5. Ethernet YANG Module

5.1 YANG module structure

Two modules defined in this clause are focused on the configuration and monitoring of IEEE Std 802.3 Ethernet interfaces. The *ieee802-ethernet-interface* YANG module contains definitions of current attributes used widely in the industry in current products, while the *ieee802-ethernet-interface-half-duplex* YANG module contains definitions of half-duplex attributes. The *ieee802-ethernet-lldp* YANG module contains definitions for configuring LLDP for IEEE Std 802.3 compliant interfaces.

This standard does not have a normative requirement for data nodes of the base ietf-interfaces YANG module, but the following data nodes are supported: name, description, type, enabled, admin-status, oper-status, if-index, and phys-address.

5.2 Mapping of IEEE Std 802.3, Clause 30 managed objects

This subclause contains the mapping between YANG data nodes included in *ieee802-ethernet-interface* (see Table 5–1), ~~and~~ *ieee802-ethernet-interface-half-duplex* (see Table 5–4) and ieee802-ethernet-lldp (see Table 5-5) YANG modules, managed objects, and attributes defined in IEEE Std 802.3, Clause 30.

Table 5–1—Mapping between IEEE Std 802.3, Clause 30 managed objects and *ieee802-ethernet-interface* YANG data nodes

IEEE Std 802.3, Clause 30		Reference	Corresponding *ieee802-ethernet-interface* YANG data nodes		
Managed object(s)	**Attribute(s)**		**Container(s)**	**Data node(s)**	**R/W**
oAutoNegoti-aion	acAutoNegAdminControl	30.6.1.2.2	interfaces/interface/ethernet/	auto-negotiation/enable	R/W
	aAutoNegAutoConfig	30.6.1.1.4		negotiation-status	R
N/A	N/A			flow-control/pause/direction	R/W
oMACControl-FunctionEntity	aPAUSEMACCtrlFramesReceived	30.3.4.3		flow-control/pause/statistics/in-frames-pause	R
	aPAUSEMACCtrlFramesTransmitted	30.3.4.2		flow-control/pause/statistics/out-frames-pause	R
N/A	dot3HCOutPFCFrames				
N/A	N/A			flow-control/force-flow-control	R/W
N/A	N/A			speed	R/W
oMACEntity	aDuplexStatus	30.3.1.1.32		duplex	R/W
	aMaxFrameLength	30.3.1.1.37		max-frame-length	R
	aSlowProtocolFrameLimit	30.3.1.1.38		frame-limit-slow-protocol	R
oEXTENSION	aEXTENSIONMACCtrlStatus	30.3.8.3		mac-control-extension-control	R
N/A	N/A			capabilities/auto-negotiation	R

Table 5–1—Mapping between IEEE Std 802.3, Clause 30 managed objects and *ieee802-ethernet-interface* YANG data nodes *(continued)*

IEEE Std 802.3, Clause 30		Reference	Corresponding *ieee802-ethernet-interface* YANG data nodes		
Managed object(s)	**Attribute(s)**		**Container(s)**	**Data node(s)**	**R/W**
oMACEntity	aFramesReceivedOK	30.3.1.1.5	interfaces/interface/ethernet/statistics/frame	in-frames	R
	aMulticastFramesReceivedOK	30.3.1.1.21		in-multicast-frames	R
	aBroadcastFramesReceivedOK	30.3.1.1.22		in-broadcast-frames	R
	aFrameCheckSequenceErrors + aAlignmentErrors	30.4.3.1.6, 30.4.3.1.7		in-error-fcs-frames	R
oMACEntity	aFrameTooLongErrors	30.3.1.1.25		in-error-oversize-frames	R
	aFramesLostDueToIntMACRcvError	30.3.1.1.15		in-error-mac-internal-frames	R
	aFramesTransmittedOK	30.3.1.1.2		out-frames	R
	aMulticastFramesXmittedOK	30.3.1.1.18		out-multicast-frames	R
	aBroadcastFramesXmittedOK	30.3.1.1.19		out-broadcast-frames	R
	aFramesLostDueToIntMACXmitError	30.3.1.1.12		out-error-mac-internal-frames	R
oPHYEntity	aSymbolErrorDuringCarrier	30.3.2.1.5	interfaces/interface/ethernet/statistics/phy	in-error-symbol	R
	aReceiveLPITransitions	30.3.2.1.11	interfaces/interface/ethernet/statistics/phy/lpi	in-lpi-transitions	R
	aReceiveLPIMicroseconds	30.3.2.1.9		in-lpi-time	R
	aTransmitLPITransitions	30.3.2.1.10		out-lpi-transitions	R
	aTransmitLPIMicroseconds	30.3.2.1.8		out-lpi-time	R

Table 5–1—Mapping between IEEE Std 802.3, Clause 30 managed objects and *ieee802-ethernet-interface* YANG data nodes *(continued)*

IEEE Std 802.3, Clause 30		Reference	Corresponding *ieee802-ethernet-interface* YANG data nodes		
Managed object(s)	Attribute(s)		Container(s)	Data node(s)	R/W
oMACControlEntity	aUnsupportedOpcodesReceived	30.3.3.5	interfaces/interface/ethernet/statistics/mac-control	in-frames-mac-control-unknown	R
oEXTENSION	aEXTENSIONMACCtrlFramesReceived	30.3.8.2		in-frames-mac-control-extension	R
	aEXTENSIONMACCtrlFramesTransmitted	30.3.8.1		out-frames-mac-control-extension	R

Table 5–2—Mapping between IETF RFC 2819 managed objects and *ieee802-ethernet-interface* YANG data nodes

IETF RFC 2819 Attribute(s)	Corresponding *ieee802-ethernet-interface* YANG data nodes		
	Container(s)	Data node(s)	R/W
no direct object[a]	interfaces/interface/ethernet/statistics/frame	in-total-frames	R
etherStatsOctets		in-total-octets	R
etherStatsUndersizePkts + etherStatsFragments		in-error-undersize-frames	R

[a] Can be calculated as: aFramesReceivedOK + aFrameCheckSequenceErrors + aAlignmentErrors + aFrameTooLongErrors + aFramesLostDueToIntMACRcvError.

