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 Entity|       |FCIP Entity|      |
  |   |           |       |           |      |
  |   |           |       |           |      |
  |   +--+--+--+--+       +--+--+--+--+      |
  |      |  |  |             |  |  |         |
  |      |  |  |             |  |  |         |
  |     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>
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."
The module defines management information specific to FCIP devices.

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REVISION "200602060000Z"

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

::= { mib-2 224 }

fcipObjects OBJECT IDENTIFIER ::= { fcipMIB 1 }
fcpConformance OBJECT IDENTIFIER ::= { fcipMIB 2 }
fcpConfig 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
recovery.
REFERENCE
"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 }
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 ::= [
  FcipLinkIndex          Unsigned32,
  fcipLinkIFIndex        InterfaceIndex,
  fcipLinkCost           Unsigned32,
  fcipLinkLocalFcipEntityMode  FcipEntityMode,
  fcipLinkLocalFcipEntityAddressType InetAddressType,
  fcipLinkLocalFcipEntityAddress InetAddress,
  fcipLinkRemFcipEntityWWN  FcNameIdOrZero,
  fcipLinkRemFcipEntityId FcipEntityId,
  fcipLinkRemFcipEntityAddressType InetAddressType,
  fcipLinkRemFcipEntityAddress InetAddress,
  fcipLinkStatus         RowStatus,
  fcipLinkCreateTime     TimeStamp
]

fcipLinkIndex OBJECT-TYPE
SYNTAX Unsigned32 (1..4294967295)
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"An arbitrary integer that uniquely identifies one FCIP link
within an FCIP entity."
::= { fcipLinkEntry 1 }
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."
 ::= { fcipTcpConnEntry 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
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 10 }

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 11 }

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))
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DESCRIPTION
"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 }
STATUS current
DESCRIPTION
"A collection of objects providing information about FCIP
Links."
 ::= { fcipGroups 3 }

fcipTcpConnGroup OBJECT-GROUP
OBJECTS {
   fcipTcpConnRWSizex,
   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,
   fcipLinkFcipSfInvalidWNNs,
   fcipLinkFcipBB2LkaTimeOuts,
   fcipLinkFcipSntpExpiredTimeStamps,
   fcipLinkTcpTooManyErrors,
   fcipLinkTcpExcessiveDroppedDatagrams,
   fcipLinkTcpSaParamMismatches
}
STATUS current
DESCRIPTION
"A collection of objects providing information about FCIP
link errors."
 ::= { fcipGroups 6 }
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, 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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