Internet-Draft
draft-ietf-ipv6-rfc2096-update-07.txt
Expires: August 2004

B. Haberman
Caspian Networks
February 2004

IP Forwarding Table MIB

Status of this Memo

This document is a product of the IPv6 MIB Revision Design Team and it is a working item of the IPv6 Working Group. Comments should be addressed to the editors, or to the IPv6 Working Group mailing list at ipv6@ietf.org.

Abstract

This document 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 related to the forwarding of Internet Protocol (IP) packets in an IP version-independent manner. This document obsoletes RFC 2096.

Copyright Notice

Table of Contents

Revision History

[Note to RFC Editor: Please remove prior to publication]

Changes from draft-ietf-ipv6-rfc2096-update-06.txt:

09 Feb 2004 Removed range from inetCidrRoutePfxLen

Clarified text in DESCRIPTION clause of inetCidrRoutePfxLen and inetCidrRouteDest to exclude bit-wise comparison of zone indexes

Changed syntax of inetCidrRouteIfIndex to InterfaceIndexOrZero

Changes from draft-ietf-ipv6-rfc2096-update-05.txt:

07 Jan 2004 Corrected editor information

Changed mailing list information

Limited InetAddress objects to (ipv4, ipv6, ipv4z, ipv6z)

Updated MODULE-IDENTITY REVISION clause to detail the

replacement of ipCidrRouteTable with
inetCidrRouteTable

Updated DESCRIPTION clause of ipForwardCompliance to
indicate the replacement of ipForwardCompliance with
ipForwardFullCompliance and
ipForwardReadOnlyCompliance

Added statement to DESCRIPTION clause of
ipForwardCidrRouteGroup pointing out its replacement

with inetForwardCidrRouteGroup

Added detail to section 3 on relationship of this MIB
with previous versions

Fixed references within DESCRIPTION clauses

Added SYNTAX statements to read-only OBJECTs

21 Jan 2004 Added clarifying text to Introduction on the usage of
the MIB definition

Enhanced Overview section to include explicit text on
relationship to other RFCs

Clarified DESCRIPTION text for inetCidrRouteDiscards

Added text to DESCRIPTION clause of
inetCidrRouteIfIndex to allow the value of 0

28 Jan 2004 Added range of (0..128) to inetCidrRoutePfxLen

Changes from draft-ietf-ipv6-rfc2096-update-04.txt:

28 Aug 2003 Corrected copyright statement in DESCRIPTION clause

Added inetCidrRouteNumber to
inetForwardCidrRouteGroup conformance statement

Removed SIZE constraints for inetCidrRouteDest and
inetCidrRouteNextHop

Added constraints statement to DESCRIPTION clause of
inetCidrRouteEntry

Added Intellectual Property section per requirements

of RFC 2026

Removed reference to RFC 2026

Removed ipForwardCompliance2

Changed definition of inetCidrRouteAge from Integer32 to Gauge32

Changes from draft-ietf-ipv6-rfc2096-update-03.txt:

27 Jun 2003 Updated text to DESCRIPTION of inetCidrRouteDiscards

Re-instated inetCidrRouteNumber

Added references for IF-MIB, IP-MIB, and IANA-

RTPROTO-MIB

Changed reference to RFC 2096 from normative to informative

Added RFC editor note to remove Revision History at publication time

Updated REVISION clause

Added section describing changes from RFC 2096

Added REVISION clause for original publication as RFC 1354

Added MIB Copyright statement to DESCRIPTION

Changes from draft-ietf-ipv6-rfc2096-update-02.txt:

16 Jan 2003 Changed lower-case 'h' to upper-case 'H' in hex number.

Updated REVISION and LAST UPDATED dates.

13 Jun 2003 Changed inetCidrRouteDscp to inetCidrRoutePolicy.

Updated MIB Boilerplate.

17 Jun 2003 Added read-only compliance statement.

Added text to DESCRIPTION clause for

inetCidrRouteStatus to indicate a row cannot be modified when it is active.

Removed numbered references from DESCRIPTION clauses.

Removed Unsigned32 from IMPORTS list.

Changed section numbers to conform with ID-nits.

Split references into normative/informative.

Updated security section.

Changes from draft-ietf-ipv6-rfc2096-update-01.txt:

02 Nov 2002 Fixed bugs that caused the MIB not to compile.

Changed the type of inetCidrRouteDscp to Dscp.

Improved the revision information.

Removed inetCidrRouteNumber and inetCidrRouteWeight.

Other editorial changes.

Changes from draft-ietf-ipv6-rfc-2096-update-00.txt:

22 Aug 2002 Minor editorial changes and clean-up

Changes from draft-ietf-ipngwg-rfc2096-update-00.txt:

27 Jun 2002 Added inetCidrRouteDscp index and inetCidrRouteWeight object to the inetCidrRouteTable.

Restored inetCidrRouteNextHopType variable (may be different from inetCidrRouteDestType, due to global vs. non-global distinction in new InetAddress TCs).

Removed inetCidrRouteInstance object. Use to identify a conceptual routing table is obviated by new InetAddress types and inclusion of DSCP index.

Changed editor, moved author information to end, several editorial changes.

Changed name to draft-ietf-ipv6-rfc-2096-update-*.txt

13 Jul 2002 Removed inetCidrRouteNextHopType.

Changes from draft-ops-rfc2096-update-00.txt:

12 Jul 2001	Renamed to IPNG working group draft Added scopes to the uses of instance Added inetCidrRouteDiscards to replace ipRoutingDiscards Fixed some remaining ipCidr*/inetCidr* confusion in DESCRIPTIONs

Changes from first draft posted to v6mib mailing list:

23 Feb 2001	Updated MODULE-IDENTITY Deleted inetCidrRouteTos, add inetCidrRouteInstance in INDEX of inetCidrRouteTable. Used InterfaceIndex, InetAddressPrefixLength and InetAutonomousSystemNumber TC's, and limited the SIZE of inetCidrRouteDest and inetCidrRouteNextHop Updated conformance info. Added copyright and table of contents.

1 Introduction

This document defines a portion of the Management Information Base (MIB) for use in managing objects related to the forwarding of Internet Protocol (IP) packets in an IP version-independent manner.

It should be noted that the MIB definition described herein does not support multiple instances based on the same address family type. However, it does support an instance of the MIB per address family.

2 Conventions Used In This Document

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

[RFC2119].

3 The Internet-Standard Management Framework

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

4 Overview

The MIB consists of one current table and two current global objects.

1. The object inetCidrRouteNumber indicates the number of current routes. This is primarily to avoid having to read the table in order to determine this number.

2. The object inetCidrRouteDiscards counts the number of valid routes that were discarded from inetCidrRouteTable for any reason. This object replaces the ipRoutingDiscards and ipv6DiscardedRoutes objects.

