Multiprotocol Label Switching (MPLS) Traffic Engineering Management Information Base for Fast Reroute
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This memo defines a portion of the Management Information Base for use with network management protocols in the Internet community. In particular, it describes managed objects used to support two fast reroute (FRR) methods for Multiprotocol Label Switching (MPLS) based traffic engineering (TE). The two methods are one-to-one backup method and facility backup method.
1. Introduction

This memo defines a portion of the Management Information Base (MIB) containing objects used to manage Multiprotocol Label Switching (MPLS)-based fast rerouting features on MPLS Label Switching Routers as defined in [RFC4090]. This MIB module should be used in conjunction with [RFC3811], [RFC3812] and [RFC3813].

Comments should be made directly to the MPLS mailing list at mpls@ietf.org.

1.1. Conventions Used in This Document

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in RFC-2119 [RFC2119].

2. Terminology

This document uses terminology from the document describing the Multiprotocol Label Switching Architecture [RFC3031] and from the document describing Fast Reroute Extensions to RSVP-TE for LSP Tunnels [RFC4090].

3. The Internet-Standard Management Framework

For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of [RFC3410].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. MIB module objects are generally accessed through the Simple Network Management Protocol (SNMP). Objects in the MIB are defined using the mechanisms defined in the Structure of Management Information (SMI). This memo specifies a MIB module that is compliant to the SMIv2, which is described in STD 58, RFC 2578 [RFC2578], STD 58, RFC 2579 [RFC2579] and STD 58, RFC 2580 [RFC2580].

4. Overview of the MIB Modules

The specification [RFC4090] stipulates two different approaches to implementing MPLS TE fast reroute: one-to-one and facility
backups.

We define three MIB modules to represent the respective components: general, one-to-one and facility backup.

They are:

- MPLS-FRR-GENERAL-STD-MIB: Contains objects that apply to any MPLS LSR implementing MPLS TE fast reroute functionality.
- MPLS-FRR-ONE2ONE-STD-MIB: Contains objects that apply to one-to-one backup method.
- MPLS-FRR-FACILITY-STD-MIB: Contains objects that apply to facility backup method.

Although [RFC4090] specifies that a node is able to support both fast reroute methods simultaneously, common practice has shown that operators choose to configure either one-to-one backup method or facility backup at any given time. So by dividing the MIB modules into three, we allow the developers to choose the MIB modules they want to implement depending on the method supported on that node.

4.1. MPLS-FRR-GENERAL-STD-MIB

This MIB module MUST be implemented if either of the fast reroute methods is supported.

4.1.1 mplsFrrConstraintsTable

This table contains objects that apply to all LSRs implementing MPLS TE fast reroute functions. In particular, this table defines fast reroute constraints such as bandwidth for a tunnel instance to be protected by using backup LSPs (detour LSPs or bypass tunnels).

This table MUST be implemented at the ingress node of the protected TE tunnel instance to configure backup LSP setup constraints.

4.1.2 mplsFrrTunnelARHopTable

This table extends mplsTunnelARHopTable (defined in the MPLS-TE-STD-MIB [RFC3812]) with fast-reroute objects which specify the local protection type or types of availability, as well as what type or types are actually in-use for each tunnel hop traversed by a protected TE tunnel.

This table MUST be supported when the Record Route Object (RRO)
is supported by the implementation.

4.2. MPLS-FRR-ONE2ONE-STD-MIB

This MIB module MUST be supported when one-to-one backup fastreroute method is used.

4.2.1 mplsFrrOne2OnePlrTable

The mplsFrrOne2OnePlrTable contains information about Points of Local Repair (PLR) that initiated detour LSPs to protect tunnel instances. This table MUST be supported for LSRs implementing the one-to-one backup method. In these cases, the detour LSPs are reflected in the mplsFrrOne2OneDetourTable.

4.2.2 mplsFrrOne2OneDetourTable

The mplsFrrOne2OneDetourTable shows the detour LSPs in each node (ingress, transit and egress nodes). An entry of this table represents a detour LSP.

Each detour is identified by the following indexes:

- mplsTunnelIndex [RFC3812]: set to the tunnel-id of an LSP protected by a detour.
- mplsTunnelInstance [RFC3812]: consists of two parts
  1) the lower 16 bits: protected TE tunnel instance
     - uniquely identifies a protected LSP within a tunnel.
  2) the higher 16 bits: detour instance
     - uniquely identifies a detour LSP of a protected TE tunnel instance. Multiple detours of the same protected LSP may go through the same node. In this case, the higher 16 bits of the tunnel instance object is used as a detour instance.
- ingress node’s LSR ID (mplsFrrOne2OnePlrTunnelIngressLSRId): set to the ingress node of an LSP protected by a detour.
- egress node’s LSR ID (mplsFrrOne2OnePlrTunnelEgressLSRId): set to the egress node of an LSP protected by a detour.

A detour LSP is also considered as an instance of a protected
TE tunnel. Therefore, each detour LSP SHOULD have an entry in the mplsTunnelTable (defined in the MPLS-TE-STD-MIB[RFC3812]).

In the mplsTunnelTable, the higher 16 bits of the tunnel instance SHOULD be used as a detour instance. Note that for the protected TE tunnel instances, the higher 16 bits of the tunnel instance MUST all be set to zero.

This table MUST be supported if one-to-one backup method is used.

4.2.3 Example of relationship between mplsFrrOne2OnePlrTable, mplsFrrOne2OneDetourTable and mplsTunnelTable

This section contains an example depicting the inter relationship between the mplsFrrOne2OnePlrTable, mplsFrrOne2OneDetourTable and mplsTunnelTable tables.

```
[R1]----[R2]----[R3]------[R4]------[R5]
\       \       /    /  
[R6]----[R7]----[R8]  
```

Protected LSP: [R1->R2->R3->R4->R5]

R1’s Backup: [R1->R6->R7->R8->R3]

In the above topology the various tables will be populated as below.

