Definitions of Managed Objects for Fibre Channel Over TCP/IP (FCIP)

Status of This Memo

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

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Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in TCP/IP-based internets. In particular, it defines objects for managing Fibre Channel Over TCP/IP (FCIP) entities, which are used to interconnect Fibre Channel (FC) fabrics with IP networks.

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1. 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].

2. Overview of FCIP Management Model

Note that the Fibre Channel Over TCP/IP (FCIP) Entity is fully described in [RFC3821] from a functional point of view. A collection of multiple instances of FCIP Entities and the corresponding FC Entities, described in [FCBB2], within an SNMP Context is referred to as an FCIP device here. This section describes FCIP from a management point of view.

```
+-----------------------------+     +-----------------------------+     +-----------------------------+
|                             |     |                             |     |                             |
|                             |     |                             |     |                             |
|                             |     |                             |     |                             |
|                             |     |                             |     |                             |
|                             |     |                             |     |                             |
|                             |     |                             |     |                             |
|     FCIP Device             |     |     FCIP Device             |     |     FCIP Device             |
|     +--------------------+     |     +--------------------+     |     +--------------------+     |
|     | FCIP Entity           |     | FCIP Entity                |     | FCIP Entity                |
|     |                       |     |                           |     |                           |
|     |                       |     |                           |     |                           |
|     |                       |     |                           |     |                           |
|     | FCIP Links            |     | FCIP Links                 |     | FCIP Links                 |
|     +--------------------+     |     +--------------------+     |     +--------------------+     |
```

The FCIP device provides an IP-based interconnection model for interconnecting 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 Endpoint contains one or more Data Engines.

The FCIP device can work as a stand-alone box or as part of a FC fabric element.

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

2.1. FCIP Entity Instances Table

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

2.2. FCIP Link Table

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

2.3. FCIP TCP Connection Table

The FCIP TCP Connection table contains information about existing TCP connections. Each FCIP link within an 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.

2.4. 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 [RFC3822] in conjunction with other protocols, such as Fabric Shortest Path First (FSPF), to dynamically discover other FCIP entities and populate this table to map destination domains to FCIP Links.

2.5. FCIP Static Route Table

The FCIP static route table contains routing information that is statically configured into this FCIP device by the Network Admin. In the absence of dynamic discovery of remote FCIP entities, the Network Manager can configure remote domains and FCIP Entities that are reachable by this device into this table.
At any point in time, both the static and dynamic routing tables can be active. If a DID is present in both tables, information in the static route table will take precedence over the entry in the dynamic route table for the same DID.

2.6. FCIP Discovery Domain Table

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

2.7. FCIP Link Error Table

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

3. Relationship to Other MIBs

Objects accessible from other MIB modules applicable to FCIP devices have not been included in this MIB module. The following subsections list all applicable MIB modules that should be present with FCIP-MGMT-MIB.

3.1. Relationship to the ‘TCP’ Group

This group is mandatory for all systems that implement TCP. Objects relevant to TCP must be obtained from this group [RFC4022].

3.2. 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 ‘fcipLink’ (224) for each such interface. For a complete list of interface types, refer to the IANA registry at "http://www.iana.org/assignments/smi-numbers". These are the only ifIndex values of relevance to an FCIP Entity because FCIP runs on top of TCP/IP.

FCIP runs over TCP. Thus, by definition, there is no ifTable interface directly beneath it, and so ifStackLowerLayer is always 0. For any protocol using FCIP (i.e., above FCIP), FCIP appears to be a regular FC interface. As stated in [RFC4044], a regular "FC interface will typically have no other ifTable rows stacked on top of it", and thus, ifStackHigherLayer is typically zero.
3.3. Relationship to the Fibre Channel Management MIB

The Fibre Channel Management MIB [RFC4044] is assumed for FC functionality managed objects.

3.4. Specific Interface Group MIB Objects

The following table provides specific implementation guidelines for applying the objects defined in the Interfaces Group MIB to FCIP Links. For those objects not listed here, refer to their generic definitions in [RFC2863].

