IP Forwarding Table MIB
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This document is a product of the IPv6 MIB Revision Design Team. Comments should be addressed to the authors, or the mailing list at ipv6mib@ibr.cs.tu-bs.de.

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This memo 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 used for implementations of the Internet Protocol (IP) in an IP version independent manner.

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1. The SNMP Management Framework

The SNMP Management Framework presently consists of five major components:

- An overall architecture, described in RFC 2571 [2].

- Mechanisms for describing and naming objects and events for the purpose of management. The first version of this Structure of Management Information (SMI) is called SMIv1 and described in STD 16, RFC 1155 [3], STD 16, RFC 1212 [4] and RFC 1215 [5]. The second version, called SMIv2, is described in STD 58, RFC 2578 [6], STD 58, RFC 2579 [7] and STD 58, RFC 2580 [8].

- Message protocols for transferring management information. The first version of the SNMP message protocol is called SNMPv1 and described in STD 15, RFC 1157 [9]. A second version of the SNMP message protocol, which is not an Internet standards track protocol, is called SNMPv2c and described in RFC 1901 [10] and RFC 1906 [11]. The third version of the message protocol is called SNMPv3 and described in RFC 1906 [11], RFC 2572 [12] and RFC 2574 [13].

- Protocol operations for accessing management information. The first set of protocol operations and associated PDU formats is described in STD 15, RFC 1157 [9]. A second set of protocol operations and associated PDU formats is described in RFC 1905 [14].
A set of fundamental applications described in RFC 2573 [15] and the view-based access control mechanism described in RFC 2575 [16].

A more detailed introduction to the current SNMP Management Framework can be found in RFC 2570 [17].

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. Objects in the MIB are defined using the mechanisms defined in the SMI.

This memo specifies a MIB module that is compliant to the SMIv2. A MIB conforming to the SMIv1 can be produced through the appropriate translations. The resulting translated MIB must be semantically equivalent, except where objects or events are omitted because no translation is possible (use of Counter64). Some machine readable information in SMIv2 will be converted into textual descriptions in SMIv1 during the translation process. However, this loss of machine readable information is not considered to change the semantics of the MIB.

2. Revision History

Changes from first draft posted to v6mib mailing list:

23 Feb 2001

Update MODULE-IDENTITY

Delete inetCidrRouteTos, add inetCidrRouteInstance in INDEX of inetCidrRouteTable.

Use InterfaceIndex, InetAddressPrefixLength and InetAutonomousSystemNumber TC’s, and limit the SIZE of inetCidrRouteDest and inetCidrRouteNextHop

Update conformance info.

Added copyright and table of contents.

3. Overview

The MIB consists of three tables and one? global object.

(1) The object ipForwardNumber indicates the number of current routes. This is primarily to avoid having to read the table in order to determine this number.
(2) The ipForwardTable updates the RFC 1213 ipRouteTable to display multipath IP Routes. This is in turn obsoleted by the ipCidrRouteTable.

(3) The ipCidrRouteTable updates the RFC 1213 ipRouteTable to display multipath IP Routes having the same network number but differing network masks.

(4) The inetCidrRouteTable updates the RFC 2096 ipCidrRouteTable to contain IP version independent routing information.

4. Definitions

IP-FORWARD-MIB DEFINITIONS ::= BEGIN

IMPORTS
    MODULE-IDENTITY, OBJECT-TYPE,
    IpAddress, Integer32, Gauge32,
    Unsigned32 FROM SNMPv2-SMI
    RowStatus FROM SNMPv2-TC
    MODULE-COMPLIANCE, OBJECT-GROUP FROM SNMPv2-CONF
    InterfaceIndex 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 "200102220000Z"
    ORGANIZATION "IETF IPv6 MIB Revision Team"
    CONTACT-INFO
        "Editor:
        Bill Fenner
        AT&T Labs - Research
        75 Willow Rd
        Menlo Park, CA
        Phone: +1 650 330-7893
        Email: <fenner@research.att.com>"
    DESCRIPTION
        "The MIB module for the management of CIDR multipath IP Routes."
    REVISION "2001022200000Z"
    DESCRIPTION
        "IP version neutral revision, published as RFC XXXX."
    REVISION "96091900000Z"
    DESCRIPTION

Fenner     Section 4.  [Page 4]
"Revised to support CIDR routes."

