             OSPF Version 2 Management Information Base

Status of this Memo

   This document specifies an Internet standards track protocol for the
   Internet community, and requests discussion and suggestions for
   improvements. Please refer to the current edition of the "Internet
   Official Protocol Standards" (STD 1) for the standardization state
   and status of this protocol. Distribution of this memo is unlimited.

Abstract

   This memo defines a portion of the Management Information Base (MIB)
   for use with network management protocols in TCP/IP-based internets.
   In particular, it defines objects for managing the Open Shortest Path
   First Routing Protocol.

Table of Contents

1. The SNMPv2 Network Management Framework

    The SNMPv2 Network Management Framework consists of four major
    components. They are:

        o RFC 1441 which defines the SMI, the mechanisms used for
          describing and naming objects for the purpose of
          management.

        o STD 17, RFC 1213 defines MIB-II, the core set of managed objects
          for the Internet suite of protocols.

        o RFC 1445 which defines the administrative and other
          architectural aspects of the framework.

        o RFC 1448 which defines the protocol used for network
          access to managed objects.

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

1.1. Object Definitions

   Managed objects are accessed via a virtual information store, termed
   the Management Information Base or MIB. Objects in the MIB are
   defined using the subset of Abstract Syntax Notation One (ASN.1)
   defined in the SMI. In particular, each object object type is named
   by an OBJECT IDENTIFIER, an administratively assigned name. The
   object type together with an object instance serves to uniquely
   identify a specific instantiation of the object. For human
   convenience, we often use a textual string, termed the descriptor, to
   refer to the object type.

2. Overview

2.1. Changes from RFC 1253

   The changes from RFC 1253 are the following:

   (1)   The textual convention PositiveInteger was changed from
          1..'FFFFFFFF'h to 1..'7FFFFFFF'h at the request of
          Marshall Rose.

   (2)   The textual convention TOSType was changed to reflect the
          TOS values defined in the Router Requirements Draft, and
          in accordance with the IP Forwarding Table MIB's values.

   (3)   The names of some objects were changed, conforming to the
          convention that an acronym (for example, LSA) is a single
          word ("Lsa") in most SNMP names.

   (4)   textual changes were made to make the MIB readable by
          Dave Perkins' SMIC MIB Compiler in addition to Mosy.
          This involved changing the case of some characters in
          certain names and removing the DEFVAL clauses for
          Counters.

   (5)   The variables ospfAreaStatus and ospfIfStatus were added,
          having been overlooked in the original MIB.

   (6)   The range of the variable ospfLsdbType was extended to
          include multicastLink (Group-membership LSA) and
          nssaExternalLink (NSSA LSA).

   (7)   The variable ospfIfMetricMetric was renamed
          ospfIfMetricValue, and the following text was removed
          from its description:

          "The value FFFF is distinguished to mean 'no route via

this TOS'."

(8) The variable ospfNbmaNbrPermanence was added, with the
     values 'dynamic' and 'permanent'; by this means,
     dynamically learned and configured neighbors can be
     distinguished.

(9) The DESCRIPTION of the variable ospfNbrIpAddr was changed
     from

     "The IP address of this neighbor."

     to

     "The IP address this neighbor is using in its IP Source
     Address. Note that, on addressless links, this will not
     be 0.0.0.0, but the address of another of the neighbor's
     interfaces."

     This is by way of clarification and does not change the
     specification.

(10) The OSPF External Link State Database was added. The
     OSPF Link State Database used to display all LSAs stored;
     in this MIB, it displays all but the AS External LSAs.
     This is because there are usually a large number of
     External LSAs, and they are relicated in all non-Stub
     Areas.

(11) The variable ospfAreaSummary was added to control the
     import of summary LSAs into stub areas. If it is
     noAreaSummary (default) the router will neither originate
     nor propagate summary LSAs into the stub area. It will
     rely entirely on its default route. If it is
     sendAreaSummary, the router will both summarize and
     propagate summary LSAs.

(12) The general variables ospfExtLsdbLimit and
     ExitOverflowInterval were introduced to help handle LSDB
     overflow.

(13) The use of the IP Forwarding Table is defined.

(14) The ospfAreaRangeTable was obsoleted and replaced with
     the ospfAreaAggregateTable to accommodate two additional
     indexes. The ospfAreaAggregateEntry keys now include a
     LsdbType (which can be used to differentiate between the
     traditional type-3 Aggregates and NSSA Aggregates) and an

ospfAreaAggregateMask (which will more clearly express
the range).

(15) The variable ospfAreaAggregateEffect was added. This
permits the network manager to hide a subnet within an
area.

(16) Normally, the border router of a stub area advertises a
default route as an OSPF network summary. An NSSA border
router will generate a type-7 LSA indicating a default
route, and import it into the NSSA. ospfStubMetricType
(ospf internal, type 1 external, or type 2 external)
indicates the type of the default metric advertised.

(17) ospfMulticastExtensions is added to the OSPF General
Group. This indicates the router's ability to forward IP
multicast (Class D) datagrams.

(18) ospfIfMulticastForwarding is added to the Interface
Group. It indicates whether, and if so, how, multicasts
should be forwarded on the interface.

(19) The MIB is converted to SNMP Version 2. Beyond simple
text changes and the addition of the MODULE-IDENTITY and
MODULE-COMPLIANCE macros, this involved trading the
TruthValue Textual Convention for SNMP Version 2's, which
has the same values, and trading the Validation Textual
Convention for SNMP Version 2's RowStatus.

(20) ospfAuthType (area authentication type) was changed to an
interface authentication type to match the key. It also
has an additional value, to indicate the use of MD5 for
authentication.

(21) ospfIfIntfType has a new value, pointToMultipoint.

(22) ospfIfDemand (read/write) is added, to permit control of
Demand OSPF features.

(23) ospfNbrHelloSuppressed and ospfVirtNbrHelloSuppressed
were added, (read only). They indicate whether Hellos are
being suppressed to the neighbor.

(24) ospfDemandExtensions was added to indicate whether the
Demand OSPF extensions have been implemented, and to
disable them if appropriate.

2.2. Textual Conventions

   Several new data types are introduced as a textual convention in this
   MIB document. These textual conventions enhance the readability of
   the specification and can ease comparison with other specifications
   if appropriate. It should be noted that the introduction of the
   these textual conventions has no effect on either the syntax nor the
   semantics of any managed objects. The use of these is merely an
   artifact of the explanatory method used. Objects defined in terms of
   one of these methods are always encoded by means of the rules that
   define the primitive type. Hence, no changes to the SMI or the SNMP
   are necessary to accommodate these textual conventions which are
   adopted merely for the convenience of readers and writers in pursuit
   of the elusive goal of clear, concise, and unambiguous MIB documents.

   The new data types are AreaID, RouterID, TOSType, Metric, BigMetric,
   Status, PositiveInteger, HelloRange, UpToMaxAge, InterfaceIndex, and
   DesignatedRouterPriority.

2.3. Structure of MIB

   The MIB is composed of the following sections:

      General Variables
      Area Data Structure
      Area Stub Metric Table
      Link State Database
      Address Range Table
      Host Table
      Interface Table
      Interface Metric Table
      Virtual Interface Table
      Neighbor Table
      Virtual Neighbor Table
      External Link State Database
      Aggregate Range Table

   There exists a separate MIB for notifications ("traps"), which is
   entirely optional.

2.3.1. General Variables

   The General Variables are about what they sound like; variables which
   are global to the OSPF Process.

2.3.2. Area Data Structure and Area Stub Metric Table

   The Area Data Structure describes the OSPF Areas that the router
   participates in. The Area Stub Metric Table describes the metrics
   advertised into a stub area by the default router(s).

2.3.3. Link State Database and External Link State Database

   The Link State Database is provided primarily to provide detailed
   information for network debugging.

2.3.4. Address Table and Host Tables

   The Address Range Table and Host Table are provided to view
   configured Network Summary and Host Route information.

2.3.5. Interface and Interface Metric Tables

   The Interface Table and the Interface Metric Table together describe
   the various IP interfaces to OSPF. The metrics are placed in
   separate tables in order to simplify dealing with multiple types of
   service, and to provide flexibility in the event that the IP TOS
   definition is changed in the future. A Default Value specification
   is supplied for the TOS 0 (default) metric.

2.3.6. Virtual Interface Table

   Likewise, the Virtual Interface Table describe virtual links to the
   OSPF Process.

2.3.7. Neighbor and Virtual Neighbor Tables

   The Neighbor Table and the Virtual Neighbor Table describe the
   neighbors to the OSPF Process.

2.4. Conceptual Row Creation

   For the benefit of row-creation in "conceptual" (see [9]) tables,
   DEFVAL (Default Value) clauses are included in the definitions in
   section 3, suggesting values which an agent should use for instances
   of variables which need to be created due to a Set-Request, but which
   are not specified in the Set-Request. DEFVAL clauses have not been
   specified for some objects which are read-only, implying that they
   are zeroed upon row creation. These objects are of the SYNTAX
   Counter32 or Gauge32.

   For those objects not having a DEFVAL clause, both management
   stations and agents should heed the Robustness Principle of the

Internet (see RFC-791):

    "be liberal in what you accept, conservative in what you
    send"

That is, management stations should include as many of these columnar
objects as possible (e.g., all read-write objects) in a Set-Request
when creating a conceptual row; agents should accept a Set-Request
with as few of these as they need (e.g., the minimum contents of a
row creating SET consists of those objects for which, as they cannot
be intuited, no default is specified.).

There are numerous read-write objects in this MIB, as it is designed
for SNMP management of the protocol, not just SNMP monitoring of its
state. However, in the absence of a standard SNMP Security
architecture, it is acceptable for implementations to implement these
as read-only with an alternative interface for their modification.

2.5. Default Configuration

OSPF is a powerful routing protocol, equipped with features to handle
virtually any configuration requirement that might reasonably be
found within an Autonomous System. With this power comes a fair
degree of complexity, which the sheer number of objects in the MIB
will attest to. Care has therefore been taken, in constructing this
MIB, to define default values for virtually every object, to minimize
the amount of parameterization required in the typical case. That
default configuration is as follows:

Given the following assumptions:

-     IP has already been configured

-     The ifTable has already been configured

-     ifSpeed is estimated by the interface drivers

-     The OSPF Process automatically discovers all IP
      Interfaces and creates corresponding OSPF Interfaces

-     The TOS 0 metrics are autonomously derived from ifSpeed

-     The OSPF Process automatically creates the Areas required
      for the Interfaces

The simplest configuration of an OSPF process requires that:

-     The OSPF Process be Enabled.

This can be accomplished with a single SET:

                  ospfAdminStat := enabled.

The configured system will have the following attributes:

-    The RouterID will be one of the IP addresses of the
     device

-    The device will be neither an Area Border Router nor an
     Autonomous System Border Router.

-    Every IP Interface, with or without an address, will be
     an OSPF Interface.

-    The AreaID of each interface will be 0.0.0.0, the
     Backbone.

-    Authentication will be disabled

-    All Broadcast and Point to Point interfaces will be
     operational. NBMA Interfaces require the configuration
     of at least one neighbor.

-    Timers on all direct interfaces will be:

        Hello Interval: 10 seconds
        Dead Timeout: 40 Seconds
        Retransmission: 5 Seconds
        Transit Delay: 1 Second
        Poll Interval: 120 Seconds

-    no direct links to hosts will be configured.

-    no addresses will be summarized

-    Metrics, being a measure of bit duration, are unambiguous
     and intelligent.

-    No Virtual Links will be configured.

3. Definitions

OSPF-MIB DEFINITIONS ::= BEGIN

        IMPORTS
                MODULE-IDENTITY, OBJECT-TYPE, Counter32, Gauge32,
                Integer32, IpAddress
                    FROM SNMPv2-SMI
                TEXTUAL-CONVENTION, TruthValue, RowStatus
                    FROM SNMPv2-TC
                MODULE-COMPLIANCE, OBJECT-GROUP   FROM SNMPv2-CONF
                mib-2   FROM RFC1213-MIB;

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

ospf MODULE-IDENTITY
          LAST-UPDATED "9501201225Z" -- Fri Jan 20 12:25:50 PST 1995
          ORGANIZATION "IETF OSPF Working Group"
          CONTACT-INFO
        "   Fred Baker
        Postal: Cisco Systems
                519 Lado Drive
                Santa Barbara, California 93111
        Tel: +1 805 681 0115
        E-Mail: fred@cisco.com

                Rob Coltun
        Postal: RainbowBridge Communications
        Tel: (301) 340-9416
        E-Mail: rcoltun@rainbow-bridge.com"
     DESCRIPTION
        "The MIB module to describe the OSPF Version 2
        Protocol"
     ::= { mib-2 14 }

--   The Area ID, in OSPF, has the same format as an IP Address,
--   but has the function of defining a summarization point for
--   Link State Advertisements

AreaID ::= TEXTUAL-CONVENTION
    STATUS   current
    DESCRIPTION
        "An OSPF Area Identifier."
    SYNTAX   IpAddress

--   The Router ID, in OSPF, has the same format as an IP Address,

```
--   but identifies the router independent of its IP Address.

RouterID ::= TEXTUAL-CONVENTION
    STATUS        current
    DESCRIPTION
        "A OSPF Router Identifier."
    SYNTAX        IpAddress


--   The OSPF Metric is defined as an unsigned value in the range

Metric ::= TEXTUAL-CONVENTION
    STATUS        current
    DESCRIPTION
        "The OSPF Internal Metric."
    SYNTAX        Integer32 (0..'FFFF'h)

BigMetric ::= TEXTUAL-CONVENTION
    STATUS        current
    DESCRIPTION
        "The OSPF External Metric."
    SYNTAX        Integer32 (0..'FFFFFF'h)

--   Status Values

Status ::= TEXTUAL-CONVENTION
    STATUS        current
    DESCRIPTION
        "The status of an interface: 'enabled' indicates that
        it is willing to communicate with other OSPF Routers,
        while 'disabled' indicates that it is not."
    SYNTAX        INTEGER { enabled (1), disabled (2) }

--   Time Durations measured in seconds

PositiveInteger ::= TEXTUAL-CONVENTION
    STATUS        current
    DESCRIPTION
        "A positive integer. Values in excess are precluded as
        unnecessary and prone to interoperability issues."
    SYNTAX        Integer32 (0..'7FFFFFFF'h)

HelloRange ::= TEXTUAL-CONVENTION
    STATUS        current
    DESCRIPTION
        "The range of intervals on which hello messages are
        exchanged."
    SYNTAX        Integer32 (1..'FFFF'h)
```

UpToMaxAge ::= TEXTUAL-CONVENTION
    STATUS   current
    DESCRIPTION
       "The values that one might find or configure for
       variables bounded by the maximum age of an LSA."
    SYNTAX   Integer32 (0..3600)