Table 5–3—Mapping between IETF RFC 3635 managed objects and *ieee802-ethernet-interface* YANG data nodes

ETHERLIKE MIB Attribute(s)	Corresponding *ieee802-ethernet-interface* YANG data nodes		
	Container(s)	Data node(s)	R/W
dot3HCInPFCFrames	interfaces/interface/ethernet/	flow-control/pfc{ethernet-pfc} / statistics/in-frames-pfc	R
dot3HCOutPFCFrames		flow-control/pfc{ethernet-pfc} / statistics/out-frames-pfc	R

Table 5–4—Mapping between IEEE Std 802.3, Clause 30 managed objects and *ieee802-ethernet-interface-half-duplex* YANG data nodes

IEEE Std 802.3, Clause 30		Reference	Corresponding *ieee802-ethernet-interface-half-duplex* YANG data nodes		
Managed object(s)	Attribute(s)		Container(s)	Data node(s)	R/W
oMACEntity	aRateControlAbility	30.3.1.1.33	interfaces/interface/ethernet	dynamic-rate-control	R/W
			interfaces/interface/ethernet/capability	dynamic-rate-control-supported	R
oPHYEntity	aSQETestErrors	30.3.2.1.4	interfaces/interface/ethernet/statistics/frame/ csmacd{csma-cd}	in-errors-sqe-test	R
oMACEntity	aSingleCollisionFrames	30.3.1.1.3		out-frames-collision-single	R
	aMultipleCollisionFrames	30.3.1.1.4		out-frames-collision-multiple	R
	aFramesWithDeferredXmissions	30.3.1.1.9		out-frames-deferred	R
	aFramesAbortedDueToXSColls	30.3.1.1.11		out-frames-collisions-excessive	R
	aLateCollisions	30.3.1.1.10		out-collisions-late	R
	aCarrierSenseErrors	30.3.1.1.13		out-errors-carrier-sense	R
	aCollisionFrames	30.3.1.1.30		collision-histogram/collision-count	R
				collision-histogram/collision-count-frames	R

Table 5–5—Mapping between IEEE Std 802.3, Clause 30 managed objects and *ieee802-ethernet-interface-half-duplex* YANG data nodes

IEEE Std 802.3, Clause 30		Reference	Corresponding *ieee802-ethernet-lldp* YANG data nodes		
Managed object(s)	**Attribute(s)**		**Container(s)**	**Data node(s)**	**R/W**
oLldpXdot3-Config	aLldpXdot3PortConfigTLVsTx-Enable	30.12.1.1.1	lldp/port	tlvs-port-config-enable	R/W
oLldpX-dot3LocSys-temsGroup	aLldpXdot3LocPortAutoNeg-Supported	30.12.2.1.1		auto-negotiation-supported	R
	aLldpXdot3LocPortAutoNegEn-abled	30.12.2.1.2		auto-negotiation-enabled	R
	aLldpXdot3LocPortAutoNe-gAdvertisedCap	30.12.2.1.3		auto-negotiation-cap	R
	aLldpXdot3LocPortOperMau-Type	30.12.2.1.4		operational-mau-type	R
	aLldpXdot3LocPowerPortClass	30.12.2.1.5		power-port-class	R
	aLldpXdot3LocPowerMDISup-ported	30.12.2.1.6		mdi-power-supported	R
	aLldpXdot3LocPowerMDIEn-abled	30.12.2.1.7		mdi-power-enabled	R
	aLldpXdot3LocPowerPairCon-trollable	30.12.2.1.8		power-pair-controlable	R

IEEE Std 802.3, Clause 30		**Reference**	**Corresponding *ieee802-ethernet-lldp* YANG data nodes**		
Managed object(s)	**Attribute(s)**		**Container(s)**	**Data node(s)**	**R/W**
	aLldpXdot3LocPowerPairs	30.12.2.1.9		power-pairs	R
	aLldpXdot3LocPowerClass	30.12.2.1.10		local-power-class	R
	aLldpXdot3LocLinkAggStatus	30.12.2.1.11		link-aggregation-status	R
	aLldpXdot3LocLinkAggPortId	30.12.2.1.12		aggregation-port-id	R
	aLldpXdot3LocMaxFrameSize	30.12.2.1.13		local-max-frame-size	R
	aLldpXdot3LocPowerType	30.12.2.1.14		power-type	R
	aLldpXdot3LocPowerSource	30.12.2.1.15		power-source	R
	aLldpXdot3LocPowerPriority	30.12.2.1.16		local-power-priority	R/W
	aLldpXdot3LocPDRequested-PowerValue	30.12.2.1.17		pd-requested-power-value	R
			Continue when YANG has been updated from supporting 802.3-2015 to 802.3-2022		
oLldpX-dot3RemSys-temsGroup	aLldpXdot3RemPortAutoNeg-Supported	30.12.3.1.1	lldp/port/remote-systems-data	auto-negotiation-supported	R
	aLldpXdot3RemPortAutoNe-gEnabled	30.12.3.1.2		auto-negotiation-enabled	R
	aLldpXdot3RemPortAutoNe-gAdvertisedCap	30.12.3.1.3		auto-negotiation-cap	R
	aLldpXdot3RemPortOperMau-Type	30.12.3.1.4		operational-mau-type	R
	aLldpXdot3RemPowerPortClass	30.12.3.1.5		power-port-class	R
	aLldpXdot3RemPowerMDISup-ported	30.12.3.1.6		mdi-power-supported	R

IEEE Std 802.3, Clause 30		Reference	Corresponding *ieee802-ethernet-lldp* YANG data nodes		
Managed object(s)	**Attribute(s)**		**Container(s)**	**Data node(s)**	**R/W**
	aLldpXdot3RemPowerMDIEnabled	30.12.3.1.7		mdi-power-enabled	R
	aLldpXdot3RemPowerPairControllable	30.12.3.1.8		power-pair-controlable	R
	aLldpXdot3RemPowerPairs	30.12.3.1.9		power-pairs	R
	aLldpXdot3RemPowerClass	30.12.3.1.10		power-class	R
	aLldpXdot3RemLinkAggStatus	30.12.3.1.11		link-aggregation-status	R
	aLldpXdot3RemLinkAggPortId	30.12.3.1.12		aggregation-port-id	R
	aLldpXdot3RemMaxFrameSize	30.12.3.1.13		local-max-frame-size	R
	aLldpXdot3RemPowerType	30.12.3.1.14		power-type	R
	aLldpXdot3RemPowerSource	30.12.3.1.15		power-source	R
	aLldpXdot3RemPowerPriority	30.12.3.1.16		power-priority	RW
	aLldpXdot3RemPDRequestedPowerValue	30.12.3.1.17		pd-requested-power-value	R
			Continue when YANG has been updated from supporting 802.3-2015 to 802.3-2022		

5.3 YANG module definition[j]

The YANG module tree hierarchy uses terms defined in IETF RFC 8407.

