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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.

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1. The SNMP Management Framework

The SNMP Management Framework presently consists of five major components:

- o An overall architecture, described in RFC 2571 [RFC2571].
- o 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].
- o 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

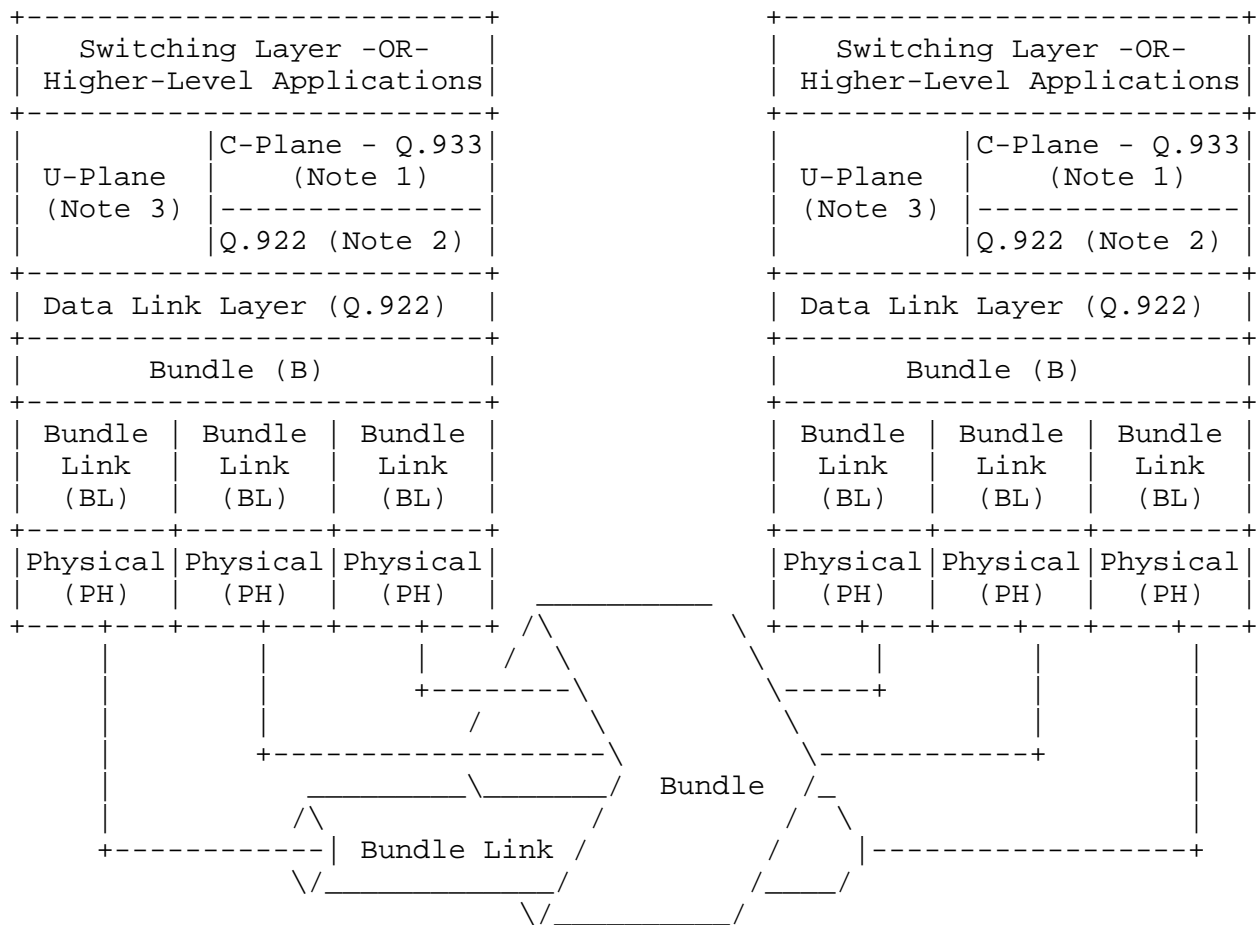


Figure 1: MFR Reference Diagram

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:

- 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	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 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 Tls each. The bundles have a mfrBundleIndex of 10 and 20 respectively.

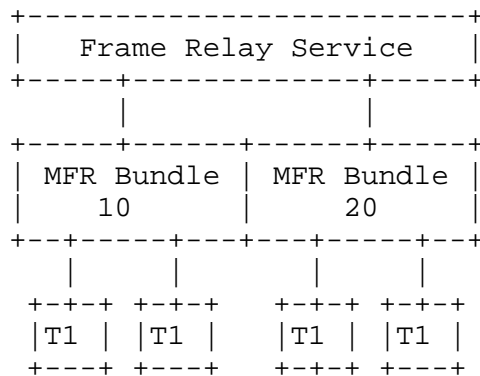


Figure 2: Frame Relay Service Being Carried on 4 Tls

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.

HigherLayer	LowerLayer
0	1
1	2
1	3
2	4
2	5
3	6
3	7
4	0
5	0
6	0
7	0

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

ifIndex	mfrBundleIfIndexMappingIndex
2	10
3	20

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

mfrBundleIndex	mfrBundleIfIndex
10	2
20	3

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

mfrBundleIndex	mfrBundleLinkIfIndex
-----+-----	
10	4
10	5
20	6
20	7

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 an 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:
```

```
            http://www.ietf.org/html.charters/frnetmib-charter.html
```

```
        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
```

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                        Vivace Networks
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        Email:         Andy.Malis@vivacenetworks.com
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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 }

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

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)."

```

mfrBundleTable OBJECT-TYPE

SYNTAX SEQUENCE OF MfrBundleEntry

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 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

"

::= { mfrMibBundleObjects 3 }

mfrBundleEntry OBJECT-TYPE

SYNTAX MfrBundleEntry

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry in the bundle table."

INDEX { mfrBundleIndex }

::= { mfrBundleTable 1 }

MfrBundleEntry ::=

SEQUENCE {

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,
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

```
        the ifTable with an index of 10 and an ifType of 163."
 ::= { 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."

```

 ::= { 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

```



```
        Counter32
    }

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 }

```

-- -----
-- -----
-- Units of Conformance
-- -----
-- -----

```

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.

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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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