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YANG Model for OSPFv3 Extended LSAs

Abstract

This document defines a YANG data model augmenting the IETF OSPF YANG model to provide support for OSPFv3 Link State Advertisement (LSA) Extensibility as defined in RFC 8362. OSPFv3 Extended LSAs provide extensible TLV-based LSAs for the base LSA types defined in RFC 5340.

Status of This Memo

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This Internet-Draft will expire on 5 August 2024.

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1. Overview

YANG [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 augmenting the IETF OSPF YANG model [RFC9129], which itself augments [RFC8349], to provide support for configuration and operational state for OSPFv3 Extended LSAs as defined in [RFC8362].

The YANG modules in this document conform to the Network Management Datastore Architecture (NMDA) [RFC8342].

2. Tree Diagrams

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

3. OSPFv3 Extended LSAs

This document defines a model for the OSPFv3 Extended LSA feature. It is an augmentation of the OSPF base model provided support for OSPFv3 Link State Advertisement (LSA) Extensibility [RFC8362]. OSPFv3 Extended LSAs provide extensible TLV-based LSAs for the base LSA types defined in [RFC5340].

The OSPFv3 Extended LSA YANG module requires support for the OSPF base model[RFC9129] which defines basic OSPF configuration and state. The OSPF YANG model augments the ietf-routing YANG model defined in [RFC8349]. The augmentations defined in the ietf-ospfv3-

