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
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
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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."

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

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."

-- 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.

::= { 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 that 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 4001"

::= { 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.

Haberman Standards Track [Page 12]
-- 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, 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,
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  |
|                 |                       |     |
+-----+-----+-----+-----+-----+-----+-----+-----+

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</table>
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 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-ANDeed 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   |
+----------------+---------------------+-----+

<table>
<thead>
<tr>
<th>IP TOS Field</th>
<th>Policy Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 0 0 0</td>
<td>0</td>
</tr>
<tr>
<td>0 0 1 0</td>
<td>4</td>
</tr>
<tr>
<td>0 1 0 0</td>
<td>8</td>
</tr>
<tr>
<td>0 1 1 0</td>
<td>12</td>
</tr>
<tr>
<td>1 0 0 0</td>
<td>16</td>
</tr>
<tr>
<td>1 0 1 0</td>
<td>20</td>
</tr>
<tr>
<td>1 1 0 0</td>
<td>24</td>
</tr>
<tr>
<td>1 1 1 0</td>
<td>28</td>
</tr>
</tbody>
</table>

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."
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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