Introduction

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in TCP/IP based internets. In particular it defines objects for managing FCIP entities, as defined in [FCIP] and used in FC fabrics as described in [FCBB2].
3. The SNMP Management Framework

The SNMP Management Framework presently consists of five major components:

- **An overall architecture**, described in RFC 2571 [RFC2571].
- **Mechanisms for describing and naming objects and events for the purpose of management.** The first version of this Structure of Management Information (SMI) is called SMIv1 and described in STD 16, RFC 1155 [RFC1155], STD 16, RFC 1212 [RFC1212] and RFC 1215 [RFC1215]. The second version, called SMIv2, is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].
- **Message protocols for transferring management information.** The first version of the SNMP message protocol is called SNMPv1 and described in STD 15, RFC 1157 [RFC1157]. A second version of the SNMP message protocol, which is not an Internet standards track protocol, is called SNMPv2c and described in RFC 1901 [RFC1901] and RFC 1906 [RFC1906]. The third version of the message protocol is called SNMPv3 and described in RFC 1906 [RFC1906], RFC 2572 [RFC2572] and RFC 2574 [RFC2574].
- **Protocol operations for accessing management information.** The first set of protocol operations and associated PDU formats is described in STD 15, RFC 1157 [RFC1157]. A second set of protocol operations and associated PDU formats is described in RFC 1905 [RFC1905].
- **A set of fundamental applications described in RFC 2573 [RFC2573]** and the view-based access control mechanism described in RFC 2575 [RFC2575].

A more detailed introduction to the current SNMP Management Framework can be found in RFC 2570 [RFC2570].

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

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

4. Overview of FCIP management model

Note that the FCIP Entity is fully described in [FCIP] from a functional point of view. A collection of multiple instances of FCIP Entities and the corresponding FC Entities, described in [BB2], within a single management entity is referred to as a FCIP device here. This section describes FCIP from a management point of view.

The FCIP device provides IP-based interconnection model to interconnect FC fabric elements. In this model, the FCIP devices along with the IP network on which they are running provide a new FCIP transport network.

This IP-based FCIP Interconnection Model supports the following topology:
- The FCIP-based transport network is formed by interconnecting the FCIP-devices.
- Each FCIP device has one or more FCIP Entities or Instances.
- Peer FCIP Entities are connected by FCIP Links, attached to VE_ports/B_Access.
- Each FCIP Link contains one or more Data Engines.
- The FCIP device can work as a standalone box or as part of a FC fabric element.

Each FCIP Entity managed by this MIB is referred to as a FCIP Instance. The MIB is broken up as follows:

4.1 FCIP Entity Instances Table
The FCIP Entity table contains information about this entity’s existing instances of FCIP entities.

4.2 FCIP Link Table
The FCIP link table contains information about this FCIP device’s existing FCIP links.

4.3 FCIP TCP Connection Table
The FCIP TCP Connection table contains information about existing TCP connections. Each FCIP link within a FCIP entity contains one or more TCP connections. The FCIP entity employs a Data Engine for each TCP connection for handling FC frame encapsulation, de-encapsulation and transmission of FCIP frames on the connection.

4.4 FCIP Dynamic Route Table
The FCIP dynamic route table contains routing information that is dynamically discovered by this FCIP device. The FCIP device may use
the SLPv2 protocol in conjunction with other protocols, such as FSPF, to dynamically discover other FCIP entities, and populate this table to map destination domains to FCIP Links.

4.5 FCIP Static Route Table
The FCIP static route table contains routing information that is statically configured into this FCIP device by Network Admin. In the absence of dynamic discovery of remote FCIP entities, the Network Manager will configure remote domains and FCIP Entities that are reachable by this device into this table.

4.6 FCIP Discovery Domain Table
The FCIP Discovery Domain Table maps this device’s FCIP Entities into FCIP Discovery Domains.

4.7 FCIP Link Error Table
The FCIP Link Errors Table contains counters that indicate error conditions on an FCIP Link.

5. Relationship to other MIBs
Objects accessible from other MIBs applicable to FCIP devices have not been included in this MIB.

5.1 Relationship to the ‘TCP’ group of MIB-II
This group is mandatory for all systems which implement TCP. Objects relevant to TCP must be obtained from this group.

5.2 Relationship to the ‘interfaces’ MIB
The ‘interfaces’ group is defined as being mandatory for all systems and contains information on an entity’s interfaces. Each logical/virtual interface created as an FCIP Link should be represented as a row in the ifTable with a unique ifIndex value and a value of ifType common to all such FCIP Links. These are the only ifIndex values of relevance to an FCIP Entity because FCIP runs over top of TCP/IP. When an FCIP entity has data to transmit to a peer FCIP entity, it gives it to TCP, and TCP formats the data into segments and gives them to IP; IP puts the data into datagrams which it sends on whatever one or more physical interfaces IP has available. Therefore, only IP, not an FCIP Entity, has knowledge of the ifIndex values for physical interfaces. Note that ifStackTable may be used to find the physical interface over which an FCIP Link is running.