extended-lsa YANG module provide global configuration, area configuration, and addition of OSPFv3 Extended LSAs to the Link State Database (LSDB) operational state.

```
module: ietf-ospfv3-extended-lsa

  augment /rt:routing/rt:control-plane-protocols
            /rt:control-plane-protocol/ospf:ospf:
    +--rw extended-lsa-support?   boolean
  augment /rt:routing/rt:control-plane-protocols
            /rt:control-plane-protocol/ospf:ospf/ospf:areas
            /ospf:area:
    +--rw extended-lsa-support?   boolean
  augment /rt:routing/rt:control-plane-protocols
            /rt:control-plane-protocol/ospf:ospf/ospf:areas/ospf:area
            /ospf:interfaces/ospf:interface/ospf:database
            /ospf:link-scope-lsa-type/ospf:link-scope-lsas
            /ospf:link-scope-lsa/ospf:version/ospf:ospfv3/ospf:ospfv3
            /ospf:body:
    +--ro e-link
       +--ro rtr-priority?   uint8
       +--ro lsa-options
       |  +--ro lsa-options*   identityref
       +--ro e-link-tlvs* []
          +--ro unknown-tlv
          |  +--ro type?     uint16
          |  +--ro length?   uint16
          |  +--ro value?    yang:hex-string
          +--ro intra-prefix-tlv
          |  +--ro metric?           ospf:ospf-metric
          |  +--ro prefix?           inet:ip-prefix
          |  +--ro prefix-options
          |  |  +--ro prefix-options*   identityref
          |  +--ro sub-tlvs* []
          |     +--ro unknown-sub-tlv
          |        +--ro type?     uint16
          |        +--ro length?   uint16
          |        +--ro value?    yang:hex-string
          +--ro ipv6-link-local-tlv
          |  +--ro link-local-address?   inet:ipv6-address
          |  +--ro sub-tlvs* []
          |     +--ro unknown-sub-tlv
          |        +--ro type?     uint16
          |        +--ro length?   uint16
          |        +--ro value?    yang:hex-string
          +--ro ipv4-link-local-tlv
             +--ro link-local-address?   inet:ipv4-address
             +--ro sub-tlvs* []
                +--ro unknown-sub-tlv
                   +--ro type?     uint16
                   +--ro length?   uint16
                   +--ro value?    yang:hex-string
  augment /rt:routing/rt:control-plane-protocols
```

```
        /rt:control-plane-protocol/ospf:ospf/ospf:areas/ospf:area
        /ospf:database/ospf:area-scope-lsa-type
        /ospf:area-scope-lsas/ospf:area-scope-lsa/ospf:version
        /ospf:ospfv3/ospf:ospfv3/ospf:body:
+--ro e-router
|  +--ro router-bits
|  |  +--ro rtr-lsa-bits*   identityref
|  +--ro lsa-options
|  |  +--ro lsa-options*   identityref
|  +--ro e-router-tlvs* []
|     +--ro unknown-tlv
|     |  +--ro type?     uint16
|     |  +--ro length?   uint16
|     |  +--ro value?    yang:hex-string
|     +--ro link-tlv
|        +--ro interface-id?            uint32
|        +--ro neighbor-interface-id?   uint32
|        +--ro neighbor-router-id?      rt-types:router-id
|        +--ro type?                    ospf:router-link-type
|        +--ro metric?                  ospf:ospf-link-metric
|        +--ro sub-tlvs* []
|           +--ro unknown-sub-tlv
|              +--ro type?     uint16
|              +--ro length?   uint16
|              +--ro value?    yang:hex-string
+--ro e-network
|  +--ro lsa-options
|  |  +--ro lsa-options*   identityref
|  +--ro e-network-tlvs* []
|     +--ro unknown-tlv
|     |  +--ro type?     uint16
|     |  +--ro length?   uint16
|     |  +--ro value?    yang:hex-string
|     +--ro attached-router-tlv
|        +--ro adjacent-neighbor-router-id*   rt-types:router-id
+--ro e-nssa
|  +--ro e-external-tlvs* []
|     +--ro unknown-tlv
|     |  +--ro type?     uint16
|     |  +--ro length?   uint16
|     |  +--ro value?    yang:hex-string
|     +--ro external-prefix-tlv
|        +--ro flags
|        |  +--ro ospfv3-e-external-prefix-bits*   identityref
|        +--ro metric?           ospf:ospf-metric
|        +--ro prefix?           inet:ip-prefix
|        +--ro prefix-options
|        |  +--ro prefix-options*   identityref
|        +--ro sub-tlvs* []
```

```
|           +--ro ipv6-fwd-addr-sub-tlv
|           |  +--ro forwarding-address?   inet:ipv6-address
|           +--ro ipv4-fwd-addr-sub-tlv
|           |  +--ro forwarding-address?   inet:ipv4-address
|           +--ro route-tag-sub-tlv
|           |  +--ro route-tag?   uint32
|           +--ro unknown-sub-tlv
|              +--ro type?     uint16
|              +--ro length?   uint16
|              +--ro value?    yang:hex-string
+--ro e-inter-area-prefix
|  +--ro e-inter-prefix-tlvs* []
|     +--ro unknown-tlv
|     |  +--ro type?     uint16
|     |  +--ro length?   uint16
|     |  +--ro value?    yang:hex-string
|     +--ro inter-prefix-tlv
|        +--ro metric?           ospf:ospf-metric
|        +--ro prefix?           inet:ip-prefix
|        +--ro prefix-options
|        |  +--ro prefix-options*   identityref
|        +--ro sub-tlvs* []
|           +--ro unknown-sub-tlv
|              +--ro type?     uint16
|              +--ro length?   uint16
|              +--ro value?    yang:hex-string
+--ro e-inter-area-router
|  +--ro e-inter-router-tlvs* []
|     +--ro unknown-tlv
|     |  +--ro type?     uint16
|     |  +--ro length?   uint16
|     |  +--ro value?    yang:hex-string
|     +--ro inter-router-tlv
|        +--ro lsa-options
|        |  +--ro lsa-options*   identityref
|        +--ro metric?                  ospf:ospf-metric
|        +--ro destination-router-id?   rt-types:router-id
|        +--ro sub-tlvs* []
|           +--ro unknown-sub-tlv
|              +--ro type?     uint16
|              +--ro length?   uint16
|              +--ro value?    yang:hex-string
+--ro e-intra-area-prefix
   +--ro referenced-ls-type?         uint16
   +--ro referenced-link-state-id?   uint32
   +--ro referenced-adv-router?      rt-types:router-id
   +--ro e-intra-prefix-tlvs* []
      +--ro unknown-tlv
      |  +--ro type?     uint16
```

```
        |  +--ro length?   uint16
        |  +--ro value?    yang:hex-string
        +--ro intra-prefix-tlv
           +--ro metric?           ospf:ospf-metric
           +--ro prefix?           inet:ip-prefix
           +--ro prefix-options
           |  +--ro prefix-options*   identityref
           +--ro sub-tlvs* []
              +--ro unknown-sub-tlv
                 +--ro type?     uint16
                 +--ro length?   uint16
                 +--ro value?    yang:hex-string
augment /rt:routing/rt:control-plane-protocols
          /rt:control-plane-protocol/ospf:ospf/ospf:database
          /ospf:as-scope-lsa-type/ospf:as-scope-lsas
          /ospf:as-scope-lsa/ospf:version/ospf:ospfv3/ospf:ospfv3
          /ospf:body:
  +--ro e-as-external
     +--ro e-external-tlvs* []
        +--ro unknown-tlv
        |  +--ro type?     uint16
        |  +--ro length?   uint16
        |  +--ro value?    yang:hex-string
        +--ro external-prefix-tlv
           +--ro flags
           |  +--ro ospfv3-e-external-prefix-bits*   identityref
           +--ro metric?           ospf:ospf-metric
           +--ro prefix?           inet:ip-prefix
           +--ro prefix-options
           |  +--ro prefix-options*   identityref
           +--ro sub-tlvs* []
              +--ro ipv6-fwd-addr-sub-tlv
              |  +--ro forwarding-address?   inet:ipv6-address
              +--ro ipv4-fwd-addr-sub-tlv
              |  +--ro forwarding-address?   inet:ipv4-address
              +--ro route-tag-sub-tlv
              |  +--ro route-tag?   uint32
              +--ro unknown-sub-tlv
                 +--ro type?     uint16
                 +--ro length?   uint16
                 +--ro value?    yang:hex-string
```