In mplsFrrOne2OnePlrTable:

```{mplsFrrOne2OnePlrTunnelIndex
mplsFrrOne2OnePlrTunnelDetourInstance
mplsFrrOne2OnePlrTunnelIngressLSRId
mplsFrrOne2OnePlrTunnelEgressLSRId
mplsFrrOne2OnePlrId
mplsFrrOne2OnePlrSenderAddrType
mplsFrrOne2OnePlrSenderAddr
mplsFrrOne2OnePlrAvoidNodeAddrType
mplsFrrOne2OnePlrAvoidNodeAddr
} = 1, 6553601, 192.0.2.1, 192.0.2.5, 192.0.2.1, ipv4(1), "192.0.2.1", ipv4(1), "192.0.2.2", -- R1 is PLR, -- R1-R2(Avoid)

In mplsFrrOne2OneDetourTable:
{  
mplsFrrOne2OnePlrTunnelIndex = 1,  
mplsFrrOne2OnePlrTunnelDetourInstance = 6553601,  
--  
--  (100 << 16 | 1) == 6553601  
--  
--  100 is mplsTunnelInstance for the protected tunnel  
--  from mplsTunnelTable. Marked by AAA below.  
--  Shift 16 to put this into the high order bits  
--  
--  1 is mplsTunnelInstance for the detour lsp  
--  from the mplsTunnelTable. Marked by BBB below.  
--  Need to OR the index value into low order bits)  
--  
-- To get all detours of a protected tunnel(of instance 100)  
-- we could do a snmpwalk of the mplsFrrOne2OneDetourEntry  
-- where mplsFrrOne2OnePlrTunnelIndex == 1  
-- mplsFrrOne2OnePlrTunnelDetourInstance == 6553600  
--  
-- The first value would be:  
-- mplsFrrOne2OneDetourActive.1.6553601  
mplsFrrOne2OnePlrTunnelIngressLSRId = 192.0.2.1, --R1  
mplsFrrOne2OnePlrTunnelEgressLSRId = 192.0.2.3, --R3  
mplsFrrOne2OneDetourActive = false(2),  
mplsFrrOne2OneDetourMergedStatus = notMerged(1),  
mplsFrrOne2OneDetourMergedDetourInst = 0  
}

In mplsTunnelTable(protected tunnel entry):

{  
mplsTunnelIndex = 1,  
mplsTunnelInstance = 100,-- Indicating protected tunnel  
-- AAA  
mplsTunnelIngressLSRId = 192.0.2.1,  
mplsTunnelEgressLSRId = 192.0.2.5,  
mplsTunnelName = "R1-R5",  
mplsTunnelDescr = "R1-R5",  
mplsTunnelIsIf = true (1),  
mplsTunnelXCPPointer = 0.0,  
mplsTunnelSignallingProto = none (1),  
mplsTunnelSetupPrio = 0,  
mplsTunnelHoldingPrio = 0,  
mplsTunnelSessionAttributes = 0,  
mplsTunnelLocalProtectInUse = true(1),  
mplsTunnelResourcePointer = mplsTunnelResourceMaxRate.5,  
mplsTunnelInstancePriority = 1,  
}
In mplsTunnelTable(detour lsp entry):
{
  mplsTunnelIndex      = 1,
  mplsTunnelInstance   = 1,
                  -- Indicating detour lsp(higher 16 bits)
                  -- BBB
mplsTunnelIngressLSRId   = 192.0.2.1,
mplsTunnelEgressLSRId    = 192.0.2.3,
mplsTunnelName          = "R1-R3",
mplsTunnelDescr         = "R1-R3",
mplsTunnelIsIf          = true (1),
mplsTunnelXCPPointer     = 0.0,
mplsTunnelSignallingProto = none (1),
mplsTunnelSetupPrio     = 0,
mplsTunnelHoldingPrio   = 0,
mplsTunnelSessionAttributes = 0,
mplsTunnelLocalProtectInUse = false (0),
mplsTunnelResourcePointer = mplsTunnelResourceMaxRate.6,
mplsTunnelInstancePriority = 1,
mplsTunnelHopTableIndex = 1,
mplsTunnelIncludeAnyAffinity = 0,
mplsTunnelIncludeAllAffinity = 0,
mplsTunnelExcludeAnyAffinity = 0,
mplsTunnelPathInUse     = 1,
mplsTunnelRole          = head (1),
}

4.3 MPLS-FRR-FACILITY-STD-MIB

This MIB module MUST be supported when facility backup fastreroute method is used.

4.3.1 mplsFrrFacilityDBTable

The mplsFrrFacilityDBTable provides information about the fast reroute database for facility-based fast reroute. An entry is created in this table for each tunnel being protected by a backup tunnel. Backup tunnels are defined
to protect the tunnels traversing an interface. The protecting tunnel will exist on the PLR as per [RFC4090]. Protected tunnels are the LSPs that traverse the protected link.

This table MUST be supported when facility backup is used.

5. Handling IPv6 Tunnels

As described in [RFC4990], in order to support IPv6 MPLS tunnels in the mplsTunnelTable [RFC3812] all LSRs in the network MUST have a 32-bit LSR ID that can be used to identify the LSR with the existing mplsTunnelIngressLSRId and mplsTunnelEgressLSRId objects which are 32-bit long.

In this MIB, the following objects which refer to ingress/egress LSRs will have then the 32-bit LSR ID to support IPv6 tunnels:
- mplsFrrOne2OnePlrTunnelIngressLSRId
- mplsFrrOne2OnePlrTunnelEgressLSRId
  objects of the mplsFrrOne2OnePlrTable,
- mplsFrrOne2OnePlrTunnelIngressLSRId
- mplsFrrOne2OnePlrTunnelEgressLSRId
  objects of the mplsFrrOne2OneDetourTable
- mplsFrrFacilityBackupTunnelIngressLSRId
- mplsFrrFacilityBackupTunnelEgressLSRId
  objects of the mplsFrrFacilityDBTable

6. MIB Module Definitions

6.1. MPLS-FRR-GENERAL-STD-MIB Module:

-- Start of MPLS-FRR-GENERAL-STD-MIB

MPLS-FRR-GENERAL-STD-MIB DEFINITIONS ::= BEGIN

IMPORTS
  MODULE-IDENTITY, OBJECT-TYPE, mib-2,
  Unsigned32,
  Counter32
  FROM SNMPv2-SMI -- [RFC2578]
  MODULE-COMPLIANCE, OBJECT-GROUP
  FROM SNMPv2-CONF -- [RFC2580]
  RowStatus, StorageType
  FROM SNMPv2-TC -- [RFC2579]
  InterfaceIndexOrZero,
  ifGeneralInformationGroup,
  ifCounterDiscontinuityGroup
  FROM IF-MIB -- [RFC2863]
MplsTunnelIndex, MplsTunnelInstanceIndex,
MplsBitRate,
MplsTunnelAffinity
FROM MPLS-TC-STD-MIB -- [RFC3811]
mplsTunnelGroup, mplsTunnelScalarGroup,
mplsTunnelARHopListIndex, mplsTunnelARHopIndex
FROM MPLS-TE-STD-MIB -- [RFC3812]
;

mplsFrrGeneralMIB MODULE-IDENTITY
LAST-UPDATED
"200906041200Z" -- 04 Jun 2009 12:00:00 GMT
ORGANIZATION
"Multiprotocol Label Switching (MPLS) Working Group"
CONTACT-INFO
"Riza Cetin
Email: riza.cetin@alcatel.be

Thomas D. Nadeau
Email: tom.nadeau@bt.com

A S Kiran Koushik
Email: kkoushik@cisco.com

Stefaan De Cnodder
Email: Stefaan.de_cnodder@alcatel.be

Der-Hwa Gan
Email: dhg@juniper.net"

DESCRIPTION
"Copyright (c) 2010 IETF Trust and the persons identified as the document authors. All rights reserved. This version of this MIB module is part of RFC xxxx; See the RFC itself for full legal notices.

-- RFC EDITOR: please replace xxxx with actual number
-- and remove this note.

This MIB module contains generic object definitions for
MPLS Traffic Engineering Fast Reroute as defined in
RFC4090."

-- Revision history.
REVISION
"200906041200Z" -- 04 Jun 2009 12:00:00 GMT
DESCRIPTION
"Initial version. Published as RFC xxxx."
-- RFC-editor pls fill in xxxx

::= { mib-2 yyy }  -- RFC-editor please fill in
    -- yyy with value assigned by IANA,
    -- see section 8.1 for details

-- Top level components of this MIB module.

mplsFrrGeneralObjects
    OBJECT IDENTIFIER ::= { mplsFrrGeneralMIB 1 }

mplsFrrGeneralConformance
    OBJECT IDENTIFIER ::= { mplsFrrGeneralMIB 2 }

-- MPLS Fast Reroute generic scalars.

mplsFrrGeneralProtectionMethod OBJECT-TYPE
    SYNTAX INTEGER {
        unknown(1),
        oneToOneBackup(2),
        facilityBackup(3)
    }
    MAX-ACCESS    read-write
    STATUS        current
    DESCRIPTION
    "Indicates which protection method is to be used for fast
    reroute on this device. Some devices may require a reboot
    if this variable is to take affect after being modified.
    The value of unknown(1) is read-only and cannot be set.
    If the value of unknown(1) is set an inconsistentValue error
    MUST be returned. It is provided to correct any
    misconfiguration."
    ::= { mplsFrrGeneralObjects 1 }

mplsFrrGeneralIngressTunnelInstances OBJECT-TYPE
    SYNTAX        Counter32
    MAX-ACCESS    read-only
    STATUS        current
    DESCRIPTION
    "The number of tunnel instances for either detour LSPs or
    bypass tunnels for which this LSR is the ingress."
    ::= { mplsFrrGeneralObjects 2 }

--
-- General FRR Table Section
--
-- These tables apply to both types of FRR
-- and should be implemented by all LSRs supporting
-- FRR.
--
-- MPLS Fast Reroute Constraints table

mplsFrrGeneralConstraintsTable OBJECT-TYPE
SYNTAX        SEQUENCE OF MplsFrrGeneralConstraintsEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION    "This table shows detour LSP or bypass tunnel setup constraints."
::= {  mplsFrrGeneralObjects 3 }

mplsFrrGeneralConstraintsEntry OBJECT-TYPE
