Definitions of Managed Objects for BGP-4

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 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 managing the Border Gateway Protocol Version 4 or lower.

The origin of this memo is from RFC 1269 "Definitions of Managed Objects for the Border Gateway Protocol (Version 3)", which was updated to support BGP-4 in RFC 1657. This memo fixes errors introduced when the MIB module was converted to use the SMIv2 language. This memo also updates references to the current SNMP framework documents.

This memo is intended to document deployed implementations of this MIB module in a historical context, to provide clarifications of some items, and to note errors where the MIB module fails to fully represent the BGP protocol. Work is currently in progress to replace this MIB module with a new one representing the current state of the BGP protocol and its extensions.

This document obsoletes RFC 1269 and RFC 1657.
1. Introduction

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 managing the Border Gateway Protocol Version 4 or lower [BGP4, BGP4APP].

This memo obsoletes RFC 1657 and RFC 1269.

2. 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].

3. Overview

These objects are used to control and manage a BGP-4 implementation.

Apart from a few system-wide scalar objects, this MIB is broken into three tables: the BGP Peer Table, the BGP Received Path Attribute Table, and the BGP-4 Received Path Attribute Table. The BGP Peer Table contains information about state and current activity of connections with the BGP peers. The BGP Received Path Attribute Table contains path attributes received from all peers running BGP version 3 or less. The BGP-4 Received Path Attribute Table contains path attributes received from all BGP-4 peers. The actual attributes used in determining a route are a subset of the received attribute tables after local routing policy has been applied.
4. Definitions

BGP4-MIB DEFINITIONS ::= BEGIN

IMPORTS

MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
IpAddress, Integer32, Counter32, Gauge32, mib-2
FROM SNMPv2-SMI

MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
FROM SNMPv2-CONF;

bgp MODULE-IDENTITY

LAST-UPDATED "200601110000Z"

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DESCRIPTION

"The MIB module for the BGP-4 protocol.

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version of this MIB module is part of RFC 4273;
see the RFC itself for full legal notices."

REVISION "200601110000Z"

DESCRIPTION

"Changes from RFC 1657:

1) Fixed the definitions of the notifications
to make them equivalent to their initial
definition in RFC 1269.
2) Added compliance and conformance info.
3) Updated information for the values of
bgpPeerNegotiatedVersion, bgp4PathAttrLocalPref,
bgp4PathAttrCalcLocalPref,
bgp4PathAttrMultiExitDisc,
bgp4PathAttrASPathSegement.
4) Added additional clarification comments where
needed."
5) Noted where objects do not fully reflect the protocol as Known Issues.

6) Updated the DESCRIPTION for the bgp4PathAttrAtomicAggregate object.

7) The following objects have had their DESCRIPTION clause modified to remove the text that suggested (using ‘should’ verb) initializing the counter to zero on a transition to the established state:
   bgpPeerInUpdates, bgpPeerOutUpdates,
   bgpPeerInTotalMessages, bgpPeerOutTotalMessages
Those implementations that still do this are still compliant with this new wording. Applications should not assume counters have started at zero.

Published as RFC 4273."

REVISION "199405050000Z"
DESCRIPTION
"Translated to SMIv2 and published as RFC 1657."

REVISION "199110261839Z"
DESCRIPTION
"Initial version, published as RFC 1269."
 ::= { mib-2 15 }

bgpVersion OBJECT-TYPE
SYNTAX OCTET STRING (SIZE (1..255))
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Vector of supported BGP protocol version numbers. Each peer negotiates the version from this vector. Versions are identified via the string of bits contained within this object. The first octet contains bits 0 to 7, the second octet contains bits 8 to 15, and so on, with the most significant bit referring to the lowest bit number in the octet (e.g., the MSB of the first octet refers to bit 0). If a bit, i, is present and set, then the version (i+1) of the BGP is supported."

REFERENCE
"RFC 4271, Section 4.2."
 ::= { bgp 1 }

bgpLocalAs OBJECT-TYPE
SYNTAX     Integer32 (0..65535)
MAX-ACCESS read-only
STATUS     current
DESCRIPTION "The local autonomous system number."
REFERENCE
   "RFC 4271, Section 4.2, 'My Autonomous System'."
 ::= { bgp 2 }

-- BGP Peer table. This table contains, one entry per
-- BGP peer, information about the BGP peer.

bgpPeerTable OBJECT-TYPE
SYNTAX     SEQUENCE OF BgpPeerEntry
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION "BGP peer table. This table contains,
    one entry per BGP peer, information about the
    connections with BGP peers."
 ::= { bgp 3 }

bgpPeerEntry OBJECT-TYPE
SYNTAX     BgpPeerEntry
MAX-ACCESS not-accessible
STATUS     current
DESCRIPTION "Entry containing information about the
    connection with a BGP peer."
INDEX { bgpPeerRemoteAddr }
 ::= { bgpPeerTable 1 }