5.3.1 Tree hierarchy

```
module: ieee802-ethernet-interface
  augment /if:interfaces/if:interface:
    +--rw ethernet
       +--rw auto-negotiation!
       |  +--rw enable?               boolean
       |  +--ro negotiation-status?   enumeration
       +--rw duplex?                          duplex-type
       +--rw speed?                           eth-if-speed-type
       +--rw flow-control
       |  +--rw pause {ethernet-pause}?
       |  |  +--rw direction?    pause-fc-direction-type
       |  |  +--ro statistics
       |  |     +--ro in-frames-pause?    yang:counter64
       |  |     +--ro out-frames-pause?   yang:counter64
       |  +--rw pfc {ethernet-pfc}?
       |  |  +--rw enable?       boolean
       |  |  +--ro statistics
       |  |     +--ro in-frames-pfc?    yang:counter64
       |  |     +--ro out-frames-pfc?   yang:counter64
       |  +--rw force-flow-control?   boolean
       +--ro max-frame-length?                uint16
       +--ro mac-control-extension-control?   boolean
       +--ro frame-limit-slow-protocol?       uint64
       +--ro capabilities
       |  +--ro auto-negotiation?   boolean
       +--ro statistics
          +--ro frame
          |  +--ro in-total-frames?                yang:counter64
          |  +--ro in-total-octets?                yang:counter64
          |  +--ro in-frames?                      yang:counter64
          |  +--ro in-multicast-frames?            yang:counter64
          |  +--ro in-broadcast-frames?            yang:counter64
          |  +--ro in-error-fcs-frames?            yang:counter64
          |  +--ro in-error-undersize-frames?      yang:counter64
          |  +--ro in-error-oversize-frames?       yang:counter64
          |  +--ro in-error-mac-internal-frames?   yang:counter64
          |  +--ro out-frames?                     yang:counter64
          |  +--ro out-multicast-frames?           yang:counter64
          |  +--ro out-broadcast-frames?           yang:counter64
          |  +--ro out-error-mac-internal-frames?  yang:counter64
          +--ro phy
          |  +--ro in-error-symbol?   yang:counter64
          |  +--ro lpi
          |     +--ro in-lpi-transitions?    yang:counter64
          |     +--ro in-lpi-time?           decimal64
```

[j]Copyright release for YANG modules: Users of this standard may freely reproduce the YANG module contained in this subclause so that it can be used for its intended purpose.

```
           |     +--ro out-lpi-transitions?   yang:counter64
           |     +--ro out-lpi-time?          decimal64
           +--ro mac-control
              +--ro in-frames-mac-control-unknown?      yang:counter64
              +--ro in-frames-mac-control-extension?    yang:counter64
              +--ro out-frames-mac-control-extension?   yang:counter64


module: ieee802-ethernet-interface-half-duplex
  augment /if:interfaces/if:interface/ieee802-eth-if:ethernet:
     +--rw dynamic-rate-control?    dynamic-rate-control-type {dynamic-
rate-control}?
   augment /if:interfaces/if:interface/ieee802-eth-if:ethernet/ieee802-
eth-if:capabilities:
     +--ro dynamic-rate-control-supported?   boolean {dynamic-rate-con-
trol}?
   augment /if:interfaces/if:interface/ieee802-eth-if:ethernet/ieee802-
eth-if:statistics/ieee802-eth-if:frame:
    +--ro csma-cd {csma-cd}?
       +--ro in-errors-sqe-test?               yang:counter64
       +--ro out-frames-collision-single?      yang:counter64
       +--ro out-frames-collision-multiple?    yang:counter64
       +--ro out-frames-deferred?              yang:counter64
       +--ro out-frames-collisions-excessive?  yang:counter64
       +--ro out-collisions-late?              yang:counter64
       +--ro out-errors-carrier-sense?         yang:counter64
       +--ro collision-histogram* [collision-count]
          +--ro collision-count          yang:counter64
          +--ro collision-count-frames?  yang:counter64
```

5.3.2 YANG module

In the following YANG module definitions, should any discrepancy between the text of the description for individual YANG nodes and the corresponding definition in 5.2 through 5.3 of this clause occur, the definitions and mappings in 5.3 shall take precedence.

An ASCII text version of the Ethernet YANG module can be found at the following URL:[k] https://github.com/YangModels/yang/tree/master/standard/ieee/published/802.3.

5.3.2.1 Ethernet interface module

```
module ieee802-ethernet-interface {
  yang-version 1.1;

  namespace
    "urn:ieee:std:802.3:yang:ieee802-ethernet-interface";

  prefix ieee802-eth-if;

  revision 2019-06-21 {
    description "Initial revision.";
  }

  import ietf-yang-types {
    prefix yang;
    reference "IETF RFC 6991";
  }

  import ietf-interfaces {
    prefix if;
    reference "IETF RFC 8343";
  }

  import iana-if-type {
    prefix ianaift;
    reference "http://www.iana.org/assignments/yang-parameters/
      iana-if-type@2018-07-03.yang";
  }

  organization
    "IEEE Std 802.3 Ethernet Working Group
     Web URL: http://www.ieee802.org/3/";

  contact
    "Web URL: http://www.ieee802.org/3/";

  description
    "This module contains YANG definitions for configuring IEEE Std
     802.3 Ethernet Interfaces.
     In this YANG module, 'Ethernet interface' can be interpreted
     as referring to 'IEEE Std 802.3 compliant Ethernet
```

