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IP MIB for IP Fast-Reroute
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Abstract

This draft defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it describes managed objects relevant for IP routes using IP Fast-Reroute [RFC5714]

Requirements Language

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 [RFC2119].

Status of This Memo

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1. Introduction

This document defines a portion of the Management Information Base (MIB) for use with network management protocols in the Internet community. In particular, it defines the managed objects used for IP routes and interfaces in relation to IP Fast-Reroute. This document uses terminology from [RFC5714] and [RFC5286].

Current work is underway to define mechanisms for determining alternate paths for traffic to use when the original path becomes unavailable due to a local failure. The alternate next-hops can be computed in the context of any IGP.

There are certain configuration attributes for IP Fast-Reroute that should be configured to enable IP Fast Reroute in the context of the IGP. These configuration attributes of IP Fast-Reroute are not covered by this MIB module. Examples include whether IP Fast-Reroute is enabled on a network region (i.e. an OSPF area or IS-IS level) and the desired local hold-down timer [RFC5286], whose proper value is dependent upon the size of the network region.

It is possible for traffic other than IP to depend upon and use the alternate next-hops computed by IP Fast-Reroute. An example would be MPLS traffic whose path is configured via LDP [RFC5036]. The additional details (for example, outgoing MPLS label) pertaining to alternate next-hops that are required by such traffic are not covered by this MIB module.

An IP route may be reachable via multiple primary next-hops which provide equal-cost paths. Where IP Fast-Reroute is enabled, each primary next-hop will be protected by one or more alternate next-hops. Such an alternate next-hop may itself be a primary next-hop.

1.1. The SNMP 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 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, [RFC2578], STD 58, [RFC2579] and STD 58, [RFC2580].

2. Brief description of MIB Objects

2.1. ipFrrProtectStats Group

The global objects in this group provide summary information related to protection for all IP routes. The information available includes counts of all routes, of all protected routes, of all unprotected routes, of all routes which are protected against a link failure, and of all routes which are protected against a node failure.

2.2. ipFrrInstanceTable

The ipFrrInstanceTable provides information about configuration of IP FRR instantiations on a node. A single node may have multiple instances of IP FRR using different algorithms or protocols.

2.3. ipFrrIfTable

The ipFrrIfTable provides information about configuration of interfaces for IPFRR.

2.4. ipFrrProtectStatsTable

The ipFrrProtectStatsTable complements the ipFrrProtectStats group by providing statistics per IP FRR instance.

2.5. ipFrrAltTable

The ipFrrAltTable extends the inetCidrRouteTable [RFC4292] to provide information about each alternate next-hop associated with a primary next-hop used by a route. Statically configured alternate next-hops associated with primary next-hops can be created.

2.6. ipFrrNoAltTable

The ipFrrNoAltTable extends the inetCidrRouteTable [RFC4292] to provide information about the routes which do not have an alternate next-hop associated with any of the route's primary next-hop. The entry provides an explanation for the lack of protection.

3. IP Fast-Reroute MIB Module Definitions

```
IPFRR-MIB DEFINITIONS ::= BEGIN
```

```
IMPORTS
```

```
    MODULE-IDENTITY,
```

```
    OBJECT-TYPE,
```

```
    Gauge32,
```

```
    Integer32
```

```
    FROM SNMPv2-SMI
```

```
    -- [RFC2578]
```

```
    RowStatus
```

```
    FROM SNMPv2-TC
```

```
    -- [RFC2579]
```

```
    MODULE-COMPLIANCE,
```

```
    OBJECT-GROUP
```

```
    FROM SNMPv2-CONF
```

```
    -- [RFC2580]
```

```
    InetAddressType,
```

```
    InetAddress
```

```
    FROM INET-ADDRESS-MIB
```

```
    -- [RFC4001]
```

```
3]      ifIndex, InterfaceIndex          FROM IF-MIB          -- [RFC286

      ip                                FROM IP-MIB          -- [RFC4293]

      inetCidrRouteDestType,
      inetCidrRouteDest,
      inetCidrRoutePfxLen,
      inetCidrRoutePolicy,
      inetCidrRouteNextHopType,
      inetCidrRouteNextHop FROM IP-FORWARD-MIB
      -- [RFC4292]

      IANAipRouteProtocol FROM IANA-RTPROTO-MIB

;

ipFrrMIB MODULE-IDENTITY
  LAST-UPDATED "201405261200Z" -- May 26, 2014
  ORGANIZATION "draft-ietf-ipfrr-ip-mib-03.txt"
  CONTACT-INFO
    "
      A S Kiran Koushik
      Cisco Systems Inc.
      Email: kkoushik@cisco.com

      John W Flick
      Hewlett Packard Company
      Email: john.flick@hp.com

      Alia Atlas
      Juniper Networks
      Email: akatlas@juniper.net

      Stephane Litkowski
      Orange Business Service
      Email: stephane.litkowski@orange.com
    "
  DESCRIPTION
    "IP MIB module for management of IP Fast-Reroute.

    Copyright (C) The Internet Society (date).
    This version of this MIB module is part of
    draft-ietf-rtgwg-ipfrr-ip-mib-03.txt"
  REVISION      "201406131200Z" -- Jun 13, 2014
```