<table>
<thead>
<tr>
<th>Object</th>
<th>Guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>ifType</td>
<td>'fcipLink' (224)</td>
</tr>
<tr>
<td>ifSpeed</td>
<td>The ifSpeed for the physical interface(s) over which the FCIP Link runs.</td>
</tr>
<tr>
<td>ifPhysAddress</td>
<td>There is no physical address corresponding to an FCIP Link (only World Wide Name, WWN). Reported as 0.</td>
</tr>
<tr>
<td>ifAdminStatus</td>
<td>Write access is not required, and support for ‘testing’ is not required.</td>
</tr>
<tr>
<td>ifOperStatus</td>
<td>Support for ‘testing’ is not required. The value ‘dormant’ has no meaning for FCIP Links.</td>
</tr>
<tr>
<td>ifInOctets</td>
<td>The number of octets of FCIP information contained in received frames in TCP streams, starting with FCIP header.</td>
</tr>
<tr>
<td>ifHCInOctets</td>
<td></td>
</tr>
<tr>
<td>ifInUcastPkts</td>
<td>The number of FCIP frames received on this FCIP Link.</td>
</tr>
<tr>
<td>ifHCInUcastPkts</td>
<td></td>
</tr>
<tr>
<td>ifOutOctets</td>
<td>The number of octets of FCIP information contained in transmitted frames in TCP streams, starting with FCIP header.</td>
</tr>
<tr>
<td>ifHCOOutOctets</td>
<td></td>
</tr>
<tr>
<td>ifOutUcastPkts</td>
<td>The number of FCIP frames transmitted on this FCIP Link.</td>
</tr>
<tr>
<td>ifHCOOutUcastPkts</td>
<td></td>
</tr>
</tbody>
</table>
ifInMulticastPkts  These counters are not incremented.
ifInBroadcastPkts
ifOutMulticastPkts
ifOutBroadcastPkts
ifHCInMulticastPkts
ifHCInBroadcastPkts
ifHCOOutMulticastPkts
ifHCOOutBroadcastPkts

ifLinkUpDownTrapEnable  Default is ‘disabled’.
ifPromiscuousMode  This will be ‘false’.
ifConnectorPresent  This will be ‘false’.

4. MIB Definitions

The following MIB module has IMPORTS from [RFC2578], [RFC2579],
[RFC4001], [RFC4044], [RFC2863], [RFC2580], and [RFC3411]. In
REFERENCE clauses, it refers to [FC-SW-3], [RFC3821], [RFC2883],
[RFC1323], [RFC2474] and [RFC3822].

FCIP-MGMT-MIB DEFINITIONS ::= BEGIN

IMPORTS
  OBJECT-TYPE,
  MODULE-IDENTITY,
  Unsigned32,
  Counter32,
  mib-2               FROM SNMPv2-SMI
  TEXTUAL-CONVENTION,
  TruthValue, RowStatus, TimeStamp FROM SNMPv2-TC
  InetAddressType,
  InetAddress,
  InetPortNumber FROM INET-ADDRESS-MIB
  FcNameIdOrZero FROM FC-MGMT-MIB
  InterfaceIndex FROM IF-MIB
  MODULE-COMPLIANCE,
  OBJECT-GROUP FROM SNMPv2-CONF
  SnmpAdminString FROM SNMP-FRAMEWORK-MIB;

fcipMIB MODULE-IDENTITY
  LAST-UPDATED "200602060000Z"
  ORGANIZATION "IETF IPFC Working Group"
  CONTACT-INFO "Anil Rijhsinghani
  Accton Technology Corporation
  5 Mount Royal Ave
  Marlboro, MA 01752 USA."
DESCRIPTION
"The module defines management information specific to
FCIP devices.

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of this MIB module is part of RFC 4404; see the RFC
itself for full legal notices."

REVISION "200602060000Z"

DESCRIPTION
"Initial version of this module, published as RFC 4404."