BgpPeerEntry ::= SEQUENCE {
    bgpPeerIdentifier     IpAddress,
    bgpPeerState          INTEGER,
    bgpPeerAdminStatus    INTEGER,
    bgpPeerNegotiatedVersion  Integer32,
    bgpPeerLocalAddr      IpAddress,
    bgpPeerLocalPort      Integer32,
    bgpPeerRemoteAddr     IpAddress,
    bgpPeerRemotePort     Integer32,
bgpPeerRemoteAs
Integer32,
bgpPeerInUpdates
Counter32,
bgpPeerOutUpdates
Counter32,
bgpPeerInTotalMessages
Counter32,
bgpPeerOutTotalMessages
Counter32,
bgpPeerLastError
OCTET STRING,
bgpPeerFsmEstablishedTransitions
Counter32,
bgpPeerFsmEstablishedTime
Gauge32,
bgpPeerConnectRetryInterval
Integer32,
bgpPeerHoldTime
Integer32,
bgpPeerKeepAlive
Integer32,
bgpPeerHoldTimeConfigured
Integer32,
bgpPeerKeepAliveConfigured
Integer32,
bgpPeerMinASOriginationInterval
Integer32,
bgpPeerMinRouteAdvertisementInterval
Integer32,
bgpPeerInUpdateElapsedTime
Gauge32
}

bgpPeerIdentifier OBJECT-TYPE
SYNTAX     IpAddress
MAX-ACCESS read-only
STATUS     current
DESCRIPTION "The BGP Identifier of this entry’s BGP peer. This entry MUST be 0.0.0.0 unless the bgpPeerState is in the openconfirm or the established state."
REFERENCE "RFC 4271, Section 4.2, ‘BGP Identifier’.
 ::= { bgpPeerEntry 1 }
bgpPeerState OBJECT-TYPE
SYNTAX       INTEGER {
               idle(1),
               connect(2),
               active(3),
               opensent(4),
               openconfirm(5),
               established(6)
           }
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION "The BGP peer connection state."
REFERENCE   "RFC 4271, Section 8.2.2."
::= { bgpPeerEntry 2 }

bgpPeerAdminStatus OBJECT-TYPE
SYNTAX       INTEGER {
               stop(1),
               start(2)
           }
MAX-ACCESS  read-write
STATUS      current
DESCRIPTION "The desired state of the BGP connection. A transition from 'stop' to 'start' will cause the BGP Manual Start Event to be generated. A transition from 'start' to 'stop' will cause the BGP Manual Stop Event to be generated. This parameter can be used to restart BGP peer connections. Care should be used in providing write access to this object without adequate authentication."
REFERENCE   "RFC 4271, Section 8.1.2."
::= { bgpPeerEntry 3 }

bgpPeerNegotiatedVersion OBJECT-TYPE
SYNTAX       Integer32
MAX-ACCESS  read-only
STATUS      current
DESCRIPTION "The negotiated version of BGP running between the two peers.

This entry MUST be zero (0) unless the bgpPeerState is in the openconfirm or the
established state.

Note that legal values for this object are between 0 and 255."

REFERENCE
"RFC 4271, Section 4.2.
RFC 4271, Section 7."
::= { bgpPeerEntry 4 }

bgpPeerLocalAddr OBJECT-TYPE
SYNTAX IpAddress
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The local IP address of this entry’s BGP connection."
::= { bgpPeerEntry 5 }

bgpPeerLocalPort OBJECT-TYPE
SYNTAX Integer32 (0..65535)
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The local port for the TCP connection between the BGP peers."
::= { bgpPeerEntry 6 }

bgpPeerRemoteAddr OBJECT-TYPE
SYNTAX IpAddress
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The remote IP address of this entry’s BGP peer."
::= { bgpPeerEntry 7 }

bgpPeerRemotePort OBJECT-TYPE
SYNTAX Integer32 (0..65535)
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The remote port for the TCP connection between the BGP peers. Note that the objects bgpPeerLocalAddr, bgpPeerLocalPort, bgpPeerRemoteAddr, and bgpPeerRemotePort provide the appropriate reference to the standard MIB TCP connection table."
::= { bgpPeerEntry 8 }

bgpPeerRemoteAs OBJECT-TYPE
SYNTAX Integer32 (0..65535)
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The remote autonomous system number received in 
the BGP OPEN message."
REFERENCE "RFC 4271, Section 4.2."
 ::= { bgpPeerEntry 9 }

