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D. Yeung  
Arrcus  
Y. Qu  
Huawei  
J. Zhang  
Juniper Networks  
I. Chen  
Jabil  
A. Lindem  
Cisco Systems  
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Yang Data Model for OSPF Protocol  
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## Abstract

This document defines a YANG data model that can be used to configure and manage OSPF. The model is based on YANG 1.1 as defined in [RFC 7950](#) and conforms to the Network Management Datastore Architecture (NDMA) as described in [RFC 8342](#).

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## [1.](#) Overview

YANG [[RFC6020](#)][RFC7950] is a data definition language used to define the contents of a conceptual data store that allows networked devices to be managed using NETCONF [[RFC6241](#)]. YANG is proving relevant beyond its initial confines, as bindings to other interfaces (e.g., ReST) and encodings other than XML (e.g., JSON) are being defined. Furthermore, YANG data models can be used as the basis for implementation of other interfaces, such as CLI and programmatic APIs.

This document defines a YANG data model that can be used to configure and manage OSPF and it is an augmentation to the core routing data

model. If fully conforms to the Network Management Datastore Architecture (NDMA) [RFC8342]. A core routing data model is defined in [RFC8349], and it provides the basis for the development of data models for routing protocols. The interface data model is defined in [RFC8343] and is used for referencing interfaces from the routing

protocol. The key-chain data model used for OSPF authentication is defined in [RFC8177] and provides both a reference to configured key-chains and an enumeration of cryptographic algorithms.

Both OSPFv2 [RFC2328] and OSPFv3 [RFC5340] are supported. In addition to the core OSPF protocol, features described in other OSPF RFCs are also supported. These includes demand circuit [RFC1793], traffic engineering [RFC3630], multiple address family [RFC5838], graceful restart [RFC3623] [RFC5187], NSSA [RFC3101], and OSPF(v3) as a PE-CE Protocol [RFC4577], [RFC6565]. These non-core features are optional in the OSPF data model.

### 1.1. Requirements Language

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14](#) [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

### 1.2. Tree Diagrams

This document uses the graphical representation of data models defined in [RFC8340].

## 2. Design of Data Model

Although the basis of OSPF configuration elements like routers, areas, and interfaces remains the same, the detailed configuration model varies among router vendors. Differences are observed in terms of how the protocol engine is tied to the routing domain, how multiple protocol engines are be instantiated among others.

The goal of this document is to define a data model that provides a common user interface to the OSPFv2 and OSPFv3 protocols. There is very little information that is designated as "mandatory", providing

freedom for vendors to adapt this data model to their respective product implementations.

## [2.1.](#) OSPF Operational State

The OSPF operational state is included in the same tree as OSPF configuration consistent with Network Management Datastore Architecture [[RFC8342](#)]. Consequently, only the routing container in the ietf-routing model [[RFC8349](#)] is augmented. The routing-state container is not augmented.

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OSPF Yang Data Model

August 2018

## [2.2.](#) Overview

The OSPF YANG module defined in this document has all the common building blocks for the OSPF protocol.

The OSPF YANG module augments the /routing/control-plane-protocols/control-plane-protocol path defined in the ietf-routing module.

```
module: ietf-ospf
  augment /rt:routing/rt:control-plane-protocols/
    rt:control-plane-protocol:
      +--rw ospf
      .
      .
      +--rw operation-mode?          identityref
      +--rw af?                      identityref
      .
      .
      +--rw areas
      |   +--rw area* [area-id]
      |       +--rw area-id          area-id-type
      |       .
      |       .
      |       +--rw virtual-links
      |       |   +--rw virtual-link* [transit-area-id router-id]
      |       |   .
      |       |   .
      |       +--rw sham-links {pe-ce-protocol}?
      |       |   +--rw sham-link* [local-id remote-id]
```

```

|       |       .
|       |       .
|       +--rw interfaces
|           +--rw interface* [name]
|           .
|           .
+--rw topologies {multi-topology}?
    +--rw topology* [name]
    .
    .

```

The ospf module is intended to match to the vendor specific OSPF configuration construct that is identified by the local identifier 'name'. The field 'version' allows support for OSPFv2 and OSPFv3.

The ospf container includes one OSPF protocol engine instance. The instance includes OSPF router level configuration and operational state.

The area and area/interface containers respectively define the OSPF configuration and operational state for OSPF areas and interfaces.

The topology container defines the OSPF configuration and operational state for OSPF topologies when the multi-topology feature is supported.

### [2.3.](#) OSPFv2 and OSPFv3

The data model defined herein supports both OSPFv2 and OSPFv3.

The field 'version' is used to indicate the OSPF version and is mandatory. Based on the configured version, the data model varies to accommodate the differences between OSPFv2 and OSPFv3.

### [2.4.](#) Optional Features

Optional features are beyond the basic OSPF configuration and it is the responsibility of each vendor to decide whether to support a given feature on a particular device.

This model defines the following optional features:

1. multi-topology: Support Multiple-Topology Routing (MTR) [[RFC4915](#)].
2. multi-area-adj: Support OSPF multi-area adjacency [[RFC5185](#)].
3. explicit-router-id: Support explicit per-instance Router-ID specification.
4. demand-circuit: Support OSPF demand circuits [[RFC1793](#)].
5. mtu-ignore: Support disabling OSPF Database Description packet MTU mismatch checking.
6. lls: Support OSPF link-local signaling (LLS) [[RFC5613](#)].
7. prefix-suppression: Support OSPF prefix advertisement suppression [[RFC6860](#)].
8. ttl-security: Support OSPF Time to Live (TTL) security check suppression [[RFC5082](#)].
9. nsr: Support OSPF Non-Stop Routing (NSR).
10. graceful-restart: Support Graceful OSPF Restart [[RFC3623](#)], [[RFC5187](#)].

11. admin-control: Support Administrative control of the protocol state.
12. auto-cost: Support OSPF interface cost calculation according to reference bandwidth [[RFC2328](#)].
13. max-ecmp: Support configuration of the maximum number of Equal-Cost Multi-Path (ECMP) paths.
14. max-lsa: Support configuration of the maximum number of LSAs the OSPF instance will accept [[RFC1765](#)].
15. te-rid: Support configuration of the Traffic Engineering (TE) Router-ID [[RFC3630](#)], [[RFC5329](#)].

16. `ldp-igp-sync`: Support LDP IGP synchronization [[RFC5443](#)].
17. `ospfv3-authentication-ipsec`: Support IPsec for OSPFv3 authentication [[RFC4552](#)].
18. `fast-reroute`: Support IP Fast Reroute (IP-FRR) [[RFC5714](#)].
19. `node-flag`: Support node-flag for OSPF prefixes. [[RFC7684](#)].
20. `node-tag`: Support node admin tag for OSPF instances [[RFC7777](#)].
21. `lfa`: Support Loop-Free Alternates (LFAs) [[RFC5286](#)].
22. `remote-lfa`: Support Remote Loop-Free Alternates (R-LFA) [[RFC7490](#)].
23. `stub-router`: Support [RFC 6987](#) OSPF Stub Router advertisement [[RFC6987](#)].
24. `pe-ce-protocol`: Support OSPF as a PE-CE protocol [[RFC4577](#)], [[RFC6565](#)].
25. `ietf-spf-delay`: Support IETF SPF delay algorithm [[RFC8405](#)].
26. `bfd`: Support BFD detection of OSPF neighbor reachability [[RFC5880](#)], xref target="[RFC5881](#)">

It is expected that vendors will support additional features through vendor-specific augmentations.

## [2.5](#). OSPF Router Configuration/Operational State

The `ospf` container is the top level container in this data model. It represents an OSPF protocol engine instance and contains the router level configuration and operational state. The operational state includes the instance statistics, IETF SPF delay statistics, AS-Scoped Link State Database, local RIB, SPF Log, and the LSA log.

```

module: ietf-ospf
augment /rt:routing/rt:control-plane-protocols/
    rt:control-plane-protocol:
    +--rw ospf
    .
    .
    +--rw af iana-rt-types:address-family
    +--rw explicit-router-id? rt-types:router-id
    | {explicit-router-id}?
    +--rw preference
    | +--rw (scope)?
    | | +--:(single-value)
    | | | +--rw all? uint8
    | | +--:(multi-values)
    | | | +--rw (granularity)?
    | | | | +--:(detail)
    | | | | | +--rw intra-area? uint8
    | | | | | +--rw inter-area? uint8
    | | | | +--:(coarse)
    | | | | +--rw internal? uint8
    | | | +--rw external? uint8
    +--rw nsr {nsr}?
    | +--rw enable? boolean
    +--rw graceful-restart {graceful-restart}?
    | +--rw enable? boolean
    | +--rw helper-enable? boolean
    | +--rw restart-interval? uint16
    | +--rw helper-strict-lsa-checking? boolean
    +--rw enable? boolean {admin-control}?
    +--rw auto-cost {auto-cost}?
    | +--rw enable? boolean
    | +--rw reference-bandwidth? uint32
    +--rw spf-control
    | +--rw paths? uint16 {max-ecmp}?
    | +--rw ietf-spf-delay {ietf-spf-delay}?
    | | +--rw initial-delay? uint16
    | | +--rw short-delay? uint16
    | | +--rw long-delay? uint16
    | | +--rw hold-down? uint16
    | | +--rw time-to-learn? uint16

```



```

|      +---ro remaining-time-to-learn?    uint16
|      +---ro remaining-hold-down?        uint16
|      +---ro last-event-received?        yang:timestamp
|      +---ro next-spf-time?              yang:timestamp
|      +---ro last-spf-time?              yang:timestamp
+---rw database-control
|   +---rw max-lsa?    uint32 {max-lsa}?
+---rw stub-router {stub-router}?
|   +---rw (trigger)?
|       +---:(always)
|       +---rw always!
+---rw mpls
|   +---rw te-rid {te-rid}?
|   |   +---rw ipv4-router-id?    inet:ipv4-address
|   |   +---rw ipv6-router-id?    inet:ipv6-address
|   +---rw ldp
|       +---rw igp-sync?    boolean {ldp-igp-sync}?
+---rw fast-reroute {fast-reroute}?
|   +---rw lfa {lfa}?
+---ro protected-routes
|   +---ro af-stats* [af prefix alternate]
|       +---ro af                iana-rt-types:address-family
|       +---ro prefix            string
|       +---ro alternate         string
|       +---ro alternate-type?    enumeration
|       +---ro best?             boolean
|       +---ro non-best-reason?   string
|       +---ro protection-available? bits
|       +---ro alternate-metric1? uint32
|       +---ro alternate-metric2? uint32
|       +---ro alternate-metric3? uint32
+---ro unprotected-routes
|   +---ro af-stats* [af prefix]
|       +---ro af                iana-rt-types:address-family
|       +---ro prefix            string
+---ro protection-statistics* [frr-protection-method]
|   +---ro frr-protection-method string
|   +---ro af-stats* [af]
|       +---ro af                iana-rt-types:address-family
|       +---ro total-routes?      uint32
|       +---ro unprotected-routes? uint32
|       +---ro protected-routes?  uint32
|       +---ro linkprotected-routes? uint32
|       +---ro nodeprotected-routes? uint32
+---rw node-tags {node-tag}?
|   +---rw node-tag* [tag]
|       +---rw tag    uint32

```

```

+--ro router-id?
+--ro local-rib
|   +--ro route* [prefix]
|       +--ro prefix          inet:ip-prefix
|       +--ro next-hops
|           |   +--ro next-hop* [next-hop]
|           |       +--ro outgoing-interface?  if:interface-ref
|           |       +--ro next-hop            inet:ip-address
|       +--ro metric?          uint32
|       +--ro route-type?      route-type
|       +--ro route-tag?       uint32
+--ro statistics
|   +--ro originate-new-lsa-count?  yang:counter32
|   +--ro rx-new-lsas-count?         yang:counter32
|   +--ro as-scope-lsa-count?        yang:gauge32
|   +--ro as-scope-lsa-chksum-sum?   uint32
|   +--ro database
|       +--ro as-scope-lsa-type*
|           +--ro lsa-type?          uint16
|           +--ro lsa-count?         yang:gauge32
|           +--ro lsa-cksum-sum?     int32
+--ro database
|   +--ro as-scope-lsa-type* [lsa-type]
|       +--ro as-scope-lsas
|           +--ro as-scope-lsa* [lsa-id adv-router]
|               +--ro lsa-id          union
|               +--ro adv-router       inet:ipv4-address
|               +--ro decoded-completed?  boolean
|               +--ro raw-data?         yang:hex-string
|               +--ro (version)?
|                   +--:(ospfv2)
|                       |   +--ro ospfv2
|                       .
|                       .
|                       +--:(ospfv3)
|                           +--ro ospfv3
|                       .
|                       .
+--ro spf-log
|   +--ro event* [id]
|       +--ro id                    uint32
|       +--ro spf-type?             enumeration
|       +--ro schedule-timestamp?   yang:timestamp
|       +--ro start-timestamp?      yang:timestamp
|       +--ro end-timestamp?        yang:timestamp
|       +--ro trigger-lsa*

```

```

|         +---ro area-id?      area-id-type
|         +---ro link-id?      union

```

```

|         +---ro type?          uint16
|         +---ro lsa-id?        yang:dotted-quad
|         +---ro adv-router?    yang:dotted-quad
|         +---ro seq-num?       uint32
+---ro lsa-log
|   +---ro event* [id]
|     +---ro id                  uint32
|     +---ro lsa
|       | +---ro area-id?        area-id-type
|       | +---ro link-id?        union
|       | +---ro type?           uint16
|       | +---ro lsa-id?         yang:dotted-quad
|       | +---ro adv-router?     yang:dotted-quad
|       | +---ro seq-num?        uint32
|       +---ro received-timestamp? yang:timestamp
|       +---ro reason?           identityref
|
|
|

```

## 2.6. OSPF Area Configuration/Operational State

The area container contains OSPF area configuration and the list of interface containers representing all the OSPF interfaces in the area. The area operational state includes the area statistics and the Area Link State Database (LSDB).

```

module: ietf-ospf
  augment /rt:routing/rt:control-plane-protocols/
    rt:control-plane-protocol:
      +---rw ospf
      |
      |
      |
      +---rw areas
      |   +---rw area* [area-id]
      |     +---rw area-id          area-id-type
      |     +---rw area-type?       identityref
      |     +---rw summary?         boolean
      |     +---rw default-cost?    uint32
      |     +---rw ranges

```

```

|         +---rw range* [prefix]
|         |         +---rw prefix          inet:ip-prefix
|         |         +---rw advertise?      boolean
|         |         +---rw cost?           uint24
| +---ro statistics
|         +---ro spf-runs-count?            yang:counter32
|         +---ro abr-count?                 yang:gauge32
|         +---ro asbr-count?                yang:gauge32
|         +---ro ar-nssa-translator-event-count?

