                     Fibre Channel Management MIB

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 describes managed objects for information related
   to the Fibre Channel.

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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 describes managed objects for information related
   to the Fibre Channel.

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. Short Overview of the Fibre Channel

   The Fibre Channel (FC) is logically a bidirectional point-to-point
   serial data channel, structured for high performance capability. The
   Fibre Channel provides a general transport vehicle for higher level
   protocols such as Intelligent Peripheral Interface (IPI) and Small
   Computer System Interface (SCSI) command sets, the High-Performance
   Parallel Interface (HIPPI) data framing, IP (Internet Protocol), IEEE
   802.2, and others.

   Physically, the Fibre Channel is an interconnection of multiple
   communication points, called N_Ports, interconnected either by a

   switching network, called a Fabric, or by a point-to-point link. A
   Fibre Channel "node" consists of one or more N_Ports. A Fabric may
   consist of multiple Interconnect Elements, some of which are
   switches. An N_Port connects to the Fabric via a port on a switch
   called an F_Port. When multiple FC nodes are connected to a single
   port on a switch via an "Arbitrated Loop" topology, the switch port
   is called an FL_Port, and the nodes' ports are called NL_Ports. The
   term Nx_Port refers to either an N_Port or an NL_port. The term
   Fx_Port refers to either an F_Port or an FL_port. A switch port,
   which is interconnected to another switch port via an Inter Element
   Link (IEL), is called an E_Port. A B_Port connects a bridge device
   with an E_Port on a switch; a B_Port provides a subset of E_Port
   functionality.

   Many Fibre Channel components, including the fabric, each node, and
   most ports, have globally-unique names. These globally-unique names
   are typically formatted as World Wide Names (WWNs). More information
   on WWNs can be found in [WWN1] and [WWN2]. WWNs are expected to be
   persistent across agent and unit resets.

   Fibre Channel frames contain 24-bit address identifiers that identify
   the frame's source and destination ports. Each FC port has an
   address identifier and a WWN. When a fabric is in use, the FC
   address identifiers are dynamic and are assigned by a switch.

4. MIB Overview

   This MIB contains the notion of a Fibre Channel management instance,
   which is defined as a separable managed instance of Fibre Channel
   functionality. Fibre Channel functionality may be grouped into Fibre
   Channel management instances in whatever way is most convenient for
   the implementation(s). For example, one such grouping accommodates a
   single SNMP agent having multiple AgentX [RFC2741] sub-agents, with
   each sub-agent implementing a different Fibre Channel management
   instance. To represent such multiple Fibre Channel management
   instances within the same SNMP context (see section 3.3.1 of
   [RFC3411]), all tables in this MIB are INDEX-ed by fcmInstanceIndex,
   which is defined as an arbitrary integer to uniquely identify a
   particular Fibre Channel management instance.

   This MIB contains eleven MIB groups, as follows.

4.1. The fcmInstanceBasicGroup Group

   This group contains basic information about a Fibre Channel managed
   instance, including its name and description, the Fibre Channel
   function(s) it performs, and optional pointers to hardware and/or
   software components.

4.2. The fcmSwitchBasicGroup Group

   This group contains basic information about a Fibre Channel switch,
   including its domain-id and whether it is the principal switch of its
   fabric.

4.3. The fcmPortBasicGroup Group

   This group contains basic information about a Fibre Channel port,
   including its port name (WWN), the name of the node (if any) of which
   it is a part, the type of port, the classes of service it supports,
   its transmitter and connector types, and the higher level protocols
   it supports.

   Each Fibre Channel port is represented by an entry in the ifTable
   (see below). The tables relating to ports in this MIB are indexed by
   the port's value of ifIndex.

4.4. The fcmPortStatsGroup Group

   This group contains traffic statistics, which are not specific to any
   particular class of service, for Fibre Channel ports.

4.5. The fcmPortClass23StatsGroup Group

   This group contains traffic statistics that are specific to Class 2
   or Class 3 traffic on Fibre Channel ports, including class-specific
   frame and octet counters and counters of busy and reject frames.

4.6. The fcmPortLcStatsGroup Group

   Some of the statistics in the fcmPortClass23StatsGroup can increase
   rapidly enough to warrant them being defined using the Counter64
   syntax. However, some old SNMP systems do not (yet) support
   Counter64 objects. Thus, this group defines low-capacity
   (Counter32-based) equivalents for the Counter64-based statistics in
   the fcmPortClass23StatsGroup group.

4.7. The fcmPortClassFStatsGroup Group

   This group contains traffic statistics that are specific to Class F
   traffic on the E_Ports of a Fibre Channel switch.

4.8. The fcmPortErrorsGroup Group

   This group contains counters of various error conditions that can
   occur on Fibre Channel ports.

4.9. The fcmSwitchPortGroup Group

   This group contains information about ports on a Fibre Channel
   switch. For an Fx_Port, it includes the port's timeout values, its
   hold-time, and its capabilities in terms of maximum and minimum
   buffer-to-buffer credit allocations, maximum and minimum data field
   sizes, and support for class 2 and class 3 sequenced delivery. For
   an E_Port or B_Port, it includes the buffer-to-buffer credit
   allocation and data field size.

4.10. The fcmSwitchLoginGroup Group

   This group contains information, known to a Fibre Channel switch,
   about its attached/logged-in Nx_Ports and the service parameters that
   have been agreed with them.

4.11. The fcmLinkBasicGroup Group

   This group contains information known to a local Fibre Channel
   management instance, and concerning Fibre Channel links including
   those which terminate locally.

5. Relationship to Other MIBs

   This MIB is a replacement for two other MIBs: RFC 2837, and the
   Fibre Channel Management Integration MIB which was originally
   submitted as an Internet Draft to the IETF's IPFC Working Group, and
   is now available as [MIB-FA].

5.1. The Interfaces Group MIB

   The Interfaces Group MIB [RFC2863] contains generic information about
   all lower layer interfaces, i.e., interfaces which are (potentially)
   below the internet layer. Thus, each Fibre Channel port should have
   its own row in the ifTable, and that row will contain the generic
   information about the interface/port. The Interfaces Group MIB
   specifies that additional information which is specific to a
   particular type of interface media, should be defined in a media-
   specific MIB. This MIB is the media-specific MIB for Fibre Channel
   ports/interfaces.

   Section 4 of [RFC2863] requires that a media-specific MIB clarify how
   the generic definitions apply for the particular type of media. The
   clarifications for Fibre Channel interfaces are as follows.

5.1.1. Layering Model

   The Interfaces Group MIB permits multiple ifTable entries to be
   defined for interface sub-layers, and for those multiple entries to
   be arranged in a stack.

   For Fibre Channel interfaces, no sublayers are defined and a Fibre
   Channel interface will typically have no other ifTable rows stacked
   on top of it, nor underneath it.

5.1.2. Virtual Circuits

   This Fibre Channel MIB does not deal with virtual circuits.

5.1.3. ifRcvAddressTable

   The ifRcvAddressTable does not apply to Fibre Channel interfaces.

5.1.4. ifType

   The value of ifType for a Fibre Channel interface is 56.

5.1.5. ifXxxOctets

   The definitions of ifInOctets and ifOutOctets (and similarly,
   ifHCInOctets and ifHCOutOctets) specify that their values include
   framing characters. For Fibre Channel interfaces, they include all
   the octets contained in frames between the Start-of-Frame and End-
   of-Frame delimiters (excluding the delimiters).

5.1.6. Specific Interface Group MIB Objects

   The following table provides specific implementation guidelines for
   applying the objects defined in the Interfaces Group MIB to Fibre
   Channel interfaces. For those objects not listed here, refer to
   their generic definitions in [RFC2863]. (RFC 2863 takes precedence
   over these guidelines in the event of any conflict.)

       Object   Guidelines

       ifType   56

       ifMtu   The MTU as seen by a higher layer
                                protocol, like IP.
                                That is, when IP is running over the
                                interface, this object is the size of the
                                largest IP datagram that can be
                                sent/received over the interface.

ifSpeed   For 1Gbs, this will be 1,000,000,000;
                        for 2Gbs, it will be 2,000,000,000. If
                        auto-negotiation is implemented and
                        enabled on an interface, and the
                        interface has not yet negotiated an
                        operational speed, this object SHOULD
                        reflect the maximum speed supported by
                        the interface.

ifPhysAddress   The interface's 24-bit Fibre Channel
                        Address Identifier, or the zero-length
                        string if no Address Identifier has been
                        assigned to the interface.

ifAdminStatus   Write access is not required, and support
                        for 'testing' is not required.

ifOperStatus   Support for 'testing' is not required.
                        The value 'dormant' has no meaning for
                        Fibre Channel interfaces.

ifInOctets   The number of octets of information

ifHCInOctets   contained in received frames between the
                        Start-of-Frame and End-of-Frame
                        delimiters (excluding the delimiters).

ifInUcastPkts   The number of unicast frames received,

ifHCInUcastPkts   i.e., the number of Start-of-Frame
                        delimiters received for unicast frames.

ifInErrors   The sum for this interface of

                            fcmPortLossofSynchs
                            fcmPortLossofSignals
                            fcmPortPrimSeqProtocolErrors
                            fcmPortInvalidTxWords
                            fcmPortInvalidCRCs
                            fcmPortAddressErrors
                            fcmPortDelimiterErrors
                            fcmPortTruncatedFrames
                            fcmPortEncodingDisparityErrors

                        plus any errors in fcmPortOtherErrors
                        that were input errors.

      ifOutOctets   The number of octets of information
      ifHCOutOctets   contained in transmitted frames between
                              the Start-of-Frame and End-of-Frame
                              delimiters (excluding the delimiters).

      ifOutUcastPkts   The number of frames transmitted,
                              ifHCOutUcastPkts   i.e., the number
                              of start-of-frame delimiters transmitted
                              for unicast frames.

      ifOutErrors   This is the number of errors in
                              fcmPortOtherErrors that were output
                              errors.

      ifInMulticastPkts   These counters are not incremented

      ifInBroadcastPkts   (unless a proprietary mechanism for
      ifOutMulticastPkts   multicast/broadcast is supported).
      ifOutBroadcastPkts
      ifHCInMulticastPkts
      ifHCInBroadcastPkts
      ifHCOutMulticastPkts
      ifHCOutBroadcastPkts

      ifLinkUpDownTrapEnable   Refer to [RFC2863]. Default is 'enabled'

      ifHighSpeed   The current operational speed of the
                              interface in millions of bits per second.
                              For 1Gbs, this will be 1000; for 2Gbs, it
                              will be 2000. If auto-negotiation is
                              implemented and enabled on an interface,
                              and the interface has not yet negotiated
                              an operational speed, this object SHOULD
                              reflect the maximum speed supported by
                              the interface.

      ifPromiscuousMode   This will normally be 'false'

      ifConnectorPresent   This will normally be 'true'.

5.2. Entity MIB

   The Entity MIB [RFC2737] contains information about individual
   physical components and any hierarchical relationship that may exist
   between them. Any Fibre Channel management instance with a
   relationship to a physical component (or to a hierarchy of physical
   components) will have its value of the fcmInstancePhysicalIndex
   object contain a pointer to the relevant row in the Entity MIB. If

    there is no correspondence with a physical component (or said
    component does not have a row in the Entity MIB), then the value of
    fcmInstancePhysicalIndex is zero. (Note that an implementation is
    not required to support a non-zero value of
    fcmInstancePhysicalIndex.)

5.3. Host Resources MIB

    The Host Resources MIB [RFC2790] includes information about installed
    software modules. Any Fibre Channel management instance with a
    correspondence to a software module, will have its value of the
    fcmInstanceSoftwareIndex object contain a pointer to the relevant row
    in the Host Resources MIB. If there is no correspondence to a
    software module (or said software module does not have a row in the
    Host Resources MIB), then the value of fcmInstanceSoftwareIndex is
    zero. (Note that an agent implementation is not required to support
    a non-zero value of fcmInstanceSoftwareIndex.)

