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Definitions of Managed Objects for the Fourth Version of Border Gateway Protocol (BGP-4), Second Version
draft-ietf-idr-bgp4-mibv2-07

Status of This Memo

Abstract

This memo defines a portion of the Management Information Base (MIB) for use with network management protocols. In particular it defines objects for managing the Border Gateway Protocol, Version 4.

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1. Introduction

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This memo defines a portion of the Management Information Base (MIB) for use with network management protocols. In particular it defines objects for managing the Border Gateway Protocol, Version 4 [RFC4271] (Rekhter, Y., Li, T., and S. Hares, "A Border Gateway Protocol 4 (BGP-4)," January 2006.).

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2. The Internet-Standard Management Framework

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For a detailed overview of the documents that describe the current Internet-Standard Management Framework, please refer to section 7 of RFC 3410 [RFC3410] (Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework," December 2002.).
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] (McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 (SMIv2)," April 1999.), STD 58, RFC 2579 [RFC2579] (McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIv2," April 1999.) and STD 58, RFC 2580 [RFC2580] (McCloghrie, K., Perkins,

D., and J. Schoenwaelder, “Conformance Statements for SMIv2,” April 1999.).

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3. Conventions

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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] (Bradner, S., “Key words for use in RFCs to Indicate Requirement Levels,” March 1997.).

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4. Overview

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As part of the IETF standardization effort for the BGP-4 protocol, [RFC4273] (Haas, J. and S. Hares, “Definitions of Managed Objects for BGP-4,” January 2006.) was written to address open issues in the previous version of the BGP-4 MIB, [RFC1657] (Willis, S., Burruss, J., and J. Chu, “Definitions of Managed Objects for the Fourth Version of the Border Gateway Protocol (BGP-4) using SMIv2,” July 1994.). However, that RFC was primarily intended to address the base BGP-4 protocol as documented in [RFC4271] (Rekhter, Y., Li, T., and S. Hares, “A Border Gateway Protocol 4 (BGP-4),” January 2006.).

The BGP-4 protocol has greatly increased in scope over the years from its original definition. Scaling mechanisms such as Route Reflection (Bates, T., Chen, E., and R. Chandra, “BGP Route Reflection: An Alternative to Full Mesh Internal BGP (IBGP),” April 2006.) [RFC4456] and Confederations (Traina, P., McPherson, D., and J. Scudder, “Autonomous System Confederations for BGP,” August 2007.) [RFC5065] have been introduced. Multi-protocol extensions (Bates, T., Chandra, R., Katz, D., and Y. Rekhter, “Multiprotocol Extensions for BGP-4,” January 2007.) [RFC4760] were introduced which allowed advertisement of reachability such as IPv6 (Marques, P. and F. Dupont, “Use of BGP-4 Multiprotocol Extensions for IPv6 Inter-Domain Routing,” March 1999.) [RFC2545], MPLS Labeled routes (Rekhter, Y. and E. Rosen, “Carrying Label Information in BGP-4,” May 2001.) [RFC3107], etc.

This MIB addresses several of the deficiencies of the previous BGP-4 MIB and provides an extension mechanism to permit additional MIB modules to be authored without requiring the base BGP-4 MIB to be updated. This is seen as a desirable goal since the BGP-4 protocol continues to receive attention by those wishing to add to its functionality.

In particular, this MIB addresses some specific weaknesses of the previous version:

*Add the ability to monitor IPv6 BGP-4 peering sessions and carry IPv6 reachability. Other forms of reachability can be added at a later date courtesy of the address-family independent manner in which this was done.

*Add several counters of operational interest. For example, the number of routes received from a given BGP peer.

*Replaces objects that were incapable of carrying the full range of their values with ones that can.

*Provides human-readable output for some complex data structures, such as the AS_PATH while also preserving a version of the data that is canonically machine readable.

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5. Structure of the MIB Module

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5.1. Global Scalars

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*bgpVersion - A vector of supported BGP Versions.

*bgpIdentifier - The BGP identifier of the local system.

*bgpLocalAsNew - A 4-byte capable local AS number which replaces the bgpLocalAs object.

*bgpAfPathAttrCounter - The number of entries in the bgpAfPathAttrTable.

5.2. Tables

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*bgpPeerAfTable - The BGP peer table. This table is capable of representing IPv6 and other address-family (Af) independent peering sessions. This table replaces the bgpPeerTable from previous versions of this MIB.

*bgpPeerAfErrorsTable - A table of peering session errors. This table covers information previously present in bgpPeerTable.

*bgpPeerAfEventTimesTable - A table of peer-specific event timers. This table covers information previously present in bgpPeerTable.

*bgpPeerAfConfiguredTimersTable - A table of the configured values of peer-specific event timers. This table covers information previously present in bgpPeerTable.

*bgpPeerAfNegotiatedTimersTable - A table of per-peer negotiated timers. This information covers information previously derived from the bgpPeerTable.

*bgpPerAfCountersTable - A table of per-peer counters for messages and the BGP FSM.

*bgpPrefixCountersTable - A table of per-peer per Address Family Identifer-Subsequent Address Family Identifier (AFI-SAFI) [RFC4760] (Bates, T., Chandra, R., Katz, D., and Y. Rekhter, "Multiprotocol Extensions for BGP-4," January 2007.) counters for prefixes.

*bgpNlriTable - A table of per-peer per AFI-SAFI prefix data. This table covers information previously present in bgp4PathAttrTable.

*bgpAdjRibsOutTable - A per-peer per AFI-SAFI table indicating what reachability has been advertised to a given peer.

*bgpAfPathAttrTable - A table of BGP Path Attribute information.

*bgpAsPathTable - A table that decomposes the elements of a BGP AS Path.

*bgpAfPathUnknownTable - A table that decomposes the unknown elements received in a BGP Path Attribute tuple.

5.3. Obsoleted Tables

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*bgpPeerTable - Replaced by the information in bgpPeerAfTable, bgpPeerAfErrorsTable, bgpPeerConfiguredTimersTable, bgpPeerAfNegotiatedTimersTable, bgpPeerAfCountersTable.

*bgpRcvPathAttrTable - Covered BGP-3 and earlier.

*bgp4PathAttrTable - Replaced by the information in bgpNlriTable, bgpAfPathAttrTable and bgpAfPathUnknownTable.

5.4. Textual Conventions

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*BgpIdentifierTC - Representation of a BGP Identifier

*BgpAddressFamilyIdentifierTC - Representation of a BGP Address Family Identifier

*BgpSubsequentAddressFamilyIdentifierTC - Representation of a BGP Subsequent Address Family Identifier

*BgpPathAttributeFlagsTC - Representation of BGP-4 Path Attribute Flags.

5.5. Notifications

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*bgpAfEstablishedNotification - Sent when a BGP peer transitions into the Established state. Replaces the previous bgpEstablishedNotification, which was not address family independent.

*bgpAfBackwardTransitionNotification - Sent when a BGP peer transitions out of the Established state. Replaces the previous bgpBackwardTransNotification, which was not addrss family independent.

*bgpEstablished - Erroneously added to an incorrect OID in a previous version of this MIB.

*bgpBackwardsTransition - Erroneously added to an incorrect OID in a previous version of this MIB.

5.6. Extensions

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A feature of this MIB is the recognition that the BGP protocol continues to grow in functionality. The bgpExtensions OID is defined to provide a place for IDR-approved MIB modules for BGP extensions to be added to the bgp MIB subtree.
It is intended that, where possible, that tables added via extensions that add information via additional path attributes use bgpAfPathAttrIndex as a common index, either via INDEX or AUGMENTS.

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6. Relationship to Other MIB Modules

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6.1. Relationship to the TCP-MIB

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The bgpPeerAfLocalAddrType/bgpPeerAfLocalAddr/bgpPeerAfLocalPort and bgpPeerAfRemoteAddrType/bgpPeerAfRemoteAddr/bgpPeerAfRemotePort objects may provide a suitable index for monitoring the BGP peering session's TCP session via the TCP-MIB (Raghunarayan, R., "Management Information Base for the Transmission Control Protocol (TCP)," March 2005.) [RFC4022].
Note that conducting BGP peering sessions over transport protocols other than TCP over IP are out of scope of the current BGP specifications.

6.2. MIB modules required for IMPORTS

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The following MIB module IMPORTS objects from SNMPv2-SMI [RFC2578] (McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Structure of Management Information Version 2 (SMIv2)," April 1999.), SNMPv2-TC [RFC2579] (McCloghrie, K., Ed., Perkins, D., Ed., and J. Schoenwaelder, Ed., "Textual Conventions for SMIv2," April 1999.), SNMPv2-CONF [RFC2580] (McCloghrie, K., Perkins, D., and J. Schoenwaelder, "Conformance Statements for SMIv2," April 1999.), INET-ADDRESS-MIB [RFC4001] (Daniele, M., Haberman, B., Routhier, S., and J. Schoenwaelder, "Textual Conventions for Internet Network Addresses," February 2005.) and SNMP-FRAMEWORK-MIB [RFC3411] (Harrington, D., Presuhn, R., and B. Wijnen, "An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks," December 2002.).