SYNTAX        MplsFrrGeneralConstraintsEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION    "An entry in this table represents detour LSP or bypass tunnel setup constraints for an interface or link to be protected by detour LSPs or a bypass tunnel.

Once the LSP or tunnel instance to be protected is identified in the mplsTunnelTable, the corresponding mplsTunnelIfIndex value of that tunnel can be used to get the ifIndex of the underlying physical interface using the ifStackTable. That ifIndex of the underlying physical interface will be used as mplsFrrGeneralConstraintsIfIndexOrZero in this table to protect the LSPs or tunnel instances determined earlier.

Agents must only allow entries in this table to be created for tunnel instances that require fast-reroute as indicated by the presence of the FAST_REROUTE Object in the signaling for the LSP in question.

Entries indexed with mplsFrrGeneralConstraintsIfIndexOrZero set to 0 apply to all interfaces on this device for which the FRR feature can operate.

Note that as per [RFC3812] the mplsTunnelInstance object set to a value of 0 indicates that the mplsTunnelEntry contains a tunnel ingress. This is typically how configuration of this feature is performed on devices where the actual protection LSP used is left up to the protecting tunnel. However, in cases where static configuration is possible, any valid tunnel instance is possible; however, it is STRONGLY RECOMMENDED that the instance index SHOULD use the following convention to identify backup LSPs:
- lower 16 bits: protected tunnel instance
- higher 16 bits: must be all zeros

REFERENCE "Section 4.1 of RFC4090."

INDEX {mplsFrrGeneralConstraintsIfIndexOrZero,
  mplsFrrGeneralConstraintsTunnelIndex,
  mplsFrrGeneralConstraintsTunnelInstance
}
::= {mplsFrrGeneralConstraintsTable 1}

MplsFrrGeneralConstraintsEntry ::= SEQUENCE {
  mplsFrrGeneralConstraintsIfIndexOrZero   InterfaceIndexOrZero,
  mplsFrrGeneralConstraintsTunnelIndex     MplsTunnelIndex,
  mplsFrrGeneralConstraintsTunnelInstance  MplsTunnelInstanceIndex,
  mplsFrrGeneralConstraintsProtectionType  INTEGER,
  mplsFrrGeneralConstraintsSetupPrio       Unsigned32,
  mplsFrrGeneralConstraintsHoldingPrio     Unsigned32,
  mplsFrrGeneralConstraintsInclAnyAffinity MplsTunnelAffinity,
  mplsFrrGeneralConstraintsInclAllAffinity MplsTunnelAffinity,
  mplsFrrGeneralConstraintsExclAnyAffinity MplsTunnelAffinity,
  mplsFrrGeneralConstraintsHopLimit        Unsigned32,
  mplsFrrGeneralConstraintsBandwidth       MplsBitRate,
  mplsFrrGeneralConstraintsStorageType     StorageType,
  mplsFrrGeneralConstraintsRowStatus       RowStatus
}

mplsFrrGeneralConstraintsIfIndexOrZero OBJECT-TYPE
SYNTAX InterfaceIndexOrZero
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "Uniquely identifies an interface which a fast reroute protection tunnel is configured to potentially protect in the event of a fault. Entries with this index set to 0 indicates that the protection tunnel configured protects all interfaces on this device (i.e.: node protection)."
::= {mplsFrrGeneralConstraintsEntry 1}

mplsFrrGeneralConstraintsTunnelIndex OBJECT-TYPE
SYNTAX MplsTunnelIndex
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "Uniquely identifies a tunnel in the mplsTunnelTable which is configured to possibly protect the interface(s) specified by mplsFrrGeneralConstraintsIfIndexOrZero in the event of a fault."
REFERENCE "mplsTunnelTable from RFC3812."
::= {mplsFrrGeneralConstraintsEntry 2}
mplsFrrGeneralConstraintsTunnelInstance OBJECT-TYPE
SYNTAX MplsTunnelInstanceIndex
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "Uniquely identifies an existing instance of this tunnel for which fast reroute is requested. Note that a value of 0 indicates that the configuration points at a tunnel head (as specified in RFC3812). This is typically how configuration of this feature is performed on devices where the actual protection LSP used is left up to the protecting tunnel. However, in cases where static configuration is possible, any valid tunnel instance is permissible. In these cases, it is recommended that the instance index follow the following convention as to make identification of backup LSPs easier:

- lower 16 bits: protected tunnel instance
- higher 16 bits: must be all zeros"
::= { mplsFrrGeneralConstraintsEntry 3 }

mplsFrrGeneralConstraintsProtectionType OBJECT-TYPE
SYNTAX INTEGER { linkProtection(1), nodeProtection(2) }
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Indicates type of the resource protection:

linkProtection(1) indicates that this tunnel is setup to protect a particular link’s resources.
nodeProtection(2) indicates that this tunnel is setup to protect an entire node from failure."
REFERENCE "Section 3 in RFC4090."
DEFVAL { nodeProtection }
::= { mplsFrrGeneralConstraintsEntry 4 }
mplsFrrGeneralConstraintsSetupPrio OBJECT-TYPE
SYNTAX Unsigned32 (0..7)
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Indicates the setup priority of the detour LSP or bypass tunnel."
REFERENCE "Section 4.7 in RFC 3209"
DEFVAL { 7 }
 ::= { mplsFrrGeneralConstraintsEntry 5 }

mplsFrrGeneralConstraintsHoldingPrio OBJECT-TYPE
SYNTAX Unsigned32 (0..7)
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Indicates the holding priority for detour LSP or bypass tunnel."
REFERENCE "Section 4.7 RFC 3209"
DEFVAL { 0 }
 ::= { mplsFrrGeneralConstraintsEntry 6 }

mplsFrrGeneralConstraintsInclAnyAffinity OBJECT-TYPE
SYNTAX MplsTunnelAffinity
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Indicates the include-any link constraint for the detour LSP or bypass tunnel. A link satisfies the include-any constraint if and only if the constraint is zero, or the link and the constraint have a resource class in common."
REFERENCE "Section 4.7 in RFC 3209"
DEFVAL { 0 }
 ::= { mplsFrrGeneralConstraintsEntry 7 }

mplsFrrGeneralConstraintsInclAllAffinity OBJECT-TYPE
SYNTAX MplsTunnelAffinity
MAX-ACCESS read-create
STATUS current
DESCRIPTION "Indicates the include-all link constraint for the detour LSP or bypass tunnel. A link satisfies the include-all constraint if and only if the link contains all of the administrative groups specified in the constraint."
REFERENCE "Section 4.7 in RFC 3209"
DEFVAL { 0 }
 ::= { mplsFrrGeneralConstraintsEntry 8 }
mplsFrrGeneralConstraintsExclAnyAffinity OBJECT-TYPE
SYNTAX        MplsTunnelAffinity
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
"Indicates the exclude-any link constraint for the
detour LSP or bypass tunnel. A link satisfies the
exclude-any constraint if and only if the link contains
none of the administrative groups specified in the
constraint."
REFERENCE
"Section 4.7 in RFC 3209"
DEFVAL { 0 }
::= { mplsFrrGeneralConstraintsEntry 9 }

mplsFrrGeneralConstraintsHopLimit OBJECT-TYPE
SYNTAX        Unsigned32(0..255)
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
"The maximum number of hops that the detour LSP or
bypass tunnel may traverse."
REFERENCE
"Section 4.1 in RFC4090."
DEFVAL { 32 }
::= { mplsFrrGeneralConstraintsEntry 10 }

mplsFrrGeneralConstraintsBandwidth OBJECT-TYPE
SYNTAX        MplsBitRate
UNITS         "kilobits per second"
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
"The maximum bandwidth specifically reserved for a detour
LSP or bypass tunnel, in units of thousands of bits
per second (Kbps). Note that setting this value to 0
indicates best-effort treatment."
DEFVAL { 0 }
::= { mplsFrrGeneralConstraintsEntry 11 }

mplsFrrGeneralConstraintsStorageType OBJECT-TYPE
SYNTAX        StorageType
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
"The storage type for this configuration entry.
Conceptual rows having the value ‘permanent’
need not allow write-access to any columnar
objects in the row."
REFERENCE
"RFC2579"
DEFVAL { volatile }
::= { mplsFrrGeneralConstraintsEntry 12 }
mplsFrrGeneralConstraintsRowStatus OBJECT-TYPE
SYNTAX RowStatus
MAX-ACCESS read-create
STATUS current
