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Definitions of Managed Objects for the Ethernet-like Interface Types

Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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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. In particular, it defines objects for managing Ethernet-like interfaces. This memo obsoletes RFC 2665. It updates that specification by including management information useful for the management of 10 Gigabit per second (Gb/s) Ethernet interfaces.

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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, module, RFC 2665 [RFC2665].

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.

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 [RFC2119].

2. The Internet-Standard Management Framework

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

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIV2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

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 [RFC2863]. 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, 2002 Edition [IEEE802.3], amended by IEEE Std. 802.3ae-2002 [IEEE802.3ae], as originally interpreted by Frank Kastenholz, then of Interlan in [KASTEN]. Implementors of these MIB objects should note that IEEE Std. 802.3 [IEEE802.3] 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 [IEEE802.3] are represented by previously defined objects in MIB-2 [RFC1213] or in the Interfaces MIB [RFC2863], 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" [RFC1213] 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 IDENTIFIER ::= { transmission 7 }
```

3.2. Relation to the Interfaces MIB

The Interface MIB [RFC2863] 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 [RFC2863] 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 [RFC2863] 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 [IEEE802.3] describes the layering model and the use of the ifStackTable for representing aggregated links. Another example is the use of the 802.3 WAN Interface Sublayer. In this case, The 802.3 WIS MIB [RFC3637] describes the layering model and the use of the ifStackTable for representing the WAN sublayer.

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 [RFC3636]. Note that implementation of the 802.3 MAU MIB [RFC3636] is REQUIRED for all ethernet-like interfaces.

3.2.5. ifXxxOctets

The Interface MIB octet counters, ifInOctets, ifOutOctets, ifHCInOctets and ifHCOctets, 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 [IEEE802.3] (frameSize is defined in bits rather than octets, and is defined as $2 \times \text{addressSize} + \text{lengthOrTypeSize} + \text{dataSize} + \text{crcSize}$). 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 counted by `ifOutXcastPkts`, but are not 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:

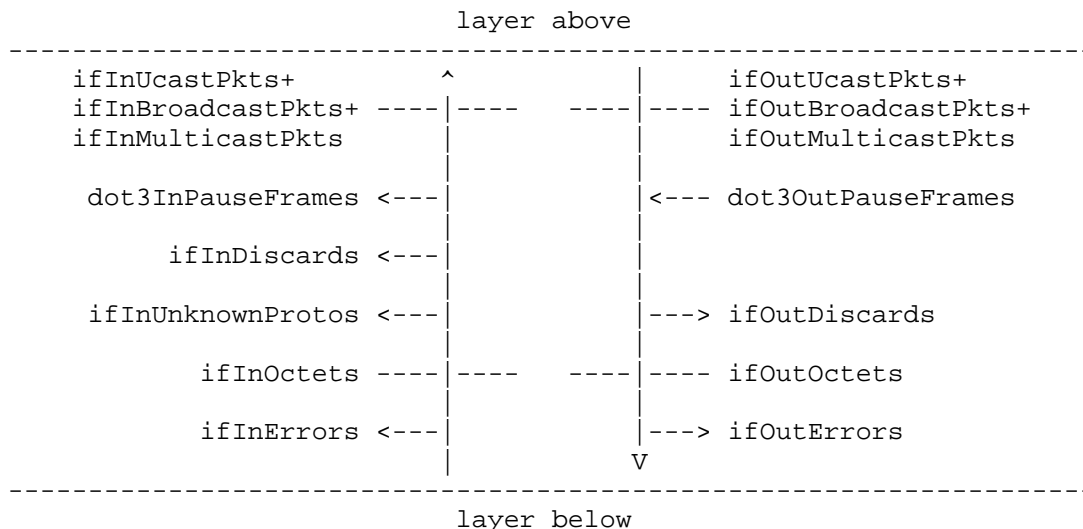
$$\text{aFramesTransmittedOK} = \text{ifOutUcastPkts} + \text{ifOutMulticastPkts} + \\ \text{ifOutBroadcastPkts} + \text{dot3OutPauseFrames} - \\ (\text{ifOutErrors} + \text{ifOutDiscards})$$

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:

$$\text{aFramesReceivedOK} = \text{ifInUcastPkts} + \text{ifInMulticastPkts} + \\ \text{ifInBroadcastPkts} + \text{dot3InPauseFrames} + \\ \text{ifInDiscards} + \text{ifInUnknownProtos}$$

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.

To better understand the issues surrounding the mapping of the IF-MIB packet and octet counters to an Ethernet interface, it is useful to refer to a Case Diagram [CASE] for the IF-MIB counters, with modifications to show the proper interpretation for the Ethernet interface layer.



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 implementations of 10 Gb/s, and 9,294 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 [RFC2863].

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 [RFC3636].

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 [RFC2863]. |
| 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 [RFC2863]. |
| 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 [RFC2863]. 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 [RFC2863]. |
| ifInErrors | The sum for this interface of dot3StatsAlignmentErrors, dot3StatsFCSErrors, dot3StatsFrameTooLongs, and dot3StatsInternalMacReceiveErrors. |
| ifInUnknownProtos | Refer to [RFC2863]. |
| 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 [RFC2863]. 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 [RFC2863]. |
| 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 [RFC2863]. 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 [RFC2863]. 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. |
| ifOutMulticastPkts | Refer to [RFC2863]. 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. |
| ifOutBroadcastPkts | Refer to [RFC2863]. 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 ifHCOctets | 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 ifHCOctetsUcastPkts ifHCOctetsMulticastPkts ifHCOctetsBroadcastPkts | 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 [RFC2863]. Default is 'enabled' |
| ifHighSpeed | Refer to section 3.2.8. |
| ifPromiscuousMode | Refer to [RFC2863]. |
| ifConnectorPresent | This will normally be 'true'. It will be 'false' in the case where this interface uses the WAN Interface Sublayer. See [RFC3637] for details. |
| ifAlias | Refer to [RFC2863]. |

ifCounterDiscontinuityTime Refer to [RFC2863]. 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 Refer to section 3.2.1.
ifStackLowerLayer
ifStackStatus

ifRcvAddressAddress Refer to section 3.2.3.
ifRcvAddressStatus
ifRcvAddressType

3.3. Relation to the 802.3 MAU MIB

Support for the mauModIfCompl3 compliance statement of the MAU-MIB [RFC3636] 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 previous versions of this document have now been moved to a separate document [RFC2666].

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 compatibility may continue to use the values defined in [RFC2666]. For chipsets not listed in [RFC2666], 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
  .aSQUETestErrors        dot3StatsSQUETestErrors
  .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 [RFC1369] 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 - ifAdminStatus 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,  
    Integer32, 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 "200309190000Z" -- September 19, 2003  
    ORGANIZATION "IETF Ethernet Interfaces and Hub MIB  
        Working Group"
```

