Definitions of Managed Objects  
for Monitoring and Controlling the  
UNI/NNI Multilink Frame Relay Function

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 Management Information Base (MIB) for monitoring and controlling a UNI/NNI Multilink Frame Relay Function as defined in Frame Relay Forum FRF.16. This MIB also includes conformance and notification information.

Table of Contents

1 The SNMP Management Framework .................................. 2  
2 Overview ................................................................... 3  
2.1 Multilink Frame Relay Background .............................. 3  
2.1.2 Reference Model .............................................. 4  
2.2 Structure of the MIB ........................................... 5  
2.2.1 mfrBundleMaxNumBundles .................................. 6  
2.2.2 mfrBundleNextIndex ........................................ 6  
2.2.3 mfrBundleTable ............................................. 6  
2.2.4 Bundle-to-ifIndex Mapping Table .......................... 6  
2.2.5 mfrBundleLinkTable ......................................... 6  
2.3 Relationship With Other MIBS and Tables .................... 7  
2.3.1 Relationship With Interface Table .......................... 7  
2.3.1.1 Bundle Links ............................................. 7  
2.3.1.2 Bundles ................................................ 7
1. 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], RFC 2579 [RFC2579] and 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].
o 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].

o 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.

2. Overview

This document defines a Management Information Base (MIB) for monitoring and controlling the UNI/NNI Multilink Frame Relay function. The agreement on which this MIB is based was defined and documented by the Frame Relay Forum in the Frame Relay Forum Document FRF.16 [FRF.16].

2.1. Multilink Frame Relay Background

Multilink Frame Relay (MFR) for the User-to-Network Interface (UNI) and the Network-to-Network Interface (NNI) provides physical interface emulation for frame relay devices. The emulated physical interface consists of one or more physical links, called "bundle links", aggregated together into a single "bundle" of bandwidth. This service provides a frame-based inverse multiplexing function, sometimes referred to as an "IMUX".
The bundle provides the same order-preserving service as a physical layer for frames sent on a data link connection. In addition, the bundle provides support for all Frame Relay services based on UNI and NNI standards.

### 2.1.1. Terminology

**Physical Link** -- A single physical interface that interconnects two devices in a frame relay network (e.g., DS1, DS0, Bearer channel, refer to FRF.14).

**Bundle** -- A grouping of one or more physical links using the formats and procedures of multilink frame relay. The bundle operates as a logical interface function that emulates a single physical interface to the Q.922 data link layer.

**Bundle Link** -- A MFR sub-component that controls operation of one of the bundle’s physical links.
2.1.2. Reference Model

![Diagram of MFR Reference Model]

Figure 1: MFR Reference Diagram

Note 1: C-Plane operation as described in Q.933 [Q.933] and FRF.4 [FRF.4]

Note 2: Multiple frame acknowledged information transfer mode as described in Q.922 [Q.922]

Note 3: Core aspects for use with frame relay bearer service as described in Q.922, Annex A [Q.922]

2.2. Structure of the MIB

The UNI/NNI MFR managed objects consist of two scalar objects and three tables.
2.2.1. mfrBundleMaxNumBundles

This scalar is used to inform the manager of the maximum number of bundles supported by this device.

2.2.2. mfrBundleNextIndex

This scalar is used to assist the manager in selecting a value for mfrBundleIndex during row creation. It can also be used to avoid race conditions with multiple managers trying to create rows in the table (see RFC 2494 [RFC2494] for one such algorithm).

2.2.3. mfrBundleTable

This table provides a means to configure and monitor bundles. It is indexed by mfrBundleIndex and contains these columns:

- mfrBundleIndex Integer32
- mfrBundleIfIndex InterfaceIndex
- mfrBundleRowStatus RowStatus
- mfrBundleNearEndName SnmpAdminString
- mfrBundleFragmentation INTEGER
- mfrBundleMaxFragSize Integer32
- mfrBundleTimerHello INTEGER
- mfrBundleTimerAck INTEGER
- mfrBundleCountMaxRetry INTEGER
- mfrBundleActivationClass INTEGER
- mfrBundleThreshold Integer32
- mfrBundleMaxDiffDelay Integer32
- mfrBundleSeqNumSize INTEGER
- mfrBundleLinksConfigured Integer32
- mfrBundleLinksActive Integer32
- mfrBundleBandwidth Integer32
- mfrBundleFarEndName SnmpAdminString
- mfrBundleResequencingErrors Counter32

2.2.4. Bundle-to-ifIndex Mapping Table

This table provides a means to take an ifIndex and find the corresponding mfrBundleIndex. It is indexed by ifIndex and contains these columns:

- mfrBundleIfIndexMapping Integer32

2.2.5. mfrBundleLinkTable

This table provides a means to configure and monitor bundle links. It is indexed by ifIndex and contains these columns:
2.3. Relationship With Other MIBS and Tables

2.3.1. Relationship With Interface Table

2.3.1.1. Bundle Links

Each bundle link will appear as an interface in the ifTable. The ifIndex that appears in the ifTable is used for indexing the bundle link tables in the UNI-NNI MFR MIB.