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7. Definitions

```
BGP4-MIB DEFINITIONS ::= BEGIN

    IMPORTS
        MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE,
        IpAddress, Counter32, Gauge32, mib-2, Unsigned32, Integer32
            FROM SNMPv2-SMI
        InetAddressType, InetAddress, InetPortNumber,
        InetAutonomousSystemNumber, InetAddressPrefixLength
            FROM INET-ADDRESS-MIB
        TEXTUAL-CONVENTION, TruthValue, RowPointer, TimeStamp
            FROM SNMPv2-TC
        MODULE-COMPLIANCE, OBJECT-GROUP, NOTIFICATION-GROUP
            FROM SNMPv2-CONF
        SnmpAdminString
            FROM SNMP-FRAMEWORK-MIB;

        bgp MODULE-IDENTITY
            LAST-UPDATED "200806220000Z"
            ORGANIZATION "IETF IDR Working Group"
            CONTACT-INFO "E-mail:  idr@ietf.org"

            DESCRIPTION
                    "The MIB module for the BGP-4 protocol.

                     Copyright (C) The Internet Society (2008).  This
                     version of this MIB module is part of RFC XXX;
                     see the RFC itself for full legal notices."
-- RFC Editor - replace XXX with RFC number

            REVISION "200806220000Z"
            DESCRIPTION
                   "Changes from RFC 4273:

                    TODO"

            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 }

    --
    -- Textual Conventions
    --


-- TODO: Separate into BGP4-TC-MIB
    BgpIdentifierTC ::= TEXTUAL-CONVENTION
        DISPLAY-HINT "1d."
        STATUS       current
        DESCRIPTION
            "The representation of a BGP Identifier.  BGP Identifiers
             are presented in the received network byte order.

             The BGP Identifier is displayed as if it is an IP address,
             even if it would be an illegal one."
        REFERENCE
            "RFC 4273, Section 4.2"
        SYNTAX OCTET STRING(SIZE (4))


-- TODO: Separate into BGP4-TC-MIB
    BgpAddressFamilyIdentifierTC ::= TEXTUAL-CONVENTION
        DISPLAY-HINT "d"
```

```
        STATUS       current
        DESCRIPTION
            "The representation of a BGP AFI"
        REFERENCE
            "RFC 4760, Section 3"
        SYNTAX Unsigned32(0..65535)


-- TODO: Separate into BGP4-TC-MIB
    BgpSubsequentAddressFamilyIdentifierTC ::= TEXTUAL-CONVENTION
        DISPLAY-HINT "d"
        STATUS       current
        DESCRIPTION
            "The representation of a BGP SAFI"
        REFERENCE
            "RFC 4760, Section 3"
        SYNTAX Unsigned32(0..255)

    BgpPathAttributeFlagsTC ::= TEXTUAL-CONVENTION
        STATUS       current
        DESCRIPTION
            "The representation of BGP Path Attribute Flags.  Note that this
             textual convention is meant to directly map to a BGP Path
             Attribute's Flags and is thus constrained by protocol to have no
             more than 8 total bits in use."
        REFERENCE
            "RFC 4271, Sec. 4.3"
        SYNTAX BITS {
            optional(0),    -- When set, path attribute is optional instead of
                            -- well known.
            transitive(1),  -- Path attribute is transitive when set.
            partial(2),     -- Path attribute is partial when set.
            extLength(3)    -- Path attributes has extended length field.
            -- 4-7 are reserved
            -- values 8 or greater are illegal.
        }

    --
    -- Top level scalars for this MIB
    --

    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 }

    -- { bgp 2 } and { bgp 3 } have been deprecated and are documented
    -- elsewhere in this MIB

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

            A SYNTAX of BgpIdentifierTC would be used here,
            however it would cause this object to be
            deprecated with no additional value.  The
            comments in the DESCRIPTION of BgpIdentifierTC
            apply here."
        REFERENCE
                "RFC 4271, Section 4.2."
        ::= { bgp 4 }

    bgpLocalAsNew OBJECT-TYPE
        SYNTAX     InetAutonomousSystemNumber
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "The local autonomous system number.

            This object supports 4 byte ASes and replaces
            bgpLocalAs."
        REFERENCE
                 "RFC 4271, Section 4.2, 'My Autonomous System'.

                  RFC 4893, BGP Support for Four-octet AS Number
                  Space."
        ::= { bgp 9 }

    --
```

```
-- Address Family (Af) independent per-peer management information.
--

bgpPeerAf
    OBJECT IDENTIFIER ::= { bgp 10 }

--
-- Address Family (Af) independent per-peer session management
-- information.
--

bgpPeerAfTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF BgpPeerAfEntry
    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.

         This table replaces bgpPeerTable."
    ::= { bgpPeerAf 1 }

bgpPeerAfEntry OBJECT-TYPE
    SYNTAX     BgpPeerAfEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Entry containing information about the connection with
         a remote BGP peer."
    INDEX {
        bgpPeerAfInstance,
        bgpPeerAfLocalAddrType,
        bgpPeerAfLocalAddr,
        bgpPeerAfRemoteAddrType,
        bgpPeerAfRemoteAddr
    }
    ::= { bgpPeerAfTable 1 }

BgpPeerAfEntry ::= SEQUENCE {
    -- INDEX information
    bgpPeerAfInstance
        Unsigned32,
    bgpPeerAfLocalAddrType
        InetAddressType,
    bgpPeerAfLocalAddr
        InetAddress,
    bgpPeerAfRemoteAddrType
        InetAddressType,
    bgpPeerAfRemoteAddr
```

```
        InetAddress,

    -- Local
    bgpPeerAfLocalPort
        InetPortNumber,
    bgpPeerAfLocalAs
        InetAutonomousSystemNumber,

    -- Remote
    bgpPeerAfRemotePort
        InetPortNumber,
    bgpPeerAfRemoteAs
        InetAutonomousSystemNumber,
    bgpPeerAfIdentifier
        BgpIdentifierTC,

    -- Session status
    bgpPeerAfAdminStatus
        INTEGER,
    bgpPeerAfPeerState
        INTEGER,
    bgpPeerAfConfiguredVersion
        Unsigned32,
    bgpPeerAfNegotiatedVersion
        Unsigned32
}

bgpPeerAfInstance OBJECT-TYPE
    SYNTAX     Unsigned32 (1..4294967295)
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "The routing instance index.

         Some BGP implementations permit the creation of
         multiple instances of a BGP routing process. An
         example includes routers running BGP/MPLS IP Virtual
         Private Networks.

         Implementations that do not support multiple
         routing instances should return 1 for this object."
    ::= { bgpPeerAfEntry 1 }

bgpPeerAfLocalAddrType OBJECT-TYPE
    SYNTAX     InetAddressType
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "The address family of the local end of the peering
```

```
         session."
    ::= { bgpPeerAfEntry 2 }

bgpPeerAfLocalAddr OBJECT-TYPE
    SYNTAX     InetAddress
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "The local IP address of this entry's BGP connection."
    ::= { bgpPeerAfEntry 3 }

bgpPeerAfRemoteAddrType OBJECT-TYPE
    SYNTAX     InetAddressType
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "The address family of the remote end of the peering
         session."
    ::= { bgpPeerAfEntry 4 }

bgpPeerAfRemoteAddr OBJECT-TYPE
    SYNTAX     InetAddress
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "The remote IP address of this entry's BGP peer."
    ::= { bgpPeerAfEntry 5 }

bgpPeerAfLocalPort OBJECT-TYPE
    SYNTAX     InetPortNumber
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The local port for the TCP connection between the BGP
         peers."
    ::= { bgpPeerAfEntry 6 }

bgpPeerAfLocalAs OBJECT-TYPE
    SYNTAX     InetAutonomousSystemNumber
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "Some implementations of BGP can represent themselves
         as multiple ASes. This is the AS that this peering
         session is representing itself as to the remote peer."
    ::= { bgpPeerAfEntry 7 }

bgpPeerAfRemotePort OBJECT-TYPE
    SYNTAX     InetPortNumber
```

```
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The remote port for the TCP connection between the BGP
         peers.

         Note that the objects bgpPeerAfLocalAddr,
         bgpPeerAfLocalPort, bgpPeerAfRemoteAddr and
         bgpPeerAfRemotePort provide the appropriate reference to
         the standard MIB TCP connection table, or even the ipv6
         TCP MIB as in RFC 4022."
    REFERENCE
        "RFC 2012 - SNMPv2 Management Information Base for the
         Transmission Control Protocol using SMIv2.
         RFC 4022 - IP Version 6 Management Information Base
         for the Transmission Control Protocol."
    ::= { bgpPeerAfEntry 8 }

bgpPeerAfRemoteAs OBJECT-TYPE
    SYNTAX     InetAutonomousSystemNumber
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The remote autonomous system number received in the BGP
         OPEN message."
    REFERENCE
        "RFC 4271, Section 4.2."
    ::= { bgpPeerAfEntry 9 }

bgpPeerAfIdentifier OBJECT-TYPE
    SYNTAX     BgpIdentifierTC
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The BGP Identifier of this entry's remote BGP peer.

         This entry should be 0.0.0.0 unless the
         bgpPeerAfPeerState is in the openconfirm or the
         established state."
    REFERENCE
        "RFC 4271, Section 4.2, 'BGP Identifier'."
    ::= { bgpPeerAfEntry 10 }

bgpPeerAfAdminStatus OBJECT-TYPE
    SYNTAX     INTEGER {
        halted(1),
        running(2)
    }
    MAX-ACCESS read-only
```

```
    STATUS     current
    DESCRIPTION
        "Whether or not the BGP FSM for this remote peer is
         halted or running. The BGP FSM for a remote peer is
         halted after processing a Stop event. Likewise, it is
         in the running state after a Start event.

         The bgpPeerAfState will generally be in the idle state
         when the FSM is halted, although some extensions such
         as Graceful Restart will leave the peer in the Idle
         state but with the FSM running."
    REFERENCE
        "RFC 4271, Section 8.1.2."
    ::= { bgpPeerAfEntry 11 }

-- TODO - update according to new FSM
bgpPeerAfPeerState 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."
    ::= { bgpPeerAfEntry 12 }

bgpPeerAfConfiguredVersion OBJECT-TYPE
    SYNTAX     Unsigned32 (1..255)
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The configured version to originally start with this
         remote peer. The BGP speaker may permit negotiation to a
         lower version number of the protocol."
    REFERENCE
        "RFC 4271, Section 4.2.
         RFC 4271, Section 7."
    ::= { bgpPeerAfEntry 13 }

bgpPeerAfNegotiatedVersion OBJECT-TYPE
    SYNTAX     Unsigned32 (1..255)
    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
         bgpPeerAfState 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."
    ::= { bgpPeerAfEntry 14 }


--
-- Address Family (Af) independent per-peer error management
-- information.
--

bgpPeerAfErrors
    OBJECT IDENTIFIER ::= { bgpPeerAf 2 }

bgpPeerAfErrorsTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF BgpPeerAfErrorsEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "On a per-peer basis, this table reflects the last
         protocol-defined error encountered and reported on
         the peer session. If no entry for a given peer
         exists in this table, then no such errors have been
         observed, reported, and recorded on the session."
    ::= { bgpPeerAfErrors 1 }

bgpPeerAfErrorsEntry OBJECT-TYPE
    SYNTAX     BgpPeerAfErrorsEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Each entry contains information about errors sent
         and received for a particular BGP peer."
    AUGMENTS {
        bgpPeerAfEntry
    }
    ::= { bgpPeerAfErrorsTable 1 }

BgpPeerAfErrorsEntry ::= SEQUENCE {
```

```
    bgpPeerAfLastErrorCodeReceived
        OCTET STRING,
    bgpPeerAfLastErrorSubCodeReceived
        OCTET STRING,
    bgpPeerAfLastErrorReceivedTime
        TimeStamp,
    bgpPeerAfLastErrorReceivedText
        SnmpAdminString,
    bgpPeerAfLastErrorReceivedData
        OCTET STRING,
    bgpPeerAfLastErrorCodeSent
        OCTET STRING,
    bgpPeerAfLastErrorSubCodeSent
        OCTET STRING,
    bgpPeerAfLastErrorSentTime
        TimeStamp,
    bgpPeerAfLastErrorSentText
        SnmpAdminString,
    bgpPeerAfLastErrorSentData
        OCTET STRING
}

bgpPeerAfLastErrorCodeReceived OBJECT-TYPE
    SYNTAX     OCTET STRING (SIZE (1))
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The last error code received from this peer via NOTIFICATION
         message on this connection.  If no error has occurred, this
         field is zero."
    REFERENCE
        "RFC 4271, Section 4.5.
         RFC 4486 optionally supported.
         RFC 3362, Section 5 optionally supported."
    ::= { bgpPeerAfErrorsEntry 1 }

bgpPeerAfLastErrorSubCodeReceived OBJECT-TYPE
    SYNTAX     OCTET STRING (SIZE (1))
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The last subcode received from this peer via NOTIFICATION
         message on this connection.  If no error has occurred, this
         field is zero."
    REFERENCE
        "RFC 4271, Section 4.5.
         RFC 4486 optionally supported.
         RFC 3362, Section 5 optionally supported."
    ::= { bgpPeerAfErrorsEntry 2 }
```

```
bgpPeerAfLastErrorReceivedTime OBJECT-TYPE
    SYNTAX     TimeStamp
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The timestamp that the last NOTIFICATION was received from