-- The range of ifIndex

InterfaceIndex ::= TEXTUAL-CONVENTION
    STATUS   current
    DESCRIPTION
       "The range of ifIndex."
    SYNTAX   Integer32

-- Potential Priorities for the Designated Router Election

DesignatedRouterPriority ::= TEXTUAL-CONVENTION
    STATUS   current
    DESCRIPTION
       "The values defined for the priority of a system for
       becoming the designated router."
    SYNTAX   Integer32 (0..'FF'h)

TOSType ::= TEXTUAL-CONVENTION
    STATUS   current
    DESCRIPTION
       "Type of Service is defined as a mapping to the IP Type of
       Service Flags as defined in the IP Forwarding Table MIB

        +-----+-----+-----+-----+-----+-----+-----+-----+
        | | | | |
        | PRECEDENCE | TYPE OF SERVICE | 0 |
        | | | | |
        +-----+-----+-----+-----+-----+-----+-----+-----+

               IP TOS   IP TOS
           Field   Policy   Field   Policy

           Contents   Code   Contents   Code
           0 0 0 0   ==>   0   0 0 0 1   ==>   2
           0 0 1 0   ==>   4   0 0 1 1   ==>   6
           0 1 0 0   ==>   8   0 1 0 1   ==>   10
           0 1 1 0   ==>   12   0 1 1 1   ==>   14
           1 0 0 0   ==>   16   1 0 0 1   ==>   18
           1 0 1 0   ==>   20   1 0 1 1   ==>   22

```
            1 1 0 0  ==>  24      1 1 0 1  ==>  26
            1 1 1 0  ==>  28      1 1 1 1  ==>  30

       The remaining values are left for future definition."
     SYNTAX       Integer32 (0..30)


--   OSPF General Variables

--       These parameters apply globally to the Router's
--       OSPF Process.

ospfGeneralGroup OBJECT IDENTIFIER ::= { ospf 1 }


     ospfRouterId OBJECT-TYPE
        SYNTAX    RouterID
        MAX-ACCESS    read-write
        STATUS    current
        DESCRIPTION
           "A  32-bit  integer  uniquely  identifying  the
           router in the Autonomous System.

           By  convention,  to  ensure  uniqueness,   this
           should  default  to  the  value  of  one of the
           router's IP interface addresses."
        REFERENCE
           "OSPF Version 2, C.1 Global parameters"
       ::= { ospfGeneralGroup 1 }


     ospfAdminStat OBJECT-TYPE
        SYNTAX    Status
        MAX-ACCESS    read-write
        STATUS    current
        DESCRIPTION
           "The  administrative  status  of  OSPF  in  the
           router.   The  value 'enabled' denotes that the
           OSPF Process is active on at least  one  inter-
           face;  'disabled'  disables  it  on  all inter-
           faces."
       ::= { ospfGeneralGroup 2 }

     ospfVersionNumber OBJECT-TYPE
        SYNTAX    INTEGER    { version2 (2) }
        MAX-ACCESS    read-only
        STATUS    current
        DESCRIPTION
```

```
          "The current version number of the OSPF  proto-
          col is 2."
      REFERENCE
         "OSPF Version 2, Title"
    ::= { ospfGeneralGroup 3 }


   ospfAreaBdrRtrStatus OBJECT-TYPE
      SYNTAX    TruthValue
      MAX-ACCESS    read-only
      STATUS    current
      DESCRIPTION
         "A flag to note whether this router is an  area
         border router."
      REFERENCE
         "OSPF Version 2, Section 3 Splitting the AS into
         Areas"
    ::= { ospfGeneralGroup 4 }


   ospfASBdrRtrStatus OBJECT-TYPE
      SYNTAX    TruthValue
      MAX-ACCESS    read-write
      STATUS    current
      DESCRIPTION
         "A flag to note whether this router is  config-
         ured as an Autonomous System border router."
      REFERENCE
         "OSPF Version 2, Section 3.3  Classification  of
         routers"
    ::= { ospfGeneralGroup 5 }

   ospfExternLsaCount OBJECT-TYPE
      SYNTAX    Gauge32
      MAX-ACCESS    read-only
      STATUS    current
      DESCRIPTION
         "The number of external (LS type 5)  link-state
         advertisements in the link-state database."
      REFERENCE
         "OSPF Version 2, Appendix A.4.5 AS external link
         advertisements"
    ::= { ospfGeneralGroup 6 }


   ospfExternLsaCksumSum OBJECT-TYPE
      SYNTAX    Integer32
      MAX-ACCESS    read-only
```

```
              STATUS    current
              DESCRIPTION
                 "The 32-bit unsigned sum of the LS checksums of
                 the   external  link-state  advertisements  con-
                 tained in the link-state  database.   This  sum
                 can  be  used  to determine if there has been a
                 change in a router's link state  database,  and
                 to  compare  the  link-state  database  of  two
                 routers."
           ::= { ospfGeneralGroup 7 }


      ospfTOSSupport OBJECT-TYPE
          SYNTAX    TruthValue
          MAX-ACCESS    read-write
          STATUS    current
          DESCRIPTION
             "The router's support for type-of-service rout-
             ing."
         REFERENCE
             "OSPF Version 2,  Appendix  F.1.2  Optional  TOS
             support"
        ::= { ospfGeneralGroup 8 }

      ospfOriginateNewLsas OBJECT-TYPE
          SYNTAX    Counter32
          MAX-ACCESS    read-only
          STATUS    current
          DESCRIPTION
             "The number of  new  link-state  advertisements
             that  have been originated.  This number is in-
             cremented each time the router originates a new
             LSA."
         ::= { ospfGeneralGroup 9 }


      ospfRxNewLsas OBJECT-TYPE
          SYNTAX    Counter32
          MAX-ACCESS    read-only
          STATUS    current
          DESCRIPTION
             "The number of  link-state  advertisements  re-
             ceived  determined  to  be  new instantiations.
             This number does not include  newer  instantia-
             tions  of self-originated link-state advertise-
             ments."
         ::= { ospfGeneralGroup 10 }
```

```
ospfExtLsdbLimit OBJECT-TYPE
    SYNTAX   Integer32 (-1..'7FFFFFFF'h)
    MAX-ACCESS   read-write
    STATUS   current
    DESCRIPTION
        "The  maximum   number   of   non-default  AS-
        external-LSAs entries that can be stored in the
        link-state database.  If the value is -1,  then
        there is no limit.

        When the number of non-default AS-external-LSAs
        in   a  router's  link-state  database  reaches
        ospfExtLsdbLimit, the  router    enters  Overflow-
        State.   The   router   never   holds   more  than
        ospfExtLsdbLimit  non-default  AS-external-LSAs
        in  its  database. OspfExtLsdbLimit MUST be set
        identically in all routers attached to the OSPF
        backbone  and/or  any  regular OSPF area. (i.e.,
        OSPF stub areas and NSSAs are excluded)."
    DEFVAL { -1 }
    ::= { ospfGeneralGroup 11 }

ospfMulticastExtensions OBJECT-TYPE
    SYNTAX   Integer32
    MAX-ACCESS   read-write
    STATUS   current
    DESCRIPTION
        "A Bit Mask indicating whether  the  router  is
        forwarding  IP multicast (Class D) datagrams
        based on the algorithms defined in  the  Multi-
        cast Extensions to OSPF.

        Bit 0, if set, indicates that  the  router  can
        forward  IP multicast datagrams in the router's
        directly attached areas (called intra-area mul-
        ticast routing).

        Bit 1, if set, indicates that  the  router  can
        forward  IP  multicast  datagrams  between  OSPF
        areas (called inter-area multicast routing).

        Bit 2, if set, indicates that  the  router  can
        forward  IP  multicast  datagrams between Auto-
        nomous Systems (called inter-AS multicast rout-
        ing).

        Only certain combinations of bit  settings  are
        allowed,  namely: 0 (no multicast forwarding is
```

```
          enabled), 1 (intra-area multicasting  only),  3
          (intra-area  and  inter-area  multicasting),  5
          (intra-area and inter-AS  multicasting)  and  7
          (multicasting  everywhere). By default, no mul-
          ticast forwarding is enabled."
       DEFVAL { 0 }
       ::= { ospfGeneralGroup 12 }

   ospfExitOverflowInterval OBJECT-TYPE
       SYNTAX   PositiveInteger
       MAX-ACCESS   read-write
       STATUS   current
       DESCRIPTION
          "The number of  seconds  that,  after  entering
          OverflowState,  a  router will attempt to leave
          OverflowState. This allows the router to  again
          originate  non-default  AS-external-LSAs.  When
          set to 0, the router will not  leave  Overflow-
          State until restarted."
       DEFVAL { 0 }
       ::= { ospfGeneralGroup 13 }

   ospfDemandExtensions OBJECT-TYPE
       SYNTAX   TruthValue
       MAX-ACCESS   read-write
       STATUS   current
       DESCRIPTION
          "The router's support for demand routing."
       REFERENCE
          "OSPF Version 2, Appendix on Demand Routing"
       ::= { ospfGeneralGroup 14 }

--      The OSPF Area Data Structure contains information
--      regarding the various areas. The interfaces and
--      virtual links are configured as part of these areas.
--      Area 0.0.0.0, by definition, is the Backbone Area

   ospfAreaTable OBJECT-TYPE
       SYNTAX   SEQUENCE OF OspfAreaEntry
       MAX-ACCESS   not-accessible
       STATUS   current
       DESCRIPTION
          "Information describing the configured  parame-
          ters  and cumulative statistics of the router's
          attached areas."
```

```
         REFERENCE
            "OSPF Version 2, Section 6  The Area Data Struc-
            ture"
        ::= { ospf 2 }


    ospfAreaEntry OBJECT-TYPE
        SYNTAX   OspfAreaEntry
        MAX-ACCESS   not-accessible
        STATUS   current
        DESCRIPTION
           "Information describing the configured  parame-
           ters  and  cumulative  statistics of one of the
           router's attached areas."
        INDEX { ospfAreaId }
        ::= { ospfAreaTable 1 }

OspfAreaEntry ::=
    SEQUENCE {
        ospfAreaId
            AreaID,
        ospfAuthType
            Integer32,
        ospfImportAsExtern
            INTEGER,
        ospfSpfRuns
            Counter32,
        ospfAreaBdrRtrCount
            Gauge32,
        ospfAsBdrRtrCount
            Gauge32,
        ospfAreaLsaCount
            Gauge32,
        ospfAreaLsaCksumSum
            Integer32,
        ospfAreaSummary
            INTEGER,
        ospfAreaStatus
            RowStatus
              }

    ospfAreaId OBJECT-TYPE
        SYNTAX   AreaID
        MAX-ACCESS   read-only
        STATUS   current
        DESCRIPTION
           "A 32-bit integer uniquely identifying an area.
           Area ID 0.0.0.0 is used for the OSPF backbone."
```

```
        REFERENCE
           "OSPF Version 2, Appendix C.2 Area parameters"
       ::= { ospfAreaEntry 1 }


   ospfAuthType OBJECT-TYPE
       SYNTAX   Integer32
                   -- none (0),
                   -- simplePassword (1)
                   -- md5 (2)
                   -- reserved for specification by IANA (> 2)
       MAX-ACCESS   read-create
       STATUS   obsolete
       DESCRIPTION
          "The authentication type specified for an area.
          Additional authentication types may be assigned
          locally on a per Area basis."
        REFERENCE
           "OSPF Version 2, Appendix E Authentication"
      DEFVAL { 0 }         -- no authentication, by default
       ::= { ospfAreaEntry 2 }

   ospfImportAsExtern OBJECT-TYPE
       SYNTAX    INTEGER    {
                   importExternal (1),
                   importNoExternal (2),
                   importNssa (3)
                 }
       MAX-ACCESS   read-create
       STATUS    current
       DESCRIPTION
          "The area's support for importing  AS  external
          link- state advertisements."
        REFERENCE
           "OSPF Version 2, Appendix C.2 Area parameters"
      DEFVAL { importExternal }
       ::= { ospfAreaEntry 3 }


   ospfSpfRuns OBJECT-TYPE
       SYNTAX   Counter32
       MAX-ACCESS   read-only
       STATUS   current
       DESCRIPTION
          "The number of  times  that  the  intra-area  route
          table  has  been  calculated  using this area's
          link-state database. This  is  typically  done
          using Dijkstra's algorithm."
```

```
         ::= { ospfAreaEntry 4 }


    ospfAreaBdrRtrCount OBJECT-TYPE
        SYNTAX   Gauge32
        MAX-ACCESS   read-only
        STATUS   current
        DESCRIPTION
           "The total number of area border routers reach-
           able within this area.  This is initially zero,
           and is calculated in each SPF Pass."
        ::= { ospfAreaEntry 5 }

    ospfAsBdrRtrCount OBJECT-TYPE
        SYNTAX   Gauge32
        MAX-ACCESS   read-only
        STATUS   current
        DESCRIPTION
           "The total number of Autonomous  System  border
           routers  reachable  within  this  area.  This is
           initially zero, and is calculated in  each  SPF
           Pass."
        ::= { ospfAreaEntry 6 }


    ospfAreaLsaCount OBJECT-TYPE
        SYNTAX   Gauge32
        MAX-ACCESS   read-only
        STATUS   current
        DESCRIPTION
           "The total number of link-state  advertisements
           in  this  area's link-state database, excluding
           AS External LSA's."
        ::= { ospfAreaEntry 7 }


    ospfAreaLsaCksumSum OBJECT-TYPE
        SYNTAX   Integer32
        MAX-ACCESS   read-only
        STATUS   current
        DESCRIPTION
           "The 32-bit unsigned sum of the link-state  ad-
           vertisements'  LS  checksums  contained in this
           area's link-state database.  This sum  excludes
           external (LS type 5) link-state advertisements.
           The sum can be used to determine if  there  has
           been  a  change  in a router's link state data-
           base, and to compare the link-state database of
```

```
                 two routers."
            DEFVAL    { 0 }
            ::= { ospfAreaEntry 8 }


        ospfAreaSummary OBJECT-TYPE
            SYNTAX    INTEGER    {
                        noAreaSummary (1),
                        sendAreaSummary (2)
                    }
            MAX-ACCESS    read-create
            STATUS    current
            DESCRIPTION
               "The variable ospfAreaSummary controls the  im-
               port  of  summary LSAs into stub areas.  It has
               no effect on other areas.

               If it is noAreaSummary, the router will neither
               originate  nor  propagate summary LSAs into the
               stub area.  It will rely entirely  on  its  de-
               fault route.

               If it is sendAreaSummary, the router will  both
               summarize and propagate summary LSAs."
            DEFVAL    { noAreaSummary }
            ::= { ospfAreaEntry 9 }


        ospfAreaStatus OBJECT-TYPE
            SYNTAX    RowStatus
            MAX-ACCESS    read-create
            STATUS    current
            DESCRIPTION
               "This variable displays the status of  the  en-
               try.  Setting it to 'invalid' has the effect of
               rendering it inoperative.  The internal  effect
               (row removal) is implementation dependent."
            ::= { ospfAreaEntry 10 }



-- OSPF Area Default Metric Table

--      The OSPF Area Default Metric Table describes the metrics
--      that a default Area Border Router will advertise into a
--      Stub area.


        ospfStubAreaTable OBJECT-TYPE
            SYNTAX    SEQUENCE OF OspfStubAreaEntry
```

```
        MAX-ACCESS   not-accessible
        STATUS    current
        DESCRIPTION
           "The set of metrics that will be advertised  by
            a default Area Border Router into a stub area."
         REFERENCE
           "OSPF Version 2, Appendix C.2, Area Parameters"
       ::= { ospf 3 }


    ospfStubAreaEntry OBJECT-TYPE
        SYNTAX   OspfStubAreaEntry
        MAX-ACCESS   not-accessible
        STATUS    current
        DESCRIPTION
           "The metric for a given Type  of  Service  that
            will  be  advertised  by  a default Area Border
            Router into a stub area."
         REFERENCE
           "OSPF Version 2, Appendix C.2, Area Parameters"
        INDEX { ospfStubAreaId, ospfStubTOS }
        ::= { ospfStubAreaTable 1 }

OspfStubAreaEntry ::=
    SEQUENCE {
        ospfStubAreaId
            AreaID,
        ospfStubTOS
            TOSType,
        ospfStubMetric
            BigMetric,
        ospfStubStatus
            RowStatus,
        ospfStubMetricType
            INTEGER
              }

    ospfStubAreaId OBJECT-TYPE
        SYNTAX   AreaID
        MAX-ACCESS   read-only
        STATUS    current
        DESCRIPTION
           "The 32 bit identifier for the Stub  Area.   On
            creation,  this  can  be  derived  from the in-
            stance."
         ::= { ospfStubAreaEntry 1 }
```

```
     ospfStubTOS OBJECT-TYPE
         SYNTAX    TOSType
         MAX-ACCESS    read-only
         STATUS    current
         DESCRIPTION
            "The  Type  of  Service  associated  with   the
            metric.   On creation, this can be derived from
            the instance."
        ::= { ospfStubAreaEntry 2 }


     ospfStubMetric OBJECT-TYPE
         SYNTAX    BigMetric
         MAX-ACCESS    read-create
         STATUS    current
         DESCRIPTION
            "The metric value applied at the indicated type
            of  service.  By default, this equals the least
            metric at the type of service among the  inter-
            faces to other areas."
        ::= { ospfStubAreaEntry 3 }


     ospfStubStatus OBJECT-TYPE
         SYNTAX    RowStatus
         MAX-ACCESS    read-create
         STATUS    current
         DESCRIPTION
            "This variable displays the status of  the  en-
            try.  Setting it to 'invalid' has the effect of
            rendering it inoperative.  The internal  effect
            (row removal) is implementation dependent."
        ::= { ospfStubAreaEntry 4 }

     ospfStubMetricType OBJECT-TYPE
         SYNTAX    INTEGER    {
                    ospfMetric (1),              -- OSPF Metric
                    comparableCost (2),      -- external type 1
                    nonComparable  (3)       -- external type 2
                  }
         MAX-ACCESS    read-create
         STATUS    current
         DESCRIPTION
            "This variable displays the type of metric  ad-
            vertised as a default route."
         DEFVAL    { ospfMetric }
        ::= { ospfStubAreaEntry 5 }
```