5.3 Relationship to the Fibre Channel Management MIB
The Fibre Channel Management MIB [FCMGMT] is assumed for FC functionality managed objects.

6. Changes from draft-ietf-ips-fcip-mib-01.txt

  o Comments from NM advisor Keith McCloghrie
  o Added this change log
  o Updated introductory text
  o Added instance terminology to FCIP Entity for consistency with IPS MIBs.
  o Changed fcFcip prefix to fcip.
  o Removed fcFcipMode as a scalar applicable to all instances; moved into the FCIP Link table.
  o RowStatus object added to the tables that support row creation (fcipEntityTable, fcipLinkTable, fcipStaticRouteTable)
  o WWN of a FC Entity, FcNameIdOrZero, imported from FC-MGMT-MIB.
  o IpAddress format replaced by InetAddressType and InetAddress pair from INET-ADDRESS-MIB.
  o fcipEntityTcpConnPort - description modified to say "it contains the value zero(0) if the FCIP Entity only listens on the well-known port."
  o fcipEntityPHBIpOption object renamed as fcipEntityPHBSupport.
  o_truthValue type added and used wherever necessary.
  o fcipTcpConnRemPort added as part of Index list in the fcipTcpConnTable table.
  o The advertised TCP RW Size changed to default maximum TCP RW size.
  o FSPF usage added for finding domain IDs in the fcipDynamicRouteTable.
  o INDEX modified in fcipDynamicRouteTable and fcipStaticRouteTable.
  o fcipLinkIfIndex removed from INDEX in fcipLinkTable.
  o Added name object to FCIP Entity table (Display String of
Size 32 with read-write access).

- Added fcipDiscoveryDomainTable.

- fcEntityMode textual convention added to define the type of port mode provided by an FCIP entity for FCIP Links.

- fcipLinkLocalFcipEntityMode added to the fcipLinkTable to indicate the type of port mode (E_Port or B_Port) provided by the local FCIP entity.

- fcipLinkErrorsTable added to define counters for error cases that cause closing down TCP connections.

- Specified in "Relationship to interfaces MIB" that each FCIP Link runs over a virtual interface represented by an entry in the interfaces table. Updated fcipLinkIfIndex accordingly.

- REVISION and DESCRIPTION clause added to MODULE-IDENTITY.

- Object fcipFabricWWN renamed as fcipDeviceWWN.

- fcipEntityInstanceTable - read-write attributes changed to read-create.

- Moved fcipEntitySACKOption to device level from FCIP entity level, and changed MAX-ACCESS to read-only.

- IP Address objects fcipLinkLocalFcipEntityAddressType and fcipLinkLocalFcipEntityAddress added to the fcipLinkTable.

- fcipLinkTable - read-write attributes changed to read-create.

- fcipTcpConnTimeOut removed from fcipTcpConnTable.

- Added fcipDynamicRouteIndex to the INDEX clause of the fcipDynamicRouteTable.

- Added fcipStaticRouteIndex to the INDEX clause of the fcipStaticRouteTable.

- Removed objects fcipStaticRouteRemFcipEntityWNN, fcipStaticRouteRemFcipEntityId, fcipStaticRouteRemFcipEntityAddressType and fcipStaticRouteRemFcipEntityAddress from fcipStaticRouteTable and added fcipStaticRouteLinkIndex to the same.

- All read-write attributes changed to read-create in the fcipStaticRouteTable.
- Added REFERENCE clauses for fcipEntitySACKOption, fcipEntitySeqNumWrap, fcipEntityPHBSupport

- Made tables fcipDynamicRouteEntry and fcipStaticRoute conditionally mandatory rather than mandatory. They will be optional for implementations which contain the same information in another FC MIB (although such implementations may choose to report these tables for convenience).

- Added conformance groups and compliance statement.

- Added security considerations section.

- Updated references section.
7. MIB Definitions

FCIP-MGMT-MIB DEFINITIONS ::= BEGIN

IMPORTS
  OBJECT-TYPE,
  MODULE-IDENTITY,
  Unsigned32,
  Counter32,
  mib-2 FROM SNMPv2-SMI
  TEXTUAL-CONVENTION,
  TruthValue,
  DisplayString, RowStatus FROM SNMPv2-TC
  InetAddressType,
  InetAddress FROM INET-ADDRESS-MIB
  FcNameIdOrZero FROM FC-MGMT-MIB
  MODULE-COMPLIANCE,
  OBJECT-GROUP FROM SNMPv2-CONF;

fcipMIB MODULE-IDENTITY
  LAST-UPDATED "200210070000Z"
  ORGANIZATION "IETF IPS (IP Storage) Working Group"
  CONTACT-INFO "Anil Rijhsinghani
  McDATA Corporation
  4 McDATA Parkway
  Broomfield, CO 80021 USA.
  Phone: +1 508 870 6593
  Email: anil.rijhsinghani@mcdata.com