4. OSPFv3 Extended LSA Yang Module

The following RFCs and drafts are not referenced in the document text but are referenced in the ietf-ospfv3-extended-lsa.yang module: [RFC6991], [RFC8294].

```
<CODE BEGINS> file "ietf-ospfv3-extended-lsa@2024-02-02.yang"
module ietf-ospfv3-extended-lsa {
  yang-version 1.1;
  namespace "urn:ietf:params:xml:ns:yang:ietf-ospfv3-extended-lsa";
  prefix ospfv3-e-lsa;

  import ietf-routing-types {
    prefix rt-types;
    reference
      "RFC 8294: Common YANG Data Types for the Routing Area";
  }
  import ietf-inet-types {
    prefix inet;
    reference
      "RFC 6991: Common YANG Data Types";
  }
  import ietf-routing {
    prefix rt;
    reference
      "RFC 8349: A YANG Data Model for Routing
       Management (NMDA Version)";
  }
  import ietf-ospf {
    prefix ospf;
    reference
      "RFC 9129: A YANG Data Model for OSPF Protocol";
  }

  organization
    "IETF LSR - Link State Routing Working Group";
  contact
    "WG Web:   <https://datatracker.ietf.org/wg/lsr/>
     WG List:  <mailto:lsr@ietf.org>

     Author:   Acee Lindem
               <mailto:acee.ietf@gmail.com>
     Author:   Sharmila Palani
               <mailto:sharmila.palani@microsoft.com>
     Author:   Yingzhen Qu
               <mailto:yingzhen.ietf@gmail.com>";
  description
    "This YANG module defines the configuration
     and operational state for OSPFv3 Extended LSAs, which is
     common across all of the vendor implementations. The
     semantics and encodings for OSPFv3 Extended LSAs are
     described in RFC 8362. OSPFv3 Extended LSAs provide extensible
     TLV-based LSAs for the base LSA types defined in RFC 5340.

     This YANG model conforms to the Network Management
```

```
   Datastore Architecture (NMDA) as described in RFC 8342.

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   Relating to IETF Documents
   (https://trustee.ietf.org/license-info).

   This version of this YANG module is part of RFC XXXX
   (https://www.rfc-editor.org/info/rfcXXXX); see the RFC itself
   for full legal notices.";

reference
  "RFC XXXX - YANG Model for OSPFv3 Extended LSAs";

revision 2024-02-02 {
  description
    "Initial revision.";
  reference
    "RFC XXXX: YANG Data Model for OSPFv3 Extended LSAs.";
}

/*
 * OSPFv3 Extended LSA Type Identities
 */

identity ospfv3-e-router-lsa {
  base ospf:ospfv3-lsa-type;
  description
    "OSPFv3 Extended Router LSA - Type 0xA021";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4.1";
}

identity ospfv3-e-network-lsa {
  base ospf:ospfv3-lsa-type;
  description
    "OSPFv3 Extended Network LSA - Type 0xA022";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4.2";
}

identity ospfv3-e-summary-lsa-type {
  base ospf:ospfv3-lsa-type;
```

```
  description
    "OSPFv3 Extended Summary LSA types";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4.3 and Section 4.4";
}

identity ospfv3-e-inter-area-prefix-lsa {
  base ospfv3-e-summary-lsa-type;
  description
    "OSPFv3 Extended Inter-area Prefix LSA - Type 0xA023";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4.3";
}

identity ospfv3-e-inter-area-router-lsa {
  base ospfv3-e-summary-lsa-type;
  description
    "OSPFv3 Extended Inter-area Router LSA - Type 0xA024";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4.4";
}

identity ospfv3-e-external-lsa-type {
  base ospf:ospfv3-lsa-type;
  description
    "OSPFv3 Extended External LSA types";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4.5 and Section 4.6";
}

identity ospfv3-e-as-external-lsa {
  base ospfv3-e-external-lsa-type;
  description
    "OSPFv3 Extended AS-External LSA - Type 0xC025";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4.5";
}

identity ospfv3-e-nssa-lsa {
  base ospfv3-e-external-lsa-type;
  description
    "OSPFv3 Extended Not-So-Stubby-Area (NSSA) LSA -
     Type 0xA027";
  reference
```

```
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4.6";
}

identity ospfv3-e-link-lsa {
  base ospf:ospfv3-lsa-type;
  description
    "OSPFv3 Extended Link LSA - Type 0x8028";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4.7";
}

identity ospfv3-e-intra-area-prefix-lsa {
  base ospf:ospfv3-lsa-type;
  description
    "OSPFv3 Extended Intra-area Prefix LSA - Type 0xA029";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4.8";
}

identity ospfv3-e-prefix-option {
  description
    "Base identity for OSPFv3 Prefix Options.";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 3.1";