-- OSPF Link State Database

--   The Link State Database contains the Link State
--   Advertisements from throughout the areas that the
--   device is attached to.

     ospfLsdbTable OBJECT-TYPE
         SYNTAX   SEQUENCE OF OspfLsdbEntry
         MAX-ACCESS   not-accessible
         STATUS   current
         DESCRIPTION
            "The OSPF Process's Link State Database."
        REFERENCE
            "OSPF Version 2, Section 12 Link State Adver-
            tisements"
       ::= { ospf 4 }

     ospfLsdbEntry OBJECT-TYPE
         SYNTAX   OspfLsdbEntry
         MAX-ACCESS   not-accessible
         STATUS   current
         DESCRIPTION
            "A single Link State Advertisement."
        INDEX { ospfLsdbAreaId, ospfLsdbType,
              ospfLsdbLsid, ospfLsdbRouterId }
        ::= { ospfLsdbTable 1 }

OspfLsdbEntry ::=
     SEQUENCE {
         ospfLsdbAreaId
             AreaID,
         ospfLsdbType
             INTEGER,
         ospfLsdbLsid
             IpAddress,
         ospfLsdbRouterId
             RouterID,
         ospfLsdbSequence
             Integer32,
         ospfLsdbAge
             Integer32,
         ospfLsdbChecksum
             Integer32,
         ospfLsdbAdvertisement
             OCTET STRING
               }

```
     ospfLsdbAreaId OBJECT-TYPE
         SYNTAX    AreaID
         MAX-ACCESS    read-only
         STATUS    current
         DESCRIPTION
            "The 32 bit identifier of the Area  from  which
            the LSA was received."
         REFERENCE
            "OSPF Version 2, Appendix C.2 Area parameters"
        ::= { ospfLsdbEntry 1 }

-- External Link State Advertisements are permitted
-- for backward compatibility, but should be displayed in
-- the ospfExtLsdbTable rather than here.

     ospfLsdbType OBJECT-TYPE
         SYNTAX    INTEGER    {
                    routerLink (1),
                    networkLink (2),
                    summaryLink (3),
                    asSummaryLink (4),
                    asExternalLink (5), -- but see ospfExtLsdbTable
                    multicastLink (6),
                    nssaExternalLink (7)
                   }
         MAX-ACCESS    read-only
         STATUS    current
         DESCRIPTION
            "The type  of  the  link  state  advertisement.
            Each  link state type has a separate advertise-
            ment format."
         REFERENCE
            "OSPF Version 2, Appendix A.4.1 The  Link  State
            Advertisement header"
        ::= { ospfLsdbEntry 2 }

     ospfLsdbLsid OBJECT-TYPE
         SYNTAX    IpAddress
         MAX-ACCESS    read-only
         STATUS    current
         DESCRIPTION
            "The Link State ID is an LS Type Specific field
            containing either a Router ID or an IP Address;
            it identifies the piece of the  routing  domain
            that is being described by the advertisement."
         REFERENCE
            "OSPF Version 2, Section 12.1.4 Link State ID"
        ::= { ospfLsdbEntry 3 }
```

```
    ospfLsdbRouterId OBJECT-TYPE
        SYNTAX    RouterID
        MAX-ACCESS    read-only
        STATUS    current
        DESCRIPTION
           "The 32 bit number that uniquely identifies the
           originating router in the Autonomous System."
        REFERENCE
           "OSPF Version 2, Appendix C.1 Global parameters"
        ::= { ospfLsdbEntry 4 }

--  Note that the OSPF Sequence Number is a 32 bit signed
--  integer.  It starts with the value '80000001'h,
--  or -'7FFFFFFF'h, and increments until '7FFFFFFF'h
--  Thus, a typical sequence number will be very negative.

    ospfLsdbSequence OBJECT-TYPE
        SYNTAX    Integer32
        MAX-ACCESS    read-only
        STATUS    current
        DESCRIPTION
           "The sequence number field is a  signed  32-bit
           integer.  It  is used to detect old and dupli-
           cate link state advertisements.  The   space  of
           sequence  numbers  is  linearly  ordered.   The
           larger the sequence number the more recent  the
           advertisement."
        REFERENCE
           "OSPF Version  2,  Section  12.1.6  LS  sequence
           number"
        ::= { ospfLsdbEntry 5 }


    ospfLsdbAge OBJECT-TYPE
        SYNTAX    Integer32    -- Should be 0..MaxAge
        MAX-ACCESS    read-only
        STATUS    current
        DESCRIPTION
           "This field is the age of the link state adver-
           tisement in seconds."
        REFERENCE
           "OSPF Version 2, Section 12.1.1 LS age"
        ::= { ospfLsdbEntry 6 }

    ospfLsdbChecksum OBJECT-TYPE
        SYNTAX    Integer32
        MAX-ACCESS    read-only
        STATUS    current
```

                DESCRIPTION
                   "This field is the checksum of the complete
                   contents of the advertisement, excepting the
                   age field. The age field is excepted so that
                   an advertisement's age can be incremented
                   without updating the checksum.   The checksum
                   used is the same that is used for ISO connec-
                   tionless datagrams; it is commonly referred to
                   as the Fletcher checksum."
                REFERENCE
                   "OSPF Version 2, Section 12.1.7 LS checksum"
             ::= { ospfLsdbEntry 7 }

        ospfLsdbAdvertisement OBJECT-TYPE
            SYNTAX   OCTET STRING (SIZE (1..65535))
            MAX-ACCESS   read-only
            STATUS   current
            DESCRIPTION
               "The entire Link State Advertisement, including
               its header."
            REFERENCE
               "OSPF Version 2, Section 12 Link State Adver-
               tisements"
          ::= { ospfLsdbEntry 8 }

    -- Address Range Table

    --   The Address Range Table acts as an adjunct to the Area
    --   Table; It describes those Address Range Summaries that
    --   are configured to be propagated from an Area to reduce
    --   the amount of information about it which is known beyond
    --   its borders.

        ospfAreaRangeTable OBJECT-TYPE
            SYNTAX   SEQUENCE OF OspfAreaRangeEntry
            MAX-ACCESS   not-accessible
            STATUS   obsolete
            DESCRIPTION
               "A range if IP addresses specified by an IP
               address/IP network mask pair.   For example,
               class B address range of X.X.X.X with a network
               mask of 255.255.0.0 includes all IP addresses
               from X.X.0.0 to X.X.255.255"
            REFERENCE
               "OSPF Version 2, Appendix C.2 Area parameters"
          ::= { ospf 5 }

```
     ospfAreaRangeEntry OBJECT-TYPE
         SYNTAX    OspfAreaRangeEntry
         MAX-ACCESS    not-accessible
         STATUS    obsolete
         DESCRIPTION
            "A range if IP addresses  specified  by  an  IP
            address/IP  network  mask  pair.  For example,
            class B address range of X.X.X.X with a network
            mask   of  255.255.0.0 includes all IP addresses
            from X.X.0.0 to X.X.255.255"
          REFERENCE
            "OSPF Version 2, Appendix C.2  Area parameters"
         INDEX { ospfAreaRangeAreaId, ospfAreaRangeNet }
         ::= { ospfAreaRangeTable 1 }

 OspfAreaRangeEntry ::=
     SEQUENCE {
         ospfAreaRangeAreaId
             AreaID,
         ospfAreaRangeNet
             IpAddress,
         ospfAreaRangeMask
             IpAddress,
         ospfAreaRangeStatus
             RowStatus,
         ospfAreaRangeEffect
             INTEGER
               }

     ospfAreaRangeAreaId OBJECT-TYPE
         SYNTAX    AreaID
         MAX-ACCESS    read-only
         STATUS    obsolete
         DESCRIPTION
            "The Area the Address  Range  is  to  be  found
            within."
         REFERENCE
            "OSPF Version 2, Appendix C.2 Area parameters"
         ::= { ospfAreaRangeEntry 1 }


     ospfAreaRangeNet OBJECT-TYPE
         SYNTAX    IpAddress
         MAX-ACCESS    read-only
         STATUS    obsolete
         DESCRIPTION
            "The IP Address of the Net or Subnet  indicated
            by the range."
```

```
        REFERENCE
           "OSPF Version 2, Appendix C.2 Area parameters"
        ::= { ospfAreaRangeEntry 2 }


    ospfAreaRangeMask OBJECT-TYPE
       SYNTAX    IpAddress
       MAX-ACCESS    read-create
       STATUS    obsolete
       DESCRIPTION
          "The Subnet Mask that pertains to  the  Net  or
          Subnet."
        REFERENCE
           "OSPF Version 2, Appendix C.2 Area parameters"
        ::= { ospfAreaRangeEntry 3 }

    ospfAreaRangeStatus OBJECT-TYPE
       SYNTAX    RowStatus
       MAX-ACCESS    read-create
       STATUS    obsolete
       DESCRIPTION
          "This variable displays the status of  the  en-
          try.  Setting it to 'invalid' has the effect of
          rendering it inoperative.  The internal  effect
          (row removal) is implementation dependent."
        ::= { ospfAreaRangeEntry 4 }


    ospfAreaRangeEffect OBJECT-TYPE
       SYNTAX    INTEGER    {
                 advertiseMatching (1),
                 doNotAdvertiseMatching (2)
                }
       MAX-ACCESS    read-create
       STATUS    obsolete
       DESCRIPTION
          "Subnets subsumed by ranges either trigger  the
          advertisement  of the indicated summary (adver-
          tiseMatching), or result in  the  subnet's  not
          being advertised at all outside the area."
       DEFVAL    { advertiseMatching }
        ::= { ospfAreaRangeEntry 5 }



-- OSPF Host Table

--      The Host/Metric Table indicates what hosts are directly
```

```
--        attached to the Router, and what metrics and types of
--        service should be advertised for them.

     ospfHostTable OBJECT-TYPE
         SYNTAX    SEQUENCE OF OspfHostEntry
         MAX-ACCESS   not-accessible
         STATUS    current
         DESCRIPTION
            "The list of Hosts, and their metrics, that the
            router will advertise as host routes."
        REFERENCE
            "OSPF Version 2, Appendix C.6  Host route param-
            eters"
       ::= { ospf 6 }


     ospfHostEntry OBJECT-TYPE
         SYNTAX    OspfHostEntry
         MAX-ACCESS   not-accessible
         STATUS    current
         DESCRIPTION
            "A metric to be advertised, for a given type of
            service, when a given host is reachable."
         INDEX { ospfHostIpAddress, ospfHostTOS }
         ::= { ospfHostTable 1 }

OspfHostEntry ::=
     SEQUENCE {
         ospfHostIpAddress
            IpAddress,
         ospfHostTOS
            TOSType,
         ospfHostMetric
            Metric,
         ospfHostStatus
            RowStatus,
         ospfHostAreaID
            AreaID
              }

     ospfHostIpAddress OBJECT-TYPE
         SYNTAX    IpAddress
         MAX-ACCESS   read-only
         STATUS    current
         DESCRIPTION
            "The IP Address of the Host."
        REFERENCE
            "OSPF Version 2, Appendix C.6 Host route parame-
```

```
       ters"
    ::= { ospfHostEntry 1 }



    ospfHostTOS OBJECT-TYPE
       SYNTAX    TOSType
       MAX-ACCESS    read-only
       STATUS    current
       DESCRIPTION
          "The Type of Service of the route being config-
           ured."
      REFERENCE
          "OSPF Version 2, Appendix C.6 Host route parame-
           ters"
    ::= { ospfHostEntry 2 }



    ospfHostMetric OBJECT-TYPE
       SYNTAX    Metric
       MAX-ACCESS    read-create
       STATUS    current
       DESCRIPTION
          "The Metric to be advertised."
      REFERENCE
          "OSPF Version 2, Appendix C.6 Host route parame-
           ters"
    ::= { ospfHostEntry 3 }


    ospfHostStatus OBJECT-TYPE
       SYNTAX    RowStatus
       MAX-ACCESS    read-create
       STATUS    current
       DESCRIPTION
          "This variable displays the status of  the  en-
           try.  Setting it to 'invalid' has the effect of
           rendering it inoperative.  The internal  effect
           (row removal) is implementation dependent."
       ::= { ospfHostEntry 4 }



    ospfHostAreaID OBJECT-TYPE
       SYNTAX    AreaID
       MAX-ACCESS    read-only
       STATUS    current
       DESCRIPTION
          "The Area the Host Entry is to be found within.
           By  default, the area that a subsuming OSPF in-
           terface is in, or 0.0.0.0"
```