::= { mib-2 224 }

fcipObjects OBJECT IDENTIFIER ::= { fcipMIB 1 }
fcipConformance OBJECT IDENTIFIER ::= { fcipMIB 2 }
fcipConfig OBJECT IDENTIFIER ::= { fcipObjects 1 }

-- ************************************************************************
-- Textual conventions
--

FcipDomainIdInOctetForm ::= TEXTUAL-CONVENTION
STATUS current
DESCRIPTION
"The Domain ID of a FC entity in octet form
to support the concatenation(000000h||Domain_ID)
format defined in the FSPF routing protocol."
REFERENCE
"FC-SW-3 section 4.8"
SYNTAX OCTET STRING (SIZE(1))

FcipEntityMode ::= TEXTUAL-CONVENTION
STATUS current
DESCRIPTION
"The type of port mode provided by an FCIP Entity
for an FCIP Link. An FCIP Entity can be an E-Port
mode for one of its FCIP Link Endpoints or a B-Port
mode for another of its FCIP Link Endpoints."
REFERENCE
"FC-BB, rev 4.7, 2 May 1997, section 3."
SYNTAX INTEGER {
    ePortMode(1),
    bPortMode(2)
}
FcipEntityId ::= TEXTUAL-CONVENTION
    STATUS current
    DESCRIPTION "The FCIP entity identifier as defined in RFC 3821."
    REFERENCE "RFC 3821, Section 7.1, FCIP Special Frame Format"
    SYNTAX OCTET STRING (SIZE(8))

-- ******************************************************************
-- 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 discovery protocol used to discover remote
        FCIP entities. The value of this object is persistent
        across system restarts."
    ::= { 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 "Indication of whether the TCP Selective Acknowledgement
        Option is enabled at this FCIP device to let the receiver
        acknowledge multiple lost packets in a single ACK for faster
The Selective Ack option is defined in RFC 2883.

::= { fcipConfig 3 }

-- The FCIP Entity Table

fcipEntityInstanceTable OBJECT-TYPE
SYNTAX SEQUENCE OF FcipEntityInstanceEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"Information about this FCIP device’s existing instances of FCIP entities."
REFERENCE
"RFC 3821, Section 5.4, FCIP Entity"
::= { fcipConfig 4 }

fcipEntityInstanceEntry OBJECT-TYPE
SYNTAX FcipEntityInstanceEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"A conceptual row of the FCIP entity table with information about a particular FCIP entity. Once a row has been created, it is non-volatile across agent restarts until it is deleted."
INDEX { fcipEntityId }
::= { fcipEntityInstanceTable 1 }

FcipEntityInstanceEntry ::= SEQUENCE {
    fcipEntityId       FcipEntityId,
    fcipEntityName     SnmpAdminString,
    fcipEntityAddressType  InetAddressType,
    fcipEntityAddress   InetAddress,
    fcipEntityTcpConnPort  InetPortNumber,
    fcipEntitySeqNumWrap TruthValue,
    fcipEntityPHBSupport TruthValue,
    fcipEntityStatus    RowStatus
}

fcipEntityId OBJECT-TYPE
SYNTAX FcipEntityId
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"The FCIP entity identifier."
REFERENCE
"RFC 3821, Section 7.1, FCIP Special Frame Format"
::= { fcipEntityInstanceEntry 1 }

fcipEntityName OBJECT-TYPE
SYNTAX SnmpAdminString (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. Only address types IPv4 and IPv6 are supported."
::= { fcipEntityInstanceEntry 3 }

fcipEntityAddress OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The Internet address for the entity, if configured. The format of this address is determined by the value of the fcipEntityAddressType object."
::= { fcipEntityInstanceEntry 4 }

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

fcipEntitySeqNumWrap OBJECT-TYPE
SYNTAX TruthValue
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"An indication of whether the FCIP Entity supports 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
quality of service (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 object specifies the operational status of the row.

When a management station sets the status to active(1), then
the values for the objects fcipEntityName,
fcipEntityAddressType, and fcipEntityAddress should be
supplied as part of the set request. The values of the
objects fcipEntityName, fcipEntityAddressType, and
fcipEntityAddress can be changed if the row status is in
active state. The object fcipEntityTcpConnPort takes the
default value zero(0), if no value is supplied at the time
of row creation.