DESCRIPTION "This object is used to create, modify, and/or delete a row in this table. When a row in this table is in active(1) state, no objects in that row can be modified by the agent except mplsFrrGeneralConstraintsRowStatus and mplsFrrGeneralConstraintsStorageType."
 ::= { mplsFrrGeneralConstraintsEntry 13 }

-- MPLS Fast Reroute Tunnel Actual Route Hop table

mplsFrrGeneralTunnelARHopTable OBJECT-TYPE
SYNTAX SEQUENCE OF MplsFrrGeneralTunnelARHopEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "This table sparsely extends mplsTunnelARHopTable defined in the MPLS-TE-STD-MIB MIB module with fast-reroute objects. These objects specify the status of local protection including availability and active use, on a per-hop basis, of hops traversed by a protected tunnel. Note that object availability in this table is governed by the support of the Record Route Object in the RSVP-TE signaling of the implementation."
 ::= { mplsFrrGeneralObjects 4 }

MplsFrrGeneralTunnelARHopEntry OBJECT-TYPE
SYNTAX MplsFrrGeneralTunnelARHopEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "This entry contains fast-reroute protection status of a single protected tunnel hop."
INDEX {
 mplstunnelARHopListIndex,
 mplstunnelARHopIndex
}
 ::= { mplsFrrGeneralTunnelARHopTable 1 }

MplsFrrGeneralTunnelARHopEntry ::= SEQUENCE {
 mplsFrrGeneralTunnelARHopProtectType BITS,
 mplsFrrGeneralTunnelARHopProtectTypeInUse BITS
}

mplsFrrGeneralTunnelARHopProtectType OBJECT-TYPE
SYNTAX BITS { node(0), bandwidth(1) }
MAX-ACCESS read-only
STATUS current
DESCRIPTION "This object indicates the desired protection type or types of the associated SESSION_ATTRIBUTE object. Note that since
this object is a BITS type, one, none or all of the bits may be set to indicate various desired combinations of protection types."

REFERENCE
"See section 4 of RFC4090 where the SESSION_ATTRIBUTE objects is extended to support desired bandwidth and node protection features."

::= { mplsFrrGeneralTunnelARHopEntry 1 }

mplsFrrGeneralTunnelARHopProtectTypeInUse OBJECT-TYPE
SYNTAX                       BITS { node(0), bandwidth(1) }
MAX-ACCESS                   read-only
STATUS                       current
DESCRIPTION
"This object indicates the protection type or types that are currently in use by the associated RRO IPv4 sub-object. Note that since this object is a BITS type, one, none or all of the bits may be set to indicate various combinations of protection types. If no bits are set, this indicates that no protection types are in use."

REFERENCE
"See section 4 of RFC4090 where RRO IPv4 sub-object is extended to support bandwidth and node protection features."

::= { mplsFrrGeneralTunnelARHopEntry 2 }

-- Notifications

-- Module Conformance Statement

mplsFrrGeneralCompliances
OBJECT IDENTIFIER ::= {mplsFrrGeneralConformance 1 }

mplsFrrGeneralGroups
OBJECT IDENTIFIER ::= {mplsFrrGeneralConformance 2 }

mplsFrrGeneralModuleFullCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION
"Compliance statements for agents that support the MPLS-FRR-GENERALSTD-MIB MIB module."

MODULE IF-MIB -- The Interfaces Group MIB module, RFC 2863.
MANDATORY-GROUPS {
    ifGeneralInformationGroup,
    ifCounterDiscontinuityGroup
}

MODULE MPLS-TE-STD-MIB -- The MPLS Traffic Engineering MIB module, RFC 3812
MANDATORY-GROUPS {
    mplsTunnelGroup,
mplsTunnelScalarGroup

MODULE -- this module
MANDATORY-GROUPS {
    mplsFrrGeneralScalarGroup,
    mplsFrrGeneralTunnelARHopGroup,
    mplsFrrGeneralConstraintsGroup
}

OBJECT       mplsFrrGeneralConstraintsRowStatus
SYNTAX       RowStatus { active(1), notInService(2) }
WRITE-SYNTAX RowStatus { active(1), notInService(2),
                        createAndGo(4), destroy(6) }
DESCRIPTION "Support for createAndWait and notReady is
not required."

::= { mplsFrrGeneralCompliances 1 }

mplsFrrGeneralModuleReadOnlyCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION "Compliance statements for agents that support the MPLS FRR
MIB."

MANDATORY-GROUPS {
    mplsFrrGeneralScalarGroup,
    mplsFrrGeneralTunnelARHopGroup,
    mplsFrrGeneralConstraintsGroup
}

-- Scalars

OBJECT        mplsFrrGeneralProtectionMethod
MIN-ACCESS    read-only
DESCRIPTION "Write access is not required."

-- mplsFrrGeneralConstraintsTable

OBJECT        mplsFrrGeneralConstraintsSetupPrio
MIN-ACCESS    read-only
DESCRIPTION "Write access is not required."

OBJECT        mplsFrrGeneralConstraintsHoldingPrio
MIN-ACCESS    read-only
DESCRIPTION
"Write access is not required."

OBJECT mplsFrrGeneralConstraintsInclAnyAffinity
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT mplsFrrGeneralConstraintsInclAllAffinity
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT mplsFrrGeneralConstraintsExclAnyAffinity
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT mplsFrrGeneralConstraintsBandwidth
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT mplsFrrGeneralConstraintsProtectionType
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT mplsFrrGeneralConstraintsHopLimit
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT mplsFrrGeneralConstraintsStorageType
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

OBJECT mplsFrrGeneralConstraintsRowStatus
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

::= { mplsFrrGeneralCompliances 2 }

-- Units of conformance

mplsFrrGeneralScalarGroup OBJECT-GROUP
OBJECTS {
mplsFrrGeneralIngressTunnelInstances,
mplsFrrGeneralProtectionMethod
}
STATUS        current
DESCRIPTION
"Objects that are required to display general fast reroute
information."
::= { mplsFrrGeneralGroups 1 }

mplsFrrGeneralConstraintsGroup OBJECT-GROUP
OBJECTS {
    mplsFrrGeneralConstraintsProtectionType,
    mplsFrrGeneralConstraintsSetupPrio,
    mplsFrrGeneralConstraintsHoldingPrio,
    mplsFrrGeneralConstraintsInclAnyAffinity,
    mplsFrrGeneralConstraintsInclAllAffinity,
    mplsFrrGeneralConstraintsExclAnyAffinity,
    mplsFrrGeneralConstraintsHopLimit,
    mplsFrrGeneralConstraintsBandwidth,
    mplsFrrGeneralConstraintsStorageType,
    mplsFrrGeneralConstraintsRowStatus
}
STATUS        current
DESCRIPTION
"Objects that are required to configure fast reroute
constraints at the ingress LSR of the tunnel that requires
fast reroute service."
::= { mplsFrrGeneralGroups 2 }

mplsFrrGeneralTunnelARHopGroup OBJECT-GROUP
OBJECTS {
    mplsFrrGeneralTunnelARHopProtectType,
    mplsFrrGeneralTunnelARHopProtectTypeInUse
}
STATUS        current
DESCRIPTION
"Objects that are required to present per hop fast-reroute
protection status."
::= { mplsFrrGeneralGroups 3 }

END

-- End of MPLS-FRR-GENERAL-STD-MIB

6.2. MPLS-FRR-ONE2ONE-STD-MIB

-- Start of MPLS-FRR-ONE2ONE-STD-MIB
IMPORTS
MODULE-IDENTITY, OBJECT-TYPE, mib-2,
   Integer32, Gauge32 FROM SNMPv2-SMI -- [RFC2578]
MODULE-COMPLIANCE, OBJECT-GROUP
   FROM SNMPv2-CONF -- [RFC2580]
TruthValue FROM SNMPv2-TC -- [RFC2579]
MplsTunnelIndex, MplsTunnelInstanceIndex,
   MplsLsrIdentifier FROM MPLS-TC-STD-MIB -- [RFC3811]
InetAddressType, InetAddress FROM INET-ADDRESS-MIB -- [RFC4001]
mplsFrrGeneralScalarGroup, mplsFrrGeneralTunnelARHopGroup,
   mplsFrrGeneralConstraintsGroup FROM MPLS-FRR-GENERAL-STD-MIB
;
mplsFrrOne2OneMIB MODULE-IDENTITY
LAST-UPDATED "200906041200Z" -- 04 Jun 2009 12:00:00 GMT
ORGANIZATION "Multiprotocol Label Switching (MPLS) Working Group"
CONTACT-INFO
   "Riza Cetin
      Email: riza.cetin@alcatel.be

   Thomas D. Nadeau
      Email: tom.nadeau@bt.com

   A S Kiran Koushik
      Email: kkoushik@cisco.com

   Stefaan De Cnodder
      Email: Stefaan.de_cnodder@alcatel.be

   Der-Hwa Gan
      Email: dhg@juniper.net"

DESCRIPTION
"Copyright (c) 2010 IETF Trust and the persons identified
as the document authors. All rights reserved. This version
of this MIB module is part of RFC xxxx; See the RFC itself
for full legal notices.

-- RFC EDITOR: please replace xxxx with actual number
This MIB module contains object definitions for
MPLS Traffic Engineering one-to-one backup method for
Fast Reroute as defined in RFC4090."