           REFERENCE
              "OSPF Version 2, Appendix C.2 Area parameters"
          ::= { ospfHostEntry 5 }

-- OSPF Interface Table

--   The OSPF Interface Table augments the ipAddrTable
--   with OSPF specific information.

     ospfIfTable OBJECT-TYPE
         SYNTAX   SEQUENCE OF OspfIfEntry
         MAX-ACCESS   not-accessible
         STATUS   current
         DESCRIPTION
            "The OSPF Interface Table describes the inter-
            faces from the viewpoint of OSPF."
        REFERENCE
           "OSPF Version 2, Appendix C.3 Router interface
           parameters"
         ::= { ospf 7 }

     ospfIfEntry OBJECT-TYPE
         SYNTAX   OspfIfEntry
         MAX-ACCESS   not-accessible
         STATUS   current
         DESCRIPTION
            "The OSPF Interface Entry describes one inter-
            face from the viewpoint of OSPF."
         INDEX { ospfIfIpAddress, ospfAddressLessIf }
         ::= { ospfIfTable 1 }

OspfIfEntry ::=
     SEQUENCE {
         ospfIfIpAddress
             IpAddress,
         ospfAddressLessIf
             Integer32,
         ospfIfAreaId
             AreaID,
         ospfIfType
             INTEGER,
         ospfIfAdminStat
             Status,
         ospfIfRtrPriority
             DesignatedRouterPriority,
         ospfIfTransitDelay

```
                UpToMaxAge,
            ospfIfRetransInterval
                UpToMaxAge,
            ospfIfHelloInterval
                HelloRange,
            ospfIfRtrDeadInterval
                PositiveInteger,
            ospfIfPollInterval
                PositiveInteger,
            ospfIfState
                INTEGER,
            ospfIfDesignatedRouter
                IpAddress,
            ospfIfBackupDesignatedRouter
                IpAddress,
            ospfIfEvents
                Counter32,
            ospfIfAuthType
                INTEGER,
            ospfIfAuthKey
                OCTET STRING,
            ospfIfStatus
                RowStatus,
            ospfIfMulticastForwarding
                INTEGER,
            ospfIfDemand
                TruthValue
                    }

    ospfIfIpAddress OBJECT-TYPE
        SYNTAX    IpAddress
        MAX-ACCESS    read-only
        STATUS    current
        DESCRIPTION
            "The IP address of this OSPF interface."
        ::= { ospfIfEntry 1 }

    ospfAddressLessIf OBJECT-TYPE
        SYNTAX    Integer32
        MAX-ACCESS    read-only
        STATUS    current
        DESCRIPTION
            "For the purpose of easing  the  instancing  of
            addressed   and   addressless   interfaces; This
            variable takes the value 0 on  interfaces  with
            IP  Addresses,  and  the corresponding value of
            ifIndex for interfaces having no IP Address."
        ::= { ospfIfEntry 2 }
```

```
      ospfIfAreaId OBJECT-TYPE
         SYNTAX    AreaID
         MAX-ACCESS    read-create
         STATUS    current
         DESCRIPTION
            "A 32-bit integer uniquely identifying the area
            to   which   the   interface   connects.   Area   ID
            0.0.0.0 is used for the OSPF backbone."
         DEFVAL    { '00000000'H }     -- 0.0.0.0
         ::= { ospfIfEntry 3 }

      ospfIfType OBJECT-TYPE
         SYNTAX    INTEGER     {
                    broadcast (1),
                    nbma (2),
                    pointToPoint (3),
                    pointToMultipoint (5)
                  }
         MAX-ACCESS    read-create
         STATUS    current
         DESCRIPTION
            "The OSPF interface type.

            By way of a default, this field may be intuited
            from the corresponding value of ifType.  Broad-
            cast LANs, such as  Ethernet   and   IEEE  802.5,
            take   the   value   'broadcast', X.25 and similar
            technologies take the value 'nbma',  and  links
            that   are  definitively point to point take the
            value 'pointToPoint'."
         ::= { ospfIfEntry 4 }


      ospfIfAdminStat OBJECT-TYPE
         SYNTAX    Status
         MAX-ACCESS    read-create
         STATUS    current
         DESCRIPTION
            "The OSPF   interface's   administrative   status.
            The   value formed on the interface, and the in-
            terface will be advertised as an internal route
            to   some   area.   The   value 'disabled' denotes
            that the interface is external to OSPF."
         DEFVAL { enabled }
         ::= { ospfIfEntry 5 }

      ospfIfRtrPriority OBJECT-TYPE
         SYNTAX    DesignatedRouterPriority
```

```
            MAX-ACCESS   read-create
            STATUS    current
            DESCRIPTION
               "The  priority  of  this  interface.  Used  in
               multi-access  networks,  this  field is used in
               the designated router election algorithm.   The
               value 0 signifies that the router is not eligi-
               ble to become the  designated  router  on  this
               particular  network.   In the event of a tie in
               this value, routers will use their Router ID as
               a tie breaker."
            DEFVAL { 1 }
            ::= { ospfIfEntry 6 }


        ospfIfTransitDelay OBJECT-TYPE
            SYNTAX   UpToMaxAge
            MAX-ACCESS   read-create
            STATUS    current
            DESCRIPTION
               "The estimated number of seconds  it  takes  to
               transmit  a  link state update packet over this
               interface."
            DEFVAL { 1 }
            ::= { ospfIfEntry 7 }


        ospfIfRetransInterval OBJECT-TYPE
            SYNTAX   UpToMaxAge
            MAX-ACCESS   read-create
            STATUS    current
            DESCRIPTION
               "The number of seconds between  link-state  ad-
               vertisement  retransmissions,  for  adjacencies
               belonging to this  interface.   This  value  is
               also used when retransmitting database descrip-
               tion and link-state request packets."
            DEFVAL { 5 }
            ::= { ospfIfEntry 8 }


        ospfIfHelloInterval OBJECT-TYPE
            SYNTAX   HelloRange
            MAX-ACCESS   read-create
            STATUS    current
            DESCRIPTION
               "The length of time, in  seconds,  between  the
               Hello  packets that the router sends on the in-
```

```
            terface.  This value must be the same  for  all
            routers attached to a common network."
        DEFVAL { 10 }
        ::= { ospfIfEntry 9 }


    ospfIfRtrDeadInterval OBJECT-TYPE
        SYNTAX    PositiveInteger
        MAX-ACCESS    read-create
        STATUS    current
        DESCRIPTION
           "The number of seconds that  a  router's  Hello
           packets  have  not been seen before it's neigh-
           bors declare the router down.  This   should  be
           some  multiple  of  the  Hello  interval. This
           value must be the same for all routers attached
           to a common network."
        DEFVAL { 40 }
        ::= { ospfIfEntry 10 }


    ospfIfPollInterval OBJECT-TYPE
        SYNTAX    PositiveInteger
        MAX-ACCESS    read-create
        STATUS    current
        DESCRIPTION
           "The larger time interval, in seconds,  between
           the  Hello  packets  sent  to  an inactive non-
           broadcast multi- access neighbor."
        DEFVAL { 120 }
        ::= { ospfIfEntry 11 }


    ospfIfState OBJECT-TYPE
        SYNTAX    INTEGER    {
                    down (1),
                    loopback (2),
                    waiting (3),
                    pointToPoint (4),
                    designatedRouter (5),
                    backupDesignatedRouter (6),
                    otherDesignatedRouter (7)
                  }
        MAX-ACCESS    read-only
        STATUS    current
        DESCRIPTION
           "The OSPF Interface State."
        DEFVAL { down }
```

```
     ::= { ospfIfEntry 12 }


  ospfIfDesignatedRouter OBJECT-TYPE
     SYNTAX    IpAddress
     MAX-ACCESS    read-only
     STATUS    current
     DESCRIPTION
        "The IP Address of the Designated Router."
     DEFVAL   { '00000000'H }    -- 0.0.0.0
     ::= { ospfIfEntry 13 }


  ospfIfBackupDesignatedRouter OBJECT-TYPE
     SYNTAX    IpAddress
     MAX-ACCESS    read-only
     STATUS    current
     DESCRIPTION
        "The  IP  Address  of  the  Backup   Designated
        Router."
     DEFVAL   { '00000000'H }    -- 0.0.0.0
     ::= { ospfIfEntry 14 }

  ospfIfEvents OBJECT-TYPE
     SYNTAX    Counter32
     MAX-ACCESS    read-only
     STATUS    current
     DESCRIPTION
        "The number of times this  OSPF  interface  has
        changed its state, or an error has occurred."
     ::= { ospfIfEntry 15 }


  ospfIfAuthKey OBJECT-TYPE
     SYNTAX    OCTET STRING (SIZE (0..256))
     MAX-ACCESS    read-create
     STATUS    current
     DESCRIPTION
        "The Authentication Key.  If the Area's Author-
        ization  Type  is  simplePassword,  and the key
        length is shorter than 8 octets, the agent will
        left adjust and zero fill to 8 octets.

        Note that unauthenticated  interfaces  need  no
        authentication key, and simple password authen-
        tication cannot use a key of more  than  8  oc-
        tets.  Larger keys are useful only with authen-
        tication mechanisms not specified in this docu-
```

                    ment.

                    When read, ospfIfAuthKey always returns an Oc-
                    tet String of length zero."
                REFERENCE
                    "OSPF Version 2, Section 9 The Interface Data
                    Structure"
              DEFVAL   { '0000000000000000'H }   -- 0.0.0.0.0.0.0.0
              ::= { ospfIfEntry 16 }

          ospfIfStatus OBJECT-TYPE
              SYNTAX   RowStatus
              MAX-ACCESS   read-create
              STATUS   current
              DESCRIPTION
                    "This variable displays the status of the en-
                    try. Setting it to 'invalid' has the effect of
                    rendering it inoperative. The internal effect
                    (row removal) is implementation dependent."
              ::= { ospfIfEntry 17 }

          ospfIfMulticastForwarding OBJECT-TYPE
              SYNTAX   INTEGER   {
                                blocked (1),   -- no multicast forwarding
                                multicast (2),   -- using multicast address
                                unicast (3)   -- to each OSPF neighbor
                       }
              MAX-ACCESS   read-create
              STATUS   current
              DESCRIPTION
                    "The way multicasts should forwarded on this
                    interface; not forwarded, forwarded as data
                    link multicasts, or forwarded as data link uni-
                    casts.   Data link multicasting is not meaning-
                    ful on point to point and NBMA interfaces, and
                    setting ospfMulticastForwarding to 0 effective-
                    ly disables all multicast forwarding."
              DEFVAL { blocked }
              ::= { ospfIfEntry 18 }

