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

March 9, 2000

draft-ietf-frnetmib-mfrmib-01

Prayson Pate/Bob Lynch
Larscom
pate@larscom.com

Kenneth Rehbehn
Visual Networks
krehbehn@visualnetworks.com

Status of this Memo

This document is an Internet-Draft and is in full conformance with all provisions of Section 10 of RFC 2026. Internet-Drafts are working documents of the Internet Engineering Task Force (IETF), its areas, and its working groups. Note that other groups may also distribute working documents as Internet-Drafts.

Internet-Drafts are draft documents valid for a maximum of six months and may be updated, replaced, or obsoleted by other documents at any time. It is inappropriate to use Internet-Drafts as reference material or to cite them other than as "work in progress."

The list of current Internet-Drafts can be accessed at http://www.ietf.org/ietf/1id-abstracts.txt

The list of Internet-Draft Shadow Directories can be accessed at http://www.ietf.org/shadow.html.
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 include conformance and notification information.

Copyright Notice

Copyright (C) The Internet Society (2000). All Rights Reserved.
Table of Contents

1 The SNMP Management Framework ..................................... 4
2 Overview ........................................................................ 5
2.1 Multilink Frame Relay Background ................................... 5
2.1.1 Terminology .................................................. 5
2.1.2 Reference Model ........................................... 6
2.2 Structure of the MIB ............................................... 7
2.2.1 bundleMaxNumBundles ....................................... 7
2.2.2 bundleNextIndex ............................................ 7
2.2.3 bundleTable ................................................ 7
2.2.4 Bundle-to-ifIndex Mapping Table .............................. 7
2.2.5 bundleLinkTable ........................................... 8
2.3 Relationship With Other MIBS and Tables .......................... 8
2.3.1 Relationship With Interface Table ............................. 8
2.3.1.1 Bundle Links .......................................... 8
2.3.1.2 Bundles ................................................ 8
2.3.1.3 Mapping Between ifIndex and bundleIndex ............. 9
2.3.1.4 ifTable Objects ......................................... 9
2.3.2 Relationship With Interface Stack Table ....................... 9
2.3.3 Relationship With Frame Relay DTE MIB ..................... 10
2.3.4 Relationship With Frame Relay Service MIB .................. 10
2.3.5 Example .................................................... 10
2.4 Creation Of Bundles and Bundle Links ............................ 12
2.4.1 Creation Of Bundles ....................................... 12
2.4.2 Creation Of Bundle Links ................................... 12
2.5 Notifications .................................................... 12
2.5.1 Bundle ..................................................... 12
2.5.1.1 linkUp ................................................ 12
2.5.1.2 linkDown ............................................. 12
2.5.2 Bundle Link ................................................ 12
2.5.2.1 linkUp ................................................ 13
2.5.2.2 linkDown ............................................. 13
2.5.2.3 mfrMibTrapBundleLinkMismatch ...................... 13
3 Object Definitions .................................................... 14
4 Acknowledgments ........................................................ 34
5 References .................................................................... 35
6 Security Considerations .................................................. 37
7 Authors’ Addresses ....................................................... 38
8 Copyright Section ........................................................ 38
# 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].

- **Protocol operations for accessing management information.** The first set of protocol operations and associated PDU formats is described in STD 15, RFC 1157 [RFC1157]. A second set of protocol operations and associated PDU formats is described in RFC 1905 [RFC1905].

- **A set of fundamental applications** described in RFC 2573 [RFC2573] and the view-based access control mechanism described in RFC 2575 [RFC2575].