bgpPeerInUpdates OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of BGP UPDATE messages 
received on this connection."
REFERENCE "RFC 4271, Section 4.3."
 ::= { bgpPeerEntry 10 }

bgpPeerOutUpdates OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The number of BGP UPDATE messages 
transmitted on this connection."
REFERENCE "RFC 4271, Section 4.3."
 ::= { bgpPeerEntry 11 }

bgpPeerInTotalMessages OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The total number of messages received 
from the remote peer on this connection."
REFERENCE "RFC 4271, Section 4."
 ::= { bgpPeerEntry 12 }

bgpPeerOutTotalMessages OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The total number of messages transmitted to
the remote peer on this connection."
REFERENCE
"RFC 4271, Section 4."
::= { bgpPeerEntry 13 }

bgpPeerLastError OBJECT-TYPE
SYNTAX OCTET STRING (SIZE (2))
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The last error code and subcode seen by this
peer on this connection. If no error has
occurred, this field is zero. Otherwise, the
first byte of this two byte OCTET STRING
contains the error code, and the second byte
contains the subcode."
REFERENCE
"RFC 4271, Section 4.5."
::= { bgpPeerEntry 14 }

bgpPeerFsmEstablishedTransitions OBJECT-TYPE
SYNTAX Counter32
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The total number of times the BGP FSM
transitioned into the established state
for this peer."
REFERENCE
"RFC 4271, Section 8."
::= { bgpPeerEntry 15 }

bgpPeerFsmEstablishedTime OBJECT-TYPE
SYNTAX Gauge32
UNITS "seconds"
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This timer indicates how long (in
seconds) this peer has been in the
established state or how long
since this peer was last in the
established state. It is set to zero when
a new peer is configured or when the router is
booted.
REFERENCE
"RFC 4271, Section 8."
::= { bgpPeerEntry 16 }

bgpPeerConnectRetryInterval OBJECT-TYPE
SYNTAX Integer32 (1..65535)
UNITS "seconds"
MAX-ACCESS read-write
STATUS current
DESCRIPTION
"Time interval (in seconds) for the ConnectRetry timer. The suggested value for this timer is 120 seconds."
REFERENCE
"RFC 4271, Section 8.2.2. This is the value used to initialize the 'ConnectRetryTimer'."
::= { bgpPeerEntry 17 }

bgpPeerHoldTime OBJECT-TYPE
SYNTAX Integer32  ( 0 | 3..65535 )
UNITS "seconds"
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Time interval (in seconds) for the Hold Timer established with the peer. The value of this object is calculated by this BGP speaker, using the smaller of the values in bgpPeerHoldTimeConfigured and the Hold Time received in the OPEN message.

This value must be at least three seconds if it is not zero (0).

If the Hold Timer has not been established with the peer this object MUST have a value of zero (0).

If the bgpPeerHoldTimeConfigured object has a value of (0), then this object MUST have a value of (0)."
REFERENCE
"RFC 4271, Section 4.2."
::= { bgpPeerEntry 18 }

bgpPeerKeepAlive OBJECT-TYPE
SYNTAX Integer32 ( 0 | 1..21845 )
UNITS "seconds"
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"Time interval (in seconds) for the KeepAlive timer established with the peer. The value of this object is calculated by this BGP speaker such that, when compared with bgpPeerHoldTime, it has the same proportion that bgpPeerKeepAliveConfigured has, compared with bgpPeerHoldTimeConfigured.

If the KeepAlive timer has not been established with the peer, this object MUST have a value of zero (0).

If the of bgpPeerKeepAliveConfigured object has a value of (0), then this object MUST have a value of (0)."

REFERENCE
"RFC 4271, Section 4.4."
::= { bgpPeerEntry 19 }

bgpPeerHoldTimeConfigured OBJECT-TYPE
SYNTAX Integer32 ( 0 | 3..65535 )
UNITS "seconds"
MAX-ACCESS read-write
STATUS current
DESCRIPTION
"Time interval (in seconds) for the Hold Time configured for this BGP speaker with this peer. This value is placed in an OPEN message sent to this peer by this BGP speaker, and is compared with the Hold Time field in an OPEN message received from the peer when determining the Hold Time (bgpPeerHoldTime) with the peer. This value must not be less than three seconds if it is not zero (0). If it is zero (0), the Hold Time is NOT to be established with the peer. The suggested value for this timer is 90 seconds."