         this peer."
    REFERENCE
        "RFC 4271, Section 4.5."
    ::= { bgpPeerAfErrorsEntry 3 }

bgpPeerAfLastErrorReceivedText OBJECT-TYPE
    SYNTAX     SnmpAdminString
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "This object contains an implementation specific
         explanation of the error that was reported."
    ::= { bgpPeerAfErrorsEntry 4 }

bgpPeerAfLastErrorReceivedData OBJECT-TYPE
    SYNTAX     OCTET STRING (SIZE(0..4075))
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The last error code's data seen by this peer.

         Per RFC 2578, some implementations may have limitations
         dealing with OCTET STRINGS larger than 255.  Thus, this
         data may be truncated."
    REFERENCE
        "RFC 4271, Section 4.5,
         RFC 2578, Section 7.1.2,
         RFC 4486 optionaly supported.
         RFC 3362, Section 5 optionally supported."
    ::= { bgpPeerAfErrorsEntry 5 }

bgpPeerAfLastErrorCodeSent OBJECT-TYPE
    SYNTAX     OCTET STRING (SIZE (1))
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The last error code sent to this peer via NOTIFICATION
         message on this connection.  If no error has occurred, this
         field is zero."
    REFERENCE
        "RFC 4271, Section 4.5.
         RFC 4486 optionally supported.
```

```
            RFC 3362, Section 5 optionally supported."
        ::= { bgpPeerAfErrorsEntry 6 }

    bgpPeerAfLastErrorSubCodeSent OBJECT-TYPE
        SYNTAX     OCTET STRING (SIZE (1))
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "The last subcode sent to this peer via NOTIFICATION
             message on this connection.  If no error has occurred, this
             field is zero."
        REFERENCE
            "RFC 4271, Section 4.5.
             RFC 4486 optionally supported.
             RFC 3362, Section 5 optionally supported."
        ::= { bgpPeerAfErrorsEntry 7 }

    bgpPeerAfLastErrorSentTime OBJECT-TYPE
        SYNTAX     TimeStamp
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "The timestamp that the last NOTIFICATION was sent to
             this peer."
        REFERENCE
            "RFC 4271, Section 4.5."
        ::= { bgpPeerAfErrorsEntry 8 }

    bgpPeerAfLastErrorSentText OBJECT-TYPE
        SYNTAX     SnmpAdminString
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "This object contains an implementation specific
             explanation of the error that is being reported."
        ::= { bgpPeerAfErrorsEntry 9 }

    bgpPeerAfLastErrorSentData OBJECT-TYPE
        SYNTAX     OCTET STRING (SIZE(0..4075))
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "The last error code's data sent to this peer.

             Per RFC 2578, some implementations may have limitations
             dealing with OCTET STRINGS larger than 255.  Thus, this
             data may be truncated."
        REFERENCE
            "RFC 4271, Section 4.5,
```

```
         RFC 2578, Section 7.1.2
         RFC 4486 optionaly supported.
         RFC 3362, Section 5 optionally supported."
    ::= { bgpPeerAfErrorsEntry 10 }

--
-- Address Family (Af) independent per-peer timer information
--

bgpPeerAfTimers
    OBJECT IDENTIFIER ::= { bgpPeerAf 3 }

--
-- Per-peer Event Times
--

bgpPeerAfEventTimesTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF BgpPeerAfEventTimesEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "A table reporting the per-peering session amount
         of time elapsed and update events since the peering
         session advanced into the established state."
    ::= { bgpPeerAfTimers 1 }

bgpPeerAfEventTimesEntry OBJECT-TYPE
    SYNTAX     BgpPeerAfEventTimesEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Each row contains a set of statistics about time
         spent and events encountered in the peer session
         established state."
    AUGMENTS {
        bgpPeerAfEntry
    }
    ::= { bgpPeerAfEventTimesTable 1 }

BgpPeerAfEventTimesEntry ::= SEQUENCE {
    bgpPeerAfFsmEstablishedTime
        Gauge32,
    bgpPeerAfInUpdatesElapsedTime
        Gauge32
}

bgpPeerAfFsmEstablishedTime 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.  If the peer has never reached the established
         state, the value remains zero."
    REFERENCE
        "RFC 4271, Section 8."
    ::= { bgpPeerAfEventTimesEntry 1 }

bgpPeerAfInUpdatesElapsedTime 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."

    ::= { bgpPeerAfEventTimesEntry 2 }

--
-- Per-Peer Configured Timers
--

bgpPeerAfConfiguredTimersTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF BgpPeerAfConfiguredTimersEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Per peer management data on BGP session timers."
    ::= { bgpPeerAfTimers 2 }

bgpPeerAfConfiguredTimersEntry OBJECT-TYPE
    SYNTAX     BgpPeerAfConfiguredTimersEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Each entry corresponds to the current state of
         BGP timers on a given peering session."
    AUGMENTS {
```

```
        bgpPeerAfEntry
    }
    ::= { bgpPeerAfConfiguredTimersTable 1 }

BgpPeerAfConfiguredTimersEntry ::= SEQUENCE {
    bgpPeerAfConnectRetryInterval
        Unsigned32,
    bgpPeerAfHoldTimeConfigured
        Unsigned32,
    bgpPeerAfKeepAliveConfigured
        Unsigned32,
    bgpPeerAfMinASOrigInterval
        Unsigned32,
    bgpPeerAfMinRouteAdverInterval
        Unsigned32
}

bgpPeerAfConnectRetryInterval OBJECT-TYPE
    SYNTAX     Unsigned32 (1..65535)
    UNITS      "seconds"
    MAX-ACCESS read-only
    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'."
    ::= { bgpPeerAfConfiguredTimersEntry 1 }

bgpPeerAfHoldTimeConfigured OBJECT-TYPE
    SYNTAX     Unsigned32 ( 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."
      ::= { bgpPeerAfConfiguredTimersEntry 2 }

  bgpPeerAfKeepAliveConfigured OBJECT-TYPE
      SYNTAX     Unsigned32 ( 0 | 1..21845 )
      UNITS      "seconds"
      MAX-ACCESS read-only
      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 periodic
           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."
      ::= { bgpPeerAfConfiguredTimersEntry 3 }

  bgpPeerAfMinASOrigInterval OBJECT-TYPE
      SYNTAX     Unsigned32 (0..65535)
      UNITS      "seconds"
      MAX-ACCESS read-only
      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."
      ::= { bgpPeerAfConfiguredTimersEntry 4 }

  bgpPeerAfMinRouteAdverInterval OBJECT-TYPE
      SYNTAX     Unsigned32 (0..65535)
      UNITS      "seconds"
      MAX-ACCESS read-only
```

```
    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."
    ::= { bgpPeerAfConfiguredTimersEntry 5 }

--
-- Per-Peer Negotiated Timers
--

bgpPeerAfNegotiatedTimersTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF BgpPeerAfNegotiatedTimersEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Configured values of per-peer timers are seen
         in the bgpPeerAfConfiguredTimersTable.

         Values in this table reflect the current
         operational values, after negotiation from values
         derived from initial configuration."
    ::= { bgpPeerAfTimers 3 }

bgpPeerAfNegotiatedTimersEntry OBJECT-TYPE
    SYNTAX     BgpPeerAfNegotiatedTimersEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Each entry reflects a value of the currently
         operational, negotiated timer as reflected in the
         BgpPeerAfNegotiatedTimersEntry."
    AUGMENTS {
        bgpPeerAfEntry
    }
    ::= { bgpPeerAfNegotiatedTimersTable 1 }

BgpPeerAfNegotiatedTimersEntry ::= SEQUENCE {
    bgpPeerAfHoldTime
        Unsigned32,
    bgpPeerAfKeepAlive
        Unsigned32
}
```

```
bgpPeerAfHoldTime OBJECT-TYPE
    SYNTAX     Unsigned32 ( 0 | 3..65535 )
    UNITS      "seconds"
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The value of this object is calculated by this BGP
         Speaker as being;

         zero (0) - if this was the value sent by the peer and
         this value is permitted by this BGP Speaker. In this
         case, no keepalive messages are sent and the Hold Timer
         is not set.

         At least three (3). This value is the smaller of
         the value sent by this peer in the OPEN message and
         bgpPeerAfHoldTimeConfigured for this peer.

         This value is only defined when the peering session is
         in the Established state."
    REFERENCE
        "RFC 4271, Section 4.2."
    ::= { bgpPeerAfNegotiatedTimersEntry 1 }

bgpPeerAfKeepAlive OBJECT-TYPE
    SYNTAX     Unsigned32 ( 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 bgpPeerAfHoldTime, it has the same
         proportion as what bgpPeerAfKeepAliveConfigured has
         when compared with bgpPeerAfHoldTimeConfigured. If
         the value of this object is zero (0), it indicates
         that the KeepAlive timer has not been established
         with the peer, or, the value of
         bgpPeerAfKeepAliveConfigured is zero (0).

         This value is only defined when the peering session is
         in the Established state."
    REFERENCE
        "RFC 4271, Section 4.4."
    ::= { bgpPeerAfNegotiatedTimersEntry 2 }

--
-- Per-peer counters
```

```
--

bgpPeerAfCounters
    OBJECT IDENTIFIER ::= { bgpPeerAf 4 }

bgpPeerAfCountersTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF BgpPeerAfCountersEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "The counters associated with a BGP Peer."
    ::= { bgpPeerAfCounters 1 }

bgpPeerAfCountersEntry OBJECT-TYPE
    SYNTAX     BgpPeerAfCountersEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Each entry contains counters of message transmissions
         and FSM transitions for a given BGP Peering session."
    AUGMENTS {
        bgpPeerAfEntry
    }
    ::= { bgpPeerAfCountersTable 1 }

BgpPeerAfCountersEntry ::= SEQUENCE {
    bgpPeerAfInUpdates
        Counter32,
    bgpPeerAfOutUpdates
        Counter32,
    bgpPeerAfInTotalMessages
        Counter32,
    bgpPeerAfOutTotalMessages
        Counter32,
    bgpPeerAfFsmEstablishedTransitions
        Counter32
}

bgpPeerAfInUpdates OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The number of BGP UPDATE messages received on this
         connection."
    ::= { bgpPeerAfCountersEntry 1 }

bgpPeerAfOutUpdates OBJECT-TYPE
    SYNTAX     Counter32
```

```
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The number of BGP UPDATE messages transmitted on this
         connection."
    ::= { bgpPeerAfCountersEntry 2 }

bgpPeerAfInTotalMessages OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The total number of messages received from the remote
         peer on this connection."
    ::= { bgpPeerAfCountersEntry 3 }

bgpPeerAfOutTotalMessages OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The total number of messages transmitted to the remote
         peer on this connection."
    ::= { bgpPeerAfCountersEntry 4 }

bgpPeerAfFsmEstablishedTransitions 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."
    ::= { bgpPeerAfCountersEntry 5 }

--
-- Per-Peer Prefix Counters
--

bgpPrefixCountersTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF BgpPrefixCountersEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Additional per-peer, per AFI-SAFI counters for
         prefixes"
    ::= { bgpPeerAfCounters 2 }

bgpPrefixCountersEntry OBJECT-TYPE
    SYNTAX     BgpPrefixCountersEntry
```

```
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Entry containing information about a bgp-peers prefix
         counters."
    INDEX {
        bgpPeerAfInstance,
        bgpPeerAfLocalAddrType,
        bgpPeerAfLocalAddr,
        bgpPeerAfRemoteAddrType,
        bgpPeerAfRemoteAddr,
        bgpPrefixCountersAfi,
        bgpPrefixCountersSafi
    }
    ::= { bgpPrefixCountersTable 1 }

BgpPrefixCountersEntry ::= SEQUENCE {
    bgpPrefixCountersAfi
        BgpAddressFamilyIdentifierTC,
    bgpPrefixCountersSafi
        BgpSubsequentAddressFamilyIdentifierTC,
    bgpPrefixInPrefixes
        Gauge32,
    bgpPrefixInPrefixesAccepted
        Gauge32,
    bgpPrefixOutPrefixes
        Gauge32
}

bgpPrefixCountersAfi OBJECT-TYPE
    SYNTAX     BgpAddressFamilyIdentifierTC
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "The AFI index of the per-peer, per prefix counters"
    ::= { bgpPrefixCountersEntry 1 }

bgpPrefixCountersSafi OBJECT-TYPE
    SYNTAX     BgpSubsequentAddressFamilyIdentifierTC
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "The SAFI index of the per-peer, per prefix counters"
    ::= { bgpPrefixCountersEntry 2 }

bgpPrefixInPrefixes OBJECT-TYPE
    SYNTAX     Gauge32
    MAX-ACCESS read-only
    STATUS     current
```

```
    DESCRIPTION
        "The number of prefixes received from a peer and are
         stored in the Adj-Ribs-In for that peer.

         Note that this number does not reflect prefixes that
         have been discarded due to policy."
    REFERENCE
        "RFC 4271, Sections 3.2 and 9."
    ::= { bgpPrefixCountersEntry 3 }

bgpPrefixInPrefixesAccepted OBJECT-TYPE
    SYNTAX     Gauge32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The number of prefixes for a peer that are installed
         in the Adj-Ribs-In and are eligible to become active
         in the Loc-Rib."
    REFERENCE
        "RFC 4271, Sections 3.2 and 9."
    ::= { bgpPrefixCountersEntry 4 }

bgpPrefixOutPrefixes OBJECT-TYPE
    SYNTAX     Gauge32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The number of prefixes for a peer that are installed
         in that peer's Adj-Ribs-Out."
    REFERENCE