Setting the status to destroy(6) deletes the specified FCIP
entity instance row from the table. It also deletes all the
rows corresponding to the specified FCIP entity from the
fcipLinkTable and fcipTcpConnTable tables."
::= { fcipEntityInstanceEntry 8 }
-- ******************************************************************
-- The FCIP Link Table
--
fcipLinkTable OBJECT-TYPE
SYNTAX SEQUENCE OF FcipLinkEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"Information about FCIP links that exist on this device."
 ::= { 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. The values of the
read-create objects in this table are persistent across
system restarts."
INDEX { fcipEntityId, fcipLinkIndex }
 ::= { fcipLinkTable 1 }

FcipLinkEntry ::= SEQUENCE {
  fcipLinkIndex     OBJECT-TYPE
  SYNTAX Unsigned32
  MAX-ACCESS not-accessible
  STATUS current
  DESCRIPTION
  "An arbitrary integer that uniquely identifies one FCIP link
  within an FCIP entity."
  ::= { fcipLinkEntry 1 }
  fcipLinkIndex
  fcipLinkIfIndex
  fcipLinkCost
  fcipLinkLocalFcipEntityMode
  fcipLinkLocalFcipEntityAddressType
  fcipLinkLocalFcipEntityAddress
  fcipLinkRemFcipEntityWWN
  fcipLinkRemFcipEntityId
  fcipLinkRemFcipEntityAddressType
  fcipLinkRemFcipEntityAddress
  fcipLinkStatus
  fcipLinkCreateTime
}
fcipLinkIfIndex OBJECT-TYPE
   SYNTAX InterfaceIndex
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "The ifIndex value of the virtual interface corresponding to
      the FCIP Link running over TCP/IP."
   ::= { fcipLinkEntry 2 }

fcipLinkCost OBJECT-TYPE
   SYNTAX Unsigned32
   MAX-ACCESS read-create
   STATUS current
   DESCRIPTION
      "The FSPF cost associated with this FCIP Link."
   DEFVAL { 0 }
   ::= { fcipLinkEntry 3 }

fcipLinkLocalFcipEntityMode OBJECT-TYPE
   SYNTAX FcipEntityMode
   MAX-ACCESS read-only
   STATUS current
   DESCRIPTION
      "The mode of the local end of the FCIP link."
   ::= { fcipLinkEntry 4 }

fcipLinkLocalFcipEntityAddressType OBJECT-TYPE
   SYNTAX InetAddressType
   MAX-ACCESS read-create
   STATUS current
   DESCRIPTION
      "The type of Internet address contained in the corresponding
      instance of fcipLinkLocalFcipEntityAddress. Only address
      types IPv4 and IPv6 are supported."
   ::= { fcipLinkEntry 5 }

fcipLinkLocalFcipEntityAddress OBJECT-TYPE
   SYNTAX InetAddress
   MAX-ACCESS read-create
   STATUS current
   DESCRIPTION
      "The Internet address for the local end of this FCIP Link.
      The format of this object is determined by the value of the
      fcipLinkLocalFcipEntityAddressType object."
   ::= { fcipLinkEntry 6 }

fcipLinkRemFcipEntityWWN OBJECT-TYPE
   SYNTAX FcNameIdOrZero
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The World Wide Name of the remote FC Fabric Entity."
REFERENCE
"RFC 3821, Section 7.1, FCIP Special Frame Format"
::= { fcipLinkEntry 7 }

fcipLinkRemFcipEntityId OBJECT-TYPE
SYNTAX FcipEntityId
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The remote FCIP entity's identifier."
REFERENCE
"RFC 3821, Section 7.1, FCIP Special Frame Format"
::= { fcipLinkEntry 8 }

fcipLinkRemFcipEntityAddressType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The type of Internet address contained in the corresponding instance of fcipLinkRemFcipEntityAddress. Only address types IPv4 and IPv6 are supported."
::= { fcipLinkEntry 9 }