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

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

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

2. Overview

This document defines a Management Information Base (MIB) for monitoring and controlling UNI/NNI Multilink Frame Relay interfaces. 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

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

Note 2: Multiple frame acknowledged information transfer mode 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. bundleMaxNumBundles

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

2.2.2. bundleNextIndex

This scalar is used to assist the manager in selecting a value for bundleIndex 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. bundleTable

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

- bundleIndex: Integer32
- bundleIfIndex: InterfaceIndex
- bundleRowStatus: RowStatus
- bundleNearEndName: SnmpAdminString
- bundleFragmentation: INTEGER
- bundleMaxFragSize: Integer32
- bundleTimerHello: INTEGER
- bundleTimerAck: INTEGER
- bundleCountMaxRetry: INTEGER
- bundleActivationClass: INTEGER
- bundleThreshold: Integer32
- bundleMaxDiffDelay: Integer32
- bundleSeqNumSize: INTEGER
- bundleLinksConfigured: Integer32
- bundleLinksActive: Integer32
- bundleBandwidth: Integer32
- bundleFarEndName: SnmpAdminString
- bundleResequencingErrors: Counter32

2.2.4. Bundle-to-ifIndex Mapping Table

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

- bundleIfIndexMapping: InterfaceIndex
2.2.5. bundleLinkTable

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

- bundleLinkRowStatus                    RowStatus
- bundleLinkConfigBundleIndex            Integer32
- bundleLinkNearEndName                  SnmpAdminString
- bundleLinkState                        BundleLinkState
- bundleLinkFarEndName                   SnmpAdminString
- bundleLinkFarEndBundleName             SnmpAdminString
- bundleLinkDelay                        Integer32
- bundleLinkFramesControlTx             Counter32
- bundleLinkFramesControlRx             Counter32
- bundleLinkFramesControlInvalid        Counter32
- bundleLinkTimerExpiredCount           Counter32
- bundleLinkLoopbackSuspected           Counter32
- bundleLinkUnexpectedSequence          Counter32
- bundleLinkMismatch                     Counter32

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 bundleIndex 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 creatable as they do not have row status. RFC 2233 [RFC2233] 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. 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 bundleIndex

The bundleIfIndexMappingTable is indexed by ifIndex and provides the means to map a given ifIndex into the corresponding bundleIndex. The bundleIfIndexMapping object in the bundleConfigTable (indexed by bundleIndex) provides the reverse mapping of a bundleIndex to the corresponding ifIndex in the ifTable.

2.3.1.4. ifTable Objects

See the DESCRIPTION clauses for the bundleTable and bundleLinkTable for a description of how they relate to the ifTable [RFC1573].

2.3.2. Relationship With Interface Stack Table

The bundles and bundle links will appear in the ifStackTable defined in RFC 2233 [RFC2233]. 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]. There is no other relationship between these MIBs.

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 bundleIndex 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:

<table>
<thead>
<tr>
<th>ifIndex</th>
<th>Description</th>
<th>ifType</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FrameRelayService</td>
<td>frameRelayService(44)</td>
</tr>
<tr>
<td>2</td>
<td>MFR Bundle #10</td>
<td>frf16MfrBundle(163)</td>
</tr>
<tr>
<td>3</td>
<td>MFR Bundle #20</td>
<td>frf16MfrBundle(163)</td>
</tr>
<tr>
<td>4</td>
<td>ds1 #1/MFR Bundle Link #1</td>
<td>ds1(18)</td>
</tr>
<tr>
<td>5</td>
<td>ds1 #2/MFR Bundle Link #2</td>
<td>ds1(18)</td>
</tr>
<tr>
<td>6</td>
<td>ds1 #3/MFR Bundle Link #3</td>
<td>ds1(18)</td>
</tr>
<tr>
<td>7</td>
<td>ds1 #4/MFR Bundle Link #4</td>
<td>ds1(18)</td>
</tr>
</tbody>
</table>
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>3</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>6</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 bundleIfIndexMappingTable shows the relationship between the ifTable ifIndex and the bundleIndex:

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

The bundleConfigTable shows the relationship between the bundleIndex and the ifIndex:

<table>
<thead>
<tr>
<th>bundleIndex</th>
<th>bundleIfIndex</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>20</td>
<td>3</td>
</tr>
</tbody>
</table>

The bundleLinkConfigTable shows the relationship between the bundles and bundle links:

<table>
<thead>
<tr>
<th>bundleIndex</th>
<th>bundleLinkIfIndex</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 bundle is created using the bundleConfigRowStatus RowStatus object. There is no minimum set of objects required in order to create a new bundle i.e. all of the parameters can assume default values.