6. Definitions

    FC-MGMT-MIB DEFINITIONS ::= BEGIN

    IMPORTS
        MODULE-IDENTITY, OBJECT-TYPE,
        Integer32, Unsigned32, Counter32, Counter64, transmission
                            FROM SNMPv2-SMI
        MODULE-COMPLIANCE, OBJECT-GROUP
                            FROM SNMPv2-CONF
        TruthValue, TEXTUAL-CONVENTION
                            FROM SNMPv2-TC
        ifIndex   FROM IF-MIB
        SnmpAdminString   FROM SNMP-FRAMEWORK-MIB;

    fcMgmtMIB MODULE-IDENTITY
        LAST-UPDATED   "200504260000Z" -- 26 April 2005
        ORGANIZATION   "IETF IPS (IP-Storage) Working Group"
        CONTACT-INFO
                "   Keith McCloghrie
                         Cisco Systems, Inc.
                    Tel: +1 408 526-5260
                 E-mail: kzm@cisco.com
                 Postal: 170 West Tasman Drive
                         San Jose, CA USA 95134
                "
        DESCRIPTION
                "This module defines management information specific to
                Fibre Channel-attached devices.

                Copyright (C) The Internet Society (2005). This version
                of this MIB module is part of RFC 4044; see the RFC
                itself for full legal notices."
         REVISION   "200504260000Z" -- 26 April 2005
          DESCRIPTION
                "Initial version of the Fibre Channel Mgmt MIB module."
       ::= { transmission 56 }

 fcmgmtObjects   OBJECT IDENTIFIER ::= { fcMgmtMIB 1 }
 fcmgmtNotifications OBJECT IDENTIFIER ::= { fcMgmtMIB 2 }
 fcmgmtNotifPrefix   OBJECT IDENTIFIER ::= { fcmgmtNotifications 0 }
 fcmgmtConformance   OBJECT IDENTIFIER ::= { fcMgmtMIB 3 }

 --*******************************
 -- Textual Conventions
 --

 FcNameIdOrZero ::= TEXTUAL-CONVENTION
      STATUS current
       DESCRIPTION
               "The World Wide Name (WWN) associated with a Fibre Channel
               (FC) entity. WWNs were initially defined as 64-bits in
               length. The latest definition (for future use) is 128-bits
               long. The zero-length string value is used in
               circumstances in which the WWN is unassigned/unknown."
      SYNTAX OCTET STRING (SIZE(0 | 8 | 16))

 FcAddressIdOrZero ::= TEXTUAL-CONVENTION
     STATUS current
     DESCRIPTION
             "A Fibre Channel Address ID, a 24-bit value unique within
             the address space of a Fabric. The zero-length string value
             is used in circumstances in which the WWN is
             unassigned/unknown."
     SYNTAX OCTET STRING (SIZE(0 | 3))

 FcDomainIdOrZero ::= TEXTUAL-CONVENTION
     STATUS current
     DESCRIPTION
             "The Domain Id (of an FC switch), or zero if the no Domain
             Id has been assigned."
     SYNTAX Integer32 (0..239)

FcPortType ::= TEXTUAL-CONVENTION
    STATUS current
    DESCRIPTION
            "The type of a Fibre Channel port, as indicated by the use
            of the appropriate value assigned by IANA."
    REFERENCE
             "The IANA-maintained registry for
              Fibre Channel port types (http://www.iana.org/)."
    SYNTAX   Unsigned32

FcClasses ::= TEXTUAL-CONVENTION
    STATUS current
    DESCRIPTION
            "A set of Fibre Channel classes of service."
    REFERENCE
             "Classes of service are described in FC-FS Section 13."
    SYNTAX   BITS { classF(0), class1(1), class2(2), class3(3),
                     class4(4), class5(5), class6(6) }

FcBbCredit ::= TEXTUAL-CONVENTION
    STATUS current
    DESCRIPTION
            "The buffer-to-buffer credit of an FC port."
    SYNTAX   Integer32 (0..32767)

FcBbCreditModel ::= TEXTUAL-CONVENTION
    STATUS current
    DESCRIPTION
            "The buffer-to-buffer credit model of an Fx_Port."
    SYNTAX   INTEGER { regular(1), alternate (2) }

FcDataFieldSize ::= TEXTUAL-CONVENTION
    STATUS current
    DESCRIPTION
            "The Receive Data Field Size associated with an FC port."
    SYNTAX   Integer32 (128..2112)

FcUnitFunctions ::= TEXTUAL-CONVENTION
    STATUS current
    DESCRIPTION
            "A set of functions that a Fibre Channel Interconnect
            Element or Platform might perform. A value with no bits set
            indicates the function(s) are unknown. The individual bits
            have the following meanings:

            other - none of the following.

            hub - a device that interconnects L_Ports, but does not
            operate as an FL_Port.

            switch - a fabric element conforming to the Fibre Channel
            switch fabric set of standards (e.g., [FC-SW-3]).

            bridge - a device that encapsulates Fibre Channel frames
            within another protocol (e.g., [FC-BB], FC-BB-2).

            gateway - a device that converts an FC-4 to another protocol
            (e.g., FCP to iSCSI).

            host - a computer system that provides end users with
            services such as computation and storage access.

            storageSubsys - an integrated collection of storage
            controllers, storage devices, and necessary software that
            provides storage services to one or more hosts.

            storageAccessDev - a device that provides storage management
            and access for heterogeneous hosts and heterogeneous devices
            (e.g., medium changer).

            nas - a device that connects to a network and provides file
            access services.

            wdmux - a device that modulates/demodulates each of several
            data streams (e.g., Fibre Channel protocol data streams)
            onto/from a different part of the light spectrum in an
            optical fiber.

            storageDevice - a disk/tape/etc. device (without the
            controller and/or software required for it to be a
            'storageSubsys')."
    SYNTAX BITS {
            other(0),   -- none of the following
            hub(1),
            switch(2),

```
                bridge(3),
                gateway(4),
                host(5),
                storageSubsys(6),
                storageAccessDev(7),
                nas(8),
                wdmux(9),
                storageDevice(10)
            }

--******************************
--  MIB object definitions
--

fcmInstanceTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF FcmInstanceEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
            "Information about the local Fibre Channel management
            instances."
    ::= { fcmgmtObjects 1 }

fcmInstanceEntry OBJECT-TYPE
    SYNTAX      FcmInstanceEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
            "A list of attributes for a particular local Fibre Channel
            management instance."
    INDEX { fcmInstanceIndex }
    ::= { fcmInstanceTable 1 }

FcmInstanceEntry ::=
    SEQUENCE {
        fcmInstanceIndex           Unsigned32,
        fcmInstanceWwn             FcNameIdOrZero,
        fcmInstanceFunctions       FcUnitFunctions,
        fcmInstancePhysicalIndex   Integer32,
        fcmInstanceSoftwareIndex   Integer32,
        fcmInstanceStatus          INTEGER,
        fcmInstanceTextName        SnmpAdminString,
        fcmInstanceDescr           SnmpAdminString,
        fcmInstanceFabricId        FcNameIdOrZero
    }
```

```
fcmInstanceIndex OBJECT-TYPE
    SYNTAX     Unsigned32 (1..4294967295)
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
            "An arbitrary integer value that uniquely identifies this
            instance amongst all local Fibre Channel management
            instances.

            It is mandatory to keep this value constant between restarts
            of the agent, and to make every possible effort to keep it
            constant across restarts (but note, it is unrealistic to
            expect it to remain constant across all re-configurations of
            the local system, e.g., across the replacement of all non-
            volatile storage)."
    ::= { fcmInstanceEntry 1 }

fcmInstanceWwn  OBJECT-TYPE
    SYNTAX     FcNameIdOrZero
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
            "If the instance has one (or more) WWN(s), then this object
            contains that (or one of those) WWN(s).

            If the instance does not have a WWN associated with it, then
            this object contains the zero-length string."
    ::= { fcmInstanceEntry 2 }

fcmInstanceFunctions OBJECT-TYPE
    SYNTAX     FcUnitFunctions
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
            "One (or more) Fibre Channel unit functions being performed
            by this instance."
    ::= { fcmInstanceEntry 3 }

fcmInstancePhysicalIndex OBJECT-TYPE
    SYNTAX     Integer32 (0..2147483647)
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
            "If this management instance corresponds to a physical
            component (or to a hierarchy of physical components)
            identified by the Entity-MIB, then this object's value is
            the value of the entPhysicalIndex of that component (or of
            the component at the root of that hierarchy).  If there is
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```
            no correspondence to a physical component (or no component
            that has an entPhysicalIndex value), then the value of this
            object is zero."
     REFERENCE
         "entPhysicalIndex is defined in the Entity MIB, RFC 2737."
     ::= { fcmInstanceEntry 4 }

fcmInstanceSoftwareIndex OBJECT-TYPE
     SYNTAX     Integer32 (0..2147483647)
     MAX-ACCESS read-only
     STATUS     current
     DESCRIPTION
            "If this management instance corresponds to an installed
            software module identified in the Host Resources MIB, then
            this object's value is the value of the hrSWInstalledIndex
            of that module.  If there is no correspondence to an
            installed software module (or no module that has a
            hrSWInstalledIndex value), then the value of this object is
            zero."
     REFERENCE
         "hrSWInstalledIndex is defined in the Host Resources MIB,
          RFC 2790"
     ::= { fcmInstanceEntry 5 }

fcmInstanceStatus OBJECT-TYPE
     SYNTAX     INTEGER {
                    unknown(1),
                    ok(2),      -- able to operate correctly
                    warning(3), -- needs attention
                    failed(4)   -- something has failed
                }
     MAX-ACCESS read-only
     STATUS     current
     DESCRIPTION
            "Overall status of the Fibre Channel entity/entities managed
            by this management instance.  The value should reflect the
            most serious status of such entities."
     ::= { fcmInstanceEntry 6 }

fcmInstanceTextName OBJECT-TYPE
     SYNTAX     SnmpAdminString (SIZE(0..79))
     MAX-ACCESS read-write
     STATUS     current
     DESCRIPTION
            "A textual name for this management instance and the Fibre
            Channel entity/entities that it is managing."
     ::= { fcmInstanceEntry 7 }
```

```
fcmInstanceDescr OBJECT-TYPE
    SYNTAX      SnmpAdminString
    MAX-ACCESS read-write
    STATUS      current
    DESCRIPTION
            "A textual description of this management instance and the
            Fibre Channel entity/entities that it is managing."
    ::= { fcmInstanceEntry 8 }

fcmInstanceFabricId OBJECT-TYPE
    SYNTAX      FcNameIdOrZero
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The globally unique Fabric Identifier that identifies the
            fabric to which the Fibre Channel entity/entities managed by
            this management instance are connected, or, of which they
            are a part.  This is typically the Node WWN of the principal
            switch of a Fibre Channel fabric.  The zero-length string
            indicates that the fabric identifier is unknown (or not
            applicable).

            In the event that the Fibre Channel entity/entities managed
            by this management instance is/are connected to multiple
            fabrics, then this object records the first (known) one."
    ::= { fcmInstanceEntry 9 }

--******************************
-- The Fibre Channel Switch Table
--

fcmSwitchTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF FcmSwitchEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
            "A table of information about Fibre Channel switches that
            are managed by Fibre Channel management instances.  Each
            Fibre Channel management instance can manage one or more
            Fibre Channel switches."
    ::= { fcmgmtObjects 2 }

fcmSwitchEntry OBJECT-TYPE
    SYNTAX      FcmSwitchEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
            "Information about a particular Fibre Channel switch that is
```

```
                    managed by the management instance given by
                    fcmInstanceIndex."
             INDEX { fcmInstanceIndex, fcmSwitchIndex }
             ::= { fcmSwitchTable 1 }

     FcmSwitchEntry ::=
             SEQUENCE {
                 fcmSwitchIndex          Unsigned32,
                 fcmSwitchDomainId       FcDomainIdOrZero,
                 fcmSwitchPrincipal      TruthValue,
                 fcmSwitchWWN            FcNameIdOrZero
             }

     fcmSwitchIndex OBJECT-TYPE
             SYNTAX      Unsigned32 (1..4294967295)
             MAX-ACCESS not-accessible
             STATUS      current
             DESCRIPTION
                     "An arbitrary integer that uniquely identifies a Fibre
                     Channel switch amongst those managed by one Fibre Channel
                     management instance.

                     It is mandatory to keep this value constant between restarts
                     of the agent, and to make every possible effort to keep it
                     constant across restarts."
             ::= { fcmSwitchEntry 1 }

     fcmSwitchDomainId OBJECT-TYPE
             SYNTAX      FcDomainIdOrZero
             MAX-ACCESS read-write
             STATUS      current
             DESCRIPTION
                     "The Domain Id of this switch.  A value of zero indicates
                     that a switch has not (yet) been assigned a Domain Id."
             ::= { fcmSwitchEntry 2 }

     fcmSwitchPrincipal OBJECT-TYPE
             SYNTAX      TruthValue
             MAX-ACCESS read-only
             STATUS      current
             DESCRIPTION
                     "An indication of whether this switch is the principal
                     switch within its fabric."
             ::= { fcmSwitchEntry 3 }
```

```
fcmSwitchWWN  OBJECT-TYPE
    SYNTAX      FcNameIdOrZero
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The World Wide Name of this switch."
    ::= { fcmSwitchEntry 4 }

--*******************************
-- The Fibre Channel Port Table
--

fcmPortTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF FcmPortEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
            "Information about Fibre Channel ports.  Each Fibre Channel
            port is represented by one entry in the IF-MIB's ifTable."
    REFERENCE
        "RFC 2863, The Interfaces Group MIB, June 2000."
    ::= { fcmgmtObjects 3 }

fcmPortEntry OBJECT-TYPE
    SYNTAX      FcmPortEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
            "Each entry contains information about a specific port."
    INDEX { ifIndex }
    ::= { fcmPortTable 1 }

FcmPortEntry ::=
    SEQUENCE {
        fcmPortInstanceIndex    Unsigned32,
        fcmPortWwn              FcNameIdOrZero,
        fcmPortNodeWwn          FcNameIdOrZero,
        fcmPortAdminType        FcPortType,
        fcmPortOperType         FcPortType,
        fcmPortFcCapClass       FcClasses,
        fcmPortFcOperClass      FcClasses,
        fcmPortTransmitterType  INTEGER,
        fcmPortConnectorType    INTEGER,
        fcmPortSerialNumber     SnmpAdminString,
        fcmPortPhysicalNumber   Unsigned32,
        fcmPortAdminSpeed       INTEGER,
        fcmPortCapProtocols     BITS,
        fcmPortOperProtocols    BITS
```

```
        }

fcmPortInstanceIndex OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The value of fcmInstanceIndex by which the Fibre Channel
            management instance, which manages this port, is identified
            in the fcmInstanceTable."
    ::= { fcmPortEntry 1 }

fcmPortWwn OBJECT-TYPE
    SYNTAX      FcNameIdOrZero
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The World Wide Name of the port, or the zero-length string
            if the port does not have a WWN."
     ::= { fcmPortEntry 2 }

fcmPortNodeWwn OBJECT-TYPE
    SYNTAX      FcNameIdOrZero
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The World Wide Name of the Node that contains this port, or
            the zero-length string if the port does not have a node
            WWN."
     ::= { fcmPortEntry 3 }

fcmPortAdminType OBJECT-TYPE
    SYNTAX      FcPortType
    MAX-ACCESS read-write
    STATUS      current
    DESCRIPTION
            "The administratively desired type of this port."
    ::= { fcmPortEntry 4 }

fcmPortOperType OBJECT-TYPE
    SYNTAX      FcPortType
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The current operational type of this port."
    ::= { fcmPortEntry 5 }
```