DESCRIPTION

"Add ipFrrTunnelType in ipFrrAltEntry
Modify ipFrrAltType"

REVISION "201405261200Z" -- May 26, 2014

DESCRIPTION

"Add ipFrrInstanceTable.
Add ipFrrIfTable.

ipFrrProtectStatsTable complements ipFrrProtectStats to have statistics per instance.

Add ipFrrAltMetric2, ipFrrAltMetric3, ipFrrAltBest, ipFrrAltNonBestReason to ipFrrAltEntry.

Add integer values to ipFrrAltType.

Add integer values to ipFrrAltProtectionAvailable.

Changed attachment of ipFrrAltStatus in ipFrrAltEntry.

Added IPv6 objects in ipFrrProtectStats."

REVISION "201203131200Z" -- Mar 13, 2012

DESCRIPTION

"Editorial changes. Added new type to ipFrrAltType."

REVISION "200502181200Z" -- February 18, 2005

DESCRIPTION

"Add Set operations on ipFrrAltTable"

REVISION "200502131200Z" -- February 13, 2005

DESCRIPTION

"Initial version."

::= { ip ZZZ } -- To be assigned by IANA

-- Top level components of this MIB module.

ipFrrMIBObjects OBJECT IDENTIFIER ::= { ipFrrMIB 1 }

ipFrrProtectStats OBJECT IDENTIFIER ::= { ipFrrMIBObjects 1 }

-- the IP FRR MIB-Group

-- A collection of objects providing summarized information
-- about the protection availability and type of alternate paths
-- provided by IP Fast-Reroute mechanisms.

ipFrrTotalRoutes OBJECT-TYPE

SYNTAX Gauge32

MAX-ACCESS read-only

STATUS current

DESCRIPTION

"The number of IPv4 valid routes known by this entity."

::= { ipFrrProtectStats 1 }

ipFrrUnprotectedRoutes OBJECT-TYPE

SYNTAX Gauge32

MAX-ACCESS read-only


```
STATUS      current
DESCRIPTION
    "The number of IPv4 valid routes known by this entity
    which do not have an alternate next-hop associated
    with any primary next-hop."
 ::= { ipFrrProtectStats 2 }

ipFrrProtectedRoutes    OBJECT-TYPE
SYNTAX      Gauge32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The number of IPv4 routes known by this entity
    which have at least one alternate next-hop."
 ::= { ipFrrProtectStats 3 }

ipFrrLinkProtectedRoutes OBJECT-TYPE
SYNTAX      Gauge32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The number of IPv4 routes known by this entity
    for which all alternate next-hops provide link
    protection for their associated primary next-hops."
 ::= { ipFrrProtectStats 4 }

ipFrrNodeProtectedRoutes OBJECT-TYPE
SYNTAX      Gauge32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The number of IPv4 routes known by this entity
    for which all alternate next-hops provide node
    protection for their associated primary next-hops."
 ::= { ipFrrProtectStats 5 }

ipv6FrrTotalRoutes     OBJECT-TYPE
SYNTAX      Gauge32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION
    "The number of IPv6 valid routes known by this entity."
 ::= { ipFrrProtectStats 6 }

ipv6FrrUnprotectedRoutes OBJECT-TYPE
SYNTAX      Gauge32
MAX-ACCESS  read-only
STATUS      current
```



```
DESCRIPTION
    "The number of IPv6 valid routes known by this entity
    which do not have an alternate next-hop associated
    with any primary next-hop."
 ::= { ipFrrProtectStats 7 }

ipv6FrrProtectedRoutes    OBJECT-TYPE
    SYNTAX      Gauge32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of IPv6 routes known by this entity
        which have at least one alternate next-hop."
 ::= { ipFrrProtectStats 8 }

ipv6FrrLinkProtectedRoutes OBJECT-TYPE
    SYNTAX      Gauge32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of IPv6 routes known by this entity
        for which all alternate next-hops provide link
        protection for their associated primary next-hops."
 ::= { ipFrrProtectStats 9 }

ipv6FrrNodeProtectedRoutes OBJECT-TYPE
    SYNTAX      Gauge32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of IPv6 routes known by this entity
        for which all alternate next-hops provide node
        protection for their associated primary next-hops."
 ::= { ipFrrProtectStats 10 }

-- the IP FRR instance MIB-group
--
-- The ipFrrInstanceTable provides detail on current IPFRR
-- instances activated on the node

ipFrrInstanceTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF IpFrrInstanceEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This entity's IP Fast Reroute Instance table."
 ::= { ipFrrMIBObjects 4 }
```

```

ipFrrInstanceEntry OBJECT-TYPE
    SYNTAX      IpFrrInstanceEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "An entry containing information on a particular
        IP FRR instance on the node."