2.3.1.2. Bundles

Each bundle will appear as an interface in the ifTable. There will be corresponding mfrBundleIndex which may be different than the ifIndex of the bundle.

The reason is best summarized in RFC 2494 [RFC2494], which describes frame relay bundle of DS0. It says:

This table is not indexed by ifIndex because the manager has to choose the index in a createable row and the agent must be allowed to select ifIndex values.

The rows in the ifEntry table are not createable as they do not have row status. RFC 2863 [RFC2863] suggests that the ifIndex should be chosen by the agent. Here is its statement regarding row creation and deletion:

While some interfaces, for example, most physical interfaces, cannot be created via network management, other interfaces such as logical interfaces sometimes can be. The ifTable contains only generic information about an interface. Almost all ‘create-able’ interfaces have other, media-specific, information through which
configuration parameters may be supplied prior to creating such an interface. Thus, the ifTable does not itself support the creation or deletion of an interface (specifically, it has no RowStatus column). Rather, if a particular interface type supports the dynamic creation and/or deletion of an interface of that type, then that media-specific MIB should include an appropriate RowStatus object (see the ATM LAN-Emulation Client MIB [ATMLANE] for an example of a MIB which does this). Typically, when such a RowStatus object is created/deleted, then the conceptual row in the ifTable appears/disappears as a by-product, and an ifIndex value (chosen by the agent) is stored in an appropriate object in the media-specific MIB.

The ATM LAN-Emulation Client MIB [ATMLANE] uses different indices and so does the IMA MIB [ATMIMA]. Looking at the examples we have, and the statements from RFC, it seems better to have two indices. This gives the SNMP agent implementor the freedom to manage their ifIndex in the way they like.

2.3.1.3. Mapping Between ifIndex and mfrBundleIndex

The mfrBundleIfIndexMappingTable is indexed by ifIndex and provides the means to map a given ifIndex into the corresponding mfrBundleIndex. The mfrBundleIfIndexMapping object in the mfrBundleTable (indexed by mfrBundleIndex) provides the reverse mapping of a mfrBundleIndex to the corresponding ifIndex in the ifTable.

2.3.1.4. ifTable Objects

The bundle configuration and status table. There is a one-to-one correspondence between a bundle and an interface represented in the ifTable.

The following objects of the ifTable have specific meaning for an MFR bundle:

- ifAdminStatus - the bundle admin status
- ifOperStatus - the bundle operational status
- ifSpeed - the current bandwidth of the bundle
- ifInUcastPkts - the number of frames received on the bundle
- ifOutUcastPkts - the number of frames transmitted on the bundle
- ifInErrors - frame (not fragment) errors
- ifOutErrors - frame (not fragment) errors

The following objects of the ifTable have specific meaning for an MFR bundle link:
ifAdminStatus - the bundle link admin status
ifOperStatus - the bundle link operational status
ifSpeed - the bandwidth of the bundle link interface
ifInUcastPkts - the number of frames received on the bundle link
ifOutUcastPkts - the number of frames transmitted on the bundle link
ifInErrors - frame and fragment errors
ifOutErrors - frame and fragment errors

2.3.2. Relationship With Interface Stack Table

The bundles and bundle links will appear in the ifStackTable defined in RFC 2863 [RFC2863]. Each bundle link will appear a lower layer to its owner bundle. The bundle will appear as a higher layer to the bundle links and as a lower layer to a frame relay service or UNI.

2.3.3. Relationship With Frame Relay DTE MIB

The bundle will have a one-to-one correspondence with a DLCMI or UNI that appear in the DTE MIB tables [RFC2115].

2.3.4. Relationship With Frame Relay Service MIB

There is a one-to-one relationship between the MFR bundle and the frame relay service logical port defined in RFC1604 [RFC1604].

2.3.5. Example

Figure two shows an example of how the various tables are related. This example shows two bundles composed of 2 T1s each. The bundles have a mfrBundleIndex of 10 and 20 respectively.

```
+-------------------------+
|   Frame Relay Service   |
+-------------------------+

+---------------------+
| MFR Bundle | MFR Bundle |
| 10         | 20         |
+---------------------+

|++++ |++++ |++++ |++++ |
| T1  | T1  | T1  | T1  |
```

Figure 2: Frame Relay Service Being Carried on 4 T1s
The assignment of the ifTable index values could for example be:

| ifIndex | Description               | ifType              |
|---------|----------------------------+---------------------|
| 1       | FrameRelayService          | frameRelayService(44) |
| 2       | MFR Bundle #10             | frf16MfrBundle(163) |
| 3       | MFR Bundle #20             | frf16MfrBundle(163) |
| 4       | ds1 #1/MFR Bundle Link #1  | ds1(18)             |
| 5       | ds1 #2/MFR Bundle Link #2  | ds1(18)             |
| 6       | ds1 #3/MFR Bundle Link #3  | ds1(18)             |
| 7       | ds1 #4/MFR Bundle Link #4  | ds1(18)             |

The ifStackTable is then used to show the relationships between the various interfaces.