2.4.2. Creation Of Bundle Links

A bundle link is created using the bundleLinkConfigRowStatus RowStatus object. There is no minimum set of objects required in order to create a new bundle link i.e. all of the parameters can assume default values.

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

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

2.5. Notifications

The linkUp and linkDown traps are defined in RFC 1573 [RFC1573].

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 bundleActivationClass and bundleThreshold) 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 bundleActivationClass and bundleThreshold) 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 bundle link transitions into the up state.

2.5.2.2. linkDown

This trap is sent when a bundle link transitions from the up state.

2.5.2.3. mfrMibTrapBundleLinkMismatch

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

- bundleNearEndName: configured name of near end bundle
- bundleFarEndName: previously reported name of far end bundle
- bundleLinkNearEndName: configured name of near end bundle
- bundleLinkFarEndName: reported name of far end bundle
- bundleLinkFarEndBundleName: currently reported name of far end bundle

Note that the configured items may have been configured automatically. Note also that the bundleLinkMismatch 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.

FRF16-MFR-MIB-EXP DEFINITIONS ::= BEGIN

IMPORTS
  MODULE-IDENTITY, OBJECT-TYPE, Integer32, Counter32,
  NOTIFICATION-TYPE, experimental
  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 "0003090000Z"
  ORGANIZATION "IETF Frame Relay Service MIB (frnetmib) Working Group"
  CONTACT-INFO
    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
   Email:  amalis@lucent.com

WG editor:  Prayson Pate
   Email:  pate@larscom.com

Co-author:  Bob Lynch
   Email:  blynch@larscom.com

Co-author:  Kenneth Rehbehn

Expires September 2000
Visual Networks  
EMail: krehbehn@visualnetworks.com

DESCRIPTION
"This is the MIB used to control and monitor the multilink frame relay (MFR) function described in FRF.16. This was originally submitted to the Frame Relay Forum as contribution FRFTC 99-151 and then updated as FRFTC 99-193."

-- Revision History
-- ---------------------------------------------------------

REVISION "0003090000Z"  
DESCRIPTION
"Initial version of the FRF.16 UNI/NNI Multilink Frame Relay MIB. Published as RFC [RFC-EDITOR: Enter RFC # here]."

REVISION "0003090000Z"  
DESCRIPTION
"[RFC-EDITOR: Remove this and all following REVISION statements prior to publication as an RFC]

Changes from draft-ietf-frnetmib-mfrmib-00.txt
  o changed experimental number to IANA-approved 105.
  o changed interface type for frf16MfrBundle to IANA-approved 163.
"

REVISION "9912061700Z"  
DESCRIPTION
"Updates:
  o changed name to draft-ietf-frnetmib-mfrmib-00
  o updated text to match last MIB revisions
  o corrected description of bundleIfIndexMappingTable
  o added objects to show configured and current bundle links.
"

REVISION "9910212020Z"  
DESCRIPTION
"Updated after comments from Michael Allen and Ken Rehben.
  o corrected options for sequence number length
  o changed frf16Mfr prefix to mfr
  o created a sub-group for scalars
  o created an entry in the bundleTable for maximum links per bundle
  o changed indices to not-accessible
  o changed DisplayString to SnmpAdminString
  o updated some of the object descriptions"
o added a -EXP to the name of the MIB
o added some DEFVAL and REFERENCE clauses

REVISION "9910151300Z"
DESCRIPTION
"Updated after review at the October meeting in Huntsville:
o removed log table
o removed several columns from each table
o combined configuration, status and error tables into
  one table each for bundles and bundle links
o added new objects for
  - maximum number of bundles
  - maximum fragment size
  - size of sequence number
o added notifications
  o added conformance information"

REVISION "9910011440Z"
DESCRIPTION
"Initial version submitted to the Frame Relay Forum
October meeting in Huntsville as FRFTC/99-151."