  Ravi Natarajan
  LightSand Communications Inc,
  279 Sinclair Frontage Road
  Milpitas, CA 95035 USA.
  Phone: +1 408 404 3149
  Email: ravin@lightsand.com"
  DESCRIPTION "The FCIP management MIB module."
  REVISION "200209270000Z"
  DESCRIPTION "This module defines management information specific to
  FCIP devices."
  ::= { mib-2 8889 } -- TO BE ASSIGNED by IANA

fcipObjects OBJECT IDENTIFIER ::= { fcipMIB 1 }
fcipConformance OBJECT IDENTIFIER ::= { fcipMIB 2 }
fcipConfig OBJECT IDENTIFIER ::= { fcipObjects 1 }
-- ******************************************************************
-- Textual conventions
--
FcDomainId ::= TEXTUAL-CONVENTION
  STATUS    current
  DESCRIPTION    "The Domain ID of a FC entity."
  SYNTAX    OCTET STRING (SIZE(1))

FcEntityMode ::= TEXTUAL-CONVENTION
  STATUS    current
  DESCRIPTION    "The type of port mode provided by an FCIP Entity
  for a FCIP Link. An FCIP Entity can be an E-Port
  mode for one of its FCIP Link Endpoints, an B-Port
  mode for another of its FCIP Link Endpoints."
  SYNTAX INTEGER {
    ePortMode(1),
    bPortMode(2),
    other(3)
  }

-- ******************************************************************
-- The FCIP group
--
-- This group defines the global scalar objects applicable to FCIP
-- devices only
--
fcipDynIpConfType       OBJECT-TYPE
SYNTAX INTEGER {
  slpv2(1),
  none(2)
}
MAX-ACCESS read-write
STATUS    current
DESCRIPTION    "The type of dynamic discovery protocol used to discover
remote FCIP entities."
::= { fcipConfig 1 }

fcipDeviceWWN   OBJECT-TYPE
SYNTAX FcNameIdOrZero
MAX-ACCESS read-only
STATUS    current
DESCRIPTION    "The World Wide Name of this FCIP device."
::= { fcipConfig 2 }
fcipEntitySACKOption  OBJECT-TYPE
SYNTAX  INTEGER {
    enabled(1),
    disabled(2)
}
MAX-ACCESS  read-only
STATUS  current
DESCRIPTION
   "An indication of whether the TCP Selective Acknowledgement Option
is enabled at this FCIP device to allow the receiver end to
acknowledge multiple lost packets in a single ACK, enabling
faster recovery."
REFERENCE
   "The Selective Ack option is defined in RFC 2883."
 ::= { fcipConfig 3 }

-- ******************************************************************
-- fcipEntityInstanceTable
--
-- The FCIP Entity table contains information about this entity’s existing
-- FCIP entities.

fcipEntityInstanceTable  OBJECT-TYPE
SYNTAX  SEQUENCE OF FcipEntityInstanceEntry
MAX-ACCESS  not-accessible
STATUS  current
DESCRIPTION
   "A table containing FCIP entity-specific information."
 ::= { fcipConfig 4 }

FcipEntityInstanceEntry  OBJECT-TYPE
SYNTAX  FcipEntityInstanceEntry
MAX-ACCESS  not-accessible
STATUS  current
DESCRIPTION
   "A conceptual row of the FCIP entity table containing information
about a particular FCIP entity."
INDEX  { fcipEntityId }
 ::= { fcipEntityInstanceTable 1 }

FcipEntityInstanceEntry ::= SEQUENCE {
    fcipEntityId                Unsigned32,
    fcipEntityName              DisplayString,
    fcipEntityAddressType       InetAddressType,
    fcipEntityAddress           InetAddress,
fcipEntityTcpConnPort  INTEGER,
fcipEntitySeqNumWrap   TruthValue,
fcipEntityPHBSupport   TruthValue,
fcipEntityStatus       RowStatus
}

fcipEntityId  OBJECT-TYPE
  SYNTAX Unsigned32
  MAX-ACCESS read-create
  STATUS current
  DESCRIPTION
    "The FCIP entity identifier as defined in [FCIP]."
  ::= { fcipEntityInstanceEntry 1 }

fcipEntityName  OBJECT-TYPE
  SYNTAX DisplayString (SIZE (0..32))
  MAX-ACCESS read-create
  STATUS current
  DESCRIPTION
    "An administratively-assigned name for this FCIP entity."
  ::= { fcipEntityInstanceEntry 2 }