}

identity nu-bit {
  base ospfv3-e-prefix-option;
  description
    "When set, the prefix should be excluded
     from IPv6 unicast calculations.";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 3.1
     RFC 5340: OSPF for IPv6, Appendix A.4.1.1";
}

identity la-bit {
  base ospfv3-e-prefix-option;
  description
    "When set, the prefix is actually an IPv6 interface
     address of the Advertising Router.";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 3.1
```

```
     RFC 5340: OSPF for IPv6, Appendix A.4.1.1";
}

identity p-bit {
  base ospfv3-e-prefix-option;
  description
    "When set, the NSSA area prefix should be
     translated to an AS External LSA and advertised
     by the translating NSSA Border Router.";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 3.1
     RFC 5340: OSPF for IPv6, Appendix A.4.1.1";
}

identity dn-bit {
  base ospfv3-e-prefix-option;
  description
    "When set, the inter-area-prefix LSA or
     AS-external LSA prefix has been advertised as an
     L3VPN prefix.";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 3.1
     RFC 5340: OSPF for IPv6, Appendix A.4.1.1";
}

identity n-bit {
  base ospfv3-e-prefix-option;
  description
    "When set, the prefix is a host address that identifies
     the advertising router.";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 3.1
     RFC 5340: OSPF for IPv6, Appendix A.4.1.1";
}

identity ospfv3-e-external-prefix-option {
  description
    "Base identity for OSPFv3 External Prefix Options.";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 3.6";
}

identity e-bit {
  base ospfv3-e-external-prefix-option;
  description
```

```
    "When the E-bit is set, the metric specified is a Type 2
     external metric. This means the metric is considered larger
     than any intra-AS path.  When the E-bit is clear, the
     specified metric is a Type 1 external metric.  This means
     that it is expressed in the same units as other LSAs (i.e.,
     the same units as the interface costs in router-LSAs).";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 3.6";
}

grouping unknown-sub-tlv {
  description
    "Unknown TLV grouping";
  container unknown-sub-tlv {
    uses ospf:tlv;
    description
      "Unknown External TLV Sub-TLV";
  }
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 6.3";
}

grouping ospfv3-lsa-prefix {
  description
    "OSPFv3 LSA prefix";
  leaf prefix {
    type inet:ip-prefix;
    description
      "LSA Prefix";
  }
  container prefix-options {
    leaf-list prefix-options {
      type identityref {
        base ospfv3-e-prefix-option;
      }
      description
        "OSPFv3 prefix option flag list. This list will
         contain the identities for the OSPFv3 options
         that are set for the OSPFv3 prefix.";
    }
    description
      "Prefix options.";
    reference
      "RFC 8362:  OSPFv3 Link State Advertisement (LSA)
       Extensibility, Section 3.1";
  }
  reference
```

```
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 3";
}

grouping external-prefix-tlv {
  container external-prefix-tlv {
    description
      "External Prefix LSA TLV";
    container flags {
      leaf-list ospfv3-e-external-prefix-bits {
        type identityref {
          base ospfv3-e-external-prefix-option;
        }
        description
          "OSPFv3 external-prefix TLV bits list.";
      }
      description
        "External Prefix Flags";
    }
    leaf metric {
      type ospf:ospf-metric;
      description
        "External Prefix Metric";
    }
    uses ospfv3-lsa-prefix;
    list sub-tlvs {
      description
        "External Prefix TLV Sub-TLVs";
      container ipv6-fwd-addr-sub-tlv {
        description
          "IPv6 Forwarding address Sub-TLV for E-AS-External and
           E-NSSA LSAs for the IPv6 address family.";
        leaf forwarding-address {
          type inet:ipv6-address;
          description
            "IPv6 Forwarding Address";
        }
        reference
          "RFC 8362: OSPFv3 Link State Advertisement (LSA)
           Extensibility, Section 3.10";
      }
      container ipv4-fwd-addr-sub-tlv {
        description
          "IPv4 Forwarding address Sub-TLV for E-AS-External and
           E-NSSA LSAs for the IPv4 address family.";
        leaf forwarding-address {
          type inet:ipv4-address;
          description
            "IPv4 Forwarding Address";
```

```
        }