::= { experimental 105 }

-- ---------------------------------------------------------
-- Textual Conventions
-- ---------------------------------------------------------

BundleLinkState ::= 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 {
    bundleLinkStateAddSent       (1),
    bundleLinkStateAddRx         (2),
    bundleLinkStateAddAckRx      (3),
    bundleLinkStateUp            (4),
    bundleLinkStateIdlePending   (5),
    bundleLinkStateIdle          (6),
    bundleLinkStateDown          (7),
    bundleLinkStateDownIdle      (8)
  }

-- ---------------------------------------------------------
-- Textual Conventions
-- ---------------------------------------------------------

Expires September 2000
-- Object Identifiers
-- ---------------------------------------------------------
-- ---------------------------------------------------------
mfrMibObjects OBJECT IDENTIFIER ::= { mfrMib 1 }
mfrMibTraps OBJECT IDENTIFIER ::= { mfrMib 2 }
mfrMibConformance OBJECT IDENTIFIER ::= { mfrMib 3 }
mfrMibScalarObjects OBJECT IDENTIFIER ::= { mfrMibObjects 1 }
mfrMibBundleObjects OBJECT IDENTIFIER ::= { mfrMibObjects 2 }
mfrMibBundleLinkObjects OBJECT IDENTIFIER ::= { mfrMibObjects 3 }
mfrMibTrapsPrefix OBJECT IDENTIFIER ::= { mfrMibTraps 0 }
mfrMibGroups OBJECT IDENTIFIER ::= { mfrMibConformance 1 }
mfrMibCompliances OBJECT IDENTIFIER ::= { mfrMibConformance 2 }

-- Scalars
-- ---------------------------------------------------------
-- ---------------------------------------------------------

bundleMaxNumBundles 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 }

bundleNextIndex OBJECT-TYPE
SYNTAX  TestAndIncr
MAX-ACCESS read-write
STATUS current
DESCRIPTION
   "This object is used to assist the manager in selecting a value for bundleIndex during row creation in the bundleTable. 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 }

-- ---------------------------------------------------------
-- ---------------------------------------------------------

-- Bundle Table

Expires September 2000
bundleTable OBJECT-TYPE
    SYNTAX  SEQUENCE OF BundleEntry
    MAX-ACCESS not-accessible
    STATUS  current
    DESCRIPTION
        "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 a 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

    ::= { mfrMibBundleObjects 3 }

bundleEntry OBJECT-TYPE
    SYNTAX  BundleEntry
    MAX-ACCESS not-accessible
    STATUS  current
    DESCRIPTION
        "An entry in the bundle table."
    INDEX   { bundleIndex }
    ::= { bundleTable 1 }

BundleEntry ::= 
    SEQUENCE {
        bundleIndex
            Integer32,
        bundleIfIndex
            InterfaceIndex,
        bundleRowStatus
            RowStatus,
        bundleNearEndName
            SnmpAdminString,
        bundleFragmentation
            INTEGER,
        bundleMaxFragSize
            Integer32,
bundleTimerHello
  INTEGER,
bundleTimerAck
  INTEGER,
bundleCountMaxRetry
  INTEGER,
bundleActivationClass
  INTEGER,
bundleThreshold
  Integer32,
bundleMaxDiffDelay
  Integer32,
bundleSeqNumSize
  INTEGER,
bundleMaxBundleLinks
  Integer32,
bundleLinksConfigured
  Integer32,
bundleLinksActive
  Integer32,
bundleBandwidth
  Integer32,
bundleFarEndName
  SnmpAdminString,
bundleResequencingErrors
  Counter32
}

bundleIndex 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 bundleIndex
    need not match that of the ifIndex in the ifTable.
    A manager can use bundleNextIndex to select a unique
    bundleIndex for creating a new row."
  ::= { bundleEntry 1 }

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

    For example: if the value of bundleIfIndex is 10,
then a corresponding entry should be present in
the ifTable with an index of 10."
 ::= { bundleEntry 2 }

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

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

bundleFragmentation 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 }
 ::= { bundleEntry 5 }

bundleMaxFragSize 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 bundleFragmentation is set to enable(1).