[k]Copyright release for YANG modules: Users of this standard may freely reproduce the YANG module contained in this subclause so that it can be used for its intended purpose.

```
       interfaces'.";

  reference "IEEE Std 802.3-2018, unless dated explicitly";

  typedef eth-if-speed-type {
    type decimal64 {
      fraction-digits 3;
    }
    units "Gb/s";
    description
      "Used to represent the configured, negotiated, or actual speed
       of an Ethernet interface in Gigabits per second (Gb/s),
       accurate to 3 decimal places (i.e., accurate to 1 Mb/s).";
  }

  typedef duplex-type {
    type enumeration {
      enum full {
        description
          "Full duplex.";
      }
      enum half {
        description
          "Half duplex.";
      }
      enum unknown {
        description
          "Link is currently disconnected or initializing.";
      }
    }
    default full;
    description
      "Used to represent the configured, negotiated, or actual
       duplex mode of an Ethernet interface.";
    reference "IEEE Std 802.3, 30.3.1.1.32, aDuplexStatus";
  }

  typedef pause-fc-direction-type {
    type enumeration {
      enum "disabled" {
        description
          "Flow-control disabled in both ingress and egress
           directions, i.e., PAUSE frames are not transmitted and
           PAUSE frames received in the ingress direction are
           discarded without processing.";
      }
      enum "ingress-only" {
        description
          "PAUSE frame based flow control is enabled in the ingress
           direction only, i.e., PAUSE frames may be transmitted to
           reduce the ingress traffic flow, but PAUSE frames received
           in the ingress direction are discarded without reducing
           the egress traffic rate.";
      }
```

```
        enum "egress-only" {
          description
            "PAUSE frame based flow control is enabled in the egress
             direction only, i.e., PAUSE frames are not transmitted,
             but PAUSE frames received in the ingress direction are
             processed to reduce the egress traffic rate.";
        }
        enum "bi-directional" {
          description
            "PAUSE frame based flow control is enabled in both ingress
             and egress directions, i.e., PAUSE frames may be
             transmitted to reduce the ingress traffic flow, and
             PAUSE frames received on ingress are processed to reduce
             the egress traffic rate.";
        }
        enum "undefined" {
          description
            "Link is currently disconnected or initializing.";
        }
      }
      description
        "Used to represent the configured, negotiated, or actual
         PAUSE frame-based flow control setting.";

      reference
        "IEEE Std 802.3.1, dot3PauseAdminMode and dot3PauseOperMode";
    }

    feature ethernet-pfc {
      description
        "This device supports Ethernet priority flow-control.";
    }

    feature ethernet-pause {
      description
        "This device supports Ethernet PAUSE.";
    }

    augment "/if:interfaces/if:interface" {
      when "derived-from-or-self(if:type, 'ianaift:ethernetCsmacd')" {
        description
          "Applies to all P2P Ethernet interfaces.";
      }
      description
        "Augment interface model with Ethernet interface
         specific configuration nodes.";

      container ethernet {
        description
          "Contains all Ethernet interface related configuration.";

        container auto-negotiation {
          presence
            "The presence of this container indicates that
```

```
            auto-negotiation is supported on this Ethernet
            interface.";
          description
            "Contains auto-negotiation transmission parameters

            This container contains a data node that allows the
            advertised duplex value in the negotiation to be
            restricted.

            If not specified then the default behavior for the duplex
            data node is to negotiate all available values for the
            particular type of Ethernet PHY associated with the
            interface.

            If auto-negotiation is enabled, and PAUSE frame based flow
            control has not been explicitly configured, then the
            default PAUSE frame based flow control capabilities that
            are negotiated allow for bi-directional or egress-only
            PAUSE frame based flow control.

            If auto-negotiation is enabled, and PAUSE frame based flow
            control has been explicitly configured, then the
            configuration settings restrict the values that may be
            negotiated. However, it should be noted that the protocol
            does not allow only egress PAUSE frame based flow control
            to be negotiated without also allowing bi-directional
            PAUSE frame based flow control.";
          reference
            "IEEE Std 802.3, Clause 28 and Annexes 28A-D";

          leaf enable {
            type boolean;
            default true;

            description
              "Controls whether auto-negotiation is enabled or
               disabled.
               For interface types that support auto-negotiation then
               it defaults to being enabled.

               For interface types that do not support auto-negotiation,
               the related configuration data is ignored.";
          }
          leaf negotiation-status {
            when "../enable = 'true'";
            type enumeration {
              enum in-progress {
                description
                  "The auto-negotiation protocol is running and
                   negotiation is currently in-progress.";
              }
              enum complete {
                description
                  "The auto-negotiation protocol has completed
```

```
                successfully.";
            }
            enum failed {
              description
                "The auto-negotiation protocol has failed.";
            }
            enum unknown {
              description
                "The auto-negotiation status is not currently known,
                 this could be because it is still negotiating or the
                 protocol cannot run (e.g., if no medium is present).";
            }
            enum no-negotiation {
              description
                "No auto-negotiation is executed.
                 The auto-negotation function is either not supported
                 on this interface or has not been enabled.";
            }
          }
          config false;
          description
            "The status of the auto-negotiation protocol.";
          reference
            "IEEE 802.3, 30.6.1.1.4, aAutoNegAutoConfig";
        }

      }

      leaf duplex {
        type duplex-type;
        description
          "Operational duplex mode of the Ethernet interface.";
        reference
          "IEEE Std 802.3, 30.3.1.1.32 aDuplexStatus";
      }

      leaf speed {
        type eth-if-speed-type;
        units "Gb/s";
        description
          "Operational speed (data rate) of the Ethernet interface.
           The default value is implementation-dependent.";
      }

      container flow-control {
        description
          "Holds the different types of Ethernet PAUSE frame based
           flow control that can be enabled.";
        container pause {
          if-feature "ethernet-pause";
          description
            "IEEE Std 802.3 PAUSE frame based PAUSE frame based flow
             control.";
          reference
```

```
            "IEEE Std 802.3, Annex 31B";
          leaf direction {
            type pause-fc-direction-type;
            description
              "Indicates which direction PAUSE frame based flow
               control is enabled in, or whether it is disabled.