        reference
          "RFC 8362: OSPFv3 Link State Advertisement (LSA)
           Extensibility, Section 3.11";
      }
      container route-tag-sub-tlv {
        description
          "Route Tag Sub-TLV";
        leaf route-tag {
          type uint32;
          description
            "Route Tag";
        }
        reference
          "RFC 8362: OSPFv3 Link State Advertisement (LSA)
           Extensibility, Section 3.12";
      }
      uses unknown-sub-tlv;
    }
  }
  description
    "External Prefix TLV Grouping";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 3.6";
}

grouping intra-area-prefix-tlv {
  container intra-prefix-tlv {
    description
      "Intra-Area Prefix LSA TLV";
    leaf metric {
      type ospf:ospf-metric;
      description
        "Intra-Area Prefix Metric";
    }
    uses ospfv3-lsa-prefix;
    list sub-tlvs {
      description
        "Intra-Area Prefix TLV Sub-TLVs";
      uses unknown-sub-tlv;
    }
  }
  description
    "Intra-Area Prefix TLV Grouping";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 3.7";
}
```

```
grouping ipv6-link-local-tlv {
  container ipv6-link-local-tlv {
    description
      "IPv6 Link-Local LSA TLV";
    leaf link-local-address {
      type inet:ipv6-address;
      description
        "IPv6 Link Local address";
    }
    list sub-tlvs {
      description
        "IPv6 Link Local TLV Sub-TLVs";
      uses unknown-sub-tlv;
    }
  }
  description
    "IPv6 Link-Local TLV Grouping";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 3.8";
}

grouping ipv4-link-local-tlv {
  container ipv4-link-local-tlv {
    description
      "IPv4 Link-Local LSA TLV";
    leaf link-local-address {
      type inet:ipv4-address;
      description
        "IPv4 Link Local address";
    }
    list sub-tlvs {
      description
        "IPv4 Link Local TLV Sub-TLVs";
      uses unknown-sub-tlv;
    }
  }
  description
    "IPv4 Link-Local TLV Grouping";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 3.9";
}

/* Configuration */

augment "/rt:routing/rt:control-plane-protocols"
      + "/rt:control-plane-protocol/ospf:ospf" {
```

```
  when "../rt:type = 'ospf:ospfv3'" {
    description
      "This augments the OSPFv3 routing protocol when used.";
  }
  description
    "This augments the OSPFv3 protocol instance-level configuration
     with Extended LSA support. When enabled, OSPFv3 Extended LSAs
     will be advertised and OSPFv3 Legacy LSAs will not be
     advertised. When disabled, OSPFv3 Legacy LSAs will be
     advertised. However, OSPFv3 Extended LSAs could still be
     advertised in Extended LSA Sparse-Mode to support
     incrementally-deployed features as described insection 6.2 of
     RFC 8362.";
  leaf extended-lsa-support {
    type boolean;
    default "false";
    description
      "Enable OSPFv3 Extended LSA Support for the OSPFv3
       domain";
    reference
      "RFC 8362 - OSPFv3 Link State Advertisement (LSA)
       Extensibility, Appendix A - Global Configuration Support";
  }
}

augment "/rt:routing/rt:control-plane-protocols/"
      + "rt:control-plane-protocol/ospf:ospf/ospf:"
      + "areas/ospf:area" {
  when "../../../rt:type = 'ospf:ospfv3'" {
    description
      "This augments the OSPFv3 protocol area-level configuration
       when used.";
  }
  description
    "This augments the OSPFv3 protocol area-level
     configuration with Extended LSA support.";
  leaf extended-lsa-support {
    type boolean;
    must "derived-from(../ospf:area-type,'stub-nssa-area') or "
       + "(current() = 'true') or "
       + "(../../../extended-lsa-support = 'false')" {
      description
        "For regular areas, i.e., areas where AS-scoped LSAs
         are flooded, disabling AreaExtendedLSASupport at the
         area level is prohibited when ExtendedLSASupport is
         enabled at the instance level. AS-External LSAs
         are flooded into all OSPFv3 regular areas  (i.e., not
         a stub or an NSSA area) and disabling support at the
         area level is not possible.";
```

```
    }
    description
      "This augments the OSPFv3 protocol area-level configuration
       with Extended LSA support. When enabled, OSPFv3 Extended
       LSAs will be advertised and OSPFv3 Legacy LSAs will not be
       advertised. When disabled, OSPFv3 Legacy LSAs will be
       advertised. However, OSPFv3 Extended LSAs could still be
       advertised in Extended LSA Sparse-Mode to support