fcipLinkRemFcipEntityAddress OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The Internet address for the remote end of this FCIP Link. The format of this object is determined by the value of the fcipLinkRemFcipEntityAddressType object."
::= { fcipLinkEntry 10 }

fcipLinkStatus OBJECT-TYPE
SYNTAX RowStatus
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"This object specifies the operational status of the row. The values of objects fcipLinkLocalFcipEntityAddressType, fcipLinkLocalFcipEntityAddress, fcipLinkRemFcipEntityWWN, fcipLinkRemFcipEntityId, fcipLinkRemFcipEntityAddressType,
and fcipLinkRemFcipEntityAddress can be changed if the row is in active(1) state. The object fcipLinkCost is set to the value zero(0) if no value is supplied at the time of row creation.

Setting the status to destroy(6) deletes the specified FCIP link from the table. It also deletes all rows corresponding to the specified FCIP link from the fcipTcpConnTable table.

::= { fcipLinkEntry 11 }

fcipLinkCreateTime OBJECT-TYPE
SYNTAX     TimeStamp
MAX-ACCESS read-only
STATUS      current
DESCRIPTION  "The value of sysUpTime when this entry was last created."
::= { fcipLinkEntry 12 }

-- ******************************************************************
-- The TCP Connection Table
--

fcipTcpConnTable OBJECT-TYPE
SYNTAX SEQUENCE OF FcipTcpConnEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION  "Information about existing TCP connections. Each FCIP link within an FCIP entity manages 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."
::= { 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 InetPortNumber, 
      fcipTcpConnRemPort InetPortNumber, 
      fcipTcpConnRWSize Unsigned32,  
      fcipTcpConnMSS Unsigned32  
    } 

fcipTcpConnLocalPort OBJECT-TYPE 
  SYNTAX InetPortNumber 
  MAX-ACCESS not-accessible 
  STATUS current 
  DESCRIPTION 
    "The local port number for this TCP connection." 
  ::= { fcipTcpConnEntry 1 } 

fcipTcpConnRemPort OBJECT-TYPE 
  SYNTAX InetPortNumber 
  MAX-ACCESS not-accessible 
  STATUS current 
  DESCRIPTION 
    "The remote port number for this TCP connection." 
  ::= { fcipTcpConnEntry 2 } 

fcipTcpConnRWSize OBJECT-TYPE 
  SYNTAX Unsigned32 
  MAX-ACCESS read-only 
  STATUS current 
  DESCRIPTION 
    "The default maximum TCP Receiver Window size for this TCP connection." 
  ::= { fcipTcpConnEntry 3 } 

fcipTcpConnMSS OBJECT-TYPE 
  SYNTAX Unsigned32 
  MAX-ACCESS read-only 
  STATUS current 
  DESCRIPTION 
    "The TCP Maximum Segment Size (MSS) for this TCP connection." 
  ::= { fcip TcpConnEntry 4 }
The Dynamic Route Table

fcipDynamicRouteTable OBJECT-TYPE
SYNTAX SEQUENCE OF FcipDynamicRouteEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"Information about dynamically discovered routing information. The FCIP device may use the SLPv2 protocol in conjunction with other protocols (say, FSPF) for dynamically discovering other FCIP entities and may populate this table with FCIP link information for each Destination Address Identifier."
::= { 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 }
::= { fcipDynamicRouteTable 1 }

FcipDynamicRouteEntry ::= SEQUENCE {
  fcipDynamicRouteDID          FcipDomainIdInOctetForm,
  fcipDynamicRouteLinkIndex    Unsigned32
}

fcipDynamicRouteDID    OBJECT-TYPE
SYNTAX FcipDomainIdInOctetForm
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"8-bit ID of a Fibre Channel Domain that is reachable from this FCIP device."
::= { fcipDynamicRouteEntry 1 }

fcipDynamicRouteLinkIndex    OBJECT-TYPE
SYNTAX Unsigned32 (1..4294967295)
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The FCIP Link used to reach the domain specified by the
corresponding instance of fcipDynamicRouteDID. The link identified by a value of this object is the same FCIP link as identified by the same value of fcipLinkIndex for the same FCIP entity."