          ospfIfDemand OBJECT-TYPE
              SYNTAX   TruthValue
              MAX-ACCESS   read-create
              STATUS   current
              DESCRIPTION
                    "Indicates whether Demand OSPF procedures (hel-

```
               lo supression to FULL neighbors and setting the
               DoNotAge flag on proogated LSAs) should be per-
               formed on this interface."
          DEFVAL { false }
          ::= { ospfIfEntry 19 }


      ospfIfAuthType OBJECT-TYPE
          SYNTAX   INTEGER (0..255)
                        -- none (0),
                        -- simplePassword (1)
                        -- md5 (2)
                        -- reserved for specification by IANA (> 2)
          MAX-ACCESS   read-create
          STATUS   current
          DESCRIPTION
             "The authentication type specified for  an  in-
             terface.   Additional  authentication types may
             be assigned locally."
          REFERENCE
             "OSPF Version 2, Appendix E Authentication"
         DEFVAL { 0 }          -- no authentication, by default
          ::= { ospfIfEntry 20 }



--   OSPF Interface Metric Table

--        The Metric Table describes the metrics to be advertised
--        for a specified interface at the various types of service.
--        As such, this table is an adjunct of the OSPF Interface
--        Table.


-- Types of service, as defined by RFC 791, have the ability
-- to request low delay, high bandwidth, or reliable linkage.


-- For the purposes of this specification, the measure of
-- bandwidth


--        Metric = 10^8 / ifSpeed

-- is the default value.  For multiple link interfaces, note
-- that ifSpeed is the sum of the individual link speeds.
-- This yields a number having the following typical values:


--        Network Type/bit rate    Metric


--        >= 100 MBPS                   1
--        Ethernet/802.3               10
```

```
--        E1                              48
--        T1 (ESF)                        65
--         64 KBPS                      1562
--         56 KBPS                      1785
--         19.2 KBPS                    5208
--          9.6 KBPS                   10416


-- Routes that are not specified use the default (TOS 0) metric

     ospfIfMetricTable OBJECT-TYPE
         SYNTAX   SEQUENCE OF OspfIfMetricEntry
         MAX-ACCESS   not-accessible
         STATUS   current
         DESCRIPTION
            "The TOS metrics for  a  non-virtual  interface
            identified by the interface index."
        REFERENCE
            "OSPF Version 2, Appendix C.3  Router  interface
            parameters"
        ::= { ospf 8 }


     ospfIfMetricEntry OBJECT-TYPE
         SYNTAX   OspfIfMetricEntry
         MAX-ACCESS   not-accessible
         STATUS    current
         DESCRIPTION
            "A particular TOS metric for a non-virtual  in-
            terface identified by the interface index."
        REFERENCE
            "OSPF Version 2, Appendix C.3  Router  interface
            parameters"
        INDEX { ospfIfMetricIpAddress,
  ospfIfMetricAddressLessIf,
  ospfIfMetricTOS }
        ::= { ospfIfMetricTable 1 }

OspfIfMetricEntry ::=
     SEQUENCE {
        ospfIfMetricIpAddress
            IpAddress,
        ospfIfMetricAddressLessIf
            Integer32,
        ospfIfMetricTOS
            TOSType,
        ospfIfMetricValue
            Metric,
        ospfIfMetricStatus
            RowStatus
```

```
               }

     ospfIfMetricIpAddress OBJECT-TYPE
         SYNTAX    IpAddress
         MAX-ACCESS   read-only
         STATUS    current
         DESCRIPTION
            "The IP address of this OSPF interface.  On row
            creation,  this  can  be  derived  from the in-
            stance."
        ::= { ospfIfMetricEntry 1 }

     ospfIfMetricAddressLessIf OBJECT-TYPE
         SYNTAX    Integer32
         MAX-ACCESS   read-only
         STATUS    current
         DESCRIPTION
            "For the purpose of easing  the  instancing  of
            addressed   and  addressless  interfaces;  This
            variable takes the value 0 on  interfaces  with
            IP  Addresses, and the value of ifIndex for in-
            terfaces having no IP Address.   On  row  crea-
            tion, this can be derived from the instance."
        ::= { ospfIfMetricEntry 2 }


     ospfIfMetricTOS OBJECT-TYPE
         SYNTAX    TOSType
         MAX-ACCESS    read-only
         STATUS    current
         DESCRIPTION
            "The type of service metric  being  referenced.
            On  row  creation, this can be derived from the
            instance."
        ::= { ospfIfMetricEntry 3 }


     ospfIfMetricValue OBJECT-TYPE
         SYNTAX    Metric
         MAX-ACCESS    read-create
         STATUS    current
         DESCRIPTION
            "The metric of using this type  of  service  on
            this interface.  The default value of the TOS 0
            Metric is 10^8 / ifSpeed."
        ::= { ospfIfMetricEntry 4 }

     ospfIfMetricStatus OBJECT-TYPE
```

```
        SYNTAX    RowStatus
        MAX-ACCESS    read-create
        STATUS    current
        DESCRIPTION
           "This variable displays the status of  the  en-
           try.  Setting it to 'invalid' has the effect of
           rendering it inoperative.  The internal  effect
           (row removal) is implementation dependent."
       ::= { ospfIfMetricEntry 5 }


-- OSPF Virtual Interface Table

--      The Virtual Interface Table describes the virtual
--      links that the OSPF Process is configured to
--      carry on.

    ospfVirtIfTable OBJECT-TYPE
        SYNTAX    SEQUENCE OF OspfVirtIfEntry
        MAX-ACCESS    not-accessible
        STATUS    current
        DESCRIPTION
           "Information about this router's virtual inter-
           faces."
       REFERENCE
          "OSPF Version  2,  Appendix  C.4   Virtual  link
          parameters"
        ::= { ospf 9 }


    ospfVirtIfEntry OBJECT-TYPE
        SYNTAX    OspfVirtIfEntry
        MAX-ACCESS    not-accessible
        STATUS    current
        DESCRIPTION
           "Information about a single Virtual Interface."
        INDEX { ospfVirtIfAreaId, ospfVirtIfNeighbor }
        ::= { ospfVirtIfTable 1 }

OspfVirtIfEntry ::=
    SEQUENCE {
        ospfVirtIfAreaId
            AreaID,
        ospfVirtIfNeighbor
            RouterID,
        ospfVirtIfTransitDelay
            UpToMaxAge,
        ospfVirtIfRetransInterval
```

```
           UpToMaxAge,
        ospfVirtIfHelloInterval
           HelloRange,
        ospfVirtIfRtrDeadInterval
           PositiveInteger,
        ospfVirtIfState
           INTEGER,
        ospfVirtIfEvents
           Counter32,
        ospfVirtIfAuthType
           INTEGER,
        ospfVirtIfAuthKey
           OCTET STRING,
        ospfVirtIfStatus
           RowStatus
             }

    ospfVirtIfAreaId OBJECT-TYPE
        SYNTAX    AreaID
        MAX-ACCESS   read-only
        STATUS    current
        DESCRIPTION
           "The  Transit  Area  that  the  Virtual   Link
           traverses.  By definition, this is not 0.0.0.0"
        ::= { ospfVirtIfEntry 1 }


    ospfVirtIfNeighbor OBJECT-TYPE
        SYNTAX    RouterID
        MAX-ACCESS   read-only
        STATUS    current
        DESCRIPTION
           "The Router ID of the Virtual Neighbor."
        ::= { ospfVirtIfEntry 2 }


    ospfVirtIfTransitDelay OBJECT-TYPE
        SYNTAX    UpToMaxAge
        MAX-ACCESS   read-create
        STATUS    current
        DESCRIPTION
           "The estimated number of seconds  it  takes  to
           transmit  a link- state update packet over this
           interface."
        DEFVAL { 1 }
        ::= { ospfVirtIfEntry 3 }
```

```
   ospfVirtIfRetransInterval OBJECT-TYPE
       SYNTAX    UpToMaxAge
       MAX-ACCESS    read-create
       STATUS    current
       DESCRIPTION
          "The number of seconds between  link-state  ad-
          vertisement  retransmissions,  for  adjacencies
          belonging to this  interface.   This  value  is
          also used when retransmitting database descrip-
          tion  and  link-state  request  packets.   This
          value  should  be well over the expected round-
          trip time."
       DEFVAL { 5 }
       ::= { ospfVirtIfEntry 4 }


   ospfVirtIfHelloInterval OBJECT-TYPE
       SYNTAX    HelloRange
       MAX-ACCESS    read-create
       STATUS    current
       DESCRIPTION
          "The length of time, in  seconds,  between  the
          Hello  packets that the router sends on the in-
          terface.  This value must be the same  for  the
          virtual neighbor."
       DEFVAL { 10 }
       ::= { ospfVirtIfEntry 5 }


   ospfVirtIfRtrDeadInterval OBJECT-TYPE
       SYNTAX    PositiveInteger
       MAX-ACCESS    read-create
       STATUS    current
       DESCRIPTION
          "The number of seconds that  a  router's  Hello
          packets  have  not been seen before it's neigh-
          bors declare the router down.  This  should  be
          some  multiple  of  the  Hello  interval.  This
          value must be the same for the  virtual  neigh-
          bor."
       DEFVAL { 60 }
       ::= { ospfVirtIfEntry 6 }


   ospfVirtIfState OBJECT-TYPE
       SYNTAX    INTEGER    {
                   down (1),            -- these use the same encoding
                   pointToPoint (4)     -- as the ospfIfTable
```

```
               }
         MAX-ACCESS   read-only
          STATUS    current
          DESCRIPTION
             "OSPF virtual interface states."
        DEFVAL    { down }
        ::= { ospfVirtIfEntry 7 }


    ospfVirtIfEvents OBJECT-TYPE
        SYNTAX    Counter32
        MAX-ACCESS   read-only
        STATUS    current
        DESCRIPTION
           "The number of state changes or error events on
           this Virtual Link"
        ::= { ospfVirtIfEntry 8 }


    ospfVirtIfAuthKey OBJECT-TYPE
        SYNTAX    OCTET STRING (SIZE(0..256))
        MAX-ACCESS   read-create
        STATUS    current
        DESCRIPTION
           "If Authentication Type is simplePassword,  the
           device  will left adjust and zero fill to 8 oc-
           tets.

           Note that unauthenticated  interfaces  need  no
           authentication key, and simple password authen-
           tication cannot use a key of more  than  8  oc-
           tets.  Larger keys are useful only with authen-
           tication mechanisms not specified in this docu-
           ment.

           When  read,  ospfVifAuthKey  always  returns  a
           string of length zero."
         REFERENCE
           "OSPF Version 2, Section 9  The  Interface  Data
           Structure"
        DEFVAL   { '0000000000000000'H }    -- 0.0.0.0.0.0.0.0
        ::= { ospfVirtIfEntry 9 }


    ospfVirtIfStatus OBJECT-TYPE
        SYNTAX    RowStatus
        MAX-ACCESS   read-create
        STATUS    current
```

```
        DESCRIPTION
           "This variable displays the status of  the  en-
           try.  Setting it to 'invalid' has the effect of
           rendering it inoperative.  The internal  effect
           (row removal) is implementation dependent."
        ::= { ospfVirtIfEntry 10 }


    ospfVirtIfAuthType OBJECT-TYPE
        SYNTAX    INTEGER (0..255)
                     -- none (0),
                     -- simplePassword (1)
                     -- md5 (2)
                     -- reserved for specification by IANA (> 2)
        MAX-ACCESS   read-create
        STATUS    current
        DESCRIPTION
           "The authentication type specified for a virtu-
           al  interface.  Additional authentication types
           may be assigned locally."
         REFERENCE
           "OSPF Version 2, Appendix E Authentication"
       DEFVAL { 0 }          -- no authentication, by default
        ::= { ospfVirtIfEntry 11 }


--  OSPF Neighbor Table

--      The OSPF Neighbor Table describes all neighbors in
--      the locality of the subject router.

    ospfNbrTable OBJECT-TYPE
        SYNTAX    SEQUENCE OF OspfNbrEntry
        MAX-ACCESS   not-accessible
        STATUS    current
        DESCRIPTION
           "A table of non-virtual neighbor information."
         REFERENCE
           "OSPF Version 2, Section 10  The  Neighbor  Data
           Structure"
        ::= { ospf 10 }


    ospfNbrEntry OBJECT-TYPE
        SYNTAX    OspfNbrEntry
        MAX-ACCESS   not-accessible
        STATUS    current
        DESCRIPTION
```

```
            "The information regarding a single neighbor."
        REFERENCE
           "OSPF Version 2, Section 10  The  Neighbor  Data
           Structure"
       INDEX { ospfNbrIpAddr, ospfNbrAddressLessIndex }
       ::= { ospfNbrTable 1 }


OspfNbrEntry ::=
     SEQUENCE {
        ospfNbrIpAddr
            IpAddress,
        ospfNbrAddressLessIndex
            InterfaceIndex,
        ospfNbrRtrId
            RouterID,
        ospfNbrOptions
            Integer32,
        ospfNbrPriority
            DesignatedRouterPriority,
        ospfNbrState
            INTEGER,
        ospfNbrEvents
            Counter32,
        ospfNbrLsRetransQLen
            Gauge32,
        ospfNbmaNbrStatus
            RowStatus,
        ospfNbmaNbrPermanence
            INTEGER,
        ospfNbrHelloSuppressed
            TruthValue
              }

     ospfNbrIpAddr OBJECT-TYPE
        SYNTAX   IpAddress
        MAX-ACCESS   read-only
        STATUS   current
        DESCRIPTION
           "The IP address this neighbor is using  in  its
           IP  Source  Address. Note that, on addressless
           links, this will not be 0.0.0.0,  but  the  ad-
           dress of another of the neighbor's interfaces."
        ::= { ospfNbrEntry 1 }


     ospfNbrAddressLessIndex OBJECT-TYPE
        SYNTAX   InterfaceIndex
        MAX-ACCESS   read-only
```

```
          STATUS    current
          DESCRIPTION
             "On an interface having an  IP  Address,  zero.
             On  addressless  interfaces,  the corresponding
             value of ifIndex in the Internet Standard  MIB.
             On  row  creation, this can be derived from the
             instance."
         ::= { ospfNbrEntry 2 }


    ospfNbrRtrId OBJECT-TYPE
          SYNTAX    RouterID
          MAX-ACCESS    read-only
          STATUS    current
          DESCRIPTION
             "A 32-bit integer (represented as a type  IpAd-
             dress)  uniquely  identifying  the  neighboring
             router in the Autonomous System."
         DEFVAL    { '00000000'H }     -- 0.0.0.0
         ::= { ospfNbrEntry 3 }


    ospfNbrOptions OBJECT-TYPE
          SYNTAX    Integer32
          MAX-ACCESS    read-only
          STATUS    current
          DESCRIPTION
             "A Bit Mask corresponding to the neighbor's op-
             tions field.

             Bit 0, if set, indicates that the  system  will
             operate  on  Type of Service metrics other than
             TOS 0.  If zero, the neighbor will  ignore  all
             metrics except the TOS 0 metric.

             Bit 1, if set, indicates  that  the  associated
             area  accepts and operates on external informa-
             tion; if zero, it is a stub area.

             Bit 2, if set, indicates that the system is ca-
             pable  of routing IP Multicast datagrams; i.e.,
             that it implements the Multicast Extensions  to
             OSPF.

             Bit 3, if set, indicates  that  the  associated
             area  is  an  NSSA.  These areas are capable of
             carrying type 7 external advertisements,  which
             are  translated into type 5 external advertise-
```

```
     ments at NSSA borders."
   REFERENCE
      "OSPF Version 2, Section 12.1.2 Options"
  DEFVAL { 0 }
  ::= { ospfNbrEntry 4 }


ospfNbrPriority OBJECT-TYPE
    SYNTAX   DesignatedRouterPriority
    MAX-ACCESS   read-create
    STATUS   current
    DESCRIPTION
       "The priority of this neighbor in the designat-
       ed router election algorithm.  The value 0 sig-
       nifies that the neighbor is not eligible to be-
       come  the  designated router on this particular
       network."
    DEFVAL { 1 }
    ::= { ospfNbrEntry 5 }


ospfNbrState  OBJECT-TYPE
    SYNTAX    INTEGER    {
             down (1),
             attempt (2),
             init (3),
             twoWay (4),
             exchangeStart (5),
             exchange (6),
             loading (7),
             full (8)
            }
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
       "The State of the relationship with this Neigh-
       bor."
    REFERENCE
       "OSPF Version 2, Section 10.1 Neighbor States"
   DEFVAL    { down }
   ::= { ospfNbrEntry 6 }


ospfNbrEvents OBJECT-TYPE
    SYNTAX   Counter32
    MAX-ACCESS   read-only
    STATUS   current
    DESCRIPTION
```

```
                "The number of times this neighbor relationship
                has changed state, or an error has occurred."
            ::= { ospfNbrEntry 7 }


       ospfNbrLsRetransQLen OBJECT-TYPE
            SYNTAX    Gauge32
            MAX-ACCESS    read-only
            STATUS    current
            DESCRIPTION
                "The   current   length   of   the    retransmission
                queue."
            ::= { ospfNbrEntry 8 }


       ospfNbmaNbrStatus OBJECT-TYPE
            SYNTAX    RowStatus
            MAX-ACCESS    read-create
            STATUS    current
            DESCRIPTION
                "This variable displays the status of  the  en-
                try.  Setting it to 'invalid' has the effect of
                rendering it inoperative.  The internal  effect
                (row removal) is implementation dependent."
            ::= { ospfNbrEntry 9 }


       ospfNbmaNbrPermanence OBJECT-TYPE
            SYNTAX    INTEGER    {
                        dynamic (1),         -- learned through protocol
                        permanent (2)        -- configured address
                      }
            MAX-ACCESS    read-only
            STATUS    current
            DESCRIPTION
                "This variable displays the status of  the  en-
                try.  'dynamic'  and  'permanent' refer to how
                the neighbor became known."
          DEFVAL { permanent }
            ::= { ospfNbrEntry 10 }


       ospfNbrHelloSuppressed OBJECT-TYPE
            SYNTAX    TruthValue
            MAX-ACCESS    read-only
            STATUS    current
            DESCRIPTION
                "Indicates whether Hellos are being  suppressed
```

```
           to the neighbor"
        ::= { ospfNbrEntry 11 }



--   OSPF Virtual Neighbor Table

--        This table describes all virtual neighbors.
--        Since Virtual Links are configured in the
--        virtual interface table, this table is read-only.

     ospfVirtNbrTable OBJECT-TYPE
         SYNTAX   SEQUENCE OF OspfVirtNbrEntry
         MAX-ACCESS   not-accessible
         STATUS   current
         DESCRIPTION
            "A table of virtual neighbor information."
        REFERENCE
            "OSPF Version 2, Section 15  Virtual Links"
        ::= { ospf 11 }


     ospfVirtNbrEntry OBJECT-TYPE
         SYNTAX   OspfVirtNbrEntry
         MAX-ACCESS   not-accessible
         STATUS   current
         DESCRIPTION
            "Virtual neighbor information."
         INDEX { ospfVirtNbrArea, ospfVirtNbrRtrId }
         ::= { ospfVirtNbrTable 1 }

 OspfVirtNbrEntry ::=
     SEQUENCE {
         ospfVirtNbrArea
             AreaID,
         ospfVirtNbrRtrId
             RouterID,
         ospfVirtNbrIpAddr
             IpAddress,
         ospfVirtNbrOptions
             Integer32,
         ospfVirtNbrState
             INTEGER,
         ospfVirtNbrEvents
             Counter32,
         ospfVirtNbrLsRetransQLen
             Gauge32,
         ospfVirtNbrHelloSuppressed
                 TruthValue
```

```
                   }

         ospfVirtNbrArea OBJECT-TYPE
             SYNTAX    AreaID
             MAX-ACCESS   read-only
             STATUS    current
             DESCRIPTION
                "The Transit Area Identifier."
          ::= { ospfVirtNbrEntry 1 }


         ospfVirtNbrRtrId OBJECT-TYPE
             SYNTAX    RouterID
             MAX-ACCESS   read-only
             STATUS    current
             DESCRIPTION
                "A  32-bit  integer  uniquely  identifying  the
                neighboring router in the Autonomous System."
          ::= { ospfVirtNbrEntry 2 }


         ospfVirtNbrIpAddr OBJECT-TYPE
             SYNTAX    IpAddress
             MAX-ACCESS   read-only
             STATUS    current
             DESCRIPTION
                "The IP address this Virtual  Neighbor  is  us-
                ing."
          ::= { ospfVirtNbrEntry 3 }


         ospfVirtNbrOptions OBJECT-TYPE
             SYNTAX    Integer32
             MAX-ACCESS   read-only
             STATUS    current
             DESCRIPTION
                "A Bit Mask corresponding to the neighbor's op-
                tions field.

                Bit 1, if set, indicates that the  system  will
                operate  on  Type of Service metrics other than
                TOS 0.  If zero, the neighbor will  ignore  all
                metrics except the TOS 0 metric.

                Bit 2, if set, indicates  that  the  system  is
                Network  Multicast  capable; ie, that it imple-
                ments OSPF Multicast Routing."
          ::= { ospfVirtNbrEntry 4 }
```

```
        ospfVirtNbrState OBJECT-TYPE
            SYNTAX   INTEGER     {
                        down (1),
                        attempt (2),
                        init (3),
                        twoWay (4),
                        exchangeStart (5),
                        exchange (6),
                        loading (7),
                        full (8)
                      }
            MAX-ACCESS   read-only
            STATUS   current
            DESCRIPTION
               "The state of the  Virtual  Neighbor  Relation-
               ship."
            ::= { ospfVirtNbrEntry 5 }


        ospfVirtNbrEvents OBJECT-TYPE
            SYNTAX   Counter32
            MAX-ACCESS   read-only
            STATUS    current
            DESCRIPTION
               "The number of  times  this  virtual  link  has
               changed its state, or an error has occurred."
            ::= { ospfVirtNbrEntry 6 }


        ospfVirtNbrLsRetransQLen OBJECT-TYPE
            SYNTAX   Gauge32
            MAX-ACCESS   read-only
            STATUS    current
            DESCRIPTION
               "The  current  length  of  the   retransmission
               queue."
            ::= { ospfVirtNbrEntry 7 }


        ospfVirtNbrHelloSuppressed OBJECT-TYPE
            SYNTAX   TruthValue
            MAX-ACCESS   read-only
            STATUS    current
            DESCRIPTION
               "Indicates whether Hellos are being  suppressed
               to the neighbor"
            ::= { ospfVirtNbrEntry 8 }
```

```
--   OSPF Link State Database, External

--        The Link State Database contains the Link State
--        Advertisements from throughout the areas that the
--        device is attached to.

--              This table is identical to the OSPF LSDB Table in
--        format, but contains only External Link State
--              Advertisements.  The purpose is to allow external
--        LSAs to be displayed once for the router rather
--        than once in each non-stub area.

     ospfExtLsdbTable OBJECT-TYPE
         SYNTAX   SEQUENCE OF OspfExtLsdbEntry
         MAX-ACCESS   not-accessible
         STATUS   current
         DESCRIPTION
            "The OSPF Process's Links State Database."
         REFERENCE
            "OSPF Version 2, Section 12  Link  State  Adver-
            tisements"
        ::= { ospf 12 }


     ospfExtLsdbEntry OBJECT-TYPE
         SYNTAX   OspfExtLsdbEntry
         MAX-ACCESS   not-accessible
         STATUS    current
         DESCRIPTION
            "A single Link State Advertisement."
         INDEX { ospfExtLsdbType, ospfExtLsdbLsid, ospfExtLsdbRouterId }
         ::= { ospfExtLsdbTable 1 }

OspfExtLsdbEntry ::=
     SEQUENCE {
         ospfExtLsdbType
             INTEGER,
         ospfExtLsdbLsid
             IpAddress,
         ospfExtLsdbRouterId
             RouterID,
         ospfExtLsdbSequence
             Integer32,
         ospfExtLsdbAge
             Integer32,
         ospfExtLsdbChecksum
             Integer32,
         ospfExtLsdbAdvertisement
```

```
            OCTET STRING
              }

    ospfExtLsdbType OBJECT-TYPE
        SYNTAX    INTEGER    {
                   asExternalLink (5)
              }
       MAX-ACCESS   read-only
       STATUS    current
       DESCRIPTION
          "The type  of  the  link  state  advertisement.
           Each  link state type has a separate advertise-
           ment format."
       REFERENCE
          "OSPF Version 2, Appendix A.4.1 The  Link  State
           Advertisement header"
       ::= { ospfExtLsdbEntry 1 }


    ospfExtLsdbLsid OBJECT-TYPE
        SYNTAX    IpAddress
        MAX-ACCESS   read-only
        STATUS    current
        DESCRIPTION
           "The Link State ID is an LS Type Specific field
            containing either a Router ID or an IP Address;
            it identifies the piece of the  routing  domain
            that is being described by the advertisement."
        REFERENCE
           "OSPF Version 2, Section 12.1.4 Link State ID"
        ::= { ospfExtLsdbEntry 2 }


    ospfExtLsdbRouterId OBJECT-TYPE
        SYNTAX    RouterID
        MAX-ACCESS    read-only
        STATUS    current
        DESCRIPTION
           "The 32 bit number that uniquely identifies the
            originating router in the Autonomous System."
        REFERENCE
           "OSPF Version 2, Appendix C.1 Global parameters"
        ::= { ospfExtLsdbEntry 3 }

-- Note that the OSPF Sequence Number is a 32 bit signed
-- integer.  It starts with the value '80000001'h,
-- or -'7FFFFFFF'h, and increments until '7FFFFFFF'h
-- Thus, a typical sequence number will be very negative.
```

```
      ospfExtLsdbSequence OBJECT-TYPE
          SYNTAX   Integer32
          MAX-ACCESS   read-only
          STATUS   current
          DESCRIPTION
             "The sequence number field is a  signed  32-bit
             integer.  It  is used to detect old and dupli-
             cate link state advertisements. The   space  of
             sequence   numbers  is  linearly  ordered.   The
             larger the sequence number the more recent  the
             advertisement."
        REFERENCE
             "OSPF Version  2,  Section  12.1.6  LS  sequence
             number"
        ::= { ospfExtLsdbEntry 4 }


      ospfExtLsdbAge OBJECT-TYPE
          SYNTAX   Integer32     -- Should be 0..MaxAge
          MAX-ACCESS   read-only
          STATUS   current
          DESCRIPTION
             "This field is the age of the link state adver-
             tisement in seconds."
        REFERENCE
             "OSPF Version 2, Section 12.1.1 LS age"
        ::= { ospfExtLsdbEntry 5 }


      ospfExtLsdbChecksum OBJECT-TYPE
          SYNTAX   Integer32
          MAX-ACCESS   read-only
          STATUS   current
          DESCRIPTION
             "This field is the  checksum  of  the  complete
             contents  of  the  advertisement, excepting the
             age field.  The age field is excepted  so  that
             an   advertisement's  age  can  be  incremented
             without updating  the  checksum.   The  checksum
             used  is  the same that is used for ISO connec-
             tionless datagrams; it is commonly referred  to
             as the Fletcher checksum."
        REFERENCE
             "OSPF Version 2, Section 12.1.7 LS checksum"
        ::= { ospfExtLsdbEntry 6 }


      ospfExtLsdbAdvertisement OBJECT-TYPE
```

```
      SYNTAX    OCTET STRING (SIZE(36))
      MAX-ACCESS    read-only
      STATUS    current
      DESCRIPTION
         "The entire Link State Advertisement, including
          its header."
       REFERENCE
         "OSPF Version 2, Section 12  Link  State  Adver-
          tisements"
      ::= { ospfExtLsdbEntry 7 }
```