Zero is not a valid fragment size.

A bundle that does not support fragmentation must be
set to -1.

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

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

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

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

bundleActivationClass OBJECT-TYPE
SYNTAX  INTEGER {
  bundleActivationClassA (1), -- at least one must link up
  bundleActivationClassB (2), -- all links must be up
  bundleActivationClassC (3), -- a certain number must be up
  bundleActivationClassD (4) -- custom
}
MAX-ACCESS read-create
"Controls the conditions under which the bundle is activated. The following settings are available:

- bundleActivationClassA(1) - at least one must link up
- bundleActivationClassB(2) - all links must be up
- bundleActivationClassC(3) - a certain number must be up. Refer to bundleThreshold for the required number.
- bundleActivationClassD(4) - custom (implementation specific)."

REFERENCE "FRF.16 section 4.2.2.1"

DEFVAL { bundleActivationClassA }
::= { bundleEntry 10 }

bundleThreshold OBJECT-TYPE
SYNTAX  Integer32
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 bundleActivationClass is set to bundleActivationClassC or, depending upon the implementation, to bundleActivationClassD."

REFERENCE "FRF.16 section 4.2.2.1"
DEFVAL { -1 }
::= { bundleEntry 11 }

bundleMaxDiffDelay OBJECT-TYPE
SYNTAX  Integer32
UNITS "Milliseconds"
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The maximum delay difference between the bundle links."
DEFVAL { -1 }
::= { bundleEntry 12 }

bundleSeqNumSize 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 }
 ::= { bundleEntry 13 }

bundleMaxBundleLinks OBJECT-TYPE
SYNTAX  Integer32
UNITS "Bundle Links"
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The maximum number of bundle links supported for this bundle."
 ::= { bundleEntry 14 }

bundleLinksConfigured OBJECT-TYPE
SYNTAX  Integer32
UNITS "Bundle Links"
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of links configured for the bundle."
 ::= { bundleEntry 15 }

bundleLinksActive OBJECT-TYPE
SYNTAX  Integer32
UNITS "Bundle Links"
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of links that are active."
 ::= { bundleEntry 16 }

bundleBandwidth OBJECT-TYPE
SYNTAX  Integer32
UNITS "Bits/Sec"
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The amount of available bandwidth on the bundle"
 ::= { bundleEntry 17 }
bundleFarEndName 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"
::= { bundleEntry 18 }

bundleResequencingErrors 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."
::= { bundleEntry 19 }

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

bundleIfIndexMappingTable OBJECT-TYPE
SYNTAX  SEQUENCE OF BundleIfIndexMappingEntry
MAX-ACCESS not-accessible
STATUS  current
DESCRIPTION
 "A table mapping the values of ifIndex to the
bundleIndex. This is required in order to find
the bundleIndex given an ifIndex. The mapping of
bundleIndex to ifIndex is provided by the bundleIfIndex
entry in the bundleTable."
::= { mfrMibBundleObjects 4 }

bundleIfIndexMappingEntry OBJECT-TYPE
SYNTAX  BundleIfIndexMappingEntry
MAX-ACCESS not-accessible
STATUS  current
DESCRIPTION
 "Each row describes one ifIndex to bundleIndex mapping."
INDEX  ( ifIndex )
::= { bundleIfIndexMappingTable 1 }
BundleIfIndexMappingEntry ::= SEQUENCE {
  bundleIfIndexMappingIndex InterfaceIndex
}

bundleIfIndexMappingIndex OBJECT-TYPE
SYNTAX InterfaceIndex
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The bundleIndex of the given ifIndex."
::= { bundleIfIndexMappingEntry 2 }