```

```

|         |         +---ro area-scope-lsa-count?            yang:counter32
|         |         +---ro area-scope-lsa-cksum-sum?      yang:gauge32
|         |         +---ro area-scope-lsa-cksum-sum?      int32
|         +---ro database
|         |         +---ro area-scope-lsa-type*
|         |         |         +---ro lsa-type?            uint16
|         |         |         +---ro lsa-count?           yang:gauge32
|         |         |         +---ro lsa-cksum-sum?       int32
| +---ro database
|         +---ro area-scope-lsa-type* [lsa-type]
|         |         +---ro lsa-type            uint16
|         |         +---ro area-scope-lsas
|         |         |         +---ro area-scope-lsa* [lsa-id adv-router]
|         |         |         |         +---ro lsa-id            union
|         .         .         .
|         .         .         .
|         |         +---ro (version)?
|         |         |         +---:(ospfv2)
|         |         |         |         +---ro ospfv2
|         |         |         |         |         +---ro header
|         .         .         .         .
|         .         .         .         .
|         |         |         +---ro body
|         |         |         |         +---ro router
|         .         .         .         .
|         .         .         .         .
|         |         |         +---ro network
|         .         .         .         .
|         .         .         .         .
|         |         |         +---ro summary
|         .         .         .         .
|         .         .         .         .

```

```

|      |      |      +--ro external
.      .      .      .
.      .      .      .
|      |      |      +--ro opaque
.      .      .      .
.      .      .      .
|      |      +---:(ospfv3)
|      |      +--ro ospfv3
|      |      +--ro header
.      .      .
.      .      .
|      |      +--ro body
|      |      +--ro router
.      .      .
.      .      .
|      |      +--ro network

```

```

.      .      .
.      .      .
|      |      +--ro inter-area-prefix
.      .      .
.      .      .
|      |      +--ro inter-area-router
.      .      .
.      .      .
|      |      +--ro as-external
.      .      .
.      .      .
|      |      +--ro nssa
.      .      .
.      .      .
|      |      +--ro link
.      .      .
.      .      .
|      |      +--ro intra-area-prefix
.      .      .
.      .      .
|      |      +--ro router-information
.      .      .
.      .      .
|      +---rw virtual-links
|      |  +---rw virtual-link* [transit-area-id router-id]

```

```

+--rw transit-area-id      -> ../../../../
                             area/area-id
+--rw router-id            rt-types:router-id
+--rw hello-interval?     uint16
+--rw dead-interval?      uint32
+--rw retransmit-interval? uint16
+--rw transmit-delay?     uint16
+--rw lls?                 boolean {lls}?
+--rw ttl-security {ttl-security}?
|   +--rw enable?         boolean
|   +--rw hops?           uint8
+--rw enable?              boolean
                             {admin-control}?
+--rw authentication
|   +--rw (auth-type-selection)?
|       +--:(auth-ipsec)
|           {ospfv3-authentication-ipsec}?
|       |   +--rw sa?             string
|       +--:(auth-trailer-key-chain)
|       |   +--rw key-chain?
|       |       key-chain:key-chain-ref
|       +--:(auth-trailer-key)
|           +--rw key?             string

```

```

|   +--rw crypto-algorithm? identityref
+--ro cost?                uint16
+--ro state?               if-state-type
+--ro hello-timer?         uint32
+--ro wait-timer?          uint32
+--ro dr-router-id?        rt-types:router-id
+--ro dr-ip-addr?          inet:ip-address
+--ro bdr-router-id?       rt-types:router-id
+--ro bdr-ip-addr?         inet:ip-address
+--ro statistics
|   +--ro if-event-count?   yang:counter32
|   +--ro link-scope-lsa-count? yang:gauge32
|   +--ro link-scope-lsa-cksum-sum?
|       uint32
|   +--ro database
|       +--ro link-scope-lsa-type*
|           +--ro lsa-type?   uint16
|           +--ro lsa-count?   yang:gauge32

```

```

|         +---ro lsa-cksum-sum?   int32
| +---ro neighbors
|   +---ro neighbor* [neighbor-router-id]
|     +---ro neighbor-router-id
|       rt-types:router-id
|     +---ro address?             inet:ip-address
|     +---ro dr-router-id?        rt-types:router-id
|     +---ro dr-ip-addr?          inet:ip-address
|     +---ro bdr-router-id?       rt-types:router-id
|     +---ro bdr-ip-addr?         inet:ip-address
|     +---ro state?               nbr-state-type
|     +---ro dead-timer?          uint32
|     +---ro statistics
|       +---ro nbr-event-count?
|         yang:counter32
|       +---ro nbr-retrans-qlen?
|         yang:gauge32
| +---ro database
|   +---ro link-scope-lsa-type* [lsa-type]
|   +---ro lsa-type               uint16
|   +---ro link-scope-lsas
|
| .
| .
| +---rw sham-links {pe-ce-protocol}?
|   +---rw sham-link* [local-id remote-id]
|     +---rw local-id             inet:ip-address
|     +---rw remote-id            inet:ip-address
|     +---rw hello-interval?      uint16
|     +---rw dead-interval?       uint32
|     +---rw retransmit-interval? uint16

```

```

|         +---rw transmit-delay?   uint16
|         +---rw lls?               boolean {lls}?
|         +---rw ttl-security {ttl-security}?
|           +---rw enable?         boolean
|           +---rw hops?           uint8
|         +---rw enable?            boolean
|                                   {admin-control}?
|         +---rw authentication
|           +---rw (auth-type-selection)?
|             +---:(auth-ipsec)
|               {ospfv3-authentication-ipsec}?

```







```

|      +---rw poll-interval?    uint16
|      +---rw priority?         uint8
+---rw node-flag?               boolean
|                               {node-flag}?
+---rw bfd {bfd}?
|   +---rw enable?             boolean
+---rw fast-reroute {fast-reroute}?
|   +---rw lfa {lfa}?
|       +---rw candidate-enable? boolean
|       +---rw enable?          boolean
|       +---rw remote-lfa {remote-lfa}?
|       +---rw enable?          boolean
+---rw hello-interval?         uint16
+---rw dead-interval?          uint32
+---rw retransmit-interval?    uint16
+---rw transmit-delay?         uint16
+---rw lls?                    boolean {lls}?
+---rw ttl-security {ttl-security}?
|   +---rw enable?             boolean
|   +---rw hops?               uint8
+---rw enable?                 boolean
|                               {admin-control}?
+---rw authentication
|   +---rw (auth-type-selection)?
|       +---:(auth-ipsec)
|       |   {ospfv3-authentication-ipsec}?
|       |   +---rw sa?          string
|       +---:(auth-trailer-key-chain)
|       |   +---rw key-chain?
|       |   |       key-chain:key-chain-ref
|       +---:(auth-trailer-key)
|       |   +---rw key?          string
|       |   +---rw crypto-algorithm? identityref
+---rw cost?                    uint16
+---rw mtu-ignore?              boolean
|                               {mtu-ignore}?
+---rw prefix-suppression?     boolean
|                               {prefix-suppression}?
+---ro state?                   if-state-type
+---ro hello-timer?             uint32
+---ro wait-timer?              uint32
+---ro dr-router-id?            rt-types:router-id
+---ro dr-ip-addr?              inet:ip-address
+---ro bdr-router-id?           rt-types:router-id
+---ro bdr-ip-addr?             inet:ip-address
+---ro statistics
|   +---ro if-event-count?      yang:counter32

```

| | +--ro link-scope-lsa-count? yang:gauge32

```
| | +--ro link-scope-lsa-cksum-sum?
| | |                               uint32
| | +--ro database
| | |   +--ro link-scope-lsa-type*
| | |   |   +--ro lsa-type?         uint16
| | |   |   +--ro lsa-count?        yang:gauge32
| | |   |   +--ro lsa-cksum-sum?    int32
| | +--ro neighbors
| | |   +--ro neighbor* [neighbor-router-id]
| | |   |   +--ro neighbor-router-id
| | |   |   |                               rt-types:router-id
| | |   |   +--ro address?            inet:ip-address
| | |   |   +--ro dr-router-id?       rt-types:router-id
| | |   |   +--ro dr-ip-addr?         inet:ip-address
| | |   |   +--ro bdr-router-id?     rt-types:router-id
| | |   |   +--ro bdr-ip-addr?       inet:ip-address
| | |   |   +--ro state?             nbr-state-type
| | |   |   +--ro dead-timer?        uint32
| | |   +--ro statistics
| | |   |   +--ro nbr-event-count?
| | |   |   |                               yang:counter32
| | |   |   +--ro nbr-retrans-qlen?
| | |   |   |                               yang:gauge32
| | +--ro database
| | |   . +--ro link-scope-lsa-type* [lsa-type]
| | |   .   +--ro lsa-type            uint16
| | |   .   +--ro link-scope-lsas
| | |   .
| | |   .
| | |   .
| | +--rw topologies {ospf:multi-topology}?
| | |   +--rw topology* [name]
| | |   |   +--rw name -> ../../../../rt:ribs/rib/name
| | |   |   +--rw cost? uint32
| | +--rw instance-id?                uint8
| |
| |
| |
```

## [2.8.](#) OSPF notification

This YANG model defines a list of notifications that inform YANG clients of important events detected during protocol operation. The defined notifications cover the common set of traps from the OSPFv2 MIB [[RFC4750](#)] and OSPFv3 MIB [[RFC5643](#)].

notifications:

```
+---n if-state-change
|   +--ro routing-protocol-name?
```

```
|   +   -> /rt:routing/control-plane-protocols/
|   +       control-plane-protocol/name
|   +--ro af?
|   +   -> /rt:routing/control-plane-protocols/
|   +       control-plane-protocol
|   +       [rt:name=current()/../routing-protocol-name]/
|   +       ospf:ospf/af
|   +--ro (if-link-type-selection)?
|   |   +--:(interface)
|   |   |   +--ro interface
|   |   |   |   +--ro interface?   if:interface-ref
|   |   +--:(virtual-link)
|   |   |   +--ro virtual-link
|   |   |   |   +--ro transit-area-id?   area-id-type
|   |   |   |   +--ro neighbor-router-id? rt-types:router-id
|   |   +--:(sham-link)
|   |   |   +--ro sham-link
|   |   |   |   +--ro area-id?   area-id-type
|   |   |   |   +--ro local-ip-addr?   inet:ip-address
|   |   |   |   +--ro remote-ip-addr?   inet:ip-address
|   |   +--ro state?   if-state-type
+---n if-config-error
|   +--ro routing-protocol-name?
|   +   -> /rt:routing/control-plane-protocols/
|   +       control-plane-protocol/name
|   +--ro af?
|   +   -> /rt:routing/control-plane-protocols/
|   +       control-plane-protocol
|   +       [rt:name=current()/../routing-protocol-name]/
|   +       ospf:ospf/af
|   +--ro (if-link-type-selection)?
|   |   +--:(interface)
|   |   |   +--ro interface
```

```

| | | +--ro interface?   if:interface-ref
| | | +---:(virtual-link)
| | | | +--ro virtual-link
| | | | | +--ro transit-area-id?   area-id-type
| | | | | +--ro neighbor-router-id? rt-types:router-id
| | | +---:(sham-link)
| | | | +--ro sham-link
| | | | | +--ro area-id?   area-id-type
| | | | | +--ro local-ip-addr?   inet:ip-address
| | | | | +--ro remote-ip-addr?   inet:ip-address
| | +--ro packet-source?   yang:dotted-quad
| | +--ro packet-type?     packet-type
| | +--ro error?           enumeration
+---n nbr-state-change
| +--ro routing-protocol-name?

```

```

| +      -> /rt:routing/control-plane-protocols/
| +      control-plane-protocol/name
| +--ro af?
| +      -> /rt:routing/control-plane-protocols/
| +      control-plane-protocol
| +      [rt:name=current()/../routing-protocol-name]/
| +      ospf:ospf/af
| +--ro (if-link-type-selection)?
| | +---:(interface)
| | | +--ro interface
| | | | +--ro interface?   if:interface-ref
| | | +---:(virtual-link)
| | | | +--ro virtual-link
| | | | | +--ro transit-area-id?   area-id-type
| | | | | +--ro neighbor-router-id? rt-types:router-id
| | | +---:(sham-link)
| | | | +--ro sham-link
| | | | | +--ro area-id?   area-id-type
| | | | | +--ro local-ip-addr?   inet:ip-address
| | | | | +--ro remote-ip-addr?   inet:ip-address
| | +--ro neighbor-router-id?   rt-types:router-id
| | +--ro neighbor-ip-addr?     yang:dotted-quad
| | +--ro state?               nbr-state-type
+---n nbr-restart-helper-status-change
| +--ro routing-protocol-name?
| +      -> /rt:routing/control-plane-protocols/

```

```

| +          control-plane-protocol/name
| +--ro af?
| +   -> /rt:routing/control-plane-protocols/
| +       control-plane-protocol
| +       [rt:name=current()/../routing-protocol-name]/
| +       ospf:ospf/af
| +--ro (if-link-type-selection)?
| | +--:(interface)
| | | +--ro interface
| | |   +--ro interface?   if:interface-ref
| | | +--:(virtual-link)
| | | | +--ro virtual-link
| | | |   +--ro transit-area-id?       area-id-type
| | | |   +--ro neighbor-router-id?   rt-types:router-id
| | | +--:(sham-link)
| | | | +--ro sham-link
| | | |   +--ro area-id?               area-id-type
| | | |   +--ro local-ip-addr?        inet:ip-address
| | | |   +--ro remote-ip-addr?      inet:ip-address
| | +--ro neighbor-router-id?        rt-types:router-id
| +--ro neighbor-ip-addr?            yang:dotted-quad
| +--ro status?                      restart-helper-status-type

```

```

| +--ro age?                uint32
| +--ro exit-reason?       restart-exit-reason-type
+---n if-rx-bad-packet
| +--ro routing-protocol-name?
| +   -> /rt:routing/control-plane-protocols/
| +       control-plane-protocol/name
| +--ro af?
| +   -> /rt:routing/control-plane-protocols/
| +       control-plane-protocol
| +       [rt:name=current()/../routing-protocol-name]/
| +       ospf:ospf/af
| +--ro (if-link-type-selection)?
| | +--:(interface)
| | | +--ro interface
| | |   +--ro interface?   if:interface-ref
| | | +--:(virtual-link)
| | | | +--ro virtual-link
| | | |   +--ro transit-area-id?       area-id-type
| | | |   +--ro neighbor-router-id?   rt-types:router-id

```

```

| | +---:(sham-link)
| |   +---ro sham-link
| |     +---ro area-id?          area-id-type
| |     +---ro local-ip-addr?    inet:ip-address
| |     +---ro remote-ip-addr?   inet:ip-address
| |   +---ro packet-source?       yang:dotted-quad
| |   +---ro packet-type?         packet-type
+---n lsdbs-approaching-overflow
| +---ro routing-protocol-name?
| +   -> /rt:routing/control-plane-protocols/
| +     control-plane-protocol/name
| +---ro af?
| +   -> /rt:routing/control-plane-protocols/
| +     control-plane-protocol
| +     [rt:name=current()/../routing-protocol-name]/
| +     ospf:ospf/af
| +---ro ext-lsdb-limit?          uint32
+---n lsdbs-overflow
| +---ro routing-protocol-name?
| +   -> /rt:routing/control-plane-protocols/
| +     control-plane-protocol/name
| +---ro af?
| +   -> /rt:routing/control-plane-protocols/
| +     control-plane-protocol
| +     [rt:name=current()/../routing-protocol-name]/
| +     ospf:ospf/af
| +---ro ext-lsdb-limit?          uint32
+---n nssa-translator-status-change
| +---ro routing-protocol-name?

