3HCOutPauseFrames
                    }
        STATUS      current
        DESCRIPTION "A collection of objects providing high-capacity
                    statistics for the MAC Control PAUSE function on
                    higher-speed ethernet-like network interfaces."
        ::= { etherGroups 14 }

    etherRateControlGroup OBJECT-GROUP
        OBJECTS     { dot3StatsRateControlAbility,
                      dot3StatsRateControlStatus
                    }
        STATUS      current
        DESCRIPTION "A collection of objects providing information
                    about the Rate Control function on ethernet-like
                    interfaces."
        ::= { etherGroups 15 }

END
```

5. Intellectual Property

The IETF takes no position regarding the validity or scope of any intellectual property or other rights that might be claimed to pertain to the implementation or use of the technology described in this document or the extent to which any license under such rights

might or might not be available; neither does it represent that it has made any effort to identify any such rights. Information on the IETF's procedures with respect to rights in standards-track and standards-related documentation can be found in BCP-11. Copies of claims of rights made available for publication and any assurances of licenses to be made available, or the result of an attempt made to obtain a general license or permission for the use of such proprietary rights by implementors or users of this specification can be obtained from the IETF Secretariat.

The IETF invites any interested party to bring to its attention any copyrights, patents or patent applications, or other proprietary rights which may cover technology that may be required to practice this standard. Please address the information to the IETF Executive Director.

6. Acknowledgements

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Lynn Kubinec
Steve McRobert
Dan Romascanu
Andrew Smith
Geoff Thompson

This document is based on the Proposed Standard Ethernet MIB, RFC 2665 [26], edited by John Flick of Hewlett-Packard and Jeffrey Johnson of RedBack Networks and produced by the Ethernet Interfaces and Hub MIB Working Group. It extends that document by providing support for 10 Gb/s Ethernet interfaces as defined in [18].

RFC 2665, in turn, is based on the Proposed Standard Ethernet MIB, RFC 2358 [25], edited by John Flick of Hewlett-Packard and Jeffrey Johnson of RedBack Networks and produced by the 802.3 Hub MIB Working Group. It extends that document by providing support for full-duplex Ethernet interfaces and 1000 Mb/sec Ethernet interfaces as outlined in [17].

RFC 2358, in turn, is almost completely based on both the Standard Ethernet MIB, RFC 1643 [23], and the Proposed Standard Ethernet MIB using the SNMPv2 SMI, RFC 1650 [24], both of which were edited by Frank Kastenholz of FTP Software and produced by the Interfaces MIB Working Group. RFC 2358 extends those documents by providing support for 100 Mb/sec ethernet interfaces.

RFC 1643 and RFC 1650, in turn, are based on the Draft Standard Ethernet MIB, RFC 1398 [22], also edited by Frank Kastenholz and produced by the Ethernet MIB Working Group.

RFC 1398, in turn, is based on the Proposed Standard Ethernet MIB, RFC 1284 [20], which was edited by John Cook of Chipcom and produced by the Transmission MIB Working Group. The Ethernet MIB Working Group gathered implementation experience of the variables specified in RFC 1284, documented that experience in RFC 1369 [21], and used that information to develop this revised MIB.

RFC 1284, in turn, is based on a document written by Frank Kastenholz, then of Interlan, entitled IEEE 802.3 Layer Management Draft M compatible MIB for TCP/IP Networks [19]. This document was 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 RFC 1212 [3] 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.

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8. Security Considerations

There are two management objects defined in this MIB that have a MAX-ACCESS clause of read-write. 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.

There are a number of managed objects in this MIB that may be considered to contain sensitive information. In particular, the dot3StatsEtherChipSet object may be considered sensitive in many environments, since it would allow an intruder to obtain information about which vendor's equipment is in use on the network. Note that this object has been deprecated. However, some implementors may still choose to implement it for backwards compatability.

Therefore, it may be important in some environments to control read access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP. Not all versions of SNMP provide features for such a secure environment.

SNMPv1 by itself is such an insecure environment. 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 (read) the objects in this MIB.

It is recommended that the implementors consider the security features as provided by the SNMPv3 framework. Specifically, the use of the User-based Security Model RFC 2574 [12] and the View-based Access Control Model RFC 2575 [15] is recommended.

It is then a customer/user responsibility to ensure that the SNMP entity giving access to an instance of this MIB, is properly configured to give access to those objects only to those principals (users) that have legitimate rights to access them.