-- Revision history.
REVISION
"200906041200Z" -- 04 Jun 2009 12:00:00 GMT
DESCRIPTION
"Initial version. Published as RFC xxxx."
-- RFC-editor pls fill in xxxx
::= { mib-2 yyy } -- RFC-editor please fill in
-- yyy with value assigned by IANA,
-- see section 8.2 for details

-- Top level components of this MIB module.

mplsFrrOne2OneObjects OBJECT IDENTIFIER
::= { mplsFrrOne2OneMIB 1 }

mplsFrrOne2OneConformance OBJECT IDENTIFIER
::= { mplsFrrOne2OneMIB 2 }

-- Scalar objects defined for 1-to-1 style FRR

mplsFrrIncomingDetourLSPs OBJECT-TYPE
SYNTAX Integer32 (0..2147483647)
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of detour LSPs entering the device."
DEFVAL { 0 }
::= { mplsFrrOne2OneObjects 1 }

mplsFrrOutgoingDetourLSPs OBJECT-TYPE
SYNTAX Integer32 (0..2147483647)
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of detour LSPs leaving the device."
DEFVAL { 0 }
::= { mplsFrrOne2OneObjects 2 }

mplsFrrOne2OneDetourOriginating OBJECT-TYPE
SYNTAX Integer32 (0..2147483647)
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of detour LSPs originating at this PLR."
DEFVAL { 0 }
::= { mplsFrrOne2OneObjects 3 }

mplsFrrActiveProtectedLSPs OBJECT-TYPE
SYNTAX        Gauge32
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
  "Indicates the number of LSPs currently protected by
  the FRR feature where this device acts as the PLR
  for those LSPs."
DEFVAL { 0 }
::= { mplsFrrOne2OneObjects 4 }

--
-- One-to-One Specific Tables
--
-- Tables in this section pertain only to the 1-1
-- style of FRR.
--

-- MPLS Fast Reroute Point of Local Repair table

mplsFrrOne2OnePlrTable  OBJECT-TYPE
SYNTAX        SEQUENCE OF MplsFrrOne2OnePlrEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
  "This table shows a list of protected TE tunnels with
  the corresponding protecting tunnel, as well as the PLR
  where the protecting tunnel that initiated the detour
  LSPs traverse this node."
::= { mplsFrrOne2OneObjects 5 }

mplsFrrOne2OnePlrEntry  OBJECT-TYPE
SYNTAX        MplsFrrOne2OnePlrEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
  "An entry in this table represents a protected tunnel LSP
  together with its detour tunnel instance. An entry in
  this table is only created by an SNMP agent as instructed
  by an MPLS signaling protocol.

  The entries of this table are present in all LSRs on the path
  of the detour LSP.

  The objects mplsFrrOne2OnePlrSenderAddrType and
mplsFrrOne2OnePlrSenderAddr can be modified after the row is created.

The objects mplsFrrOne2OnePlrTunnelIndex, mplsFrrOne2OnePlrTunnelDetourInstance, mplsFrrOne2OnePlrTunnelIngressLSRId and mplsFrrOne2OnePlrTunnelEgressLSRId have the same values as the objects mplsTunnelIndex, mplsTunnelInstance, mplsTunnelIngressLSRId and mplsTunnelEgressLSRId of the detour tunnel instance created in the mplsTunnelTable (MPLS-TE-STD-MIB)."

INDEX ( mplxFrrOne2OnePlrTunnelIndex, -- from MPLS-TE-STD-MIB
mplxFrrOne2OnePlrTunnelDetourInstance,-- mplsTunnelTable
mplxFrrOne2OnePlrTunnelIngressLSRId,-- Tunnels must exist
mplxFrrOne2OnePlrTunnelEgressLSRId, -- a priori
mplxFrrOne2OnePlrId )
::= { mplxFrrOne2OnePlrTable 1 }

mplxFrrOne2OnePlrEntry ::= SEQUENCE {
  mplxFrrOne2OnePlrTunnelIndex         MplsTunnelIndex,
  mplxFrrOne2OnePlrTunnelDetourInstance  MplsTunnelInstanceIndex,
  mplxFrrOne2OnePlrTunnelIngressLSRId   MplsLsrIdentifier,
  mplxFrrOne2OnePlrTunnelEgressLSRId    MplsLsrIdentifier,
  mplxFrrOne2OnePlrId             MplsLsrIdentifier,
  mplxFrrOne2OnePlrSenderAddrType InetAddressType,
  mplxFrrOne2OnePlrSenderAddr     InetAddress,
  mplxFrrOne2OnePlrAvoidNodeAddrType InetAddressType,
  mplxFrrOne2OnePlrAvoidNodeAddr     InetAddress
}

mplxFrrOne2OnePlrTunnelIndex OBJECT-TYPE
SYNTAX        MplsTunnelIndex
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"Uniquely identifies a tunnel between a pair of LSRs from the mplsTunnelEntry."
::= { mplxFrrOne2OnePlrEntry 1 }

mplxFrrOne2OnePlrTunnelDetourInstance OBJECT-TYPE
SYNTAX        MplsTunnelInstanceIndex
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"Uniquely identifies a detour instance of a tunnel from the mplsTunnelEntry.

- lower 16 bits : protected tunnel instance
- higher 16 bits: detour instance"
::= { mplsFrrOne2OnePlrEntry 2 }

mplsFrrOne2OnePlrTunnelIngressLSRId OBJECT-TYPE
SYNTAX        MplsLsrIdentifier
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
 "The purpose of this object is to uniquely identify a
tunnel within a network. When the MPLS signalling
protocol is rsvp(2) this object SHOULD contain the
same value as the Extended Tunnel Id field in the
SESSION object. When the MPLS signalling protocol
is crldp(3) this object SHOULD contain the same
value as the Ingress LSR Router ID field in the
LSPID TLV object.

This value represents the head-end of the protected
tunnel instance."
REFERENCE
 "RFC3209"
::= { mplsFrrOne2OnePlrEntry 3 }

mplsFrrOne2OnePlrTunnelEgressLSRId OBJECT-TYPE
SYNTAX        MplsLsrIdentifier
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
 "Specifies the egress LSR ID of the protected tunnel instance."
::= { mplsFrrOne2OnePlrEntry 4 }

mplsFrrOne2OnePlrId OBJECT-TYPE
SYNTAX        MplsLsrIdentifier
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
 "This value represents the PLR that has initiated a detour LSP
to protect a tunnel instance.
This value is signalled via the DETOUR object defined in MPLS
RSVP protocol."
REFERENCE
 "RFC4090"
::= { mplsFrrOne2OnePlrEntry 5 }

mplsFrrOne2OnePlrSenderAddrType OBJECT-TYPE
SYNTAX        InetAddressType
MAX-ACCESS    read-create
STATUS        current
DESCRIPTION
 "Denotes the address type of this detour instance’s sender"
address.
DEFVAL { ipv4 }
::= { mplsFrrOne2OnePlrEntry 6 }

mplsFrrOne2OnePlrSenderAddr OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS read-create
STATUS current
DESCRIPTION "The IP address of the PLR which has initiated the detour LSP.
The type of this address is determined by the value of the
mplsFrrOne2OnePlrSenderAddrType object."
::= { mplsFrrOne2OnePlrEntry 7 }

mplsFrrOne2OnePlrAvoidNodeAddrType OBJECT-TYPE
SYNTAX InetAddressType
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Denotes the address type of the node that this PLR tries to
avoid."
DEFVAL { ipv4 }
::= { mplsFrrOne2OnePlrEntry 8 }

mplsFrrOne2OnePlrAvoidNodeAddr OBJECT-TYPE
SYNTAX InetAddress
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The IP address of the node that this PLR tries to avoid.
The type of this address is determined by the value of the
mplsFrrOne2OnePlrAvoidNodeAddrType object.
This value is signalled via the DETOUR object defined in MPLS RSVP protocol."
REFERENCE "RFC4090"
::= { mplsFrrOne2OnePlrEntry 9 }

-- MPLS One-To-One Fast Reroute Detour table.

mplsFrrOne2OneDetourTable OBJECT-TYPE
SYNTAX SEQUENCE OF MplsFrrOne2OneDetourEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "This table shows detour LSPs."
::= { mplsFrrOne2OneObjects 6 }

mplsFrrOne2OneDetourEntry OBJECT-TYPE
SYNTAX        MplsFrrOne2OneDetourEntry
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"An entry in this table represents a detour. An entry in this
table is only created by an SNMP agent as instructed by an MPLS
signaling protocol."
INDEX {
  mplsFrrOne2OnePlrTunnelIndex,     -- from MPLS-TE-STD-MIB
  mplsFrrOne2OnePlrTunnelDetourInstance, -- mplsTunnelTable
  mplsFrrOne2OnePlrTunnelIngressLSRId, -- Tunnels must exist
  mplsFrrOne2OnePlrTunnelEgressLSRId    -- a priori
}
::= { mplsFrrOne2OneDetourTable 1 }

MplsFrrOne2OneDetourEntry ::= SEQUENCE {
  mplsFrrOne2OneDetourActive             TruthValue,
  mplsFrrOne2OneDetourMergedStatus            INTEGER,
  mplsFrrOne2OneDetourMergedDetourInst   MplsTunnelInstanceIndex
}

mplsFrrOne2OneDetourActive OBJECT-TYPE
SYNTAX        TruthValue
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
"Indicates whether or not the main LSP has switched over to
this detour LSP.
If the value of this object is ‘true’, then it means that