               The default flow-control settings are vendor specific.
               If auto-negotiation is enabled, then PAUSE based
               flow-control is negotiated by default.
               The default value is implementation-dependent.";
          }

          container statistics {
            config false;
            description
              "Contains the number of PAUSE frames received or
               transmitted.";
            leaf in-frames-pause {
              type yang:counter64;
              units frames;
              description
                "A count of PAUSE MAC Control frames transmitted on
                 this Ethernet interface.

                 Discontinuities in the values of counters in
                 this container can occur at re-initialization of the
                 management system, and at other times as indicated
                 by the value of the 'discontinuity-time' leaf
                 defined in the ietf-interfaces YANG module
                 (IETF RFC 8343).";
              reference
                "IEEE Std 802.3, 30.3.4.3 aPAUSEMACCtrlFramesReceived";
            }
            leaf out-frames-pause {
              type yang:counter64;
              units frames;
              description
                "A count of PAUSE MAC Control frames transmitted on
                 this Ethernet interface.

                 Discontinuities in the values of counters in
                 this container can occur at re-initialization of the
                 management system, and at other times as indicated
                 by the value of the 'discontinuity-time' leaf
                 defined in the ietf-interfaces YANG module
                 (IETF RFC 8343).";
              reference
                "IEEE Std 802.3, 30.3.4.2
                 aPAUSEMACCtrlFramesTransmitted";
            }
          }
        }

        container pfc {
```

```
            if-feature "ethernet-pfc";
            description
              "IEEE Std 802.3 Priority-based flow control.";
            reference
              "IEEE Std 802.3, Annex 31D";

            leaf enable {
              type boolean;

              description
                "True indicates that IEEE Std 802.3 priority-based
                 flow control is enabled, false indicates that
                 IEEE Std 802.3 priority-based flow control is disabled.
                 For interfaces that have auto-negotiation,
                 the priority-based flow control is enabled by default.";
            }

            container statistics {
              config false;
              description
                "This container collects all statistics for
                 Ethernet interfaces.";

              leaf in-frames-pfc {
                type yang:counter64;
                units frames;
                description
                  "A count of PFC MAC Control frames received on this
                   Ethernet interface.

                   Discontinuities in the values of counters in
                   this container can occur at re-initialization of the
                   management system, and at other times as indicated
                   by the value of the 'discontinuity-time' leaf
                   defined in the ietf-interfaces YANG module
                   (IETF RFC 8343).";
                reference
                  "IEEE Std 802.3.1, dot3HCInPFCFrames";
              }

              leaf out-frames-pfc {
                type yang:counter64;
                units frames;
                description
                  "A count of PFC MAC Control frames transmitted on
                   this interface.

                   Discontinuities in the values of counters in
                   this container can occur at re-initialization of the
                   management system, and at other times as indicated
                   by the value of the 'discontinuity-time' leaf
                   defined in the ietf-interfaces YANG module
                   (IETF RFC 8343).";
                reference
```

```
                "IEEE Std 802.3.1, dot3HCInPFCFrames";
            }
          }
        }

        leaf force-flow-control {
          type boolean;
          default false;
          description
            "Explicitly forces the local PAUSE frame based flow control
             settings regardless of what has been negotiated.

             Since the auto-negotiation of flow-control settings
             does not allow all sane combinations to be negotiated
             (e.g., consider a device that is only capable of sending
             PAUSE frames connected to a peer device that is only
             capable of receiving and acting on PAUSE frames) and
             failing to agree on the flow-control settings does not
             cause the auto-negotiation to fail completely, then it is
             sometimes useful to be able to explicitly enable
             particular PAUSE frame based flow control settings on
             the local device regardless of what is being advertised
             or negotiated.";
          reference
            "IEEE Std 802.3, Table 28B-3";
        }
      }

      leaf max-frame-length {
        type uint16;
        units octets;
        config false;
        description
          "This indicates the MAC frame length (including FCS bytes)
           at which frames are dropped for being too long.";
        reference
          "IEEE Std 802.3, 30.3.1.1.37 aMaxFrameLength";
      }

      leaf mac-control-extension-control {
        type boolean;
        config false;
        description
          "A value that identifies the current EXTENSION MAC Control
           function, as specified in IEEE Std 802.3, Annex 31C.";
        reference
          "IEEE Std 802.3, 30.3.8.3 aEXTENSIONMACCtrlStatus
           IEEE Std 802.3.1, dot3ExtensionMacCtrlStatus ";
      }

      leaf frame-limit-slow-protocol {
        type uint64;
        units f/s;
        default 10;
```

```
      config false;
      description
        "The maximum number of Slow Protocol frames of a given
         subtype that can be transmitted in a one second interval.
         The default value is 10.";
      reference
        "IEEE Std 802.3, 30.3.1.1.38 aSlowProtocolFrameLimit";
    }

    container capabilities {
      config false;
      description
        "Container all Ethernet interface specific capabilities.";

      leaf auto-negotiation {
        type boolean;
        description
          "Indicates whether auto-negotiation may be configured on
           this interface.";
      }

    }

    container statistics {
      config false;
      description
        "Contains statistics specific to Ethernet interfaces.

         Discontinuities in the values of counters in the
         container can occur at re-initialization of the management
         system, and at other times as indicated by the value of
         the 'discontinuity-time' leaf defined in the
         ietf-interfaces YANG module (IETF RFC 8343).";

      container frame {
        description
          "Contains frame statistics specific to Ethernet
           interfaces.

           All octet frame lengths include the 4 byte FCS.

           Error counters are only reported once ... 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 Std 802.3 Layer
           Management, counted exclusively according to the error
           status presented to the LLC.

           A frame that is counted by an instance of this object is
           also counted by the corresponding instance of 'in-errors'
           leaf defined in the ietf-interfaces YANG module
           (IETF RFC 8343).
```

```
            Discontinuities in the values of counters in the
            container can occur at re-initialization of the
            management system, and at other times as indicated by
            the value of the 'discontinuity-time' leaf defined in