```

```

INDEX { ipFrrInstanceId
}
 ::= { ipFrrInstanceTable 1 }

```

```

IpFrrInstanceEntry ::= SEQUENCE {
    ipFrrInstanceId          INTEGER,
    ipFrrInstanceProtocol   IANAipRouteProtocol,
    ipFrrInstanceAlgorithm  Integer32,
    ipFrrInstancePerPrefixComputation  INTEGER,
    ipFrrInstanceRowStatus  RowStatus
}

```

```

ipFrrInstanceId OBJECT-TYPE
    SYNTAX      Integer32 (1..255)
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This object specifies an identifier of a particular IPFR
R instance. "
    ::= { ipFrrInstanceEntry 1 }

```

```

ipFrrInstanceProtocol OBJECT-TYPE
    SYNTAX      IANAipRouteProtocol
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This object specifies the protocol used by the IPFRR instan
ce."
    ::= { ipFrrInstanceEntry 2 }

```

```

ipFrrInstanceAlgorithm OBJECT-TYPE
    SYNTAX      INTEGER {
        loopFree(1),
        loopFreeRemote(2),
        loopFreeTI(3),
        mrt(4)
    }
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This object specifies the algorithm used by the IPFRR insta
nce."
    ::= { ipFrrInstanceEntry 3 }

```


ipFrrInstancePerPrefixComputation OBJECT-TYPE

```
SYNTAX      INTEGER {
                false(0),
                true(1)
            }
```

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"This object specifies if per prefix computation is used."

```
::= { ipFrrInstanceEntry 4 }
```

ipFrrInstanceRowStatus OBJECT-TYPE

```
SYNTAX      RowStatus
```

MAX-ACCESS read-create

STATUS current

DESCRIPTION

."

```
::= { ipFrrInstanceEntry 5 }
```

-- the IP FRR Interface MIB-Group

--

-- ipFrrIfTable provides information on configuration

-- of interfaces for IPFRR

ipFrrIfTable OBJECT-TYPE

```
SYNTAX      SEQUENCE OF IpFrrIfEntry
```

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"This entity's IP Fast Reroute Alternates Interface configuration table."

```
::= { ipFrrMIBObjects 5 }
```

ipFrrIfEntry OBJECT-TYPE

```
SYNTAX      IpFrrIfEntry
```

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"An entry containing information on a particular instance of an IPFRR interface."

```
INDEX { ipFrrInstanceId,
        ifIndex
      }
```

```
::= { ipFrrIfTable 1 }
```