::= {fcipDynamicRouteEntry 2}

-- ******************************************************************
-- The Static Route Table
--
fcipStaticRouteTable OBJECT-TYPE
SYNTAX SEQUENCE OF FcipStaticRouteEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"Information about static route entries configured by the Network Admin. In the absence of dynamic discovery of remote FCIP entities, the Network Manager will figure out all remote FCIP devices that are reachable from this device and populate this table with FCIP link information for each Domain ID. At any time, both static and dynamic routing can be active, and an entry in the static route table for a given DID takes precedence over the entry in the dynamic route table for the same Domain ID."

 ::= {fcipConfig 8}

fcipStaticRouteEntry OBJECT-TYPE
SYNTAX FcipStaticRouteEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"A conceptual row of the FCIP Static Route Table containing information about a particular FCIP route. The values of the read-create objects in this table are persistent across system restarts."
INDEX {fcipEntityId, fcipStaticRouteDID}
::= {fcipStaticRouteTable 1}

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

fcipStaticRouteDID OBJECT-TYPE
SYNTAX FcipDomainIdInOctetForm
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"8-bit ID of a Fibre Channel Domain that is reachable from
this FCIP device."
::= { fcipStaticRouteEntry 1 }

fcipStaticRouteLinkIndex OBJECT-TYPE
SYNTAX Unsigned32 (1..4294967295)
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The FCIP Link used to reach the domain specified by the
 corresponding instance of fcipStaticRouteDID. The link
 identified by a value of this object is the same FCIP link
 as identified by the same value of fcipLinkIndex for the
 same FCIP entity."
::= { fcipStaticRouteEntry 2 }

fcipStaticRouteStatus OBJECT-TYPE
SYNTAX RowStatus
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"This object specifies the operational status of the row.

When a management station sets the status to active(1),
the values for the object fcipStaticRouteLinkIndex should be
supplied as part of the set request.

Setting the status to destroy(6) deletes the specified FCIP
static route entry from the table."
::= { fcipStaticRouteEntry 3 }

-- ******************************************************************
-- The FCIP Discovery Domain Table
--

fcipDiscoveryDomainTable OBJECT-TYPE
SYNTAX SEQUENCE OF FcipDiscoveryDomainEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"Information about FCIP Discovery Domains. Each FCIP
Discovery Domain is associated with one or more 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 that is associated with one or more FCIP entities. The values of the read-write object fcipDiscoveryDomainName are persistent across system restarts."
INDEX { fcipEntityId, fcipDiscoveryDomainIndex }
::= { fcipDiscoveryDomainTable 1 }

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

fcipDiscoveryDomainIndex OBJECT-TYPE
SYNTAX Unsigned32 (1..4294967295)
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"An integer that uniquely identifies an FCIP Discovery Domain associated with this FCIP entity."
::= { fcipDiscoveryDomainEntry 1 }

fcipDiscoveryDomainName OBJECT-TYPE
SYNTAX SnmpAdminString (SIZE (0..128))
MAX-ACCESS read-write
STATUS current
DESCRIPTION
"The name of this FCIP Discovery Domain."
REFERENCE
"RFC 3822, Section 4.1.1, FCIP Discovery Domains"
::= { fcipDiscoveryDomainEntry 2 }
-- The FCIP Link Errors

fcipLinkErrorsTable OBJECT-TYPE
SYNTAX SEQUENCE OF FcipLinkErrorsEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"A list of error counters for FCIP Links. Each counter
records the number of times a particular error happened that
caused a TCP connection to close down."
REFERENCE
"RFC 3821, Section 5.2, FCIP Link"
::= { 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 an FCIP Link."
INDEX { fcipEntityId, fcipLinkIndex }
::= { fcipLinkErrorsTable 1 }