```

```

| +   -> /rt:routing/control-plane-protocols/
| +     control-plane-protocol/name
| +---ro af?
| +   -> /rt:routing/control-plane-protocols/
| +     control-plane-protocol
| +     [rt:name=current()/../routing-protocol-name]/
| +     ospf:ospf/af
| +---ro area-id?          area-id-type
| +---ro status?          nssa-translator-state-type
+---n restart-status-change
| +---ro routing-protocol-name?
| +   -> /rt:routing/control-plane-protocols/

```

```

+         control-plane-protocol/name
+--ro af?
+   -> /rt:routing/control-plane-protocols/
+     control-plane-protocol
+     [rt:name=current()/../routing-protocol-name]/
+     ospf:ospf/af
+--ro status?                restart-status-type
+--ro restart-interval?      uint16
+--ro exit-reason?           restart-exit-reason-type

```

## 2.9. OSPF RPC Operations

The "ietf-ospf" module defines two RPC operations:

- o clear-database: reset the content of a particular OSPF Link State Database.
- o clear-neighbor: restart a particular set of OSPF neighbor.

```

rpcs:
  +---x clear-neighbor
  |   +---w input
  |   |   +---w routing-protocol-name
  |   |   +   -> /rt:routing/control-plane-protocols/
  |   |   +   control-plane-protocol/name
  |   |   +---w interface?                if:interface-ref
  +---x clear-database
  |   +---w input
  |   |   +---w routing-protocol-name
  |   |   |   -> /rt:routing/control-plane-protocols/
  |   |   |   control-plane-protocol/name

```

## 3. OSPF Yang Module

The following RFCs and drafts are not referenced in the document text but are referenced in the ietf-ospf.yang module: [\[RFC0905\]](#), [\[RFC4576\]](#), [\[RFC5250\]](#), [\[RFC5881\]](#), [\[RFC6021\]](#), [\[RFC7770\]](#), [\[RFC8294\]](#), and



[[I-D.ietf-bfd-yang](#)].

```
<CODE BEGINS> file "ietf-ospf@2018-08-28.yang"
module ietf-ospf {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-ospf";

  prefix ospf;

  import ietf-inet-types {
    prefix "inet";
    reference "RFC 6021 - Common YANG Data Types";
  }

  import ietf-yang-types {
    prefix "yang";
    reference "RFC 6021 - Common YANG Data Types";
  }

  import ietf-interfaces {
    prefix "if";
    reference "RFC 8343 - A YANG Data Model for Interface
              Management (NDMA Version)";
  }

  import ietf-routing-types {
    prefix "rt-types";
    reference "RFC 8294 - Common YANG Data Types for the
              Routing Area";
  }

  import iana-routing-types {
    prefix "iana-rt-types";
    reference "RFC 8294 - Common YANG Data Types for the
              Routing Area";
  }

  import ietf-routing {
    prefix "rt";
    reference "RFC 8349 - A YANG Data Model for Routing
              Management (NMDA Version)";
  }
```

```

import ietf-key-chain {
  prefix "key-chain";
  reference "RFC 8177 - YANG Data Model for Key Chains";
}

import ietf-bfd-types {
  prefix "bfd-types";
  reference "RFC YYYY - YANG Data Model for Bidirectional
    Forwarding Detection (BFD)";
}

```

```

organization
  "IETF OSPF - OSPF Working Group";

```

```

contact
  "WG Web:  <http://datatracker.ietf.org/group/ospf/>
  WG List:  <mailto:ospf@ietf.org>

```

```

  Editor:    Derek Yeung
             <mailto:derek@arrcus.com>
  Author:    Acee Lindem
             <mailto:acee@cisco.com>
  Author:    Yingzhen Qu
             <mailto:yingzhen.qu@huawei.com>
  Author:    Jeffrey Zhang
             <mailto:zzhang@juniper.net>
  Author:    Ing-Wher Chen
             <mailto:ing-wher_chen@jabil.com>
  Author:    Dean Bogdanovic
             <mailto:ivandean@gmail.com>
  Author:    Kiran Agrahara Sreenivasa
             <mailto:kkoushik@cisco.com>";

```

#### description

"This YANG module defines the generic configuration and operational state for the OSPF protocol common to all vendor implementations. It is intended that the module will be extended by vendors to define vendor-specific OSPF configuration parameters and policies, for example route maps or route policies.

This YANG model conforms to the Network Management Datastore Architecture (NDMA) as described in [RFC 8242](#).

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This version of this YANG module is part of RFC XXXX; see the RFC itself for full legal notices.";

```
revision 2018-08-28 {
  description
    "Initial revision.";
  reference
    "RFC XXXX: A YANG Data Model for OSPF.";
}

feature multi-topology {
  description
    "Support Multiple-Topology Routing (MTR).";
  reference "RFC 4915 - Multi-Topology Routing";
}

feature multi-area-adj {
  description
    "OSPF multi-area adjacency support as in RFC 5185.";
  reference "RFC 5185 - Multi-Area Adjacency";
}

feature explicit-router-id {
  description
    "Set Router-ID per instance explicitly.";
}

feature demand-circuit {
  description
    "OSPF demand circuit support as in RFC 1793.";
  reference "RFC 1793 - OSPF Demand Circuits";
}

feature mtu-ignore {
  description
    "Disable OSPF Database Description packet MTU
    mismatch checking.";
```

```
}
```

```
feature lls {  
    description  
        "OSPF link-local signaling (LLS) as in RFC 5613.";  
    reference "RFC 5613 - OSPF Link-Local Signaling";  
}
```

```
}
```

```
feature prefix-suppression {  
    description  
        "OSPF prefix suppression support as in RFC 6860.";  
    reference "RFC 6860 - Hide Transit-Only Networks in OSPF";  
}
```

```
feature ttl-security {  
    description  
        "OSPF Time to Live (TTL) security check support.";  
    reference "RFC 5082 - The Generalized TTL Security  
        Mechanism (GTSM)";  
}
```

```
feature nsr {  
    description  
        "Non-Stop-Routing (NSR) support.";  
}
```

```
feature graceful-restart {  
    description  
        "Graceful OSPF Restart as defined in RFC 3623 and  
        RFC 5187.";  
    reference "RFC 3623 - Graceful OSPF Restart  
        RFC 5187 - OSPFv3 Graceful Restart";  
}
```

```
feature admin-control {  
    description  
        "Administrative control of the protocol state.";  
}
```

```
feature auto-cost {  
    description
```

```

        "Calculate OSPF interface cost according to
        reference bandwidth.";
    reference "RFC 2328 - OSPF Version 2";
}

feature max-ecmp {
    description
        "Setting maximum number of ECMP paths.";
}

feature max-lsa {
    description
        "Setting the maximum number of LSAs the OSPF instance

```

```

        will accept.";
    reference "RFC 1765 - OSPF Database Overload";
}

feature te-rid {
    description
        "TE Router-ID.";
    reference "RFC 3630 - Traffic Engineering (TE) Extensions
        to OSPF Version 2
        RFC 5329 - Traffic Engineering (TE) Extensions
        to OSPF Version 3";
}

feature ldp-igp-sync {
    description
        "LDP IGP synchronization.";
    reference "RFC 5443 - LDP IGP Synchronization";
}

feature ospfv3-authentication-ipsec {
    description
        "Use IPsec for OSPFv3 authentication.";
    reference "RFC 4552 - Authentication/Confidentiality
        for OSPFv3";
}

feature fast-reroute {
    description

```

```

    "Support for IP Fast Reroute (IP-FRR).";
    reference "RFC 5714 - IP Fast Rereoute Framework";
}

feature node-flag {
    description
        "Support for node-flag for OSPF prefixes.";
    reference "RFC 7684 - OSPFv2 Prefix/Link Advertisement";
}

feature node-tag {
    description
        "Support for node admin tag for OSPF routing instances.";
    reference "RFC 7777 - Advertising Node Administrative
        Tags in OSPF";
}

feature lfa {
    description
        "Support for Loop-Free Alternates (LFAs).";
}

```

```

    reference "RFC 5286 - Basic Specification for IP Fast
        Reroute: Loop-Free Alternates";
}

feature remote-lfa {
    description
        "Support for Remote Loop-Free Alternates (R-LFA).";
    reference "RFC 7490 - Remote Loop-Free Alternate (LFA)
        Fast Reroute (FRR)";
}

feature stub-router {
    description
        "Support for RFC 6987 OSPF Stub Router Advertisement.";
    reference "RFC 6987 - OSPF Stub Router Advertisement";
}

feature pe-ce-protocol {
    description
        "Support for OSPF as a PE-CE protocol";
    reference "RFC 4577 - OSPF as the Provider/Customer Edge

```

```

        Protocol for BGP/MPLS IP Virtual Private
        Networks (VPNs)
        RFC 6565 - OSPFv3 as a Provider Edge to Customer
        Edge (PE-CE) Routing Protocol";
    }

    feature ietf-spf-delay {
        description
            "Support for IETF SPF delay algorithm.";
        reference "RFC 8405 - SPF Back-off algorithm for link
            state IGPs";
    }

    feature bfd {
        description
            "Support for BFD detection of OSPF neighbor reachability.";
        reference "RFC 5880 - Bidirectional Forwarding Detection (BFD)
            RFC 5881 - Bidirectional Forwarding Detection
            (BFD) for IPv4 and IPv6 (Single Hop)";
    }

    identity ospf-protocol {
        base "rt:routing-protocol";
        description "Any OSPF protocol version";
    }

    identity ospfv2 {

```

```

        base "ospf-protocol";
        description "OSPFv2 protocol";
    }

    identity ospfv3 {
        base "ospf-protocol";
        description "OSPFv3 protocol";
    }

    identity operation-mode {
        description
            "OSPF operation mode.";
    }

```

```

identity area-type {
    description "Base identity for OSPF area type.";
}

identity normal-area {
    base area-type;
    description "OSPF normal area.";
}

identity stub-nssa-area {
    base area-type;
    description "OSPF stub or NSSA area.";
}

identity stub-area {
    base stub-nssa-area;
    description "OSPF stub area.";
}

identity nssa-area {
    base stub-nssa-area;
    description "OSPF Not-So-Stubby Area (NSSA).";
    reference "RFC 3101 - The OSPF Not-So-Stubby Area
                (NSSA) Option";
}

identity ospf-lsa-type {
    description
        "Base identity for OSPFv3 and OSPFv3
        Link State Advertisement (LSA) types";
}

identity ospfv2-lsa-type {
    base ospf-lsa-type;
}

```

```

    description
        "OSPFv2 LSA types";
}

identity ospfv2-router-lsa {
    base ospfv2-lsa-type;
    description

```



```

        "OSPFv2 Router LSA - Type 1";
    }

    identity ospfv2-network-lsa {
        base ospfv2-lsa-type;
        description
            "OSPFv2 Network LSA - Type 2";
    }

    identity ospfv2-summary-lsa-type {
        base ospfv2-lsa-type;
        description
            "OSPFv2 Summary LSA types";
    }

    identity ospfv2-network-summary-lsa {
        base ospfv2-summary-lsa-type;
        description
            "OSPFv2 Network Summary LSA - Type 3";
    }

    identity ospfv2-asbr-summary-lsa {
        base ospfv2-summary-lsa-type;
        description
            "OSPFv2 AS Boundary Router (ASBR) Summary LSA - Type 4";
    }

    identity ospfv2-external-lsa-type {
        base ospfv2-lsa-type;
        description
            "OSPFv2 External LSA types";
    }

    identity ospfv2-as-external-lsa {
        base ospfv2-external-lsa-type;
        description
            "OSPFv2 AS External LSA - Type 5";
    }

    identity ospfv2-nssa-lsa {
        base ospfv2-external-lsa-type;

```

```
    description
        "OSPFv2 Not-So-Stubby-Area (NSSA) LSA - Type 7";
}

identity ospfv2-opaque-lsa-type {
    base ospfv2-lsa-type;
    description
        "OSPFv2 Opaque LSA types";
}

identity ospfv2-link-scope-opaque-lsa {
    base ospfv2-opaque-lsa-type;
    description
        "OSPFv2 Link-Scoped Opaque LSA - Type 9";
}

identity ospfv2-area-scope-opaque-lsa {
    base ospfv2-opaque-lsa-type;
    description
        "OSPFv2 Area-Scoped Opaque LSA - Type 10";
}

identity ospfv2-as-scope-opaque-lsa {
    base ospfv2-opaque-lsa-type;
    description
        "OSPFv2 AS-Scoped Opaque LSA - Type 11";
}

identity ospfv2-unknown-lsa-type {
    base ospfv2-lsa-type;
    description
        "OSPFv2 Unknown LSA type";
}

identity ospfv3-lsa-type {
    base ospf-lsa-type;
    description
        "OSPFv3 LSA types.";
}

identity ospfv3-router-lsa {
    base ospfv3-lsa-type;
    description
        "OSPFv3 Router LSA - Type 0x2001";
}

identity ospfv3-network-lsa {
    base ospfv3-lsa-type;
```

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```
    description
      "OSPFv3 Network LSA - Type 0x2002";
  }

  identity ospfv3-summary-lsa-type {
    base ospfv3-lsa-type;
    description
      "OSPFv3 Summary LSA types";
  }

  identity ospfv3-inter-area-prefix-lsa {
    base ospfv3-summary-lsa-type;
    description
      "OSPFv3 Inter-area Prefix LSA - Type 0x2003";
  }

  identity ospfv3-inter-area-router-lsa {
    base ospfv3-summary-lsa-type;
    description
      "OSPFv3 Inter-area Router LSA - Type 0x2004";
  }

  identity ospfv3-external-lsa-type {
    base ospfv3-lsa-type;
    description
      "OSPFv3 External LSA types";
  }

  identity ospfv3-as-external-lsa {
    base ospfv3-external-lsa-type;
    description
      "OSPFv3 AS-External LSA - Type 0x4005";
  }

  identity ospfv3-nssa-lsa {
    base ospfv3-external-lsa-type;
    description
      "OSPFv3 Not-So-Stubby-Area (NSSA) LSA - Type 0x2007";
  }

  identity ospfv3-link-lsa {
    base ospfv3-lsa-type;
    description
```

```

        "OSPFv3 Link LSA - Type 0x0008";
    }

    identity ospfv3-intra-area-prefix-lsa {
        base ospfv3-lsa-type;

```

```

        description
            "OSPFv3 Intra-area Prefix LSA - Type 0x2009";
    }

    identity ospfv3-router-information-lsa {
        base ospfv3-lsa-type;
        description
            "OSPFv3 Router Information LSA - Types 0x800C,
            0xA00C, and 0xC00C";
    }

    identity ospfv3-unknown-lsa-type {
        base ospfv3-lsa-type;
        description
            "OSPFv3 Unknown LSA type";
    }

    identity lsa-log-reason {
        description
            "Base identity for an LSA log reason.";
    }

    identity lsa-refresh {
        base lsa-log-reason;
        description
            "Identity used when the LSA is logged
            as a result of receiving a refresh LSA.";
    }

    identity lsa-content-change {
        base lsa-log-reason;
        description
            "Identity used when the LSA is logged
            as a result of a change in the content
            of the LSA.";
    }

```