IpFrrIfEntry ::= SEQUENCE {

```
    ipFrrIfProtectionType          BITS,
```



```
        ipFrrIfCandidate          INTEGER,
        ipFrrIfRowStatus          RowStatus
    }
```

```
ipFrrIfProtectionType OBJECT-TYPE
```

```
    SYNTAX      BITS {
                nodeProtect(0),
                linkProtect(1),
                nodelinkProtect(2)
            }
```

```
    MAX-ACCESS read-create
```

```
    STATUS      current
```

```
    DESCRIPTION
```

```
        "This object specifies the scope of protection requested for
the protection of the destinations.
```

```
        nodeProtect means node protection only compared to nodelink
Protect which means node protection
```

```
        if available and link protection if not available. "
```

```
 ::= { ipFrrIfEntry 1 }
```

```
ipFrrIfCandidate OBJECT-TYPE
```

```
    SYNTAX      INTEGER {
                false (0),
                true (1)
            }
```

```
    MAX-ACCESS read-create
```

```
    STATUS      current
```

```
    DESCRIPTION
```

```
        "This object specifies the scope of protection requested for
the protection of the destinations.
```

```
        nodeProtect means node protection only compared to nodelink
Protect which means node protection
```

```
        if available and link protection if not available. "
```

```
 ::= { ipFrrIfEntry 2 }
```

```
ipFrrIfRowStatus OBJECT-TYPE
```

```
    SYNTAX      RowStatus
```

```
    MAX-ACCESS read-create
```

```
    STATUS      current
```

```
    DESCRIPTION
```

```
        "."
```

```
 ::= { ipFrrIfEntry 3 }
```

```
-- the IP FRR Stats MIB-Group
```

```
--
```

```
-- ipFrrProtectStatsTable provides provides
```

```
-- protection availability and type of alternate paths
```

```
-- provided by IP Fast-Reroute mechanisms per IPFRR instance.
```



```

ipFrrProtectStatsTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF IpFrrProtectStatsEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This entity's IP Fast Reroute Alternates statistics table.

```

```

 ::= { ipFrrMIBObjects 6 }

```

```

ipFrrProtectStatsEntry OBJECT-TYPE
    SYNTAX      IpFrrProtectStatsEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "An entry containing information on a particular instance of
IPFRR.

```

```

. "

```

```

INDEX { ipFrrInstanceId
        }
 ::= { ipFrrProtectStatsTable 1 }

```

```

IpFrrProtectStatsEntry ::= SEQUENCE {
    ipFrrStatsTotalRoutes      Gauge32,
    ipFrrStatsUnprotectedRoutes Gauge32,
    ipFrrStatsProtectedRoutes  Gauge32,
    ipFrrStatsLinkProtectedRoutes Gauge32,
    ipFrrStatsNodeProtectedRoutes Gauge32,
    ipv6FrrStatsTotalRoutes    Gauge32,
    ipv6FrrStatsUnprotectedRoutes Gauge32,
    ipv6FrrStatsProtectedRoutes Gauge32,
    ipv6FrrStatsLinkProtectedRoutes Gauge32,
    ipv6FrrStatsNodeProtectedRoutes Gauge32
}

```

```

    ipFrrStatsTotalRoutes      OBJECT-TYPE
    SYNTAX      Gauge32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of valid routes known by this entity."
 ::= { ipFrrProtectStatsEntry 1 }

```

```

ipFrrStatsUnprotectedRoutes      OBJECT-TYPE
    SYNTAX      Gauge32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of valid routes known by this entity

```



```
        which do not have an alternate next-hop associated
        with any primary next-hop."
 ::= { ipFrrProtectStatsEntry 2 }
```

```
ipFrrStatsProtectedRoutes      OBJECT-TYPE
    SYNTAX      Gauge32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of routes known by this entity
        which have at least one alternate next-hop."
 ::= { ipFrrProtectStatsEntry 3 }
```

```
ipFrrStatsLinkProtectedRoutes OBJECT-TYPE
    SYNTAX      Gauge32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of routes known by this entity
        for which all alternate next-hops provide link
        protection for their associated primary next-hops."
 ::= { ipFrrProtectStatsEntry 4 }
```

```
ipFrrStatsNodeProtectedRoutes OBJECT-TYPE
    SYNTAX      Gauge32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of routes known by this entity
        for which all alternate next-hops provide node
        protection for their associated primary next-hops."
 ::= { ipFrrProtectStatsEntry 5 }
```

```
ipv6FrrStatsTotalRoutes      OBJECT-TYPE
    SYNTAX      Gauge32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of valid IPv6 routes known by this entity."
 ::= { ipFrrProtectStatsEntry 6 }
```

```
ipv6FrrStatsUnprotectedRoutes OBJECT-TYPE
    SYNTAX      Gauge32
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "The number of valid IPv6 routes known by this entity
        which do not have an alternate next-hop associated
```