       incrementally-deployed features as described insection
       6.2 of RFC 8362. If not specified, Extended LSA support
       status is inherited from the instance-level configuration.";
    reference
      "RFC 8362: OSPFv3 Link State Advertisement (LSA)
       Extensibility, Appendix B - Area Configuration Support";
  }
}

/*
 * Link State Database (LSDB) Augmentations
 */

augment "/rt:routing/"
      + "rt:control-plane-protocols/rt:control-plane-protocol/"
      + "ospf:ospf/ospf:areas/ospf:area/"
      + "ospf:interfaces/ospf:interface/ospf:database/"
      + "ospf:link-scope-lsa-type/ospf:link-scope-lsas/"
      + "ospf:link-scope-lsa/ospf:version/ospf:ospfv3/"
      + "ospf:ospfv3/ospf:body" {
  when "../../../../../../../../../../../../"
     + "rt:type = 'ospf:ospfv3'" {
    description
      "This augmentation is only valid for OSPFv3.";
  }
  description
    "This augmentation adds OSPFv3 Link-Scoped Extended LSAs
     to the operational state for an interface Link State
     Database (LSDB).";
  container e-link {
    when "../../ospf:header/ospf:type = "
       + "'ospfv3-e-lsa:ospfv3-e-link-lsa'" {
      description
        "Only applies to Extended Link LSAs.";
    }
    description
      "E-Link LSA";
    reference
      "RFC 8362: OSPFv3 Link State Advertisement (LSA)
       Extensibility, Section 4.7";
    leaf rtr-priority {
```

```
      type uint8;
      description
        "Router Priority for the interface.";
    }
    uses ospf:ospfv3-lsa-options;
    list e-link-tlvs {
      description
        "E-Link LSA TLVs";
      container unknown-tlv {
        uses ospf:tlv;
        description
          "Unknown E-Link TLV";
      }
      uses intra-area-prefix-tlv;
      uses ipv6-link-local-tlv;
      uses ipv4-link-local-tlv;
    }
  }
}

augment "/rt:routing/"
      + "rt:control-plane-protocols/rt:control-plane-protocol/"
      + "ospf:ospf/ospf:areas/ospf:area/ospf:database/"
      + "ospf:area-scope-lsa-type/ospf:area-scope-lsas/"
      + "ospf:area-scope-lsa/ospf:version/ospf:ospfv3/"
      + "ospf:ospfv3/ospf:body" {
  when "../../../../../../../../../"
     + "rt:type = 'ospf:ospfv3'" {
    description
      "This augmentation is only valid for OSPFv3.";
  }
  description
    "This augmentation adds OSPFv3 Area-Scoped Extended LSAs
     to the operational state for an area Link State
     Database (LSDB).";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4";
  container e-router {
    when "../../ospf:header/ospf:type = "
       + "'ospfv3-e-lsa:ospfv3-e-router-lsa'" {
      description
        "Only valid for OSPFv3 Extended-Router LSAs";
    }
    description
      "OSPv3 Extended Router LSA";
    reference
      "RFC 8362: OSPFv3 Link State Advertisement (LSA)
       Extensibility, Section 4.1";
```

```
  uses ospf:ospf-router-lsa-bits;
  uses ospf:ospfv3-lsa-options;
  list e-router-tlvs {
    description
      "E-Router LSA TLVs";
    container unknown-tlv {
      uses ospf:tlv;
      description
        "Unknown E-Router TLV";
    }
    container link-tlv {
      description
        "E-Router LSA TLV";
      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 ospf:router-link-type;
        description
          "Link type: 1 - Point-to-Point Link
                      2 - Transit Network Link
                      3 - Stub Network Link Link
                      4 - Virtual Link";
      }
      leaf metric {
        type ospf:ospf-link-metric;
        description
          "Link Metric";
      }
      list sub-tlvs {
        description
          "Link TLV Sub-TLVs";
        uses unknown-sub-tlv;
      }
    }
  }
}
```

```
container e-network {
  when "../../ospf:header/ospf:type = "
     + "'ospfv3-e-lsa:ospfv3-e-network-lsa'" {
    description
      "Only applies to E-Network LSAs.";
  }
  description
    "Extended Network LSA";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4.2";
  uses ospf:ospfv3-lsa-options;
  list e-network-tlvs {
    description
      "E-Network LSA TLVs";
    container unknown-tlv {
      uses ospf:tlv;
      description
        "Unknown E-Network TLV";
    }
    container attached-router-tlv {
      description
        "Attached Router TLV";
      leaf-list adjacent-neighbor-router-id {
        type rt-types:router-id;
        description
          "Adjacent Neighbor's Router ID";
      }
    }
  }
}
container e-nssa {
  when "../../ospf:header/ospf:type = "
     + "'ospfv3-e-lsa:ospfv3-e-nssa-lsa'" {