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A. Change Log

A.1. Changes since RFC 2665

This section enumerates changes made to RFC 2665 to produce this document.

(1) Updated references to the IEEE 802.3 standard to refer to the 2000 edition.

(2) Added reference to 802.3ae.

(3) Updated WG e-mail address.

(4) The following DESCRIPTION clauses have been updated to reflect behaviour on 10 Gb/s interfaces: dot3StatsAlignmentErrors and dot3StatsSymbolErrors.

(5) The following objects have been added for management of the Rate Control function in WAN applications of ethernet: dot3StatsRateControlAbility and dot3StatsRateControlStatus.

(6) The following 64-bit counters have been added to support operation on high-speed ethernet interfaces: dot3HCControlInUnknownOpcodes, dot3HCInPauseFrames, dot3HCOutPauseFrames, dot3HCStatsAlignmentErrors, dot3HCStatsFCSErrors, dot3HCStatsFrameTooLongs, dot3HCStatsInternalMacTransmitErrors, dot3HCStatsInternalMacReceiveErrors, dot3StatsSymbolErrors

(7) Object groups and compliances have been added to contain the new objects.

(8) The MODULE-IDENTITY clause has been updated to reflect the changes in the MIB module.

(9) Use of the various ifType values for ethernet has been clarified to emphasize that all ethernet-like interfaces must use the ethernetCsmacd ifType.

(10) Several clarifications were made to the section on the mapping of the Interface MIB objects to ethernet.

(11) MIB boilerplate in section 2 has been updated to the latest approved text.

A.2. Changes between RFC 2358 and RFC 2665

This section enumerates changes made to RFC 2358 to produce RFC 2665.

(1) Section 2 has been replaced with the current SNMP Management Framework boilerplate.

(2) The ifMtu mapping has been clarified.

(3) The relationship between the IEEE 802.3 octet counters and the IF-MIB octet counters has been clarified.

(4) REFERENCE clauses have been updated to reflect the actual IEEE 802.3 managed object that each MIB object is based on.

(5) The following object DESCRIPTION clauses have been updated to reflect that they do not increment in full-duplex mode: dot3StatsSingleCollisionFrames, dot3StatsMultipleCollisionFrames, dot3StatsSQETestErrors, dot3StatsDeferredTransmissions, dot3StatsLateCollisions, dot3StatsExcessiveCollisions, dot3StatsCarrierSenseErrors, dot3CollFrequencies.

(6) The following object DESCRIPTION clauses have been updated to reflect behaviour on full-duplex and 1000 Mb/s interfaces: dot3StatsAlignmentErrors, dot3StatsFCSErrors, dot3StatsSQETestErrors, dot3StatsLateCollisions, dot3StatsSymbolErrors.

(7) Two new tables, dot3ControlTable and dot3PauseTable, have been added.

(8) A new object, dot3StatsDuplexStatus, has been added.

(9) The object groups and compliances have been restructured.

(10) The dot3StatsEtherChipSet object has been deprecated.

(11) The dot3ChipSets have been moved to a separate document.

A.3. Changes between RFC 1650 and RFC 2358

This section enumerates changes made to RFC 1650 to produce RFC 2358.

(1) The MODULE-IDENTITY has been updated to reflect the changes in the MIB.

(2) A new object, dot3StatsSymbolErrors, has been added.

(3) The definition of the object dot3StatsIndex has been converted to use the SMIv2 OBJECT-TYPE macro.

(4) A new conformance group, etherStats100MbsGroup, has been added.

(5) A new compliance statement, ether100MbsCompliance, has been added.

(6) The Acknowledgements were extended to provide a more complete history of the origin of this document.

(7) The discussion of ifType has been expanded.

(8) A section on mapping of Interfaces MIB objects has been added.

(9) A section defining the relationship of this MIB to the MAU MIB has been added.

(10) A section on the mapping of IEEE 802.3 managed objects to this MIB and the Interfaces MIB has been added.

(11) Converted the dot3Tests, dot3Errors, and dot3ChipSets OIDs to use the OBJECT-IDENTITY macro.

(12) Added to the list of registered dot3ChipSets.

(13) An intellectual property notice and copyright notice were added, as required by RFC 2026.

B. Full Copyright Statement