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Fibre Channel Management MIB

Status of This Memo

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Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. 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 ifHCInOctets	The number of octets of information contained in received frames between the Start-of-Frame and End-of-Frame delimiters (excluding the delimiters).
ifInUcastPkts ifHCInUcastPkts	The number of unicast frames received, 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 ifHCOutOctets	The number of octets of information contained in transmitted frames between the Start-of-Frame and End-of-Frame delimiters (excluding the delimiters).
ifOutUcastPkts ifHCOutUcastPkts	The number of frames transmitted, 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 ifInBroadcastPkts ifOutMulticastPkts ifOutBroadcastPkts ifHCInMulticastPkts ifHCInBroadcastPkts ifHCOutMulticastPkts ifHCOutBroadcastPkts	These counters are not incremented (unless a proprietary mechanism for multicast/broadcast is supported).
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
```

```
            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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