with any primary next-hop."
 ::= { ipFrrProtectStatsEntry 7 }

ipv6FrrStatsProtectedRoutes OBJECT-TYPE
 SYNTAX Gauge32
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION
 "The number of IPv6 routes known by this entity
 which have at least one alternate next-hop."
 ::= { ipFrrProtectStatsEntry 8 }

ipv6FrrStatsLinkProtectedRoutes OBJECT-TYPE
 SYNTAX Gauge32
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION
 "The number of IPv6 routes known by this entity
 for which all alternate next-hops provide link
 protection for their associated primary next-hops."
 ::= { ipFrrProtectStatsEntry 9 }

ipv6FrrStatsNodeProtectedRoutes OBJECT-TYPE
 SYNTAX Gauge32
 MAX-ACCESS read-only
 STATUS current
 DESCRIPTION
 "The number of IPv6 routes known by this entity
 for which all alternate next-hops provide node
 protection for their associated primary next-hops."
 ::= { ipFrrProtectStatsEntry 10 }

-- the IP FRR Alternate MIB-Group

--

-- The ipFrrAltTable extends the inetCidrRouteTable to indicate
 -- the alternate next-hop(s) associated with each primary
 -- next-hop. The additional indices (ipFrrAltNextHopType and
 -- ipFrrAltNextHop) allow for multiple alternate paths for a
 -- given primary next-hop.

ipFrrAltTable OBJECT-TYPE
 SYNTAX SEQUENCE OF IpFrrAltEntry
 MAX-ACCESS not-accessible
 STATUS current
 DESCRIPTION
 "This entity's IP Fast Reroute Alternates table."
 ::= { ipFrrMIBObjects 2 }

```

ipFrrAltEntry OBJECT-TYPE
    SYNTAX      IpFrrAltEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "An entry containing information on a particular route,
         one of its particular (primary) next-hops and one of
         the associated alternate next-hops.

         Implementers need to be aware that if the total
         number of elements (octets or sub-identifiers) in
         inetCidrRouteDest, inetCidrRoutePolicy,
         inetCidrRouteNextHop, and ipFrrAltNextHop exceeds 107
         then OIDs of column instances in this table will have
         more than 128 sub-identifiers and cannot be accessed
         using SNMPv1, SNMPv2c, or SNMPv3."

    INDEX { inetCidrRouteDestType,
            inetCidrRouteDest,
            inetCidrRoutePfxLen,
            inetCidrRoutePolicy,
            inetCidrRouteNextHopType,
            inetCidrRouteNextHop,
            ipFrrAltNextHopType,
            ipFrrAltNextHop
          }
    ::= { ipFrrAltTable 1 }

IpFrrAltEntry ::= SEQUENCE {
    ipFrrAltNextHopType      InetAddressType,
    ipFrrAltNextHop          InetAddress,
    ipFrrAltIfIndex          InterfaceIndex,
    ipFrrAltType              INTEGER,
    ipFrrTunnelType          INTEGER,
    ipFrrAltProtectionAvailable BITS,
    ipFrrAltMetric1          Integer32,
    ipFrrAltMetric2          Integer32,
    ipFrrAltMetric3          Integer32,
    ipFrrAltBest              INTEGER,
    ipFrrAltNonBestReason    OCTET STRING,
    ipFrrAltStatus           RowStatus
}

ipFrrAltNextHopType OBJECT-TYPE
    SYNTAX      InetAddressType
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION

```

"The type of the ipFrrNextHop address, as defined in the InetAddress MIB.

Only those address types that may appear in an actual routing table are allowed as values of this object."

REFERENCE "RFC 4001"

::= { ipFrrAltEntry 1 }

ipFrrAltNextHop OBJECT-TYPE

SYNTAX InetAddress

MAX-ACCESS not-accessible

STATUS current

DESCRIPTION

"The address of the next system along the alternate route.

The type of this address is determined by the value of the ipFrrAltNextHopType."

::= { ipFrrAltEntry 2 }

ipFrrAltIfIndex OBJECT-TYPE

SYNTAX InterfaceIndex

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The ifIndex value which identifies the local interface through which the next hop of this alternate route should be reached."