REFERENCE
"RFC 4271, Section 4.2.
RFC 4271, Section 10."
::= { bgpPeerEntry 20 }

bgpPeerKeepAliveConfigured OBJECT-TYPE
SYNTAX     Integer32 ( 0 | 1..21845 )
UNITS      "seconds"
MAX-ACCESS read-write
STATUS     current
DESCRIPTION
"Time interval (in seconds) for the
KeepAlive timer configured for this BGP
speaker with this peer. The value of this
object will only determine the
KEEPALIVE messages' frequency relative to
the value specified in
bgpPeerHoldTimeConfigured; the actual
time interval for the KEEPALIVE messages is
indicated by bgpPeerKeepAlive. A
reasonable maximum value for this timer
would be one third of that of
bgpPeerHoldTimeConfigured.
If the value of this object is zero (0),
no periodical KEEPALIVE messages are sent
to the peer after the BGP connection has
been established. The suggested value for
this timer is 30 seconds."

REFERENCE
"RFC 4271, Section 4.4.
RFC 4271, Section 10."
::= { bgpPeerEntry 21 }

bgpPeerMinASOriginationInterval OBJECT-TYPE
SYNTAX     Integer32 (1..65535)
UNITS      "seconds"
MAX-ACCESS read-write
STATUS     current
DESCRIPTION
"Time interval (in seconds) for the
MinASOriginationInterval timer.
The suggested value for this timer is 15
seconds."

REFERENCE
"RFC 4271, Section 9.2.1.2.
RFC 4271, Section 10."
::= { bgpPeerEntry 22 }

bgpPeerMinRouteAdvertisementInterval OBJECT-TYPE
SYNTAX     Integer32 (1..65535)
UNITS      "seconds"
MAX-ACCESS read-write
STATUS     current
DESCRIPTION
"Time interval (in seconds) for the
MinRouteAdvertisementInterval timer.
The suggested value for this timer is 30
seconds for EBGP connections and 5
seconds for IBGP connections."

REFERENCE
"RFC 4271, Section 9.2.1.1.
RFC 4271, Section 10."

::= { bgpPeerEntry 23 }

bgpPeerInUpdateElapsedTime OBJECT-TYPE
SYNTAX     Gauge32
UNITS      "seconds"
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"Elapsed time (in seconds) since the last BGP
UPDATE message was received from the peer.
Each time bgpPeerInUpdates is incremented,
the value of this object is set to zero (0)."

REFERENCE
"RFC 4271, Section 4.3.
RFC 4271, Section 8.2.2, Established state."

::= { bgpPeerEntry 24 }

bgpIdentifier OBJECT-TYPE
SYNTAX     IpAddress
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
"The BGP Identifier of the local system."

REFERENCE
"RFC 4271, Section 4.2."

::= { bgp 4 }

-- BGP Received Path Attribute Table. This table contains
-- one entry per path to a network, and path attributes
-- received from all peers running BGP version 3 or less.
-- This table is obsolete, having been replaced in
-- functionality by the bgp4PathAttrTable.

bgpRcvdPathAttrTable OBJECT-TYPE
SYNTAX     SEQUENCE OF BgpPathAttrEntry
MAX-ACCESS not-accessible
STATUS     obsolete
DESCRIPTION
"The BGP Received Path Attribute Table
contains information about paths to
destination networks, received from all peers running BGP version 3 or less.

::= { bgp 5 }

bgpPathAttrEntry OBJECT-TYPE
SYNTAX     BgpPathAttrEntry
MAX-ACCESS not-accessible
STATUS     obsolete
DESCRIPTION
 "Information about a path to a network."
INDEX { bgpPathAttrDestNetwork,
        bgpPathAttrPeer         }
::= { bgpRcvdPathAttrTable 1 }

BgpPathAttrEntry ::= SEQUENCE {
  bgpPathAttrPeer
   IpAddress,
  bgpPathAttrDestNetwork
   IpAddress,
  bgpPathAttrOrigin
   INTEGER,
  bgpPathAttrASPath
   OCTET STRING,
  bgpPathAttrNextHop
   IpAddress,
  bgpPathAttrInterASMetric
   Integer32
}

bgpPathAttrPeer OBJECT-TYPE
SYNTAX     IpAddress
MAX-ACCESS read-only
STATUS     obsolete
DESCRIPTION
 "The IP address of the peer where the path information was learned."
::= { bgpPathAttrEntry 1 }

bgpPathAttrDestNetwork OBJECT-TYPE
SYNTAX     IpAddress
MAX-ACCESS read-only
STATUS     obsolete
DESCRIPTION
 "The address of the destination network."
REFERENCE
 "RFC 1267, Section 4.3."
::= { bgpPathAttrEntry 2 }
bgpPathAttrOrigin OBJECT-TYPE
SYNTAX INTEGER {
  igp(1), -- networks are interior
  egp(2), -- networks learned via the
    -- EGP protocol
  incomplete(3) -- networks that
    -- are learned by some other
    -- means
}
MAX-ACCESS read-only
STATUS obsolete
DESCRIPTION "The ultimate origin of the path information."
REFERENCE
  "RFC 1267, Section 4.3.
  RFC 1267, Section 5."
 ::= { bgpPathAttrEntry 3 }