fcipEntityAddressType  OBJECT-TYPE
  SYNTAX InetAddressType
  MAX-ACCESS read-create
  STATUS current
  DESCRIPTION
    "The type of Internet address by which the entity is reachable."
  ::= { fcipEntityInstanceEntry 3 }

fcipEntityAddress  OBJECT-TYPE
  SYNTAX InetAddress
  MAX-ACCESS read-create
  STATUS current
  DESCRIPTION
    "The Internet address for the entity, if configured."
  ::= { fcipEntityInstanceEntry 4 }

fcipEntityTcpConnPort  OBJECT-TYPE
  SYNTAX INTEGER (0..65535)
  MAX-ACCESS read-create
  STATUS current
  DESCRIPTION
    "A TCP port other than the FCIP Well-Known port on which the FCIP
     entity entity listens for new TCP connection requests. It contains
     the value zero(0) if the FCIP Entity only listens on the Well-Known
     port."
  ::= { fcipEntityInstanceEntry 5 }


fcipEntitySeqNumWrap OBJECT-TYPE
SYNTAX TruthValue
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"An indication of whether the FCIP Entity supports the protection against sequence number wrap."
REFERENCE
"The PAWS option is defined in RFC 1323."
::= { fcipEntityInstanceEntry 6 }

fcipEntityPHBSupport OBJECT-TYPE
SYNTAX TruthValue
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"An indication of whether the FCIP Entity supports PHB IP QoS."
REFERENCE
"Per hop behavior is defined in RFC 2474, definition of the Differentiated Services Field."
::= { fcipEntityInstanceEntry 7 }

fcipEntityStatus OBJECT-TYPE
SYNTAX RowStatus
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"This variable displays the status of the entry."
::= { fcipEntityInstanceEntry 8 }

-- ******************************************************************
-- fcipLinkTable
--
-- The FCIP link table contains information about this FCIP device's existing FCIP links.

fcipLinkTable OBJECT-TYPE
SYNTAX SEQUENCE OF FcipLinkEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"A table containing FCIP Link-specific information."
::= { fcipConfig 5 }

fcipLinkEntry OBJECT-TYPE
SYNTAX FcipLinkEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
    "A conceptual row of the FCIP link table containing information about a particular FCIP link."
INDEX { fcipEntityId, fcipLinkIndex }
 ::= { fcipLinkTable 1 }

FcipLinkEntry ::=  
    SEQUENCE {
        fcipLinkIndex                       Unsigned32,
        fcipLinkIfIndex                     INTEGER,
        fcipLinkCost                        Unsigned32,
        fcipLinkLocalFcipEntityMode         FcEntityMode,
        fcipLinkLocalFcipEntityAddressType  InetAddressType,
        fcipLinkLocalFcipEntityAddress      InetAddress,
        fcipLinkRemFcipEntityWWN            FcNameIdOrZero,
        fcipLinkRemFcipEntityId             Unsigned32,
        fcipLinkRemFcipEntityAddressType    InetAddressType,
        fcipLinkRemFcipEntityAddress        InetAddress,
        fcipLinkStatus                      RowStatus
    }

fcipLinkIndex OBJECT-TYPE
SYNTAX  Unsigned32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
    "An arbitrary integer which uniquely identifies one FCIP link within a FCIP entity."
 ::= { fcipLinkEntry 1 }

fcipLinkIfIndex OBJECT-TYPE
SYNTAX  INTEGER
MAX-ACCESS read-only
STATUS current
DESCRIPTION
    "The ifIndex value of the virtual interface corresponding to the FCIP Link running over TCP/IP. Also see section up top on Relationship to the interfaces MIB."
 ::= { fcipLinkEntry 2 }

fcipLinkCost OBJECT-TYPE
SYNTAX  Unsigned32
MAX-ACCESS read-create
STATUS current
DESCRIPTION
    "The cost associated with this FCIP Link."

::= { fcipLinkEntry 3 }

fcipLinkLocalFcipEntityMode OBJECT-TYPE
SYNTAX FcEntityMode
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The mode of the local FCIP Entity to which this FCIP Link
pertains."
::= { fcipLinkEntry 4 }

fcipLinkLocalFcipEntityAddressType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The Internet address type of the local FCIP entity."
::= { fcipLinkEntry 5 }

fcipLinkLocalFcipEntityAddress OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The Internet address for the local FCIP Link, if configured."
::= { fcipLinkEntry 6 }

fcipLinkRemFcipEntityWWN OBJECT-TYPE
SYNTAX FcNameIdOrZero
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The World Wide Name of the remote FC Fabric Entity."
::= { fcipLinkEntry 7 }

fcipLinkRemFcipEntityId OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The remote FCIP entity’s identifier."
::= { fcipLinkEntry 8 }

fcipLinkRemFcipEntityAddressType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The type of Internet address by which the remote FCIP entity is reachable." ::= { fcipLinkEntry 9 }

fcipLinkRemFcipEntityAddress OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS read-create
STATUS current
DESCRIPTION "The Internet address for the remote FCIP Link."
 ::= { fcipLinkEntry 10 }

fcipLinkStatus OBJECT-TYPE
SYNTAX RowStatus
MAX-ACCESS read-create
STATUS current
DESCRIPTION "This variable displays the status of the entry."
 ::= { fcipLinkEntry 11 }