        "RFC 4271, Sections 3.2 and 9."
    ::= { bgpPrefixCountersEntry 5 }

--
-- BGP NLRI Data
--

bgpRib
    OBJECT IDENTIFIER ::= { bgp 11 }

--
-- NLRI Table
--

bgpNlriTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF BgpNlriEntry
    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. Collectively, this
         represents the Adj-Ribs-In. The route where
         bgpNlriBest is true represents, for this NLRI,
         the route that is installed in the LocRib from the
         Adj-Ribs-In."
    REFERENCE
        "RFC 4271, Sections 3.2 and 9."
    ::= { bgpRib 1 }

bgpNlriEntry OBJECT-TYPE
    SYNTAX     BgpNlriEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Information about a path to a network."
    INDEX {
        bgpNlriAfi,
        bgpNlriSafi,
        bgpNlriPrefix,
        bgpNlriPrefixLen,
        bgpNlriIndex,
        bgpPeerAfInstance,
        bgpPeerAfLocalAddrType,
        bgpPeerAfLocalAddr,
        bgpPeerAfRemoteAddrType,
        bgpPeerAfRemoteAddr
    }
    ::= { bgpNlriTable 1 }

BgpNlriEntry ::= SEQUENCE {
    bgpNlriIndex
        Unsigned32,
    bgpNlriAfi
        BgpAddressFamilyIdentifierTC,
    bgpNlriSafi
        BgpSubsequentAddressFamilyIdentifierTC,
    bgpNlriPrefixType
        InetAddressType,
    bgpNlriPrefix
        InetAddress,
    bgpNlriPrefixLen
        InetAddressPrefixLength,
    bgpNlriBest
        TruthValue,
    bgpNlriCalcLocalPref
        Unsigned32,
    bgpAfPathAttrIndex
```

```
        Unsigned32,
    bgpAfPathAttrUnknownIndex
        Unsigned32
}

bgpNlriIndex OBJECT-TYPE
    SYNTAX     Unsigned32
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "This index allows for multiple instances of a base
         prefix for a certain AFI-SAFI from a given peer.
         This is currently useful for two things:
         1. Allowing for a peer in future implementations to
            send more than a single route instance.
         2. Allow for extensions which extend the NLRI field
            to send the same prefix while utilizing other
            extension specific information. An example of
            this is RFC 3107 - Carrying MPLS labels in BGP."
    REFERENCE
        "RFC 3107 - Carrying Label Information in BGP-4."
    ::= { bgpNlriEntry 1 }

bgpNlriAfi OBJECT-TYPE
    SYNTAX     BgpAddressFamilyIdentifierTC
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "The address family of the prefix for this NLRI.

         Note that the AFI is not necessarily equivalent to
         the an InetAddressType."
    REFERENCE
        "RFC 4760 - Multiprotocol Extensions for BGP-4"
    ::= { bgpNlriEntry 2 }

bgpNlriSafi OBJECT-TYPE
    SYNTAX     BgpSubsequentAddressFamilyIdentifierTC
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "The subsequent address family of the prefix for
         this NLRI"
    REFERENCE
        "RFC 4760 - Multiprotocol Extensions for BGP-4"
    ::= { bgpNlriEntry 3 }

bgpNlriPrefixType OBJECT-TYPE
    SYNTAX     InetAddressType
```

```
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The type of the IP address prefix in the
         Network Layer Reachability Information field.
         The value of this object is derived from the
         appropriate value from the bgpNlriAfi field.
         Where an appropriate InetAddressType is not
         available, the value of the object must be
         unknown(0)."
    ::= { bgpNlriEntry 4 }

bgpNlriPrefix OBJECT-TYPE
    SYNTAX     InetAddress
    MAX-ACCESS not-accessible
    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
         bgpAfPathAttrAddrPrefixLen.
         Any bits beyond the length specified by
         bgpAfPathAttrAddrPrefixLen are zeroed."
    REFERENCE
        "RFC 4271, Section 4.3."
    ::= { bgpNlriEntry 5 }

bgpNlriPrefixLen OBJECT-TYPE
    SYNTAX     InetAddressPrefixLength
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Length in bits of the address prefix in
         the Network Layer Reachability Information field."
    ::= { bgpNlriEntry 6 }

bgpNlriBest OBJECT-TYPE
    SYNTAX     TruthValue
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "An indication of whether or not this route
         was chosen as the best BGP4 route for this
         destination."
    REFERENCE
        "RFC 4271, Section 9.1.2."
    ::= { bgpNlriEntry 7 }
```

```
bgpNlriCalcLocalPref OBJECT-TYPE
    SYNTAX     Unsigned32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The degree of preference calculated by the
         receiving BGP4 speaker for an advertised
         route.

         In the case where this prefix is ineligible, this
         object will be absent."
    REFERENCE
        "RFC 4271, Section 9.1.1"
    ::= { bgpNlriEntry 8 }

bgpAfPathAttrIndex OBJECT-TYPE
    SYNTAX     Unsigned32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "This value is a unique index for entries in the
         bgpAfPathAttrTable. It is assigned by the agent at the
         point of creation of the bgpAfPathAttrTable row entry.
         While its value is guaranteed to be unique at any time,
         it is otherwise opaque to the management application
         with respect to its value or the contiguity of
         bgpAfPathAttrIndex row instance values across rows of the
         bgpAfPathAttrTable.

         Note well that this index is used to distinguish unique
         sets of Path Attributes sent as part of BGP NLRI.  The
         implementor is thus encouraged to make this index unique
         per set of all received path attributes.  This value may
         be used to index tables in extension MIBs that share the
         property of belonging to the same received Path Attribute
         tuple."
    ::= { bgpNlriEntry 9 }

bgpAfPathAttrUnknownIndex OBJECT-TYPE
    SYNTAX     Unsigned32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "This value is a unique index for entries in the
         bgpAfPathAttrUnknownTable. It is assigned by the agent at
         the point of creation of the bgpAfPathAttrUnknownTable row
         entry.  While its value is guaranteed to be unique at
         any time, it is otherwise opaque to the management
         application with respect to its value or the contiguity
```

```
          of bgpAfPathAttrUnknownIndex row instance values across
          rows of the bgpAfPathAttrUnknownTable."
    ::= { bgpNlriEntry 10 }

--
-- Adj-Ribs-Out Table
--

bgpAdjRibsOutTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF BgpAdjRibsOutEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "This table contains on a per-peer basis one or more
         routes from the bgpNlriTable that have been
         placed in this peer's Adj-Ribs-Out."
    REFERENCE
        "RFC 4271, Section 3.2."
    ::= { bgpRib 2 }

bgpAdjRibsOutEntry OBJECT-TYPE
    SYNTAX     BgpAdjRibsOutEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "List of BGP routes that have been placed into a
         peer's Adj-Ribs-Out."
    INDEX {
        bgpNlriAfi,
        bgpNlriSafi,
        bgpNlriPrefix,
        bgpNlriPrefixLen,
        bgpAdjRibsOutIndex,
        bgpPeerAfInstance,
        bgpPeerAfLocalAddrType,
        bgpPeerAfLocalAddr,
        bgpPeerAfRemoteAddrType,
        bgpPeerAfRemoteAddr
    }
    ::= { bgpAdjRibsOutTable 1 }

BgpAdjRibsOutEntry ::= SEQUENCE {
    bgpAdjRibsOutIndex
        Unsigned32,
    bgpAdjRibsOutRoute
        RowPointer
}

bgpAdjRibsOutIndex OBJECT-TYPE
```

```
    SYNTAX     Unsigned32
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Certain extensions to BGP permit multiple instance of
         a per afi, per safi prefix to be advertised to a peer.
         This object allows the enumeration of them."
    ::= { bgpAdjRibsOutEntry 1 }

bgpAdjRibsOutRoute OBJECT-TYPE
    SYNTAX     RowPointer
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "This object points to the route in the bgpNlriTable
         that corresponds to the entry in the peer's
         Adj-Rib-Out. Outgoing route maps are not
         reflected at this point as those are part of the
         Update-Send process."
    REFERENCE
        "RFC 4271, Section 9.2."
    ::= { bgpAdjRibsOutEntry 2 }

--
-- Path Attribute Counter
--

bgpAfPathAttrCounter OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The number of entries in the bgpAfPathAttrTable."
    ::= { bgpRib 3 }

--
-- Path Attributes Table
--

bgpAfPathAttrTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF BgpAfPathAttrEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Provides per advertised network-prefix attribute data,
         as advertised over a peering session."
    ::= { bgpRib 4 }

bgpAfPathAttrEntry OBJECT-TYPE
```

```
    SYNTAX     BgpAfPathAttrEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Each entry contains data about path attributes
         associated with a given prefix in the bgpNlriTable."
    REFERENCE
         "RFC 4271, Section 5."
    INDEX {
        bgpAfPathAttrIndex
    }
    ::= { bgpAfPathAttrTable 1 }

BgpAfPathAttrEntry ::= SEQUENCE {
    bgpAfPathAttrOrigin
        INTEGER,
    bgpAfPathAttrNextHopAddrType
        InetAddressType,
    bgpAfPathAttrNextHopAddr
        InetAddress,
    bgpAfPathAttrLinkLocalNextHopAddrType
        InetAddressType,
    bgpAfPathAttrLinkLocalNextHopAddr
        InetAddress,
    bgpAfPathAttrMedPresent
        TruthValue,
    bgpAfPathAttrMed
        Unsigned32,
    bgpAfPathAttrLocalPref
        Unsigned32,
    bgpAfPathAttrAtomicAggregate
        INTEGER,
    bgpAfPathAttrAggregatorAS
        InetAutonomousSystemNumber,
    bgpAfPathAttrAggregatorAddr
        BgpIdentifierTC,
    bgpAsPathCalcLength
        Unsigned32,
    bgpAsPathIndex
        Unsigned32,
    bgpAsPathString
        SnmpAdminString
}

bgpAfPathAttrOrigin 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."
    ::= { bgpAfPathAttrEntry 1 }

bgpAfPathAttrNextHopAddrType OBJECT-TYPE
    SYNTAX     InetAddressType
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The address family of the address for
         the border router that should be used
         to access the destination network."
    ::= { bgpAfPathAttrEntry 2 }

bgpAfPathAttrNextHopAddr OBJECT-TYPE
    SYNTAX     InetAddress (SIZE(4..20))
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The address of the border router that
         should be used to access the destination
         network. This address is the nexthop
         address received in the UPDATE packet associated with
         this prefix.

         Note that for RFC2545 style double nexthops,
         this object will always contain the global scope
         nexthop. bgpPathAttrLinkLocalNextHop will contain
         the linklocal scope nexthop, if it is present.

         In the case a mechanism is developed to use only a link
         local nexthop, bgpAfPathAttrNextHopAddr will contain the
         link local nexthop."
    REFERENCE
        "RFC 4271, Section 4.3,
         RFC 4271, Section 5.1.3,
         RFC 2545, Section 3."
    ::= { bgpAfPathAttrEntry 3 }

bgpAfPathAttrLinkLocalNextHopAddrType OBJECT-TYPE
    SYNTAX     InetAddressType
```

```
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The address type for IPv6 link local addresses.
         This is present only when receiving RFC 2545
         style double nexthops.

         This object is optionally present in BGP
         implementations that do not support IPv6."
    REFERENCE
        "RFC 2545, Section 3."
    ::= { bgpAfPathAttrEntry 4 }

bgpAfPathAttrLinkLocalNextHopAddr OBJECT-TYPE
    SYNTAX     InetAddress
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "This value contains an IPv6 link local address
         and is present only when receiving RFC 2545 style
         double nexthops.

         This object is optionally present in BGP
         implementations that do not support IPv6."
    REFERENCE
        "RFC 2545, Section 3."
    ::= { bgpAfPathAttrEntry 5 }

bgpAfPathAttrMedPresent OBJECT-TYPE
    SYNTAX     TruthValue
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "This value is true when the MED value was sent in
         the UPDATE message."
    ::= { bgpAfPathAttrEntry 6 }

bgpAfPathAttrMed OBJECT-TYPE
    SYNTAX     Unsigned32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "This metric is used to discriminate between multiple
         exit points to an adjacent autonomous system.  When the MED
         value is absent but has a calculated default value, this
         object will contain the calculated value."
    REFERENCE
        "RFC 4271, Section 4.3.
         RFC 4271, Section 5.1.4."
```

```
    ::= { bgpAfPathAttrEntry 7 }

bgpAfPathAttrLocalPref OBJECT-TYPE
    SYNTAX     Unsigned32
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The originating BGP4 speakers degree of preference for an
         advertised route.  If the route was not sent with a LOCAL_PREF
         value, this object will be absent."
    REFERENCE
        "RFC 4271, Section 4.3.
         RFC 4271, Section 5.1.5."
    ::= { bgpAfPathAttrEntry 8 }

bgpAfPathAttrAtomicAggregate OBJECT-TYPE
    SYNTAX     INTEGER {
        atomicAggregatePresent(1),
        atomicAggregateMissing(2)
        }
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "When this object is set to atomicAggregatePresent,
         the ATOMIC_AGGREGATE Path Attribute is present and
         indicates that the NLRI MUST NOT be made more
         specific."
    REFERENCE
        "RFC 4271, Sections 5.1.6 and 9.1.4."
    ::= { bgpAfPathAttrEntry 9 }

bgpAfPathAttrAggregatorAS OBJECT-TYPE