3. The inetCidrRouteTable provides the ability to display IP version-independent multipath CIDR routes.

4.1 Relationship to other MIBs

This MIB definition contains several deprecated and obsolete tables and objects. The following subsections describe the relationship between these objects and other MIB modules.

4.1.1 RFC 1213

The ipRouteTable object was originally defined in RFC 1213. It was updated by ipForwardTable in RFC 1354.

4.1.2 RFC 1354

The ipForwardTable object replaced the ipRouteTable object from RFC 1213. It was in turn obsoleted by the ipCidrRouteTable defined in RFC 2096.

In addition, RFC 1354 introduced ipForwardNumber. This object reflects the number of entries found in ipForwardTable. It was obsoleted by ipCidrRouteNumber, defined in RFC 2096.

4.1.3 RFC 2096

In RFC 2096, the ipCidrRouteTable and ipCidrRouteNumber were introduced. The ipCidrRouteTable object supports multipath IP routes having the same network number but differing network masks. The number of entries in that table is reflected in ipCidrRouteNumber. These objects are deprecated by the definitions contained in this MIB definition.

4.1.4 RFC 2011 and 2465

RFC 2011 contains the ipRoutingDiscards object which counts the number of valid routes which have been removed from the ipCidrRouteTable object. The corresponding ipv6DiscardedRoutes object is defined in RFC 2465. These objects are deprecated in favor of the version-independent object inetCidrRouteDiscards defined in this MIB.