::= { 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 }

-- 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."
INDEX {
    inetCidrRouteInstance,
    inetCidrRouteDestType,
    inetCidrRouteDest,
    inetCidrRoutePfxLen,
    inetCidrRouteNextHopType,
    inetCidrRouteNextHop
}
::= { inetCidrRouteTable 1 }

InetCidrRouteEntry ::= SEQUENCE {
    inetCidrRouteInstance Unsigned32,
    inetCidrRouteDestType InetAddressType,
inetCidrRouteDest        InetAddress,  
inetcidrRoutePfxLen       InetAddressPrefixLength,  
inetcidrRouteNextHopType  InetAddressType,  
inetcidrRouteNextHop      InetAddress,  
inetcidrRouteIfIndex      InterfaceIndex,  
inetcidrRouteProto        IANAipRouteProtocol,  
inetcidrRouteAge          Integer32,  
inetcidrRouteNextHopAS    InetAutonomousSystemNumber,  
inetcidrRouteMetric1      Integer32,  
inetcidrRouteMetric2      Integer32,  
inetcidrRouteMetric3      Integer32,  
inetcidrRouteMetric4      Integer32,  
inetcidrRouteMetric5      Integer32,  
inetcidrRouteStatus       RowStatus  
} 

inetCidrRouteInstance OBJECT-TYPE  
SYNTAX     Unsigned32  
MAX-ACCESS not-accessible  
STATUS     current  
DESCRIPTION  
"The instance identifier of the (conceptual) routing table containing this route. This identifier may be used to represent multiple routing tables, type-of-service routing, or any other use of multiple tables.  

XXX This needs more discussion."  
::= { inetCidrRouteEntry 1 } 

inetCidrRouteDestType OBJECT-TYPE  
SYNTAX     InetAddressType  
MAX-ACCESS not-accessible  
STATUS     current  
DESCRIPTION  
"The type of ipCidrRouteDest. Only IPv4 and IPv6 addresses are expected."  
::= { inetCidrRouteEntry 2 } 

inetCidrRouteDest OBJECT-TYPE  
SYNTAX     InetAddress (SIZE(0..36))  
MAX-ACCESS not-accessible  
STATUS     current  
DESCRIPTION  
"The destination IP address of this route.  

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 mask formed from the corresponding instance of the inetCidrRoutePfxLen object is not equal to x.

 ::= { inetCidrRouteEntry 3 }

inetCidrRoutePfxLen OBJECT-TYPE
SYNTAX  InetAddressPrefixLength
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
"Indicate 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 ipCidrRouteDest field.

Any assignment (implicit or otherwise) of an instance of this object to a value x must be rejected if the bitwise logical-AND of the mask formed from x with the value of the corresponding instance of the inetCidrRouteDest object is not equal to inetCidrRouteDest."

 ::= { inetCidrRouteEntry 4 }

inetCidrRouteNextHopType OBJECT-TYPE
SYNTAX  InetAddressType
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
"The address type of inetCidrRouteNextHop. Must be the same as that of inetCidrRouteDestType, or unknown if there is no next hop."

 ::= { inetCidrRouteEntry 5 }

inetCidrRouteNextHop OBJECT-TYPE
SYNTAX  InetAddress (SIZE(0..36))
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION
"On remote routes, the address of the next system en route; otherwise, a zero-length string."

 ::= { inetCidrRouteEntry 6 }

inetCidrRouteIfIndex OBJECT-TYPE
SYNTAX  InterfaceIndex
MAX-ACCESS read-create
STATUS     current
DESCRIPTION
"The ifIndex value which identifies the local interface through which the next hop of this route should be reached."

 ::= { inetCidrRouteEntry 7 }
inetCidrRouteType OBJECT-TYPE
SYNTAX INTEGER {
  other     (1), -- not specified by this MIB
  reject    (2), -- route which discards traffic and
  -- returns 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 }

-- XXX new type? TimeTicks?
inetCidrRouteAge OBJECT-TYPE
SYNTAX            Integer32
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."
::= { inetCidrRouteEntry 17 }  

-- Conformance information

ipForwardConformance OBJECT IDENTIFIER ::= { ipForward 5 }

ipForwardGroups OBJECT IDENTIFIER ::= { ipForwardConformance 1 }
ipForwardCompliances OBJECT IDENTIFIER ::= { ipForwardConformance 2 }  

-- Compliance statements
ipForwardCompliance2 MODULE-COMPLIANCE
   STATUS         current
   DESCRIPTION    "The compliance statement for systems which have routing
tables. XXX is this right?"
   MODULE         -- this module
   MANDATORY-GROUPS { inetForwardCidrRouteGroup }
   ::= { ipForwardCompliances 3 }