the main LSP has switched over to this detour LSP. Otherwise
it contains a value of ‘false’.
This is only relevant for detours originated by this node."
::= { mplsFrrOne2OneDetourEntry 1 }

mplsFrrOne2OneDetourMergedStatus OBJECT-TYPE
SYNTAX        INTEGER { notMerged(1),
  mergedWithProtectedTunnel(2),
  mergedWithDetour(3) }
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
"This value represents whether or not this detour is merged.
This value is set to notMerged(1) if this detour is not
merged.
This value is set to mergedWithProtectedTunnel(2) if
this detour is merged with the protected tunnel. This value
is mergedWithDetour(3) if this detour is merged"
with another detour protecting the same tunnel."
::= { mplsFrrOne2OneDetourEntry 2 }

mplsFrrOne2OneDetourMergedDetourInst OBJECT-TYPE
SYNTAX        MplsTunnelInstanceIndex
MAX-ACCESS    read-only
STATUS        current
DESCRIPTION
"This value represents the mplsTunnelInstance of the detour
with which this detour is merged. This object is only valid
when mplsFrrOne2OneDetourMergedStatus is set to
mergedWithDetour(3).

- lower 16 bits : protected tunnel instance
- higher 16 bits: detour instance"
::= { mplsFrrOne2OneDetourEntry 3 }

-- Module Conformance Statement

mplsFrrOne2OneCompliances
OBJECT IDENTIFIER ::= {mplsFrrOne2OneConformance 1 }

mplsFrrOne2OneGroups
OBJECT IDENTIFIER ::= {mplsFrrOne2OneConformance 2 }

mplsFrrOne2OneModuleFullCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION
"Compliance statements for agents that support the
MPLS-FRR-ONE2ONE-STD-MIB MIB module."

MODULE MPLS-FRR-GENERAL-STD-MIB -- MPLS FRR Generic MIB
MANDATORY-GROUPS {
  mplsFrrGeneralScalarGroup,
  mplsFrrGeneralTunnelARHopGroup,
  mplsFrrGeneralConstraintsGroup
}

MODULE -- this module
MANDATORY-GROUPS {
  mplsFrrOne2OneScalarsGroup,
  mplsFrrOne2OnePLRDetourGroup,
  mplsFrrOne2OnePlrGroup
}
::= { mplsFrrOne2OneCompliances 1 }

mplsFrrOne2OneModuleReadOnlyCompliance MODULE-COMPLIANCE
STATUS current
DESCRIPTION
"Compliance statements for agents that support the MPLS FRR ONE2ONE MIB."

MODULE
MANDATORY-GROUPS {
  mplsFrrOne2OneScalarsGroup,
  mplsFrrOne2OnePLRDetourGroup,
  mplsFrrOne2OnePlrGroup
}

-- mplsFrrOne2OnePlrTable
OBJECT          mplsFrrOne2OnePlrSenderAddrType
MIN-ACCESS      read-only
DESCRIPTION      "Write access is not required."

OBJECT          mplsFrrOne2OnePlrSenderAddr
MIN-ACCESS      read-only
DESCRIPTION      "Write access is not required."

::= { mplsFrrOne2OneCompliances 2 }

-- Units of conformance

mplsFrrOne2OneScalarsGroup OBJECT-GROUP
OBJECTS {
  mplsFrrIncomingDetourLSPs,
  mplsFrrOutgoingDetourLSPs,
  mplsFrrOne2OneDetourOriginating,
  mplsFrrActiveProtectedLSPs
}
STATUS          current
DESCRIPTION      "Objects that are required for general One-2-One PLR information."
::= { mplsFrrOne2OneGroups 1 }

mplsFrrOne2OnePLRDetourGroup OBJECT-GROUP
OBJECTS {
  mplsFrrOne2OneDetourActive,
  mplsFrrOne2OneDetourMergedStatus,
  mplsFrrOne2OneDetourMergedDetourInst
}
STATUS          current
DESCRIPTION      "Objects that are required to present the detour LSP information at the detour ingress, transit and egress LSRs."
mplsFrrOne2OnePlrGroup OBJECT-GROUP
  OBJECTS {
    mplsFrrOne2OnePlrSenderAddrType,
    mplsFrrOne2OnePlrSenderAddr,
    mplsFrrOne2OnePlrAvoidNodeAddrType,
    mplsFrrOne2OnePlrAvoidNodeAddr
  }
STATUS current
DESCRIPTION
  "Objects that are required to represent the FRR One-2-One PLR information."
::= { mplsFrrOne2OneGroups 3 }

END

-- End of MPLS-FRR-ONE2ONE-STD-MIB

6.3. MPLS-FRR-FACILITY-STD-MIB

-- Start of MPLS-FRR-FACILITY-STD-MIB

MPLS-FRR-FACILITY-STD-MIB DEFINITIONS ::= BEGIN

IMPORTS
  MODULE-IDENTITY, OBJECT-TYPE, mib-2,
  Integer32, NOTIFICATION-TYPE, Gauge32
  FROM SNMPv2-SMI -- [RFC2578]
  MODULE-COMPLIANCE, OBJECT-GROUP,
  NOTIFICATION-GROUP
  FROM SNMPv2-CONF -- [RFC2580]
  TruthValue FROM SNMPv2-TC -- [RFC2579]
  InterfaceIndex FROM IF-MIB -- [RFC2863]
  MplsTunnelIndex, MplsTunnelInstanceIndex,
  MplsLsrIdentifier, MplsBitRate
  FROM MPLS-TC-STD-MIB -- [RFC3811]
  mplsFrrGeneralScalarGroup, mplsFrrGeneralTunnelARHopGroup,
  mplsFrrGeneralConstraintsGroup
  FROM MPLS-FRR-GENERAL-STD-MIB
;

mplsFrrFacilityMIB MODULE-IDENTITY
LAST-UPDATED "200906041200Z" -- 04 Jun 2009 12:00:00 GMT
This MIB module contains object definitions for MPLS Traffic Engineering facility backup method for Fast Reroute as defined in RFC4090.

-- Revision history.

REVISION
"200906041200Z" -- 04 Jun 2009 12:00:00 GMT

DESCRIPTION
"Initial version. Published as RFC xxxx."

 ::= { mib-2 yyy }
   -- RFC-editor pls fill in xxxx
   -- yyy with value assigned by IANA,
   -- see section 8.3 for details

-- Top level components of this MIB module.

mplsFrrFacilityNotifications          OBJECT IDENTIFIER
   ::= { mplsFrrFacilityMIB 0 }

mplsFrrFacilityObjects               OBJECT IDENTIFIER
   ::= { mplsFrrFacilityMIB 1 }

mplsFrrFacilityConformance           OBJECT IDENTIFIER

::= { mplsFrrFacilityMIB 2 }

-- Scalar objects defined for Facility Backup style FRR

mplsFrrConfiguredInterfaces OBJECT-TYPE
SYNTAX Integer32(0..2147483647)
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Indicates the number of MPLS interfaces configured for
protection."
DEFVAL { 0 }
::= { mplsFrrFacilityObjects 1 }

mplsFrrActiveInterfaces OBJECT-TYPE
SYNTAX Gauge32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Indicates the number of interfaces currently being
protected. This value MUST be less than or equal
to mplsFrrConfiguredInterfaces."
DEFVAL { 0 }
::= { mplsFrrFacilityObjects 2 }

mplsFrrConfiguredBypassTunnels OBJECT-TYPE
SYNTAX Gauge32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Indicates the number of bypass tunnels configured to
protect TE tunnels on this LSR."
DEFVAL { 0 }
::= { mplsFrrFacilityObjects 3 }

mplsFrrActiveBypassTunnels OBJECT-TYPE
SYNTAX Gauge32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "Indicates the number of bypass tunnels indicated in
mplsFrrConfiguredBypassTunnels whose operStatus
is up(1) indicating that they are currently protecting
TE tunnels on this LSR."
DEFVAL { 0 }
::= { mplsFrrFacilityObjects 4 }
mplsFrrFacilityNotificationsEnabled OBJECT-TYPE
SYNTAX TruthValue
MAX-ACCESS read-write
STATUS current
DESCRIPTION "Enables or disables FRR notifications defined in this MIB module. Notifications are disabled by default. This object is needed to control the notifications emitted by this implementation."
DEFVAL { false }
::= { mplsFrrFacilityObjects 5 }

mplsFrrFacilityNotificationsMaxRate OBJECT-TYPE
SYNTAX Gauge32
UNITS "Notifications per Second"
MAX-ACCESS read-write
STATUS current
DESCRIPTION "This variable indicates the maximum number of notifications issued per second. If events occur more rapidly, the implementation may simply fail to emit these notifications during that period, or may queue them until an appropriate time. In case the implementation chooses to drop the events during throttling instead of queuing them to be sent at a later time, it is assumed that there will be no indication that events are being thrown away. A value of 0 means no throttling is applied and events may be generated at the rate at which they occur."
DEFVAL { 0 }
::= { mplsFrrFacilityObjects 6 }

-- Facility-based FRR-specific Tables
-- Tables in this section pertain only to the facility-based style of FRR.
--

mplsFrrFacilityDBTable OBJECT-TYPE
SYNTAX SEQUENCE OF MplsFrrFacilityDBEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "The mplsFrrFacilityDBTable provides information about the fast reroute database. Each entry belongs to a protected interface, protecting backup tunnel and protected tunnel."