-- ******************************************************************
-- fcipTcpConnTable
--
-- The FCIP TCP Connection table contains information about existing TCP connections. Each FCIP link within a FCIP entity contains one or more TCP connections. The FCIP entity employs a Data Engine for each TCP connection for handling FC frame encapsulation, de-encapsulation and transmission of FCIP frames on the connection.

fcipTcpConnTable OBJECT-TYPE
SYNTAX SEQUENCE OF FcipTcpConnEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "A table containing FCIP specific information about this FCIP device’s existing TCP connections."
 ::= { fcipConfig 6 }

fcipTcpConnEntry OBJECT-TYPE
SYNTAX FcipTcpConnEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "A conceptual row of the FCIP TCP Connection table containing information about a particular TCP connection."
INDEX { fcipEntityId,
fcipLinkIndex,  
fcipTcpConnLocalPort,  
fcipTcpConnRemPort }  
::= { fcipTcpConnTable 1 }

FcipTcpConnEntry ::=  
SEQUENCE {  
  fcipTcpConnLocalPort INTEGER,  
  fcipTcpConnRemPort INTEGER,  
  fcipTcpConnPurpose INTEGER,  
  fcipTcpConnRWSize Unsigned32,  
  fcipTcpConnMSS Unsigned32  
}

fcipTcpConnLocalPort OBJECT-TYPE  
SYNTAX INTEGER (0..65535)  
MAX-ACCESS read-only  
STATUS current  
DESCRIPTION  
"The local port number for this TCP connection."
::= { fcipTcpConnEntry 1 }

fcipTcpConnRemPort OBJECT-TYPE  
SYNTAX INTEGER (0..65535)  
MAX-ACCESS read-only  
STATUS current  
DESCRIPTION  
"The remote port number for this TCP connection."
::= { fcipTcpConnEntry 2 }

fcipTcpConnPurpose OBJECT-TYPE  
SYNTAX INTEGER {  
  control(1),  
  data(2),  
  both(3)  
}  
MAX-ACCESS read-only  
STATUS current  
DESCRIPTION  
"The nature of messages that get transmitted on this TCP connection."
::= { fcipTcpConnEntry 3 }

fcipTcpConnRWSize OBJECT-TYPE  
SYNTAX Unsigned32  
MAX-ACCESS read-only  
STATUS current  
DESCRIPTION  
"The size of messages that get transmitted on this TCP connection."
::= { fcipTcpConnEntry 4 }

fcipTcpConnMSS OBJECT-TYPE  
SYNTAX Unsigned32  
MAX-ACCESS read-only  
STATUS current  
DESCRIPTION  
"The maximum size of segments that get transmitted on this TCP connection."
::= { fcipTcpConnEntry 5 }
"The default maximum TCP Receiver Window size for this TCP connection."
::= { fcipTcpConnEntry 4 }

fcipTcpConnMSS OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The TCP Maximum Segment Size(MSS) for this TCP connection."
::= { fcipTcpConnEntry 5 }

-- ******************************************************************
-- fcipDynamicRouteTable
--
-- The FCIP dynamic route table contains routing information that is
dynamically discovered by this FCIP device. The FCIP device may use
the SLPv2 protocol in conjunction with other protocols, such as FSPF,
to dynamically discover other FCIP entities, and populate this table
to map destination domains to FCIP Links.

fcipDynamicRouteTable OBJECT-TYPE
SYNTAX SEQUENCE OF FcipDynamicRouteEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"A table containing FCIP Route specific information."
::= { fcipConfig 7 }

fcipDynamicRouteEntry OBJECT-TYPE
SYNTAX FcipDynamicRouteEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"A conceptual row of the FCIP Dynamic Route Table containing
information about a particular FCIP route."
INDEX { fcipEntityId, fcipDynamicRouteDID, fcipDynamicRouteIndex }
::= { fcipDynamicRouteTable 1 }