-- OSPF Use of the CIDR Route Table

```
ospfRouteGroup           OBJECT IDENTIFIER ::= { ospf 13 }
```

-- The IP Forwarding Table defines a number of objects for use by
-- the routing protocol to externalize its information. Most of
-- the variables (ipForwardDest, ipForwardMask, ipForwardPolicy,
-- ipForwardNextHop, ipForwardIfIndex, ipForwardType,
-- ipForwardProto, ipForwardAge, and ipForwardNextHopAS) are
-- defined there.

-- Those that leave some discretion are defined here.

-- ipCidrRouteProto is, of course, ospf (13).

-- ipCidrRouteAge is the time since the route was first calculated,
-- as opposed to the time since the last SPF run.

-- ipCidrRouteInfo is an OBJECT IDENTIFIER for use by the routing
-- protocol. The following values shall be found there depending
-- on the way the route was calculated.

```
ospfIntraArea       OBJECT IDENTIFIER ::= { ospfRouteGroup 1 }
ospfInterArea       OBJECT IDENTIFIER ::= { ospfRouteGroup 2 }
ospfExternalType1   OBJECT IDENTIFIER ::= { ospfRouteGroup 3 }
ospfExternalType2   OBJECT IDENTIFIER ::= { ospfRouteGroup 4 }
```

-- ipCidrRouteMetric1 is, by definition, the primary routing
-- metric. Therefore, it should be the metric that route
-- selection is based on. For intra-area and inter-area routes,
-- it is an OSPF metric. For External Type 1 (comparable value)
-- routes, it is an OSPF metric plus the External Metric. For
-- external Type 2 (non-comparable value) routes, it is the
-- external metric.