5 Definitions

```
IP-FORWARD-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE,
    IpAddress, Integer32, Gauge32,
    Counter32                           FROM SNMPv2-SMI
    RowStatus                           FROM SNMPv2-TC
    MODULE-COMPLIANCE, OBJECT-GROUP     FROM SNMPv2-CONF
    InterfaceIndexOrZero                FROM IF-MIB
    ip                                  FROM IP-MIB
    IANAipRouteProtocol                 FROM IANA-RTPROTO-MIB
    InetAddress, InetAddressType,
    InetAddressPrefixLength,
    InetAutonomousSystemNumber          FROM INET-ADDRESS-MIB;

ipForward MODULE-IDENTITY
    LAST-UPDATED "200402091200Z"
    ORGANIZATION
           "IETF IPv6 Working Group
            http://www.ietf.org/html.charters/ipv6-charter.html"
    CONTACT-INFO
           "Editor:
            Brian Haberman
            Caspian Networks
            753 Bridgewater Drive
            Sykesville, MD  21784

            Phone: +1 410 552-1421
            Email: brian@innovationslab.net

            Send comments to <ipv6@ietf.org>"
    DESCRIPTION
           "The MIB module for the management of CIDR multipath IP
            Routes.

            Copyright (C) The Internet Society (2004). This version
            of this MIB module is a part of RFC xxxx; see the RFC
            itself for full legal notices."
    -- RFC Ed : replace xxxx with actual RFC number & remove note

    REVISION      "200402091200Z"
    DESCRIPTION
           "IPv4/v6 version-independent revision.  Minimal changes
            were made to the original RFC 2096 MIB, to allow easy
            upgrade of existing IPv4 implementations to the
            version-independent MIB.  These changes include:

            Adding inetCidrRouteDiscards as a replacement for the
            deprecated ipRoutingDiscards and ipv6DiscardedRoutes
            objects.
```

```
            Adding a new conformance statement to support the
            implementation of the IP Forwarding MIB in a
            read-only mode.

            The inetCidrRouteTable replaces the IPv4-specific
            ipCidrRouteTable, its related objects, and related
            conformance statements.

            Published as RFC xxxx."
    -- RFC Ed : replace xxxx with actual RFC number & remove note

    REVISION      "199609190000Z"
    DESCRIPTION
           "Revised to support CIDR routes.
            Published as RFC 2096."

    REVISION      "199207022156Z"
    DESCRIPTION
           "Initial version, published as RFC 1354."
    ::= { ip 24 }

inetCidrRouteNumber OBJECT-TYPE
    SYNTAX     Gauge32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
           "The number of current inetCidrRouteTable entries that
            are not invalid."
::= { ipForward 6 }

inetCidrRouteDiscards OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
           "The number of valid route entries discarded from
            inetCidrRouteTable.  Discarded route entries do not
            appear in inetCidrRouteTable.  One possible reason for
            discarding an entry would be to free-up buffer space
            for other route table entries."
    ::= { ipForward 8 }

--  Inet CIDR Route Table

--  The Inet CIDR Route Table deprecates and replaces the
--  ipCidrRoute Table currently in the IP Forwarding Table MIB.
```

```
--  It adds IP protocol independence.

inetCidrRouteTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF InetCidrRouteEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
           "This entity's IP Routing table."
```



```
    REFERENCE
           "RFC 1213 Section 6.6, The IP Group"
    ::= { ipForward 7 }

inetCidrRouteEntry OBJECT-TYPE
    SYNTAX     InetCidrRouteEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
           "A particular route to a particular destination, under a
            particular policy (as reflected in the
            inetCidrRoutePolicy object).

            Dynamically created rows will survive an agent reboot.

            Implementers need to be aware that if the total number
            of elements (octets or sub-identifiers) in
            inetCidrRouteDest, inetCidrRoutePolicy, and
            inetCidrRouteNextHop exceeds 111 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
        }
    ::= { inetCidrRouteTable 1 }

InetCidrRouteEntry ::= SEQUENCE {
        inetCidrRouteDestType     InetAddressType,
        inetCidrRouteDest         InetAddress,
        inetCidrRoutePfxLen       InetAddressPrefixLength,
        inetCidrRoutePolicy       OBJECT IDENTIFIER,
        inetCidrRouteNextHopType  InetAddressType,
        inetCidrRouteNextHop      InetAddress,
```

```
        inetCidrRouteIfIndex      InterfaceIndexOrZero,
        inetCidrRouteType         INTEGER,
        inetCidrRouteProto        IANAipRouteProtocol,
        inetCidrRouteAge          Gauge32,
        inetCidrRouteNextHopAS    InetAutonomousSystemNumber,
        inetCidrRouteMetric1      Integer32,
        inetCidrRouteMetric2      Integer32,
        inetCidrRouteMetric3      Integer32,
        inetCidrRouteMetric4      Integer32,
        inetCidrRouteMetric5      Integer32,
        inetCidrRouteStatus       RowStatus
    }

inetCidrRouteDestType OBJECT-TYPE
    SYNTAX     InetAddressType
```



```
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
           "The type of the inetCidrRouteDest 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"
    ::= { inetCidrRouteEntry 1 }

inetCidrRouteDest OBJECT-TYPE
    SYNTAX     InetAddress
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
           "The destination IP address of this route.

            The type of this address is determined by the value of
            the inetCidrRouteDestType object.

            The values for the index objects inetCidrRouteDest and
            inetCidrRoutePfxLen must be consistent.  When the value
            of inetCidrRouteDest (excluding the zone index, if one
            is present) is x, then the bitwise logical-AND
            of x with the value of the mask formed from the
            corresponding index object inetCidrRoutePfxLen MUST be
            equal to x.  If not, then the index pair is not
            consistent and an inconsistentName error must be
            returned on SET or CREATE requests."

    ::= { inetCidrRouteEntry 2 }
```

```
inetCidrRoutePfxLen OBJECT-TYPE
    SYNTAX     InetAddressPrefixLength
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
           "Indicates the number of leading one bits which form the
            mask to be logical-ANDed with the destination address
            before being compared to the value in the
            inetCidrRouteDest field.

            The values for the index objects inetCidrRouteDest and
            inetCidrRoutePfxLen must be consistent.  When the value
            of inetCidrRouteDest (excluding the zone index, if one
            is present) is x, then the bitwise logical-AND
            of x with the value of the mask formed from the
            corresponding index object inetCidrRoutePfxLen MUST be
            equal to x.  If not, then the index pair is not
            consistent and an inconsistentName error must be
            returned on SET or CREATE requests."

    ::= { inetCidrRouteEntry 3 }
```



```
inetCidrRoutePolicy OBJECT-TYPE
    SYNTAX     OBJECT IDENTIFIER
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
           "This object is an opaque object without any defined
            semantics.  Its purpose is to serve as an additional
            index which may delineate between multiple entries to
            the same destination.  The value { 0 0 } shall be used
            as the default value for this object."
    ::= { inetCidrRouteEntry 4 }

inetCidrRouteNextHopType OBJECT-TYPE
    SYNTAX     InetAddressType
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
           "The type of the inetCidrRouteNextHop address, as
            defined in the InetAddress MIB.

            Value should be set to unknown(0) for non-remote
            routes.

            Only those address types that may appear in an actual
```

```
            routing table are allowed as values of this object."
    REFERENCE "RFC 3291"
    ::= { inetCidrRouteEntry 5 }

inetCidrRouteNextHop OBJECT-TYPE
    SYNTAX     InetAddress
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
