IP MIB for IP Fast-Reroute
draft-ietf-rtgwg-ipfrr-ip-mib-08

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

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

Internet-Drafts are working documents of the Internet Engineering Task Force (IETF). Note that other groups may also distribute working documents as Internet-Drafts. The list of current Internet-Drafts is at http://datatracker.ietf.org/drafts/current/.

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

This Internet-Draft will expire on August 12, 2016.

Copyright Notice

Copyright (c) 2016 IETF Trust and the persons identified as the document authors. All rights reserved.
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.

ipFrrInstances cannot be created through the MIB.
2.3. ipFrrIfTable

The ipFrrIfTable provides information about configuration of interfaces for IPFRR. Entries can be created to activate IPFRR on a particular interface or setting the candidate properties.

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.

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,
    Gauge32FROM SNMPv2-SMI -- [RFC2578]
    Integer32 FROM SNMPv2-SMI -- [RFC2863]
    RowStatus FROM SNMPv2-TC -- [RFC2579]
    MODULE-COMPLIANCE,
    OBJECT-GROUP FROM SNMPv2-CONF -- [RFC2580]
    InetAddressType,
    InetAddress FROM INET-ADDRESS-MIB -- [RFC4001]
    ifIndex, InterfaceIndex FROM IF-MIB -- [RFC2863]
    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 "201508040000Z" -- Aug 04, 2015
ORGANIZATION "draft-ietf-ipfrr-ip-mib-06.txt"
CONTACT-INFO
"A S Kiran Koushik
Cisco Systems Inc.
EMail: kkoushik@cisco.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-07.txt"

REVISION      "201508040000Z" -- Aug 04, 2015
DESCRIPTION
"Fixing some syntax issues
Moved ipFrrInstanceTable to readonly
Moved ipFrrAltTable to readonly
Modified Readonly conformance"
Deleting ipFrrInstanceRowStatus
Deleting ipFrrAltStatus
Added notProtect to ipFrrIfProtectionType

REVISION "201406141200Z" -- Jun 14, 2014
DESCRIPTION
"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 50 } -- 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
}

ipFrrInstanceId OBJECT-TYPE
SYNTAX     Integer32 (1..255)
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
"This object specifies an identifier a of particular IPFRR instance."
::= { ipFrrInstanceEntry 1 }
ipFrrInstanceProtocol OBJECT-TYPE
SYNTAX    IANAipRouteProtocol
MAX-ACCESS read-only
STATUS    current
DESCRIPTION
  "This object specifies the protocol used by the IPFRR instance."
 ::= { ipFrrInstanceEntry 2 }

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

ipFrrInstancePerPrefixComputation OBJECT-TYPE
SYNTAX     INTEGER {
    false(0),
    true(1)
}
MAX-ACCESS read-only
STATUS    current
DESCRIPTION
  "This object specifies if per prefix computation is used."
 ::= { ipFrrInstanceEntry 4 }

-- 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),
    notProtect(3)
}
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 nodeLinkProtect 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 nodeLinkProtect which means node protection
if available and link protection if not available." :
DEFVAL {1}
::= { 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
"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  
}

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
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 topology independent algorithm
   mrt                    (8)  -- Maximally Redundant Trees
}
MAX-ACCESS read-only
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-rtgwg-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-rtgwg-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 ...}
    srmpls                (5), -- SPRING tunnel using MPLS dataplane
    sripv6                (6), -- SPRING tunnel using IPv6 dataplane
    rsvpte                (7), -- RSVP-TE tunnel
    mtldp                 (8) -- LDP tunnel on another topology
}
MAX-ACCESS read-only
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
    srmpls or sripv6 : use SPRING based tunnel (typically the case of TI-LFA)
    rsvpte : use a RSVP-TE LSP to reach the alternate
    mtldp : 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-only
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-only
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-only
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-only
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-only
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-only
STATUS current
DESCRIPTION "This object provides reason why an alternate is not the best one."
::= { ipFrrAltEntry 11 }

-- 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  ipFrrIfRowStatus
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  ipFrrIfProtectionType
MIN-ACCESS read-only
DESCRIPTION
"Write access is not required."

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

OBJECT  ipFrrIfRowStatus
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,
   ipFrrTunnelType,
   ipFrrAltProtectionAvailable,
   ipFrrAltMetric1,
   ipFrrAltMetric2,
   ipFrrAltMetric3,
   ipFrrAltNonBestReason,
   ipFrrAltBest,
   ipFrrNoAltCause,
   ipFrrInstanceAlgorithm,
   ipFrrInstanceProtocol,
   ipFrrInstancePerPrefixComputation,
   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."
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, John Flick 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


IP Fast Reroute: Loop-Free Alternates", RFC 5286,
DOI 10.17487/RFC5286, September 2008,

7.2. Informative References

Schoenwaelder, Ed., "Structure of Management Information
Version 2 (SMIv2)", STD 58, RFC 2578,
DOI 10.17487/RFC2578, April 1999,

Schoenwaelder, Ed., "Textual Conventions for SMIv2",
STD 58, RFC 2579, DOI 10.17487/RFC2579, April 1999,

Schoenwaelder, Ed., "Conformance Statements for SMIv2",
STD 58, RFC 2580, DOI 10.17487/RFC2580, April 1999,

[RFC3410] Case, J., Mundy, R., Partain, D., and B. Stewart,
"Introduction and Applicability Statements for Internet-
Standard Management Framework", RFC 3410,
DOI 10.17487/RFC3410, December 2002,

"LDP Specification", RFC 5036, DOI 10.17487/RFC5036,

RFC 5714, DOI 10.17487/RFC5714, January 2010,

Authors’ Addresses

Alia Atlas
Juniper Networks

Email: akatlas@juniper.net