IP Forwarding Table MIB

Status of This Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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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.

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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 [RFC1213]. It was updated by ipForwardTable in RFC 1354 [RFC1354].

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 [RFC2096].

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 [RFC2011] contains the ipRoutingDiscards object, which counts the number of valid routes that have been removed from the ipCidrRouteTable object. The corresponding ipv6DiscardedRoutes object is defined in RFC 2465 [RFC2465]. 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 "200602010000Z"
ORGANIZATION
"IETF IPv6 Working Group
http://www.ietf.org/html.charters/ipv6-charter.html"
CONTACT-INFO
"Editor:
Brian Haberman
Johns Hopkins University - Applied Physics Laboratory
Mailstop 17-S442
11100 Johns Hopkins Road
Laurel MD, 20723-6099 USA
Phone: +1-443-778-1319
Email: brian@innovationslab.net

Send comments to <ipv6@ietf.org>"

DESCRIPTION
"The MIB module for the management of CIDR multipath IP Routes.

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REVISION "200602010000Z"

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 4292."

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 the inetCidrRouteTable. Discarded route entries do not appear in the 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,
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 4001"
   ::= { 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 that form the
      mask to be logical-ANDed with the destination address
      before being compared to the value in the
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.

\[
::= \{ \text{inetCidrRouteEntry} 3 \}
\]

inetCidrRoutePolicy OBJECT-TYPE
SYNTAX ObjectIdentifier
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 that may delineate between multiple entries to the same destination. The value \(\{0\ 0\}\) shall be used as the default value for this object."

\[
::= \{ \text{inetCidrRouteEntry} 4 \}
\]

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 4001"

\[
::= \{ \text{inetCidrRouteEntry} 5 \}
\]

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 that 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 that discards traffic and
                   -- returns ICMP notification
    local    (3), -- local interface
    remote   (4), -- remote destination
    blackhole(5) -- route that 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 that 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 that, 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 that, 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 }
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.

"
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, 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 Contents  | Policy Code     | Field Contents  | Policy Code     |
| 0 0 0 0 ==> 0   | 0               | 0 0 0 1 ==> 2   |
| 0 0 1 0 ==> 4   | 0               | 0 0 1 1 ==> 6   |
| 0 1 0 0 ==> 8   | 0               | 0 1 0 1 ==> 10  |
| 0 1 1 0 ==> 12  | 0               | 0 1 1 1 ==> 14  |
| 1 0 0 0 ==> 16  | 0               | 1 0 0 1 ==> 18  |
| 1 0 1 0 ==> 20  | 0               | 1 0 1 1 ==> 22  |

Haberman                    Standards Track                    [Page 17]
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 that 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 that 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 that 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 that, 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 that 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 that 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"
::= { 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,
   ipForward metricl   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 that 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 that 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 that 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 that  
      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. Changes from RFC 2096

This document obsoletes RFC 2096 in the following ways:

1. Replaces ipCidrRouteTable with inetCidrRouteTable. This applies to corresponding objects and conformance statements.

2. Utilizes the InetAddress TC to support IP version-independent implementations of the forwarding MIB. This gives common forwarding MIB support for IPv4 and IPv6.

3. Creates a read-only conformance statement to support implementations that only wish to retrieve data.

4. Creates 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.
8. Normative References


9. Informative References


10. Authors and Acknowledgements

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Editors’ Contact Information

Comments or questions regarding this document should be sent to:

Brian Haberman
Johns Hopkins University - Applied Physics Laboratory
Mailstop 17-S442
11100 Johns Hopkins Road
Laurel MD, 20723-6099 USA

Phone: +1-443-778-1319
EMail: brian@innovationslab.net