fcmPortFcCapClass OBJECT-TYPE
    SYNTAX   FcClasses
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The classes of service capability of this port."
    ::= { fcmPortEntry 6 }

fcmPortFcOperClass OBJECT-TYPE
    SYNTAX   FcClasses
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The classes of service that are currently operational on
            this port. For an FL_Port, this is the union of the classes
            being supported across all attached NL_Ports."
    ::= { fcmPortEntry 7 }

fcmPortTransmitterType OBJECT-TYPE
    SYNTAX   INTEGER {
        unknown(1),
        other(2),
        shortwave850nm(3),
        longwave1550nm(4),
        longwave1310nm(5),
        electrical(6)
     }
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The technology of the port transceiver."
    REFERENCE
        "FC-GS-3, section 6.1.2.2.3"
    ::= { fcmPortEntry 8 }

fcmPortConnectorType OBJECT-TYPE
    SYNTAX   INTEGER {
        unknown(1),
        other(2),
        gbic(3),
        embedded(4),
        glm(5),
        gbicSerialId(6),
        gbicNoSerialId(7),
        sfpSerialId(8),
        sfpNoSerialId(9)
    }
    MAX-ACCESS read-only

```
    STATUS      current
    DESCRIPTION
            "The module type of the port connector.  This object refers
            to the hardware implementation of the port.  It will be
            'embedded' if the hardware equivalent to Gigabit interface
            card (GBIC) is part of the line card and is unremovable.  It
            will be 'glm' if it's a gigabit link module (GLM).  It will
            be 'gbicSerialId' if the GBIC serial id can be read, else it
            will be 'gbicNoSerialId'.  It will be 'sfpSerialId' if the
            small form factor (SFP) pluggable GBICs serial id can be
            read, else it will be 'sfpNoSerialId'."
    REFERENCE
        "FC-GS-3, section 6.1.2.2.4"
    ::= { fcmPortEntry 9 }

fcmPortSerialNumber OBJECT-TYPE
    SYNTAX      SnmpAdminString
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The serial number associated with the port (e.g., for a
            GBIC).  If not applicable, the object's value is a zero-
            length string."
    REFERENCE
        "FC-GS-3, section 6.1.2.2.4"
    ::= { fcmPortEntry 10 }

fcmPortPhysicalNumber OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "This is the port's 'Physical Port Number' as defined by
            GS-3."
    REFERENCE
        "FC-GS-3, section 6.1.2.2.5"
    ::= { fcmPortEntry 11 }

fcmPortAdminSpeed OBJECT-TYPE
    SYNTAX      INTEGER {
                auto(1),
                eighthGbs(2),   -- 125Mbs
                quarterGbs(3),  -- 250Mbs
                halfGbs(4),     -- 500Mbs
                oneGbs(5),      --   1Gbs
                twoGbs(6),      --   2Gbs
                fourGbs(7),     --   4Gbs
                tenGbs(8)       --  10Gbs
```

```
                }
    MAX-ACCESS read-write
    STATUS     current
    DESCRIPTION
            "The speed of the interface:

                    'auto'        - auto-negotiation
                    'tenGbs'      - 10Gbs
                    'fourGbs'     -  4Gbs
                    'twoGbs'      -  2Gbs
                    'oneGbs'      -  1Gbs
                    'halfGbs'     - 500Mbs
                    'quarterGbs'  - 250Mbs
                    'eighthGbs'   - 125Mbs"
    ::= { fcmPortEntry 12 }

fcmPortCapProtocols OBJECT-TYPE
    SYNTAX     BITS {
                    unknown(0),
                    loop(1),
                    fabric(2),
                    scsi(3),
                    tcpIp(4),
                    vi(5),
                    ficon(6)
                }
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
            "A bit mask specifying the higher level protocols that are
            capable of running over this port.  Note that for generic
            Fx_Ports, E_Ports, and B_Ports, this object will indicate
            all protocols."
    ::= { fcmPortEntry 13 }

fcmPortOperProtocols OBJECT-TYPE
    SYNTAX     BITS {
                    unknown(0),
                    loop(1),
                    fabric(2),
                    scsi(3),
                    tcpIp(4),
                    vi(5),
                    ficon(6)
                }
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
```

```
                "A bit mask specifying the higher level protocols that are
                currently operational on this port.  For Fx_Ports, E_Ports,
                and B_Ports, this object will typically have the value
                'unknown'."
        ::= { fcmPortEntry 14 }


--*******************************
-- Port Statistics
--

fcmPortStatsTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF FcmPortStatsEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
            "A list of statistics for Fibre Channel ports."
    ::= { fcmgmtObjects 4 }

fcmPortStatsEntry OBJECT-TYPE
    SYNTAX     FcmPortStatsEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
            "An entry containing statistics for a Fibre Channel port.
            If any counter in this table suffers a discontinuity, the
            value of ifCounterDiscontinuityTime (defined in the IF-MIB)
            must be updated."
    REFERENCE  "The Interfaces Group MIB, RFC 2863, June 2000."
    AUGMENTS   { fcmPortEntry }
    ::= { fcmPortStatsTable 1 }

FcmPortStatsEntry ::=
    SEQUENCE {
        fcmPortBBCreditZeros     Counter64,
        fcmPortFullInputBuffers  Counter64,
        fcmPortClass2RxFrames    Counter64,
        fcmPortClass2RxOctets    Counter64,
        fcmPortClass2TxFrames    Counter64,
        fcmPortClass2TxOctets    Counter64,
        fcmPortClass2Discards    Counter64,
        fcmPortClass2RxFbsyFrames  Counter64,
        fcmPortClass2RxPbsyFrames  Counter64,
        fcmPortClass2RxFrjtFrames  Counter64,
        fcmPortClass2RxPrjtFrames  Counter64,
        fcmPortClass2TxFbsyFrames  Counter64,
        fcmPortClass2TxPbsyFrames  Counter64,
        fcmPortClass2TxFrjtFrames  Counter64,
        fcmPortClass2TxPrjtFrames  Counter64,
```

```
        fcmPortClass3RxFrames       Counter64,
        fcmPortClass3RxOctets       Counter64,
        fcmPortClass3TxFrames       Counter64,
        fcmPortClass3TxOctets       Counter64,
        fcmPortClass3Discards       Counter64,
        fcmPortClassFRxFrames       Counter32,
        fcmPortClassFRxOctets       Counter32,
        fcmPortClassFTxFrames       Counter32,
        fcmPortClassFTxOctets       Counter32,
        fcmPortClassFDiscards       Counter32
    }

fcmPortBBCreditZeros OBJECT-TYPE
    SYNTAX      Counter64
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of transitions in/out of the buffer-to-buffer
            credit zero state.  The other side is not providing any
            credit."
    ::= { fcmPortStatsEntry 1 }

fcmPortFullInputBuffers OBJECT-TYPE
    SYNTAX      Counter64
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of occurrences when all input buffers of a port
            were full and outbound buffer-to-buffer credit transitioned
            to zero, i.e., there became no credit to provide to other
            side."
    ::= { fcmPortStatsEntry 2 }

fcmPortClass2RxFrames OBJECT-TYPE
    SYNTAX      Counter64
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of Class 2 frames received at this port."
    ::= { fcmPortStatsEntry 3 }

fcmPortClass2RxOctets OBJECT-TYPE
    SYNTAX      Counter64
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of octets contained in Class 2 frames received
            at this port."
```