           "On remote routes, the address of the next system en
            route.  For non-remote routes, a zero length string.

            The type of this address is determined by the value of
            the inetCidrRouteNextHopType object."
    ::= { inetCidrRouteEntry 6 }

inetCidrRouteIfIndex OBJECT-TYPE
    SYNTAX     InterfaceIndexOrZero
    MAX-ACCESS read-create
    STATUS     current
    DESCRIPTION
           "The ifIndex value which identifies the local interface
            through which the next hop of this route should be
            reached.  A value of 0 is valid and represents the
            scenario where no interface is specified."
    ::= { inetCidrRouteEntry 7 }

inetCidrRouteType OBJECT-TYPE
    SYNTAX     INTEGER {
```



```
                other    (1), -- not specified by this MIB
                reject   (2), -- route which discards traffic and
                              --   returns ICMP notification
                local    (3), -- local interface
                remote   (4), -- remote destination
                blackhole(5)  -- route which discards traffic
                              --   silently
             }
    MAX-ACCESS read-create
    STATUS     current
    DESCRIPTION
           "The type of route.  Note that local(3) refers to a
            route for which the next hop is the final destination;
            remote(4)refers to a route for which the next hop is
            not the final destination.

            Routes which do not result in traffic forwarding or
            rejection should not be displayed even if the
```

```
            implementation keeps them stored internally.

            reject(2) refers to a route which, if matched, discards
            the message as unreachable and returns a notification
            (e.g. ICMP error) to the message sender.  This is used
            in some protocols as a means of correctly aggregating
            routes.

            blackhole(5) refers to a route which, if matched,
            discards the message silently."
    ::= { inetCidrRouteEntry 8 }

inetCidrRouteProto OBJECT-TYPE
    SYNTAX     IANAipRouteProtocol
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
           "The routing mechanism via which this route was learned.
            Inclusion of values for gateway routing protocols is
            not intended to imply that hosts should support those
            protocols."
    ::= { inetCidrRouteEntry 9 }

inetCidrRouteAge OBJECT-TYPE
    SYNTAX     Gauge32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
           "The number of seconds since this route was last updated
            or otherwise determined to be correct.  Note that no
            semantics of 'too old' can be implied except through
            knowledge of the routing protocol by which the route
            was learned."
    ::= { inetCidrRouteEntry 10 }

inetCidrRouteNextHopAS OBJECT-TYPE
```



```
    SYNTAX     InetAutonomousSystemNumber
    MAX-ACCESS read-create
    STATUS     current
    DESCRIPTION
           "The Autonomous System Number of the Next Hop.  The
            semantics of this object are determined by the routing-
            protocol specified in the route's inetCidrRouteProto
            value. When this object is unknown or not relevant its
            value should be set to zero."
    DEFVAL { 0 }
    ::= { inetCidrRouteEntry 11 }
```

```
inetCidrRouteMetric1 OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-create
    STATUS     current
    DESCRIPTION
           "The primary routing metric for this route.  The
            semantics of this metric are determined by the routing-
            protocol specified in the route's inetCidrRouteProto
            value.  If this metric is not used, its value should be
            set to -1."
    DEFVAL { -1 }
    ::= { inetCidrRouteEntry 12 }

inetCidrRouteMetric2 OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-create
    STATUS     current
    DESCRIPTION
           "An alternate routing metric for this route.  The
            semantics of this metric are determined by the routing-
            protocol specified in the route's inetCidrRouteProto
            value.  If this metric is not used, its value should be
            set to -1."
    DEFVAL { -1 }
    ::= { inetCidrRouteEntry 13 }

inetCidrRouteMetric3 OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-create
    STATUS     current
    DESCRIPTION
           "An alternate routing metric for this route.  The
            semantics of this metric are determined by the routing-
            protocol specified in the route's inetCidrRouteProto
            value.  If this metric is not used, its value should be
            set to -1."
    DEFVAL { -1 }
    ::= { inetCidrRouteEntry 14 }

inetCidrRouteMetric4 OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-create
```



```
    STATUS     current
    DESCRIPTION
           "An alternate routing metric for this route.  The
            semantics of this metric are determined by the routing-
```

```
            protocol specified in the route's inetCidrRouteProto
            value.  If this metric is not used, its value should be
            set to -1."
    DEFVAL { -1 }
    ::= { inetCidrRouteEntry 15 }

inetCidrRouteMetric5 OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-create
    STATUS     current
    DESCRIPTION
           "An alternate routing metric for this route.  The
            semantics of this metric are determined by the routing-
            protocol specified in the route's inetCidrRouteProto
            value.  If this metric is not used, its value should be
            set to -1."
    DEFVAL { -1 }
    ::= { inetCidrRouteEntry 16 }

inetCidrRouteStatus OBJECT-TYPE
    SYNTAX     RowStatus
    MAX-ACCESS read-create
    STATUS     current
    DESCRIPTION
           "The row status variable, used according to row
            installation and removal conventions.

            A row entry cannot be modified when the status is
            marked as active(1)."
    ::= { inetCidrRouteEntry 17 }

--  Conformance information

ipForwardConformance
     OBJECT IDENTIFIER ::= { ipForward 5 }

ipForwardGroups
     OBJECT IDENTIFIER ::= { ipForwardConformance 1 }

ipForwardCompliances
     OBJECT IDENTIFIER ::= { ipForwardConformance 2 }

--  Compliance statements

ipForwardFullCompliance MODULE-COMPLIANCE
    STATUS     current
    DESCRIPTION
           "When this MIB is implemented for read-create, the
            implementation can claim full compliance.
```

```
            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), ipv6(2),
            --                              ipv4z(3), ipv6z(4))
            -- DESCRIPTION
            --     This MIB requires support for global and
            --     non-global ipv4 and ipv6 addresses.
            --
            -- OBJECT      inetCidrRouteDest
            -- SYNTAX      InetAddress (SIZE (4 | 8 | 16 | 20))
            -- DESCRIPTION
            --     This MIB requires support for global and
            --     non-global IPv4 and IPv6 addresses.
            --
            -- OBJECT      inetCidrRouteNextHopType
            -- SYNTAX      InetAddressType (unknown(0), ipv4(1),
            --                              ipv6(2), ipv4z(3)
            --                              ipv6z(4))
            -- DESCRIPTION
            --     This MIB requires support for global and
            --     non-global ipv4 and ipv6 addresses.
            --
            -- OBJECT      inetCidrRouteNextHop
            -- SYNTAX      InetAddress (SIZE (0 | 4 | 8 | 16 | 20))
            -- DESCRIPTION
            --     This MIB requires support for global and
            --     non-global IPv4 and IPv6 addresses.
            "

   MODULE -- this module
   MANDATORY-GROUPS { inetForwardCidrRouteGroup }

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

   ::= { ipForwardCompliances 3 }

ipForwardReadOnlyCompliance MODULE-COMPLIANCE
   STATUS     current
   DESCRIPTION
           "When this MIB is implemented without support for read-
```

```
            create (i.e. in read-only mode), the implementation can
            claim read-only compliance."
    MODULE -- this module
    MANDATORY-GROUPS { inetForwardCidrRouteGroup }

    OBJECT      inetCidrRouteIfIndex
```