-- ipCidrRouteMetric2 is, by definition, a secondary routing

```
-- metric.  Therefore, it should be the metric that breaks a tie
-- among routes having equal metric1 values and the same
-- calculation rule.  For intra-area, inter-area routes, and
-- External Type 1 (comparable value) routes, it is unused.  For
-- external Type 2 (non-comparable value) routes, it is the metric
-- to the AS border router.

-- ipCidrRouteMetric3, ipCidrRouteMetric4, and ipCidrRouteMetric5 are
-- unused.


--
--        The OSPF Area Aggregate Table
--
--        This table replaces the OSPF Area Summary Table, being an
--        extension of that for CIDR routers.

    ospfAreaAggregateTable OBJECT-TYPE
        SYNTAX    SEQUENCE OF OspfAreaAggregateEntry
        MAX-ACCESS    not-accessible
        STATUS    current
        DESCRIPTION
           "A range of IP addresses  specified  by  an  IP
           address/IP network  mask  pair.  For example,
           class B address range of X.X.X.X with a network
           mask  of  255.255.0.0 includes all IP addresses
           from X.X.0.0  to  X.X.255.255.   Note  that  if
           ranges  are configured such that one range sub-
           sumes  another  range  (e.g.,   10.0.0.0   mask
           255.0.0.0  and  10.1.0.0 mask 255.255.0.0), the
           most specific match is the preferred one."
         REFERENCE
           "OSPF Version 2, Appendix C.2  Area parameters"
         ::= { ospf 14 }


      ospfAreaAggregateEntry OBJECT-TYPE
          SYNTAX    OspfAreaAggregateEntry
          MAX-ACCESS    not-accessible
          STATUS    current
          DESCRIPTION
             "A range of IP addresses  specified  by  an  IP
             address/IP network  mask  pair.  For example,
             class B address range of X.X.X.X with a network
             mask  of  255.255.0.0 includes all IP addresses
             from X.X.0.0  to  X.X.255.255.   Note  that  if
             ranges are range configured such that one range
             subsumes another  range  (e.g.,   10.0.0.0  mask
             255.0.0.0  and  10.1.0.0 mask 255.255.0.0), the
```

```
         most specific match is the preferred one."
       REFERENCE
          "OSPF Version 2, Appendix C.2  Area parameters"
      INDEX { ospfAreaAggregateAreaID, ospfAreaAggregateLsdbType,
              ospfAreaAggregateNet, ospfAreaAggregateMask }
      ::= { ospfAreaAggregateTable 1 }


OspfAreaAggregateEntry ::=
    SEQUENCE {
        ospfAreaAggregateAreaID
            AreaID,
        ospfAreaAggregateLsdbType
            INTEGER,
        ospfAreaAggregateNet
            IpAddress,
        ospfAreaAggregateMask
            IpAddress,
        ospfAreaAggregateStatus
            RowStatus,
        ospfAreaAggregateEffect
            INTEGER
              }

    ospfAreaAggregateAreaID OBJECT-TYPE
        SYNTAX   AreaID
        MAX-ACCESS   read-only
        STATUS   current
        DESCRIPTION
           "The Area the Address Aggregate is to be  found
           within."
       REFERENCE
          "OSPF Version 2, Appendix C.2 Area parameters"
      ::= { ospfAreaAggregateEntry 1 }


    ospfAreaAggregateLsdbType OBJECT-TYPE
        SYNTAX    INTEGER    {
                  summaryLink (3),
                  nssaExternalLink (7)
                }
        MAX-ACCESS   read-only
        STATUS    current
        DESCRIPTION
           "The type of the Address Aggregate.  This field
           specifies  the  Lsdb type that this Address Ag-
           gregate applies to."
       REFERENCE
```

```
            "OSPF Version 2, Appendix A.4.1 The  Link  State
            Advertisement header"
       ::= { ospfAreaAggregateEntry 2 }


    ospfAreaAggregateNet OBJECT-TYPE
       SYNTAX    IpAddress
       MAX-ACCESS    read-only
       STATUS    current
       DESCRIPTION
           "The IP Address of the Net or Subnet  indicated
           by the range."
       REFERENCE
           "OSPF Version 2, Appendix C.2 Area parameters"
       ::= { ospfAreaAggregateEntry 3 }


    ospfAreaAggregateMask OBJECT-TYPE
       SYNTAX    IpAddress
       MAX-ACCESS    read-only
       STATUS    current
       DESCRIPTION
           "The Subnet Mask that pertains to  the  Net  or
           Subnet."
       REFERENCE
           "OSPF Version 2, Appendix C.2 Area parameters"
       ::= { ospfAreaAggregateEntry 4 }


    ospfAreaAggregateStatus OBJECT-TYPE
       SYNTAX    RowStatus
       MAX-ACCESS    read-create
       STATUS    current
       DESCRIPTION
           "This variable displays the status of  the  en-
           try.  Setting it to 'invalid' has the effect of
           rendering it inoperative.  The internal  effect
           (row removal) is implementation dependent."
       ::= { ospfAreaAggregateEntry 5 }


    ospfAreaAggregateEffect OBJECT-TYPE
       SYNTAX    INTEGER    {
                   advertiseMatching (1),
                   doNotAdvertiseMatching (2)
                 }
       MAX-ACCESS    read-create
       STATUS    current
```

```
     DESCRIPTION
         "Subnets subsumed by ranges either trigger  the
         advertisement  of  the indicated aggregate (ad-
         vertiseMatching), or result in the subnet's not
         being advertised at all outside the area."
     DEFVAL   { advertiseMatching }
     ::= { ospfAreaAggregateEntry 6 }


-- conformance information

ospfConformance OBJECT IDENTIFIER ::= { ospf 15 }

ospfGroups       OBJECT IDENTIFIER ::= { ospfConformance 1 }
ospfCompliances OBJECT IDENTIFIER ::= { ospfConformance 2 }

-- compliance statements

   ospfCompliance MODULE-COMPLIANCE
      STATUS   current
      DESCRIPTION
         "The compliance statement "
     MODULE  -- this module
     MANDATORY-GROUPS {
                 ospfBasicGroup,
                 ospfAreaGroup,
                 ospfStubAreaGroup,
                 ospfIfGroup,
                 ospfIfMetricGroup,
                 ospfVirtIfGroup,
                 ospfNbrGroup,
                 ospfVirtNbrGroup,
                 ospfAreaAggregateGroup
         }
     ::= { ospfCompliances 1 }


-- units of conformance

   ospfBasicGroup    OBJECT-GROUP
      OBJECTS {
                 ospfRouterId,
                 ospfAdminStat,
                 ospfVersionNumber,
                 ospfAreaBdrRtrStatus,
                 ospfASBdrRtrStatus,
                 ospfExternLsaCount,
                 ospfExternLsaCksumSum,
```

```
            ospfTOSSupport,
            ospfOriginateNewLsas,
            ospfRxNewLsas,
            ospfExtLsdbLimit,
            ospfMulticastExtensions,
            ospfExitOverflowInterval,
            ospfDemandExtensions
    }
    STATUS  current
    DESCRIPTION
       "These objects are required for OSPF systems."
    ::= { ospfGroups 1 }


ospfAreaGroup     OBJECT-GROUP
    OBJECTS {
            ospfAreaId,
            ospfImportAsExtern,
            ospfSpfRuns,
            ospfAreaBdrRtrCount,
            ospfAsBdrRtrCount,
            ospfAreaLsaCount,
            ospfAreaLsaCksumSum,
            ospfAreaSummary,
            ospfAreaStatus
    }
    STATUS  current
    DESCRIPTION
       "These objects are required  for  OSPF  systems
       supporting areas."
    ::= { ospfGroups 2 }


ospfStubAreaGroup     OBJECT-GROUP
    OBJECTS {
            ospfStubAreaId,
            ospfStubTOS,
            ospfStubMetric,
            ospfStubStatus,
            ospfStubMetricType
    }
    STATUS  current
    DESCRIPTION
       "These objects are required  for  OSPF  systems
       supporting stub areas."
    ::= { ospfGroups 3 }
```

        ospfLsdbGroup   OBJECT-GROUP
            OBJECTS {
                        ospfLsdbAreaId,
                        ospfLsdbType,
                        ospfLsdbLsid,
                        ospfLsdbRouterId,
                        ospfLsdbSequence,
                        ospfLsdbAge,
                        ospfLsdbChecksum,
                        ospfLsdbAdvertisement
            }
            STATUS current
            DESCRIPTION
              "These objects are required for OSPF systems
              that display their link state database."
            ::= { ospfGroups 4 }

        ospfAreaRangeGroup   OBJECT-GROUP
            OBJECTS {
                        ospfAreaRangeAreaId,
                        ospfAreaRangeNet,
                        ospfAreaRangeMask,
                        ospfAreaRangeStatus,
                        ospfAreaRangeEffect
            }
            STATUS obsolete
            DESCRIPTION
              "These objects are required for non-CIDR OSPF
              systems that support multiple areas."
            ::= { ospfGroups 5 }

        ospfHostGroup   OBJECT-GROUP
            OBJECTS {
                        ospfHostIpAddress,
                        ospfHostTOS,
                        ospfHostMetric,
                        ospfHostStatus,
                        ospfHostAreaID
            }
            STATUS current
            DESCRIPTION
              "These objects are required for OSPF systems
              that support attached hosts."
            ::= { ospfGroups 6 }

          ospfIfGroup   OBJECT-GROUP
              OBJECTS {
                          ospfIfIpAddress,
                          ospfAddressLessIf,
                          ospfIfAreaId,
                          ospfIfType,
                          ospfIfAdminStat,
                          ospfIfRtrPriority,
                          ospfIfTransitDelay,
                          ospfIfRetransInterval,
                          ospfIfHelloInterval,
                          ospfIfRtrDeadInterval,
                          ospfIfPollInterval,
                          ospfIfState,
                          ospfIfDesignatedRouter,
                          ospfIfBackupDesignatedRouter,
                          ospfIfEvents,
                          ospfIfAuthType,
                          ospfIfAuthKey,
                          ospfIfStatus,
                          ospfIfMulticastForwarding,
                          ospfIfDemand
                }
              STATUS current
              DESCRIPTION
                 "These objects are required for OSPF systems."
            ::= { ospfGroups 7 }

          ospfIfMetricGroup   OBJECT-GROUP
              OBJECTS {
                          ospfIfMetricIpAddress,
                          ospfIfMetricAddressLessIf,
                          ospfIfMetricTOS,
                          ospfIfMetricValue,
                          ospfIfMetricStatus
                }
              STATUS current
              DESCRIPTION
                 "These objects are required for OSPF systems."
            ::= { ospfGroups 8 }

          ospfVirtIfGroup   OBJECT-GROUP
              OBJECTS {
                          ospfVirtIfAreaId,
                          ospfVirtIfNeighbor,
                          ospfVirtIfTransitDelay,

```
                    ospfVirtIfRetransInterval,
                    ospfVirtIfHelloInterval,
                    ospfVirtIfRtrDeadInterval,
                    ospfVirtIfState,
                    ospfVirtIfEvents,
                    ospfVirtIfAuthType,
                    ospfVirtIfAuthKey,
                    ospfVirtIfStatus
        }
       STATUS  current
       DESCRIPTION
          "These objects are required for OSPF systems."
       ::= { ospfGroups 9 }


   ospfNbrGroup     OBJECT-GROUP
       OBJECTS {
                   ospfNbrIpAddr,
                   ospfNbrAddressLessIndex,
                   ospfNbrRtrId,
                   ospfNbrOptions,
                   ospfNbrPriority,
                   ospfNbrState,
                   ospfNbrEvents,
                   ospfNbrLsRetransQLen,
                   ospfNbmaNbrStatus,
                   ospfNbmaNbrPermanence,
                   ospfNbrHelloSuppressed
        }
       STATUS  current
       DESCRIPTION
          "These objects are required for OSPF systems."
       ::= { ospfGroups 10 }


   ospfVirtNbrGroup    OBJECT-GROUP
       OBJECTS {
                   ospfVirtNbrArea,
                   ospfVirtNbrRtrId,
                   ospfVirtNbrIpAddr,
                   ospfVirtNbrOptions,
                   ospfVirtNbrState,
                   ospfVirtNbrEvents,
                   ospfVirtNbrLsRetransQLen,
                   ospfVirtNbrHelloSuppressed
        }
       STATUS  current
       DESCRIPTION
```

```
            "These objects are required for OSPF systems."
        ::= { ospfGroups 11 }


   ospfExtLsdbGroup      OBJECT-GROUP
       OBJECTS {
                   ospfExtLsdbType,
                   ospfExtLsdbLsid,
                   ospfExtLsdbRouterId,
                   ospfExtLsdbSequence,
                   ospfExtLsdbAge,
                   ospfExtLsdbChecksum,
                   ospfExtLsdbAdvertisement
        }
        STATUS  current
        DESCRIPTION
           "These objects are required  for  OSPF  systems
           that display their link state database."
        ::= { ospfGroups 12 }


   ospfAreaAggregateGroup      OBJECT-GROUP
       OBJECTS {
                   ospfAreaAggregateAreaID,
                   ospfAreaAggregateLsdbType,
                   ospfAreaAggregateNet,
                   ospfAreaAggregateMask,
                   ospfAreaAggregateStatus,
                   ospfAreaAggregateEffect
        }
        STATUS  current
        DESCRIPTION
           "These objects are required for OSPF systems."
        ::= { ospfGroups 13 }

END
```

4. OSPF Traps

   OSPF is an event driven routing protocol, where an event can be a
   change in an OSPF interface's link-level status, the expiration of an
   OSPF timer or the reception of an OSPF protocol packet. Many of the
   actions that OSPF takes as a result of these events will result in a
   change of the routing topology. As routing topologies become large
   and complex it is often difficult to locate the source of a topology
   change or unpredicted routing path by polling a large number or
   routers. Another approach is to notify a network manager of
   potentially critical OSPF events with SNMP traps.

This section defines a set of traps, objects and mechanisms to
enhance the ability to manage IP internetworks which use OSPF as its
IGP. It is an optional but useful extension to the OSPF MIB.

4.1. Format Of Trap Definitions

Section 7 contains contains the trap definitions.

4.2. Approach

The mechanism for sending traps is straight-forward. When an
exception event occurs, the application notifies the local agent who
sends a trap to the appropriate SNMP management stations. The
message includes the trap type and may include a list of trap
specific variables. A new object is defined in section 3.2 that will
allow a network manager to enable or disable particular OSPF traps.
Section 5 gives the trap definitions which includes the variable
lists. The router ID of the originator of the trap is included in
the variable list so that the network manager may easily determine
the source of the trap.

To limit the frequency of OSPF traps, the following additional
mechanisms are suggested.

4.3. Ignoring Initial Activity

The majority of critical events occur when OSPF is enabled on a
router, at which time the designated router is elected and neighbor
adjacencies are formed. During this initial period a potential flood
of traps is unnecessary since the events are expected. To avoid
unnecessary traps, a router should not originate expected OSPF
interface related traps until two of that interface's dead timer
intervals have elapsed. The expected OSPF interface traps are
ospfIfStateChange, ospfVirtIfStateChange, ospfNbrStateChange,
ospfVirtNbrStateChange, ospfTxRetranmit and ospfVirtIfTxRetransmit.
Additionally, ospfMaxAgeLsa and ospfOriginateLsa traps should not be
originated until two dead timer intervals have elapsed where the dead
timer interval used should be the dead timer with the smallest value.

4.4. Throttling Traps

The mechanism for throttling the traps is similar to the mechanism
explained in RFC 1224 [11], section 5. The basic idea is that there
is a sliding window in seconds and an upper bound on the number of
traps that may be generated within this window. Unlike RFC 1224,
traps are not sent to inform the network manager that the throttling
mechanism has kicked in.

A single window should be used to throttle all OSPF traps types
except for the ospfLsdbOverflow and the ospfLsdbApproachingOverflow
trap which should not be throttled. For example, if the window time
is 3, the upper bound is 3 and the events that would cause trap types
1,3,5 and 7 occur within a 3 second period, the type 7 trap should
not be generated.

Appropriate values are 7 traps with a window time of 10 seconds.

4.5. One Trap Per OSPF Event

Several of the traps defined in section 5 are generated as the result
of finding an unusual condition while parsing an OSPF packet or a
processing a timer event. There may be more than one unusual
condition detected while handling the event. For example, a link-
state update packet may contain several retransmitted link-state
advertisements (LSAs), or a retransmitted database description packet
may contain several database description entries. To limit the
number of traps and variables, OSPF should generate at most one trap
per OSPF event. Only the variables associated with the first unusual
condition should be included with the trap. Similarly, if more than
one type of unusual condition is encountered while parsing the
packet, only the first event will generate a trap.

4.6. Polling Event Counters

Many of the tables in the OSPF MIB contain generalized event
counters. By enabling the traps defined in this document a network
manager can obtain more specific information about these events. A
network manager may want to poll these event counters and enable
specific OSPF traps when a particular counter starts increasing
abnormally.

The following table shows the relationship between the event counters
defined in the OSPF MIB and the trap types defined in section 5.