MPLS interfaces defined on this node are protected by backup tunnels and are indicated by the index mplsFrrFacilityProtectedIfIndex. If the interface index is set to 0, this indicates that the remaining indexes apply to all configured protected interfaces. The protecting tunnel is indicated by the index mplsFrrFacilityProtectingTunnelIndex and represents a valid mplsTunnelEntry. Note that the tunnel instance index of the protecting tunnel may be set to 0 which indicates the tunnel head interface for the protecting tunnel, as per RFC3812, but it may also be defined using the following semantics:

- lower 16 bits : protected tunnel instance
- higher 16 bits: must be all zeros

 ::= { mplsFrrFacilityObjects 7 }

mplsFrrFacilityDBEntry OBJECT-TYPE
SYNTAX MplsFrrFacilityDBEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "An entry in the mplsFrrFacilityDBTable represents a single protected LSP, protected by a backup tunnel on a specific protected interface, or if the interface index is set to 0, on all interfaces. Note that for brevity, managers should consult the mplsTunnelTable present in the MPLS-TE-STD-MIB MIB module for additional information about the protecting and protected tunnels, and the ifEntry in the IF-MIB MIB module for the protected interface."

INDEX {
  mplsFrrFacilityProtectedIfIndex, -- protected ifIndex
  mplsFrrFacilityProtectingTunnelIndex,-- protecting TE tun
  mplsFrrFacilityBackupTunnelIndex, -- protected TE tun
  mplsFrrFacilityBackupTunnelInstance, -- LSP
  mplsFrrFacilityBackupTunnelIngressLSRId,
  mplsFrrFacilityBackupTunnelEgressLSRId
}
 ::= { mplsFrrFacilityDBTable 1 }

MplsFrrFacilityDBEntry ::= SEQUENCE {
  mplsFrrFacilityProtectedIfIndex          InterfaceIndex,
  mplsFrrFacilityProtectingTunnelIndex     MplsTunnelIndex,
  mplsFrrFacilityBackupTunnelIndex         MplsTunnelIndex,
  mplsFrrFacilityBackupTunnelInstance      MplsTunnelInstanceIndex,
  mplsFrrFacilityBackupTunnelIngressLSRId  MplsLsrIdentifier,
  mplsFrrFacilityBackupTunnelEgressLSRId   MplsLsrIdentifier,
  mplsFrrFacilityDBNumProtectingTunnelOnIf Gauge32,
mplsFrrFacilityDBNumProtectedLspOnIf  Gauge32,
mplsFrrFacilityDBNumProtectedTunnels   Gauge32,
mplsFrrFacilityDBProtectingTunnelStatus INTEGER,
mplsFrrFacilityDBProtectingTunnelResvBw  MplsBitRate
}

mplsFrrFacilityProtectedIfIndex OBJECT-TYPE
SYNTAX        InterfaceIndex
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"Uniquely identifies the interface configured for FRR protection. If this object is set to 0, this indicates that the remaining indexing combinations for this row apply to all interfaces on this device for which the FRR feature can operate."
::= { mplsFrrFacilityDBEntry 1 }

mplsFrrFacilityProtectingTunnelIndex OBJECT-TYPE
SYNTAX        MplsTunnelIndex
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"Uniquely identifies the mplsTunnelEntry primary index for the tunnel head interface designated to protect the interface as specified in the mplsFrrFacilityProtectedIfIndex (and all of the tunnels using this interface). Note that the corresponding mplsTunnelInstance MUST BE 0 as per the indexing convention stipulated."
REFERENCE
"RFC3812"
::= { mplsFrrFacilityDBEntry 2 }

mplsFrrFacilityBackupTunnelIndex OBJECT-TYPE
SYNTAX        MplsTunnelIndex
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"Uniquely identifies the mplsTunnelEntry primary index for the TE tunnel LSP being protected on the interface as specified by mplsFrrFacilityProtectedIfIndex."
::= { mplsFrrFacilityDBEntry 3 }

mplsFrrFacilityBackupTunnelInstance OBJECT-TYPE
SYNTAX        MplsTunnelInstanceIndex
MAX-ACCESS    not-accessible
STATUS        current
DESCRIPTION
"Uniquely identifies the mplsTunnelEntry secondary index for the TE tunnel LSP being protected on the interface as specified by mplsFrrFacilityProtectedIfIndex."
 ::= { mplsFrrFacilityDBEntry 4 }

mplsFrrFacilityBackupTunnelIngressLSRId OBJECT-TYPE
SYNTAX MplsLsrIdentifier
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"Uniquely identifies the mplsTunnelEntry third index for the TE tunnel LSP being protected on the interface as specified by mplsFrrFacilityProtectedIfIndex."
REFERENCE
"RFC3209, RFC3212"
 ::= { mplsFrrFacilityDBEntry 5 }

mplsFrrFacilityBackupTunnelEgressLSRId OBJECT-TYPE
SYNTAX MplsLsrIdentifier
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"Uniquely identifies the mplsTunnelEntry fourth index for the TE tunnel LSP being protected on the interface as specified by mplsFrrFacilityProtectedIfIndex."
 ::= { mplsFrrFacilityDBEntry 6 }

mplsFrrFacilityDBNumProtectingTunnelOnIf OBJECT-TYPE
SYNTAX Gauge32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of backup tunnels protecting the interface specified by mplsFrrFacilityProtectedIfIndex."
 ::= { mplsFrrFacilityDBEntry 7 }

mplsFrrFacilityDBNumProtectedLspOnIf OBJECT-TYPE
SYNTAX Gauge32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The number of LSPs currently being protected on the interface specified by mplsFrrFacilityProtectedIfIndex."
 ::= { mplsFrrFacilityDBEntry 8 }

mplsFrrFacilityDBNumProtectedTunnels OBJECT-TYPE
SYNTAX Gauge32
MAX-ACCESS read-only
STATUS  current
DESCRIPTION "The number of tunnels protected on the interface specified by mplsFrrFacilityProtectedIfIndex."
::= { mplsFrrFacilityDBEntry 9 }

mplsFrrFacilityDBProtectingTunnelStatus OBJECT-TYPE
SYNTAX INTEGER {
    active(1),
    ready(2),
    partial(3)
}
MAX-ACCESS read-only
STATUS  current
DESCRIPTION "Specifies the state of the protecting tunnel as specified by mplsFrrFacilityProtectingTunnelIndex.
active  This tunnel’s label has been placed in the LFIB and is ready to be applied to incoming packets.
ready -  This tunnel’s label entry has been created but is not yet in the LFIB.
partial - This tunnel’s label entry has not been fully created."
::= { mplsFrrFacilityDBEntry 10 }

mplsFrrFacilityDBProtectingTunnelResvBw  OBJECT-TYPE
SYNTAX MplsBitRate
UNITS "kilobits per second"
MAX-ACCESS read-only
STATUS  current
DESCRIPTION "Specifies the amount of bandwidth in units of ’1,000 bits per second’, actually reserved by the protecting tunnel for facility backup purposes. This value is repeated here from the MPLS-TE-STD-MIB MIB module because the tunnel entry will reveal the bandwidth reserved by the signaling protocol, which is typically 0 for backup tunnels so as to not over-book bandwidth. However, internal reservations are typically made on the PLR, thus this value should be revealed here as it is often different from mplsTunnelResourceMeanRate found in the MPLS-TE-STD-MIB MIB module."
::= { mplsFrrFacilityDBEntry 11 }

-- Notifications
mplsFrrFacilityInitialBkupTunnelInvoked NOTIFICATION-TYPE
OBJECTS { mplsFrrFacilityDBNumProtectingTunnelOnIf,
mplsFrrFacilityDBNumProtectedLspOnIf,
mplsFrrFacilityDBNumProtectedTunnels,
mplsFrrFacilityDBProtectingTunnelStatus,
mplsFrrFacilityDBProtectingTunnelResvBw
}
STATUS current
DESCRIPTION
"This notification is generated when a tunnel running over an
interface as specified in the mplsFrrConstraintsTable is
initially protected by the backup tunnel also specified in the
mplsFrrConstraintsTable. In some implementations there may be
a difference between when the control plane triggers
this notification and when the hardware is programmed to
utilize the protection path. Due to the urgency of this
operation, it is acceptable for the control plane to
either issue this notification before or after it programs
the hardware. In cases where it is the latter approach,
the notification MUST be sent immediately after the
data plane has been altered.

This notification should not be generated
for each subsequent tunnel that is backed up by the FRR feature
on this LSR, as this may result in potential scaling issues
with regard to LSR performance and network load. Note also
that notifications MUST be generated in accordance with the
mplsFrrNotificationsMaxRate."

::= { mplsFrrFacilityNotifications 1 }

mplsFrrFacilityFinalTunnelRestored NOTIFICATION-TYPE
OBJECTS { mplsFrrFacilityDBNumProtectingTunnelOnIf,
mplsFrrFacilityDBNumProtectedLspOnIf,
mplsFrrFacilityDBNumProtectedTunnels,
mplsFrrFacilityDBProtectingTunnelStatus,