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

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

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

    OBJECT      inetCidrRouteMetric1
    MIN-ACCESS  read-only
    DESCRIPTION
       "Write access is not required."

    OBJECT      inetCidrRouteMetric2
    MIN-ACCESS  read-only
    DESCRIPTION
       "Write access is not required."

    OBJECT      inetCidrRouteMetric3
    MIN-ACCESS  read-only
    DESCRIPTION
       "Write access is not required."

    OBJECT      inetCidrRouteMetric4
    MIN-ACCESS  read-only
    DESCRIPTION
       "Write access is not required."

    OBJECT      inetCidrRouteMetric5
    MIN-ACCESS  read-only
    DESCRIPTION
       "Write access is not required."

    OBJECT      inetCidrRouteStatus
    SYNTAX      RowStatus { active(1) }
```

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

   ::= { ipForwardCompliances 4 }

-- units of conformance

inetForwardCidrRouteGroup OBJECT-GROUP
    OBJECTS { inetCidrRouteDiscards,
              inetCidrRouteIfIndex, inetCidrRouteType,
              inetCidrRouteProto, inetCidrRouteAge,
              inetCidrRouteNextHopAS, inetCidrRouteMetric1,
```



```
              inetCidrRouteMetric2, inetCidrRouteMetric3,
              inetCidrRouteMetric4, inetCidrRouteMetric5,
              inetCidrRouteStatus, inetCidrRouteNumber
        }
    STATUS     current
    DESCRIPTION
           "The IP version-independent CIDR Route Table."
    ::= { ipForwardGroups 4 }

--  Deprecated Objects

ipCidrRouteNumber OBJECT-TYPE
    SYNTAX     Gauge32
    MAX-ACCESS read-only
    STATUS     deprecated
    DESCRIPTION
           "The number of current ipCidrRouteTable entries that are
            not invalid.  This object is deprecated in favor of
            inetCidrRouteNumber and the inetCidrRouteTable."
    ::= { ipForward 3 }

--  IP CIDR Route Table

--  The IP CIDR Route Table obsoletes and replaces the ipRoute
--  Table current in MIB-I and MIB-II and the IP Forwarding Table.
--  It adds knowledge of the autonomous system of the next hop,
--  multiple next hops, and policy routing, and Classless
--  Inter-Domain Routing.

ipCidrRouteTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF IpCidrRouteEntry
    MAX-ACCESS not-accessible
    STATUS     deprecated
    DESCRIPTION
```

```
            "This entity's IP Routing table.  This table has been
             deprecated in favor of the IP version neutral
             inetCidrRouteTable."
        REFERENCE
               "RFC 1213 Section 6.6, The IP Group"
        ::= { ipForward 4 }

    ipCidrRouteEntry OBJECT-TYPE
        SYNTAX     IpCidrRouteEntry
        MAX-ACCESS not-accessible
        STATUS     deprecated
        DESCRIPTION
               "A particular route to a particular destination, under a
                particular policy."
        INDEX {
            ipCidrRouteDest,
            ipCidrRouteMask,
            ipCidrRouteTos,
            ipCidrRouteNextHop
            }
```



```
        ::= { ipCidrRouteTable 1 }

    IpCidrRouteEntry ::= SEQUENCE {
            ipCidrRouteDest       IpAddress,
            ipCidrRouteMask       IpAddress,
            ipCidrRouteTos        Integer32,
            ipCidrRouteNextHop    IpAddress,
            ipCidrRouteIfIndex    Integer32,
            ipCidrRouteType       INTEGER,
            ipCidrRouteProto      INTEGER,
            ipCidrRouteAge        Integer32,
            ipCidrRouteInfo       OBJECT IDENTIFIER,
            ipCidrRouteNextHopAS  Integer32,
            ipCidrRouteMetric1    Integer32,
            ipCidrRouteMetric2    Integer32,
            ipCidrRouteMetric3    Integer32,
            ipCidrRouteMetric4    Integer32,
            ipCidrRouteMetric5    Integer32,
            ipCidrRouteStatus     RowStatus
        }

    ipCidrRouteDest OBJECT-TYPE
        SYNTAX     IpAddress
        MAX-ACCESS read-only
        STATUS     deprecated
        DESCRIPTION
               "The destination IP address of this route.
```

```
            This object may not take a Multicast (Class D) address
            value.

            Any assignment (implicit or otherwise) of an instance
            of this object to a value x must be rejected if the
            bitwise logical-AND of x with the value of the
            corresponding instance of the ipCidrRouteMask object is
            not equal to x."
    ::= { ipCidrRouteEntry 1 }

ipCidrRouteMask OBJECT-TYPE
    SYNTAX     IpAddress
    MAX-ACCESS read-only
    STATUS     deprecated
    DESCRIPTION
           "Indicate the mask to be logical-ANDed with the
            destination address before being compared to the value
            in the ipCidrRouteDest field.  For those systems that
            do not support arbitrary subnet masks, an agent
            constructs the value of the ipCidrRouteMask by
            reference to the IP Address Class.

            Any assignment (implicit or otherwise) of an instance
            of this object to a value x must be rejected if the
            bitwise logical-AND of x with the value of the
            corresponding instance of the ipCidrRouteDest object is
```



```
            not equal to ipCidrRouteDest."
    ::= { ipCidrRouteEntry 2 }

-- The following convention is included for specification
-- of TOS Field contents.  At this time, the Host Requirements
-- and the Router Requirements documents disagree on the width
-- of the TOS field.  This mapping describes the Router
-- Requirements mapping, and leaves room to widen the TOS field
-- without impact to fielded systems.

ipCidrRouteTos OBJECT-TYPE
    SYNTAX     Integer32 (0..2147483647)
    MAX-ACCESS read-only
    STATUS     deprecated
    DESCRIPTION
           "The policy specifier is the IP TOS Field.  The encoding
            of IP TOS is as specified by the following convention.
            Zero indicates the default path if no more specific
            policy applies.
```

```
            +-----+-----+-----+-----+-----+-----+-----+-----+
            |                 |                       |     |
            |   PRECEDENCE    |    TYPE OF SERVICE    |  0  |
            |                 |                       |     |
            +-----+-----+-----+-----+-----+-----+-----+-----+

                          IP TOS                IP TOS
                Field     Policy      Field     Policy
                Contents    Code      Contents    Code
                0 0 0 0  ==>   0      0 0 0 1  ==>   2
                0 0 1 0  ==>   4      0 0 1 1  ==>   6
                0 1 0 0  ==>   8      0 1 0 1  ==>  10
                0 1 1 0  ==>  12      0 1 1 1  ==>  14
                1 0 0 0  ==>  16      1 0 0 1  ==>  18
                1 0 1 0  ==>  20      1 0 1 1  ==>  22
                1 1 0 0  ==>  24      1 1 0 1  ==>  26
                1 1 1 0  ==>  28      1 1 1 1  ==>  30"
    ::= { ipCidrRouteEntry 3 }

ipCidrRouteNextHop OBJECT-TYPE
    SYNTAX     IpAddress
    MAX-ACCESS read-only
    STATUS     deprecated
    DESCRIPTION
           "On remote routes, the address of the next system en
            route; Otherwise, 0.0.0.0."
    ::= { ipCidrRouteEntry 4 }

ipCidrRouteIfIndex OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-create
    STATUS     deprecated
    DESCRIPTION
           "The ifIndex value which identifies  the local interface
```



```
            through which the next hop of this route should be
            reached."
    DEFVAL { 0 }
    ::= { ipCidrRouteEntry 5 }

ipCidrRouteType OBJECT-TYPE
    SYNTAX     INTEGER {
                other    (1), -- not specified by this MIB
                reject   (2), -- route which discards traffic
                local    (3), -- local interface
                remote   (4)  -- remote destination
             }
    MAX-ACCESS read-create
```

```
    STATUS     deprecated
    DESCRIPTION
           "The type of route.  Note that local(3) refers to a
            route for which the next hop is the final destination;
            remote(4) refers to a route for which the next hop is
            not the final destination.

            Routes which do not result in traffic forwarding or
            rejection should not be displayed even if the
            implementation keeps them stored internally.

            reject (2) refers to a route which, if matched,
            discards the message as unreachable. This is used in
            some protocols as a means of correctly aggregating
            routes."
    ::= { ipCidrRouteEntry 6 }

ipCidrRouteProto OBJECT-TYPE
    SYNTAX     INTEGER {
                 other     (1),  -- not specified
                 local     (2),  -- local interface
                 netmgmt   (3),  -- static route
                 icmp      (4),  -- result of ICMP Redirect

                         -- the following are all dynamic
                         -- routing protocols
                 egp         (5),  -- Exterior Gateway Protocol
                 ggp         (6),  -- Gateway-Gateway Protocol
                 hello       (7),  -- FuzzBall HelloSpeak
                 rip         (8),  -- Berkeley RIP or RIP-II
                 isIs        (9),  -- Dual IS-IS
                 esIs        (10), -- ISO 9542
                 ciscoIgrp   (11), -- Cisco IGRP
                 bbnSpfIgp   (12), -- BBN SPF IGP
                 ospf        (13), -- Open Shortest Path First
                 bgp         (14), -- Border Gateway Protocol
                 idpr        (15), -- InterDomain Policy Routing
                 ciscoEigrp  (16)  -- Cisco EIGRP
               }
    MAX-ACCESS read-only
    STATUS     deprecated
```



```
    DESCRIPTION
