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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 [IPFRR].

## Table of Contents

<a href="#">1.</a>	Introduction . . . . .	<a href="#">3</a>
<a href="#">1.1.</a>	The SNMP Management Framework . . . . .	<a href="#">3</a>
<a href="#">2.</a>	Brief Description of MIB Objects . . . . .	<a href="#">4</a>
<a href="#">2.1.</a>	ipFrrProtectStats Group . . . . .	<a href="#">4</a>
<a href="#">2.2.</a>	ipFrrAltTable . . . . .	<a href="#">4</a>
<a href="#">2.3.</a>	ipFrrNoAltTable . . . . .	<a href="#">4</a>
<a href="#">3.</a>	IP Fast-Reroute MIB Module Definitions . . . . .	<a href="#">5</a>
<a href="#">4.</a>	Security Considerations . . . . .	<a href="#">16</a>
<a href="#">5.</a>	References . . . . .	<a href="#">16</a>
	Authors' Addresses . . . . .	<a href="#">18</a>
	Intellectual Property and Copyright Statements . . . . .	<a href="#">19</a>



## **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 [[I-D.ietf-rtgwg-ipfrr-framework](#)], [[I-D.ietf-rtgwg-ipfrr-spec-base](#)] and [[IPFRR-UTURN](#)].

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 [[I-D.ietf-rtgwg-ipfrr-spec-base](#)], 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 [[RFC3036](#)]. 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 RFC 3410](#) [[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, [RFC 2578](#) [[RFC2578](#)], STD 58, [RFC 2579](#) [[RFC2579](#)] and STD 58, [RFC 2580](#) [[RFC2580](#)].



## **2. Brief Description of MIB Objects**

This MIB module consists of five global objects, organized into the ipFrrProtectStats group, and two tables.

### **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. ipFrrAltTable**

The ipFrrAltTable extends the inetCidrRouteTable[I-D.ietf-ipv6-rfc2096-update] 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.

### **2.3. ipFrrNoAltTable**

The ipFrrNoAltTable extends the inetCidrRouteTable[I-D.ietf-ipv6-rfc2096-update] 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            -- [RFC3291]
```

```
    InterfaceIndex
```

```
                                FROM IF-MIB                    -- [RFC2863]
```

```
    ip
```

```
                                FROM IP-MIB                    -- [RFC2011]
```

```
    inetCidrRouteDestType,
```

```
    inetCidrRouteDest,
```

```
    inetCidrRoutePfxLen,
```

```
    inetCidrRoutePolicy,
```

```
    inetCidrRouteNextHopType,
```

```
    inetCidrRouteNextHop FROM IP-FORWARD-MIB
```

```
                                -- [draft-ietf-ipv6-rfc2096-update-07]
```

```
;
```

```
ipFrrMIB MODULE-IDENTITY
```

```
    LAST-UPDATED "200502181200Z" -- June 10, 2005
```

```
    ORGANIZATION "draft-ietf-ipfrr-ip-mib-00.txt"
```

```
    CONTACT-INFO
```

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```





```
"
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-00.txt"

REVISION      "200502181200Z"  -- February 18, 2005
DESCRIPTION
    "Add Set operations on ipFrrAltTable"
REVISION      "200502131200Z"  -- February 13, 2005
DESCRIPTION
    "Initial version."

 ::= {  ip 999 } -- To be assigned by IANA
-- RFC Ed.: replace 999 with actual RFC number
-- & remove this note

-- 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 valid routes known by this entity."
    ::= { ipFrrProtectStats 1 }

ipFrrUnprotectedRoutes    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."
    ::= { ipFrrProtectStats 2 }
```



```
ipFrrProtectedRoutes    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."
    ::= { ipFrrProtectStats 3 }

ipFrrLinkProtectedRoutes 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."
    ::= { ipFrrProtectStats 4 }

ipFrrNodeProtectedRoutes 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."
    ::= { ipFrrProtectStats 5 }

-- 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,
    ipFrrAltProtectionAvailable BITS,
    ipFrrAltMetric1          Integer32,
    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 3291](#)"

```
::= { 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

uTurn (4) -- u-turn alternate

}

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.

loopFree : The shortest route to the destination IP address from the alternate next-hop does not traverse this system. See [draft-ietf-rtgwg-ipfrr-spec-base-04](#).

uTurn : The alternate next system, which is indicated by the alternate next-hop, has itself a primary path that traverses this system but also has an alternate next-hop





for this route that does not traverse this system. See [draft-atlas-ip-local-protect-uturn-02](#).

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

::= { ipFrrAltEntry 4 }

ipFrrAltProtectionAvailable OBJECT-TYPE

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

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 5 }

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 6 }

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 7 }



```
-- 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
```

```
        ipFrrUturnDisabled (4), -- Protection not enabled
```

```
        other             (5) -- 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.

ipFrrUturnDisabled : Finding of u-turn alternate next-hops is operationally disabled. No loop-free alternate could be found. See [draft-atlas-ip-local-protect-uturn-02](#)

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,
            ipFrrAltIfIndex,
            ipFrrAltType,
            ipFrrAltProtectionAvailable,
            ipFrrAltMetric1,
            ipFrrAltStatus,
            ipFrrNoAltCause
          }
  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. References**

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