```

identity lsa-purge {
  base lsa-log-reason;
  description
    "Identity used when the LSA is logged
    as a result of being purged.";
}

typedef uint24 {
  type uint32 {
    range "0 .. 16777215";
  }
}

```

```

  description
    "24-bit unsigned integer.";
}

typedef area-id-type {
  type yang:dotted-quad;
  description
    "Area ID type.";
}

typedef route-type {
  type enumeration {
    enum intra-area {
      description "OSPF intra-area route.";
    }
    enum inter-area {
      description "OSPF inter-area route.";
    }
    enum external-1 {
      description "OSPF type 1 external route.";
    }
    enum external-2 {
      description "OSPF type 2 external route.";
    }
    enum nssa-1 {
      description "OSPF type 1 NSSA route.";
    }
    enum nssa-2 {
      description "OSPF type 2 NSSA route.";
    }
  }
}

```

```

    }
  }
  description "OSPF route type.";
}

typedef if-state-type {
  type enumeration {
    enum down {
      value "1";
      description
        "Interface down state.";
    }
    enum loopback {
      value "2";
      description
        "Interface loopback state.";
    }
    enum waiting {
      value "3";

```

```

    description
      "Interface waiting state.";
  }
  enum point-to-point {
    value "4";
    description
      "Interface point-to-point state.";
  }
  enum dr {
    value "5";
    description
      "Interface Designated Router (DR) state.";
  }
  enum bdr {
    value "6";
    description
      "Interface Backup Designated Router (BDR) state.";
  }
  enum dr-other {
    value "7";
    description
      "Interface Other Designated Router state.";

```

```

    }
  }
  description
    "OSPF interface state.";
}

typedef nbr-state-type {
  type enumeration {
    enum down {
      value "1";
      description
        "Neighbor down state.";
    }
    enum attempt {
      value "2";
      description
        "Neighbor attempt state.";
    }
    enum init {
      value "3";
      description
        "Neighbor init state.";
    }
    enum 2-way {
      value "4";
      description

```

```

    "Neighbor 2-Way state.";
  }
  enum ex-start {
    value "5";
    description
      "Neighbor exchange start state.";
  }
  enum exchange {
    value "6";
    description
      "Neighbor exchange state.";
  }
  enum loading {
    value "7";
    description

```

```

        "Neighbor loading state.";
    }
    enum full {
        value "8";
        description
            "Neighbor full state.";
    }
}
description
    "OSPF neighbor state type.";
}

typedef restart-helper-status-type {
    type enumeration {
        enum not-helping {
            value "1";
            description
                "Restart helper status not helping.";
        }
        enum helping {
            value "2";
            description
                "Restart helper status helping.";
        }
    }
}
description
    "Restart helper status type.";
}

typedef restart-exit-reason-type {
    type enumeration {
        enum none {
            value "1";

```

```

        description
            "Restart not attempted.";
    }
    enum in-progress {
        value "2";
        description
            "Restart in progress.";
    }
}

```



```

enum completed {
    value "3";
    description
        "Restart successfully completed.";
}
enum timed-out {
    value "4";
    description
        "Restart timed out.";
}
enum topology-changed {
    value "5";
    description
        "Restart aborted due to topology change.";
}
}
description
    "Describes the outcome of the last attempt at a
    graceful restart, either by itself or acting
    as a helper.";
}

typedef packet-type {
    type enumeration {
        enum hello {
            value "1";
            description
                "OSPF Hello packet.";
        }
        enum database-descripton {
            value "2";
            description
                "OSPF Database Description packet.";
        }
        enum link-state-request {
            value "3";
            description
                "OSPF Link State Request packet.";
        }
        enum link-state-update {

```

```

    value "4";

```

```

        description
            "OSPF Link State Update packet.";
    }
    enum link-state-ack {
        value "5";
        description
            "OSPF Link State Acknowledgement packet.";
    }
}
description
    "OSPF packet type.";
}

typedef nssa-translator-state-type {
    type enumeration {
        enum enabled {
            value "1";
            description
                "NSSA translator enabled state.";
        }
        enum elected {
            description
                "NSSA translator elected state.";
        }
        enum disabled {
            value "3";
            description
                "NSSA translator disabled state.";
        }
    }
}
description
    "OSPF NSSA translator state type.";
}

typedef restart-status-type {
    type enumeration {
        enum not-restarting {
            value "1";
            description
                "Router is not restarting.";
        }
        enum planned-restart {
            description
                "Router is going through planned restart.";
        }
        enum unplanned-restart {
            value "3";
        }
    }
}

```

```
        description
            "Router is going through unplanned restart.";
    }
}
description
    "OSPF graceful restart status type.";
}

typedef fletcher-checksum16-type {
    type string {
        pattern '(0x)?[0-9a-fA-F]{4}';
    }
    description
        "Fletcher 16-bit checksum in hex-string format 0xXXXX.";
    reference "RFC 905 - ISO Transport Protocol specification
        ISO DP 8073";
}

grouping tlv {
    description
        "Type-Length-Value (TLV)";
    leaf type {
        type uint16;
        description "TLV type.";
    }
    leaf length {
        type uint16;
        description "TLV length (octets).";
    }
    leaf value {
        type yang:hex-string;
        description "TLV value.";
    }
}

grouping unknown-tlvs {
    description
        "Unknown TLVs grouping - Used for unknown TLVs or
        unknown sub-TLVs.";
    container unknown-tlvs {
        description "All unknown TLVs.";
        list unknown-tlv {
            description "Unknown TLV.";
            uses tlv;
        }
    }
}
```

}

```
grouping node-tag-tlv {
  description "OSPF Node Admin Tag TLV grouping.";
  list node-tag {
    leaf tag {
      type uint32;
      description
        "Node admin tag value.";
    }
    description
      "List of tags.";
  }
}

grouping ospf-router-lsa-flags {
  leaf flags {
    type bits {
      bit V {
        description
          "When set, the router is an endpoint of one or
           more virtual links.";
      }
      bit E {
        description
          "When set, the router is an AS Boundary Router
           (ASBR).";
      }
      bit B {
        description
          "When set, the router is an Area Border
           Router (ABR).";
      }
      bit Nt {
        description
          "When set, the router is an NSSA border router
           that is unconditionally translating NSSA LSAs
           into AS-external LSAs.";
      }
    }
  }
  description "Router LSA Flags.";
}
```

```

    }
    description
      "Router LSA Flags - Currently common for OSPFv2 and
      OSPFv3 but it may diverge with future augmentations.";
  }

  grouping ospfv2-router-link {
    description "OSPFv2 router link.";
    leaf link-id {

```

```

    type union {
      type inet:ipv4-address;
      type yang:dotted-quad;
    }
    description "Router-LSA Link ID";
  }
  leaf link-data {
    type union {
      type inet:ipv4-address;
      type uint32;
    }
    description "Router-LSA Link data.";
  }
  leaf type {
    type uint8;
    description "Router-LSA Link type.";
  }
}

grouping ospfv2-lsa-body {
  description "OSPFv2 LSA body.";
  container router {
    when "derived-from-or-self(..../header/type, "
      + "'ospf:ospfv2-router-lsa')" {
      description
        "Only applies to Router-LSAs.";
    }
    description
      "Router LSA.";
    uses ospf-router-lsa-flags;
    leaf num-of-links {
      type uint16;

```



```

        description "All attached routers.";
        leaf-list attached-router {
            type yang:dotted-quad;
            description
                "List of the routers attached to the network.";
        }
    }
}
container summary {
    when "derived-from(..../header/type, "
        + "'ospfv2-summary-lsa-type')"
```

 {
 description
 "Only applies to Summary LSAs.";
 }
 description
 "Summary LSA.";
 leaf network-mask {
 type inet:ipv4-address;
 description
 "The IP address mask for the network";
 }
 container topologies {
 description "All topologies for the summary LSA.";
 }
}

```

    list topology {
        description
            "Topology specific information.";
        leaf mt-id {
            type uint8;
            description
                "The MT-ID for the topology enabled for
                the summary.";
        }
        leaf metric {
            type uint24;
            description "Metric for the topology.";
        }
    }
}
container external {
    when "derived-from(..../header/type, "
```

```

    + "'ospfv2-external-lsa-type')" {
description
    "Only applies to AS-external LSAs and NSSA LSAs.";
}
description
    "External LSA.";
leaf network-mask {
    type inet:ipv4-address;
description
    "The IP address mask for the network";
}
container topologies {
description "All topologies for the external.";
list topology {
description
    "Topology specific information.";
leaf mt-id {
    type uint8;
description
    "The MT-ID for the topology enabled for the
        external or NSSA prefix.";
}
leaf flags {
    type bits {
        bit E {
description
            "When set, the metric specified is a Type 2
                external metric.";
        }
    }
}
}
}

```

```

description "Flags.";
}
leaf metric {
    type uint24;
description "Metric for the topology.";
}
leaf forwarding-address {
    type inet:ipv4-address;
description
    "Forwarding address.";
}
}

```



```

        leaf external-route-tag {
            type uint32;
            description
                "Route tag for the topology.";
        }
    }
}
container opaque {
    when "derived-from ../../header/type, "
        + "'ospfv2-opaque-lsa-type'" {
        description
            "Only applies to Opaque LSAs.";
    }
    description
        "Opaque LSA.";

    uses unknown-tlvs;

    container node-tag-tlvs {
        description
            "All node tag TLVs.";
        list node-tag-tlv {
            description
                "Node tag TLV.";
            uses node-tag-tlv;
        }
    }

    container router-address-tlv {
        description
            "Router address TLV.";
        leaf router-address {
            type inet:ipv4-address;
            description
                "Router address.";
        }
    }
}

```

```

    }

    container link-tlvs {
        description "All link TLVs in the LSA.";
    }
}

```

```

list link-tlv {
  description "Link TLV.";
  leaf link-type {
    type uint8;
    mandatory true;
    description "Link type.";
  }
  leaf link-id {
    type union {
      type inet:ipv4-address;
      type yang:dotted-quad;
    }
    mandatory true;
    description "Link ID.";
  }
  container local-if-ipv4-addrs {
    description "All local interface IPv4 addresses.";
    leaf-list local-if-ipv4-addr {
      type inet:ipv4-address;
      description
        "List of local interface IPv4 addresses.";
    }
  }
  container remote-if-ipv4-addrs {
    description "All remote interface IPv4 addresses.";
    leaf-list remote-if-ipv4-addr {
      type inet:ipv4-address;
      description
        "List of remote interface IPv4 addresses.";
    }
  }
  leaf te-metric {
    type uint32;
    description "TE metric.";
  }
  leaf max-bandwidth {
    type rt-types:bandwidth-ieee-float32;
    description "Maximum bandwidth.";
  }
  leaf max-reservable-bandwidth {
    type rt-types:bandwidth-ieee-float32;
    description "Maximum reservable bandwidth.";
  }
  container unreserved-bandwidths {

```

```
    description "All unreserved bandwidths.";
    list unreserved-bandwidth {
      leaf priority {
        type uint8 {
          range "0 .. 7";
        }
        description "Priority from 0 to 7.";
      }
      leaf unreserved-bandwidth {
        type rt-types:bandwidth-ieee-float32;
        description "Unreserved bandwidth.";
      }
      description
        "List of unreserved bandwidths for different
        priorities.";
    }
  }
  leaf admin-group {
    type uint32;
    description
      "Administrative group/Resource Class/Color.";
  }
  uses unknown-tlvs;
}

container extended-prefix-tlvs {
  description "All extended prefix TLVs in the LSA.";
  list extended-prefix-tlv {
    description "Extended prefix TLV.";
    leaf route-type {
      type enumeration {
        enum unspecified {
          value "0";
          description "Unspecified.";
        }
        enum intra-area {
          value "1";
          description "OSPF intra-area route.";
        }
        enum inter-area {
          value "3";
          description "OSPF inter-area route.";
        }
        enum external {
          value "5";
          description "OSPF External route.";
        }
      }
    }
  }
}
```

}

```
        enum nssa {
            value "7";
            description "OSPF NSSA external route.";
        }
    }
    description "Route type.";
}
leaf flags {
    type bits {
        bit A {
            description
                "Attach flag.";
        }
        bit N {
            description
                "Node flag.";
        }
    }
    description "Prefix Flags.";
}
leaf prefix {
    type inet:ip-prefix;
    description "Address prefix.";
}
uses unknown-tlvs;
}
}

container extended-link-tlvs {
    description "All extended link TLVs in the LSA.";
    list extended-link-tlv {
        description "Extended link TLV.";
        uses ospfv2-router-link;
        uses unknown-tlvs;
    }
}
}
}

grouping ospfv3-lsa-options {
```

```

description "OSPFv3 LSA options";
leaf options {
  type bits {
    bit AF {
      description
        "When set, the router supports OSPFv3 AFs as in RFC5838.";
    }
    bit DC {

```

```

    description
      "When set, the router supports demand circuits.";
  }
  bit R {
    description
      "When set, the originator is an active router.";
  }
  bit N {
    description
      "If set, the router is attached to an NSSA";
  }
  bit E {
    description
      "This bit describes the way AS-external LSAs
        are flooded";
  }
  bit V6 {
    description
      "If clear, the router/link should be excluded
        from IPv6 routing calculation";
  }
}
mandatory true;
description "OSPFv3 LSA options.";
}
}

grouping ospfv3-lsa-prefix {
  description
    "OSPFv3 LSA prefix.";

  leaf prefix {
    type inet:ip-prefix;

```

```

    description
        "LSA Prefix.";
}
leaf prefix-options {
    type bits {
        bit NU {
            description
                "When set, the prefix should be excluded
                from IPv6 unicast calculations.";
        }
        bit LA {
            description
                "When set, the prefix is actually an IPv6 interface
                address of the Advertising Router.";
        }
    }
}

```

```

    bit P {
        description
            "When set, the NSSA area prefix should be
            translated to an AS External LSA and readvertised
            by the translating NSSA Border Router.";
    }
    bit DN {
        description
            "When set, the inter-area-prefix LSA or
            AS-external LSA prefix has been advertised as an
            L3VPN prefix.";
    }
}
mandatory true;
description "Prefix options.";
}
}

grouping ospfv3-lsa-external {
    description
        "AS-External and NSSA LSA.";
    leaf metric {
        type uint24;
        description "Metric";
    }
}

```

```

leaf flags {
  type bits {
    bit E {
      description
        "When set, the metric specified is a Type 2
        external metric.";
    }
    bit F {
      description
        "When set, a Forwarding Address is included
        in the LSA.";
    }
    bit T {
      description
        "When set, an External Route Tag is included
        in the LSA.";
    }
  }
  description "Flags.";
}

leaf referenced-ls-type {

```

```

    type identityref {
      base ospf:ospfv3-lsa-type;
    }
    description "Referenced Link State type.";
  }
  leaf unknown-referenced-ls-type {
    type uint16;
    description
      "Value for an unknown Referenced Link State type.";
  }

  uses ospfv3-lsa-prefix;

  leaf forwarding-address {
    type inet:ipv6-address;
    description
      "Forwarding address.";
  }
}

```