-- ---------------------------------------------------------
-- Bundle Link Table
-- ---------------------------------------------------------
-- ---------------------------------------------------------
bundleLinkTable OBJECT-TYPE
SYNTAX SEQUENCE OF BundleLinkEntry
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 a 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 }

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

BundleLinkEntry ::= 
 SEQUENCE {
   bundleLinkRowStatus
      RowStatus,
   bundleLinkConfigBundleIndex
      Integer32,
   bundleLinkNearEndName
      SnmpAdminString,
   bundleLinkState
      BundleLinkState,
   bundleLinkFarEndName
      SnmpAdminString,
   bundleLinkFarEndBundleName
      SnmpAdminString,
   bundleLinkDelay
      Integer32,
   bundleLinkFramesControlTx
      Counter32,
   bundleLinkFramesControlRx
      Counter32,
   bundleLinkFramesControlInvalid
      Counter32,
   bundleLinkTimerExpiredCount
      Counter32,
   bundleLinkLoopbackSuspected
      Counter32,
   bundleLinkUnexpectedSequence
      Counter32,
   bundleLinkMismatch
      Counter32
}

bundleLinkRowStatus OBJECT-TYPE
SYNTAX  RowStatus
MAX-ACCESS  read-create
STATUS  current
DESCRIPTION
   "The bundleLinkRowStatus object allows create, change, and delete operations on bundleLink entries.
   The create operation must fail if no physical interface is associated with the bundle link."
bundleLinkConfigBundleIndex OBJECT-TYPE
SYNTAX  Integer32
MAX-ACCESS  read-create
STATUS  current
DESCRIPTION
  "The bundleLinkConfigBundleIndex 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 bundleIndex in this field, then we could put the bundleLink row in NOT_IN_SERVICE or ACTIVE rowStatus."
::= { bundleLinkEntry 2 }

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

bundleLinkState OBJECT-TYPE
SYNTAX  BundleLinkState
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"
::= { bundleLinkEntry 4 }

bundleLinkFarEndName 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"
::= { bundleLinkEntry 5 }

bundleLinkFarEndBundleName OBJECT-TYPE
SYNTAX  SnmpAdminString
MAX-ACCESS  read-only
STATUS  current
DESCRIPTION
  "Name of far end bundle for this link received from far end."
bundleLinkDelay OBJECT-TYPE
SYNTAX  Integer32
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"
::= { bundleLinkEntry 7 }

bundleLinkFramesControlTx 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"
::= { bundleLinkEntry 8 }

bundleLinkFramesControlRx 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"
::= { bundleLinkEntry 9 }

bundleLinkFramesControlInvalid 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"
::= { bundleLinkEntry 10 }

bundleLinkTimerExpiredCount OBJECT-TYPE
SYNTAX  Counter32
UNITS "Timer Expiration Events"
MAX-ACCESS read-only
bundleLinkLoopbackSuspected 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"
 ::= { bundleLinkEntry 12 }

bundleLinkUnexpectedSequence 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"
 ::= { bundleLinkEntry 13 }

bundleLinkMismatch 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"
 ::= { bundleLinkEntry 14 }
mfrMibTrapBundleLinkMismatch NOTIFICATION-TYPE
OBJECTS {
    bundleNearEndName,
    bundleFarEndName,
    bundleLinkNearEndName,
    bundleLinkFarEndName,
    bundleLinkFarEndBundleName
}
STATUS current
DESCRIPTION
"This trap indicates that a bundle link mismatch has been detected. The following objects are reported:

bundleNearEndName: configured name of near end bundle
bundleFarEndName: previously reported name of far end bundle
bundleLinkNearEndName: configured name of near end bundle
bundleLinkFarEndName: reported name of far end bundle
bundleLinkFarEndBundleName: currently reported name of far end bundle