::= { ipFrrAltEntry 3 }

ipFrrAltType OBJECT-TYPE

SYNTAX INTEGER {

other (1), -- type not defined

equalCost (2), -- primary path

loopFree (3), -- loop free alternate

loopFreeRemote (4), -- remote loop free alternate

loopFreeNH (5), -- loop free alternate using a

configured tunnel toward the nexthop

loopFreeNNH (6), -- loop free alternate using a

configured tunnel toward the nextnexthop

loopFreeTI (7), -- loop free alternate using to

pology independent algorithm

mrt (8) -- Maximally Redundant Trees

}

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The type of alternate which is provided by the alternate next-hop. The supported types are as follows:

equalCost : The alternate next-hop is another primary next-hop.

loopFreeConnected : loop free alternate (LFA as described in RFC5286)

loopFreeRemote : remote LFA (as described in draft-ietf-rtgw-remote-lfa)

loopFreeNH : loop free alternate using a configured tunnel toward the nexthop (link protection only)

loopFreeNNH : loop free alternate using a configured tunnel toward the nextnexthop (node protection)

loopFreeTI : loop free alternate using topology independent algorithm

other : The mechanism by which the alternate next-hop can be used is not specified.

MRT : Maximally Redundant Trees, where each destination has two MRTs associated with it. These two trees are referred as blue and red MRTs.
See draft-ietf-rtgw-mrt-frr-architecture-00.

::= { ipFrrAltEntry 4 }

ipFrrTunnelType OBJECT-TYPE

```
SYNTAX      INTEGER {
    none                (1), -- No tunnel used
    other               (2), -- type not defined
    LDP                 (3), -- LDP tunnel
    IP                  (4), -- IP based tunnel (GRE, IPIP,
L2TP ...)
    SPRING MPLS        (5), -- SPRING tunnel using MPLS dat
aplane
    SPRING IPv6        (6), -- SPRING tunnel using IPv6 dat
aplane
    RSVP-TE            (7), -- RSVP-TE tunnel
    MULTI-TOPOLOGY LDP(8) -- LDP tunnel on another topolo
gy
}
```

MAX-ACCESS read-create

STATUS current

DESCRIPTION

"The type of tunnel used to reach the alternate.
The supported types are as follows:

none : No tunnel used

LDP : use LDP tunnel to reach the alternate (typically the case of rLFA)

IP : use IP based tunnel to reach the alternate

SPRING MPLS or SPRING IPv6 : use SPRING based tunnel (typically the case of TI-LFA)

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RSVP-TE : use a RSVP-TE LSP to reach the alternate

MULTI-TOPOLOGY LDP : use an LDP tunnel based on another topology (typically the case of MRT)

```
"
 ::= { ipFrrAltEntry 5 }

ipFrrAltProtectionAvailable OBJECT-TYPE
    SYNTAX      BITS {
        nodeProtect(0),
        linkProtect(1),
        srlgProtect(2),
        downstreamProtect(3),
        unknownProtection(4)
    }
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This object specifies the scope of protection for
        which this alternate next-hop can provide failure
        protection.  The alternate next-hop should provide
        one or more of node-protection and link-protection.
        If the protection provided by the alternate next-hop
        is unknown, then only unknownProtection should be
        specified.  Specifying unknownProtection with any
        other type of protection is not supported. "
    ::= { ipFrrAltEntry 6 }

ipFrrAltMetric1 OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This is the primary routing metric for this
        alternate path to the destination IP address.
        If the alternate path metric is unknown, the value
        should be set to -1."
    ::= { ipFrrAltEntry 7 }

ipFrrAltMetric2 OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This is the primary routing metric for this
        alternate path from the PLR to the alternate.
        If the alternate path metric is unknown, the value
```

```
        should be set to -1."
 ::= { ipFrrAltEntry 8 }

ipFrrAltMetric3 OBJECT-TYPE
    SYNTAX      Integer32
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This is the primary routing metric for this
        alternate path from the alternate to the destination.
        If the alternate path metric is unknown, the value
        should be set to -1."
 ::= { ipFrrAltEntry 9 }

ipFrrAltBest OBJECT-TYPE
    SYNTAX      INTEGER { false(0), true(1) }
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This object provides information if the alternate is the
best one."
 ::= { ipFrrAltEntry 10 }

ipFrrAltNonBestReason OBJECT-TYPE
    SYNTAX      OCTET STRING (SIZE (0..255))
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "This object provides reason why an alternate is not the b
est one."
 ::= { ipFrrAltEntry 11 }

ipFrrAltStatus OBJECT-TYPE
    SYNTAX      RowStatus
    MAX-ACCESS  read-create
    STATUS      current
    DESCRIPTION
        "The row status variable, used according to
        row installation and removal conventions."
 ::= { ipFrrAltEntry 12 }

-- the IP FRR No Alternate MIB-Group
--
-- The ipFrrNoAltTable extends the inetCidrRouteTable
-- to indicate which routes are unprotected and the reason
-- why. The indices do not include the primary next-hop because
-- the lack of protection is for the route. This allows easy
-- access to the set of unprotected routes that would be
-- affected by a local failure of their primary next-hop.
```



```

ipFrrNoAltTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF IpFrrNoAltEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "This entity's IP Fast Reroute Unprotected Routes
        table."
    ::= { ipFrrMIBObjects 3 }

ipFrrNoAltEntry OBJECT-TYPE
    SYNTAX      IpFrrNoAltEntry
    MAX-ACCESS  not-accessible
    STATUS      current
    DESCRIPTION
        "An entry containing the reason why a route does not
        have an alternate next-hop.  The existence of an
        entry for a route indicates that there is no
        alternate next-hop."
    INDEX { inetCidrRouteDestType,
            inetCidrRouteDest,
            inetCidrRoutePfxLen
          }
    ::= { ipFrrNoAltTable 1 }

IpFrrNoAltEntry ::= SEQUENCE {
    ipFrrNoAltCause      INTEGER
}

ipFrrNoAltCause OBJECT-TYPE
    SYNTAX      INTEGER {
        ipFrrUnavailable (1), -- No valid alternate(s)
        localAddress     (2), -- local/internal address
        ipFrrDisabled    (3), -- Protection not enabled
        other             (4)  -- unknown or other cause
    }
    MAX-ACCESS  read-only
    STATUS      current
    DESCRIPTION
        "For valid routes without an alternate next-hop, this
        object enumerates the reason why no protection is
        available.  The possibilities are as follows.

        ipFrrUnavailable : The supported IP Fast-Reroute
                           mechanisms could not find a safe
                           alternate next-hop.

        localAddress : The route represents a local address.
                       This system is the destination so no

