Network Working Group
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Definitions of Managed Objects for the Border Gateway Protocol (Version 3)

Status of this Memo

This memo is an extension to the SNMP MIB. This RFC specifies an IAB standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "IAB Official Protocol Standards" for the standardization state and status of this protocol. Distribution of this memo is unlimited.

1. Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols in TCP/IP-based internets. In particular, it defines objects for managing the Border Gateway Protocol [11,12].

2. The Network Management Framework

The Internet-standard Network Management Framework consists of three components. They are:

RFC 1155 which defines the SMI, the mechanisms used for describing and naming objects for the purpose of management. RFC 1212 defines a more concise description mechanism, which is wholly consistent with the SMI.

RFC 1156 which defines MIB-I, the core set of managed objects for the Internet suite of protocols. RFC 1213, defines MIB-II, an evolution of MIB-I based on implementation experience and new operational requirements.

RFC 1157 which defines the SNMP, the protocol used for network access to managed objects.

The Framework permits new objects to be defined for the purpose of experimentation and evaluation.

3. Objects

Managed objects are accessed via a virtual information store, termed the Management Information Base or MIB. Objects in the MIB are defined using the subset of Abstract Syntax Notation One (ASN.1) [7] defined in the SMI. In particular, each object has a name, a syntax, and an encoding. The name is an object identifier, an administratively assigned name, which specifies an object type. The object type together with an object instance serves to uniquely identify a specific instantiation of the object. For human convenience, we often use a textual string, termed the OBJECT DESCRIPTOR, to also refer to the object type.

The syntax of an object type defines the abstract data structure corresponding to that object type. The ASN.1 language is used for this purpose. However, the SMI [3] purposely restricts the ASN.1 constructs which may be used. These restrictions are explicitly made for simplicity.

The encoding of an object type is simply how that object type is represented using the object type's syntax. Implicitly tied to the notion of an object type's syntax and encoding is how the object type is represented when being transmitted on the network.

The SMI specifies the use of the basic encoding rules of ASN.1 [8], subject to the additional requirements imposed by the SNMP.

3.1. Format of Definitions

Section 5 contains contains the specification of all object types contained in this MIB module. The object types are defined using the conventions defined in the SMI, as amended by the extensions specified in [9,10].

4. Overview

These objects are used to control and manage a BGP [11,12] implementation.

The Border Gateway Protocol (BGP) is an inter-Autonomous System routing protocol. The primary function of a BGP speaking system is to exchange network reachability information with other BGP systems. This network reachability information includes information on the full path of Autonomous Systems that traffic must transit to reach these networks.

BGP runs over a reliable transport protocol. This eliminates the need to implement explicit update fragmentation, retransmission,

acknowledgement, and sequencing. Any authentication scheme used by the transport protocol may be used in addition to BGP's own authentication mechanisms.

The planned use of BGP in the Internet environment, including such issues as topology, the interaction between BGP and IGPs, and the enforcement of routing policy rules is presented in a companion document [12].

Apart from a few system variables, this MIB is broken into two tables: the BGP Peer Table and the BGP Received Path Attribute Table. The Peer Table reflects information about BGP peer connections, such as their state and current activity. The Received Path Attribute Table contains all attributes received from all peers before local routing policy has been applied. The actual attributes used in determining a route are a subset of the received attribute table.