    SYNTAX     InetAutonomousSystemNumber
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The AS number of the last BGP4 speaker that performed route
         aggregation. If the AGGREGATOR path attribute is absent, this
         object will not be present in the conceptual row."
    REFERENCE
        "RFC 4271, Section 5.1.7.
         RFC 4271, Section 9.2.2.2."
    ::= { bgpAfPathAttrEntry 10 }

bgpAfPathAttrAggregatorAddr OBJECT-TYPE
    SYNTAX     BgpIdentifierTC
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
```

```
            "The IP address of the last BGP4 speaker that performed route
             aggregation.  If the AGGREGATOR path attribute is absent, this
             object will not be present in the conceptual row."
        REFERENCE
            "RFC 4271, Section 5.1.7.
             RFC 4271, Section 9.2.2.2."
        ::= { bgpAfPathAttrEntry 11 }

    bgpAsPathCalcLength OBJECT-TYPE
        SYNTAX     Unsigned32
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "This value represents the calculated length of the
             AS Path according to the rules of the BGP
             specification.  This value is used in route selection."
        REFERENCE
            "RFC 4271, Section 9.1.2.2.a"
        ::= { bgpAfPathAttrEntry 12 }

    bgpAsPathIndex OBJECT-TYPE
        SYNTAX     Unsigned32
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "This value is a unique index for the decomposed AS Path
             in the bgpAsPathTable. It is assigned by the
             agent at the point of creation of the bgpAsPathTable
             row entry. While its value is guaranteed to be unique
             at any time, it is otherwise opaque to the management
             application with respect to its value or the contiguity
             of bgpAsPathIndex row instance values across rows
             of the bgpAsPathTable."
        ::= { bgpAfPathAttrEntry 13 }

    bgpAsPathString OBJECT-TYPE
        SYNTAX     SnmpAdminString
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "This is a string depicting the autonomous system
             path to this network which was received from the
             peer which advertised it. The format of the string
             is implementation-dependent, and should be designed
             for operator readability.

             Note that SnmpAdminString is only capable of
             representing a maximum of 255 characters.  This may
             lead to the string being truncated in the presence of
```

```
          a large AS Path.  The bgpAsPathTable will give access
          to the full AS Path."
    ::= { bgpAfPathAttrEntry 14 }


--
-- BGP 4 AS_PATH.  This table provides a platform netrual
-- representation of the AS_PATH.
--

bgpAsPathTable OBJECT-TYPE
    SYNTAX     SEQUENCE OF BgpAsPathEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "The BGP-4 Path Attribute AS Path Table
         contains the per network path (NLRI)
         AS PATH data received from the
         advertising BGP peer.

         Note that the bgpAsPathElementValue is 4-byte AS capable.  This
         table and related objects in this MIB are meant to reflect the
         active AS_PATH for a 2-byte or a 4-byte AS speaker.  For a
         transitional 2-byte to 4-byte speaker, the received AS_PATH and
         AS4_PATH path attributes may be present in an extension MIB."
    REFERENCE
        "RFC 4271, Sections 4.3 and 5.1.2.
         RFC 4893, BGP Support for Four-octet AS Number Space"
    ::= { bgpRib 5 }

bgpAsPathEntry OBJECT-TYPE
    SYNTAX     BgpAsPathEntry
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "Information about an AS path provided with a path to
         a network."
    INDEX {
        bgpAsPathIndex,
        bgpAsPathSegmentIndex,
        bgpAsPathElementIndex
    }
    ::= { bgpAsPathTable 1 }

BgpAsPathEntry ::= SEQUENCE {
    bgpAsPathSegmentIndex
        Unsigned32,
    bgpAsPathElementIndex
        Unsigned32,
```

```
    bgpAsPathType
        INTEGER,
    bgpAsPathElementValue
        InetAutonomousSystemNumber
}

bgpAsPathSegmentIndex OBJECT-TYPE
    SYNTAX     Unsigned32
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "A per-AS path segment index.  This will index a set of
         autonomous systems in an AS path which are part
         of the same sequence or set (as determined by
         the row value of bgpAsPathType, which
         should be the same value for each bgpAsPathTable
         entry indexed by the same bgpAsPathIndex."
    REFERENCE
        "RFC 4271, Sections 4.3 and 5.1.2."
    ::= { bgpAsPathEntry 1 }

bgpAsPathElementIndex OBJECT-TYPE
    SYNTAX     Unsigned32
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "A per-AS element index.  This will index a particular
         AS within a sequence or set of autonomous systems in
         an AS path."
    REFERENCE
        "RFC 4271, Sections 4.3 and 5.1.2."
    ::= { bgpAsPathEntry 2 }

bgpAsPathType OBJECT-TYPE
    SYNTAX     INTEGER {
        asSet(1),
        asSequence(2),
        confedSequence(3),
        confedSet(4)
     }
     MAX-ACCESS read-only
     STATUS     current
     DESCRIPTION
         "The path segment type advertised for the per-AS element.
          Note that all asPath row instances for a given
          bgpAsPathIndex index will have their
          bgpAsPathType set to the same value.
          The values for bgpAsPathType are
          interpreted as defined in the base BGP document
```

```
            and the BGP AS Confederations document."
        REFERENCE
            "RFC 4271, Sections 4.3 and 5.1.2,
             RFC 5065 - BGP AS Confederations"
        ::= { bgpAsPathEntry 3 }

    bgpAsPathElementValue OBJECT-TYPE
        SYNTAX     InetAutonomousSystemNumber
        MAX-ACCESS read-only
        STATUS     current
        DESCRIPTION
            "An AS the NLRI traversed in the propagation of its
             advertisement.  This value is to be interpreted in
             the context of the segment type of the bgpAsPathType
             in the same conceptual row."
        ::= { bgpAsPathEntry 4 }

    -- BGP 4 Path unknown attribute. There is one row in
    -- this table for each attribute not known by this BGP
    -- implementation (or agent instrumentation), but provided
    -- from a peer.

    bgpAfPathAttrUnknownTable OBJECT-TYPE
        SYNTAX     SEQUENCE OF BgpAfPathAttrUnknownEntry
        MAX-ACCESS not-accessible
        STATUS     current
        DESCRIPTION
            "The BGP-4 Path Attribute Unknown Table
             contains the per network path (NLRI)
             data on the path attributes advertised
             with a route but not known to the local BGP
             implementation or not otherwise capable of being
             returned from this agent.

             The absence of row data for a given index value for
             bgpAfPathAttrIndex indicates a lack of such unknown
             attribute information for the indicated network path
             (as indexed by that bgpAfPathAttrIndex value in the
             bgpAfPathAttrTable)."
        REFERENCE
            "RFC 4271, Sections 4.3 and 5."
        ::= { bgpRib 6 }

    bgpAfPathAttrUnknownEntry OBJECT-TYPE
        SYNTAX     BgpAfPathAttrUnknownEntry
        MAX-ACCESS not-accessible
        STATUS     current
        DESCRIPTION
            "Information about an unknown attribute
```

```
         provided with a path to a network."
    INDEX {
        bgpAfPathAttrUnknownIndex,
        bgpAfPathAttrUnknownCode
    }
    ::= { bgpAfPathAttrUnknownTable 1 }

BgpAfPathAttrUnknownEntry ::= SEQUENCE {
    bgpAfPathAttrUnknownCode
        Unsigned32,
    bgpAfPathAttrUnknownFlags
        BgpPathAttributeFlagsTC,
    bgpAfPathAttrUnknownValue
        OCTET STRING
}

bgpAfPathAttrUnknownCode OBJECT-TYPE
    SYNTAX     Unsigned32
    MAX-ACCESS not-accessible
    STATUS     current
    DESCRIPTION
        "The path attribute code advertised with this unknown
         attribute by the peer."
    ::= { bgpAfPathAttrUnknownEntry 1 }

-- Maximum size of the following is derived as
-- 4096 max message size
-- - 16 BGP message marker bytes
-- - 2 BGP message size
-- - 1 BGP message type (UPDATE with unknown attr)
-- - 2 UPDATE routes length (even assuming no routes)
-- - 2 UPDATE path attributes length
-- - 1 path attribute flag octet
-- - 1 unknown path attr type (in bgpAfPathAttrUnknownCode)
-- ---------
-- 4071 bytes maximum per-message attribute value data

bgpAfPathAttrUnknownFlags OBJECT-TYPE
    SYNTAX     BgpPathAttributeFlagsTC
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The flags of the unknown path attribute."
    ::= { bgpAfPathAttrUnknownEntry 2 }

bgpAfPathAttrUnknownValue OBJECT-TYPE
    SYNTAX     OCTET STRING (SIZE(0..4071))
    MAX-ACCESS read-only
    STATUS     current
```

```
    DESCRIPTION
        "Value of path attribute not understood
         by the base BGP-4 document.

         Per RFC 2578, Section 7.1.2, some implementations
         may have limitations dealing with OCTET STRINGS
         larger than 255.  Thus, this data may be truncated.

         Octets beyond the maximum size, if any,
         are not recorded by this row object."
    ::= { bgpAfPathAttrUnknownEntry 3 }

--
-- Mount point for extensions
--

bgpExtensions OBJECT IDENTIFIER ::= { bgp 12 }

--
-- Discontinuity
--
bgpDiscontinuityTime OBJECT-TYPE
    SYNTAX     TimeStamp
    MAX-ACCESS read-only
    STATUS     current
    DESCRIPTION
        "The value of sysUpTime at the most recent occasion at which
         this BGP management instance has suffered a discontinuity.

         In particular, tables with abstract indexes such as
         bgpAfPathAttrIndex, bgpAsPathIndex and
         bgpAfPathAttrUnknownIndex are not guaranteed to contain the
         same data across discontinuities."
     ::= { bgp 13 }

--
-- Notifications
--

bgpNotification OBJECT IDENTIFIER ::= { bgp 0 }

-- bgpNotification 1 and 2 have been deprecated and are
-- documented elsewhere in this MIB

bgpAfEstablishedNotification NOTIFICATION-TYPE
    OBJECTS {
        bgpPeerAfPeerState,
        bgpPeerAfLocalPort,
        bgpPeerAfRemotePort
    }
```

```
    STATUS current
    DESCRIPTION
        "The BGP Established event is generated when
         the BGP FSM enters the established state."
    ::= { bgpNotification 3 }

bgpAfBackwardTransitionNotification NOTIFICATION-TYPE
    OBJECTS {
        bgpPeerAfPeerState,
        bgpPeerAfLocalPort,
        bgpPeerAfRemotePort,
        bgpPeerAfLastErrorCodeReceived,
        bgpPeerAfLastErrorSubCodeReceived,
        bgpPeerAfLastErrorReceivedText
    }
    STATUS current
    DESCRIPTION
        "The BGPBackwardTransition Event is generated
         when the BGP FSM moves from a higher numbered
         state to a lower numbered state.

         Due to the nature of the BGP state machine, an implementation MAY
         rate limit the generation of this event.  An implementation MAY
         also generate this notification ONLY when the state machine moves
         out of the established state.  An implementation should document
         its specific behavior."
    ::= { bgpNotification 4 }

--
-- Conformance Information
--

bgpConformance
    OBJECT IDENTIFIER ::= { bgp 8 }

bgp4MIBCompliances OBJECT IDENTIFIER ::=
    { bgpConformance 1 }

bgp4MIBGroups OBJECT IDENTIFIER ::=
    { bgpConformance 2 }

-- bgp4MIBCompliances 1 through 3 have been deprecated and are
-- documented elsewhere in this MIB.

bgpAfMIBCompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION
        "The compliance statement for entities which
        implement the BGP4 mib."
    MODULE -- this module
```

```
MANDATORY-GROUPS {
    bgpTimersGroup,
    bgpCountersGroup,
    bgpAsPathGroup,
    bgpBaseGroup,
    bgpErrorsGroup,
    bgpPeerAfGroup,
    bgpAfPathAttributesGroup,
    bgpAfMIBGlobalsGroup
    }
GROUP bgpAsPathGroup
DESCRIPTION
    "This group is optional for all agent implementations."
GROUP bgpAfMIBNotificationGroup
DESCRIPTION
    "Implementation of BGP Notifications are completely
     optional in this MIB."

OBJECT bgpPeerAfLocalAddr
SYNTAX InetAddress (SIZE(4|16|20))
DESCRIPTION
    "An implementation is required to support IPv4 peering
     sessions.  An implementation MAY support IPv6 peering
     sessions.  IPv6 link-local peering sessions MAY be
     supported by this MIB."

OBJECT bgpPeerAfRemoteAddr
SYNTAX InetAddress (SIZE(4|16|20))
DESCRIPTION
    "An implementation is required to support IPv4 peering
     sessions.  An implementation MAY support IPv6 peering
     sessions.  IPv6 link-local peering sessions MAY be
     supported by this MIB."

OBJECT bgpNlriPrefix
SYNTAX InetAddress (SIZE(0..16))
DESCRIPTION
    "An implementation is required to support IPv4 prefixes.
     An implementation MAY support IPv6 prefixes."

OBJECT bgpAfPathAttrLinkLocalNextHopAddrType
SYNTAX InetAddressType
DESCRIPTION
    "This object is only present when RFC 2545 double nexthops
     are sent for IPv6 reachability.  IPv6 is optionally
     supported.  When present, this object shall only have a
     value of ipv6z"

OBJECT bgpAfPathAttrLinkLocalNextHopAddr
```

```
SYNTAX InetAddress (SIZE(20))
DESCRIPTION
    "This object is only present when RFC 2545 double nexthops
     are sent for IPv6 reachability.  IPv6 is optionally
     supported.  When present, this object shall only have a
     size of 20."

OBJECT bgpPeerAfInstance