    description
      "Only applies to E-NSSA LSAs.";
  }
  list e-external-tlvs {
    description
      "E-NSSA LSA TLVs";
    container unknown-tlv {
      uses ospf:tlv;
      description
        "Unknown E-External TLV";
    }
    uses external-prefix-tlv;
  }
  description
    "E-NSSA LSA.";
```

```
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4.6";
}
container e-inter-area-prefix {
  when "../../ospf:header/ospf:type = "
     + "'ospfv3-e-lsa:ospfv3-e-inter-area-prefix-lsa'" {
    description
      "Only applies to E-Inter-Area-Prefix LSAs.";
  }
  description
    "Extended Inter-Area Prefix LSA";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4.3";
  list e-inter-prefix-tlvs {
    description
      "E-Inter-Area-Prefix LSA TLVs";
    container unknown-tlv {
      uses ospf:tlv;
      description
        "Unknown E-Inter-Area-Prefix TLV";
    }
    container inter-prefix-tlv {
      description
        "Unknown E-Inter-Area-Prefix LSA TLV";
      leaf metric {
        type ospf:ospf-metric;
        description
          "Inter-Area Prefix Metric";
      }
      uses ospfv3-lsa-prefix;
      list sub-tlvs {
        description
          "Inter-Area Prefix TLV Sub-TLVs";
        uses unknown-sub-tlv;
      }
    }
  }
}
container e-inter-area-router {
  when "../../ospf:header/ospf:type = "
     + "'ospfv3-e-lsa:ospfv3-e-inter-area-router-lsa'" {
    description
      "Only applies to E-Inter-Area-Router LSAs.";
  }
  description
    "Extended Inter-Area Router LSA";
  reference
```

```
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4.4";
  list e-inter-router-tlvs {
    description
      "E-Inter-Area-Router LSA TLVs";
    container unknown-tlv {
      uses ospf:tlv;
      description
        "Unknown E-Inter-Area-Router TLV";
    }
    container inter-router-tlv {
      description
        "Unknown E-Inter-Area-Router LSA TLV";
      uses ospf:ospfv3-lsa-options;
      leaf metric {
        type ospf:ospf-metric;
        description
          "Inter-Area Router Metric";
      }
      leaf destination-router-id {
        type rt-types:router-id;
        description
          "Destination Router ID";
      }
      list sub-tlvs {
        description
          "Inter-Area Router TLV Sub-TLVs";
        uses unknown-sub-tlv;
      }
    }
  }
}
container e-intra-area-prefix {
  when "../../ospf:header/ospf:type = "
     + "'ospfv3-e-lsa:ospfv3-e-intra-area-prefix-lsa'" {
    description
      "Only applies to E-Intra-Area-Prefix LSAs.";
  }
  description
    "E-Intra-Area-Prefix LSA";
  reference
    "RFC 8362: OSPFv3 Link State Advertisement (LSA)
     Extensibility, Section 4.8";
  leaf referenced-ls-type {
    type uint16;
    description
      "Referenced Link State type";
  }
  leaf referenced-link-state-id {
```

```
      type uint32;
      description
        "Referenced Link State ID";
    }
    leaf referenced-adv-router {
      type rt-types:router-id;
      description
        "Referenced Advertising Router";
    }
    list e-intra-prefix-tlvs {
      description
        "E-Intra-Area-Prefix LSA TLVs";
      container unknown-tlv {
        uses ospf:tlv;
        description
          "Unknown E-Intra-Area-Prefix TLV";
      }
      uses intra-area-prefix-tlv;
    }
  }
}

augment "/rt:routing/"
      + "rt:control-plane-protocols/rt:control-plane-protocol/"
      + "ospf:ospf/ospf:database/"
      + "ospf:as-scope-lsa-type/ospf:as-scope-lsas/"
      + "ospf:as-scope-lsa/ospf:version/ospf:ospfv3/"
      + "ospf:ospfv3/ospf:body" {
  when "../../../../../../../"
     + "rt:type = 'ospf:ospfv3'" {
    description
      "This augmentation is only valid for OSPFv3.";
  }
  description
    "This augmentation adds OSPFv3 AS-Scoped Extended LSAs
     to the operational state for an AS instance-level Link
     State Database (LSDB).";
  container e-as-external {
    when "../../ospf:header/ospf:type = "
       + "'ospfv3-e-lsa:ospfv3-e-as-external-lsa'" {
      description
        "Only applies to E-AS-external LSAs.";
    }
    list e-external-tlvs {
      description
        "E-External LSA TLVs";
      container unknown-tlv {
        uses ospf:tlv;
        description
```

```
            "Unknown E-External TLV";
        }
        uses external-prefix-tlv;
      }
      description
        "E-AS-External LSA.";
      reference
        "RFC 8362: OSPFv3 Link State Advertisement (LSA)
         Extensibility, Section 4.5";
    }
  }
}
<CODE ENDS>
```