FcipDynamicRouteEntry ::= 
SEQUENCE {
  fcipDynamicRouteIndex        Unsigned32,
  fcipDynamicRouteDID          FcDomainId,
  fcipDynamicRouteLinkIndex    Unsigned32
}

fcipDynamicRouteIndex OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"An index that uniquely identifies an entry in the FCIP dynamic Route table."
 ::= { fcipDynamicRouteEntry  1 }

fcipDynamicRouteDID    OBJECT-TYPE
SYNTAX FcDomainId
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"8 bit ID of a Fibre Channel Domain that is reachable from this FCIP device."
 ::= { fcipDynamicRouteEntry  2 }

fcipDynamicRouteLinkIndex    OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The FCIP Link that is represented by this value in the FCIP Link table used to reach this domain(specified by the previous object ‘fcipDynamicRouteDID’) on the remote FCIP device."
 ::= { fcipDynamicRouteEntry  3 }

-- ******************************************************************
-- fcipStaticRouteTable
--
-- The FCIP static route table contains routing information that is statically configured into this FCIP device by Network Admin.
-- In the absence of dynamic discovery of remote FCIP entities, the Network Manager will configure remote domains and FCIP Entities that are reachable by this device into this table.

fcipStaticRouteTable OBJECT-TYPE
SYNTAX SEQUENCE OF FcipStaticRouteEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"A table containing FCIP Route specific information."
 ::= { fcipConfig 8 }

fcipStaticRouteEntry OBJECT-TYPE
SYNTAX FcipStaticRouteEntry
MAX-ACCESS not-accessible
A conceptual row of the FCIP Static Route Table containing information about a particular FCIP route.

INDEX { fcipEntityId, fcipStaticRouteDID, fcipStaticRouteIndex } ::= { fcipStaticRouteTable 1 }

FcipStaticRouteEntry ::= SEQUENCE {
  fcipStaticRouteIndex                    Unsigned32,
  fcipStaticRouteDID                      FcDomainId,
  fcipStaticRouteLinkIndex                Unsigned32,
  fcipStaticRouteStatus                   RowStatus
}

fcipStaticRouteIndex    OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"An index that uniquely identifies an entry in the FCIP static Route table."
 ::= { fcipStaticRouteEntry  1 }

fcipStaticRouteDID    OBJECT-TYPE
SYNTAX FcDomainId
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"8 bit ID of a Fibre Channel Domain that is reachable from this FCIP device."
 ::= { fcipStaticRouteEntry  2 }

fcipStaticRouteLinkIndex    OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The FCIP Link that is represented by this value in the FCIP Link table used to reach the domain specified by fcipStaticRouteDID on the remote FCIP device."
 ::= { fcipStaticRouteEntry  3 }

fcipStaticRouteStatus   OBJECT-TYPE
SYNTAX RowStatus
MAX-ACCESS   read-create
STATUS   current
DESCRIPTION

"This variable displays the status of the entry. Setting it to 'invalid' has the effect of rendering it inoperative. The internal effect (row removal) is implementation dependent."
::= { fcipStaticRouteEntry 4 }

-- ******************************************************************
-- fcipDiscoveryDomainTable
--
-- The FCIP Discovery Domain Table maps this device’s FCIP Entities into
-- FCIP Discovery Domains.

fcipDiscoveryDomainTable OBJECT-TYPE
SYNTAX SEQUENCE OF FcipDiscoveryDomainEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"A table of information about FCIP Discovery Domains. Each FCIP Discovery Domain can contain one or more of this device’s FCIP entities."
::= { fcipConfig 9 }

fcipDiscoveryDomainEntry OBJECT-TYPE
SYNTAX FcipDiscoveryDomainEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"A conceptual row of the FCIP Discovery Domain Table containing information about a particular FCIP Discovery Domain which contains one or more FCIP entities."
INDEX { fcipEntityId, fcipDiscoveryDomainIndex }
::= { fcipDiscoveryDomainTable 1 }

FcipDiscoveryDomainEntry ::= SEQUENCE {
   fcipDiscoveryDomainIndex        Unsigned32,
   fcipDiscoveryDomainName         DisplayString
}

fcipDiscoveryDomainIndex OBJECT-TYPE
SYNTAX     Unsigned32
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
"An arbitrary integer which uniquely identifies a FCIP Discovery Domain amongst those contained by one FCIP Entity."
::= { fcipDiscoveryDomainEntry 1 }
fcipDiscoveryDomainName OBJECT-TYPE
SYNTAX DisplayString (SIZE (0..128))
MAX-ACCESS read-write
STATUS current
DESCRIPTION
   "The fully qualified name for this FCIP Discovery Domain."
 ::= { fcipDiscoveryDomainEntry 2 }

-- ******************************************************************
-- fcipLinkErrorsTable
--
-- The FCIP Link Errors Table contains counters that indicate error
-- conditions on an FCIP link.