```

    leaf external-route-tag {
        type uint32;
        description
            "Route tag.";
    }
    leaf referenced-link-state-id {
        type yang:dotted-quad;
        description
            "Referenced Link State ID.";
    }
}

grouping ospfv3-lsa-body {
    description "OSPFv3 LSA body.";
    container router {
        when "derived-from-or-self(..../header/type, "
            + "'ospfv3-router-lsa')" {
            description
                "Only applies to Router LSAs.";
        }
        description "Router LSA.";
        uses ospf-router-lsa-flags;
        uses ospfv3-lsa-options;

        container links {
            description "All router link.";
            list link {
                description "Router LSA link.";
                leaf interface-id {

```

```

        type uint32;
        description "Interface ID for link.";
    }
    leaf neighbor-interface-id {
        type uint32;
        description "Neighbor's Interface ID for link.";
    }
    leaf neighbor-router-id {
        type rt-types:router-id;
        description "Neighbor's Router ID for link.";
    }
    leaf type {

```



```

        type uint8;
        description "Link type: 1 - Point-to-Point Link
                        2 - Transit Network Link
                        3 - Stub Network Link Link
                        4 - Virtual Link";
    }
    leaf metric {
        type uint16;
        description "Link Metric.";
    }
}
}
}
container network {
    when "derived-from-or-self(..../header/type, "
        + "'ospfv3-network-lsa')" {
        description
            "Only applies to Network LSAs.";
    }
    description "Network LSA.";

    uses ospfv3-lsa-options;

    container attached-routers {
        description "All attached routers.";
        leaf-list attached-router {
            type yang:dotted-quad;
            description
                "List of the routers attached to the network.";
        }
    }
}
container inter-area-prefix {
    when "derived-from-or-self(..../header/type, "
        + "'ospfv3-inter-area-prefix-lsa')" {
        description

```

```

        "Only applies to Inter-Area-Prefix LSAs.";
    }
    leaf metric {
        type uint24;
        description "Inter-Area Prefix Metric";
    }
}

```

```

    }
    uses ospfv3-lsa-prefix;
    description "Prefix LSA.";
}
container inter-area-router {
    when "derived-from-or-self(..../header/type, "
        + "'ospfv3-inter-area-router-lsa')" {
        description
            "Only applies to Inter-Area-Router LSAs.";
    }
    uses ospfv3-lsa-options;
    leaf metric {
        type uint24;
        description "AS Boundary Router (ASBR) Metric.";
    }
    leaf destination-router-id {
        type rt-types:router-id;
        description
            "The Router ID of the ASBR described by the LSA.";
    }
    description "Inter-Area-Router LSA.";
}
container as-external {
    when "derived-from-or-self(..../header/type, "
        + "'ospfv3-as-external-lsa')" {
        description
            "Only applies to AS-external LSAs.";
    }
    uses ospfv3-lsa-external;

    description "AS-External LSA.";
}
container nssa {
    when "derived-from-or-self(..../header/type, "
        + "'ospfv3-nssa-lsa')" {
        description
            "Only applies to NSSA LSAs.";
    }
    uses ospfv3-lsa-external;

    description "NSSA LSA.";
}

```

```

container link {
    when "derived-from-or-self(..../header/type, "
        + "'ospfv3-link-lsa')" {
        description
            "Only applies to Link LSAs.";
    }
    leaf rtr-priority {
        type uint8;
        description "Router Priority for the interface.";
    }
    uses ospfv3-lsa-options;

    leaf link-local-interface-address {
        type inet:ipv6-address;
        description
            "The originating router's link-local
            interface address for the link.";
    }

    leaf num-of-prefixes {
        type uint32;
        description "Number of prefixes.";
    }

    container prefixes {
        description "All prefixes for the link.";
        list prefix {
            description
                "List of prefixes associated with the link.";
            uses ospfv3-lsa-prefix;
        }
    }
    description "Link LSA.";
}

container intra-area-prefix {
    when "derived-from-or-self(..../header/type, "
        + "'ospfv3-intra-area-prefix-lsa')" {
        description
            "Only applies to Intra-Area-Prefix LSAs.";
    }
    description "Intra-Area-Prefix LSA.";

    leaf referenced-ls-type {
        type identityref {
            base ospf:ospfv3-lsa-type;
        }
        description "Referenced Link State type.";
    }
}

```

```
leaf unknown-referenced-ls-type {
  type uint16;
  description
    "Value for an unknown Referenced Link State type.";
}
leaf referenced-link-state-id {
  type yang:dotted-quad;
  description
    "Referenced Link State ID.";
}
leaf referenced-adv-router {
  type rt-types:router-id;
  description
    "Referenced Advertising Router.";
}

leaf num-of-prefixes {
  type uint16;
  description "Number of prefixes.";
}
container prefixes {
  description "All prefixes in this LSA.";
  list prefix {
    description "List of prefixes in this LSA.";
    uses ospfv3-lsa-prefix;
    leaf metric {
      type uint24;
      description "Prefix Metric.";
    }
  }
}

container router-information {
  when "derived-from-or-self(..../header/type, "
    + "'ospfv3-router-information-lsa')\" {
    description
      "Only applies to Router Information LSAs (RFC7770).";
  }
}
container node-tag-tlvs {
  description
    "All node tag tlvs.";
  list node-tag-tlv {
```

```

        description
            "Node tag tlv.";
        uses node-tag-trlv;
    }
}
description "Router Information LSA.";

```

```

        reference "RFC 7770 -Extensions for Advertising Router
            Capabilities";
    }
}

grouping lsa-header {
    description
        "Common LSA for OSPFv2 and OSPFv3";
    leaf age {
        type uint16;
        mandatory true;
        description "LSA age.";
    }
    leaf type {
        type identityref {
            base ospf-lsa-type;
        }
        mandatory true;
        description "LSA type";
    }
    leaf adv-router {
        type rt-types:router-id;
        mandatory true;
        description "LSA advertising router.";
    }
    leaf seq-num {
        type uint32;
        mandatory true;
        description "LSA sequence number.";
    }
    leaf checksum {
        type fletcher-checksum16-type;
        mandatory true;
        description "LSA checksum.";
    }
}

```

```

    leaf length {
      type uint16;
      mandatory true;
      description "LSA length including the header.";
    }
  }

  grouping ospfv2-lsa {
    description
      "OSPFv2 LSA - LSAs are uniquely identified by
      the <LSA Type, Link-State ID, Advertising Router>
      tuple with the sequence number differentiating
      LSA instances.";
  }

```

```

  container header {
    must "(derived-from(type, "
      + "'ospfv2-opaque-lsa-type') and "
      + "opaque-id and opaque-type) or "
      + "(not(derived-from(type, "
      + "'ospfv2-opaque-lsa-type')) "
      + "and not(opaque-id) and not(opaque-type))" {
      description
        "Opaque type and ID only apply to Opaque LSAs.";
    }
    description
      "Decoded OSPFv2 LSA header data.";
    leaf option {
      type bits {
        bit MT {
          description
            "When set, the router supports multi-topology as
            in RFC 4915.";
        }
        bit DC {
          description
            "When set, the router supports demand circuits.";
        }
        bit P {
          description
            "Only used in type-7 LSA. When set, an NSSA
            border router should translate the type-7 LSA
            to a type-5 LSA.";
        }
      }
    }
  }

```

```

    }
    bit MC {
        description
            "When set, the router supports MOSPF.";
    }
    bit E {
        description
            "This bit describes the way AS-external LSAs
            are flooded.";
    }
    bit O {
        description
            "When set, the router is opaque-capable as in
            RFC 5250.";
    }
    bit DN {
        description
            "When a type 3, 5 or 7 LSA is sent from a PE to a CE,
            the DN bit must be set. See RFC 4576.";
    }
}

```

```

    }
    mandatory true;
    description "LSA options.";
}
leaf lsa-id {
    type yang:dotted-quad;
    mandatory true;
    description "Link-State ID.";
}

leaf opaque-type {
    type uint8;
    description "Opaque type.";
}

leaf opaque-id {
    type uint24;
    description "Opaque ID.";
}

uses lsa-header;

```

```

    }
    container body {
      description
        "Decoded OSPFv2 LSA body data.";
      uses ospfv2-lsa-body;
    }
  }

  grouping ospfv3-lsa {
    description
      "Decoded OSPFv3 LSA.";
    container header {
      description
        "Decoded OSPFv3 LSA header data.";
      leaf lsa-id {
        type uint32;
        mandatory true;
        description "OSPFv3 LSA ID.";
      }
      uses lsa-header;
    }
    container body {
      description
        "Decoded OSPF LSA body data.";
      uses ospfv3-lsa-body;
    }
  }
}

```

```

grouping lsa-common {
  description
    "Common fields for OSPF LSA represenation.";
  leaf decoded-completed {
    type boolean;
    description
      "The OSPF LSA body is fully decoded.";
  }
  leaf raw-data {
    type yang:hex-string;
    description
      "The complete LSA in network byte
       order hexadecimal as received or originated.";
  }
}

```



```

}

grouping lsa {
  description
    "OSPF LSA.";
  uses lsa-common;
  choice version {
    description
      "OSPFv2 or OSPFv3 LSA body.";
    container ospfv2 {
      description "OSPFv2 LSA";
      uses ospfv2-lsa;
    }
    container ospfv3 {
      description "OSPFv3 LSA";
      uses ospfv3-lsa;
    }
  }
}

grouping lsa-key {
  description
    "OSPF LSA key.";
  leaf lsa-id {
    type union {
      type yang:dotted-quad;
      type uint32;
    }
    description
      "Link-State ID.";
  }
  leaf adv-router {
    type rt-types:router-id;
    description

```

```

    "Advertising router.";
  }
}

grouping instance-stat {
  description "Per-instance statistics";
  leaf originate-new-lsa-count {

```

```

    type yang:counter32;
    description "The number of new LSAs originated.";
}
leaf rx-new-lsas-count {
    type yang:counter32;
    description "The number of LSAs received.";
}
leaf as-scope-lsa-count {
    type yang:gauge32;
    description "The number of AS-scope LSAs.";
}
leaf as-scope-lsa-chksum-sum {
    type uint32;
    description
        "The sum of the LSA checksums for AS-scope LSAs.";
}
container database {
    description "Container for per AS-scope LSA statistics.";
    list as-scope-lsa-type {
        description "List of AS-scope LSA statistics";
        leaf lsa-type {
            type uint16;
            description "AS-Scope LSA type.";
        }
        leaf lsa-count {
            type yang:gauge32;
            description "The number of LSAs of the LSA type.";
        }
        leaf lsa-cksum-sum {
            type int32;
            description
                "The sum of the LSA checksums of the LSA type.";
        }
    }
}
}

grouping area-stat {
    description "Per-area statistics.";
    leaf spf-runs-count {
        type yang:counter32;
    }
}

```

```

        description
            "The number of times the intra-area SPF has run.";
    }
    leaf abr-count {
        type yang:gauge32;
        description
            "The total number of Area Border Routers (ABRs)
            reachable within this area.";
    }
    leaf asbr-count {
        type yang:gauge32;
        description
            "The total number of AS Boundary Routers (ASBRs).";
    }
    leaf ar-nssa-translator-event-count {
        type yang:counter32;
        description
            "The number of NSSA translator-state changes.";
    }
    leaf area-scope-lsa-count {
        type yang:gauge32;
        description
            "The number of area-scope LSAs in the area.";
    }
    leaf area-scope-lsa-cksum-sum {
        type int32;
        description "The sum of the area-scope LSAs checksums.";
    }
    container database {
        description "Container for area-scope LSA type statistics.";
        list area-scope-lsa-type {
            description "List of area-scope LSA statistics";
            leaf lsa-type {
                type uint16;
                description "Area-scope LSA type.";
            }
            leaf lsa-count {
                type yang:gauge32;
                description "The number of LSAs of the LSA type.";
            }
            leaf lsa-cksum-sum {
                type int32;
                description
                    "The sum of the LSA checksums of the LSA type.";
            }
        }
    }
}

```

```
grouping interface-stat {
  description "Per-interface statistics";
  leaf if-event-count {
    type yang:counter32;
    description
      "The number of times this interface has changed its
       state or an error has occurred.";
  }
  leaf link-scope-lsa-count {
    type yang:gauge32;
    description "The number of link-scope LSAs.";
  }
  leaf link-scope-lsa-cksum-sum {
    type uint32;
    description "The sum of link-scope LSA checksums.";
  }
  container database {
    description "Container for link-scope LSA type statistics.";
    list link-scope-lsa-type {
      description "List of link-scope LSA statistics";
      leaf lsa-type {
        type uint16;
        description "Link scope LSA type.";
      }
      leaf lsa-count {
        type yang:gauge32;
        description "The number of LSAs of the LSA type.";
      }
      leaf lsa-cksum-sum {
        type int32;
        description
          "The sum of the LSA checksums of the LSA type.";
      }
    }
  }
}

grouping neighbor-stat {
  description "Per-neighbor statistics.";
  leaf nbr-event-count {
    type yang:counter32;
    description
      "The number of times this neighbor has changed
```

```

        state or an error has occurred.";
    }
    leaf nbr-retrans-qlen {
        type yang:gauge32;
        description

```

```

        "The current length of the retransmission queue.";
    }
}

grouping instance-fast-reroute-config {
    description
        "This group defines global configuration of IP
        Fast ReRoute (FRR).";
    container fast-reroute {
        if-feature fast-reroute;
        description
            "This container may be augmented with global
            parameters for IP-FRR.";
        container lfa {
            if-feature lfa;
            description
                "This container may be augmented with
                global parameters for Loop-Free Alternatives (LFA).
                Container creation has no effect on LFA activation.";
        }
    }
}

grouping instance-fast-reroute-state {
    description "IPFRR state data grouping";

    container protected-routes {
        if-feature fast-reroute;
        config false;
        description "Instance protection statistics";

        list af-stats {
            key "af prefix alternate";
            description "Per AF protected prefix information";

            leaf af {

```

```

    type iana-rt-types:address-family;
    description
        "Address-family";
}
leaf prefix {
    type string;
    description
        "Protected prefix.";
}
leaf alternate {
    type string;
    description

```

```

    "Alternate nexthop for the prefix.";
}
leaf alternate-type {
    type enumeration {
        enum equal-cost {
            description
                "ECMP alternate.";
        }
        enum lfa {
            description
                "LFA alternate.";
        }
        enum remote-lfa {
            description
                "Remote LFA alternate.";
        }
        enum tunnel {
            description
                "Tunnel based alternate
                (like RSVP-TE or GRE).";
        }
        enum ti-lfa {
            description
                "TI-LFA alternate.";
        }
        enum mrt {
            description
                "MRT alternate.";
        }
    }
}

```

```

        enum other {
            description
                "Unknown alternate type.";
        }
    }
    description
        "Type of alternate.";
}
leaf best {
    type boolean;
    description
        "Indicates if the alternate is the preferred.";
}
leaf non-best-reason {
    type string;
    description
        "Information field to describe why the alternate
        is not best.";
}

```