5. 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 [RFC8446].

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-ospfv3-extended-lsa.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. There are the subtrees and data nodes and their sensitivity/vulnerability:

```
/ospf:ospf/extended-lsa-support
/ospf:ospf/ospf:areas/ospf:area/extended-lsa-support
```

The ability to disable or enable OSPFv3 Extended LSA support can result in a Denial of Service (DoS) attack since OSPFv3 routers will use solely OSPFv3 Extended LSAs or OSPFv3 Legacy LSAs for the OSPFv3 SPF computation. OSPFv3 routers using different types of LSAs will result in incomplete reachability and possible partioning of the OSPFv3 routing domain. Refer to section 6 of [RFC8362] for more information on OSPFv3 Extended LSA compatibility.

Some of the readable data nodes in the ietf-ospfv3-extended-lsa.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 includes topological information from other routers. This may be undesirable due to the fact that exposure may facilitate other attacks. Additionally, network operators may consider their topologies to be sensitive confidential data.

6. 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-ospfv3-extended-lsa
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-ospfv3-extended-lsa
namespace: urn:ietf:params:xml:ns:yang:ietf-ospfv3-extended-lsa
prefix: ospfv3-e-lsa
reference: RFC XXXX

7. Acknowledgements

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Appendix A. Configuration Example

The following is an XML example using the YANG model for OSPFv3 Extended LSAs.

Note: '\' line wrapping per [RFC8792].

```
<?xml version='1.0' encoding='UTF-8'?>
  <routing xmlns="urn:ietf:params:xml:ns:yang:ietf-routing">
    <router-id>192.0.2.1</router-id>
    <control-plane-protocols>
      <control-plane-protocol>
        <type xmlns:ospf="urn:ietf:params:xml:ns:yang:ietf-ospf">\
        ospf:ospfv3</type>
        <name>"OSPFv3"</name>
        <ospf xmlns="urn:ietf:params:xml:ns:yang:ietf-ospf">
          <extended-lsa-support xmlns="urn:ietf:params:xml:ns:yang:\
            ietf-ospfv3-extended-lsa">true</extended-lsa-support>
        </ospf>
      </control-plane-protocol>
    </control-plane-protocols>
  </routing>
```

The following is the same example using JSON format.

```
{
  "routing": {
    "router-id": "192.0.2.1",
    "control-plane-protocols": {
      "control-plane-protocol": {
        "type": "ospf:ospfv3",
        "name": "\"OSPFv3\"",
        "ospf": {
          "extended-lsa-support": true
        }
      }
    }
  }
}
```

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