<table>
<thead>
<tr>
<th>HigherLayer</th>
<th>LowerLayer</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
</tr>
</tbody>
</table>

The mfrBundleIfIndexMappingTable shows the relationship between the ifTable ifIndex and the mfrBundleIndex:

<table>
<thead>
<tr>
<th>ifIndex</th>
<th>mfrBundleIfIndexMappingIndex</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
</tr>
</tbody>
</table>

The mfrBundleTable shows the relationship between the mfrBundleIndex and the ifIndex:

<table>
<thead>
<tr>
<th>mfrBundleIndex</th>
<th>mfrBundleIfIndex</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>3</td>
</tr>
</tbody>
</table>
The mfrBundleLinkTable shows the relationship between the bundles and bundle links:

<table>
<thead>
<tr>
<th>mfrBundleIndex</th>
<th>mfrBundleLinkIfIndex</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>20</td>
<td>7</td>
</tr>
</tbody>
</table>

2.4. Creation Of Bundles and Bundle Links

2.4.1. Creation Of Bundles

A new bundle is created by setting a createAndGo(4) value in the mfrBundleRowStatus RowStatus object. Optionally, an agent could also support setting a value of createAndWait(5) followed by a set to the value active(1).

When a bundle is created, the agent must create a new interface in the ifTable. The ifIndex for this new interface is used for the value of mfrBundleIfIndex.

2.4.2. Creation Of Bundle Links

A new bundle link is created by setting a createAndGo(4) value in the mfrBundleLinkRowStatus RowStatus object.

The bundle link is associated with a specific physical interface and uses the ifIndex of the physical interface. The mfrBundleLinkEntry row objects may be created after or during creation of the physical interface’s ifEntry row objects.

The bundle identified in the object mfrBundleIndex must exist at time of bundle link creation.

2.5. Notifications

The linkUp and linkDown traps are defined in RFC 2223 [RFC2223].

2.5.1. Bundle

The following SNMP traps are defined for MFR bundles.
2.5.1.1. linkUp

This trap is sent when the ifOperStatus of a bundle transitions from down to up. This occurs when a sufficient number of links (determined by mfrBundleActivationClass and mfrBundleThreshold) are in the operationally up state.

2.5.1.2. linkDown

This trap is sent when the ifOperStatus of a bundle transitions from up to down. This occurs when a insufficient number of links (determined by mfrBundleActivationClass and mfrBundleThreshold) are in the operationally up state.

2.5.2. Bundle Link

The following SNMP traps are defined for MFR bundle links.

2.5.2.1. linkUp

This trap is sent when a mfrBundleLinkState object transitions to the value mfrBundleLinkStateUp.

2.5.2.2. linkDown

This trap is sent when a mfrBundleLinkState object transitions from the value mfrBundleLinkStateUp.

2.5.2.3. mfrMibTrapBundleLinkMismatch

This trap indicates that a bundle link mismatch has been detected. The following objects are reported:

- mfrBundleNearEndName: configured name of near end bundle
- mfrBundleFarEndName: previously reported name of far end bundle
- mfrBundleLinkNearEndName: configured name of near end bundle
- mfrBundleLinkFarEndName: reported name of far end bundle
- mfrBundleLinkFarEndBundleName: currently reported name of far end bundle

Note that the configured items may have been configured automatically. Note also that the mfrBundleLinkMismatch counter is incremented when the trap is sent.
3. Object Definitions

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. Objects in the MIB are defined using the subset of Abstract Syntax Notation One (ASN.1) defined in the SMI. In particular, each object type is named by an OBJECT IDENTIFIER, an administratively assigned name. The object type together with an object instance serves to uniquely identify a specific instantiation of the object. For human convenience, we often use a textual string, termed the descriptor, to refer to the object type.

FR-MFR-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE, Integer32, Counter32,
    NOTIFICATION-TYPE, transmission
    FROM SNMPv2-SMI
    TEXTUAL-CONVENTION, TestAndIncr, RowStatus
    FROM SNMPv2-TC
    MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
    FROM SNMPv2-CONF
    SnmpAdminString
    FROM SNMP-FRAMEWORK-MIB
    InterfaceIndex, ifIndex
    FROM IF-MIB;

mfrMib MODULE-IDENTITY
    LAST-UPDATED "200011300000Z"
    ORGANIZATION "IETF Frame Relay Service MIB (frnetmib)
    Working Group"
    CONTACT-INFO
        "WG Charter:
         WG-email:      frnetmib@sunroof.eng.sun.com
         Subscribe:     frnetmib-request@sunroof.eng.sun.com
         Email Archive: ftp://ftp.ietf.org/ietf-mail-archive/frnetmib"
        Chair:      Andy Malis
                     Vivace Networks
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        WG editor:  Prayson Pate
                     Overture Networks
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        Co-author:  Bob Lynch
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E-mail: krehbehn@megisto.com

Description
"This is the MIB used to control and monitor the multilink frame relay (MFR) function described in FRF.16."

Revision History

Revision "200011300000Z"
Description
"Published as RFC 3020."