SYNTAX Unsigned32 (1..4294967295)
DESCRIPTION
    "This object represents an abstract index which can utilize the
     full range of acceptable SNMP index values."

OBJECT bgpNlriIndex
SYNTAX Unsigned32 (1..4294967295)
DESCRIPTION
    "This object represents an abstract index which can utilize the
     full range of acceptable SNMP index values."

OBJECT bgpAdjRibsOutIndex
SYNTAX Unsigned32 (1..4294967295)
DESCRIPTION
    "This object represents an abstract index which can utilize the
     full range of acceptable SNMP index values."

OBJECT bgpAfPathAttrIndex
SYNTAX Unsigned32 (1..4294967295)
DESCRIPTION
    "This object represents an abstract index which can utilize the
     full range of acceptable SNMP index values."

OBJECT bgpAsPathIndex
SYNTAX Unsigned32 (1..4294967295)
DESCRIPTION
    "This object represents an abstract index which can utilize the
     full range of acceptable SNMP index values."

OBJECT bgpAsPathSegmentIndex
SYNTAX Unsigned32 (1..4294967295)
DESCRIPTION
    "This object represents an abstract index which can utilize the
     full range of acceptable SNMP index values."

OBJECT bgpAsPathElementIndex
SYNTAX Unsigned32 (1..4294967295)
DESCRIPTION
    "This object represents an abstract index which can utilize the
     full range of acceptable SNMP index values."

OBJECT bgpAfPathAttrUnknownIndex
```

```
    SYNTAX Unsigned32 (1..4294967295)
    DESCRIPTION
        "This object represents an abstract index which can utilize the
         full range of acceptable SNMP index values."

    OBJECT bgpAfPathAttrUnknownCode
    SYNTAX Unsigned32 (0..255)
    DESCRIPTION
        "Path attribute codes are one octet."

    ::= { bgp4MIBCompliances 4 }

bgpAfMIBDeprecatedCompliances MODULE-COMPLIANCE
    STATUS deprecated
    DESCRIPTION
        "The compliance statement for entities which
        implement the BGP4 mib."
     MODULE -- this module
    GROUP bgpAfMIBOldGlobalsGroup
    DESCRIPTION
        "Implementation of the bgp4MIBGlobalsGroup is OPTIONAL.
         If it is implemented, then bgp4MIBGlobalsGroup,
         bgp4MIBPeerGroup, bgp4MIBPathAttrGroup and
         bgp4MIBNotificationGroup MUST all be implemented."
    GROUP bgp4MIBPeerGroup
    DESCRIPTION
        "Implementation of the bgp4MIBPeerGroup is OPTIONAL.
         If it is implemented, then bgp4MIBGlobalsGroup,
         bgp4MIBPeerGroup, bgp4MIBPathAttrGroup and
         bgp4MIBNotificationGroup MUST all be implemented."
    GROUP bgp4MIBPathAttrGroup
    DESCRIPTION
        "Implementation of the bgp4MIBPathAttrGroup is OPTIONAL.
         If it is implemented, then bgp4MIBGlobalsGroup,
         bgp4MIBPeerGroup, bgp4MIBPathAttrGroup and
         bgp4MIBNotificationGroup MUST all be implemented."
    GROUP bgp4MIBNotificationGroup
    DESCRIPTION
        "Implementation of the bgp4MIBNotificationGroup is OPTIONAL.
         If it is implemented, then bgp4MIBGlobalsGroup,
         bgp4MIBPeerGroup, bgp4MIBPathAttrGroup and
         bgp4MIBNotificationGroup MUST all be implemented."
    ::= { bgp4MIBCompliances 5 }

-- bgp4MIBGroups 1 through 7 have been deprecated and are documented
-- elsewhere in this MIB.

bgpAfMIBGlobalsGroup OBJECT-GROUP
    OBJECTS { bgpVersion,
```

```
                bgpIdentifier,
                bgpDiscontinuityTime }
    STATUS current
    DESCRIPTION
        "A collection of objects providing information on global
         BGP state.  This group covers objects that overlap the
         old bgp4MIBGlobalsGroup that are still current."
    ::= { bgp4MIBGroups 8 }

bgpAfMIBOldGlobalsGroup OBJECT-GROUP
    OBJECTS { bgpLocalAs }
    STATUS deprecated
    DESCRIPTION
        "A collection of objects providing information on global
         BGP state.  This group covers objects that overlap the
         old bgp4MIBGlobalsGroup that are deprecated."
    ::= { bgp4MIBGroups 9 }

bgpTimersGroup OBJECT-GROUP
    OBJECTS {
        bgpPeerAfFsmEstablishedTime,
        bgpPeerAfInUpdatesElapsedTime,
        bgpPeerAfConnectRetryInterval,
        bgpPeerAfHoldTimeConfigured,
        bgpPeerAfKeepAliveConfigured,
        bgpPeerAfMinASOrigInterval,
        bgpPeerAfMinRouteAdverInterval,
        bgpPeerAfHoldTime,
        bgpPeerAfKeepAlive
    }
    STATUS current
    DESCRIPTION
        "Objects associated with BGP peering timers."
    ::= { bgp4MIBGroups 10 }

bgpCountersGroup OBJECT-GROUP
    OBJECTS {
        bgpPeerAfInUpdates,
        bgpPeerAfOutUpdates,
        bgpPeerAfInTotalMessages,
        bgpPeerAfOutTotalMessages,
        bgpPeerAfFsmEstablishedTransitions,
        bgpPrefixInPrefixes,
        bgpPrefixInPrefixesAccepted,
        bgpPrefixOutPrefixes
    }
    STATUS current
    DESCRIPTION
        "Objects to count discrete events and exchanges on BGP
```

```
         sessions."
     ::= { bgp4MIBGroups 11 }

bgpAsPathGroup OBJECT-GROUP
    OBJECTS {
        bgpAsPathType,
        bgpAsPathElementValue
    }
    STATUS current
    DESCRIPTION
        "Objects to report AS paths received on BGP NLRIs."
    ::= { bgp4MIBGroups 12 }

bgpBaseGroup OBJECT-GROUP
    OBJECTS {
        bgpLocalAsNew
    }
    STATUS current
    DESCRIPTION
        "Basic objects in local BGP implementation."
    ::= { bgp4MIBGroups 13 }

bgpErrorsGroup OBJECT-GROUP
    OBJECTS {
        bgpPeerAfLastErrorCodeReceived,
        bgpPeerAfLastErrorSubCodeReceived,
        bgpPeerAfLastErrorReceivedData,
        bgpPeerAfLastErrorReceivedTime,
        bgpPeerAfLastErrorReceivedText,
        bgpPeerAfLastErrorCodeSent,
        bgpPeerAfLastErrorSubCodeSent,
        bgpPeerAfLastErrorSentData,
        bgpPeerAfLastErrorSentTime,
        bgpPeerAfLastErrorSentText
    }
    STATUS current
    DESCRIPTION
        "Errors received on BGP peering sessions."
    ::= { bgp4MIBGroups 14 }

bgpPeerAfGroup OBJECT-GROUP
    OBJECTS {
        bgpPeerAfIdentifier,
        bgpPeerAfPeerState,
        bgpPeerAfAdminStatus,
        bgpPeerAfConfiguredVersion,
        bgpPeerAfNegotiatedVersion,
        bgpPeerAfLocalPort,
        bgpPeerAfLocalAs,
```

```
        bgpPeerAfRemotePort,
        bgpPeerAfRemoteAs
    }
    STATUS current
    DESCRIPTION
        "Core object types on BGP peering sessions."
    ::= { bgp4MIBGroups 15 }

bgpAfPathAttributesGroup OBJECT-GROUP
    OBJECTS {
        bgpAfPathAttrCounter,
        bgpAsPathCalcLength,
        bgpAsPathElementValue,
        bgpAsPathIndex,
        bgpAsPathString,
        bgpAsPathType,
        bgpNlriBest,
        bgpNlriCalcLocalPref,
        bgpNlriPrefixType,
        bgpAdjRibsOutRoute,
        bgpAfPathAttrAggregatorAS,
        bgpAfPathAttrAggregatorAddr,
        bgpAfPathAttrAtomicAggregate,
        bgpAfPathAttrIndex,
        bgpAfPathAttrLocalPref,
        bgpAfPathAttrMed,
        bgpAfPathAttrMedPresent,
        bgpAfPathAttrNextHopAddr,
        bgpAfPathAttrNextHopAddrType,
        bgpAfPathAttrLinkLocalNextHopAddrType,
        bgpAfPathAttrLinkLocalNextHopAddr,
        bgpAfPathAttrOrigin,
        bgpAfPathAttrUnknownIndex,
        bgpAfPathAttrUnknownFlags,
        bgpAfPathAttrUnknownValue
    }
    STATUS current
    DESCRIPTION
        "Attributes received on BGP peering sessions."
    ::= { bgp4MIBGroups 16 }


-- ============================================================
--
-- Objects that are deprecated from RFC 4273 follow below.
--
-- ============================================================

bgpLocalAs OBJECT-TYPE
```

```
    SYNTAX     Integer32 (0..65535)
    MAX-ACCESS read-only
    STATUS     deprecated
    DESCRIPTION
            "The local autonomous system number.

             This object has been replaced with bgpLocalAsNew
             which can accomodate 4-byte AS numbers.  When
             the Local AS number cannot be represented by
             a 2-byte number, this object should return the
             AS_TRANS value, 23456."
    REFERENCE
             "RFC 4271, Section 4.2, 'My Autonomous System'.

              RFC 4893, BGP Support for Four-octet AS Number
              Space."
    ::= { 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     deprecated
    DESCRIPTION
            "BGP peer table.  This table contains,
             one entry per BGP peer, information about the
             connections with BGP peers.

             This table has been replaced with bgpPeerAfTable."
    ::= { bgp 3 }

bgpPeerEntry OBJECT-TYPE
    SYNTAX     BgpPeerEntry
    MAX-ACCESS not-accessible
    STATUS     deprecated
    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     deprecated
```

```
    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.

             This object has been replaced with
             bgpPeerAfIdentifier."
    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     deprecated
    DESCRIPTION
            "The BGP peer connection state.

             This object has been replaced with
             bgpPeerAfPeerState."
    REFERENCE
            "RFC 4271, Section 8.2.2."
    ::= { bgpPeerEntry 2 }

bgpPeerAdminStatus OBJECT-TYPE
    SYNTAX     INTEGER {
                       stop(1),
                       start(2)
               }
    MAX-ACCESS read-write
    STATUS     deprecated
    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.
```

```
            This object has been replaced with
            bgpPeerAfAdminStatus."
    REFERENCE
            "RFC 4271, Section 8.1.2."
    ::= { bgpPeerEntry 3 }

bgpPeerNegotiatedVersion OBJECT-TYPE
    SYNTAX     Integer32
    MAX-ACCESS read-only
    STATUS     deprecated
    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.

            This object has been replaced with
            bgpPeerAfNegotiatedVersion."
    REFERENCE
            "RFC 4271, Section 4.2.
            RFC 4271, Section 7."
    ::= { bgpPeerEntry 4 }

bgpPeerLocalAddr OBJECT-TYPE
    SYNTAX     IpAddress
    MAX-ACCESS read-only
    STATUS     deprecated
    DESCRIPTION
            "The local IP address of this entry's BGP
            connection.

            This object has been replaced with
            bgpPeerAfLocalAddrType and bgpPeerAfLocalAddr."
    ::= { bgpPeerEntry 5 }

bgpPeerLocalPort OBJECT-TYPE
    SYNTAX     Integer32 (0..65535)
    MAX-ACCESS read-only
    STATUS     deprecated
    DESCRIPTION
            "The local port for the TCP connection between
            the BGP peers.

            This object has been replaced with
```

```
                bgpPeerAfLocalPort."
        ::= { bgpPeerEntry 6 }

    bgpPeerRemoteAddr OBJECT-TYPE
        SYNTAX     IpAddress
        MAX-ACCESS read-only
        STATUS     deprecated
        DESCRIPTION
                "The remote IP address of this entry's BGP
                 peer.

                 This object has been replaced with
                 bgpPeerAfRemoteAddrType and bgpPeerAfRemoteAddr."
        ::= { bgpPeerEntry 7 }

    bgpPeerRemotePort OBJECT-TYPE
        SYNTAX     Integer32 (0..65535)
        MAX-ACCESS read-only
        STATUS     deprecated
        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.

                 This object has been replaced with
                 bgpPeerAfRemotePort."
        ::= { bgpPeerEntry 8 }

    bgpPeerRemoteAs OBJECT-TYPE
        SYNTAX     Integer32 (0..65535)
        MAX-ACCESS read-only
        STATUS     deprecated
        DESCRIPTION
                "The remote autonomous system number received in
                 the BGP OPEN message.

                 This object has been replaced with
                 bgpPeerAfRemoteAs."
        REFERENCE
                "RFC 4271, Section 4.2."
        ::= { bgpPeerEntry 9 }

    bgpPeerInUpdates OBJECT-TYPE
        SYNTAX     Counter32
        MAX-ACCESS read-only
```

```
    STATUS     deprecated
    DESCRIPTION
            "The number of BGP UPDATE messages
             received on this connection.

             This object has been replaced with
             bgpPeerAfInUpdates."
    REFERENCE
            "RFC 4271, Section 4.3."
    ::= { bgpPeerEntry 10 }

bgpPeerOutUpdates OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     deprecated
    DESCRIPTION
            "The number of BGP UPDATE messages
             transmitted on this connection.

             This object has been replaced with
             bgpPeerAfOutUpdates."
    REFERENCE
            "RFC 4271, Section 4.3."
    ::= { bgpPeerEntry 11 }

bgpPeerInTotalMessages OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     deprecated
    DESCRIPTION
            "The total number of messages received
             from the remote peer on this connection.

             This object has been replaced with
             bgpPeerAfInTotalMessages."
    REFERENCE
            "RFC 4271, Section 4."
    ::= { bgpPeerEntry 12 }

bgpPeerOutTotalMessages OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     deprecated
    DESCRIPTION
            "The total number of messages transmitted to
             the remote peer on this connection.

             This object has been replaced with
             bgpPeerAfOutTotalMessages."
```

```
    REFERENCE
            "RFC 4271, Section 4."
    ::= { bgpPeerEntry 13 }

bgpPeerLastError OBJECT-TYPE
    SYNTAX     OCTET STRING (SIZE (2))
    MAX-ACCESS read-only
    STATUS     deprecated
    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.

             This object has been replaced by
             bgpPeerAfLastErrorCodeRecieved and
             bgpPeerAfLastErrorSubCodeReceived.  Further, this
             data has been supplemented by additional objects