           "The routing mechanism via which this route was learned.
            Inclusion of values for gateway routing protocols is
            not intended to imply that hosts should support those
            protocols."
    ::= { ipCidrRouteEntry 7 }
```

```
ipCidrRouteAge OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-only
    STATUS     deprecated
    DESCRIPTION
           "The number of seconds since this route was last updated
            or otherwise determined to be correct.  Note that no
            semantics of `too old' can be implied except through
            knowledge of the routing protocol by which the route
            was learned."
    DEFVAL  { 0 }
    ::= { ipCidrRouteEntry 8 }

ipCidrRouteInfo OBJECT-TYPE
    SYNTAX     OBJECT IDENTIFIER
    MAX-ACCESS read-create
    STATUS     deprecated
    DESCRIPTION
           "A reference to MIB definitions specific to the
            particular routing protocol which is responsible for
            this route, as determined by the value specified in the
            route's ipCidrRouteProto value.  If this information is
            not present, its value should be set to the OBJECT
            IDENTIFIER { 0 0 }, which is a syntactically valid
            object identifier, and any implementation conforming to
            ASN.1 and the Basic Encoding Rules must be able to
            generate and recognize this value."
    ::= { ipCidrRouteEntry 9 }

ipCidrRouteNextHopAS OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-create
    STATUS     deprecated
    DESCRIPTION
           "The Autonomous System Number of the Next Hop.  The
            semantics of this object are determined by the routing-
            protocol specified in the route's ipCidrRouteProto
            value. When this object is unknown or not relevant its
            value should be set to zero."
    DEFVAL { 0 }
    ::= { ipCidrRouteEntry 10 }

ipCidrRouteMetric1 OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-create
    STATUS     deprecated
    DESCRIPTION
```

```
            "The primary routing metric for this route.  The
             semantics of this metric are determined by the routing-
             protocol specified in the route's ipCidrRouteProto
             value.  If this metric is not used, its value should be
             set to -1."
        DEFVAL { -1 }
        ::= { ipCidrRouteEntry 11 }

    ipCidrRouteMetric2 OBJECT-TYPE
        SYNTAX     Integer32
        MAX-ACCESS read-create
        STATUS     deprecated
        DESCRIPTION
            "An alternate routing metric for this route.  The
             semantics of this metric are determined by the routing-
             protocol specified in the route's ipCidrRouteProto
             value.  If this metric is not used, its value should be
             set to -1."
        DEFVAL { -1 }
        ::= { ipCidrRouteEntry 12 }

    ipCidrRouteMetric3 OBJECT-TYPE
        SYNTAX     Integer32
        MAX-ACCESS read-create
        STATUS     deprecated
        DESCRIPTION
            "An alternate routing metric for this route.  The
             semantics of this metric are determined by the routing-
             protocol specified in the route's ipCidrRouteProto
             value.  If this metric is not used, its value should be
             set to -1."
        DEFVAL { -1 }
        ::= { ipCidrRouteEntry 13 }

    ipCidrRouteMetric4 OBJECT-TYPE
        SYNTAX     Integer32
        MAX-ACCESS read-create
        STATUS     deprecated
        DESCRIPTION
            "An alternate routing metric for this route.  The
             semantics of this metric are determined by the routing-
             protocol specified in the route's ipCidrRouteProto
             value.  If this metric is not used, its value should be
             set to -1."
        DEFVAL { -1 }
        ::= { ipCidrRouteEntry 14 }

    ipCidrRouteMetric5 OBJECT-TYPE
        SYNTAX     Integer32
        MAX-ACCESS read-create
```

```
    STATUS     deprecated
    DESCRIPTION
           "An alternate routing metric for this route.  The
            semantics of this metric are determined by the routing-
```



```
            protocol specified in the route's ipCidrRouteProto
            value.  If this metric is not used, its value should be
            set to -1."
    DEFVAL { -1 }
    ::= { ipCidrRouteEntry 15 }

ipCidrRouteStatus OBJECT-TYPE
    SYNTAX     RowStatus
    MAX-ACCESS read-create
    STATUS     deprecated
    DESCRIPTION
           "The row status variable, used according to row
            installation and removal conventions."
    ::= { ipCidrRouteEntry 16 }



-- compliance statements

ipForwardCompliance MODULE-COMPLIANCE
    STATUS     deprecated
    DESCRIPTION
           "The compliance statement for SNMPv2 entities which
            implement the ipForward MIB.

            This compliance statement has been deprecated and
            replaced with ipForwardFullCompliance and
            ipForwardReadOnlyCompliance."

   MODULE  -- this module
   MANDATORY-GROUPS { ipForwardCidrRouteGroup }

   ::= { ipForwardCompliances 1 }

-- units of conformance

ipForwardCidrRouteGroup OBJECT-GROUP
    OBJECTS { ipCidrRouteNumber,
              ipCidrRouteDest, ipCidrRouteMask, ipCidrRouteTos,
              ipCidrRouteNextHop, ipCidrRouteIfIndex,
              ipCidrRouteType, ipCidrRouteProto, ipCidrRouteAge,
              ipCidrRouteInfo,ipCidrRouteNextHopAS,
              ipCidrRouteMetric1, ipCidrRouteMetric2,
```

```
                ipCidrRouteMetric3, ipCidrRouteMetric4,
                ipCidrRouteMetric5, ipCidrRouteStatus
            }
        STATUS      deprecated
        DESCRIPTION
                "The CIDR Route Table.

                 This group has been deprecated and replaced with
                 inetForwardCidrRouteGroup."
        ::= { ipForwardGroups 3 }
```



```
-- Obsoleted Definitions - Objects

ipForwardNumber OBJECT-TYPE
    SYNTAX      Gauge32
    MAX-ACCESS read-only
    STATUS      obsolete
    DESCRIPTION
            "The number of current ipForwardTable entries that are
             not invalid."
    ::= { ipForward 1 }

--  IP Forwarding Table

--  The IP Forwarding Table obsoletes and replaces the ipRoute
--  Table current in MIB-I and MIB-II.  It adds knowledge of
--  the autonomous system of the next hop, multiple next hop
--  support, and policy routing support.

ipForwardTable OBJECT-TYPE
    SYNTAX      SEQUENCE OF IpForwardEntry
    MAX-ACCESS not-accessible
    STATUS      obsolete
    DESCRIPTION
            "This entity's IP Routing table."
    REFERENCE
            "RFC 1213 Section 6.6, The IP Group"
    ::= { ipForward 2 }

ipForwardEntry OBJECT-TYPE
    SYNTAX      IpForwardEntry
    MAX-ACCESS not-accessible
    STATUS      obsolete
    DESCRIPTION
            "A particular route to a particular destination, under a
             particular policy."
    INDEX {
```

```
        ipForwardDest,
        ipForwardProto,
        ipForwardPolicy,
        ipForwardNextHop
        }
    ::= { ipForwardTable 1 }

IpForwardEntry ::= SEQUENCE {
        ipForwardDest       IpAddress,
        ipForwardMask       IpAddress,
        ipForwardPolicy     Integer32,
        ipForwardNextHop    IpAddress,
        ipForwardIfIndex    Integer32,
        ipForwardType       INTEGER,
        ipForwardProto      INTEGER,
        ipForwardAge        Integer32,
        ipForwardInfo       OBJECT IDENTIFIER,
        ipForwardNextHopAS  Integer32,
```



```
        ipForwardMetric1    Integer32,
        ipForwardMetric2    Integer32,
        ipForwardMetric3    Integer32,
        ipForwardMetric4    Integer32,
        ipForwardMetric5    Integer32
    }

ipForwardDest OBJECT-TYPE
    SYNTAX     IpAddress
    MAX-ACCESS read-only
    STATUS     obsolete
    DESCRIPTION
           "The destination IP address of this route.  An entry
            with a value of 0.0.0.0 is considered a default route.

            This object may not take a Multicast (Class D) address
            value.

            Any assignment (implicit or otherwise) of an instance
            of this object to a value x must be rejected if the
            bitwise logical-AND of x with the value of the
            corresponding instance of the ipForwardMask object is
            not equal to x."
    ::= { ipForwardEntry 1 }

ipForwardMask OBJECT-TYPE
    SYNTAX     IpAddress
    MAX-ACCESS read-create
    STATUS     obsolete
```

```
    DESCRIPTION
           "Indicate the mask to be logical-ANDed with the
            destination address before being compared to the value
            in the ipForwardDest field.  For those systems that do
            not support arbitrary subnet masks, an agent constructs
            the value of the ipForwardMask by reference to the IP
            Address Class.

            Any assignment (implicit or otherwise) of an instance
            of this object to a value x must be rejected if the
            bitwise logical-AND of x with the value of the
            corresponding instance of the ipForwardDest object is
            not equal to ipForwardDest."
    DEFVAL { '00000000'H }      -- 0.0.0.0
    ::= { ipForwardEntry 2 }

-- The following convention is included for specification
-- of TOS Field contents.  At this time, the Host Requirements
-- and the Router Requirements documents disagree on the width
-- of the TOS field.  This mapping describes the Router
-- Requirements mapping, and leaves room to widen the TOS field
-- without impact to fielded systems.

ipForwardPolicy OBJECT-TYPE
    SYNTAX     Integer32 (0..2147483647)
```



```
    MAX-ACCESS read-only
    STATUS     obsolete
    DESCRIPTION
           "The general set of conditions that would cause