bgpPathAttrASPath OBJECT-TYPE
SYNTAX OCTET STRING (SIZE (2..255))
MAX-ACCESS read-only
STATUS obsolete
DESCRIPTION "The set of ASes that must be traversed to reach
  the network. This object is probably best
  represented as SEQUENCE OF INTEGER. For SMI
  compatibility, though, it is represented as
  OCTET STRING. Each AS is represented as a pair
  of octets according to the following algorithm:

    first-byte-of-pair = ASN / 256;
    second-byte-of-pair = ASN & 255;

REFERENCE
  "RFC 1267, Section 4.3.
  RFC 1267, Section 5."
 ::= { bgpPathAttrEntry 4 }

bgpPathAttrNextHop OBJECT-TYPE
SYNTAX IpAddress
MAX-ACCESS read-only
STATUS obsolete
DESCRIPTION "The address of the border router that should
  be used for the destination network."
REFERENCE
  "RFC 1267, Section 4.3.
  RFC 1267, Section 5."
 ::= { bgpPathAttrEntry 5 }
bgpPathAttrInterASMetric OBJECT-TYPE
SYNTAX Integer32
MAX-ACCESS read-only
STATUS obsolete
DESCRIPTION "The optional inter-AS metric. If this attribute has not been provided for this route, the value for this object is 0."
REFERENCE "RFC 1267, Section 4.3. RFC 1267, Section 5."
 ::= { bgpPathAttrEntry 6 }

-- BGP-4 Received Path Attribute Table. This table contains one entry per path to a network, and path attributes received from all peers running BGP-4.

bgp4PathAttrTable OBJECT-TYPE
SYNTAX SEQUENCE OF Bgp4PathAttrEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "The BGP-4 Received Path Attribute Table contains information about paths to destination networks, received from all BGP4 peers."
 ::= { bgp4PathAttrTable 1 }

Bgp4PathAttrEntry OBJECT-TYPE
SYNTAX Bgp4PathAttrEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION "Information about a path to a network."
INDEX { bgp4PathAttrIpAddrPrefix, bgp4PathAttrIpAddrPrefixLen, bgp4PathAttrPeer }
 ::= { bgp4PathAttrTable 1 }

Bgp4PathAttrEntry ::= SEQUENCE {
bgp4PathAttrPeer IpAddress,
bgp4PathAttrIpAddrPrefixLen Integer32,
bgp4PathAttrIpAddrPrefix IpAddress,
bgp4PathAttrOrigin INTEGER,
bgp4PathAttrASPathSegment
  OCTET STRING,
bgp4PathAttrNextHop
  IpAddress,
bgp4PathAttrMultiExitDisc
  Integer32,
bgp4PathAttrLocalPref
  Integer32,
bgp4PathAttrAtomicAggregate
  INTEGER,
bgp4PathAttrAggregatorAS
  Integer32,
bgp4PathAttrAggregatorAddr
  IpAddress,
bgp4PathAttrCalcLocalPref
  Integer32,
bgp4PathAttrBest
  INTEGER,
bgp4PathAttrUnknown
  OCTET STRING
}

bgp4PathAttrPeer OBJECT-TYPE
SYNTAX     IpAddress
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
  "The IP address of the peer where the path
   information was learned."
 ::= { bgp4PathAttrEntry 1 }

bgp4PathAttrIpAddrPrefixLen OBJECT-TYPE
SYNTAX     Integer32 (0..32)
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
  "Length in bits of the IP address prefix in
   the Network Layer Reachability
   Information field."
 ::= { bgp4PathAttrEntry 2 }

bgp4PathAttrIpAddrPrefix OBJECT-TYPE
SYNTAX     IpAddress
MAX-ACCESS read-only
STATUS     current
DESCRIPTION
  "An IP address prefix in the Network Layer
   Reachability Information field. This object
is an IP address containing the prefix with
length specified by
bgp4PathAttrIpAddrPrefixLen.
Any bits beyond the length specified by
bgp4PathAttrIpAddrPrefixLen are zeroed.