::= {transmission 47}

Textual Conventions

MfrBundleLinkState ::= TEXTUAL-CONVENTION
STATUS current
DESCRIPTION "The possible states for a bundle link, as defined in Annex A of FRF.16."
REFERENCE "FRF.16 Annex A"
SYNTAX INTEGER {
  mfrBundleLinkStateAddSent (1),
  mfrBundleLinkStateAddRx (2),
  mfrBundleLinkStateAddAckRx (3),
  mfrBundleLinkStateUp (4),
  mfrBundleLinkStateIdlePending (5),
  mfrBundleLinkStateIdle (6),
  mfrBundleLinkStateDown (7),
  mfrBundleLinkStateDownIdle (8)
}

Object Identifiers
mfrMibScalarObjects OBJECT IDENTIFIER ::= { mfrMib 1 }
mfrMibBundleObjects OBJECT IDENTIFIER ::= { mfrMib 2 }
mfrMibBundleLinkObjects OBJECT IDENTIFIER ::= { mfrMib 3 }
mfrMibTraps OBJECT IDENTIFIER ::= { mfrMib 4 }
mfrMibConformance OBJECT IDENTIFIER ::= { mfrMib 5 }
mfrMibTrapsPrefix OBJECT IDENTIFIER ::= { mfrMibTraps 0 }
mfrMibGroups OBJECT IDENTIFIER ::= { mfrMibConformance 1 }
mfrMibCompliances OBJECT IDENTIFIER ::= { mfrMibConformance 2 }

mfrBundleMaxNumBundles OBJECT-TYPE
SYNTAX  Integer32
MAX-ACCESS read-only
STATUS  current
DESCRIPTION
   "This object is used to inform the manager of the maximum number of bundles supported by this device."
 ::= { mfrMibScalarObjects 1 }

mfrBundleNextIndex OBJECT-TYPE
SYNTAX  TestAndIncr
MAX-ACCESS read-write
STATUS  current
DESCRIPTION
   "This object is used to assist the manager in selecting a value for mfrBundleIndex during row creation in the mfrBundleTable. It can also be used to avoid race conditions with multiple managers trying to create rows in the table (see RFC 2494 [RFC2494] for one such algorithm)."
REFERENCE "RFC 2494"
 ::= { mfrMibScalarObjects 2 }

mfrMibTrapsPrefix OBJECT IDENTIFIER ::= { mfrMibTraps 0 }
The bundle configuration and status table. There is a one-to-one correspondence between a bundle and an interface represented in the ifTable.

The following objects of the ifTable have specific meaning for an MFR bundle:
- ifAdminStatus - the bundle admin status
- ifOperStatus - the bundle operational status
- ifSpeed - the current bandwidth of the bundle
- ifInUcastPkts - the number of frames received on the bundle
- ifOutUcastPkts - the number of frames transmitted on the bundle
- ifInErrors - frame (not fragment) errors
- ifOutErrors - frame (not fragment) errors

""
mfrBundleTimerAck
INTEGER,
mfrBundleCountMaxRetry
INTEGER,
mfrBundleActivationClass
INTEGER,
mfrBundleThreshold
Integer32,
mfrBundleMaxDiffDelay
Integer32,
mfrBundleSeqNumSize
INTEGER,
mfrBundleMaxBundleLinks
Integer32,
mfrBundleLinksConfigured
Integer32,
mfrBundleLinksActive
Integer32,
mfrBundleBandwidth
Integer32,
mfrBundleFarEndName
SnmpAdminString,
mfrBundleResequencingErrors
Counter32
}

mfrBundleIndex OBJECT-TYPE
SYNTAX  Integer32 (1..2147483647)
MAX-ACCESS  not-accessible
STATUS  current
DESCRIPTION
"The index into the table. While this corresponds
to an entry in the ifTable, the value of mfrBundleIndex
need not match that of the ifIndex in the ifTable.
A manager can use mfrBundleNextIndex to select a unique
mfrBundleIndex for creating a new row."
::= { mfrBundleEntry 1 }

mfrBundleIfIndex OBJECT-TYPE
SYNTAX  InterfaceIndex
MAX-ACCESS  read-only
STATUS  current
DESCRIPTION
"The value must match an entry in the interface
table whose ifType must be set to frf16MfrBundle(163).

For example: if the value of mfrBundleIfIndex is 10,
then a corresponding entry should be present in
::= { mfrBundleEntry 2 }

mfrBundleRowStatus OBJECT-TYPE
SYNTAX  RowStatus
MAX-ACCESS  read-create
STATUS  current
DESCRIPTION
"The mfrBundleRowStatus object allows create, change, and delete operations on bundle entries."
REFERENCE "RFC 1903"
::= { mfrBundleEntry 3 }

mfrBundleNearEndName OBJECT-TYPE
SYNTAX  SnmpAdminString
MAX-ACCESS  read-create
STATUS  current
DESCRIPTION
"The configured name of the bundle."
REFERENCE "FRF.16 section 3.4.1"
::= { mfrBundleEntry 4 }

mfrBundleFragmentation OBJECT-TYPE
SYNTAX  INTEGER {
    enable  (1),
    disable (2)
}
MAX-ACCESS  read-create
STATUS  current
DESCRIPTION
"Controls whether the bundle performs/accepts fragmentation and re-assembly. The possible values are:

enable(1) - Bundle links will fragment frames

disable(2) - Bundle links will not fragment frames."
DEFVAL { disable }
::= { mfrBundleEntry 5 }

mfrBundleMaxFragSize OBJECT-TYPE
SYNTAX  Integer32 (-1..8184)
UNITS "Octets"
MAX-ACCESS  read-create
STATUS  current
DESCRIPTION
"The maximum fragment size supported. Note that this
is only valid if mfrBundleFragmentation is set to enable(1).