```

alternate path is possible or necessary.

ipFrrDisabled : Finding of alternate next-hops is operationally disabled.

other : The reason is unknown or different from those specifically enumerated possible causes."
 ::= { ipFrrNoAltEntry 1 }

-- conformance information

ipFrrMIBConformance
 OBJECT IDENTIFIER ::= { ipFrrMIB 2 }

ipFrrMIBCompliances
 OBJECT IDENTIFIER ::= { ipFrrMIBConformance 1 }

ipFrrMIBGroups
 OBJECT IDENTIFIER ::= { ipFrrMIBConformance 2 }

-- compliance statements

ipFrrMIBCompliance MODULE-COMPLIANCE

STATUS deprecated

DESCRIPTION

"Minimum requirements to state conformity to this MIB. Supporting only IP v4 addresses
 This is deprecated in favor of ipFrrMIBInetCompliance

There are a number of INDEX objects that cannot be represented in the form of OBJECT clauses in SMIV2, but for which there are compliance requirements, expressed in OBJECT clause form in this description:

OBJECT inetCidrRouteDestType
 SYNTAX InetAddressType { ipv4(1), ipv4z(3) }
 MIN-ACCESS read-only
 DESCRIPTION

A (deprecated) complying implementation at this level is required to support IPv4 addresses only. This compliance level is defined so an implementation only needs to support the addresses it actually supports on the device.

OBJECT inetCidrRouteNextHopType
 SYNTAX InetAddressType { ipv4(1), ipv4z(3) }
 MIN-ACCESS read-only

DESCRIPTION

A (deprecated) complying implementation at this level is required to support IPv4 addresses only. This compliance level is defined so an implementation only needs to support the addresses it actually supports on the device.

OBJECT ipFrrAltNextHopType

SYNTAX InetAddressType { ipv4(1), ipv4z(3) }

MIN-ACCESS read-only

DESCRIPTION

A (deprecated) complying implementation at this level is required to support IPv4 addresses only. This compliance level is defined so an implementation only needs to support the addresses it actually supports on the device.

"

MODULE -- this module

MANDATORY-GROUPS { ipFrrBasicGroup }

::= { ipFrrMIBCompliances 1 }

ipFrrMIBInetCompliance MODULE-COMPLIANCE

STATUS current

DESCRIPTION

"Full conformity to this MIB."