            the ietf-interfaces YANG module (IETF RFC 8343).";

          leaf in-total-frames {
            type yang:counter64;
            units frames;
            description
              "The total number of frames (including bad frames)
               received on the Ethernet interface.

               This counter is calculated by summing the following
               IEEE Std 802.3, Clause 30 counters:
               aFramesReceivedOK +
               aFrameCheckSequenceErrors +
               aAlignmentErrors +
               aFrameTooLongErrors +
               aFramesLostDueToIntMACRcvError

               Also see the 'description' statement associated with
               the parent 'statistics' container for additional
               common semantics related to this counter.";

            reference
              "IEEE Std 802.3, Clause 30 counters, as specified
               in the description above.";
          }

          leaf in-total-octets {
            type yang:counter64;
            units octets;
            description
              "The total number of octets of data (including those in
               bad frames) received on the Ethernet interface.

               Includes the 4-octet FCS.

               Also see the 'description' statement associated with
               the parent 'statistics' container for additional
               common semantics related to this counter.";

            reference
              "IETF RFC 2819, etherStatsOctets";
          }

          leaf in-frames {
            type yang:counter64;
            units frames;
            description
              "A count of frames (including unicast, multicast and
               broadcast) that have been successfully received on the
```

```
            Ethernet interface.

            This count does not include frames received with
            frame-too-long, FCS, length or alignment errors, or
            frames lost due to internal MAC sublayer error.

            Also see the 'description' statement associated with
            the parent 'statistics' container for additional
            common semantics related to this counter.";

        reference
          "IEEE Std 802.3, 30.3.1.1.5 aFramesReceivedOK";
      }

      leaf in-multicast-frames {
        type yang:counter64;
        units frames;
        description
          "A count of multicast frames that have been
           successfully received on the Ethernet interface.

           This counter represents a subset of the frames counted
           by in-frames.

           This count does not include frames received with
           frame-too-long, FCS, length or alignment errors, or
           frames lost due to internal MAC sublayer error.

           Also see the 'description' statement associated with
           the parent 'statistics' container for additional
           common semantics related to this counter.";

        reference
          "IEEE Std 802.3, 30.3.1.1.21 aMulticastFramesReceivedOK";
      }

      leaf in-broadcast-frames {
        type yang:counter64;
        units frames;
        description
          "A count of broadcast frames that have been
           successfully received on the Ethernet interface.

           This counter represents a subset of the frames counted
           by in-frames.

           This count does not include frames received with
           frame-too-long, FCS, length or alignment errors, or
           frames lost due to internal MAC sublayer error.

           Also see the 'description' statement associated with
           the parent 'statistics' container for additional
           common semantics related to this counter.";
```

```
        reference
          "IEEE Std 802.3, 30.3.1.1.22 aBroadcastFramesReceivedOK";
      }

      leaf in-error-fcs-frames {
        type yang:counter64;
        units frames;
        description
          "A count of receive frames that are of valid length,
           but do not pass the FCS check, regardless of whether
           or not the frames are an integral number of octets in
           length.

           This count effectively comprises
           aFrameCheckSequenceErrors and aAlignmentErrors added
           together.

           Also see the 'description' statement associated with
           the parent 'statistics' container for additional
           common semantics related to this counter.";

        reference
          "IEEE Std 802.3, 30.3.1.1.6 aFrameCheckSequenceErrors;
           IEEE Std 802.3, 30.3.1.1.7 aAlignmentErrors";
      }

      leaf in-error-undersize-frames {
        type yang:counter64;
        units frames;
        description
          "A count of frames received on a particular Ethernet
           interface that are less than 64 bytes in length, and
           are discarded.

           This counter is incremented regardless of whether the
           frame passes the FCS check.

           Also see the 'description' statement associated with
           the parent 'statistics' container for additional
           common semantics related to this counter.";

        reference
          "IETF RFC 2819, etherStatsUndersizePkts and
           etherStatsFragments";
      }

      leaf in-error-oversize-frames {
        type yang:counter64;
        units frames;
        description
          "A count of frames received on a particular Ethernet
           interface that exceed the maximum permitted frame
           size, that is specified in max-frame-length, and are
           discarded.
```

```
            This counter is incremented regardless of whether the
            frame passes the FCS check.

            Also see the 'description' statement associated with
            the parent 'statistics' container for additional
            common semantics related to this counter.";

          reference "IEEE Std 802.3, 30.3.1.1.25 aFrameTooLongErrors";
        }

        leaf in-error-mac-internal-frames {
          type yang:counter64;
          units frames;
          description
            "A count of frames for which reception on a particular
             Ethernet 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 in-error-fcs-frames, in-error-undersize-frames,
             or in-error-oversize-frames.  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
             Ethernet interface that are not otherwise counted.

             Also see the 'description' statement associated with
             the parent 'statistics' container for additional
             common semantics related to this counter.";

          reference
            "IEEE Std 802.3, 30.3.1.1.15
             aFramesLostDueToIntMACRcvError";
        }

        leaf out-frames {
          type yang:counter64;
          units frames;
          description
            "A count of frames (including unicast, multicast and
             broadcast) that have been successfully transmitted on
             the Ethernet interface.

             Also see the 'description' statement associated with
             the parent 'statistics' container for additional
             common semantics related to this counter.";

          reference
            "IEEE Std 802.3, 30.3.1.1.2 aFramesTransmittedOK";
        }
```

```
          leaf out-multicast-frames {
            type yang:counter64;
            units frames;
            description
              "A count of multicast frames that have been
               successfully transmitted on the Ethernet interface.

               This counter represents a subset of the frames counted
               by out-frames.

               Also see the 'description' statement associated with
               the parent 'statistics' container for additional
               common semantics related to this counter.";

            reference
              "IEEE Std 802.3, 30.3.1.1.18 aMulticastFramesXmittedOK";
          }