Counter32	Trap Type
ospfOriginateNewLsas	ospfOriginateLsa
ospfIfEvents	ospfIfStateChange
	ospfConfigError
	ospfIfAuthFailure
	ospfRxBadPacket
	ospfTxRetransmit
ospfVirtIfEvents	ospfVirtIfStateChange
	ospfVirtIfConfigError
	ospfVirtIfAuthFailure

```
                                     ospfVirtIfRxBadPacket
                                     ospfVirtIfTxRetransmit
        ospfNbrEvents                ospfNbrStateChange
        ospfVirtNbrEvents            ospfVirtNbrStateChange
        ospfExternLSACount           ospfLsdbApproachingOverflow
        ospfExternLSACount           ospfLsdbOverflow
```

5.   OSPF Trap Definitions

OSPF-TRAP-MIB DEFINITIONS ::= BEGIN

```
        IMPORTS
                MODULE-IDENTITY, OBJECT-TYPE, NOTIFICATION-TYPE, IpAddress
                   FROM SNMPv2-SMI
                MODULE-COMPLIANCE, OBJECT-GROUP
                   FROM SNMPv2-CONF
                ospfRouterId, ospfIfIpAddress, ospfAddressLessIf, ospfIfState,
                ospfVirtIfAreaId, ospfVirtIfNeighbor, ospfVirtIfState,
                ospfNbrIpAddr, ospfNbrAddressLessIndex, ospfNbrRtrId,
                ospfNbrState, ospfVirtNbrArea, ospfVirtNbrRtrId, ospfVirtNbrStat
e,
                ospfLsdbType, ospfLsdbLsid, ospfLsdbRouterId, ospfLsdbAreaId,
                ospfExtLsdbLimit, ospf
                   FROM OSPF-MIB;

        ospfTrap MODULE-IDENTITY
                LAST-UPDATED "9501201225Z" -- Fri Jan 20 12:25:50 PST 1995
                ORGANIZATION "IETF OSPF Working Group"
                CONTACT-INFO
                "                       Fred Baker
                Postal:                 Cisco Systems
                                        519 Lado Drive
                                        Santa Barbara, California 93111
                Tel:                    +1 805 681 0115
                E-Mail:                 fred@cisco.com


                                        Rob Coltun
                Postal:                 RainbowBridge Communications
                Tel:                    (301) 340-9416
                E-Mail:                 rcoltun@rainbow-bridge.com"
             DESCRIPTION
                "The MIB module to describe traps for  the  OSPF
                Version 2 Protocol."
             ::= { ospf 16 }

-- Trap Support Objects

--          The following are support objects for the OSPF traps.
```

```
ospfTrapControl OBJECT IDENTIFIER ::= { ospfTrap 1 }
ospfTraps OBJECT IDENTIFIER ::= { ospfTrap 2 }

    ospfSetTrap OBJECT-TYPE
        SYNTAX    OCTET STRING (SIZE(4))
        MAX-ACCESS    read-write
        STATUS    current
        DESCRIPTION
           "A four-octet string serving as a bit  map  for
           the trap events defined by the OSPF traps. This
           object is used to enable and  disable  specific
           OSPF    traps   where  a  1  in  the  bit  field
           represents enabled.  The right-most bit  (least
           significant) represents trap 0."
        ::= { ospfTrapControl 1 }


    ospfConfigErrorType OBJECT-TYPE
        SYNTAX    INTEGER   {
                   badVersion (1),
                   areaMismatch (2),
                   unknownNbmaNbr (3), -- Router is Dr eligible
                   unknownVirtualNbr (4),
                   authTypeMismatch(5),
                   authFailure (6),
                   netMaskMismatch (7),
                   helloIntervalMismatch (8),
                   deadIntervalMismatch (9),
                   optionMismatch (10) }
        MAX-ACCESS    read-only
        STATUS    current
        DESCRIPTION
           "Potential types  of  configuration  conflicts.
           Used  by the ospfConfigError and ospfConfigVir-
           tError traps."
    ::= { ospfTrapControl 2 }


    ospfPacketType OBJECT-TYPE
        SYNTAX    INTEGER   {
                   hello (1),
                   dbDescript (2),
                   lsReq (3),
                   lsUpdate (4),
                   lsAck (5) }
        MAX-ACCESS    read-only
        STATUS    current
        DESCRIPTION
```

```
            "OSPF packet types."
    ::= { ospfTrapControl 3 }


   ospfPacketSrc OBJECT-TYPE
       SYNTAX   IpAddress
       MAX-ACCESS   read-only
       STATUS   current
       DESCRIPTION
           "The IP address of an inbound packet that  can-
           not be identified by a neighbor instance."
       ::= { ospfTrapControl 4 }


-- Traps


   ospfIfStateChange NOTIFICATION-TYPE
       OBJECTS {
                   ospfRouterId, -- The originator of the trap
                   ospfIfIpAddress,
                   ospfAddressLessIf,
                   ospfIfState   -- The new state
               }
       STATUS            current
       DESCRIPTION
           "An ospfIfStateChange trap signifies that there
           has been a change in the state of a non-virtual
           OSPF interface. This trap should  be  generated
           when  the interface state regresses (e.g., goes
           from Dr to Down) or progresses  to  a  terminal
           state (i.e.,  Point-to-Point, DR Other, Dr, or
           Backup)."
    ::= { ospfTraps 16 }


   ospfVirtIfStateChange NOTIFICATION-TYPE
       OBJECTS {
                   ospfRouterId, -- The originator of the trap
                   ospfVirtIfAreaId,
                   ospfVirtIfNeighbor,
                   ospfVirtIfState  -- The new state
               }
       STATUS            current
       DESCRIPTION
           "An ospfIfStateChange trap signifies that there
           has  been a change in the state of an OSPF vir-
           tual interface.
```

                  This trap should be generated when the inter-
                  face state regresses (e.g., goes from Point-
                  to-Point to Down) or progresses to a terminal
                  state (i.e., Point-to-Point)."
           ::= { ospfTraps 1 }

      ospfNbrStateChange NOTIFICATION-TYPE
          OBJECTS {
                      ospfRouterId, -- The originator of the trap
                      ospfNbrIpAddr,
                      ospfNbrAddressLessIndex,
                      ospfNbrRtrId,
                      ospfNbrState -- The new state
                    }
          STATUS   current
          DESCRIPTION
              "An ospfNbrStateChange trap signifies   that
              there has been a change in the state of a non-
              virtual OSPF neighbor.   This trap should be
              generated when the neighbor state regresses
              (e.g., goes from Attempt or Full to 1-Way or
              Down) or progresses to a terminal state (e.g.,
              2-Way or Full). When an neighbor transitions
              from or to Full on non-broadcast multi-access
              and broadcast networks, the trap should be gen-
              erated by the designated router. A designated
              router transitioning to Down will be noted by
              ospfIfStateChange."
           ::= { ospfTraps 2 }

      ospfVirtNbrStateChange NOTIFICATION-TYPE
          OBJECTS {
                      ospfRouterId, -- The originator of the trap
                      ospfVirtNbrArea,
                      ospfVirtNbrRtrId,
                      ospfVirtNbrState -- The new state
                    }
          STATUS   current
          DESCRIPTION
              "An ospfIfStateChange trap signifies that there
              has been a change in the state of an OSPF vir-
              tual neighbor. This trap should be generated
              when the neighbor state regresses (e.g., goes
              from Attempt or Full to 1-Way or Down) or
              progresses to a terminal state (e.g., Full)."
           ::= { ospfTraps 3 }

```
    ospfIfConfigError NOTIFICATION-TYPE
        OBJECTS {
                    ospfRouterId, -- The originator of the trap
                    ospfIfIpAddress,
                    ospfAddressLessIf,
                    ospfPacketSrc,  -- The source IP address
                    ospfConfigErrorType, -- Type of error
                    ospfPacketType
                   }
        STATUS             current
        DESCRIPTION
           "An ospfIfConfigError  trap  signifies  that  a
           packet  has  been received on a non-virtual in-
           terface  from  a  router  whose  configuration
           parameters  conflict  with this router's confi-
           guration parameters.  Note that the  event  op-
           tionMismatch  should  cause  a  trap only if it
           prevents an adjacency from forming."
                    ::= { ospfTraps 4 }


    ospfVirtIfConfigError NOTIFICATION-TYPE
        OBJECTS {
                    ospfRouterId, -- The originator of the trap
                    ospfVirtIfAreaId,
                    ospfVirtIfNeighbor,
                    ospfConfigErrorType, -- Type of error
                    ospfPacketType
                   }
        STATUS             current
        DESCRIPTION
           "An ospfConfigError trap signifies that a pack-
           et  has  been  received  on a virtual interface
           from a router  whose  configuration  parameters
           conflict   with   this  router's  configuration
           parameters.  Note that the event optionMismatch
           should  cause a trap only if it prevents an ad-
           jacency from forming."
      ::= { ospfTraps 5 }


    ospfIfAuthFailure NOTIFICATION-TYPE
        OBJECTS {
                    ospfRouterId, -- The originator of the trap
                    ospfIfIpAddress,
                    ospfAddressLessIf,
                    ospfPacketSrc,  -- The source IP address
                    ospfConfigErrorType, -- authTypeMismatch or
```

```
                                         -- authFailure
                    ospfPacketType
                  }
         STATUS            current
         DESCRIPTION
            "An ospfIfAuthFailure  trap  signifies  that  a
            packet  has  been received on a non-virtual in-
            terface from a router whose authentication  key
            or  authentication  type  conflicts  with  this
            router's authentication key  or  authentication
            type."
      ::= { ospfTraps 6 }


      ospfVirtIfAuthFailure NOTIFICATION-TYPE
         OBJECTS {
                    ospfRouterId, -- The originator of the trap
                    ospfVirtIfAreaId,
                    ospfVirtIfNeighbor,
                    ospfConfigErrorType, -- authTypeMismatch or
                                         -- authFailure
                    ospfPacketType
                  }
         STATUS            current
         DESCRIPTION
            "An ospfVirtIfAuthFailure trap signifies that a
            packet has been received on a virtual interface
            from a router whose authentication key  or  au-
            thentication  type conflicts with this router's
            authentication key or authentication type."
      ::= { ospfTraps 7 }


      ospfIfRxBadPacket NOTIFICATION-TYPE
         OBJECTS {
                    ospfRouterId, -- The originator of the trap
                    ospfIfIpAddress,
                    ospfAddressLessIf,
                    ospfPacketSrc,  -- The source IP address
                    ospfPacketType
                  }
         STATUS            current
         DESCRIPTION
            "An ospfIfRxBadPacket trap  signifies  that  an
            OSPF  packet has been received on a non-virtual
            interface that cannot be parsed."
      ::= { ospfTraps 8 }
```

          ospfVirtIfRxBadPacket NOTIFICATION-TYPE
              OBJECTS {
                          ospfRouterId, -- The originator of the trap
                          ospfVirtIfAreaId,
                          ospfVirtIfNeighbor,
                          ospfPacketType
                        }
              STATUS   current
              DESCRIPTION
                 "An ospfRxBadPacket trap signifies that an OSPF
                  packet has been received on a virtual interface
                  that cannot be parsed."
          ::= { ospfTraps 9 }

          ospfTxRetransmit NOTIFICATION-TYPE
              OBJECTS {
                          ospfRouterId, -- The originator of the trap
                          ospfIfIpAddress,
                          ospfAddressLessIf,
                          ospfNbrRtrId, -- Destination
                          ospfPacketType,
                          ospfLsdbType,
                          ospfLsdbLsid,
                          ospfLsdbRouterId
                        }
              STATUS   current
              DESCRIPTION
                 "An ospfTxRetransmit trap signifies than an
                  OSPF packet has been retransmitted on a non-
                  virtual interface. All packets that may be re-
                  transmitted are associated with an LSDB entry.
                  The LS type, LS ID, and Router ID are used to
                  identify the LSDB entry."
          ::= { ospfTraps 10 }

          ospfVirtIfTxRetransmit NOTIFICATION-TYPE
              OBJECTS {
                          ospfRouterId, -- The originator of the trap
                          ospfVirtIfAreaId,
                          ospfVirtIfNeighbor,
                          ospfPacketType,
                          ospfLsdbType,
                          ospfLsdbLsid,
                          ospfLsdbRouterId
                        }
              STATUS   current

```
        DESCRIPTION
           "An ospfTxRetransmit  trap  signifies  than  an
           OSPF packet has been retransmitted on a virtual
           interface.  All packets that may be retransmit-
           ted  are  associated with an LSDB entry. The LS
           type, LS ID, and Router ID are used to identify
           the LSDB entry."
      ::= { ospfTraps 11 }


      ospfOriginateLsa NOTIFICATION-TYPE
          OBJECTS {
                     ospfRouterId, -- The originator of the trap
                     ospfLsdbAreaId,  -- 0.0.0.0 for AS Externals
                     ospfLsdbType,
                     ospfLsdbLsid,
                     ospfLsdbRouterId
                   }
          STATUS             current
          DESCRIPTION
             "An ospfOriginateLsa trap signifies that a  new
             LSA  has  been originated by this router.  This
             trap should not be invoked for simple refreshes
             of  LSAs  (which happesn every 30 minutes), but
             instead will only be invoked  when  an  LSA  is
             (re)originated due to a topology change.  Addi-
             tionally, this trap does not include LSAs  that
             are  being  flushed  because  they have reached
             MaxAge."
      ::= { ospfTraps 12 }


      ospfMaxAgeLsa NOTIFICATION-TYPE
          OBJECTS {
                     ospfRouterId, -- The originator of the trap
                     ospfLsdbAreaId,  -- 0.0.0.0 for AS Externals
                     ospfLsdbType,
                     ospfLsdbLsid,
                     ospfLsdbRouterId
                   }
          STATUS             current
          DESCRIPTION
             "An ospfMaxAgeLsa trap signifies  that  one  of
             the LSA in the router's link-state database has
             aged to MaxAge."
      ::= { ospfTraps 13 }
```

```
     ospfLsdbOverflow NOTIFICATION-TYPE
         OBJECTS {
                     ospfRouterId, -- The originator of the trap
                     ospfExtLsdbLimit
                   }
         STATUS              current
         DESCRIPTION
            "An ospfLsdbOverflow trap  signifies  that  the
            number of LSAs in the router's link-state data-
            base has exceeded ospfExtLsdbLimit."
    ::= { ospfTraps 14 }


     ospfLsdbApproachingOverflow NOTIFICATION-TYPE
         OBJECTS {
                     ospfRouterId, -- The originator of the trap
                     ospfExtLsdbLimit
                   }
         STATUS              current
         DESCRIPTION
            "An ospfLsdbApproachingOverflow trap  signifies
            that  the  number of LSAs in the router's link-
            state database has exceeded ninety  percent  of
            ospfExtLsdbLimit."
    ::= { ospfTraps 15 }


-- conformance information

ospfTrapConformance OBJECT IDENTIFIER ::= { ospfTrap 3 }

ospfTrapGroups      OBJECT IDENTIFIER ::= { ospfTrapConformance 1 }
ospfTrapCompliances OBJECT IDENTIFIER ::= { ospfTrapConformance 2 }

-- compliance statements

     ospfTrapCompliance MODULE-COMPLIANCE
         STATUS   current
          DESCRIPTION
            "The compliance statement "
        MODULE  -- this module
        MANDATORY-GROUPS { ospfTrapControlGroup }


         GROUP         ospfTrapControlGroup
          DESCRIPTION
            "This group is optional but recommended for all
            OSPF systems"
```

```
        ::= { ospfTrapCompliances 1 }


-- units of conformance

   ospfTrapControlGroup     OBJECT-GROUP
       OBJECTS {
                        ospfSetTrap,
                        ospfConfigErrorType,
                        ospfPacketType,
                        ospfPacketSrc
        }
        STATUS  current
        DESCRIPTION
           "These objects are required  to  control  traps
           from OSPF systems."
        ::= { ospfTrapGroups 1 }


END
```

6. Acknowledgements

   This document was produced by the OSPF Working Group.

7. References

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8. Security Considerations

    Security issues are not discussed in this memo.

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