

Link LSA (LSA Type 8) and Intra-Area-Prefix (LSA Type 9)

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Introduction

This document describes the two new Link State Advertisement (LSA) types used for Open Shortest Path First (OSPF) v3 with the use of a Cisco router with a simple Designated Router (DR) and Backup Designated Router (BDR) on a FastEthernet segment directly connected in area 1.

Prerequisites

Requirements

Cisco recommends that you have knowledge of these topics:

- OSPFv2
- IPv6

Components Used

The information in this document is based on these software and hardware versions:

- Cisco IOS®
- IOS-XE

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

Background Information

OSPFv3 brings a few changes in the LSA types. How packet OSPFv2 exchanges LSA in order to exchange self originated routes is discussed here. OSPFv2 exchanges IPv4 routes with the help of LSA 1 (Router LSA). This helps to propagate the route. In a broadcast segment it exchanges LSA 2 (Network LSA).

What does the router send when OSPF process needs to exchange IPv6 routes?

In order to fulfil this requirement, two new LSAs are added which help exchange IPv6 routes and these are defined in RFC 5340 : <https://tools.ietf.org/html/rfc5340>

LSAs that are responsible to carry IPv6 Routes:

- LSA Type 8: Link LSA
- Link Local scope: LSA is only flooded on the local link and is further used for the LINK-LSA
- LSA Type 9: Intra-Area LSA
- Area Scope: LSA is only flooded throughout a single OSPF area. Used for router-LSA, Network-LSA, inter-area-prefix-LSA, inter-area-router-LSA and intra-area-prefix-LSA

For example:

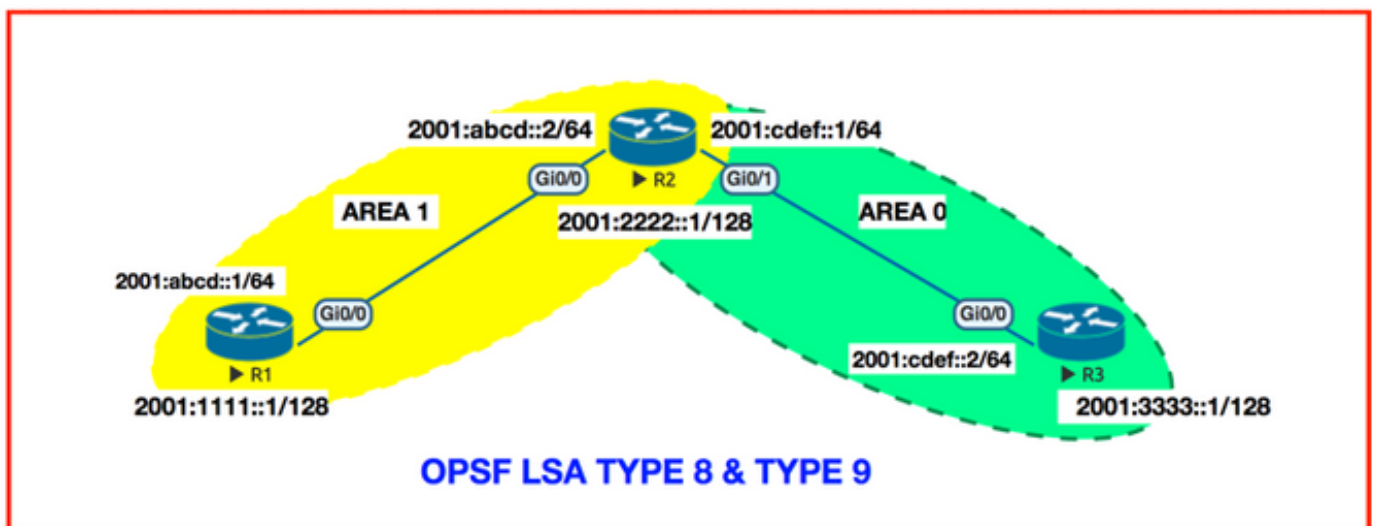
Type-3 summary LSA have been renamed **inter-area-prefix-LSA**

Type-4 summary LSA have been renamed **inter-area-router-LSA**

A new LSA called the intra-area-prefix-LSA has been introduced. This LSA carries all IPv6 prefix information that in IPv4 is included in router LSA and network LSA.