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

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

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

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

OBJECT     bundleSeqNumSize
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 }

-- _______________________________________________________________
-- ____________________________
-- Units of Conformance
-- _______________________________________________________________
-- _______________________________________________________________

mfrMibBundleGroup OBJECT-GROUP
OBJECTS {
    bundleMaxNumBundles,
    bundleNextIndex,
    bundleIfIndex,
bundleRowStatus,
bundleNearEndName,
bundleFragmentation,
bundleMaxFragSize,
bundleTimerHello,
bundleTimerAck,
bundleCountMaxRetry,
bundleActivationClass,
bundleThreshold,
bundleMaxDiffDelay,
bundleMaxBundleLinks,
bundleLinksConfigured,
bundleLinksActive,
bundleBandwidth,
bundleSeqNumSize,
bundleFarEndName,
bundleResequencingErrors,
bundleIfIndexMappingIndex

} STATUS current DESCRIPTION
"Group of objects describing bundles."
::= { mfrMibGroups 1 }

mfrMibBundleLinkGroup OBJECT-GROUP
OBJECTS {
  bundleLinkRowStatus,
bundleLinkConfigBundleIndex,
bundleLinkNearEndName,
bundleLinkState,
bundleLinkFarEndName,
bundleLinkFarEndBundleName,
bundleLinkDelay,
bundleLinkFramesControlTx,
bundleLinkFramesControlRx,
bundleLinkFramesControlInvalid,
bundleLinkTimerExpiredCount,
bundleLinkLoopbackSuspected,
bundleLinkUnexpectedSequence,
bundleLinkMismatch
}
STATUS current
DESCRIPTION
"Group of objects describing bundle links."
::= { mfrMibGroups 2 }

mfrMibTrapGroup NOTIFICATION-GROUP
NOTIFICATIONS {
mfrMibTrapBundleLinkMismatch
GROUP of objects describing notifications (traps).

::= { mfrMibGroups 3 }

END
4. Acknowledgments

This document was produced by the Frame Relay MFR MIB Working Group.
5. References


[RFC-EDITOR: Update to current RFC that replaces RFC1604]

[RFC2494] D. Fowler, "Definitions of Managed Objects for the DS0 and DS0 Bundle Interface Type" RFC 2494, Newbridge Networks, 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.
7. Authors’ Addresses

Prayson Pate/Bob Lynch
Larscom
P. O. Box 14993
RTP, NC, USA 27560

Phone: +1 919 991-9000
EMail: pate@larscom.com/blynch@larscom.com

Kenneth Rehbehn
Visual Networks
2092 Gaither Road
Rockville, MD, USA 20850

Phone: +1 301 296-2325
EMail: krehbehn@visualnetworks.com

8. Copyright Section

Copyright (C) The Internet Society (2000). All Rights Reserved.

This document and translations of it may be copied and furnished to
others, and derivative works that comment on or otherwise explain it
or assist in its implementation may be prepared, copied, published
and distributed, in whole or in part, without restriction of any
kind, provided that the above copyright notice and this paragraph are
included on all such copies and derivative works. However, this
document itself may not be modified in any way, such as by removing
the copyright notice or references to the Internet Society or other
Internet organizations, except as needed for the purpose of
developing Internet standards in which case the procedures for
copyrights defined in the Internet Standards process must be
followed, or as required to translate it into languages other than
English.

The limited permissions granted above are perpetual and will not be
revoked by the Internet Society or its successors or assigns.

This document and the information contained herein is provided on an
"AS IS" basis and THE INTERNET SOCIETY AND THE INTERNET ENGINEERING
TASK FORCE DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING
BUT NOT LIMITED TO ANY WARRANTY THAT THE USE OF THE INFORMATION
HEREIN WILL NOT INFRINGE ANY RIGHTS OR ANY IMPLIED WARRANTIES OF
MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.