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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, 2002 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
amended by IEEE Std 802.3ae-2002:
'Amendment: Media Access Control (MAC)
Parameters, Physical Layer, and Management
Parameters for 10 Gb/s Operation', August,
2002.

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

Copyright (C) The Internet Society (2003). This
version of this MIB module is part of RFC 3635;
see the RFC itself for full legal notices."

REVISION "200309190000Z" -- September 19, 2003
DESCRIPTION "Updated to include support for 10 Gb/sec
interfaces. This resulted in the following
revisions:

- Updated dot3StatsAlignmentErrors and
dot3StatsSymbolErrors DESCRIPTIONs to
reflect behaviour at 10 Gb/s
- Added dot3StatsRateControlAbility and
dot3RateControlStatus for management
of the Rate Control function in 10 Gb/s
WAN applications
- Added 64-bit versions of all counters
that are used on high-speed ethernet
interfaces
- Added object groups to contain the new
objects
- Deprecated etherStatsBaseGroup and
split into etherStatsBaseGroup2 and
etherStatsHalfDuplexGroup, so that
interfaces which can only operate at
full-duplex do not need to implement
half-duplex-only statistics
- Deprecated dot3Compliance and replaced
it with dot3Compliance2, which includes
the compliance information for the new
object groups

In addition, the dot3Tests and dot3Errors object identities have been deprecated, since there is no longer a standard method for using them.

This version published as RFC 3635."

REVISION "199908240400Z" -- August 24, 1999
 DESCRIPTION "Updated to include support for 1000 Mb/sec
 interfaces and full-duplex interfaces.
 This version published as RFC 2665."

REVISION "199806032150Z" -- June 3, 1998
 DESCRIPTION "Updated to include support for 100 Mb/sec
 interfaces.
 This version published as RFC 2358."

REVISION "199402030400Z" -- 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 -- read-only since originally an
 -- SMIV1 index

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 80 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.

This object has been deprecated. Implementation feedback indicates that it is of limited use for debugging network problems in the field, and the administrative overhead involved in maintaining a registry of chipset OIDs is not justified."

```
::= { 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      Integer32,
    dot3CollFrequencies Counter32
  }

-- { dot3CollEntry 1 } is no longer in use

dot3CollCount OBJECT-TYPE
  SYNTAX      Integer32 (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,
    dot3HCCControlInUnknownOpcodes    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 deprecated
```

```
DESCRIPTION "***** THIS IDENTITY IS DEPRECATED *****
```

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).