Zero is not a valid fragment size.

A bundle that does not support fragmentation must return
this object with a value of -1.

DEFVAL { -1 }
::= { mfrBundleEntry 6 }

mfrBundleTimerHello OBJECT-TYPE
SYNTAX INTEGER (1..180)
UNITS "Seconds"
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The configured MFR Hello Timer value."
REFERENCE "FRF.16 section 4.3.8.1"
DEFVAL { 10 }
::= { mfrBundleEntry 7 }

mfrBundleTimerAck OBJECT-TYPE
SYNTAX INTEGER (1..10)
UNITS "Seconds"
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The configured MFR T_ACK value."
REFERENCE "FRF.16 section 4.3.8.2"
DEFVAL { 4 }
::= { mfrBundleEntry 8 }

mfrBundleCountMaxRetry OBJECT-TYPE
SYNTAX INTEGER (1..5)
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The MFR N_MAX_RETRY value."
REFERENCE "FRF.16 section 4.3.8.3"
DEFVAL { 2 }
::= { mfrBundleEntry 9 }

mfrBundleActivationClass OBJECT-TYPE
SYNTAX INTEGER {
  mfrBundleActivationClassA (1),
  mfrBundleActivationClassB (2),
  mfrBundleActivationClassC (3),
  mfrBundleActivationClassD (4)
}
MAX-ACCESS  read-create
STATUS  current
DESCRIPTION  
"Controls the conditions under which the bundle is activated.  
The following settings are available:

mfrBundleActivationClassA(1) - at least one must link up
mfrBundleActivationClassB(2) - all links must be up
mfrBundleActivationClassC(3) - a certain number must be 
     up.  Refer to 
mfrBundleThreshold for 
     the required number.

mfrBundleActivationClassD(4) - custom (implementation 
specific)."

REFERENCE "FRF.16 section 4.2.2.1"
DEFVAL { mfrBundleActivationClassA }
::= { mfrBundleEntry 10 }

mfrBundleThreshold OBJECT-TYPE
SYNTAX  Integer32 (-1..2147483647)
UNITS  "Bundle Links"
MAX-ACCESS  read-create
STATUS  current
DESCRIPTION  
"Specifies the number of links that must be in operational 
     'up' state before the bundle will transition to an 
     operational up/active state.  If the number of 
     operational 'up' links falls below this value, 
     then the bundle will transition to an inactive 
     state.

Note - this is only valid when mfrBundleActivationClass 
is set to mfrBundleActivationClassC or, depending upon the 
implementation, to mfrBundleActivationClassD.  A bundle that 
is not set to one of these must return this object with a 
value of -1."
REFERENCE "FRF.16 section 4.2.2.1"
DEFVAL { -1 }
::= { mfrBundleEntry 11 }

mfrBundleMaxDiffDelay OBJECT-TYPE
SYNTAX  Integer32 (-1..2147483647)
UNITS  "Milliseconds"
MAX-ACCESS  read-create
STATUS  current
DESCRIPTION  
"The maximum delay difference between the bundle 
links."
A value of -1 indicates that this object does not contain a valid value.

DEFVAL { -1 }
::= { mfrBundleEntry 12 }

mfrBundleSeqNumSize OBJECT-TYPE
SYNTAX  INTEGER {
  seqNumSize12bit (1),
  seqNumSize24bit (2)
}
MAX-ACCESS read-create
STATUS  current
DESCRIPTION
"Controls whether the standard FRF.12 12-bit sequence number is used or the optional 24-bit sequence number."
REFERENCE "FRFTC/99-194"
DEFVAL { seqNumSize12bit }
::= { mfrBundleEntry 13 }

mfrBundleMaxBundleLinks OBJECT-TYPE
SYNTAX  Integer32 (1..2147483647)
UNITS "Bundle Links"
MAX-ACCESS read-only
STATUS  current
DESCRIPTION
"The maximum number of bundle links supported for this bundle."
::= { mfrBundleEntry 14 }

mfrBundleLinksConfigured OBJECT-TYPE
SYNTAX  Integer32 (1..2147483647)
UNITS "Bundle Links"
MAX-ACCESS read-only
STATUS  current
DESCRIPTION
"The number of links configured for the bundle."
::= { mfrBundleEntry 15 }

mfrBundleLinksActive OBJECT-TYPE
SYNTAX  Integer32 (-1..2147483647)
UNITS "Bundle Links"
MAX-ACCESS read-only
STATUS  current
DESCRIPTION
"The number of links that are active."
::= { mfrBundleEntry 16 }
mfrBundleBandwidth OBJECT-TYPE
   SYNTAX  Integer32
   UNITS "Bits/Sec"
   MAX-ACCESS read-only
   STATUS  current
   DESCRIPTION
      "The amount of available bandwidth on the bundle"
   ::= { mfrBundleEntry 17 }