FcipLinkErrorsEntry ::= SEQUENCE {
   fcipLinkFcipLossofFcSynchs            Counter32,
   fcipLinkFcipEncapErrors               Counter32,
   fcipLinkFcipNotReceivedSfResps        Counter32,
   fcipLinkFcipSfRespMismatches          Counter32,
   fcipLinkFcipSfInvalidNonces           Counter32,
   fcipLinkFcipReceivedSfDuplicates      Counter32,
   fcipLinkFcipSfInvalidWWNs             Counter32,
   fcipLinkFcipBB2LkaTimeOuts            Counter32,
   fcipLinkFcipSntpExpiredTimeStamps     Counter32,
   fcipLinkTcpTooManyErrors              Counter32,
   fcipLinkTcpExcessiveDroppedDatagrams  Counter32,
   fcipLinkTcpSaParamMismatches          Counter32
}

fcipLinkFcipLossofFcSynchs OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of times FC synchronization was lost on this FCIP
Link. The last discontinuity of this counter is indicated by fcipLinkCreateTime.
::= { 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. The last discontinuity of this counter is indicated by fcipLinkCreateTime."
::= { fcipLinkErrorsEntry 2 }

fcipLinkFcipNotReceivedSfResps OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of times an FCIP Special Frame Response was expected but not received on this FCIP Link. The last discontinuity of this counter is indicated by fcipLinkCreateTime."
::= { fcipLinkErrorsEntry 3 }

fcipLinkFcipSfRespMismatches 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. The last discontinuity of this counter is indicated by fcipLinkCreateTime."
::= { fcipLinkErrorsEntry 4 }

fcipLinkFcipInvalidNonces 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. The last discontinuity of this counter is indicated by fcipLinkCreateTime."
::= { fcipLinkErrorsEntry 5 }

fcipLinkFcipReceivedSfDuplicates 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. The last discontinuity of this
counter is indicated by fcipLinkCreateTime."
::= { fcipLinkErrorsEntry 6 }

fcipLinkFcipSfInvalidWWNs 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 were received on this FCIP
Link. The last discontinuity of this counter is indicated
by fcipLinkCreateTime."
::= { fcipLinkErrorsEntry 7 }

fcipLinkFcipBB2LkaTimeOuts OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of FC Keep Alive Time-outs that occurred on
this FCIP Link. The last discontinuity of this counter
is indicated by fcipLinkCreateTime."
::= { fcipLinkErrorsEntry 8 }

fcipLinkFcipSntpExpiredTimeStamps OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of frames discarded due to an expired Simple
Network Time Protocol (SNTP) timestamp on this FCIP Link.
The last discontinuity of this counter is indicated by
fcipLinkCreateTime."
::= { 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 on the connection. The
last discontinuity of this counter is indicated by
fcipLinkCreateTime.
::= { fcipLinkErrorsEntry 10 }

fcipLinkTcpExcessiveDroppedDatagrams 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 FCIP
packets. The last discontinuity of this counter is
indicated by fcipLinkCreateTime."
::= { fcipLinkErrorsEntry 11 }

fcipLinkTcpSaParamMismatches OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of times TCP connections with Security
Association parameter mismatches were closed down on this
FCIP Link. The last discontinuity of this counter is
indicated by fcipLinkCreateTime."
REFERENCE
"RFC 3821, Section 9.4.2, TCP Connection Security
Associations (SAs)"
::= { fcipLinkErrorsEntry 12 }

-- 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 that do not have these objects in any other FC MIB. It may be implemented even in that case for convenience."

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

OBJECT fcipEntityAddressType
SYNTAX INTEGER { ipv4(1), ipv6(2) }
DESCRIPTION
"Only IPv4 and IPv6 address types need to be supported for addressing FCIP entities."

OBJECT fcipEntityAddress
SYNTAX InetAddress (SIZE(4|16))
DESCRIPTION
"Size of FCIP entity’s IP address depends on address type. FCIP entity address size is four if the IP address is IPv4 and sixteen if the IP address type is IPv6."

OBJECT fcipLinkLocalFcipEntityAddressType
SYNTAX INTEGER { ipv4(1), ipv6(2) }
DESCRIPTION
"Only IPv4 and IPv6 address types need to be supported for addressing the local FCIP entities."