            the selection of one multipath route (set of
            next hops for a given destination) is referred
            to as 'policy'.

            Unless the mechanism indicated by ipForwardProto
            specifies otherwise, the policy specifier is
            the IP TOS Field.  The encoding of IP TOS is as
            specified by the following convention.  Zero
            indicates the default path if no more specific
            policy applies.

            +-----+-----+-----+-----+-----+-----+-----+-----+
            |                 |                       |     |
            |   PRECEDENCE    |    TYPE OF SERVICE    |  0  |
            |                 |                       |     |
            +-----+-----+-----+-----+-----+-----+-----+-----+
```

```
                          IP TOS                 IP TOS
                Field     Policy       Field     Policy
                Contents    Code       Contents    Code
                0 0 0 0  ==>   0       0 0 0 1  ==>   2
                0 0 1 0  ==>   4       0 0 1 1  ==>   6
                0 1 0 0  ==>   8       0 1 0 1  ==>  10
                0 1 1 0  ==>  12       0 1 1 1  ==>  14
                1 0 0 0  ==>  16       1 0 0 1  ==>  18
                1 0 1 0  ==>  20       1 0 1 1  ==>  22
                1 1 0 0  ==>  24       1 1 0 1  ==>  26
                1 1 1 0  ==>  28       1 1 1 1  ==>  30

            Protocols defining 'policy' otherwise must either
            define a set of values which are valid for
            this object or must implement an integer-instanced
            policy table for which this object's
            value acts as an index."
    ::= { ipForwardEntry 3 }

ipForwardNextHop OBJECT-TYPE
    SYNTAX     IpAddress
    MAX-ACCESS read-only
    STATUS     obsolete
    DESCRIPTION
           "On remote routes, the address of the next system en
            route; Otherwise, 0.0.0.0."
    ::= { ipForwardEntry 4 }

ipForwardIfIndex OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-create
```



```
    STATUS     obsolete
    DESCRIPTION
           "The ifIndex value which identifies the local interface
            through which the next hop of this route should be
            reached."
    DEFVAL { 0 }
    ::= { ipForwardEntry 5 }

ipForwardType OBJECT-TYPE
    SYNTAX     INTEGER {
                other    (1), -- not specified by this MIB
                invalid  (2), -- logically deleted
                local    (3), -- local interface
                remote   (4)  -- remote destination
              }
```

```
    MAX-ACCESS read-create
    STATUS     obsolete
    DESCRIPTION
           "The type of route.  Note that local(3) refers to a
            route for which the next hop is the final destination;
            remote(4) refers to a route for which the next hop is
            not the final destination.

            Setting this object to the value invalid(2) has the
            effect of invalidating the corresponding entry in the
            ipForwardTable object.  That is, it effectively
            disassociates the destination identified with said
            entry from the route identified with said entry.  It is
            an implementation-specific matter as to whether the
            agent removes an invalidated entry from the table.
            Accordingly, management stations must be prepared to
            receive tabular information from agents that
            corresponds to entries not currently in use.  Proper
            interpretation of such entries requires examination of
            the relevant ipForwardType object."
    DEFVAL { invalid }
    ::= { ipForwardEntry 6 }

ipForwardProto OBJECT-TYPE
    SYNTAX     INTEGER {
                 other     (1),  -- not specified
                 local     (2),  -- local interface
                 netmgmt   (3),  -- static route
                 icmp      (4),  -- result of ICMP Redirect

                         -- the following are all dynamic
                         -- routing protocols
                 egp       (5),  -- Exterior Gateway Protocol
                 ggp       (6),  -- Gateway-Gateway Protocol
                 hello     (7),  -- FuzzBall HelloSpeak
                 rip       (8),  -- Berkeley RIP or RIP-II
                 is-is     (9),  -- Dual IS-IS
                 es-is     (10), -- ISO 9542
                 ciscoIgrp (11), -- Cisco IGRP
```



```
                 bbnSpfIgp (12), -- BBN SPF IGP
                 ospf      (13), -- Open Shortest Path First
                 bgp       (14), -- Border Gateway Protocol
                 idpr      (15)  -- InterDomain Policy Routing
               }
    MAX-ACCESS read-only
    STATUS     obsolete
    DESCRIPTION
```

```
            "The routing mechanism via which this route was learned.
             Inclusion of values for gateway routing protocols is
             not intended to imply that hosts should support those
             protocols."
    ::= { ipForwardEntry 7 }

ipForwardAge OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-only
    STATUS     obsolete
    DESCRIPTION
           "The number of seconds since this route was last updated
            or otherwise determined to be correct.  Note that no
            semantics of `too old' can be implied except through
            knowledge of the routing protocol by which the route
            was learned."
    DEFVAL  { 0 }
    ::= { ipForwardEntry 8 }

ipForwardInfo OBJECT-TYPE
    SYNTAX     OBJECT IDENTIFIER
    MAX-ACCESS read-create
    STATUS     obsolete
    DESCRIPTION
           "A reference to MIB definitions specific to the
            particular routing protocol which is responsible for
            this route, as determined by the value specified in the
            route's ipForwardProto value.  If this information is
            not present, its value should be set to the OBJECT
            IDENTIFIER { 0 0 }, which is a syntactically valid
            object identifier, and any implementation conforming to
            ASN.1 and the Basic Encoding Rules must be able to
            generate and recognize this value."
    ::= { ipForwardEntry 9 }

ipForwardNextHopAS OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-create
    STATUS     obsolete
    DESCRIPTION
           "The Autonomous System Number of the Next Hop.  When
            this is unknown or not relevant to the protocol
            indicated by ipForwardProto, zero."
    DEFVAL { 0 }
    ::= { ipForwardEntry 10 }
```



```
ipForwardMetric1 OBJECT-TYPE
```

```
    SYNTAX     Integer32
    MAX-ACCESS read-create
    STATUS     obsolete
    DESCRIPTION
           "The primary routing metric for this route.  The
            semantics of this metric are determined by the routing-
            protocol specified in the route's ipForwardProto value.
            If this metric is not used, its value should be set to
            -1."
    DEFVAL { -1 }
    ::= { ipForwardEntry 11 }

ipForwardMetric2 OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-create
    STATUS     obsolete
    DESCRIPTION
           "An alternate routing metric for this route.  The
            semantics of this metric are determined by the routing-
            protocol specified in the route's ipForwardProto value.
            If this metric is not used, its value should be set to
            -1."
    DEFVAL { -1 }
    ::= { ipForwardEntry 12 }

ipForwardMetric3 OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-create
    STATUS     obsolete
    DESCRIPTION
           "An alternate routing metric for this route.  The
            semantics of this metric are determined by the routing-
            protocol specified in the route's ipForwardProto value.
            If this metric is not used, its value should be set to
            -1."
    DEFVAL { -1 }
    ::= { ipForwardEntry 13 }

ipForwardMetric4 OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-create
    STATUS     obsolete
    DESCRIPTION
           "An alternate routing metric for this route.  The
            semantics of this metric are determined by the routing-
            protocol specified in the route's ipForwardProto value.
            If this metric is not used, its value should be set to
            -1."
    DEFVAL { -1 }
    ::= { ipForwardEntry 14 }
```

```
ipForwardMetric5 OBJECT-TYPE
    SYNTAX     Integer32
```



```
    MAX-ACCESS read-create
    STATUS     obsolete
    DESCRIPTION
           "An alternate routing metric for this route.  The
            semantics of this metric are determined by the routing-
            protocol specified in the route's ipForwardProto value.
            If this metric is not used, its value should be set to
            -1."
    DEFVAL { -1 }
    ::= { ipForwardEntry 15 }

-- Obsoleted Definitions - Groups
-- compliance statements

ipForwardOldCompliance MODULE-COMPLIANCE
    STATUS     obsolete
    DESCRIPTION
           "The compliance statement for SNMP entities which
            implement the ipForward MIB."

   MODULE  -- this module
   MANDATORY-GROUPS { ipForwardMultiPathGroup }

   ::= { ipForwardCompliances 2 }

ipForwardMultiPathGroup OBJECT-GROUP
    OBJECTS { ipForwardNumber,
              ipForwardDest, ipForwardMask, ipForwardPolicy,
              ipForwardNextHop, ipForwardIfIndex, ipForwardType,
              ipForwardProto, ipForwardAge, ipForwardInfo,
              ipForwardNextHopAS,
              ipForwardMetric1, ipForwardMetric2, ipForwardMetric3,
              ipForwardMetric4, ipForwardMetric5
        }
    STATUS     obsolete
    DESCRIPTION
           "IP Multipath Route Table."
    ::= { ipForwardGroups 2 }

END
```