REFERENCE
"RFC 4271, Section 4.3."
::= { bgp4PathAttrEntry 3 }

bgp4PathAttrOrigin OBJECT-TYPE
SYNTAX INTEGER {
    igp(1), -- networks are interior
    egp(2), -- networks learned via the
        -- EGP protocol
    incomplete(3) -- networks that
        -- are learned by some other
        -- means
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The ultimate origin of the path
information."
REFERENCE
"RFC 4271, Section 4.3.
RFC 4271, Section 5.1.1."
::= { bgp4PathAttrEntry 4 }

bgp4PathAttrASPathSegment OBJECT-TYPE
SYNTAX OCTET STRING (SIZE (2..255))
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"The sequence of AS path segments. Each AS
path segment is represented by a triple
<type, length, value>.

The type is a 1-octet field that has two
possible values:
1 AS_SET: unordered set of ASes that a
route in the UPDATE message
has traversed

2 AS_SEQUENCE: ordered set of ASes that
a route in the UPDATE message
has traversed.

The length is a 1-octet field containing the
number of ASes in the value field.

The value field contains one or more AS numbers. Each AS is represented in the octet string as a pair of octets according to the following algorithm:

\[
\begin{align*}
\text{first-byte-of-pair} &= \text{ASNumber} / 256; \\
\text{second-byte-of-pair} &= \text{ASNumber} \& 255;
\end{align*}
\]

Known Issues:
- BGP Confederations will result in a type of either 3 or 4.
- An AS Path may be longer than 255 octets. This may result in this object containing a truncated AS Path.

REFERENCE
- "RFC 4271, Section 4.3."
- "RFC 4271, Section 5.1.2."

::= { bgp4PathAttrEntry 5 }

bgp4PathAttrNextHop OBJECT-TYPE
SYNTAX IpAddress
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The address of the border router that should be used for the destination network. This address is the NEXT_HOP address received in the UPDATE packet."

REFERENCE
- "RFC 4271, Section 4.3."
- "RFC 4271, Section 5.1.3."

::= { bgp4PathAttrEntry 6 }

bgp4PathAttrMultiExitDisc OBJECT-TYPE
SYNTAX Integer32 (-1..2147483647)
MAX-ACCESS read-only
STATUS current
DESCRIPTION "This metric is used to discriminate between multiple exit points to an adjacent autonomous system. A value of -1 indicates the absence of this attribute."

Known Issues:
- The BGP-4 specification uses an unsigned 32 bit number. Thus, this
object cannot represent the full range of the protocol.”

REFERENCE
"RFC 4271, Section 4.3.
RFC 4271, Section 5.1.4."
 ::= { bgp4PathAttrEntry 7 }

desc

::= { bgp4PathAttrEntry 8 }

desc

object cannot represent the full range of the protocol.”

REFERENCE
"RFC 4271, Section 4.3.
RFC 4271, Section 5.1.5."
 ::= { bgp4PathAttrEntry 8 }

desc

If the ATOMIC_AGGREGATE attribute is present in the Path Attributes then this object MUST have a value of ‘lessSpecificRouteNotSelected’.

If the ATOMIC_AGGREGATE attribute is missing in the Path Attributes then this object MUST have a value of ‘lessSpecificRouteSelected’.

Note that ATOMIC_AGGREGATE is now a primarily informational attribute.”

REFERENCE
"RFC 4271, Sections 5.1.6 and 9.1.4."
::= { bgp4PathAttrEntry 9 }

bgp4PathAttrAggregatorAS OBJECT-TYPE
SYNTAX Integer32 (0..65535)
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The AS number of the last BGP4 speaker that performed route aggregation. A value of zero (0) indicates the absence of this attribute.

Note that propagation of AS of zero is illegal in the Internet."
REFERENCE
  "RFC 4271, Section 5.1.7.
  RFC 4271, Section 9.2.2.2."
::= { bgp4PathAttrEntry 10 }

bgp4PathAttrAggregatorAddr OBJECT-TYPE
SYNTAX IpAddress
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The IP address of the last BGP4 speaker that performed route aggregation. A value of 0.0.0.0 indicates the absence of this attribute."
REFERENCE
  "RFC 4271, Section 5.1.7.
  RFC 4271, Section 9.2.2.2."
::= { bgp4PathAttrEntry 11 }

bgp4PathAttrCalcLocalPref OBJECT-TYPE
SYNTAX Integer32 (-1..2147483647)
MAX-ACCESS read-only
STATUS current
DESCRIPTION "The degree of preference calculated by the receiving BGP4 speaker for an advertised route. A value of -1 indicates the absence of this attribute.