        ::= { fcmPortStatsEntry 4 }

fcmPortClass2TxFrames OBJECT-TYPE
    SYNTAX   Counter64
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of Class 2 frames transmitted out of this port."
    ::= { fcmPortStatsEntry 5 }

fcmPortClass2TxOctets OBJECT-TYPE
    SYNTAX   Counter64
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of octets contained in Class 2 frames
            transmitted out of this port."
    ::= { fcmPortStatsEntry 6 }

fcmPortClass2Discards OBJECT-TYPE
    SYNTAX   Counter64
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of Class 2 frames that were discarded upon
            reception at this port."
    ::= { fcmPortStatsEntry 7 }

fcmPortClass2RxFbsyFrames OBJECT-TYPE
    SYNTAX   Counter64
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that F_BSY was returned to this port as
            a result of a Class 2 frame that could not be delivered to
            the other end of the link. This can occur when either the
            fabric or the destination port is temporarily busy. Note
            that this counter will never increment for an F_Port."
    ::= { fcmPortStatsEntry 8 }

fcmPortClass2RxPbsyFrames OBJECT-TYPE
    SYNTAX   Counter64
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that P_BSY was returned to this port as
            a result of a Class 2 frame that could not be delivered to
            the other end of the link. This can occur when the

            destination port is temporarily busy."
    ::= { fcmPortStatsEntry 9 }

fcmPortClass2RxFrjtFrames OBJECT-TYPE
    SYNTAX   Counter64
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that F_RJT was returned to this port as
            a result of a Class 2 frame that was rejected by the fabric.
            Note that this counter will never increment for an F_Port."
    ::= { fcmPortStatsEntry 10 }

fcmPortClass2RxPrjtFrames OBJECT-TYPE
    SYNTAX   Counter64
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that P_RJT was returned to this port as
            a result of a Class 2 frame that was rejected at the
            destination N_Port."
    ::= { fcmPortStatsEntry 11 }

fcmPortClass2TxFbsyFrames OBJECT-TYPE
    SYNTAX   Counter64
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that F_BSY was generated by this port
            as a result of a Class 2 frame that could not be delivered
            because either the Fabric or the destination port was
            temporarily busy. Note that this counter will never
            increment for an N_Port."
    ::= { fcmPortStatsEntry 12 }

fcmPortClass2TxPbsyFrames OBJECT-TYPE
    SYNTAX   Counter64
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that P_BSY was generated by this port
            as a result of a Class 2 frame that could not be delivered
            because the destination port was temporarily busy. Note
            that this counter will never increment for an F_Port."
    ::= { fcmPortStatsEntry 13 }

fcmPortClass2TxFrjtFrames OBJECT-TYPE
    SYNTAX   Counter64
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that F_RJT was generated by this port
            as a result of a Class 2 frame being rejected by the fabric.
            Note that this counter will never increment for an N_Port."
    ::= { fcmPortStatsEntry 14 }

fcmPortClass2TxPrjtFrames OBJECT-TYPE
    SYNTAX   Counter64
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that P_RJT was generated by this port
            as a result of a Class 2 frame being rejected at the
            destination N_Port. Note that this counter will never
            increment for an F_Port."
    ::= { fcmPortStatsEntry 15 }

fcmPortClass3RxFrames OBJECT-TYPE
    SYNTAX   Counter64
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of Class 3 frames received at this port."
    ::= { fcmPortStatsEntry 16 }

fcmPortClass3RxOctets OBJECT-TYPE
    SYNTAX   Counter64
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of octets contained in Class 3 frames received
            at this port."
    ::= { fcmPortStatsEntry 17 }

fcmPortClass3TxFrames OBJECT-TYPE
    SYNTAX   Counter64
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of Class 3 frames transmitted out of this port."
    ::= { fcmPortStatsEntry 18 }

```
fcmPortClass3TxOctets OBJECT-TYPE
    SYNTAX      Counter64
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of octets contained in Class 3 frames
             transmitted out of this port."
    ::= { fcmPortStatsEntry 19 }

fcmPortClass3Discards OBJECT-TYPE
    SYNTAX      Counter64
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of Class 3 frames that were discarded upon
             reception at this port."
    ::= { fcmPortStatsEntry 20 }

fcmPortClassFRxFrames OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of Class F frames received at this port."
    ::= { fcmPortStatsEntry 21 }

fcmPortClassFRxOctets OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of octets contained in Class F frames received
             at this port."
    ::= { fcmPortStatsEntry 22 }

fcmPortClassFTxFrames OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of Class F frames transmitted out of this port."
    ::= { fcmPortStatsEntry 23 }
```

fcmPortClassFTxOctets OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of octets contained in Class F frames
            transmitted out of this port."
    ::= { fcmPortStatsEntry 24 }

fcmPortClassFDiscards OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of Class F frames that were discarded upon
            reception at this port."
    ::= { fcmPortStatsEntry 25 }

--*******************************
-- Port Low-capacity Statistics
--
-- these are Counter32 "low-capacity" counters for systems
-- that do not support Counter64's

fcmPortLcStatsTable OBJECT-TYPE
    SYNTAX   SEQUENCE OF FcmPortLcStatsEntry
    MAX-ACCESS not-accessible
    STATUS   current
    DESCRIPTION
            "A list of Counter32-based statistics for systems that do
            not support Counter64."
    ::= { fcmgmtObjects 5 }

fcmPortLcStatsEntry OBJECT-TYPE
    SYNTAX   FcmPortLcStatsEntry
    MAX-ACCESS not-accessible
    STATUS   current
    DESCRIPTION
            "An entry containing low-capacity (i.e., based on Counter32)
            statistics for a Fibre Channel port. If any counter in this
            table suffers a discontinuity, the value of
            ifCounterDiscontinuityTime (defined in the IF-MIB) must be
            updated."
    REFERENCE "The Interfaces Group MIB, RFC 2863, June 2000."
    AUGMENTS   { fcmPortEntry }
    ::= { fcmPortLcStatsTable 1 }

```
FcmPortLcStatsEntry ::=
    SEQUENCE {
        fcmPortLcBBCreditZeros        Counter32,
        fcmPortLcFullInputBuffers     Counter32,
        fcmPortLcClass2RxFrames       Counter32,
        fcmPortLcClass2RxOctets       Counter32,
        fcmPortLcClass2TxFrames       Counter32,
        fcmPortLcClass2TxOctets       Counter32,
        fcmPortLcClass2Discards       Counter32,
        fcmPortLcClass2RxFbsyFrames   Counter32,
        fcmPortLcClass2RxPbsyFrames   Counter32,
        fcmPortLcClass2RxFrjtFrames   Counter32,
        fcmPortLcClass2RxPrjtFrames   Counter32,
        fcmPortLcClass2TxFbsyFrames   Counter32,
        fcmPortLcClass2TxPbsyFrames   Counter32,
        fcmPortLcClass2TxFrjtFrames   Counter32,
        fcmPortLcClass2TxPrjtFrames   Counter32,
        fcmPortLcClass3RxFrames       Counter32,
        fcmPortLcClass3RxOctets       Counter32,
        fcmPortLcClass3TxFrames       Counter32,
        fcmPortLcClass3TxOctets       Counter32,
        fcmPortLcClass3Discards       Counter32
    }

fcmPortLcBBCreditZeros OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of transitions in/out of the buffer-to-buffer
            credit zero state.  The other side is not providing any
            credit."
    ::= { fcmPortLcStatsEntry 1 }

fcmPortLcFullInputBuffers OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of occurrences when all input buffers of a port
            were full and outbound buffer-to-buffer credit transitioned
            to zero, i.e., there became no credit to provide to other
            side."
    ::= { fcmPortLcStatsEntry 2 }
```

```
fcmPortLcClass2RxFrames OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of Class 2 frames received at this port."
    ::= { fcmPortLcStatsEntry 3 }

fcmPortLcClass2RxOctets OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of octets contained in Class 2 frames received
            at this port."
    ::= { fcmPortLcStatsEntry 4 }

fcmPortLcClass2TxFrames OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of Class 2 frames transmitted out of this port."
    ::= { fcmPortLcStatsEntry 5 }

fcmPortLcClass2TxOctets OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of octets contained in Class 2 frames
            transmitted out of this port."
    ::= { fcmPortLcStatsEntry 6 }

fcmPortLcClass2Discards OBJECT-TYPE
    SYNTAX      Counter32
    MAX-ACCESS read-only
    STATUS      current
    DESCRIPTION
            "The number of Class 2 frames that were discarded upon
            reception at this port."
    ::= { fcmPortLcStatsEntry 7 }
```

fcmPortLcClass2RxFbsyFrames OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that F_BSY was returned to this port as
            a result of a Class 2 frame that could not be delivered to
            the other end of the link. This can occur when either the
            fabric or the destination port is temporarily busy. Note
            that this counter will never increment for an F_Port."
    ::= { fcmPortLcStatsEntry 8 }

fcmPortLcClass2RxPbsyFrames OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that P_BSY was returned to this port as
            a result of a Class 2 frame that could not be delivered to
            the other end of the link. This can occur when the
            destination port is temporarily busy."
    ::= { fcmPortLcStatsEntry 9 }

fcmPortLcClass2RxFrjtFrames OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that F_RJT was returned to this port as
            a result of a Class 2 frame that was rejected by the fabric.
            Note that this counter will never increment for an F_Port."
    ::= { fcmPortLcStatsEntry 10 }

fcmPortLcClass2RxPrjtFrames OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that P_RJT was returned to this port as
            a result of a Class 2 frame that was rejected at the
            destination N_Port."
    ::= { fcmPortLcStatsEntry 11 }

fcmPortLcClass2TxFbsyFrames OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that F_BSY was generated by this port
            as a result of a Class 2 frame that could not be delivered
            because either the Fabric or the destination port was
            temporarily busy. Note that this counter will never
            increment for an N_Port."
    ::= { fcmPortLcStatsEntry 12 }

fcmPortLcClass2TxPbsyFrames OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that P_BSY was generated by this port
            as a result of a Class 2 frame that could not be delivered
            because the destination port was temporarily busy. Note
            that this counter will never increment for an F_Port."
    ::= { fcmPortLcStatsEntry 13 }

fcmPortLcClass2TxFrjtFrames OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that F_RJT was generated by this port
            as a result of a Class 2 frame being rejected by the fabric.
            Note that this counter will never increment for an N_Port."
    ::= { fcmPortLcStatsEntry 14 }

fcmPortLcClass2TxPrjtFrames OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times that P_RJT was generated by this port
            as a result of a Class 2 frame being rejected at the
            destination N_Port. Note that this counter will never
            increment for an F_Port."
    ::= { fcmPortLcStatsEntry 15 }

fcmPortLcClass3RxFrames OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of Class 3 frames received at this port."
    ::= { fcmPortLcStatsEntry 16 }

fcmPortLcClass3RxOctets OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of octets contained in Class 3 frames received
            at this port."
    ::= { fcmPortLcStatsEntry 17 }

fcmPortLcClass3TxFrames OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of Class 3 frames transmitted out of this port."
    ::= { fcmPortLcStatsEntry 18 }

fcmPortLcClass3TxOctets OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of octets contained in Class 3 frames
            transmitted out of this port."
    ::= { fcmPortLcStatsEntry 19 }