```

leaf protection-available {
    type bits {
        bit node-protect {
            position 0;
            description
                "Node protection available.";
        }
        bit link-protect {
            position 1;
            description
                "Link protection available.";
        }
        bit srlg-protect {
            position 2;
            description
                "SRLG protection available.";
        }
        bit downstream-protect {
            position 3;
            description
                "Downstream protection available.";
        }
    }
}

```

```

        bit other {
            position 4;
            description
                "Other protection available.";
        }
    }
    description "Protection provided by the alternate.";
}
leaf alternate-metric1 {
    type uint32;
    description
        "Metric from Point of Local Repair (PLR) to
        destination through the alternate path.";
}
leaf alternate-metric2 {
    type uint32;
    description
        "Metric from PLR to the alternate node";
}
leaf alternate-metric3 {
    type uint32;
    description
        "Metric from alternate node to the destination";
}
}
}
}

```

```

container unprotected-routes {
    if-feature fast-reroute;
    config false;
    description "List of prefixes that are not protected";

    list af-stats {
        key "af prefix";
        description "Per AF unprotected prefix statistics";

        leaf af {
            type iana-rt-types:address-family;

            description "Address-family";
        }
        leaf prefix {

```



```

        type string;
        description "Unprotected prefix.";
    }
}
}

list protection-statistics {
    key frr-protection-method;
    config false;
    description "List protection method statistics";

    leaf frr-protection-method {
        type string;
        description "Protection method used.";
    }
    list af-stats {
        key af;
        description "Per AF protection statistics.";

        leaf af {
            type iana-rt-types:address-family;
            description "Address-family";
        }
        leaf total-routes {
            type uint32;
            description "Total prefixes.";
        }
        leaf unprotected-routes {
            type uint32;
            description
                "Total prefixes that are not protected.";
        }
        leaf protected-routes {

```

```

        type uint32;
        description
            "Total prefixes that are protected.";
    }
    leaf linkprotected-routes {
        type uint32;
        description
            "Total prefixes that are link protected.";
    }

```

```

    }
    leaf nodeprotected-routes {
        type uint32;
        description
            "Total prefixes that are node protected.";
    }
}
}
}

grouping interface-fast-reroute-config {
    description
        "This group defines interface configuration of IP-FRR.";
    container fast-reroute {
        if-feature fast-reroute;
        container lfa {
            if-feature lfa;
            leaf candidate-enable {
                type boolean;
                default true;
                description
                    "Enable the interface to be used as backup.";
            }
            leaf enable {
                type boolean;
                default false;
                description
                    "Activates LFA - Per-prefix LFA computation
                     is assumed.";
            }
        }
        container remote-lfa {
            if-feature remote-lfa;
            leaf enable {
                type boolean;
                default false;
                description
                    "Activates Remote LFA (R-LFA).";
            }
        }
        description
            "Remote LFA configuration.";
    }
}

```

}

```

        description
            "LFA configuration.";
    }
    description
        "Interface IP Fast-reroute configuration.";
}
}

grouping interface-physical-link-config {
    description
        "Interface cost configuration that only applies to
        physical interfaces and sham links.";
    leaf cost {
        type uint16 {
            range "1..65535";
        }
        description
            "Interface cost.";
    }
    leaf mtu-ignore {
        if-feature mtu-ignore;
        type boolean;
        description
            "Enable/Disable bypassing the MTU mismatch check in
            Database Description packets.";
    }
    leaf prefix-suppression {
        if-feature prefix-suppression;
        type boolean;
        description
            "Suppress advertisement of the prefixes associated
            with the interface.";
    }
}

grouping interface-common-config {
    description
        "Common configuration for all types of interfaces,
        including virtual links and sham links.";

    leaf hello-interval {
        type uint16 {
            range "1..65535";
        }
        units seconds;
        description
            "Interval between hello packets (seconds).";
    }
}

```

```
}

leaf dead-interval {
  type uint32 {
    range "1..2147483647";
  }
  units seconds;
  must "../dead-interval > ../hello-interval" {
    error-message "The dead interval must be "
      + "larger than the hello interval";
    description
      "The value MUST be greater than 'hello-interval'.";
  }
  description
    "Interval after which a neighbor is declared down
    (seconds) if hello packets are not received.";
}

leaf retransmit-interval {
  type uint16 {
    range "1..3600";
  }
  units seconds;
  description
    "Interval between retransmitting unacknowledged Link
    State Advertisements (LSAs) (seconds).";
}

leaf transmit-delay {
  type uint16 {
    range "1..3600";
  }
  units seconds;
  description
    "Estimated time needed to transmit Link State Update
    (LSU) packets on the interface (seconds).";
}

leaf lls {
  if-feature lls;
  type boolean;
  description
    "Enable/Disable link-local signaling (LLS) support.";
}

container ttl-security {
```

```
if-feature ttl-security;
description "Time to Live (TTL) security check.";
```

```
    leaf enable {
      type boolean;
      description
        "Enable/Disable TTL security check.";
    }
    leaf hops {
      type uint8 {
        range "1..254";
      }
      description
        "Maximum number of hops that an OSPF packet may
        have traversed before reception.";
    }
  }
  leaf enable {
    if-feature admin-control;
    type boolean;
    default true;
    description
      "Enable/disable OSPF protocol on the interface.";
  }

  container authentication {
    description "Authentication configuration.";
    choice auth-type-selection {
      description
        "Options for OSPFv3 authentication configuration.";
      case auth-ipsec {
        when "derived-from-or-self(..../..../..../rt:type, "
          + "'ospf:ospfv3')" {
          description "Applied to OSPFv3 only.";
        }
        if-feature ospfv3-authentication-ipsec;
        leaf sa {
          type string;
          description
            "Security Association (SA) name.";
        }
      }
    }
  }
```



```

        "Specify OSPF point-to-multipoint network.";
    }
    enum "point-to-point" {
        description
            "Specify OSPF point-to-point network.";
    }
}
description
    "Interface type.";
}

leaf passive {
    type boolean;
    description
        "Enable/Disable passive interface - a passive interface's
        prefix will be advertised but no neighbor adjacencies

```

```

        will be formed on the interface.";
    }

leaf demand-circuit {
    if-feature demand-circuit;
    type boolean;
    description
        "Enable/Disable demand circuit.";
}

leaf priority {
    type uint8;
    description
        "Configure OSPF router priority.";
}

container multi-areas {
    if-feature multi-area-adj;
    description "Container for multi-area config.";
    list multi-area {
        key multi-area-id;
        description
            "Configure OSPF multi-area adjacency.";
        leaf multi-area-id {
            type area-id-type;

```

```

        description
            "Multi-area adjacency area ID.";
    }
    leaf cost {
        type uint16;
        description
            "Interface cost for multi-area adjacency.";
    }
}

container static-neighbors {
    description "Statically configured neighbors.";

    list neighbor {
        key "identifier";
        description
            "Specify a static OSPF neighbor.";

        leaf identifier {
            type inet:ip-address;
            description
                "Neighbor Router ID, IPv4 address, or IPv6 address.";
        }
    }
}

```

```

    }

    leaf cost {
        type uint16 {
            range "1..65535";
        }
        description "Neighbor cost.";
    }
    leaf poll-interval {
        type uint16 {
            range "1..65535";
        }
        units seconds;
        description
            "Neighbor poll interval (seconds) for sending OSPF
            hello packets to discover the neighbor on NBMA
            networks.";
    }
}

```



```

        leaf priority {
            type uint8 {
                range "1..255";
            }
            description "Neighbor priority for DR election.";
        }
    }
}

leaf node-flag {
    if-feature node-flag;
    type boolean;
    default false;
    description
        "Set prefix as identifying the advertising router.";
    reference "RFC 7684 - OSPFv2 Prefix/Link Attribute
        Advertisement";
}

container bfd {
    if-feature bfd;
    description "BFD Client Configuration.";
    uses bfd-types:client-cfg-parms;
    reference "draft-ietf-bfd-yang-xx.txt:
        YANG Data Model for Bidirectional Forwarding
        Detection (BFD)";
}

uses interface-fast-reroute-config;
uses interface-common-config;

```

```

    uses interface-physical-link-config;
}

grouping neighbor-state {
    description
        "OSPF neighbor operational state.";

    leaf address {
        type inet:ip-address;
        config false;
        description

```

```

        "Neighbor address.";
    }
    leaf dr-router-id {
        type rt-types:router-id;
        config false;
        description "Neighbor's Designated Router (DR) Router ID.";
    }

    leaf dr-ip-addr {
        type inet:ip-address;
        config false;
        description "Neighbor's Designated Router (DR) IP address.";
    }

    leaf bdr-router-id {
        type rt-types:router-id;
        config false;
        description
            "Neighbor's Backup Designated Router (BDR) Router ID.";
    }

    leaf bdr-ip-addr {
        type inet:ip-address;
        config false;
        description
            "Neighbor's Backup Designated Router (BDR) IP Address.";
    }
    leaf state {
        type nbr-state-type;
        config false;
        description
            "OSPF neighbor state.";
    }
    leaf dead-timer {
        type uint32;
        units "seconds";
        config false;

```

```

        description "This timer tracks the remaining time before
                    the neighbor is declared dead.";
    }
    container statistics {

```

```

        config false;
        description "Per-neighbor statistics";
        uses neighbor-stat;
    }
}

grouping interface-common-state {
    description
        "OSPF interface common operational state.";
    reference "RFC2328 Section 9";

    leaf state {
        type if-state-type;
        config false;
        description "Interface state.";
    }

    leaf hello-timer {
        type uint32;
        units "seconds";
        config false;
        description "This timer tracks the remaining time before
                    the next hello packet is sent on the
                    interface.";
    }

    leaf wait-timer {
        type uint32;
        units "seconds";
        config false;
        description "This timer tracks the remaining time before
                    the interface exits the Waiting state.";
    }

    leaf dr-router-id {
        type rt-types:router-id;
        config false;
        description "Designated Router (DR) Router ID.";
    }

    leaf dr-ip-addr {
        type inet:ip-address;
        config false;
        description "Designated Router (DR) IP address.";
    }
}

```

```
}

leaf bdr-router-id {
  type rt-types:router-id;
  config false;
  description "Backup Designated Router (BDR) Router ID.";
}

leaf bdr-ip-addr {
  type inet:ip-address;
  config false;
  description "Backup Designated Router (BDR) IP Address.";
}

container statistics {
  config false;
  description "Per-interface statistics";
  uses interface-stat;
}

container neighbors {
  config false;
  description "All neighbors for the interface.";
  list neighbor {
    key "neighbor-router-id";
    description
      "List of interface OSPF neighbors.";
    leaf neighbor-router-id {
      type rt-types:router-id;
      description
        "Neighbor Router ID.";
    }
    uses neighbor-state;
  }
}

container database {
  config false;
  description "Link-scope Link State Database.";
  list link-scope-lsa-type {
    key "lsa-type";
    description
      "List OSPF link-scope LSAs.";
    leaf lsa-type {
      type uint16;
      description "OSPF link-scope LSA type.";
    }
    container link-scope-lsas {
```

```

    "All link-scope LSAs of this LSA type.";
  list link-scope-lsa {
    key "lsa-id adv-router";
    description "List of OSPF link-scope LSAs";
    uses lsa-key;
    uses lsa {
      refine "version/ospfv2/ospfv2" {
        must "derived-from-or-self( "
          + "../..../..../..../..../..../..../..../..../"
          + "rt:type, 'ospf:ospfv2')" {
          description "OSPFv2 LSA.";
        }
      }
      refine "version/ospfv3/ospfv3" {
        must "derived-from-or-self( "
          + "../..../..../..../..../..../..../..../..../"
          + "rt:type, 'ospf:ospfv3')" {
          description "OSPFv3 LSA.";
        }
      }
    }
  }
}

grouping interface-state {
  description
    "OSPF interface operational state.";
  reference "RFC2328 Section 9";

  uses interface-common-state;
}

grouping virtual-link-config {
  description
    "OSPF virtual link configuration state.";

  uses interface-common-config;
}

```

```

}

grouping virtual-link-state {
  description
    "OSPF virtual link operational state.";

  leaf cost {
    type uint16 {

```

```

    range "1..65535";
  }
  config false;
  description
    "Virtual link interface cost.";
}
uses interface-common-state;
}

grouping sham-link-config {
  description
    "OSPF sham link configuration state.";

  uses interface-common-config;
  uses interface-physical-link-config;
}

grouping sham-link-state {
  description
    "OSPF sham link operational state.";
  uses interface-common-state;
}

grouping af-area-config {
  description
    "OSPF address-family specific area config state.";

  container ranges {
    description "Container for summary ranges";

    list range {
      key "prefix";
      description

```

```

        "Summarize routes matching address/mask -
        Applicable to Area Border Routers (ABRs) only.";
    leaf prefix {
        type inet:ip-prefix;
        description
            "IPv4 or IPv6 prefix";
    }
    leaf advertise {
        type boolean;
        description
            "Advertise or hide.";
    }
    leaf cost {
        type uint24 {
            range "0..16777214";
        }
    }

```

```

    }
    description
        "Advertised cost of summary route.";
    }
}
}
}

grouping area-common-config {
    description
        "OSPF area common configuration state.";

    leaf summary {
        when "derived-from(..../area-type,'ospf:stub-nssa-area')" {
            description
                "Summary advertisement into the stub/NSSA area.";
        }
        type boolean;
        description
            "Enable/Disable summary advertisement into the stub or
            NSSA area.";
    }
    leaf default-cost {
        when "derived-from(..../area-type,'ospf:stub-nssa-area')" {
            description
                "Cost for LSA default route advertised into the

```

```

        stub or NSSA area.";
    }
    type uint32 {
        range "1..16777215";
    }
    description
        "Set the summary default route cost for a
        stub or NSSA area.";
}
}

```

```

grouping area-config {
    description
        "OSPF area configuration state.";

    leaf area-type {
        type identityref {
            base area-type;
        }
        default normal-area;
        description
            "Area type.";
    }
}

```

```

}

uses area-common-config;
uses af-area-config;
}

grouping area-state {
    description
        "OSPF area operational state.";

    container statistics {
        config false;
        description "Per-area statistics";
        uses area-stat;
    }

    container database {
        config false;
        description "Area-scope Link State Database.";
    }
}

```





```

config false;
description "Local-rib.";
list route {
  key "prefix";
  description "Routes";
  leaf prefix {
    type inet:ip-prefix;
    description "Destination prefix.";
  }
  container next-hops {
    description "Next hops for the route.";
    list next-hop {
      key "next-hop";
      description "List of next hops for the route";
      leaf outgoing-interface {
        type if:interface-ref;
        description
          "Name of the outgoing interface.";
      }
      leaf next-hop {
        type inet:ip-address;
        description "Nexthop address.";
      }
    }
  }
  leaf metric {
    type uint32;
    description "Metric for this route.";
  }
  leaf route-type {
    type route-type;
    description "Route type for this route.";
  }
  leaf route-tag {
    type uint32;
    description "Route tag for this route.";
  }
}

```