Known Issues:
  o The BGP-4 specification uses an unsigned 32 bit number and thus this object cannot represent the full range of the protocol."
REFERENCE
"RFC 4271, Section 9.1.1."
 ::= { bgp4PathAttrEntry 12 }

bgp4PathAttrBest OBJECT-TYPE
SYNTAX INTEGER {
    false(1) -- not chosen as best route
    true(2) -- chosen as best route
}
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"An indication of whether this route was chosen as the best BGP4 route for this destination."
REFERENCE
"RFC 4271, Section 9.1.2."
 ::= { bgp4PathAttrEntry 13 }

bgp4PathAttrUnknown OBJECT-TYPE
SYNTAX OCTET STRING (SIZE(0..255))
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"One or more path attributes not understood by this BGP4 speaker.
Path attributes are recorded in the Update Path attribute format of type, length, value.
Size zero (0) indicates the absence of such attributes.
Octets beyond the maximum size, if any, are not recorded by this object.
Known Issues:
o Attributes understood by this speaker, but not represented in this MIB, are unavailable to the agent."
REFERENCE
"RFC 4271, Section 5."
 ::= { bgp4PathAttrEntry 14 }

-- Traps.
-- Note that in RFC 1657, bgpTraps was incorrectly assigned a value of { bgp 7 } and each of the -- traps had the bgpPeerRemoteAddr object inappropriately
-- removed from their OBJECTS clause. The following
-- definitions restore the semantics of the traps as
-- they were initially defined in RFC 1269.

bgpNotification OBJECT IDENTIFIER ::= { bgp 0 }

bgpEstablishedNotification NOTIFICATION-TYPE
  OBJECTS { bgpPeerRemoteAddr,
             bgpPeerLastError,
             bgpPeerState   }
  STATUS  current
  DESCRIPTION
    "The bgpEstablishedNotification event is generated
     when the BGP FSM enters the established state.
     This Notification replaces the bgpEstablished Notification."
  ::= { bgpNotification 1 }

bgpBackwardTransNotification NOTIFICATION-TYPE
  OBJECTS { bgpPeerRemoteAddr,
             bgpPeerLastError,
             bgpPeerState   }
  STATUS  current
  DESCRIPTION
    "The bgpBackwardTransNotification event is
     generated when the BGP FSM moves from a higher
     numbered state to a lower numbered state.
     This Notification replaces the bgpBackwardsTransition Notification."
  ::= { bgpNotification 2 }

-- { bgp 7 } is deprecated. Do not allocate new objects or
-- notifications underneath this branch.

bgpTraps OBJECT IDENTIFIER ::= { bgp 7 } -- deprecated

bgpEstablished NOTIFICATION-TYPE
  OBJECTS { bgpPeerLastError,
             bgpPeerState   }
  STATUS  deprecated
  DESCRIPTION
    "The bgpEstablished event is generated when
     the BGP FSM enters the established state.
     This Notification has been replaced by the
     bgpEstablishedNotification Notification."
::= { bgpTraps 1 }

bgpBackwardTransition NOTIFICATION-TYPE
OBJECTS { bgpPeerLastError,
          bgpPeerState     }
STATUS deprecated
DESCRIPTION
  "The bgpBackwardTransition event is generated
  when the BGP FSM moves from a higher numbered
  state to a lower numbered state.

  This Notification has been replaced by the
  bgpBackwardTransNotification Notification."
::= { bgpTraps 2 }

-- Conformance information

bgp4MIBConformance OBJECT IDENTIFIER ::= { bgp 8 }
bgp4MIBCompliances OBJECT IDENTIFIER ::= { bgp4MIBConformance 1 }
bgp4MIBGroups OBJECT IDENTIFIER ::= { bgp4MIBConformance 2 }

-- Compliance statements

bgp4MIBCompliance MODULE-COMPLIANCE
  STATUS  current
  DESCRIPTION
    "The compliance statement for entities which
    implement the BGP4 mib."
  MODULE -- this module
    MANDATORY-GROUPS { bgp4MIBGlobalsGroup,
                       bgp4MIBPeerGroup,
                       bgp4MIBPathAttrGroup }
  GROUP bgp4MIBNotificationGroup
  DESCRIPTION
    "Implementation of BGP Notifications are
    completely optional in this MIB."
::= { bgp4MIBCompliances 1 }

bgp4MIBDeprecatedCompliances MODULE-COMPLIANCE
  STATUS  deprecated
  DESCRIPTION
    "The compliance statement documenting deprecated
    objects in the BGP4 mib."
  MODULE -- this module
    GROUP bgp4MIBTrapGroup
DESCRIPTION
"Group containing TRAP objects that were improperly converted from SMIv1 in RFC 1657. The proper semantics have been restored with the objects in bgp4MIBNotificationGroup."

::= { bgp4MIBCompliances 2 }

bgp4MIBObsoleteCompliances MODULE-COMPLIANCE
STATUS obsolete
DESCRIPTION
"The compliance statement documenting obsolete objects in the BGP4 mib."
MODULE -- this module
GROUP bgpRcvdPathAttrGroup
DESCRIPTION
"Group containing objects relevant to BGP-3 and earlier objects."