fcipLinkErrorsTable OBJECT-TYPE
SYNTAX SEQUENCE OF FcipLinkErrorsEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
   "A table containing error counters for FCIP Links."
 ::= { fcipConfig 10 }

fcipLinkErrorsEntry OBJECT-TYPE
SYNTAX FcipLinkErrorsEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
   "A conceptual row of the FCIP Link Errors Table containing
error counters for a FCIP Link."
INDEX { fcipEntityId, fcipLinkIndex }
 ::= { fcipLinkErrorsTable 1 }

FcipLinkErrorsEntry ::= SEQUENCE {
   fcipLinkFcipLossofFcSynchs            Counter32,
   fcipLinkFcipEncapErrors               Counter32,
   fcipLinkFcipSfRespNotReceived         Counter32,
   fcipLinkFcipSfRespMismatch            Counter32,
   fcipLinkFcipSfInvalidNonce            Counter32,
   fcipLinkFcipDuplicateSfReceived       Counter32,
   fcipLinkFcipSfInvalidWWN              Counter32,
   fcipLinkFcipBB2LkaTimeOut             Counter32,
   fcipLinkFcipSntpTimeStampExpired      Counter32,
   fcipLinkTcpTooManyErrors              Counter32,
   fcipLinkTcpKeepAliveTimeOut           Counter32,
fcipLinkTcpExcessiveDatagramsDropped Counter32,
fcipLinkTcpSaParamMismatch Counter32

fcipLinkFcipLossOfFcSynchs OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of times FC synchronization lost on this FCIP Link."
::= { fcipLinkErrorsEntry 1 }

fcipLinkFcipEncapErrors OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of FCIP frames received with encapsulation errors such as improper header, format, or length."
::= { fcipLinkErrorsEntry 2 }

fcipLinkFcipSfRespNotReceived OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of times FCIP Special Frame Response not received on this FCIP Link."
::= { fcipLinkErrorsEntry 3 }

fcipLinkFcipSfRespMismatch OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of times FCIP Special Frame Bytes mismatch happened on this FCIP Link."
::= { fcipLinkErrorsEntry 4 }

fcipLinkFcipSfInvalidNonce OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of times FCIP Special Frame Invalid connection Nonce happened on this FCIP Link."
::= { fcipLinkErrorsEntry 5 }
fcipLinkFcipDuplicateSfReceived OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of times duplicate FCIP Special Frames were received on this FCIP Link."
 ::= { fcipLinkErrorsEntry 6 }

fcipLinkFcipSfInvalidWWN OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of times FCIP Special Frames with invalid destination FC Fabric Entity WWN received on this FCIP Link."
 ::= { fcipLinkErrorsEntry 7 }

fcipLinkFcipBB2LkaTimeOut OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of Link Keep Alive Time outs that occurred on this FCIP Link."
 ::= { fcipLinkErrorsEntry 8 }

fcipLinkFcipSntpTimeStampExpired OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of frames discarded due to an expire SNTP Time Stamp on this FCIP Link."
 ::= { fcipLinkErrorsEntry 9 }

fcipLinkTcpTooManyErrors OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of TCP connections that closed down on this FCIP Link due to too many errors."
 ::= { fcipLinkErrorsEntry 10 }

fcipLinkTcpKeepAliveTimeOut OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of TCP connections that closed down on this
FCIP Link due to TCP Keep Alive Time outs."
::= { fcipLinkErrorsEntry 11 }

fcipLinkTcpExcessiveDatagramsDropped OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of TCP connections that closed down on this
FCIP Link due to an excessive number of dropped datagrams."
::= { fcipLinkErrorsEntry 12 }

fcipLinkTcpSaParamMismatch OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of times TCP connections with SA parameter
mismatches closed down on this FCIP Link."
::= { fcipLinkErrorsEntry 13 }
-- ******************************************************************
-- Conformance Statements
--

fcipCompliances OBJECT IDENTIFIER ::= { fcipConformance 1 }
fcipGroups OBJECT IDENTIFIER ::= { fcipConformance 2 }

fcipCompliance MODULE-COMPLIANCE
  STATUS current
  DESCRIPTION "Compliance statement for FCIP MIB."
  MODULE -- this module
  MANDATORY-GROUPS {
    fcipEntityScalarGroup,
    fcipEntityInstanceGroup,
    fcipLinkGroup,
    fcipTcpConnGroup,
    fcipDiscoveryDomainGroup,
    fcipLinkErrorsGroup
  }

GROUP fcipDynamicRouteGroup
  DESCRIPTION "This group is mandatory only for systems which
do not have the same information in any other
FC Routing Table MIB objects. It may be implemented
even in that case for convenience."

GROUP fcipStaticRouteGroup
  DESCRIPTION "This group is mandatory only for systems which
do not have the same information in any other
FC Routing Table MIB objects. It may be implemented
even in that case for convenience."