Configure

Network Diagram



Configurations

```
R1#sh running-config | s r o
```

```
router ospfv3 1
```

```
router-id 1.1.1.1

!

address-family ipv6 unicast

    passive-interface Loopback0

exit-address-family

R1#

interface GigabitEthernet0/0

no ip address

duplex auto

speed auto

media-type rj45

ipv6 address 2001:ABCD::1/64

ospfv3 1 ipv6 area 1

end
```

Verify

Use this section in order to confirm that your configuration works properly.

LSA Type 8 - Link LSA

Why do you need Link-LSA?

This advertises the self originating Link Local address to all other routers attached to those links that are similar to Router LSA. It informs the other router in the domain to the link of a list IPv6 prefixes to associate with the link.

Note: Virtual Link should not be able to originate Link-LSA.

How it looks like when in the router:

```
R1#sh ospfv3 database link
```

```
    OSPFv3 1 address-family ipv6 (router-id 1.1.1.1)
```

```
        Link (Type-8) Link States (Area 1)
```

```
LS age: 49
```

```
Options: (V6-Bit, E-Bit, R-Bit, DC-Bit)
```

```
LS Type: Link-LSA (Interface: GigabitEthernet0/0)
```

```
Link State ID: 2 (Interface ID)
```

```
Advertising Router: 1.1.1.1
```

```
LS Seq Number: 80000001
```

```
Checksum: 0xABAA
```

```
Length: 56
```

```
Router Priority: 1
```

```
Link Local Address: FE80::5200:FF:FE01:0
```

```
Number of Prefixes: 1
```

```
Prefix Address: 2001:ABCD::
```

```
Prefix Length: 64, Options: None
```

```
LS age: 129
```

```
Options: (V6-Bit, E-Bit, R-Bit, DC-Bit)
```

```
LS Type: Link-LSA (Interface: GigabitEthernet0/0)
```

```
Link State ID: 2 (Interface ID)
```

```
Advertising Router: 2.2.2.2
```

```
LS Seq Number: 80000001
```

```
Checksum: 0xA1AF
```

```
Length: 56
```

```
Router Priority: 1
```

```
Link Local Address: FE80::5200:FF:FE02:0
```

```
Number of Prefixes: 1
```

```
Prefix Address: 2001:ABCD::
```

```
Prefix Length: 64, Options: None
```

Wireshark Capture:

```

Frame 115: 218 bytes on wire (1744 bits), 218 bytes captured (1744 bits) on interface 0
Ethernet II, Src: 50:00:00:02:00:00 (50:00:00:02:00:00), Dst: 50:00:00:01:00:00 (50:00:00:01:00:00)
Internet Protocol Version 6, Src: fe80::5200:ff:fe02:0, Dst: fe80::5200:ff:fe01:0
Open Shortest Path First
  ▶ OSPF Header
  ▼ LS Update Packet
    Number of LSAs: 3
    ▶ LSA-type 8193 (Router-LSA), len 24
    ▼ LSA-type 8 (Link-LSA), len 56
      .000 0000 0101 0000 = LS Age (seconds): 80
      0... .... .... = Do Not Age: False
      LS Type: Link-LSA (0x0008)
      Link State ID: 0.0.0.2
      Advertising Router: 2.2.2.2
      Sequence Number: 0x80000001
      Checksum: 0xa1af
      Length: 56
      Router Priority: 1
      ▼ Options: 0x000033 (DC, R, E, V6)
        .... .... .0.. .... = AT: Not set
        .... .... ..0. .... = L: Not set
        .... .... ...0 .... = AF: Not set
        .... .... .... ..1. .... = DC: Set
        .... .... .... ...1 .... = R: Set
        .... .... .... ..0... = N: Not set
        .... .... .... .... .0.. = MC: Not set
        .... .... .... .... ..1. = E: Set
        .... .... .... .... ...1 = V6: Set
      Link-local Interface Address: fe80::5200:ff:fe02:0
      # prefixes: 1
      PrefixLength: 64
      ▶ PrefixOptions: 0x00
      Reserved: 0000
      Address Prefix: 2001:abcd::

```

The LSA type of a link-LSA is set to the value 0x0008. Link-LSAs have link local flooding scope. A router originates a separate Link-LSA for each attached link that support two or more routers.

Note: OSPFv3 sends hello and takes the source address as the Link Local Address.

LSA Type 9 - intra-area-prefix LSA

The LS Type of an intra-area-prefix-LSA is set to the value of 0x2009. Intra-area-prefix-LSA have area flooding scope.

What does intra-area-prefix-LSA do?