5. Definitions

```
RFC1269-MIB DEFINITIONS ::= BEGIN

IMPORTS
     NetworkAddress, IpAddress, Counter
          FROM RFC1155-SMI
     mib-2
          FROM RFC1213-MIB
   OBJECT-TYPE
          FROM RFC-1212
     TRAP-TYPE
          FROM RFC-1215;

-- This MIB module uses the extended OBJECT-TYPE macro as
-- defined in [9], and the TRAP-TYPE macro as defined
-- in [10].

bgp     OBJECT IDENTIFIER ::= { mib-2 15 }

bgpVersion OBJECT-TYPE
     SYNTAX OCTET STRING
     ACCESS read-only
     STATUS mandatory
     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."
               ::= { bgp 1 }

          bgpLocalAs OBJECT-TYPE
               SYNTAX INTEGER (0..65535)
               ACCESS read-only
               STATUS mandatory
               DESCRIPTION
                    "The local autonomous system number."
               ::= { bgp 2 }

          bgpPeerTable OBJECT-TYPE
               SYNTAX SEQUENCE OF BgpPeerEntry
               ACCESS not-accessible
               STATUS mandatory
               DESCRIPTION
                    "The bgp peer table."
               ::= { bgp 3 }

          bgpIdentifier OBJECT-TYPE
               SYNTAX IpAddress
               ACCESS read-only
               STATUS mandatory
               DESCRIPTION
                    "The BGP Identifier of local system."
               ::= { bgp 4 }

          bgpPeerEntry OBJECT-TYPE
               SYNTAX BgpPeerEntry
               ACCESS not-accessible
               STATUS mandatory
               DESCRIPTION
                    "Information about a BGP peer connection."
               INDEX
                    { bgpPeerRemoteAddr }
                   ::= { bgpPeerTable 1 }

          BgpPeerEntry ::= SEQUENCE {
               bgpPeerIdentifier
                    IpAddress,
               bgpPeerState
                    INTEGER,
               bgpPeerAdminStatus
                    INTEGER,
```

```
                bgpPeerNegotiatedVersion
                     INTEGER,
                bgpPeerLocalAddr
                     IpAddress,
                bgpPeerLocalPort
                     INTEGER,
                bgpPeerRemoteAddr
                     IpAddress,
                bgpPeerRemotePort
                     INTEGER,
                bgpPeerRemoteAs
                     INTEGER,
                bgpPeerInUpdates
                     Counter,
                bgpPeerOutUpdates
                     Counter,
                bgpPeerInTotalMessages
                     Counter,
                bgpPeerOutTotalMessages
                     Counter,
                bgpPeerLastError
                     OCTET STRING
                }

           bgpPeerIdentifier OBJECT-TYPE
                SYNTAX IpAddress
                ACCESS read-only
                STATUS mandatory
                DESCRIPTION
                     "The BGP Identifier of this entry's BGP peer."
                ::= { bgpPeerEntry 1 }

           bgpPeerState OBJECT-TYPE
                SYNTAX INTEGER {
                     idle(1),
                     connect(2),
                     active(3),
                     opensent(4),
                     openconfirm(5),
                     established(6)
                }
                ACCESS read-only
                STATUS mandatory
                DESCRIPTION
                     "The bgp peer connection state. "
                ::= { bgpPeerEntry 2 }
```

```
          bgpPeerAdminStatus OBJECT-TYPE
               SYNTAX INTEGER
               ACCESS read-write
               STATUS mandatory
               DESCRIPTION
                    "The desired state of the BGP connection. A
                    transition from 'stop' to 'start' will cause
                    the BGP Start Event to be generated. A
                    transition from 'start' to 'stop' will cause
                    the BGP 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."
               ::= { bgpPeerEntry 3 }

          bgpPeerNegotiatedVersion OBJECT-TYPE
               SYNTAX INTEGER
               ACCESS read-only
               STATUS mandatory
               DESCRIPTION
                    "The negotiated version of BGP running between
                    the two peers. "
               ::= { bgpPeerEntry 4 }

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

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

          bgpPeerRemoteAddr OBJECT-TYPE
               SYNTAX IpAddress
               ACCESS read-only
               STATUS mandatory
               DESCRIPTION
```

```
                "The remote IP address of this entry's BGP
                peer."
        ::= { bgpPeerEntry 7 }

    bgpPeerRemotePort OBJECT-TYPE
        SYNTAX INTEGER (0..65535)
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The remote port for the TCP connection between
                the BGP peers.  Note that the objects
                bgpLocalAddr, bgpLocalPort, bgpRemoteAddr and
                bgpRemotePort provide the appropriate reference
                to the standard MIB TCP connection table."
        ::= { bgpPeerEntry 8 }

    bgpPeerRemoteAs OBJECT-TYPE
        SYNTAX INTEGER (0..65535)
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The remote autonomous system number."
        ::= { bgpPeerEntry 9 }

    bgpPeerInUpdates OBJECT-TYPE
        SYNTAX Counter
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The number of BGP UPDATE messages received on