fcmPortLcClass3Discards OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of Class 3 frames that were discarded upon
            reception at this port."
    ::= { fcmPortLcStatsEntry 20 }

```
--*******************************
-- Port Error Counters
--

fcmPortErrorsTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF FcmPortErrorsEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
            "Error counters for Fibre Channel ports."
    ::= { fcmgmtObjects 6 }

fcmPortErrorsEntry OBJECT-TYPE
    SYNTAX      FcmPortErrorsEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
            "Error counters for a Fibre Channel port.  If any counter in
            this table suffers a discontinuity, the value of
            ifCounterDiscontinuityTime (defined in the IF-MIB) must be
            updated."
    REFERENCE  "The Interfaces Group MIB, RFC 2863, June 2000."
    AUGMENTS   { fcmPortEntry }
    ::= { fcmPortErrorsTable 1 }

FcmPortErrorsEntry ::=
    SEQUENCE {
        fcmPortRxLinkResets            Counter32,
        fcmPortTxLinkResets            Counter32,
        fcmPortLinkResets             Counter32,
        fcmPortRxOfflineSequences      Counter32,
        fcmPortTxOfflineSequences      Counter32,
        fcmPortLinkFailures            Counter32,
        fcmPortLossofSynchs            Counter32,
        fcmPortLossofSignals           Counter32,
        fcmPortPrimSeqProtocolErrors   Counter32,
        fcmPortInvalidTxWords          Counter32,
        fcmPortInvalidCRCs             Counter32,
        fcmPortInvalidOrderedSets      Counter32,
        fcmPortFrameTooLongs           Counter32,
        fcmPortTruncatedFrames         Counter32,
        fcmPortAddressErrors           Counter32,
        fcmPortDelimiterErrors         Counter32,
        fcmPortEncodingDisparityErrors Counter32,
        fcmPortOtherErrors             Counter32
    }
```

fcmPortRxLinkResets OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of Link Reset (LR) Primitive Sequences
            received."
    ::= { fcmPortErrorsEntry 1 }

fcmPortTxLinkResets OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of Link Reset (LR) Primitive Sequences
            transmitted."
    ::= { fcmPortErrorsEntry 2 }

fcmPortLinkResets OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of times the reset link protocol was initiated
            on this port. This includes the number of Loop
            Initialization Primitive (LIP) events on an arbitrated loop
            port."
    ::= { fcmPortErrorsEntry 3 }

fcmPortRxOfflineSequences OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of Offline (OLS) Primitive Sequences received at
            this port."
    ::= { fcmPortErrorsEntry 4 }

fcmPortTxOfflineSequences OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of Offline (OLS) Primitive Sequences transmitted
            by this port."
    ::= { fcmPortErrorsEntry 5 }

fcmPortLinkFailures OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of link failures. This count is part of FC-PH's
            Link Error Status Block (LESB)."
    REFERENCE
            "FC-PH, rev 4.3, 1 June 1994, section 29.8 [FC-PH]."
    ::= { fcmPortErrorsEntry 6 }

fcmPortLossofSynchs OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of instances of synchronization loss detected at
            this port. This count is part of FC-PH's Link Error Status
            Block (LESB)."
    REFERENCE
            "FC-PH, rev 4.3, 1 June 1994, section 29.8."
    ::= { fcmPortErrorsEntry 7 }

fcmPortLossofSignals OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of instances of signal loss detected at this
            port. This count is part of FC-PH's Link Error Status Block
            (LESB)."
    REFERENCE
            "FC-PH, rev 4.3, 1 June 1994, section 29.8."
    ::= { fcmPortErrorsEntry 8 }

fcmPortPrimSeqProtocolErrors OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The number of primitive sequence protocol errors detected
            at this port. This count is part of FC-PH's Link Error
            Status Block (LESB)."
    REFERENCE
            "FC-PH, rev 4.3, 1 June 1994, section 29.8."
    ::= { fcmPortErrorsEntry 9 }

```
fcmPortInvalidTxWords OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
            "The number of invalid transmission words received at this
            port.  This count is part of FC-PH's Link Error Status Block
            (LESB)."
    REFERENCE
            "FC-PH, rev 4.3, 1 June 1994, section 29.8."
    ::= { fcmPortErrorsEntry 10 }

fcmPortInvalidCRCs OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
            "The number of frames received with an invalid CRC.  This
            count is part of FC-PH's Link Error Status Block (LESB)."
    REFERENCE
            "FC-PH, rev 4.3, 1 June 1994, section 29.8."
    ::= { fcmPortErrorsEntry 11 }

fcmPortInvalidOrderedSets OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
            "The number of invalid ordered sets received at this port."
    ::= { fcmPortErrorsEntry 12 }

fcmPortFrameTooLongs OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
            "The number of frames received at this port for which the
            frame length was greater than what was agreed to in
            FLOGI/PLOGI.  This could be caused by losing the end of
            frame delimiter."
    ::= { fcmPortErrorsEntry 13 }

fcmPortTruncatedFrames OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
            "The number of frames received at this port for which the
```

             frame length was less than the minimum indicated by the
             frame header - normally 24 bytes, but it could be more if
             the DFCTL field indicates an optional header should have
             been present."
      ::= { fcmPortErrorsEntry 14 }

fcmPortAddressErrors OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
             "The number of frames received with unknown addressing; for
             example, an unknown SID or DID."
      ::= { fcmPortErrorsEntry 15 }

fcmPortDelimiterErrors OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
             "The number of invalid frame delimiters received at this
             port. An example is a frame with a class 2 start and a
             class 3 at the end."
      ::= { fcmPortErrorsEntry 16 }

fcmPortEncodingDisparityErrors OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
             "The number of encoding disparity errors received at this
             port."
      ::= { fcmPortErrorsEntry 17 }

fcmPortOtherErrors OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
             "The number of errors that were detected on this port but
             not counted by any other error counter in this row."
      ::= { fcmPortErrorsEntry 18 }

```
--*******************************
-- The Fibre Channel Fx_Port Table
--

fcmFxPortTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF FcmFxPortEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
            "Additional information about Fibre Channel ports that is
            specific to Fx_Ports.  This table will contain one entry for
            each fcmPortTable entry that represents an Fx_Port."
    ::= { fcmgmtObjects 7 }

fcmFxPortEntry OBJECT-TYPE
    SYNTAX      FcmFxPortEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
            "Each entry contains information about a specific Fx_Port."
    INDEX { ifIndex }
    ::= { fcmFxPortTable 1 }

FcmFxPortEntry ::=
    SEQUENCE {
        fcmFxPortRatov                Unsigned32,
        fcmFxPortEdtov                Unsigned32,
        fcmFxPortRttov                Unsigned32,
        fcmFxPortHoldTime             Unsigned32,
        fcmFxPortCapBbCreditMax       FcBbCredit,
        fcmFxPortCapBbCreditMin       FcBbCredit,
        fcmFxPortCapDataFieldSizeMax  FcDataFieldSize,
        fcmFxPortCapDataFieldSizeMin  FcDataFieldSize,
        fcmFxPortCapClass2SeqDeliv    TruthValue,
        fcmFxPortCapClass3SeqDeliv    TruthValue,
        fcmFxPortCapHoldTimeMax       Unsigned32,
        fcmFxPortCapHoldTimeMin       Unsigned32
    }

fcmFxPortRatov OBJECT-TYPE
    SYNTAX      Unsigned32
    UNITS       "milliseconds"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The Resource_Allocation_Timeout Value configured for this
            Fx_Port.  This is used as the timeout value for determining
            when to reuse an Nx_Port resource such as a
```

                  Recovery_Qualifier. It represents the Error_Detect_Timeout
                  value (see fcmFxPortEdtov) plus twice the maximum time that
                  a frame may be delayed within the Fabric and still be
                  delivered."
          ::= { fcmFxPortEntry 1 }

fcmFxPortEdtov OBJECT-TYPE
    SYNTAX   Unsigned32
    UNITS   "milliseconds"
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The Error_Detect_Timeout value configured for this Fx_Port.
             This is used as the timeout value for detecting an error
             condition."
    ::= { fcmFxPortEntry 2 }

fcmFxPortRttov OBJECT-TYPE
    SYNTAX   Unsigned32
    UNITS   "milliseconds"
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The Receiver_Transmitter_Timeout value of this Fx_Port.
             This is used by the receiver logic to detect a Loss of
             Synchronization."
    ::= { fcmFxPortEntry 3 }

fcmFxPortHoldTime OBJECT-TYPE
    SYNTAX   Unsigned32
    UNITS   "microseconds"
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The maximum time that this Fx_Port shall hold a frame
             before discarding the frame if it is unable to deliver the
             frame. The value 0 means that this Fx_Port does not support
             this parameter."
    ::= { fcmFxPortEntry 4 }

fcmFxPortCapBbCreditMax OBJECT-TYPE
    SYNTAX   FcBbCredit
    UNITS   "buffers"
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The maximum number of receive buffers that this port is
             capable of making available for holding frames from attached

```
           Nx_Port(s)."
    ::= { fcmFxPortEntry 5 }


fcmFxPortCapBbCreditMin OBJECT-TYPE
    SYNTAX       FcBbCredit
    UNITS        "buffers"
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
            "The minimum number of receive buffers that this port is
            capable of making available for holding frames from attached
            Nx_Port(s)."
    ::= { fcmFxPortEntry 6 }


fcmFxPortCapDataFieldSizeMax OBJECT-TYPE
    SYNTAX       FcDataFieldSize
    UNITS        "bytes"
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
            "The maximum size in bytes of the Data Field in a frame that
            this Fx_Port is capable of receiving from an attached
            Nx_Port."
    ::= { fcmFxPortEntry 7 }


fcmFxPortCapDataFieldSizeMin OBJECT-TYPE
    SYNTAX       FcDataFieldSize
    UNITS        "bytes"
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
            "The minimum size in bytes of the Data Field in a frame that
            this Fx_Port is capable of receiving from an attached
            Nx_Port."
    ::= { fcmFxPortEntry 8 }


fcmFxPortCapClass2SeqDeliv OBJECT-TYPE
    SYNTAX       TruthValue
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
            "An indication of whether this Fx_Port is capable of
            supporting Class 2 Sequential Delivery."
    ::= { fcmFxPortEntry 9 }
```

fcmFxPortCapClass3SeqDeliv OBJECT-TYPE
    SYNTAX   TruthValue
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
            "An indication of whether this Fx_Port is capable of
            supporting Class 3 Sequential Delivery."
    ::= { fcmFxPortEntry 10 }

fcmFxPortCapHoldTimeMax OBJECT-TYPE
    SYNTAX   Unsigned32
    UNITS   "microseconds"
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
            "The maximum holding time that this Fx_Port is capable of
            supporting."
    ::= { fcmFxPortEntry 11 }

fcmFxPortCapHoldTimeMin OBJECT-TYPE
    SYNTAX   Unsigned32
    UNITS   "microseconds"
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
            "The minimum holding time that this Fx_Port is capable of
            supporting."
    ::= { fcmFxPortEntry 12 }