::= { bgp4MIBCompliances 3 }

-- Units of conformance

bgp4MIBGlobalsGroup OBJECT-GROUP
OBJECTS { bgpVersion,
          bgpLocalAs,
          bgpIdentifier }
STATUS current
DESCRIPTION
"A collection of objects providing information on global BGP state."

::= { bgp4MIBGroups 1 }

bgp4MIBPeerGroup OBJECT-GROUP
OBJECTS { bgpPeerIdentifier,
          bgpPeerState,
          bgpPeerAdminStatus,
          bgpPeerNegotiatedVersion,
          bgpPeerLocalAddr,
          bgpPeerLocalPort,
          bgpPeerRemoteAddr,
          bgpPeerRemotePort,
          bgpPeerRemoteAs,
          bgpPeerInUpdates,
          bgpPeerOutUpdates,
          bgpPeerInTotalMessages,
          bgpPeerOutTotalMessages,
          bgpPeerLastError,
          bgpPeerFsmEstablishedTransitions,
          bgpPeerFsmEstablishedTime,
bgpPeerConnectRetryInterval,
bgpPeerHoldTime,
bgpPeerKeepAlive,
bgpPeerHoldTimeConfigured,
bgpPeerKeepAliveConfigured,
bgpPeerMinASOriginationInterval,
bgpPeerMinRouteAdvertisementInterval,
bgpPeerInUpdateElapsedTime }

STATUS current
DESCRIPTION
"A collection of objects for managing
BGP peers."
 ::= { bgp4MIBGroups 2 }

bgpRcvdPathAttrGroup OBJECT-GROUP
OBJECTS { bgpPathAttrPeer,
bgpPathAttrDestNetwork,
bgpPathAttrOrigin,
bgpPathAttrASPath,
bgpPathAttrNextHop,
bgpPathAttrInterASMetric }

STATUS obsolete
DESCRIPTION
"A collection of objects for managing BGP-3 and
earlier path entries.
This conformance group, like BGP-3, is obsolete."
 ::= { bgp4MIBGroups 3 }

bgp4MIBPathAttrGroup OBJECT-GROUP
OBJECTS { bgp4PathAttrPeer,
bgp4PathAttrIpAddrPrefixLen,
bgp4PathAttrIpAddrPrefix,
bgp4PathAttrOrigin,
bgp4PathAttrASPathSegment,
bgp4PathAttrNextHop,
bgp4PathAttrMultiExitDisc,
bgp4PathAttrLocalPref,
bgp4PathAttrAtomicAggregate,
bgp4PathAttrAggregatorAS,
bgp4PathAttrAggregatorAddr,
bgp4PathAttrCalcLocalPref,
bgp4PathAttrBest,
bgp4PathAttrUnknown }

STATUS current
DESCRIPTION
"A collection of objects for managing
BGP path entries."
5. Security Considerations

This MIB relates to a system providing inter-domain routing. As such, improper manipulation of the objects represented by this MIB may result in denial of service to a large number of end-users.

There are several management objects defined in this MIB that have a MAX-ACCESS clause of read-write and/or read-create. Such objects should be considered sensitive or vulnerable in most network environments. The support for SET operations in a non-secure environment without proper protection can have a negative effect on network operations. These objects include:

- bgpPeerAdminStatus

  Improper change of bgpPeerAdminStatus, from start to stop, can cause significant disruption of the connectivity to those portions of the Internet reached via the applicable remote BGP peer.
o bgpPeerConnectRetryInterval

Improper change of this object can cause connections to be disrupted for extremely long time periods when otherwise they would be restored in a relatively short period of time.

o bgpPeerHoldTimeConfigured, bgpPeerKeepAliveConfigured

Misconfiguration of these objects can make BGP sessions more fragile and less resilient to denial of service attacks on the inter-domain routing system.

o bgpPeerMinASOriginationInterval, bgpPeerMinRouteAdvertisementInterval

Misconfiguration of these objects may adversely affect global Internet convergence of the routes advertised by this BGP speaker. This may result in long-lived routing loops and blackholes for the portions of the Internet that utilize these routes.

There are a number of managed objects in this MIB that contain sensitive information regarding the operation of a network. For example, a BGP peer’s local and remote addresses might be sensitive for ISPs who want to keep interface addresses on routers confidential in order to prevent router addresses used for a denial of service attack or spoofing.

Therefore, it is important in most environments to control read access to these objects and possibly to even encrypt the values of these object when sending them over the network via SNMP.

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

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7.  Normative References


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