Before you dig further into this, lets analyze what it is:

```
Frame 115: 218 bytes on wire (1744 bits), 218 bytes captured (1744 bits) on interface 0
Ethernet II, Src: 50:00:00:02:00:00 (50:00:00:02:00:00), Dst: 50:00:00:01:00:00 (50:00:00:01:00:00)
Internet Protocol Version 6, Src: fe80::5200:ff:fe02:0, Dst: fe80::5200:ff:fe01:0
Open Shortest Path First
```

```
▶ OSPF Header
▼ LS Update Packet
  Number of LSAs: 3
  ▶ LSA-type 8193 (Router-LSA), len 24
  ▶ LSA-type 8 (Link-LSA), len 56
  ▼ LSA-type 8201 (Intra-Area-Prefix-LSA), len 64
    .000 0000 0101 0000 = LS Age (seconds): 80
    0... .... .... .... = Do Not Age: False
    LS Type: Intra-Area-Prefix-LSA (0x2009)
    Link State ID: 0.0.0.0
    Advertising Router: 2.2.2.2
    Sequence Number: 0x80000001
    Checksum: 0x0a33
    Length: 64
    # prefixes: 2
    Referenced LS type: Router-LSA (0x2001)
    Referenced Link State ID: 0.0.0.0
    Referenced Advertising Router: 2.2.2.2
    PrefixLength: 128
  ▶ PrefixOptions: 0x02 ((LA) Local Address)
    Metric: 0
    Address Prefix: 2001:222::1
    PrefixLength: 64
  ▶ PrefixOptions: 0x00
    Metric: 1
    Address Prefix: 2001:abcd::
```

It carries the Address Prefix 2001:abcd::/64. It either associates to a list of IPv6 address prefixes with a transit network link by referencing a network LSA or associates a list of IPv6 address with a router by referencing a router LSA. A stub link prefixes is associated with its attached router.

Basically it is a LSA Type 1 and LSA Type 2 as used in IPv4 OSPF in order to advertise the prefixes inside the areas.

R1#sh ospfv3 database

OSPFv3 1 address-family ipv6 (router-id 1.1.1.1)

Router Link States (Area 1)

ADV Router	Age	Seq#	Fragment ID	Link count	Bits
1.1.1.1	1019	0x80000004	0	1	None
2.2.2.2	1065	0x80000005	0	1	None

Net Link States (Area 1)

ADV Router	Age	Seq#	Link ID	Rtr count
2.2.2.2	1065	0x80000004	2	2

Link (Type-8) Link States (Area 1)

ADV Router	Age	Seq#	Link ID	Interface
1.1.1.1	1019	0x80000004	2	Gi0/0
2.2.2.2	1065	0x80000004	2	Gi0/0

Intra Area Prefix Link States (Area 1)

ADV Router	Age	Seq#	Link ID	Ref-lstype	Ref-LSID
2.2.2.2	1065	0x80000005	0	0x2001	0
2.2.2.2	1065	0x80000004	2048	0x2002	2


```
R1#sh ospfv3 database prefix
```

```
OSPFv3 1 address-family ipv6 (router-id 1.1.1.1)
```

```
Intra Area Prefix Link States (Area 1)
```

```
LS age: 1191
```

```
LS Type: Intra-Area-Prefix-LSA
```

```
Link State ID: 0
```

```
Advertising Router: 2.2.2.2
```

```
LS Seq Number: 80000005
```

```
Checksum: 0xA77A
```

```
Length: 52
```

```
Referenced LSA Type: 2001
```

```
Referenced Link State ID: 0
```

```
Referenced Advertising Router: 2.2.2.2
```

```
Number of Prefixes: 1
```

```
Prefix Address: 2001:222::1
```

```
Prefix Length: 128, Options: LA, Metric: 0
```

```
LS age: 1191
```

```
LS Type: Intra-Area-Prefix-LSA
```

```
Link State ID: 2048
```

```
Advertising Router: 2.2.2.2
```

```
LS Seq Number: 80000004
```

```
Checksum: 0x10D
```

```
Length: 44
```

```
Referenced LSA Type: 2002
```

```
Referenced Link State ID: 2
```

```
Referenced Advertising Router: 2.2.2.2
```

```
Number of Prefixes: 1
```

```
Prefix Address: 2001:ABCD::
```

```
Prefix Length: 64, Options: None, Metric: 0
```

Troubleshoot

There is currently no specific troubleshooting information available for this configuration.

Related Information

- <https://tools.ietf.org/html/rfc5340>
- [Technical Support & Documentation - Cisco Systems](#)