--*******************************
-- The Fibre Channel Inter-Switch Port Table
--

fcmISPortTable OBJECT-TYPE
    SYNTAX   SEQUENCE OF FcmISPortEntry
    MAX-ACCESS not-accessible
    STATUS   current
    DESCRIPTION
            "Additional information about E_Ports, B_Ports, and any
            other type of Fibre Channel port to which inter-switch links
            can be connected. This table will contain one entry for
            each fcmPortTable entry that represents such a port."
    ::= { fcmgmtObjects 8 }

```
fcmISPortEntry OBJECT-TYPE
    SYNTAX      FcmISPortEntry
    MAX-ACCESS not-accessible
    STATUS      current
    DESCRIPTION
            "Each entry contains information about a specific port
            connected to an inter-switch link."
    INDEX { ifIndex }
    ::= { fcmISPortTable 1 }

FcmISPortEntry ::=
    SEQUENCE {
        fcmISPortClassFCredit          FcBbCredit,
        fcmISPortClassFDataFieldSize   FcDataFieldSize
    }

fcmISPortClassFCredit OBJECT-TYPE
    SYNTAX      FcBbCredit
    MAX-ACCESS  read-write
    STATUS      current
    DESCRIPTION
            "The maximum number of Class F data frames that can be
            transmitted by the inter-switch port without receipt of ACK
            or Link_Response frames."
    ::= { fcmISPortEntry 1 }

fcmISPortClassFDataFieldSize OBJECT-TYPE
    SYNTAX      FcDataFieldSize
    UNITS       "bytes"
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The Receive Data Field Size that the inter-switch port has
            agreed to support for Class F frames to/from this port.  The
            size specifies the largest Data Field Size for an FT_1
            frame."
    ::= { fcmISPortEntry 2 }
```

```
--*******************************
-- The Fabric Login table
--
-- This table contains the information held by FC switches
-- about the Nx_Ports that are logged-in/attached to their
-- Fx_Ports

fcmFLoginTable OBJECT-TYPE
    SYNTAX       SEQUENCE OF FcmFLoginEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
            "A table that contains one entry for each Nx_Port logged-
            in/attached to a particular Fx_Port in the switch.  Each
            entry contains the services parameters established during
            the most recent Fabric Login, explicit or implicit.  Note
            that an Fx_Port may have one or more Nx_Ports attached to
            it."
    ::= { fcmgmtObjects 9 }

fcmFLoginEntry OBJECT-TYPE
    SYNTAX       FcmFLoginEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
            "An entry containing service parameters established from a
            successful Fabric Login."
    INDEX { ifIndex, fcmFLoginNxPortIndex }
    ::= { fcmFLoginTable 1 }

FcmFLoginEntry ::=
    SEQUENCE {
        fcmFLoginNxPortIndex            Unsigned32,
        fcmFLoginPortWwn                FcNameIdOrZero,
        fcmFLoginNodeWwn                FcNameIdOrZero,
        fcmFLoginBbCreditModel          FcBbCreditModel,
        fcmFLoginBbCredit               FcBbCredit,
        fcmFLoginClassesAgreed          FcClasses,
        fcmFLoginClass2SeqDelivAgreed   TruthValue,
        fcmFLoginClass2DataFieldSize    FcDataFieldSize,
        fcmFLoginClass3SeqDelivAgreed   TruthValue,
        fcmFLoginClass3DataFieldSize    FcDataFieldSize
    }
```

```
fcmFLoginNxPortIndex OBJECT-TYPE
    SYNTAX       Unsigned32 (1..4294967295)
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
            "An arbitrary integer that uniquely identifies an Nx_Port
            amongst all those attached to the Fx_Port indicated by
            ifIndex.

            After a value of this object is assigned to a particular
            Nx_Port, that value can be re-used when and only when it is
            assigned to the same Nx_Port, or, after a reset of the value
            of the relevant instance of ifCounterDiscontinuityTime."
    REFERENCE  "The Interfaces Group MIB, RFC 2863, June 2000."
    ::= { fcmFLoginEntry 1 }

fcmFLoginPortWwn  OBJECT-TYPE
    SYNTAX       FcNameIdOrZero
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
            "The port name of the attached Nx_Port, or the zero-length
            string if unknown."
    ::= { fcmFLoginEntry 2 }

fcmFLoginNodeWwn  OBJECT-TYPE
    SYNTAX       FcNameIdOrZero
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
            "The node name of the attached Nx_Port, or the zero-length
            string if unknown."
    ::= { fcmFLoginEntry 3 }

fcmFLoginBbCreditModel OBJECT-TYPE
    SYNTAX       FcBbCreditModel
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
            "The buffer-to-buffer credit model in use by the Fx_Port."
    ::= { fcmFLoginEntry 4 }

fcmFLoginBbCredit OBJECT-TYPE
    SYNTAX       FcBbCredit
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
            "The number of buffers available for holding frames to be
```

          transmitted to the attached Nx_Port. These buffers are for
          buffer-to-buffer flow control in the direction from Fx_Port
          to Nx_Port."
    ::= { fcmFLoginEntry 5 }

fcmFLoginClassesAgreed OBJECT-TYPE
    SYNTAX   FcClasses
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
          "The Classes of Service that the Fx_Port has agreed to
          support for this Nx_Port."
    ::= { fcmFLoginEntry 6 }

fcmFLoginClass2SeqDelivAgreed OBJECT-TYPE
    SYNTAX   TruthValue
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
          "An indication of whether the Fx_Port has agreed to support
          Class 2 sequential delivery for this Nx_Port. This is only
          meaningful if Class 2 service has been agreed upon."
    ::= { fcmFLoginEntry 7 }

fcmFLoginClass2DataFieldSize OBJECT-TYPE
    SYNTAX   FcDataFieldSize
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
          "The Receive Data Field Size that the Fx_Port has agreed to
          support for Class 2 frames to/from this Nx_Port. The size
          specifies the largest Data Field Size for an FT_1 frame.
          This is only meaningful if Class 2 service has been agreed
          upon."
    ::= { fcmFLoginEntry 8 }

fcmFLoginClass3SeqDelivAgreed OBJECT-TYPE
    SYNTAX   TruthValue
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
          "An indication of whether the Fx_Port has agreed to support
          Class 3 sequential delivery for this Nx_Port. This is only
          meaningful if Class 3 service has been agreed upon."
    ::= { fcmFLoginEntry 9 }

```
fcmFLoginClass3DataFieldSize OBJECT-TYPE
    SYNTAX       FcDataFieldSize
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
            "The Receive Data Field Size that the Fx_Port has agreed to
            support for Class 3 frames to/from this Nx_Port.  The size
            specifies the largest Data Field Size for an FT_1 frame.
            This is only meaningful if Class 3 service has been agreed
            upon."
    ::= { fcmFLoginEntry 10 }

--*******************************
-- The Link table
--
-- This table is intended to assist management applications
-- in determining the topology of the network.  The table
-- contains any recent information the known to the agent
-- about Fibre Channel links, not only those that terminate at
-- a local port but also any others for which information
-- is known.

fcmLinkTable OBJECT-TYPE
    SYNTAX       SEQUENCE OF FcmLinkEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
            "A table containing any Fibre Channel link information that
            is known to local Fibre Channel managed instances.  One end
            of such a link is typically at a local port, but the table
            can also contain information on links for which neither end
            is a local port.

            If one end of a link terminates locally, then that end is
            termed 'end1'; the other end is termed 'end2'."
    ::= { fcmgmtObjects 10 }

fcmLinkEntry OBJECT-TYPE
    SYNTAX       FcmLinkEntry
    MAX-ACCESS   not-accessible
    STATUS       current
    DESCRIPTION
            "An entry containing information that a particular Fibre
            Channel managed instance has about a Fibre Channel link.

            The two ends of the link are called 'end1' and 'end2'."
    INDEX { fcmInstanceIndex, fcmLinkIndex }
    ::= { fcmLinkTable 1 }
```

```
FcmLinkEntry ::=
   SEQUENCE {
        fcmLinkIndex             Unsigned32,
        fcmLinkEnd1NodeWwn       FcNameIdOrZero,
        fcmLinkEnd1PhysPortNumber Unsigned32,
        fcmLinkEnd1PortWwn       FcNameIdOrZero,
        fcmLinkEnd2NodeWwn       FcNameIdOrZero,
        fcmLinkEnd2PhysPortNumber Unsigned32,
        fcmLinkEnd2PortWwn       FcNameIdOrZero,
        fcmLinkEnd2AgentAddress  SnmpAdminString,
        fcmLinkEnd2PortType      FcPortType,
        fcmLinkEnd2UnitType      FcUnitFunctions,
        fcmLinkEnd2FcAddressId   FcAddressIdOrZero
   }

fcmLinkIndex OBJECT-TYPE
    SYNTAX      Unsigned32 (1..4294967295)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
            "An arbitrary integer that uniquely identifies one link
            within the set of links about which a particular managed
            instance has information."
    ::= { fcmLinkEntry 1 }

fcmLinkEnd1NodeWwn  OBJECT-TYPE
    SYNTAX      FcNameIdOrZero
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The node name of end1, or the zero-length string if
            unknown."
    ::= { fcmLinkEntry 2 }

fcmLinkEnd1PhysPortNumber OBJECT-TYPE
    SYNTAX      Unsigned32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
            "The physical port number of end1, or zero if unknown."
    REFERENCE
        "FC-GS-3, section 6.1.2.2.5"
    ::= { fcmLinkEntry 3 }
```

fcmLinkEnd1PortWwn OBJECT-TYPE
    SYNTAX   FcNameIdOrZero
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The port WWN of end1, or the zero-length string if unknown.
            ('end1' is local if this value is equal to the value of
            fcmPortWwn in one of the rows of the fcmPortTable.)"
    ::= { fcmLinkEntry 4 }

fcmLinkEnd2NodeWwn OBJECT-TYPE
    SYNTAX   FcNameIdOrZero
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The node name of end2, or the zero-length string if
            unknown."
    ::= { fcmLinkEntry 5 }

fcmLinkEnd2PhysPortNumber OBJECT-TYPE
    SYNTAX   Unsigned32
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The physical port number of end2, or zero if unknown."
    REFERENCE
        "FC-GS-3, section 6.1.2.2.5"
    ::= { fcmLinkEntry 6 }

fcmLinkEnd2PortWwn OBJECT-TYPE
    SYNTAX   FcNameIdOrZero
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The port WWN of end2, or the zero-length string if
            unknown."
    ::= { fcmLinkEntry 7 }

fcmLinkEnd2AgentAddress OBJECT-TYPE
    SYNTAX   SnmpAdminString
    MAX-ACCESS read-only
    STATUS   current
    DESCRIPTION
            "The address of the management agent for the Fibre Channel
            Interconnect Element or Platform of which end2 is a part.
            The GS-4 specification provides some information about
            management agents. If the address is unknown, the value of
            this object is the zero-length string."

```
    REFERENCE
        "FC-GS-3, section 6.1.2.1.7"
    ::= { fcmLinkEntry 8 }


fcmLinkEnd2PortType OBJECT-TYPE
    SYNTAX       FcPortType
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
            "The port type of end2."
    REFERENCE
        "FC-GS-3, section 6.1.2.2.2"
    ::= { fcmLinkEntry 9 }


fcmLinkEnd2UnitType OBJECT-TYPE
    SYNTAX       FcUnitFunctions
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
            "The type of/function(s) performed by the Fibre Channel
            Interconnect Element or Platform of which end2 is a part."
    REFERENCE
        "FC-GS-3, sections 6.1.2.1.2 and 6.1.2.3.2"
    ::= { fcmLinkEntry 10 }


fcmLinkEnd2FcAddressId OBJECT-TYPE
    SYNTAX       FcAddressIdOrZero
    MAX-ACCESS   read-only
    STATUS       current
    DESCRIPTION
            "The Fibre Channel Address ID of end2, or the zero-length
            string if unknown."
    ::= { fcmLinkEntry 11 }
```

--*******************************
-- Conformance Section
--

fcmgmtCompliances OBJECT IDENTIFIER ::= { fcmgmtConformance 1 }
fcmgmtGroups   OBJECT IDENTIFIER ::= { fcmgmtConformance 2 }

fcmgmtCompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION
            "Describes the requirements for compliance to this Fibre
            Channel Management MIB."
    MODULE -- this module
        MANDATORY-GROUPS { fcmInstanceBasicGroup,
                           fcmPortBasicGroup,
                           fcmPortErrorsGroup }

        GROUP   fcmPortStatsGroup
        DESCRIPTION
            "This group is mandatory for all systems that
            are able to support the Counter64 date type."

        GROUP   fcmPortClass23StatsGroup
        DESCRIPTION
            "This group is mandatory only for systems that
            keep class-specific traffic statistics on Class 2
            and Class 3 traffic and are able to support the
            Counter64 date type."

        GROUP   fcmPortClassFStatsGroup
        DESCRIPTION
            "This group is mandatory only for FC switches that
            keep statistics on Class F traffic."