          leaf out-broadcast-frames {
            type yang:counter64;
            units frames;
            description
              "A count of broadcast frames that have been
               successfully transmitted on the Ethernet interface.

               This counter represents a subset of the frames counted
               by out-frames.

               Also see the 'description' statement associated with
               the parent 'statistics' container for additional
               common semantics related to this counter.";

            reference
              "IEEE Std 802.3, 30.3.1.1.19 aBroadcastFramesXmittedOK";
          }

          leaf out-error-mac-internal-frames {
            type yang:counter64;
            units frames;
            description
              "A count of frames for which transmission on a
               particular Ethernet interface fails due to an internal
               MAC sublayer transmit error.

               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 Ethernet
               interface that are not otherwise counted.

               Also see the 'description' statement associated with
               the parent 'statistics' container for additional
               common semantics related to this counter.";
```

```
      reference
        "IEEE Std 802.3, 30.3.1.1.12
         aFramesLostDueToIntMACXmitError";
    }
  }

  container phy {
    description
      "Ethernet statistics related to the PHY layer.

       Discontinuities in the values of counters in the
       container can occur at re-initialization of the
       management system, and at other times as indicated by
       the value of the 'discontinuity-time' leaf defined in
       the ietf-interfaces YANG module (IETF RFC 8343).";

    leaf in-error-symbol {
      type yang:counter64;
      units errors;
      description
        "A count of the number of symbol errors that have
         occurred.

         For the precise definition of when the symbol error
         counter is incremented, please see the 'description'
         text associated with aSymbolErrorDuringCarrier,
         specified in IEEE Std 802.3, 30.3.2.1.5.

         Also see the 'description' statement associated with
         the parent 'phy-statistics' container for additional
         common semantics related to this counter.";
      reference
        "IEEE Std 802.3, 30.3.2.1.5 aSymbolErrorDuringCarrier";
    }

    container lpi {
      description
        "Physical Ethernet statistics for the energy efficiency
         related low power idle indications.";

      leaf in-lpi-transitions {
        type yang:counter64;
        units transitions;
        description
          "A count of occurrences of the transition from
           DEASSERT to ASSERT of the LPI_INDICATE
           parameter. The indication reflects the state of the
           PHY according to the requirements of the RS (see
           IEEE Std 802.3, 22.7, 35.4, and 46.4).

           Also see the 'description' statement associated with
           the parent 'phy-statistics' container for additional
           common semantics related to this counter.";
```

```
        reference
          "IEEE Std 802.3, 30.3.2.1.11 aReceiveLPITransitions";
      }

      leaf in-lpi-time {
        type decimal64 {
          fraction-digits 6;
        }
        units seconds;
        description
          "A count reflecting the total amount of time (in
           seconds) that the LPI_REQUEST parameter has the
           value ASSERT.  The request is indicated to the PHY
           according to the requirements of the RS (see IEEE Std
           802.3, 22.7, 35.4, and 46.4).

           Also see the 'description' statement associated with
           the parent 'phy-statistics' container for additional
           common semantics related to this counter.";

        reference
          "IEEE Std 802.3, 30.3.2.1.9 aReceiveLPIMicroseconds";
      }

      leaf out-lpi-transitions {
        type yang:counter64;
        units transitions;
        description
          "A count of occurrences of the transition from state
           LPI_DEASSERTED to state LPI_ASSERTED in the LPI
           transmit state diagram of the RS. The state
           transition corresponds to the assertion of the
           LPI_REQUEST parameter. The request is indicated to
           the PHY according to the requirements of the RS (see
           IEEE Std 802.3, 22.7, 35.4, 46.4.)

           Also see the 'description' statement associated with
           the parent 'phy-statistics' container for additional
           common semantics related to this counter.";

        reference
          "IEEE Std 802.3, 30.3.2.1.10 aTransmitLPITransitions";
      }

      leaf out-lpi-time {
        type decimal64 {
          fraction-digits 6;
        }
        units seconds;
        description
          "A count reflecting the total amount of time (in
           seconds) that the LPI_INDICATION parameter has the
           value ASSERT.  The request is indicated to the PHY
```

```
                according to the requirements of the RS (see IEEE
                802.3, 22.7, 35.4, and 46.4).

                Also see the 'description' statement associated with
                the parent 'phy-statistics' container for additional
                common semantics related to this counter.";

              reference
                "IEEE Std 802.3, 30.3.2.1.8 aTransmitLPIMicroseconds";
            }
          }
        }

        container mac-control {
          description
            "A group of statistics specific to MAC Control operation
             of selected Ethernet interfaces.

             Discontinuities in the values of counters in the
             container can occur at re-initialization of the
             management system, and at other times as indicated by
             the value of the 'discontinuity-time' leaf defined in
             the ietf-interfaces YANG module (IETF RFC 8343).";

          reference
            "IEEE Std 802.3.1, dot3ExtensionTable";

          leaf in-frames-mac-control-unknown {
            type yang:counter64;
            units frames;
            description
              "A count of MAC Control frames with an unsupported
               opcode received on this Ethernet interface.

               Frames counted against this counter are also counted
               against in-discards defined in the ietf-interfaces
               YANG module (IETF RFC 8343).

               Also see the 'description' statement associated with
               the parent 'mac-control-statistics' container for
               additional semantics.";
            reference
              "IEEE Std 802.3, 30.3.3.5 aUnsupportedOpcodesReceived";
          }

          leaf in-frames-mac-control-extension {
            type yang:counter64;
            units frames;
            description
              "The count of Extension MAC Control frames received on
               this Ethernet interface.

               Also see the 'description' statement associated with
               the parent 'mac-control-statistics' container for
```

```
                additional semantics.";
              reference
                "IEEE Std 802.3, 30.3.8.2
                 aEXTENSIONMACCtrlFramesReceived";
            }

            leaf out-frames-mac-control-extension {
              type yang:counter64;
              units frames;
              description
                "The count of Extension MAC Control frames transmitted
                 on this Ethernet interface.

                 Also see the 'description' statement associated with
                 the parent 'mac-control-statistics' container for
                 additional semantics.";
              reference
                "IEEE Std 802.3, 30.3.8.1
                 aEXTENSIONMACCtrlFramesTransmitted";
            }
          }
        }
      }
    }
  }
```