             in the bgpPeerAfErrorsTable."
    REFERENCE
            "RFC 4271, Section 4.5."
    ::= { bgpPeerEntry 14 }

bgpPeerFsmEstablishedTransitions OBJECT-TYPE
    SYNTAX     Counter32
    MAX-ACCESS read-only
    STATUS     deprecated
    DESCRIPTION
            "The total number of times the BGP FSM
             transitioned into the established state
             for this peer.

             This object has been replaced by
             bgpPeerAfFsmEstablishedTransitions."
    REFERENCE
            "RFC 4271, Section 8."
    ::= { bgpPeerEntry 15 }

bgpPeerFsmEstablishedTime OBJECT-TYPE
    SYNTAX     Gauge32
    UNITS      "seconds"
    MAX-ACCESS read-only
    STATUS     deprecated
    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.

                This object has been replaced by
                bgpPeerAfFsmEstablishedTime."
        REFERENCE
                "RFC 4271, Section 8."
        ::= { bgpPeerEntry 16 }

    bgpPeerConnectRetryInterval OBJECT-TYPE
        SYNTAX     Integer32 (1..65535)
        UNITS      "seconds"
        MAX-ACCESS read-write
        STATUS     deprecated
        DESCRIPTION
                "Time interval (in seconds) for the
                 ConnectRetry timer.  The suggested value
                 for this timer is 120 seconds.

                 This object has been replaced by
                 bgpPeerAfConnectRetryInterval."
        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     deprecated
        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).

                This object has been replaced by
                bgpPeerAfHoldTime."
        REFERENCE
                "RFC 4271, Section 4.2."
        ::= { bgpPeerEntry 18 }

    bgpPeerKeepAlive OBJECT-TYPE
        SYNTAX     Integer32 ( 0 | 1..21845 )
        UNITS      "seconds"
        MAX-ACCESS read-only
        STATUS     deprecated
        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).

                This object has been replaced by
                bgpPeerAfKeepAlive."
        REFERENCE
                "RFC 4271, Section 4.4."
        ::= { bgpPeerEntry 19 }

    bgpPeerHoldTimeConfigured OBJECT-TYPE
        SYNTAX     Integer32 ( 0 | 3..65535 )
        UNITS      "seconds"
        MAX-ACCESS read-write
        STATUS     deprecated
        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.

                This object has been replaced by
                bgpPeerAfHoldTimeConfigured."
        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     deprecated
        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 periodic KEEPALIVE messages are sent
                 to the peer after the BGP connection has
                 been established.  The suggested value for
                 this timer is 30 seconds.

                 This object has been replaced by
                 bgpPeerAfKeepAliveConfigured."
        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     deprecated
    DESCRIPTION
            "Time interval (in seconds) for the
             MinASOriginationInterval timer.
             The suggested value for this timer is 15
             seconds.

             This object has been replaced by
             bgpPeerAfMinASOrigInterval."
    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     deprecated
    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.

             This object has been replaced by
             bgpPeerAfMinRouteAdverInterval."
    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     deprecated
    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).

             This object has been replaced by
             bgpPeerAfInUpdatesElapsedTime."
    REFERENCE
            "RFC 4271, Section 4.3.
```

```
                RFC 4271, Section 8.2.2, Established state."
    ::= { bgpPeerEntry 24 }


-- 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 = ASNumber / 256;
                second-byte-of-pair = ASNumber & 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     deprecated
    DESCRIPTION
            "The BGP-4 Received Path Attribute Table
             contains information about paths to
             destination networks, received from all
             BGP4 peers.

             This table has been replaced by the functionality
             provided under the bgpRib OID."
    ::= { bgp 6 }

bgp4PathAttrEntry OBJECT-TYPE
    SYNTAX     Bgp4PathAttrEntry
```

```
    MAX-ACCESS not-accessible
    STATUS     deprecated
    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     deprecated
    DESCRIPTION
            "The IP address of the peer where the path
             information was learned.

             This object has been replaced by the following
```

```
            tuples of objects: bgpPeerAfInstance,
            bgpPeerAfLocalAddrType, bgpPeerAfLocalAddr,
            bgpPeerAfRemoteAddrType, bgpPeerAfRemoteAddr."
    ::= { bgp4PathAttrEntry 1 }

bgp4PathAttrIpAddrPrefixLen OBJECT-TYPE
    SYNTAX     Integer32 (0..32)
    MAX-ACCESS read-only
    STATUS     deprecated
    DESCRIPTION
            "Length in bits of the IP address prefix in
             the Network Layer Reachability
             Information field.

             This object has been replaced by bgpNlriPrefixLen."
    ::= { bgp4PathAttrEntry 2 }

bgp4PathAttrIpAddrPrefix OBJECT-TYPE
    SYNTAX     IpAddress
    MAX-ACCESS read-only
    STATUS     deprecated
    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.

             This object has been replaced by bgpNlriPrefixType
             and bgpNlriPrefix."
    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     deprecated
    DESCRIPTION
            "The ultimate origin of the path
```

```
                information.

                This object has been replaced by bgpAfPathAttrOrigin."
        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     deprecated
        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:

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

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

                 This object has been replaced by the bgpAsPathTable
                 and supplemented by a human readable object,
                 bgpAsPathString."
        REFERENCE
                "RFC 4271, Section 4.3.
```

```
                RFC 4271, Section 5.1.2."
        ::= { bgp4PathAttrEntry 5 }

    bgp4PathAttrNextHop OBJECT-TYPE
        SYNTAX     IpAddress
        MAX-ACCESS read-only
        STATUS     deprecated
        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.

                 This object has been replaced by
                 bgpAfPathAttrNextHop."
        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     deprecated
        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:
                 o The BGP-4 specification uses an
                   unsigned 32 bit number.  Thus, this
                   object cannot represent the full
                   range of the protocol.

                 This object has been replaced by bgpAfPathAttrMed
                 and bgpAfPathAttrMedPresent."
        REFERENCE
                "RFC 4271, Section 4.3.
                 RFC 4271, Section 5.1.4."
        ::= { bgp4PathAttrEntry 7 }

    bgp4PathAttrLocalPref OBJECT-TYPE
        SYNTAX     Integer32 (-1..2147483647)
        MAX-ACCESS read-only
        STATUS     deprecated
        DESCRIPTION
                "The originating BGP4 speaker's degree of
```

```
                preference 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.

                This object has been replaced by bgpAfPathAttrLocalPref."
        REFERENCE
                "RFC 4271, Section 4.3.
                 RFC 4271, Section 5.1.5."
        ::= { bgp4PathAttrEntry 8 }

    bgp4PathAttrAtomicAggregate OBJECT-TYPE
        SYNTAX     INTEGER {
                       lessSpecificRouteNotSelected(1),
                           -- Typo corrected from RFC 1657
                       lessSpecificRouteSelected(2)
                   }
        MAX-ACCESS read-only
        STATUS     deprecated
        DESCRIPTION
                "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.

                 This object has been replaced by
                 bgpAfPathAttrAtomicAggregate."
        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     deprecated
        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.

                This object has been replaced by
                bgpAfPathAttrAggregatorAS."
        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     deprecated
        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.

                 This object has been replaced by
                 bgpAfPathAttrAggregatorAddr."
        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     deprecated
        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.

                 This object has been replaced by
                 bgpNlriCalcLocalPref."
        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     deprecated
    DESCRIPTION
            "An indication of whether this route
             was chosen as the best BGP4 route for this
             destination.

             This object has been replaced by bgpNlriBest."
    REFERENCE
            "RFC 4271, Section 9.1.2."
    ::= { bgp4PathAttrEntry 13 }

bgp4PathAttrUnknown OBJECT-TYPE
    SYNTAX     OCTET STRING (SIZE(0..255))
    MAX-ACCESS read-only
    STATUS     deprecated
    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.

             This object has been replaced by the contents of
             bgpAfPathAttrUnknownTable."
    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.

bgpEstablishedNotification NOTIFICATION-TYPE
    OBJECTS { bgpPeerRemoteAddr,
              bgpPeerLastError,
              bgpPeerState      }
    STATUS  deprecated
    DESCRIPTION
            "The bgpEstablishedNotification event is generated
             when the BGP FSM enters the established state.

             This Notification replaces the bgpEstablished
             Notification and has been replaced by
             bgpAfEstablishedNotification."
    ::= { bgpNotification 1 }

bgpBackwardTransNotification NOTIFICATION-TYPE
    OBJECTS { bgpPeerRemoteAddr,
              bgpPeerLastError,
              bgpPeerState      }
    STATUS  deprecated
    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 and has
             been replaced by bgpAfBackwardsNotification."
    ::= { 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 }


-- Obsolete Compliance statements

bgp4MIBCompliance MODULE-COMPLIANCE
    STATUS  obsolete
    DESCRIPTION
            "The compliance statement for entities which
             implement the BGP4 mib.

             This compliance statement is obsoleted by
             bgpAfMIBCompliance."
    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  obsolete
    DESCRIPTION
            "The compliance statement documenting deprecated
             objects in the BGP4 mib.

             This compliance statement is obsoleted
             by bgpAfMIBCompliance."
    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  obsolete
    DESCRIPTION
            "A collection of objects providing
             information on global BGP state.

             This group has been replaced by
             bgpAfMIBGlobalsGroup and bgpAfMIBOldGlobalsGroup."
    ::= { 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  deprecated
    DESCRIPTION
            "A collection of objects for managing BGP peers
             from the previous version of this MIB.  The
             individual objects are deprecated and their support
             is OPTIONAL."
    ::= { 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  deprecated
    DESCRIPTION
            "A collection of objects for managing BGP path
             entries from the previous version of this MIB.  This
```

```
                individual objects are deprecated and their support
                is OPTIONAL."
        ::= { bgp4MIBGroups 4 }

    bgp4MIBTrapGroup NOTIFICATION-GROUP
        NOTIFICATIONS { bgpEstablished,
                        bgpBackwardTransition }
        STATUS  deprecated
        DESCRIPTION
                "A collection of notifications for signaling
                 changes in BGP peer relationships.

                 Obsoleted by bgp4MIBNotificationGroup.  Support of
                 the objects in this group is OPTIONAL."
        ::= { bgp4MIBGroups 5 }

    bgp4MIBNotificationGroup NOTIFICATION-GROUP
        NOTIFICATIONS { bgpEstablishedNotification,
                        bgpBackwardTransNotification }
        STATUS deprecated
        DESCRIPTION
                "A collection of notifications for signaling
                 changes in BGP peer relationships.

                 Obsoletes bgp4MIBTrapGroup.  Obsoleted by
                 bgpAfMIBNotificationGroup.  Support for objects in
                 this group is OPTIONAL."
        ::= { bgp4MIBGroups 6 }

    bgpAfMIBNotificationGroup NOTIFICATION-GROUP
        NOTIFICATIONS { bgpAfEstablishedNotification,
                        bgpAfBackwardTransitionNotification }
        STATUS current
        DESCRIPTION
                "A collection of notifications for signaling
                 changes in BGP peer relationships.

                 Obsoletes bgp4MIBNotificationGroup."
        ::= { bgp4MIBGroups 7 }

END
```