        GROUP   fcmPortLcStatsGroup
        DESCRIPTION
            "This group is mandatory only for agents that can not
            support the Counter64 data type and/or need to provide
            information accessible by SNMPv1 applications."

        GROUP   fcmSwitchBasicGroup
        DESCRIPTION
            "This group is mandatory only for Fibre Channel
            managed instances that manage Fibre Channel
            switches."

        GROUP   fcmSwitchPortGroup
        DESCRIPTION

              "This group is mandatory only for Fibre Channel
              managed instances that manage Fibre Channel
              switches."

        GROUP   fcmSwitchLoginGroup
        DESCRIPTION
              "This group is mandatory only for Fibre Channel
              managed instances that manage Fibre Channel
              switches."

        GROUP fcmLinkBasicGroup
        DESCRIPTION
              "This group is optional."

        OBJECT   fcmInstancePhysicalIndex
        SYNTAX   Integer32 (0)
        DESCRIPTION
              "Implementation of a non-zero value is not required."

        OBJECT   fcmInstanceSoftwareIndex
        SYNTAX   Integer32 (0)
        DESCRIPTION
              "Implementation of a non-zero value is not required."

        OBJECT   fcmInstanceTextName
        MIN-ACCESS read-only
        DESCRIPTION
              "Write access is not required."

        OBJECT   fcmInstanceDescr
        MIN-ACCESS read-only
        DESCRIPTION
              "Write access is not required."

        OBJECT   fcmPortAdminType
        MIN-ACCESS read-only
        DESCRIPTION
              "Write access is not required."

        OBJECT   fcmPortAdminSpeed
        MIN-ACCESS read-only
        DESCRIPTION
              "Write access is not required."

        OBJECT   fcmSwitchDomainId
        MIN-ACCESS read-only
        DESCRIPTION
              "Write access is not required."

```
          OBJECT      fcmISPortClassFCredit
          MIN-ACCESS  read-only
          DESCRIPTION
              "Write access is not required."

      ::= { fcmgmtCompliances 1 }

--******************************
-- Object Groups
--

fcmInstanceBasicGroup OBJECT-GROUP
      OBJECTS { fcmInstanceWwn, fcmInstanceFunctions,
                fcmInstancePhysicalIndex, fcmInstanceSoftwareIndex,
                fcmInstanceStatus, fcmInstanceTextName,
                fcmInstanceDescr, fcmInstanceFabricId }
      STATUS  current
      DESCRIPTION
              "Basic information about Fibre Channel managed instances."
      ::= { fcmgmtGroups 1 }

fcmSwitchBasicGroup OBJECT-GROUP
      OBJECTS { fcmSwitchDomainId, fcmSwitchPrincipal, fcmSwitchWWN }
      STATUS  current
      DESCRIPTION
              "Basic information about Fibre Channel switches."
      ::= { fcmgmtGroups 2 }

fcmPortBasicGroup OBJECT-GROUP
      OBJECTS { fcmPortInstanceIndex, fcmPortWwn, fcmPortNodeWwn,
                fcmPortAdminType, fcmPortOperType, fcmPortFcCapClass,
                fcmPortFcOperClass, fcmPortTransmitterType,
                fcmPortConnectorType, fcmPortSerialNumber,
                fcmPortPhysicalNumber, fcmPortAdminSpeed,
                fcmPortCapProtocols, fcmPortOperProtocols }
      STATUS  current
      DESCRIPTION
              "Basic information about Fibre Channel ports."
      ::= { fcmgmtGroups 3 }

fcmPortStatsGroup OBJECT-GROUP
      OBJECTS { fcmPortBBCreditZeros, fcmPortFullInputBuffers }
      STATUS  current
      DESCRIPTION
              "Traffic statistics, which are not specific to any one class
              of service, for Fibre Channel ports."
      ::= { fcmgmtGroups 4 }
```

fcmPortClass23StatsGroup OBJECT-GROUP
    OBJECTS { fcmPortClass2RxFrames, fcmPortClass2RxOctets,
              fcmPortClass2TxFrames, fcmPortClass2TxOctets,
              fcmPortClass2Discards, fcmPortClass2RxFbsyFrames,
              fcmPortClass2RxPbsyFrames,
              fcmPortClass2RxFrjtFrames,
              fcmPortClass2RxPrjtFrames,
              fcmPortClass2TxFbsyFrames,
              fcmPortClass2TxPbsyFrames,
              fcmPortClass2TxFrjtFrames,
              fcmPortClass2TxPrjtFrames, fcmPortClass3RxFrames,
              fcmPortClass3RxOctets, fcmPortClass3TxFrames,
              fcmPortClass3TxOctets, fcmPortClass3Discards }
    STATUS current
    DESCRIPTION
            "Traffic statistics for Class 2 and Class 3 traffic on Fibre
            Channel ports."
    ::= { fcmgmtGroups 5 }

fcmPortClassFStatsGroup OBJECT-GROUP
    OBJECTS { fcmPortClassFRxFrames,
              fcmPortClassFRxOctets,
              fcmPortClassFTxFrames,
              fcmPortClassFTxOctets,
              fcmPortClassFDiscards }
    STATUS current
    DESCRIPTION
            "Traffic statistics for Class F traffic on Fibre Channel
            ports."
    ::= { fcmgmtGroups 6 }

fcmPortLcStatsGroup OBJECT-GROUP
    OBJECTS { fcmPortLcBBCreditZeros, fcmPortLcFullInputBuffers,
              fcmPortLcClass2RxFrames, fcmPortLcClass2RxOctets,
              fcmPortLcClass2TxFrames, fcmPortLcClass2TxOctets,
              fcmPortLcClass2Discards, fcmPortLcClass3Discards,
              fcmPortLcClass3RxFrames, fcmPortLcClass3RxOctets,
              fcmPortLcClass3TxFrames, fcmPortLcClass3TxOctets,
              fcmPortLcClass2RxFbsyFrames,
              fcmPortLcClass2RxPbsyFrames,
              fcmPortLcClass2RxFrjtFrames,
              fcmPortLcClass2RxPrjtFrames,
              fcmPortLcClass2TxFbsyFrames,
              fcmPortLcClass2TxPbsyFrames,
              fcmPortLcClass2TxFrjtFrames,
              fcmPortLcClass2TxPrjtFrames }
    STATUS current
    DESCRIPTION

            "Low-capacity (32-bit) statistics for Fibre Channel ports."
     ::= { fcmgmtGroups 7 }

fcmPortErrorsGroup OBJECT-GROUP
     OBJECTS { fcmPortRxLinkResets, fcmPortTxLinkResets,
               fcmPortLinkResets, fcmPortRxOfflineSequences,
               fcmPortTxOfflineSequences, fcmPortLinkFailures,
               fcmPortLossofSynchs, fcmPortLossofSignals,
               fcmPortPrimSeqProtocolErrors, fcmPortInvalidTxWords,
               fcmPortInvalidCRCs, fcmPortInvalidOrderedSets,
               fcmPortFrameTooLongs, fcmPortTruncatedFrames,
               fcmPortAddressErrors, fcmPortDelimiterErrors,
               fcmPortEncodingDisparityErrors,
               fcmPortOtherErrors }
     STATUS   current
     DESCRIPTION
            "Error statistics for Fibre Channel ports."
     ::= { fcmgmtGroups 8 }

fcmSwitchPortGroup OBJECT-GROUP
     OBJECTS { fcmFxPortRatov, fcmFxPortEdtov, fcmFxPortRttov,
               fcmFxPortHoldTime, fcmFxPortCapBbCreditMax,
               fcmFxPortCapBbCreditMin,
               fcmFxPortCapDataFieldSizeMax,
               fcmFxPortCapDataFieldSizeMin,
               fcmFxPortCapClass2SeqDeliv,
               fcmFxPortCapClass3SeqDeliv,
               fcmFxPortCapHoldTimeMax,
               fcmFxPortCapHoldTimeMin,
               fcmISPortClassFCredit,
               fcmISPortClassFDataFieldSize }
     STATUS   current
     DESCRIPTION
            "Information about ports on a Fibre Channel switch."
     ::= { fcmgmtGroups 9 }

fcmSwitchLoginGroup OBJECT-GROUP
     OBJECTS { fcmFLoginPortWwn, fcmFLoginNodeWwn,
               fcmFLoginBbCreditModel, fcmFLoginBbCredit,
               fcmFLoginClassesAgreed,
               fcmFLoginClass2SeqDelivAgreed,
               fcmFLoginClass2DataFieldSize,
               fcmFLoginClass3SeqDelivAgreed,
               fcmFLoginClass3DataFieldSize }
     STATUS   current
     DESCRIPTION
            "Information known to a Fibre Channel switch about
            attached/logged-in Nx_Ports."

```
    ::= { fcmgmtGroups 10 }

fcmLinkBasicGroup OBJECT-GROUP
    OBJECTS { fcmLinkEnd1NodeWwn , fcmLinkEnd1PhysPortNumber,
              fcmLinkEnd1PortWwn, fcmLinkEnd2NodeWwn ,
              fcmLinkEnd2PhysPortNumber, fcmLinkEnd2PortWwn,
              fcmLinkEnd2AgentAddress, fcmLinkEnd2PortType,
              fcmLinkEnd2UnitType, fcmLinkEnd2FcAddressId }
    STATUS   current
    DESCRIPTION
            "Information about Fibre Channel links."
    ::= { fcmgmtGroups 11 }

END
```

7. Acknowledgements

   This memo is partly based on the information contained in the
   original submission of the Fibre Channel Management Integration MIB
   to the IETF's IPFC Working Group (now available as [MIB-FA]) and
   obsoletes RFC 2837.

   Feedback has been incorporated into this document based on comments
   from the following: Sudhir Pendse, SimpleSoft; Steve Senum, Cisco
   Systems; and Kha Sin Teow, Brocade.

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10. Security Considerations

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

      fcmInstanceTextName
      fcmInstanceDescr
      fcmSwitchDomainId
      fcmPortAdminType
      fcmPortAdminSpeed
      fcmISPortClassFCredit

   Such objects may be considered sensitive or vulnerable in some
   network environments. For example, the ability to change network
   topology or network speed may afford an attacker the ability to
   obtain better performance at the expense of other network users;
   setting fcmSwitchDomainId to an invalid value could lead to denial of
   service in some configurations. 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. 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. In particular, these objects provide
   information on network topology:

      fcmLinkEnd1NodeWwn
      fcmLinkEnd1PhysPortNumber
      fcmLinkEnd1PortWwn
      fcmLinkEnd2NodeWwn
      fcmLinkEnd2PhysPortNumber

```
        fcmLinkEnd2PortWwn
        fcmLinkEnd2AgentAddress
        fcmLinkEnd2PortType
        fcmLinkEnd2UnitType
        fcmLinkEnd2FcAddressId
```

   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 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).

   Further, 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.

11. IANA Considerations

11.1. OID Assignment

   IANA has made a MIB OID assignment under the transmission branch.
   Specifically, transmission 56 has been assigned as the OID for
   fcMgmtMIB. This sub-identifier was requested because this MIB
   contains the media-specific definitions that correspond to the ifType
   value of fibreChannel(56).

11.2. FC Port Type Registry

   IANA has established a registry for Fibre Channel Port Types. The
   registry is split into disjointed subset ranges:

   1) a 'standard' range for Fibre Channel Port Types that have been
      standardized by the InterNational Committee for Information
      Technology Standards (INCITS)'s Technical Committee T11. This
      range will be subject to the 'Expert Review' and 'Specification
      Required' policies described in [RFC2434], with the following
      provisions:

      - the Expert Reviewer is to be appointed by the IESG.