```

    }
  }
}

```

```

grouping ietf-spf-delay {
  leaf initial-delay {
    type uint16;
    units msec;
    description
      "Delay used while in QUIET state (milliseconds).";
  }
  leaf short-delay {
    type uint16;
    units msec;
    description
      "Delay used while in SHORT_WAIT state (milliseconds).";
  }
  leaf long-delay {
    type uint16;
    units msec;
    description
      "Delay used while in LONG_WAIT state (milliseconds).";
  }
  leaf hold-down {
    type uint16;
    units msec;
    description
      "Timer used to consider an IGP stability period
        (milliseconds).";
  }
  leaf time-to-learn {
    type uint16;
    units msec;
    description
      "Duration used to learn all the IGP events
        related to a single component failure (milliseconds).";
  }
  leaf current-state {
    type enumeration {
      enum "quiet" {
        description "QUIET state";
      }
      enum "short-wait" {
        description "SHORT_WAIT state";
      }
      enum "long-wait" {
        description "LONG_WAIT state";
      }
    }
  }
}

```

```

    }
  }
  config false;
  description
    "Current SPF backoff algorithm state.";
}
leaf remaining-time-to-learn {
  type uint16;
  units "seconds";
  config false;
  description
    "Remaining time until time-to-learn timer fires.";
}
leaf remaining-hold-down {
  type uint16;
  units "seconds";
  config false;
  description
    "Remaining time until hold-down timer fires.";
}
leaf last-event-received {
  type yang:timestamp;
  config false;
  description
    "Time of last SPF triggering event.";
}
leaf next-spf-time {
  type yang:timestamp;
  config false;
  description
    "Time when next SPF has been scheduled.";
}
leaf last-spf-time {
  type yang:timestamp;
  config false;
  description
    "Time of last SPF computation.";
}
description
  "Grouping for IETF SPF delay configuration and state";
}

grouping node-tag-config {
  description
    "OSPF node tag config state.";
  container node-tags {
    if-feature node-tag;
    list node-tag {

```

```
        key tag;
        leaf tag {
            type uint32;
            description
                "Node tag value.";
        }
        description
            "List of tags.";
    }
    description
        "Container for node admin tags.";
}
}

grouping instance-config {
    description
        "OSPF instance config state.";

    leaf explicit-router-id {
        if-feature explicit-router-id;
        type rt-types:router-id;
        description
            "Defined in RFC 2328. A 32-bit number
            that uniquely identifies the router.";
    }

    container preference {
        description "Route preference config state.";
        choice scope {
            description
                "Options for expressing preference
                as single or multiple values.";
            case single-value {
                leaf all {
                    type uint8;
                    description
                        "Preference for intra-area, inter-area, and
                        external routes.";
                }
            }
            case multi-values {
                choice granularity {
```

```

description
  "Options for expressing preference
   for intra-area and inter-area routes.";
case detail {
  leaf intra-area {
    type uint8;

```

```

        description
          "Preference for intra-area routes.";
      }
      leaf inter-area {
        type uint8;
        description
          "Preference for inter-area routes.";
      }
    }
    case coarse {
      leaf internal {
        type uint8;
        description
          "Preference for both intra-area and
           inter-area routes.";
      }
    }
  }
  leaf external {
    type uint8;
    description
      "Preference for AS external routes.";
  }
}
}

container nsr {
  if-feature nsr;
  description
    "Non-Stop Routing (NSR) config state.";
  leaf enable {
    type boolean;
    description
      "Enable/Disable NSR.";

```

```

    }
}

container graceful-restart {
    if-feature graceful-restart;
    description
        "Graceful restart config state.";
    reference "RFC 3623 - OSPF Graceful Restart
        RFC 5187 - OSPFv3 Graceful Restart";
    leaf enable {
        type boolean;
        description
            "Enable/Disable graceful restart as defined in RFC 3623

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```

        for OSPFv2 and RFC 5187 for OSPFv3.";
    }
    leaf helper-enable {
        type boolean;
        description
            "Enable graceful restart helper support for restarting
            routers (RFC 3623 Section 3).";
    }
    leaf restart-interval {
        type uint16 {
            range "1..1800";
        }
        units seconds;
        default "120";
        description
            "Interval to attempt graceful restart prior
            to failing (RFC 3623 Section B.1) (seconds)";
    }
    leaf helper-strict-lsa-checking {
        type boolean;
        description
            "Terminate graceful restart when an LSA topology change
            is detected (RFC 3623 Section B.2).";
    }
}

leaf enable {
    if-feature admin-control;

```

```

    type boolean;
    default true;
    description
        "Enable/Disable the protocol.";
}

container auto-cost {
    if-feature auto-cost;
    description
        "Interface Auto-cost configuration state.";
    leaf enable {
        type boolean;
        description
            "Enable/Disable interface auto-cost.";
    }
    leaf reference-bandwidth {
        when "../enable = 'true'" {
            description "Only when auto cost is enabled";
        }
        type uint32 {

```

```

        range "1..4294967";
    }
    units Mbits;
    description
        "Configure reference bandwidth used to automatically
        determine interface cost (Mbits). The cost is the
        reference bandwidth divided by the interface speed
        with 1 being the minimum cost.";
    }
}

container spf-control {
    leaf paths {
        if-feature max-ecmp;
        type uint16 {
            range "1..32";
        }
        description
            "Maximum number of Equal-Cost Multi-Path (ECMP) paths.";
    }
    container ietf-spf-delay {

```



```

        if-feature ietf-spf-delay;
        uses ietf-spf-delay;
        description
            "IETF SPF delay algorithm configuration.";
    }
    description "SPF calculation control.";
}

container database-control {
    leaf max-lsa {
        if-feature max-lsa;
        type uint32 {
            range "1..4294967294";
        }
        description
            "Maximum number of LSAs OSPF the router will accept.";
    }
    description "Database maintenance control.";
}

container stub-router {
    if-feature stub-router;
    description "Set maximum metric configuration";

    choice trigger {
        description
            "Specific triggers which will enable stub

```

```

        router state.";
    container always {
        presence
            "Enables unconditional stub router support";
        description
            "Unconditional stub router state (advertise
                transit links with max metric";
    }
}

container mpls {
    description
        "OSPF MPLS config state.";
}

```

```

    container te-rid {
        if-feature te-rid;
        description
            "Stable OSPF Router IP Address used for Traffic
            Engineering (TE)";
        leaf ipv4-router-id {
            type inet:ipv4-address;
            description
                "Explicitly configure the TE IPv4 Router ID.";
        }
        leaf ipv6-router-id {
            type inet:ipv6-address;
            description
                "Explicitly configure the TE IPv6 Router ID.";
        }
    }
    container ldp {
        description
            "OSPF MPLS LDP config state.";
        leaf igp-sync {
            if-feature ldp-igp-sync;
            type boolean;
            description
                "Enable LDP IGP synchronization.";
        }
    }
}
uses instance-fast-reroute-config;
uses instance-fast-reroute-state;
uses node-tag-config;
}

grouping instance-state {
    description

```

```

        "OSPF instance operational state.";

    leaf router-id {
        type rt-types:router-id;
        config false;
        description
            "Defined in RFC 2328. A 32-bit number

```

```

        that uniquely identifies the router.";
    }

    uses local-rib;

    container statistics {
        config false;
        description "Per-instance statistics";
        uses instance-stat;
    }

    container database {
        config false;
        description "AS-scope Link State Database.";
        list as-scope-lsa-type {
            key "lsa-type";
            description "List OSPF AS-scope LSAs.";
            leaf lsa-type {
                type uint16;
                description "OSPF AS scope LSA type.";
            }
        }
        container as-scope-lsas {
            description "All AS-scope of LSA of this LSA type.";
            list as-scope-lsa {
                key "lsa-id adv-router";
                description "List of OSPF AS-scope LSAs";
                uses lsa-key;
                uses lsa {
                    refine "version/ospfv2/ospfv2" {
                        must "derived-from-or-self( "
                            + "../..../..../..../.."
                            + "rt:type, 'ospf:ospfv2')";
                        description "OSPFv2 LSA.";
                    }
                }
                refine "version/ospfv3/ospfv3" {
                        must "derived-from-or-self( "
                            + "../..../..../..../.."
                            + "rt:type, 'ospf:ospfv3')";
                        description "OSPFv3 LSA.";
                    }
                }
            }
        }
    }

```

```

    }
  }
}
}
}
}
}
uses spf-log;
uses lsa-log;
}

grouping ospf-config {
  description
    "OSPF top configuration state - currently empty.";
}

grouping ospf-state {
  description
    "OSPF top operational state - currently empty.";
}

grouping multi-topology-area-common-config {
  description
    "OSPF multi-topology area common configuration state.";
  leaf summary {
    when "derived-from("
      + "../..../..../areas/area[area-id=current()../area-id]/"
      + "area-type, 'stub-nssa-area')" {
      description
        "Summary advertisement into the stub/NSSA area.";
    }
    type boolean;
    description
      "Enable/Disable summary advertisement into the
        topology in the stub or NSSA area.";
  }
  leaf default-cost {
    when "derived-from("
      + "../..../..../areas/area[area-id=current()../area-id]/"
      + "area-type, 'stub-nssa-area')" {
      description
        "Cost for LSA default route advertised into the
          topology into the stub or NSSA area.";
    }
    type uint32 {
      range "1..16777215";
    }
  }
  description
    "Set the summary default route cost for a

```

```
        stub or NSSA area.";
    }
}

grouping multi-topology-area-config {
    description
        "OSPF multi-topology area configuration state.";

    uses multi-topology-area-common-config;
    uses af-area-config;
}

grouping multi-topology-area-state {
    description
        "OSPF multi-topology area operational state.";
}

grouping multi-topology-config {
    description
        "OSPF multi-topology configuration state.";
}

grouping multi-topology-state {
    description
        "OSPF multi-topology operational state.";

    uses local-rib;
}

grouping multi-topology-interface-config {
    description
        "OSPF multi-topology configuration state.";

    leaf cost {
        type uint32;
        description
            "Interface cost for this topology.";
    }
}

grouping multi-topology-interface-state {
    description
        "OSPF multi-topology operational state.";
```

```
}
```

```
grouping ospfv3-interface-config {  
  description  
    "OSPFv3 interface specific configuration state.";
```

```
  leaf instance-id {  
    type uint8 {  
      range "0 .. 31";  
    }  
    description  
      "OSPFv3 instance ID.";  
  }  
}
```

```
grouping ospfv3-interface-state {  
  description  
    "OSPFv3 interface specific operational state.";  
  
  leaf interface-id {  
    type uint16;  
    config false;  
    description  
      "OSPFv3 interface ID.";  
  }  
}
```

```
grouping lsa-identifiers {  
  description  
    "The parameters that uniquely identify an LSA.";  
  leaf area-id {  
    type area-id-type;  
    description  
      "Area ID";  
  }  
  leaf type {  
    type uint16;  
    description  
      "LSA type.";  
  }  
  leaf lsa-id {  
    type yang:dotted-quad;
```

```

        description "Link-State ID.";
    }
    leaf adv-router {
        type rt-types:router-id;
        description
            "LSA advertising router.";
    }
    leaf seq-num {
        type uint32;
        description
            "LSA sequence number.";
    }
}

```

```

}

grouping spf-log {
    description
        "Grouping for SPF log.";
    container spf-log {
        config false;
        description
            "This container lists the SPF log.";
        list event {
            key id;
            description
                "List of SPF log entries represented
                as a wrapping buffer.";
            leaf id {
                type uint32;
                description
                    "Event identifier - Ppurely internal value.";
            }
            leaf spf-type {
                type enumeration {
                    enum full {
                        description
                            "SPF computation was a Full SPF.";
                    }
                    enum intra {
                        description
                            "SPF computation was only for intra-area routes.";
                    }
                }
            }
        }
    }
}

```

```

        enum inter {
            description
                "SPF computation was only for inter-area
                summary routes.";
        }
        enum external {
            description
                "SPF computation was only for AS external routes.";
        }
    }
    description
        "The SPF computation type for the SPF log entry.";
}
leaf schedule-timestamp {
    type yang:timestamp;
    description
        "This is the timestamp when the computation was
        scheduled.";
}

```

```

        leaf start-timestamp {
            type yang:timestamp;
            description
                "This is the timestamp when the computation was
                started.";
        }
        leaf end-timestamp {
            type yang:timestamp;
            description
                "This the timestamp when the computation was
                completed.";
        }
        list trigger-lsa {
            description
                "The list of LSAs that triggered the computation.";
            uses lsa-identifiers;
        }
    }
}

grouping lsa-log {

```



```

description
  "Grouping for the LSA log.";
container lsa-log {
  config false;
  description
    "This container lists the LSA log.
    Local LSA modifications are also included
    in the list.";
  list event {
    key id;
    description
      "List of LSA log entries represented
      as a wrapping buffer.";
    leaf id {
      type uint32;
      description
        "Event identifier - purely internal value.";
    }
    container lsa {
      description
        "This container describes the logged LSA.";
      uses lsa-identifiers;
    }
    leaf received-timestamp {
      type yang:timestamp;
      description

```

```

    "This is the timestamp when the LSA was received.
    In case of local LSA update, the timestamp refers
    to the LSA origination time.";
  }
  leaf reason {
    type identityref {
      base lsa-log-reason;
    }
    description
      "This reason for the LSA log entry.";
  }
}
}
}
}

```

```

augment "/rt:routing/rt:control-plane-protocols/"
  + "rt:control-plane-protocol" {
    when "derived-from(rt:type, 'ospf:ospf-protocol')" {
      description
        "This augmentation is only valid for a routing protocol
        instance of OSPF (type 'ospfv2' or 'ospfv3').";
    }
    description "OSPF protocol ietf-routing module
      control-plane-protocol augmentation.";

    container ospf {
      description
        "OSPF protocol Instance";

      uses ospf-config;
      uses ospf-state;

      leaf af {
        type iana-rt-types:address-family;
        description
          "Address-family of the instance.";
      }

      uses instance-config;
      uses instance-state;

      container areas {
        description "All areas.";
        list area {
          key "area-id";
          description
            "List of OSPF areas";
          leaf area-id {

```

```

      type area-id-type;
      description
        "Area ID";
    }

    uses area-config;
    uses area-state;

```

```

container virtual-links {
  when "derived-from-or-self(..../area-type, 'normal-area') "
    + "and ..../area-id = '0.0.0.0'" {
    description
      "Virtual links must be in backbone area.";
  }
  description "All virtual links.";
  list virtual-link {
    key "transit-area-id router-id";
    description
      "OSPF virtual link";
    leaf transit-area-id {
      type leafref {
        path "..../..../area/area-id";
      }
      must "derived-from-or-self("
        + "..../..../area[area-id=current()]/area-type, "
        + "'normal-area') and "
        + "..../..../area[area-id=current()]/area-id != "
        + "'0.0.0.0'" {
        error-message "Virtual link transit area must "
          + "be non-zero.";
      }
      description
        "Virtual-link trasit area must be
        non-zero area.";
    }
    description
      "Virtual link tranist area ID.";
  }
  leaf router-id {
    type rt-types:router-id;
    description
      "Virtual Link remote endpoint Router ID.";
  }
}
uses virtual-link-config;
uses virtual-link-state;
}
}
container sham-links {

```

if-feature pe-ce-protocol;