                this connection. This object should be
                initialized to zero when the connection is
                established."
        ::= { bgpPeerEntry 10 }

    bgpPeerOutUpdates OBJECT-TYPE
        SYNTAX Counter
        ACCESS read-only
        STATUS mandatory
        DESCRIPTION
                "The number of BGP UPDATE messages received on
                this connection. This object should be
                initialized to zero when the connection is
                established."
        ::= { bgpPeerEntry 11}

    bgpPeerInTotalMessages OBJECT-TYPE
        SYNTAX Counter
```

```
            ACCESS read-only
            STATUS mandatory
            DESCRIPTION
                 "The total number of messages received from the
                 remote peer on this connection. This object
                 should be initialized to zero when the
                 connection is established."
            ::= { bgpPeerEntry 12 }

        bgpPeerOutTotalMessages OBJECT-TYPE
            SYNTAX Counter
            ACCESS read-only
            STATUS mandatory
            DESCRIPTION
                 "The total number of messages transmitted to
                 the remote peer on this connection. This object
                 should be initialized to zero when the
                 connection is established."
            ::= { bgpPeerEntry 13 }

        bgpPeerLastError OBJECT-TYPE
            SYNTAX OCTET STRING (SIZE (2))
            ACCESS read-only
            STATUS mandatory
            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; the second contains
                 the subcode."
            ::= { bgpPeerEntry 14 }

        bgpRcvdPathAttrTable OBJECT-TYPE
            SYNTAX SEQUENCE OF BgpPathAttrEntry
            ACCESS not-accessible
            STATUS mandatory
            DESCRIPTION
                 "The BGP Received Path Attribute Table contains
                 information about paths to destination networks
                 received by all peers."
            ::= { bgp 5 }

        bgpPathAttrEntry OBJECT-TYPE
            SYNTAX BgpPathAttrEntry
            ACCESS not-accessible
            STATUS mandatory
            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
                INTEGER
          }

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

     bgpPathAttrDestNetwork OBJECT-TYPE
          SYNTAX IpAddress
          ACCESS read-only
          STATUS mandatory
          DESCRIPTION
                "The address of the destination network."
          ::= { bgpPathAttrEntry 2 }

     bgpPathAttrOrigin OBJECT-TYPE
          SYNTAX INTEGER {
                igp(1),-- networks are interior
                egp(2),-- networks learned via EGP
                incomplete(3) -- undetermined
          }
          ACCESS read-only
          STATUS mandatory
          DESCRIPTION
```

```
                    "The ultimate origin of the path information."
               ::= { bgpPathAttrEntry 3 }

          bgpPathAttrASPath OBJECT-TYPE
               SYNTAX OCTET STRING
               ACCESS read-only
               STATUS mandatory
               DESCRIPTION
                    "The set of ASs 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 = ASNumber / 256;
                         second-byte-of-pair = ASNumber & 255;"
               ::= { bgpPathAttrEntry 4 }

          bgpPathAttrNextHop OBJECT-TYPE
               SYNTAX IpAddress
               ACCESS read-only
               STATUS mandatory
               DESCRIPTION
                    "The address of the border router that should
                    be used for the destination network."
               ::= { bgpPathAttrEntry 5 }

          bgpPathAttrInterASMetric OBJECT-TYPE
               SYNTAX IpAddress
               ACCESS read-only
               STATUS mandatory
               DESCRIPTION
                    "The optional inter-AS metric. If this
                    attribute has not been provided for this route,
                    the value for this object is 0."
               ::= { bgpPathAttrEntry 6 }

          bgpEstablished TRAP-TYPE
               ENTERPRISE { bgp }
               VARIABLES  { bgpPeerRemoteAddr,
                            bgpPeerLastError,
                            bgpPeerState }
               DESCRIPTION
                    "The BGP Established event is generated when
                    the BGP FSM enters the ESTABLISHED state. "
               ::= 1
```

```
bgpBackwardTransition TRAP-TYPE
     ENTERPRISE { bgp }
     VARIABLES  { bgpPeerRemoteAddr,
                  bgpPeerLastError,
                  bgpPeerState }
     DESCRIPTION
          "The BGPBackwardTransition Event is generated
          when the BGP FSM moves from a higher numbered
          state to a lower numbered state."
     ::= 2
END
```

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7. References

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[10] Rose, M., Editor, "A Convention for Defining Traps for use with the SNMP", RFC 1215, Performance Systems International, March 1991.

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[12] Rekhter, Y., and P. Gross, Editors, "Application of the Border Gateway Protocol in the Internet", RFC 1268, T.J. Watson Research Center, IBM Corp., ANS, October 1991.

8. Security Considerations

Security issues are not discussed in this memo.

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