mplsFrrFacilityDBProtectingTunnelResvBw
}
STATUS current
DESCRIPTION
"This notification is generated when the final tunnel that is
being protected by a backup tunnel as specified in the
mplsFrrConstraintsTable is restored to normal operation. This
notification should not be generated for each restored tunnel,
as this may result in potential scaling issues with regard to
LSR performance and network load. Note also that
notifications MUST be generated in accordance with the
mplsFrrNotificationsMaxRate."

::= { mplsFrrFacilityNotifications 2 }

-- Module Conformance Statement

mplsFrrFacilityCompliances
OBJECT IDENTIFIER ::= {mplsFrrFacilityConformance 1 }

mplsFrrFacilityGroups
OBJECT IDENTIFIER ::= {mplsFrrFacilityConformance 2 }

mplsFrrFacilityModuleFullCompliance
MODULE-COMPLIANCE
STATUS current
DESCRIPTION
"Compliance statements for agents that support the MPLS-FRR-FACILITY-STD-MIB MIB module."

MODULE MPLS-FRR-GENERAL-STD-MIB -- MPLS FRR Generic MIB
MANDATORY-GROUPS {
  mplsFrrGeneralScalarGroup,
  mplsFrrGeneralTunnelARHopGroup,
  mplsFrrGeneralConstraintsGroup
}

MODULE -- this module
MANDATORY-GROUPS {
  mplsFrrFacilityScalarGroup,
  mplsFrrFacilityDBGroup,
  mplsFrrFacilityNotificationsGroup
}

::= { mplsFrrFacilityCompliances 1 }

mplsFrrFacilityModuleReadOnlyCompliance
MODULE-COMPLIANCE
STATUS current
DESCRIPTION
"Compliance statements for agents that support the MPLS FRR MIB."

MODULE MPLS-FRR-GENERAL-STD-MIB -- MPLS FRR Generic MIB
MANDATORY-GROUPS {
  mplsFrrGeneralScalarGroup,
  mplsFrrGeneralTunnelARHopGroup,
  mplsFrrGeneralConstraintsGroup
}

MODULE -- this module
MANDATORY-GROUPS {
  mplsFrrFacilityScalarGroup,
mplsFrrFacilityDBGroup,
mplsFrrFacilityNotificationsGroup
}

 ::= { mplsFrrFacilityCompliances 2 }

-- Units of conformance

mplsFrrFacilityScalarGroup OBJECT-GROUP
OBJECTS { mplsFrrConfiguredInterfaces,
mplsFrrActiveInterfaces,
mplsFrrConfiguredBypassTunnels,
mplsFrrActiveBypassTunnels,
mplsFrrFacilityNotificationsEnabled,
mplsFrrFacilityNotificationsMaxRate
}
STATUS        current
DESCRIPTION
"Objects that are required to represent the FRR Facility Route Database information."
 ::= { mplsFrrFacilityGroups 1 }

mplsFrrFacilityDBGroup OBJECT-GROUP
OBJECTS { mplsFrrFacilityDBNumProtectingTunnelOnIf,
mplsFrrFacilityDBNumProtectedLspOnIf,
mplsFrrFacilityDBNumProtectedTunnels,
mplsFrrFacilityDBProtectingTunnelStatus,
mplsFrrFacilityDBProtectingTunnelResvBw
}
STATUS        current
DESCRIPTION
"Objects that are required to represent the FRR Facility Route Database information."
 ::= { mplsFrrFacilityGroups 2 }

mplsFrrFacilityNotificationsGroup NOTIFICATION-GROUP
NOTIFICATIONS { mplsFrrFacilityInitialBkupTunnelInvoked,
mplsFrrFacilityFinalTunnelRestored
}
STATUS        current
DESCRIPTION
"Objects that are required to represent FRR notifications."
 ::= { mplsFrrFacilityGroups 3 }

END

-- End of MPLS-FRR-FACILITY-STD-MIB
7. Security Considerations

It is clear that these MIB modules are potentially useful for monitoring of MPLS LSRs supporting fast reroute. This MIB module can also be used for configuration of certain objects, and anything that can be configured can be incorrectly configured, with potentially disastrous results.

There are a number of management objects defined in these MIB modules with 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. These are the tables and objects and their sensitivity/vulnerability:

- the mplsFrrGeneralConstraintsTable (mplsFrrGeneralConstraintsProtectionType, mplsFrrGeneralConstraintsSetupPrio, etc.) and some objects in the mplsFrrScalarGroup (mplsFrrGeneralProtectionMethod, mplsFrrFacilityNotificationsEnabled, etc.) contain objects which may be used to provision MPLS fast reroute features. Unauthorized access to these objects could result in disruption of traffic on the network. This is especially true if the objects in question refer to previously provisioned protection tunnels and configuration. The use of stronger mechanisms such as SNMPv3 security should be considered where possible. Specifically, SNMPv3 VACM and USM MUST be used with any v3 agent which implements these MIB modules. Administrators should consider whether read access to these objects should be allowed, since read access may be undesirable under certain circumstances.

Some of the readable objects in these MIB modules (i.e. objects with MAX-ACCESS other than not-accessible) may be considered sensitive or vulnerable in some network environments. It is thus important to control even GET and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP. These are the tables and objects and their sensitivity/vulnerability:

- the mplsFrrOne2OnePlrTable (mplsFrrOne2OnePlrSenderAddr, mplsFrrOne2OnePlrAvoidNodeAddr, etc.), mplsFrrOne2OneDetourTable (mplsFrrOne2OneDetourActive, mplsFrrOne2OneDetourMergedDetourInst, etc.), and mplsFrrGeneralTunnelARHopTable (mplsFrrGeneralTunnelARHopProtectType, etc.).
tables and some objects contained in the mplsFrrScalarGroup (mplsFrrGeneralProtectionMethod, mplsFrrActiveInterfaces, etc.) collectively show the MPLS fast reroute interfaces, tunnels, and other associated fast reroute feature configurations as well as their linkages to other MPLS-related configuration and/or performance statistics. Administrators not wishing to reveal this information should consider these objects sensitive/vulnerable and take precautions so they are not revealed.

SNMP versions prior to SNMPv3 did not include adequate security. Even if the network itself is secure (for example by using IPSec), even then, there is no control as to who on the secure network is allowed to access and GET/SET (read/change/create/delete) the objects in these MIB modules.

It is RECOMMENDED that implementers consider the security features as provided by the SNMPv3 framework (see [RFC3410], section 8), including full support for the SNMPv3 cryptographic mechanisms (for authentication and privacy).

Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of these MIB modules, 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.

8. IANA Considerations

The MIB modules in this document use the following IANA-assigned OBJECT IDENTIFIER values recorded in the SMI Numbers registry:

8.1. IANA Considerations for MPLS-FRR-GENERAL-STD-MIB

The IANA is requested to assign { mib-2 187 } to the MPLS-FRR-GENERAL-STD-MIB MIB module specified in this document.

8.2. IANA Considerations for MPLS-FRR-ONE2ONE-STD-MIB

The IANA is requested to assign { mib-2 188 } to the MPLS-FRR-ONE2ONE-STD-MIB MIB module specified in this document.

8.3. IANA Considerations for MPLS-FRR-FACILITY-STD-MIB

The IANA is requested to assign { mib-2 189 } to the
MPLS-FRR-FACILITY-STD-MIB module specified in this document.

Editor’s Note (to be removed prior to publication): the IANA is requested to assign a value for "XXX" under the mib-2 subtree and to record the assignment in the SMI Numbers registry. When the assignment has been made, the RFC Editor is asked to replace "XXX" (here and in the MIB module) with the assigned value and to remove this note.

9. Acknowledgments

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10. References

10.1 Normative References


Engineering Management Information Base", [RFC 3812], June 2004


10.2 Informative References


11. Editors’ Addresses

Riza Cetin
Alcatel
Francis Wellesplein 1
B-2018 Antwerp, Belgium
Email: riza.cetin@alcatel.be

Thomas D. Nadeau
BT
BT Centre
81 Newgate Street
EC1A 7AJ
London
Email: tom.nadeau@bt.com

A S Kiran Koushik
Cisco Systems, Inc.
12515 Research Blvd, Bldg 4
Austin, TX 78664
Phone: +1-512-378-1482
Email: kkouushik@cisco.com

12. Contributors’ Addresses

Stefaan De Cnodder
Alcatel
Francis Wellesplein 1
B-2018 Antwerp, Belgium
Email: stefaan.de_cnodder@alcatel.be

Der-Hwa Gan
Juniper Networks, Inc.
1194 N. Mathilda Avenue
Sunnyvale, CA 94089
Email: dhg@juniper.net

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