mfrBundleFarEndName OBJECT-TYPE
   SYNTAX  SnmpAdminString
   MAX-ACCESS read-only
   STATUS  current
   DESCRIPTION
      "Name of the bundle received from the far end."
   REFERENCE "FRF.16 section 3.4.1"
   ::= { mfrBundleEntry 18 }

mfrBundleResequencingErrors OBJECT-TYPE
   SYNTAX  Counter32
   UNITS "Error Events"
   MAX-ACCESS read-only
   STATUS  current
   DESCRIPTION
      "A count of the number of resequencing errors. Each event
      may correspond to multiple lost frames. Example:
      Say sequence number 56, 59 and 60 is received for DLCI 100.
      It is decided by some means that sequence 57 and 58 is lost.
      This counter should then be incremented by ONE, even though
      two frames were lost."
   ::= { mfrBundleEntry 19 }

-- ---------------------------------------------------------
-- ---------------------------------------------------------
-- ifIndex Mapping to Bundle Index Table
-- ---------------------------------------------------------
-- ---------------------------------------------------------

mfrBundleIfIndexMappingTable OBJECT-TYPE
   SYNTAX  SEQUENCE OF MfrBundleIfIndexMappingEntry
   MAX-ACCESS not-accessible
   STATUS  current
   DESCRIPTION
      "A table mapping the values of ifIndex to the
      mfrBundleIndex. This is required in order to find
      the mfrBundleIndex given an ifIndex. The mapping of
      mfrBundleIndex to ifIndex is provided by the
      mfrBundleIfIndex entry in the mfrBundleTable."

Pate, et al.                Standards Track                    [Page 22]
::= { mfrMibBundleObjects 4 }

mfrBundleIfIndexMappingEntry OBJECT-TYPE
SYNTAX  MfrBundleIfIndexMappingEntry
MAX-ACCESS not-accessible
STATUS  current
DESCRIPTION
"Each row describes one ifIndex to mfrBundleIndex mapping."
INDEX   { ifIndex }
 ::= { mfrBundleIfIndexMappingTable 1 }

MfrBundleIfIndexMappingEntry ::=  
  SEQUENCE  
    {  
      mfrBundleIfIndexMappingIndex  
        Integer32  
    }

mfrBundleIfIndexMappingIndex OBJECT-TYPE
SYNTAX  Integer32 (1..2147483647)
MAX-ACCESS read-only
STATUS  current
DESCRIPTION
"The mfrBundleIndex of the given ifIndex."
 ::= { mfrBundleIfIndexMappingEntry 2 }

-- ---------------------------------------------------------
-- Bundle Link Table
-- ---------------------------------------------------------

mfrBundleLinkTable OBJECT-TYPE
SYNTAX  SEQUENCE OF MfrBundleLinkEntry
MAX-ACCESS not-accessible
STATUS  current
DESCRIPTION
"The bundle link configuration and status table. There is a one-to-one correspondence between a bundle link and a physical interface represented in the ifTable. The ifIndex of the physical interface is used to index the bundle link table, and to create rows."

The following objects of the ifTable have specific meaning for an MFR bundle link:

ifAdminStatus  -  the bundle link admin status
ifOperStatus   -  the bundle link operational status
ifSpeed        - the bandwidth of the bundle link interface
ifInUcastPkts  - the number of frames received on the bundle link
ifOutUcastPkts - the number of frames transmitted on the bundle link
ifInErrors     - frame and fragment errors
ifOutErrors    - frame and fragment errors

::= { mfrMibBundleLinkObjects 1 }

mfrBundleLinkEntry OBJECT-TYPE
SYNTAX   MfrBundleLinkEntry
MAX-ACCESS not-accessible
STATUS   current
DESCRIPTION
   "An entry in the bundle link table."
INDEX   { ifIndex }
::= { mfrBundleLinkTable 1 }

MfrBundleLinkEntry ::= 
SEQUENCE {
   mfrBundleLinkRowStatus   RowStatus,
   mfrBundleLinkConfigBundleIndex Integer32,
   mfrBundleLinkNearEndName  SnmpAdminString,
   mfrBundleLinkState       MfrBundleLinkState,
   mfrBundleLinkFarEndName   SnmpAdminString,
   mfrBundleLinkFarEndBundleName SnmpAdminString,
   mfrBundleLinkDelay       Integer32,
   mfrBundleLinkFramesControlTx Counter32,
   mfrBundleLinkFramesControlRx Counter32,
   mfrBundleLinkFramesControlInvalid Counter32,
   mfrBundleLinkTimerExpiredCount Counter32,
   mfrBundleLinkLoopbackSuspected Counter32,
   mfrBundleLinkUnexpectedSequence Counter32,
   mfrBundleLinkMismatch
};
mfrBundleLinkRowStatus OBJECT-TYPE
SYNTAX  RowStatus
MAX-ACCESS  read-create
STATUS  current
DESCRIPTION
"The mfrBundleLinkRowStatus object allows create, change, and delete operations on mfrBundleLink entries.