```
description
  "OSPF multi-topology instance configuration
  state augmentation.";
container topologies {
  description "All topologies.";
  list topology {
    key "name";
    description
      "OSPF topology - The OSPF topology address-family
      must coincide with the routing-instance
      address-family.";
    leaf name {
      type leafref {
        path "../..../rt:ribs/rt:rib/rt:name";
      }
      description "RIB name corresponding to the OSPF
        topology.";
    }
  }

  uses multi-topology-config;
  uses multi-topology-state;

  container areas {
    description "All areas in the topology.";
    list area {
      key "area-id";
      description
        "List of OSPF areas";
      leaf area-id {
        type area-id-type;
        description
          "Area ID.";
      }
      uses multi-topology-area-config;
      uses multi-topology-area-state;
    }
  }
}

augment "/rt:routing/rt:control-plane-protocols/"
  + "rt:control-plane-protocol/ospf:ospf/"
  + "ospf:areas/ospf:area/ospf:interfaces/ospf:interface" {
  when "derived-from-or-self(..../rt:type, "
    + "'ospf:ospfv2')" {
```

```
description
  "This augmentation is only valid for OSPFv2.";
```

```
    }
    if-feature ospf:multi-topology;
    description
      "OSPF multi-topology interface configuration state
      augmentation.";
    container topologies {
      description "All topologies for the interface.";
      list topology {
        key "name";
        description "OSPF interface topology.";
        leaf name {
          type leafref {
            path "../..../..../..../..../..../..../..../..../"
              + "rt:ribs/rt:rib/rt:name";
          }
          description
            "Single topology enabled on this interface.";
        }

        uses multi-topology-interface-config;
        uses multi-topology-interface-state;
      }
    }
  }
}

augment "/rt:routing/rt:control-plane-protocols/"
  + "rt:control-plane-protocol/ospf:ospf/"
  + "ospf:areas/ospf:area/ospf:interfaces/ospf:interface" {
  when "derived-from-or-self(..../..../..../..../rt:type, "
    + "'ospf:ospfv3')" {
    description
      "This augmentation is only valid for OSPFv3.";
  }
  description
    "OSPFv3 interface specific configuration state
    augmentation.";
  uses ospfv3-interface-config;
  uses ospfv3-interface-state;
}
```

```

grouping route-content {
  description
    "This grouping defines OSPF-specific route attributes.";
  leaf metric {
    type uint32;
    description "OSPF route metric.";
  }
  leaf tag {

```

```

    type uint32;
    default "0";
    description "OSPF route tag.";
  }
  leaf route-type {
    type route-type;
    description "OSPF route type";
  }
}

augment "/rt:routing/rt:ribs/rt:rib/rt:routes/rt:route" {
  when "derived-from(rt:source-protocol, 'ospf:ospf-protocol')" {
    description
      "This augmentation is only valid for a routes whose
       source protocol is OSPF.";
  }
  description
    "OSPF-specific route attributes.";
  uses route-content;
}

/*
 * RPCs
 */

rpc clear-neighbor {
  description
    "This RPC request clears a particular set of OSPF neighbors.
     If the operation fails for OSPF internal reason, then
     error-tag and error-app-tag should be set to a meaningful
     value.";
  input {

```

```

leaf routing-protocol-name {
  type leafref {
    path "/rt:routing/rt:control-plane-protocols/"
      + "rt:control-plane-protocol/rt:name";
  }
  mandatory "true";
  description
    "OSPF protocol instance which information for neighbors
    are to be cleared.

    If the referenced OSPF instance doesn't exist, then
    this operation SHALL fail with error-tag 'data-missing'
    and error-app-tag
    'routing-protocol-instance-not-found'.";
}

```

```

leaf interface {
  type if:interface-ref;
  description
    "Name of the OSPF interface for which neighbors are to
    be cleared.

    If the referenced OSPF interface doesn't exist, then
    this operation SHALL fail with error-tag
    'data-missing' and error-app-tag
    'ospf-interface-not-found'.";
}
}
}

rpc clear-database {
  description
    "This RPC request clears a particular OSPF Link State
    Database. If the operation fails for OSPF internal reason,
    then error-tag and error-app-tag should be set to a
    meaningful value.";
  input {
    leaf routing-protocol-name {
      type leafref {
        path "/rt:routing/rt:control-plane-protocols/"
          + "rt:control-plane-protocol/rt:name";
      }
    }
  }
}

```



```

    }
    mandatory "true";
    description
        "OSPF protocol instance whose link-state database is to
        be cleared.

        If the referenced OSPF instance doesn't exist, then
        this operation SHALL fail with error-tag 'data-missing'
        and error-app-tag
        'routing-protocol-instance-not-found.'";
    }
}

/*
 * Notifications
 */

grouping notification-instance-hdr {
    description
        "This grouping describes common instance specific
        data for OSPF notifications.";
}

```

```

leaf routing-protocol-name {
    type leafref {
        path "/rt:routing/rt:control-plane-protocols/"
            + "rt:control-plane-protocol/rt:name";
    }
    must "derived-from( "
        + "/rt:routing/rt:control-plane-protocols/"
        + "rt:control-plane-protocol[rt:name=current()]/"
        + "rt:type, 'ospf:ospf-protocol')";
    description
        "OSPF routing protocol instance name.";
}

leaf af {
    type leafref {
        path "/rt:routing/"
            + "rt:control-plane-protocols/rt:control-plane-protocol"
            + "[rt:name=current()]/../routing-protocol-name/";
    }
}

```

```

        + "ospf:ospf/af";
    }
    description
        "Address family of the OSPF instance.";
}
}

grouping notification-interface {
    description
        "This grouping provides interface information
        for the OSPF interface specific notification.";

    choice if-link-type-selection {
        description
            "Options for link type.";
        container interface {
            description "Normal interface.";
            leaf interface {
                type if:interface-ref;
                description "Interface.";
            }
        }
        container virtual-link {
            description "virtual-link.";
            leaf transit-area-id {
                type area-id-type;
                description "Area ID.";
            }
            leaf neighbor-router-id {
                type rt-types:router-id;
            }
        }
    }
}

```

```

        description "Neighbor Router ID.";
    }
}
container sham-link {
    description "sham link.";
    leaf area-id {
        type area-id-type;
        description "Area ID.";
    }
    leaf local-ip-addr {
        type inet:ip-address;
    }
}

```

```

        description "Sham link local address.";
    }
    leaf remote-ip-addr {
        type inet:ip-address;
        description "Sham link remote address.";
    }
}
}

grouping notification-neighbor {
    description
        "This grouping provides the neighbor information
        for neighbor specific notifications.";

    leaf neighbor-router-id {
        type rt-types:router-id;
        description "Neighbor Router ID.";
    }

    leaf neighbor-ip-addr {
        type yang:dotted-quad;
        description "Neighbor address.";
    }
}

notification if-state-change {
    uses notification-instance-hdr;
    uses notification-interface;

    leaf state {
        type if-state-type;
        description "Interface state.";
    }
    description
        "This notification is sent when an interface
        state change is detected.";
}

```

```

}

notification if-config-error {
    uses notification-instance-hdr;
}

```

```

uses notification-interface;

leaf packet-source {
    type yang:dotted-quad;
    description "Source address.";
}

leaf packet-type {
    type packet-type;
    description "OSPF packet type.";
}

leaf error {
    type enumeration {
        enum "bad-version" {
            description "Bad version.";
        }
        enum "area-mismatch" {
            description "Area mistmatch.";
        }
        enum "unknown-nbma-nbr" {
            description "Unknown NBMA neighbor.";
        }
        enum "unknown-virtual-nbr" {
            description "Unknown virtual link neighbor.";
        }
        enum "auth-type-mismatch" {
            description "Auth type mismatch.";
        }
        enum "auth-failure" {
            description "Auth failure.";
        }
        enum "net-mask-mismatch" {
            description "Network mask mismatch.";
        }
        enum "hello-interval-mismatch" {
            description "Hello interval mismatch.";
        }
        enum "dead-interval-mismatch" {
            description "Dead interval mismatch.";
        }
        enum "option-mismatch" {
            description "Option mismatch.";
        }
    }
}

```

```
        enum "mtu-mismatch" {
            description "MTU mismatch.";
        }
        enum "duplicate-router-id" {
            description "Duplicate Router ID.";
        }
        enum "no-error" {
            description "No error.";
        }
    }
    description "Error code.";
}
description
    "This notification is sent when an interface
    config error is detected.";
}

notification nbr-state-change {
    uses notification-instance-hdr;
    uses notification-interface;
    uses notification-neighbor;

    leaf state {
        type nbr-state-type;
        description "Neighbor state.";
    }

    description
        "This notification is sent when aa neighbor
        state change is detected.";
}

notification nbr-restart-helper-status-change {
    uses notification-instance-hdr;
    uses notification-interface;
    uses notification-neighbor;

    leaf status {
        type restart-helper-status-type;
        description "Restart helper status.";
    }

    leaf age {
        type uint32;
        units seconds;
        description
            "Remaining time in current OSPF graceful restart
```

interval when the router is acting as a restart

```
        helper for the neighbor.";
    }

    leaf exit-reason {
        type restart-exit-reason-type;
        description
            "Restart helper exit reason.";
    }
    description
        "This notification is sent when a neighbor restart
        helper status change is detected.";
}

notification if-rx-bad-packet {
    uses notification-instance-hdr;
    uses notification-interface;

    leaf packet-source {
        type yang:dotted-quad;
        description "Source address.";
    }

    leaf packet-type {
        type packet-type;
        description "OSPF packet type.";
    }

    description
        "This notification is sent when an OSPF packet that
        cannot be parsed is received on an OSPF interface.";
}

notification lsdb-approaching-overflow {
    uses notification-instance-hdr;

    leaf ext-lsdb-limit {
        type uint32;
        description
            "The maximum number of non-default AS-external LSAs
            entries that can be stored in the Link State Database.";
    }
}
```

```

    }

    description
        "This notification is sent when the number of LSAs
        in the router's Link State Database has exceeded
        ninety percent of the AS-external limit (ext-lsdb-limit).";
}

```

```

notification lsdb-overflow {
    uses notification-instance-hdr;

    leaf ext-lsdb-limit {
        type uint32;
        description
            "The maximum number of non-default AS-external LSAs
            entries that can be stored in the Link State Database.";
    }

    description
        "This notification is sent when the number of LSAs
        in the router's Link State Database has exceeded the
        AS-external limit (ext-lsdb-limit).";
}

notification nssa-translator-status-change {
    uses notification-instance-hdr;

    leaf area-id {
        type area-id-type;
        description "Area ID.";
    }

    leaf status {
        type nssa-translator-state-type;
        description
            "NSSA translator status.";
    }

    description
        "This notification is sent when there is a change
        in the router's role in translating OSPF NSSA LSAs

```

```

        to OSPF AS-External LSAs.";
    }

    notification restart-status-change {
        uses notification-instance-hdr;

        leaf status {
            type restart-status-type;
            description
                "Restart status.";
        }

        leaf restart-interval {
            type uint16 {
                range "1..1800";
            }
        }
    }

```

```

    }
    units seconds;
    default "120";
    description
        "Restart interval.";
}

leaf exit-reason {
    type restart-exit-reason-type;
    description
        "Restart exit reason.";
}

description
    "This notification is sent when the graceful restart
    state for the router has changed.";
}
}
<CODE ENDS>

```

#### 4. Security Considerations

The YANG modules specified in this document define a schema for data that is designed to be accessed via network management protocols such as NETCONF [RFC6241] or RESTCONF [RFC8040]. The lowest NETCONF layer is the secure transport layer, and the mandatory-to-implement secure



transport is Secure Shell (SSH) [[RFC6242](#)]. The lowest RESTCONF layer is HTTPS, and the mandatory-to-implement secure transport is TLS [[RFC5246](#)].

The NETCONF access control model [[RFC8341](#)] provides the means to restrict access for particular NETCONF or RESTCONF users to a pre-configured subset of all available NETCONF or RESTCONF protocol operations and content.

There are a number of data nodes defined in ietf-ospf.yang module that are writable/creatable/deletable (i.e., config true, which is the default). These data nodes may be considered sensitive or vulnerable in some network environments. Write operations (e.g., edit-config) to these data nodes without proper protection can have a negative effect on network operations. For OSPF, the ability to modify OSPF configuration will allow the entire OSPF domain to be compromised including peering with unauthorized routers to misroute traffic or mount a massive Denial-of-Service (DoS) attack. The security considerations of OSPFv2 [[RFC2328](#)] and [[RFC5340](#)] apply to the ietf-ospf.yang module as well.

Some of the readable data nodes in the ietf-ospf.yang module may be considered sensitive or vulnerable in some network environments. It is thus important to control read access (e.g., via get, get-config, or notification) to these data nodes. The exposure of the Link State Database (LSDB) will expose the detailed topology of the network. This may be undesirable since both due to the fact that exposure may facilitate other attacks. Additionally, network operators may consider their topologies to be sensitive confidential data.

For OSPF authentication, configuration is supported via the specification of key-chains [[RFC8177](#)] or the direct specification of key and authentication algorithm. Hence, authentication configuration using the "auth-table-trailer" case in the "authentication" container inherits the security considerations of [[RFC8177](#)]. This includes the considerations with respect to the local storage and handling of authentication keys.

Some of the RPC operations in this YANG module may be considered sensitive or vulnerable in some network environments. It is thus

important to control access to these operations. The OSPF Yang module support the "clear-neighbor" and "clear-database" RPCs. If access too either of these is compromised, they can result in temporary network outages be employed to mount DoS attacks.

## 5. IANA Considerations

This document registers a URI in the IETF XML registry [[RFC3688](#)]. Following the format in [[RFC3688](#)], the following registration is requested to be made:

URI: urn:ietf:params:xml:ns:yang:ietf-ospf  
Registrant Contact: The IESG.  
XML: N/A, the requested URI is an XML namespace.

This document registers a YANG module in the YANG Module Names registry [[RFC6020](#)].

name: ietf-ospf  
namespace: urn:ietf:params:xml:ns:yang:ietf-ospf  
prefix: ospf  
reference: RFC XXXX

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#### [Appendix A](#). Contributors' Addresses

Dean Bogdanovic  
Volta Networks, Inc.

EMail: dean@voltanet.io

Kiran Koushik Agrahara Sreenivasa  
Cisco Systems  
12515 Research Blvd, Bldg 4  
Austin, TX 78681  
USA

EMail: kkoushik@cisco.com

#### Authors' Addresses

Derek Yeung

Arrcus

EMail: derek@arrcus.com

Yingzhen Qu

Huawei

2330 Central Expressway

Santa Clara, CA 95050

USA

EMail: yingzhen.qu@huawei.com

Jeffrey Zhang

Juniper Networks

10 Technology Park Drive

Westford, MA 01886

USA

EMail: zzhang@juniper.net

Ing-Wher Chen

Jabil

EMail: ing-wher\_chen@jabil.com

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Acee Lindem

Cisco Systems

301 Midenhall Way

Cary, NC 27513

EMail: acee@cisco.com