MODULE -- this module

MANDATORY-GROUPS { ipFrrBasicGroup }

OBJECT ipFrrAltStatus

SYNTAX INTEGER { active(1) }

WRITE-SYNTAX INTEGER { createAndGo(4), destroy(6) }

DESCRIPTION

"Support for createAndWait and notInService is not required."

::= { ipFrrMIBCompliances 2 }

ipFrrReadOnlyCompliance MODULE-COMPLIANCE

STATUS current

DESCRIPTION

"When this MIB is implemented without support for read-create (i.e. in read-only mode), then that implementation can claim read-only compliance. In that case, ipFrrAlt group can be monitored but cannot be configured with this MIB."

```
MODULE
MANDATORY-GROUPS { ipFrrBasicGroup }

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

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

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

OBJECT ipFrrAltMetric1
MIN-ACCESS read-only
DESCRIPTION
    "Write access is not required."

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

 ::= { ipFrrMIBCompliances 3 }

-- units of conformance
ipFrrBasicGroup OBJECT-GROUP
    OBJECTS { ipFrrTotalRoutes,
              ipFrrUnprotectedRoutes,
              ipFrrProtectedRoutes,
              ipFrrLinkProtectedRoutes,
              ipFrrNodeProtectedRoutes,
              ipv6FrrTotalRoutes,
              ipv6FrrUnprotectedRoutes,
              ipv6FrrProtectedRoutes,
              ipv6FrrLinkProtectedRoutes,
              ipv6FrrNodeProtectedRoutes,
              ipFrrAltIfIndex,
              ipFrrAltType,
              ipFrrAltProtectionAvailable,
              ipFrrAltMetric1,
              ipFrrAltMetric2,
              ipFrrAltMetric3,
```

```
    ipFrrAltNonBestReason,
    ipFrrAltBest,
    ipFrrAltStatus,
    ipFrrNoAltCause,
    ipFrrInstanceAlgorithm,
    ipFrrInstanceProtocol,
    ipFrrInstancePerPrefixComputation,
    ipFrrInstanceRowStatus,
    ipFrrIfCandidate,
    ipFrrIfProtectionType,
    ipFrrIfRowStatus,
    ipFrrStatsTotalRoutes,
    ipFrrStatsUnprotectedRoutes,
    ipFrrStatsProtectedRoutes,
    ipFrrStatsLinkProtectedRoutes,
    ipFrrStatsNodeProtectedRoutes,
    ipv6FrrStatsTotalRoutes,
    ipv6FrrStatsUnprotectedRoutes,
    ipv6FrrStatsProtectedRoutes,
    ipv6FrrStatsLinkProtectedRoutes,
    ipv6FrrStatsNodeProtectedRoutes
}
STATUS current
DESCRIPTION
    "The entire collection of objects defined in
    this MIB for management of IP Fast Reroute ."
 ::= { ipFrrMIBGroups 1 }
```

END

4. Security Considerations

There are a number of management objects defined in this MIB module 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. The ipFrrAltTable contains routing and forwarding information that is critical to the operation of the network in the event of a local failure. Allowing unauthenticated write access to this table can compromise the validity of the alternate forwarding information.

Some of the readable objects in this MIB module (i.e. objects with a MAX-ACCESS other than not-accessible) may be considered sensitive or vulnerable in some network environments. It is thus important to

control even GET access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP.

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 the objects in this MIB module.

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

Further, deployment of SNMP versions prior to SNMPv3 is NOT RECOMMENDED. Instead, it is RECOMMENDED to deploy SNMPv3 and to enable cryptographic security. It is then a customer/operator responsibility to ensure that the SNMP entity giving access to an instance of this MIB module is properly configured to give access to the objects only to those principals (users) that have legitimate rights to indeed GET them.

5. Acknowledgements

The authors would like to acknowledge contributions made by Bill Anderson, Don Fedyk and Bruno Decraene.

6. IANA Considerations

The MIB module in this document uses the following IANA-assigned OBJECT IDENTIFIER value recorded in the SMI Numbers registry.

The IANA is requested to assign { ip ZZZ } to the IPFRR-MIB MIB module specified in this document.

Editor's Note (to be removed prior to publication): the IANA is requested to assign a value for "ZZZ" under the ip subtree and to record the assignments in the SMI Numbers registry. When the assignments have been made, the RFC Editor is asked to replace "ZZZ" (here and in the MIB modules) with the assigned value and to remove this note.

7. References

7.1. Normative References

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7.2. Informative References

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