-- units of conformance

inetForwardCidrRouteGroup OBJECT-GROUP
   OBJECTS { inetCidrRouteNumber, inetCidrRouteIfIndex, inetCidrRouteType, inetCidrRouteProto, inetCidrRouteAge, inetCidrRouteNextHopAS, inetCidrRouteMetric1, inetCidrRouteMetric2, inetCidrRouteMetric3, inetCidrRouteMetric4, inetCidrRouteMetric5, inetCidrRouteStatus }
   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

Fenner
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 |
+---------------------------+-------------------+---+
<table>
<thead>
<tr>
<th>IP TOS</th>
<th>IP TOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field</td>
<td>Policy</td>
</tr>
<tr>
<td>Contents</td>
<td>Code</td>
</tr>
<tr>
<td>0 0 0 0 =&gt;</td>
<td>0</td>
</tr>
<tr>
<td>0 0 1 0 =&gt;</td>
<td>4</td>
</tr>
<tr>
<td>0 1 0 0 =&gt;</td>
<td>8</td>
</tr>
<tr>
<td>0 1 1 0 =&gt;</td>
<td>12</td>
</tr>
<tr>
<td>1 0 0 0 =&gt;</td>
<td>16</td>
</tr>
<tr>
<td>1 0 1 0 =&gt;</td>
<td>20</td>
</tr>
<tr>
<td>1 1 0 0 =&gt;</td>
<td>24</td>
</tr>
<tr>
<td>1 1 1 0 =&gt;</td>
<td>28</td>
</tr>
</tbody>
</table>

::= { 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
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."

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."  
::= { 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, 
ip"ForwardNextHopAS Integer32, 
ipForwardMetric1    Integer32, 
ipForwardMetric2    Integer32, 
ipForwardMetric3    Integer32, 
ipForwardMetric4    Integer32, 
ipForwardMetric5    Integer32

Fenner Section 4. [Page 19]
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
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.

<table>
<thead>
<tr>
<th>PRECEDENCE</th>
<th>TYPE OF SERVICE</th>
<th>0</th>
</tr>
</thead>
</table>

IP TOS

<table>
<thead>
<tr>
<th>Field</th>
<th>Policy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 0 0 ==&gt; 0</td>
<td>0 0 0 1 ==&gt; 2</td>
</tr>
<tr>
<td>0 0 1 0 ==&gt; 4</td>
<td>0 0 1 1 ==&gt; 6</td>
</tr>
<tr>
<td>0 1 0 0 ==&gt; 8</td>
<td>0 1 0 1 ==&gt; 10</td>
</tr>
<tr>
<td>0 1 1 0 ==&gt; 12</td>
<td>0 1 1 1 ==&gt; 14</td>
</tr>
<tr>
<td>1 0 0 0 ==&gt; 16</td>
<td>1 0 0 1 ==&gt; 18</td>
</tr>
<tr>
<td>1 0 1 0 ==&gt; 20</td>
<td>1 0 1 1 ==&gt; 22</td>
</tr>
<tr>
<td>1 1 0 0 ==&gt; 24</td>
<td>1 1 0 1 ==&gt; 26</td>
</tr>
<tr>
<td>1 1 1 0 ==&gt; 28</td>
<td>1 1 1 1 ==&gt; 30</td>
</tr>
</tbody>
</table>

Protocols defining ‘policy’ otherwise must either define a set of values which are valid for this object or must implement an integer-instances 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
gpp  (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 }
5. Open Issues / To Do

Trash this completely and start from scratch with a new MIB?
Routing table instance identifier?
Any other objects from RFC 2465’s ipv6RouteTable?
Figure out what the inetCidrRouteTos object really should be -- DSCP?
Arbitrary mapped with no specified default?
Better wording for ipForwardCompliance2?
Note: more open issues / to do items scattered in comments in MIB.

6. Acknowledgments

This document contains objects modified from RFC 2096 [1].

7. References

8. Security Considerations

There are a number of management objects defined in this MIB that have 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.

There are a number of managed objects in this MIB that may contain sensitive information. These are:

The routing table can be used to discover information about the network topology within a domain.

It is thus important to control even GET access to these objects and possibly to even encrypt the values of these object when sending them over the network via SNMP. Not all versions of SNMP provide features for such a secure environment.

SNMPv1 by itself is not a secure environment. 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.

It is recommended that the implementers consider the security features as provided by the SNMPv3 framework. Specifically, the use of the User-based Security Model RFC 2574 [13] and the View-based Access Control Model RFC 2575 [16] is recommended.

It is then a customer/user responsibility to ensure that the SNMP entity giving access to an instance of this MIB, 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.

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