The create operation must fail if no physical interface is associated with the bundle link."
::= { mfrBundleLinkEntry 1 }

mfrBundleLinkConfigBundleIndex OBJECT-TYPE
SYNTAX  Integer32 (1..2147483647)
MAX-ACCESS  read-create
STATUS  current
DESCRIPTION
"The mfrBundleLinkConfigBundleIndex object allows the manager to control the bundle to which the bundle link is assigned. If no value were in this field, then the bundle would remain in NOT_READY rowStatus and be unable to go to active. With an appropriate mfrBundleIndex in this field, then we could put the mfrBundleLink row in NOT_IN_SERVICE or ACTIVE rowStatus."
::= { mfrBundleLinkEntry 2 }

mfrBundleLinkNearEndName OBJECT-TYPE
SYNTAX  SnmpAdminString
MAX-ACCESS  read-create
STATUS  current
DESCRIPTION
"The configured bundle link name that is sent to the far end."
::= { mfrBundleLinkEntry 3 }

mfrBundleLinkState OBJECT-TYPE
SYNTAX  MfrBundleLinkState
MAX-ACCESS  read-only
STATUS  current
DESCRIPTION
"Current bundle link state as defined by the MFR protocol described in Annex A of FRF.16."
REFERENCE "FRF.16 Annex A"
::= { mfrBundleLinkEntry 4 }

mfrBundleLinkFarEndName OBJECT-TYPE
SYNTAX  SnmpAdminString
MAX-ACCESS  read-only
STATUS  current
DESCRIPTION
"Name of bundle link received from far end."
REFERENCE "FRF.16 section 3.4.2"
::= { mfrBundleLinkEntry 5 }

mfrBundleLinkFarEndBundleName OBJECT-TYPE
SYNTAX  SnmpAdminString
MAX-ACCESS  read-only
STATUS  current
DESCRIPTION
"Name of far end bundle for this link received from far end."
REFERENCE "FRF.16 section 3.4.1"
::= { mfrBundleLinkEntry 6 }

mfrBundleLinkDelay OBJECT-TYPE
SYNTAX  Integer32 (-1..2147483647)
UNITS "Milliseconds"
MAX-ACCESS  read-only
STATUS  current
DESCRIPTION
"Current round-trip delay for this bundle link. The
value -1 is returned when an implementation does not
support measurement of the bundle link delay."
REFERENCE "FRF.16 section 3.4.4"
::= { mfrBundleLinkEntry 7 }

mfrBundleLinkFramesControlTx OBJECT-TYPE
SYNTAX  Counter32
UNITS "Frames"
MAX-ACCESS  read-only
STATUS  current
DESCRIPTION
"Number of MFR control frames sent."
REFERENCE "FRF.16 section 3.2"
::= { mfrBundleLinkEntry 8 }

mfrBundleLinkFramesControlRx OBJECT-TYPE
SYNTAX  Counter32
UNITS "Frames"
MAX-ACCESS  read-only
STATUS  current
DESCRIPTION
"Number of valid MFR control frames received."
REFERENCE "FRF.16 section 3.2"
::= { mfrBundleLinkEntry 9 }
mfrBundleLinkFramesControlInvalid OBJECT-TYPE
SYNTAX  Counter32
UNITS "Frames"
MAX-ACCESS  read-only
STATUS  current
DESCRIPTION
   "The number of invalid MFR control frames received."
REFERENCE "FRF.16 section 3.2"
::= { mfrBundleLinkEntry 10 }

mfrBundleLinkTimerExpiredCount OBJECT-TYPE
SYNTAX  Counter32
UNITS "Timer Expiration Events"
MAX-ACCESS  read-only
STATUS  current
DESCRIPTION
   "Number of times the T_HELLO or T_ACK timers expired."
REFERENCE "FRF.16 section 4.3.8.1 and 4.3.8.2"
::= { mfrBundleLinkEntry 11 }

mfrBundleLinkLoopbackSuspected OBJECT-TYPE
SYNTAX  Counter32
UNITS "Loopback Suspected Events"
MAX-ACCESS  read-only
STATUS  current
DESCRIPTION
   "The number of times a loopback has been suspected
    (based upon the use of magic numbers)."
REFERENCE "FRF.16 section 4.3.7"
::= { mfrBundleLinkEntry 12 }

mfrBundleLinkUnexpectedSequence OBJECT-TYPE
SYNTAX  Counter32
UNITS "Frames"
MAX-ACCESS  read-only
STATUS  current
DESCRIPTION
   "The number of data MFR frames discarded because the sequence
    number of the frame for a DLCI was less than (delayed frame)
    or equal to (duplicate frame) the one expected for that DLCI.
    Example:
    Say frames with sequence numbers 56, 58, 59 is received for
    DLCI 100. While waiting for sequence number 57 another frame
    with sequence number 58 arrives. Frame 58 is discarded and
    the counter is incremented."
REFERENCE "FRF.16 section 4.2.3.2"
::= { mfrBundleLinkEntry 13 }
mfrBundleLinkMismatch OBJECT-TYPE
SYNTAX Counter32
UNITS "Bundle Name Mismatch Events"
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of times that the unit has been notified by the
remote peer that the bundle name is inconsistent with other
bundle links attached to the far-end bundle."
REFERENCE "FRF.16 section 4.3.2.4"
 ::= { mfrBundleLinkEntry 14 }