5.3.2.2 Ethernet interface module (half-duplex)

```
module ieee802-ethernet-interface-half-duplex {

  yang-version 1.1;

  namespace
    "urn:ieee:std:802.3:yang:ieee802-ethernet-interface-half-duplex";

  prefix ieee802-eth-half-duplex;

revision 2019-06-21 {
    description "Initial revision.";
  }

  import ietf-yang-types {
    prefix yang;
    reference "IETF RFC 6991";
  }

  import ietf-interfaces {
    prefix if;
    reference "IETF RFC 8343";
  }

  import iana-if-type {
    prefix ianaift;
    reference "http://www.iana.org/assignments/yang-parameters/
      iana-if-type@2018-07-03.yang";
  }
```

```
import ieee802-ethernet-interface {
  prefix ieee802-eth-if;
}

organization
  "IEEE Std 802.3 Ethernet Working Group
   Web URL: http://www.ieee802.org/3/";

contact
  "Web URL: http://www.ieee802.org/3/";

description
  "This module contains YANG definitions for configuring Ethernet
   interfaces that are deprecated, and are no longer
   widely used in the industry. The definitions are maintained for
   backwards compatibility purposes, but the general expectation is
   that this module is not anticipated to be widely implemented.";
reference
  "IEEE Std 802.3-2018, unless dated explicitly";

feature dynamic-rate-control {
  description
    "This feature indicates that the device supports Ethernet
     interfaces lowering the average data rate of the MAC sublayer,
     with frame granularity, by using Rate Control to dynamically
     increase the inter-packet gap for some types of Ethernet
     interface.
     Only valid for Ethernet interfaces operating at speeds (data rates)
     above 1000 Mb/s.";
  reference "IEEE Std 802.3, 30.3.1.1.33 aRateControlAbility";
}

feature csma-cd {
  description
    "This feature indicates that the device supports Ethernet
     interfaces running at half-duplex using CSMA/CD.";
}

typedef dynamic-rate-control-type {
  type enumeration {
    enum disabled {
      description
        "Dynamic rate control is disabled";
    }

    enum "sonet-oc192" {
      value 2;
      description
        "Dynamic rate control is enabled for a 10 Gb/s Ethernet
         interface to SONET/SDH OC192/STM64.";
    }
  }
  default disabled;
  description
    "Allowed values for dynamic-rate-control.";
  reference
    "IEEE Std 802.3, 4.4.2 ipgStretchRatio and 30.3.1.1.34
     aRateControlStatus";
```

```
  }

   augment "/if:interfaces/if:interface/ieee802-eth-if:ethernet" {
   when "derived-from-or-self(../if:type, 'ianaift:ethernetCsmacd')
      and ieee802-eth-if:duplex = 'half'" {
      description
        "Applies to half-duplex Ethernet interfaces.";
    }

    description
      "Augment with Ethernet interface configuration parameters
       for half-duplex operation.";

    leaf dynamic-rate-control {
      if-feature "dynamic-rate-control";
      type dynamic-rate-control-type;
      description
        "Enables dynamic rate control and specifies what speed (data rate)
         the dynamic rate control is operating at. The value of this attribute
         is constrained by the MAC data rate and hardware support.
         The default value is implementation-dependent.";
      reference
        "IEEE Std 802.3, 30.3.1.1.34 aRateControlStatus";
    }
  }

  augment "/if:interfaces/if:interface/ieee802-eth-if:ethernet/" +
    "ieee802-eth-if:capabilities"{
     when  "derived-from-or-self(../../if:type,
       'ianaift:ethernetCsmacd') and ../ieee802-eth-if:duplex = 'half'" {
       description "Applies to half-duplex Ethernet interfaces";
    }

    description
      "Augment with configuration capabilities for half-duplex
       Ethernet interface.";

    leaf dynamic-rate-control-supported {
      if-feature "dynamic-rate-control";
      type boolean;
      default false;
      description
        "Indicates whether the Ethernet interface supports lowering
         the average data rate of the MAC sublayer, with frame
         granularity, by using Rate Control to dynamically increase
         the inter-packet gap.
         Only valid for Ethernet interfaces operating at speeds (data rates)
         above 1000 Mb/s.";
      reference
        "IEEE Std 802.3, 30.3.1.1.33 aRateControlAbility";
    }
  }

  augment "/if:interfaces/if:interface/ieee802-eth-if:ethernet/" +
    "ieee802-eth-if:statistics/ieee802-eth-if:frame" {
    when "derived-from-or-self(../../../if:type,
      'ianaift:ethernetCsmacd') and ../../ieee802-eth-if:duplex = 'half'" {
      description
        "Applies to half-duplex Ethernet interfaces.";
```

```
    }
    description
      "Augment with statistics for half-duplex Ethernet interface.";

    container "csma-cd" {
      if-feature "csma-cd";
      description
        "Holds counters that are specific to CDMA/CD half-duplex
         operation of Ethernet interfaces.
         Discontinuities in the values of the counters in this
         container can occur at re-initialization of the management
         system, and at other times as indicated by the value of the
         'discontinuity-time' leaf defined in the ietf-interfaces
         YANG module (IETF RFC 8343).";

      leaf in-errors-sqe-test {
        type yang:counter64;
        units errors;
        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, 7.2.4.6.
           This counter does not increment on Ethernet interfaces
           operating at speeds (data rates) greater than 10 Mb/s, or on
           Ethernet 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 the
           'discontinuity-time' leaf defined in the ietf-interfaces
           YANG module (IETF RFC 8343).";
        reference
          "IEEE Std 802.3, 7.2.4.6, and 30.3.2.1.4 aSQETestErrors";
      }

      leaf out-frames-collision-single {
        type yang:counter64;
        units frames;
        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
           'out-unicast-frames', 'out-broadcast-frames', or
           'out-multicast-frames', and is not counted by the
           corresponding instance of the
           'out-frames-collision-multiple'.

           This counter does not increment when the Ethernet
           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 the
           'discontinuity-time' leaf defined in the ietf-interfaces
           YANG module (IETF RFC 8343).";
        reference
          "IEEE Std 802.3, 30.3.1.1.3 aSingleCollisionFrames";
      }
```

```
        leaf out-frames-collision-multiple {
          type yang:counter64;
          units frames;
          description
            "A count of frames that are involved in multiple
             collisions, 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 'out-unicast-frames', 'out-broadcast-frames', or
             'out-multicast-frames', and is not counted by the
             corresponding instance of the 'out-frames-collision-single'.
             This counter does not increment when the Ethernet
             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 the
             'discontinuity-time' leaf defined in the ietf-interfaces
             YANG module (IETF RFC 8343).";
          reference
            "IEEE Std 802.3, 30.3.1.1.4 aMultipleCollisionFrames";
        }

        leaf out-frames-deferred {
          type yang:counter64;
          units frames;
          description
            "A count of frames for which the first transmission attempt
             on a particular Ethernet interface is delayed because the
             medium is busy.
             A deferred frame that is not subject to any number of
             collisions is not counted by an instance of
             'out-frames-collision-single' or
             'out-frames-collision-multiple' objects.
             This counter does not increment when the Ethernet
             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 the
             'discontinuity-time' leaf defined in the ietf-interfaces
             YANG module (IETF RFC 8343).";
          reference
            "IEEE Std 802.3, 30.3.1.1.9 aFramesWithDeferredXmissions";
        }

        leaf out-frames-collisions-excessive {
          type yang:counter64;
          units frames;
          description
            "A count of frames for which transmission on a particular
             Ethernet interface fails due to excessive collisions.

             This counter does not increment when the Ethernet
             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 the
             'discontinuity-time' leaf defined in the ietf-interfaces
             YANG module (IETF RFC 8343).";
```

```
        reference
          "IEEE Std 802.3, 30.3.1.1.11 aFramesAbortedDueToXSColls";
      }

      leaf out-collisions-late {
        type yang:counter64;
        units collisions;
        description
          "The number of times that a collision is detected on a
           particular Ethernet 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 Ethernet
           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 the
           'discontinuity-time' leaf defined in the ietf-interfaces
           YANG module (IETF RFC 8343).";
        reference
          "IEEE Std 802.3, 30.3.1.1.10 aLateCollisions";
      }

      leaf out-errors-carrier-sense {
        type yang:counter64;
        units errors;
        description
          "The number of times that the carrier sense condition was
           lost or never asserted when attempting to transmit a frame
           on a particular Ethernet 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 Ethernet
           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 the
           'discontinuity-time' leaf defined in the ietf-interfaces
           YANG module (IETF RFC 8343).";
        reference
          "IEEE Std 802.3, 30.3.1.1.13 aCarrierSenseErrors";
      }

      list collision-histogram {
        key collision-count;
        description
          "A collection of collision histograms for a particular
           interface.";
        reference
          "IEEE Std 802.3, 30.3.1.1.30 aCollisionFrames";
        leaf collision-count {
          type yang:counter64;
          units collisions;
          description
```

```
            "The number of per-frame media collisions for which a
             particular collision histogram cell represents the
             frequency on a particular interface.";
          }
          leaf collision-count-frames {
            type yang:counter64;
            units frames;
            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 an
               interface after experiencing exactly 4 collisions would
               be indicated by incrementing only collision-count-frames
               object associated with the collision-count value of
               4. No other instance of collision-count-frames 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 the
               'discontinuity-time' leaf defined in the ietf-interfaces
               YANG module (IETF RFC 8343).";
          }
        }
      }
    }
  }
```