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8. 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 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:

> 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.
>
> 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.
>
> 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.
>
> 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.

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:

- bgpPeerAfLocalAddrType, bgpPeerAfLocalAddr,bgpPeerAfLocalPort bgpPeerAfRemoteAddrType, bgpPeerAfRemoteAddr, bgpPeerAfRemotePort, bgpPeerLocalAddr, bgpPeerLocalPort, bgpPeerRemoteAddr, bgpPeerRemotePort - 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.

Note that other tables which share elements of these objects as indexes may similarly expose sensitive information.

*bgpNlriTable, bgpAdjRibsOutTable, bgpAfPathAttrTable, bgpAsPathTable, bgpRcvdPathAttrTable, bgp4PathAttrTable - A BGP peer's routing information may be sensitive for ISPs as the contents of their routing tables may expose details related to business relationships as implemented in Internet routing.

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] (Case, J., Mundy, R., Partain, D., and B. Stewart, "Introduction and Applicability Statements for Internet-Standard Management Framework," December 2002.), 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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9. IANA Considerations

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This document includes an OID, bgpExtensions, which defines a name space for future BGP extensions. IANA is requested to create a new registry for new OIDs under bgpExtensions that will define the root OID of future MIB modules for bgp extensions. The assignment OIDs should be done based upon IDR working group consensus.

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10. Contributors

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I owe particular thanks to Susan Hares as a mentor who let me dive head-first into the world of Internet standards work by saying, "We have this MIB that just needs a little cleanup to advance in the standards process."

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12. References

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12.1. Normative References

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