-- ---------------------------------------------------------
-- Notifications/Traps
-- ---------------------------------------------------------
-- ---------------------------------------------------------

mfrMibTrapBundleLinkMismatch NOTIFICATION-TYPE
OBJECTS {
  mfrBundleNearEndName,
  mfrBundleFarEndName,
  mfrBundleLinkNearEndName,
  mfrBundleLinkFarEndName,
  mfrBundleLinkFarEndBundleName
}
STATUS current
DESCRIPTION
"This trap indicates that a bundle link mismatch has
been detected. The following objects are reported:

  mfrBundleNearEndName: configured name of near end bundle

  mfrBundleFarEndName: previously reported name of
    far end bundle

  mfrBundleLinkNearEndName: configured name of near end bundle

  mfrBundleLinkFarEndName: reported name of far end bundle

  mfrBundleLinkFarEndBundleName: currently reported name of
    far end bundle

Note: that the configured items may have been configured
automatically.

Note: The mfrBundleLinkMismatch counter is incremented when
the trap is sent."
REFERENCE "FRF.16 section 4.3.2.4"
 ::= { mfrMibTrapsPrefix 1 }

-- Conformance/Compliance

mfrMibCompliance MODULE-COMPLIANCE
 STATUS current
 DESCRIPTION
 "The compliance statement for equipment that implements
 the FRF16 MIB. All of the current groups are mandatory,
 but a number of objects may be read-only if the
 implementation does not allow configuration."
 MODULE -- this module
 MANDATORY-GROUPS {
   mfrMibBundleGroup,
   mfrMibBundleLinkGroup,
   mfrMibTrapGroup
 }

OBJECT mfrBundleFragmentation
 MIN-ACCESS read-only
 DESCRIPTION
 "Write access is not required, but the value used must be
 reported."

OBJECT mfrBundleMaxFragSize
 MIN-ACCESS read-only
 DESCRIPTION
 "Write access is not required, but the value used must be
 reported.
 A value of -1 indicates that the value is not applicable."

OBJECT mfrBundleThreshold
 MIN-ACCESS read-only
 DESCRIPTION
 "Write access is not required, but the value used must be
 reported.
 A value of -1 indicates that the value is not applicable."

OBJECT mfrBundleMaxDiffDelay
 MIN-ACCESS read-only
 DESCRIPTION
 "Write access is not required, but the value used must be
 reported."
OBJECT  mfrBundleSeqNumSize
MIN-ACCESS  read-only
DESCRIPTION
  "Write access is not required, but the value used must be
  reported.
  A value of -1 indicates that the value is not applicable."
  ::= { mfrMibCompliances 1 }

mfrMibBundleGroup OBJECT-GROUP
OBJECTS {
  mfrBundleMaxNumBundles,
  mfrBundleNextIndex,
  mfrBundleIfIndex,
  mfrBundleRowStatus,
  mfrBundleNearEndName,
  mfrBundleFragmentation,
  mfrBundleMaxFragSize,
  mfrBundleTimerHello,
  mfrBundleTimerAck,
  mfrBundleCountMaxRetry,
  mfrBundleActivationClass,
  mfrBundleThreshold,
  mfrBundleMaxDiffDelay,
  mfrBundleMaxBundleLinks,
  mfrBundleLinksConfigured,
  mfrBundleLinksActive,
  mfrBundleBandwidth,
  mfrBundleSeqNumSize,
  mfrBundleFarEndName,
  mfrBundleResequencingErrors,
  mfrBundleIfIndexMappingIndex
}
STATUS  current
DESCRIPTION
  "Group of objects describing bundles."
  ::= { mfrMibGroups 1 }

mfrMibBundleLinkGroup OBJECT-GROUP
OBJECTS {
  mfrBundleLinkRowStatus,
mfrBundleLinkConfigBundleIndex,
mfrBundleLinkNearEndName,
mfrBundleLinkState,
mfrBundleLinkFarEndName,
mfrBundleLinkFarEndBundleName,
mfrBundleLinkDelay,
mfrBundleLinkFramesControlTx,
mfrBundleLinkFramesControlRx,
mfrBundleLinkFramesControlInvalid,
mfrBundleLinkTimerExpiredCount,
mfrBundleLinkLoopbackSuspected,
mfrBundleLinkUnexpectedSequence,
mfrBundleLinkMismatch
}
STATUS current
DESCRIPTION
   "Group of objects describing bundle links."
 ::= { mfrMibGroups 2 }

mfrMibTrapGroup NOTIFICATION-GROUP
NOTIFICATIONS {
   mfrMibTrapBundleLinkMismatch
}
STATUS current
DESCRIPTION
   "Group of objects describing notifications (traps)."
 ::= { mfrMibGroups 3 }

END
4. Acknowledgments

This document was produced by the Frame Relay Service MIB (frnetmib) Working Group in conjunction with the Frame Relay Forum.

5. References


[Q.933] ITU-T, Recommendation Q.933: "Signalling Specification For Frame Mode Basic Call Control"


[RFC2494] Fowler, D., "Definitions of Managed Objects for the DS0 and DS0 Bundle Interface Type", RFC 2494, November 1997.


6. 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.

No managed objects in this MIB contain sensitive information.

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.
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