        - the Expert Reviewer shall obtain approval (or rejection) from
           INCITS Technical Committee T11 via the chair of that Committee.
           Rejected values shall not be added to the registry.

        - if the addition is approved, the Expert shall advise IANA of
           how to record the reference to the T11 specification document
           that describes the newly added port type(s), and that is
           considered to be the "other permanent and readily available
           reference" required by [RFC2434].

     The initial assignments in the 'standard' range will be as follows:

        Assigned
         Value   Type   Meaning
        --------   ------   -------
            1   unknown   for use when the type is not known,
                              or is "unidentified" as specified in
                              section 5.1.2.10 of [FC-GS-3]
            2   other   used for types without assigned values
            3   --   an obsolete value, not to be re-assigned
            4   N_Port   see [FC-FS]
            5   NL_Port   see [FC-FS]
            6   F_Port   see [FC-FS]
            7   FL_Port   see [FC-FS]
            8   E_Port   see [FC-FS]
            9   B_Port   see [FC-FS]
           10   G_Port   see [FC-SW-3]
           11   GL_Port   see [FC-SW-3]
           12   F/NL_Port see [FC-AL-2]

     The above range extends up to a maximum of 9,999.

     2) a range assigned under the "Private Use" policy described in
        [RFC2434] for values intended for private use by one party or
        among mutually consenting parties.
        Values in this range extend from 10,000 to 99,999. IANA will not
        make any allocations from this range.

     3) values larger than 99,999 are RESERVED.

12. Comparison to the Fibre Channel Management Integration MIB

12.1. Problems with the Fibre Channel Management Integration MIB

   The Fibre Channel Management Integration MIB [MIB-FA] had the
   following major problems:

   - It wasn't formatted using SMIv2, which is mandatory.

   - The MIB seemed to have been defined with the notion that it would
      be the only MIB that a Fibre Channel product will require. The
      notion of an agent implementing just a single MIB was abandoned by
      the IETF in 1992 as being non-scalable. Rather, a Fibre Channel
      MIB needed to be another MIB in the continuing series of MIBs
      defined by the IETF, and thus, it needed to be consistent with its
      predecessors. In other words, there are existing MIBs that all
      SNMP agents must support, even if the support of Fibre Channel
      interfaces is the only functionality that they have. Thus, it was
      essential that the Fibre Channel Integration MIB contained only
      objects for information that is specific to Fibre Channel. All
      objects relevant to non-Fibre Channel environments needed to be
      removed. This issue applied to a large fraction of the objects
      defined in the MIB.

   - The MIB had some but not complete overlap in functionality with
      RFC 2837.

   - Every SNMP agent must implement the ifTable. The ifTable counters
      are the MIB objects most well-used by administrators in SNMP
      management. SNMP agents need to implement a row in the ifTable
      for each of their network interfaces, including their Fibre
      Channel interfaces. The IF-MIB requires a media-specific MIB to
      specify how that type of interface uses the ifTable (see section 4
      in RFC 2863). [RFC2837] doesn't do that, nor did the Fibre
      Channel Integration MIB.

   - It incorrectly used the OCTET STRING syntax (instead of Counter32
      or Counter64) for counters.

12.2. Detailed Changes

12.2.1. Removal of Sensor-Related Objects

   Information about sensors is not specific to Fibre Channel, and
   therefore should not be in this MIB. (At the time of writing, the
   IETF's ENTITY MIB Working Group has produced a first draft of a
   Sensor MIB, see [RFC3433].) This removed the need for:

      connUnitSensorTable (and all its contents)
      connUnitNumSensors
      connUnitSensorStatusChange

12.2.2. Removal of Trap-registration Objects

   Information about registering "traps" is not specific to Fibre
   Channel, and therefore should not be in this MIB. (For similar
   functionality, see SNMP-NOTIFICATION-MIB and SNMP-TARGET-MIB in RFC
   2573). This removed the need for:

      trapMaxClients
      trapClientCount
      trapRegTable (and all its contents)

12.2.3. Removal of Event-Related Objects

   Information about generic events is not specific to Fibre Channel,
   and therefore should not be in this MIB. (For similar functionality,
   see the Event group in RFC 2819 and the Notification Log MIB in RFC
   3014; the SNMP-NOTIFICATION-MIB provides for the filtering of
   notifications.) This removed the need for:

      connUnitEventTable (and all its contents)
      connUnitEventFilter
      connUnitNumEvents
      connUnitMaxEvents
      connUnitEventCurrID
      connUnitEventTrap

12.2.4. Removal of Inventory-Related Information

   Aspects of hardware (physical) components are represented in the
   Entity MIB (RFC 2737); aspects of software modules are represented in
   the Host Resources MIB (RFC 2790). Two new objects provide indexing
   from this MIB into those MIBs: one having the value of PhysicalIndex
   (or zero) and the other having the value of hrSWInstalledIndex (or
   zero). These replaced the need for:

      connUnitNumports
      connUnitRevsTable (and all its contents)
      connUnitNumRevs
      connUnitPortRevision
      connUnitPortVendor
      connUnitProduct
      connUnitInfo
      connUnitSn
      connUnitModuleId

          connUnitVendorId
          connUnitDeletedTrap

12.2.5. Removal of Revision Numbers

   The forward/backward compatibility rules of how to evolve MIBs are
   designed such that MIBs do not have revision numbers. This removed
   the need for:

       revisionNumber

12.2.6. Removal of Other Not FC-Specific Information

   Other information was removed because it was not specific to Fibre
   Channel:

       systemURL
       statusChangeTime
       configurationChangeTime
       connUnitUrl
       connUnitUpTime
       connUnitState
       connUnitContact
       connUnitLocation
       connUnitProxyMaster
       connUnitControl
       connUnitStatus
       connUnitStatusChange

12.2.7. Clean-up of Ambiguous/Obsolete Definitions

   Some information in the FC Management integration was obsolete or
   ambiguous:

       statusChangeTime (obsolete)
       configurationChangeTime (obsolete)
       connUnitTableChangeTime (obsolete)
       connUnitStatusChangeTime (obsolete)
       connUnitConfigurationChangeTime (obsolete)
       connUnitNumZones (obsolete)
       connUnitZoneTable (referenced but not defined)
       connUnitLinkCurrIndex (badly defined)

12.2.8. Use of an ifTable Entry

   The following objects were removed because they duplicated existing
   IF-MIB objects:

```
   redundant object                 existing object(s)
   ----------------                 ------------------
   connUnitPortStatCountError        ifInErrors & ifOutErrors
   connUnitPortStatCountTxObjects    ifOutUcastPkts &
                                     ifHCOutUcastPkts
   connUnitPortStatCountRxObjects    ifInUcastPkts &
                                     ifHCInUcastPkts
   connUnitPortStatCountTxElements   ifOutOctets &
                                     ifHCOutOctets
   connUnitPortStatCountRxElements   ifInOctets &
                                     ifHCInOctets
   connUnitPortStatCountRxMulticastObjects
                                     ifInMulticastPkts &
                                     ifHCInMulticastPkts
   connUnitPortStatCountTxMulticastObjects
                                     ifOutMulticastPkts &
                                     ifHCOutMulticastPkts
   connUnitPortStatCountRxBroadcastObjects
                                     ifInBroadcastPkts &
                                     ifHCInBroadcastPkts
   connUnitPortStatCountTxBroadcastObjects
                                     ifOutBroadcastPkts &
                                     ifHCOutBroadcastPkts
   connUnitPortFCId                  ifPhysAddress
   connUnitPortControl               ifAdminStatus
   connUnitPortState                 ifAdminStatus
   connUnitPortHWState               ifOperStatus
   connUnitPortStatus                ifOperStatus
   connUnitPortName                  ifAlias
   connUnitPortStatObject            ifSpecific
   connUnitNumports                  ifNumber
   connUnitPortStatusChange          linkUp/linkDown
```

12.2.9. Removed Because of AgentX Difficulty

   An AgentX environment [RFC2741] consists of a master agent and
   several sub-agents. It is not difficult to implement the same MIB in
   several such sub-agents if all of the MIB's tables have a common
   index variable as the first auxiliary object in their INDEX clauses.
   However, any scalars that the MIB contains pose a problem for the
   AgentX environment. All the (remaining) scalars were therefore
   removed:

      revisionNumber
      uNumber
      systemURL

12.2.10. FC Management Instance

   The term "connectivity unit" was changed to "FC management instance".

   The term "connectivity unit" was not properly defined in [MIB-FA],
   and its usage provided a confused mixture of indications to the
   implementor:

      - the definition of FcUnitType suggested it was functional;

      - the definition of uNumber suggested it was physical;

      - the definition of connUnitProduct suggested it was a vendor's
         product;

      - etc.

   The common implementation strategy for the "connectivity unit" was
   which ever grouping provided access to the management functionality
   the easiest. (One such grouping accommodates a single SNMP agent
   having multiple AgentX [RFC2741] sub-agents, each supporting a
   separate implementation of the MIB.)

   In fact, this scenario is not new; in practice, a "connectivity unit"
   will have the same semantics as a management "instance" in other
   MIBs, e.g., the IPS WG's own iSCSI MIB. For this MIB, its meaning
   is: "a separable managed instance of Fibre Channel functionality".
   Given this definition, the "FC management instance" is a better name
   because it is more accurate and more representative of the definition
   than is "connectivity unit".

12.2.11. Counter Syntax

   All packet and octet counters have been changed to be Counter64's
   (but Counter32 versions of them are also included for use by old
   agents). The error counters have been changed to Counter32's. (In
   the probably impossible, and at most improbable, circumstances that
   the rate of occurrence of errors, even on a 10Gbs Fibre Channel
   interface, might wrap faster than an hour, the fact that errors are
   occurring will almost certainly be apparent from other MIB objects.)

12.2.12. Obsolete/Little-Used Fibre Channel Features

   Information relating to Fibre Channel features that are obsolete or
   not widely-implemented has been deleted. (For more information, see
   section 6.2.1 and section 6.2.2 of [FC-MI].)

         - Class 1 service,
         - Intermix Mode,
         - Stacked Conn Mode.
         - PH version numbers

   Note that with support for Class 1 service being deleted, only class
   2 now needs F_BSY, F_RJT, P_BSY, and P_RJT counters, and thus they no
   longer need to be counted for all classes as well as for class 2, and
   therefore the following objects have been deleted:

      connUnitPortStatCountFBSYFrames
      connUnitPortStatCountPBSYFrames
      connUnitPortStatCountFRJTFrames
      connUnitPortStatCountPRJTFrames

12.3. Name Server Objects

   A table of Name Server information was present in
   the Fibre Channel Management Integration MIB [MIB-FA].
   That information is not currently represented in this MIB
   because this MIB is already quite large,
   and a set of Name Server objects are expected to be
   defined in a separate (new) MIB.

12.4. Additional Objects

   Support for Class F traffic, including 32-bit octet and frame
   counters, has been added.

13. Comparison to RFC 2837

   This MIB is a superset of RFC 2837, except for the following:

   - the fcFeClass1AccountingGroup group is obsolete,

   - fcFxPortConnectedNxPort, fcFxPortFcphVersionHigh,
      fcFxPortFcphVersionLow, fcFxPortFcphVersionAgreed,
      fcFxPortStackedConnModeAgreed, fcFxPortIntermixSuppAgreed,
      fcFxPortCapStackedConnMode, and fcFxPortCapIntermix are obsolete,

   - fcFxPortBbCredit and fcFxPortRxBufSize are per attached Nx_Port,

   - fcFxPortBbCreditAvailable is ephemeral,

   - fcFeModuleTable is mostly contained in the entPhysicalTable,

   - fcFxPortPhysAdminStatus, fcFxPortPhysOperStatus, and
      fcFxPortPhysLastChange have equivalents in the ifTable.

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