OBJECT fcipLinkLocalFcipEntityAddress
SYNTAX InetAddress (SIZE(4|16))
DESCRIPTION
"Size of FCIP entity’s IP address depends on address type. FCIP entity address size is four if the IP address is IPv4 and sixteen if the IP address type is IPv6."

OBJECT fcipLinkRemFcipEntityAddressType
SYNTAX INTEGER { ipv4(1), ipv6(2) }
DESCRIPTION
"Only IPv4 and IPv6 address types need to be supported for addressing the remote FCIP entities."

OBJECT fcipLinkRemFcipEntityAddress
SYNTAX InetAddress (SIZE(4|16))
"Size of FCIP entity’s IP address depends on the address type. FCIP entity address size is four if the IP address is IPv4 and sixteen if the IP address type is IPv6."

::= { fcipCompliances 1 }

fcipEntityScalarGroup OBJECT-GROUP
OBJECTS {
  fcipDynIpConfType,
  fcipDeviceWWN,
  fcipEntitySACKOption
}
STATUS current
DESCRIPTION
"Collection of scalar objects applicable to all FCIP instances."
::= { fcipGroups 1 }

fcipEntityInstanceGroup OBJECT-GROUP
OBJECTS {
  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 {
  fcipLinkIfIndex,
  fcipLinkCost,
  fcipLinkLocalFcipEntityMode,
  fcipLinkLocalFcipEntityAddressType,
  fcipLinkLocalFcipEntityAddress,
  fcipLinkRemFcipEntityWWN,
  fcipLinkRemFcipEntityId,
  fcipLinkRemFcipEntityAddressType,
  fcipLinkRemFcipEntityAddress,
  fcipLinkStatus,
  fcipLinkCreateTime
}
A collection of objects providing information about FCIP Links.
::= { fcipGroups 3 }

fcipTcpConnGroup OBJECT-GROUP
OBJECTS {
  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,
  fcipLinkFcipNotReceivedSfResps,
  fcipLinkFcipSfRespMismatches,
  fcipLinkFcipSfInvalidNonces,
  fcipLinkFcipReceivedSfDuplicates,
  fcipLinkFcipSfInvalidWWNs,
  fcipLinkFcipBB2LkaTimeOuts,
  fcipLinkFcipSntpExpiredTimeStamps,
  fcipLinkTcpTooManyErrors,
  fcipLinkTcpExcessiveDroppedDatagrams,
  fcipLinkTcpSaParamMismatches
}
STATUS current
DESCRIPTION
"A collection of objects providing information about FCIP link errors."
::= { fcipGroups 6 }
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fcipDynamicRouteGroup OBJECT-GROUP
  OBJECTS {
    fcipDynamicRouteLinkIndex
  }
  STATUS current
  DESCRIPTION
    "A collection of objects providing information about FCIP
dynamic routes."
 ::= { fcipGroups 7 }

fcipStaticRouteGroup OBJECT-GROUP
  OBJECTS {
    fcipStaticRouteLinkIndex,
    fcipStaticRouteStatus
  }
  STATUS current
  DESCRIPTION
    "A collection of objects providing information about FCIP
static routes."
 ::= { fcipGroups 8 }

END
5. 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. In particular, write access to fcipDiscoveryDomainName and fcipEntityAddress can cause a loss of reachability to portions of the Fibre Channel fabric, while write access to fcipStaticRouteStatus can create incorrect routes to remote devices.

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, and fcipLinkRemFcipEntityAddress
-- information on identification;

fcipDiscoveryDomainName
-- information on discovery domains;

fcipDynamicRouteLinkIndex
-- information on dynamic routes;

fcipStaticRouteLinkIndex and fcipStaticRouteStatus
-- information on static routes

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 implementers 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.

6. IANA Considerations

The IANA has assigned a MIB OID assignment under the transmission branch. Specifically, { transmission 224 } for fcipMIB since this MIB contains the media-specific definitions that correspond to the ifType value of fcipLink(224).

7. Acknowledgements

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8. Normative References


9. Informative References

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