This object identity has been deprecated, since the ifTestTable in the IF-MIB was deprecated, and there is no longer a standard mechanism for initiating an interface test. This left no standard way of using this object identity."

```
::= { dot3Tests 1 }
```

```
-- Loopback Test
```

```
dot3TestLoopBack OBJECT-IDENTITY
```

```
STATUS deprecated
```

```
DESCRIPTION "***** THIS IDENTITY IS DEPRECATED *****
```

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 provide more information as values for an appropriate test result code object.

This object identity has been deprecated, since the ifTestTable in the IF-MIB was deprecated, and there is no longer a standard mechanism for initiating an interface test. This left no standard way of using this object identity."

```
::= { dot3Tests 2 }
```

```
dot3ErrorInitError OBJECT-IDENTITY
```

```
STATUS deprecated
```

```
DESCRIPTION "***** THIS IDENTITY IS DEPRECATED *****
```

Couldn't initialize MAC chip for test.

This object identity has been deprecated, since the ifTestTable in the IF-MIB was deprecated, and there is no longer a standard mechanism for initiating an interface test. This left no standard way of using this object identity."

```
::= { dot3Errors 1 }
```

```
dot3ErrorLoopbackError OBJECT-IDENTITY
```

```
STATUS deprecated
```

```
DESCRIPTION "***** THIS IDENTITY IS DEPRECATED *****
```

Expected data not received (or not received correctly) in loopback test.

This object identity has been deprecated, since the ifTestTable in the IF-MIB was deprecated, and there is no longer a standard mechanism for initiating an interface test. This left no standard way of using this object identity."

```
::= { dot3Errors 2 }
```

```
-- { dot3 8 }, the dot3ChipSets tree, is defined in [RFC2666]
```

```
-- 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.

This compliance is deprecated and replaced by dot3Compliance2."

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.

                  Note that compliance with this MIB module
                  requires compliance with the ifCompliance3
                  MODULE-COMPLIANCE statement of the IF-MIB
                  (RFC2863).  In addition, compliance with this
                  MIB module requires compliance with the
                  mauModIfCompl3 MODULE-COMPLIANCE statement of
                  the MAU-MIB (RFC3636)."
```

```
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.

    This object group has been deprecated and
    replaced by etherStatsBaseGroup2 and
    etherStatsHalfDuplexGroup, to separate
    objects which must be implemented by all
    ethernet-like network interfaces from
    objects that need only be implemented on
    ethernet-like network interfaces that are
    capable of half-duplex operation."
    ::= { 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 Statement

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

This document was produced by the IETF Ethernet Interfaces and Hub MIB Working Group, whose efforts were greatly advanced by the contributions of the following people:

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This document is based on the Proposed Standard Ethernet MIB, RFC 2665 [RFC2665], 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 [IEEE802.3ae].

RFC 2665, in turn, is based on the Proposed Standard Ethernet MIB, RFC 2358 [RFC2358], 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 [IEEE802.3].

RFC 2358, in turn, is almost completely based on both the Standard Ethernet MIB, RFC 1643 [RFC1643], and the Proposed Standard Ethernet MIB using the SNMPv2 SMI, RFC 1650 [RFC1650], 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 [RFC1398], 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 [RFC1284], 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 [RFC1369], 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 [KASTEN]. 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 [RFC1212] concise format. Anil Rijasinghani 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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9. Security Considerations

There is one management object defined in this MIB that has a MAX-ACCESS clause of read-write. That object, dot3PauseAdminMode, may be used to change the flow control configuration on a network interface, which may result in dropped packets, or sending flow control packets on links where the link partner will not understand them. Either action could be detrimental to network performance.

Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations.

Some of the readable objects in this MIB module (i.e., objects with a MAX-ACCESS other than not-accessible) may be considered sensitive or vulnerable in some network environments. 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 compatibility.

Most of the objects in this MIB module contain statistical information about particular network links. In some network environments, this information may be considered sensitive.

It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP.

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

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

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

10. IANA Considerations

This document does not define any new name space to be administered by IANA. However, section 3.2.4 does specify that some of the defined values in a current IANA-maintained name space are to be marked as deprecated or obsolete. In particular, the following enumerated values in the IANAifType TEXTUAL-CONVENTION in the IANAifType-MIB module have had an ASN.1 comment added by IANA stating that they have been deprecated:

- iso88032Csmacd(7)
- starLan(11)

In addition, the following enumerated values have had an ASN.1 comment added by IANA stating that they are obsolete:

- fastEther(62)
- fastEtherFX(69)
- gigabitEthernet(117)

In all of the above cases, the ASN.1 comment indicates that ethernetCsmacd(6) should be used instead of these values.

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 2002 edition.
- (2) Added reference to IEEE 802.3ae-2002.
- (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, dot3HCStatsSymbolErrors
- (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.

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