::= { fcipCompliances 1 }

fcipEntityScalarGroup OBJECT-GROUP
  OBJECTS {
    fcipDynIpConfType,
    fcipDeviceWWN,
    fcipEntitySACKOption
  }
  STATUS current
  DESCRIPTION "A collection of scalar objects applicable to all FCIP instances."
  ::= { fcipGroups 1 }
fcipEntityInstanceGroup OBJECT-GROUP
OBJECTS {
    fcipEntityId,
    fcipEntityName,
    fcipEntityAddressType,
    fcipEntityAddress,
    fcipEntityTcpConnPort,
    fcipEntitySeqNumWrap,
    fcipEntityPHBSupport,
    fcipEntityStatus
}
STATUS current
DESCRIPTION
   "A collection of objects providing information about FCIP instances."
::= { fcipGroups 2 }

fcipLinkGroup OBJECT-GROUP
OBJECTS {
    fcipLinkIndex,
    fcipLinkIfIndex,
    fcipLinkCost,
    fcipLinkLocalFcipEntityMode,
    fcipLinkLocalFcipEntityAddressType,
    fcipLinkLocalFcipEntityAddress,
    fcipLinkRemFcipEntityWWN,
    fcipLinkRemFcipEntityId,
    fcipLinkRemFcipEntityAddressType,
    fcipLinkRemFcipEntityAddress,
    fcipLinkStatus
}
STATUS current
DESCRIPTION
   "A collection of objects providing information about FCIP Links."
::= { fcipGroups 3 }

fcipTcpConnGroup OBJECT-GROUP
OBJECTS {
    fcipTcpConnLocalPort,
    fcipTcpConnRemPort,
    fcipTcpConnPurpose,
    fcipTcpConnRWSize,
    fcipTcpConnMSS
}
STATUS current
DESCRIPTION
"A collection of objects providing information about FCIP
TCP connections."
::= { fcipGroups 4 }

fcipDiscoveryDomainGroup OBJECT-GROUP
OBJECTS {
    fcipDiscoveryDomainName
}
STATUS current
DESCRIPTION
"A collection of objects providing information about FCIP
Discovery Domains."
::= { fcipGroups 5 }

fcipLinkErrorsGroup OBJECT-GROUP
OBJECTS {
    fcipLinkFcipLossOfFcSynchs,
    fcipLinkFcipEncapErrors,
    fcipLinkFcipSfRespNotReceived,
    fcipLinkFcipSfRespMismatch,
    fcipLinkFcipSfInvalidNonce,
    fcipLinkFcipDuplicateSfReceived,
    fcipLinkFcipSfInvalidWNN,
    fcipLinkFcipSntpTimeStampExpired,
    fcipLinkTcpTooManyErrors,
    fcipLinkTcpKeepAliveTimeOut,
    fcipLinkTcpExcessiveDatagramsDropped,
    fcipLinkTcpSaParamMismatch
}
STATUS current
DESCRIPTION
"A collection of objects providing information about FCIP
link errors."
::= { fcipGroups 6 }

fcipDynamicRouteGroup OBJECT-GROUP
OBJECTS {
    fcipDynamicRouteIndex,
    fcipDynamicRouteDID,
    fcipDynamicRouteLinkIndex
}
STATUS current
DESCRIPTION
"A collection of objects providing information about FCIP
dynamic routes."
::= { fcipGroups 7 }
fcipStaticRouteGroup OBJECT-GROUP
   OBJECTS {
      fcipStaticRouteIndex,
      fcipStaticRouteDID,
      fcipStaticRouteLinkIndex,
      fcipStaticRouteStatus
   }
   STATUS current
   DESCRIPTION
      "A collection of objects providing information about FCIP
      static routes."
   ::= { fcipGroups 8 }
END
8. Security considerations

There are a number of management objects defined in this MIB that have a MAX-ACCESS clause of read-write and/or read-create. Such objects may be considered sensitive or vulnerable in some network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations.

There are a number of managed objects in this MIB that contain what could be considered as sensitive information. In particular, the objects which provide information on identification and network topology:

fcipDeviceWWN
fcipEntityName
fcipEntityAddress
fcipLinkLocalFcipEntityAddress
fcipLinkRemFcipEntityWWN
fcipLinkRemFcipEntityAddress
fcipDynamicRouteTable
fcipStaticRouteTable
fcipDiscoveryDomainTable

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

SNMPv1 by itself is not a secure environment. Even if the network itself is secure (for example by using IPSec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in this MIB.

It is recommended that the implementers consider the security features as provided by the SNMPv3 framework. Specifically, the use of the User-based Security Model RFC 2574 [RFC2574] and the View-based Access Control Model RFC 2575 [RFC2575] is recommended. It is then a customer/user responsibility to ensure that the SNMP entity giving access to an instance of this MIB, is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET or SET (change/create/delete) them.

9. Intellectual Property

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