6 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. These are the tables and objects and their sensitivity/vulnerability:

1. The inetCidrRouteTable contains routing and forwarding information that is critical to the operation of the network node (especially routers). Allowing unauthenticated write access to this table can compromise the validity of the 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 and/or NOTIFY access to these objects and possibly to even encrypt the values of these objects when sending them over the network via SNMP. These are the tables and objects and their sensitivity/vulnerability:

1. The inetCidrRouteTable contains routing and forwarding information that can be used to compromise a network. Specifically, this table can be used to construct a map of the network in preparation for a denial-of-service attack on the network infrastructure.
2. The inetCidrRouteProto object identifies the routing protocols in use within a network. This information can be used to determine how a denial-of-service attack should be launched.

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

objects in 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 or SET (change/create/delete) them.

7 Intellectual Property Statement

The IETF takes no position regarding the validity or scope of any intellectual property or other rights that might be claimed to pertain to the implementation or use of the technology described in this document or the extent to which any license under such rights might or might not be available; neither does it represent that it has made any effort to identify any such rights. Information on the IETF's procedures with respect to rights in standards-track and standards-related documentation can be found in BCP-11. Copies of claims of rights made available for publication and any assurances of licenses to be made available, or the result of an attempt made to obtain a general license or permission for the use of such proprietary rights by implementors or users of this specification can be obtained from the IETF Secretariat.

The IETF invites any interested party to bring to its attention any copyrights, patents or patent applications, or other proprietary rights which may cover technology that may be required to practice this standard. Please address the information to the IETF Executive Director.

8 Changes from RFC 2096

This document updates RFC 2096 in the following ways:

1. Replaces ipCidrRouteTable with inetCidrRouteTable. This applies to corresponding objects and conformance statements.
2. Utilized the InetAddress TC to support IP version-independent implementations of the forwarding MIB. This gives common forwarding MIB support for IPv4 and IPv6.

3. Created a read-only conformance statement to support implementations that only wish to retrieve data.
4. Created the inetCidrRouteDiscards object to replace the deprecated ipRoutingDiscards and ipv6DiscardedRoutes objects.

The inetCidrRouteTable retains the logical structure of the ipCidrRouteTable in order to allow the easy upgrade of existing IPv4 implementations to the version-independent MIB.

9 Normative References

[RFC2119] S. Bradner, "Key words for use in RFCs to Indicate Requirement Levels", RFC 2119, BCP14, March 1999.

[RFC2578] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M. and S. Waldbusser, "Structure of Management Information Version 2 (SMIv2)", STD 58, RFC 2578, April 1999.

[RFC2579] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M. and S. Waldbusser, "Textual Conventions for SMIv2", STD 58, RFC 2579, April 1999.

[RFC2580] McCloghrie, K., Perkins, D., Schoenwaelder, J., Case, J., Rose, M. and S. Waldbusser, "Conformance Statements for SMIv2", STD 58, RFC 2580, April 1999.

[RFC3291] Daniele, M., Haberman, B., Routhier, S., Schoenwaelder, J., "Textual Conventions for Internet Network Addresses", RFC 3291, May 2002.

-- RFC Ed : An update to RFC 3291 is in the works, in the case that
-- draft-ietf-ops-rfc3291bis is published before or at the same

-- time as this document, please update this reference and the two
-- citations in the document. Afterwards, please remove this note.

[RFC2863] McCloghrie, K., and Kastenholz, F., "The Interfaces Group MIB", RFC 2863, June 2000.

[2011upd] Routhier, S., "Management Information Base for the Internet Protocol (IP), draft-ietf-ipv6-rfc2011-update-02.txt, February 2003.

[RTPROTO] IANA, "IP Route Protocol MIB", http://www.iana.org/assignments/ianaiprouteprotocol-mib, September 2000.

10 Informative References

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

[RFC2096] Baker, F., "IP Forwarding Table MIB", RFC 2096, January 1997.

11 Authors and Acknowledgements

This document was based on RFC 2096 [RFC2096].

The following people provided text for this version of the document, or were authors of previous versions:

Fred Baker, Cisco
Bill Fenner, AT&T Research
Brian Haberman, Caspian Networks
Juergen Schoenwalder, TU Braunschweig
Dave Thaler, Microsoft
Margaret Wasserman, Thingmagic

Dario Accornero, Mark Adam, Qing Li and Shawn Routhier reviewed the document and provided helpful feedback.

Mike Heard provided valuable feedback as the MIB Doctor for this document.

12 Editors' Contact Information

Comments or questions regarding this document should be sent to:

Brian Haberman
Caspian Networks
753 Bridgewater Drive
Sykesville, MD 21784 USA

Phone: +1 410-552-1421
Email: brian@innovationslab.net

13 Full Copyright Statement