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OSPFv2 LSA Extendibility
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Abstract

OSPFv2 requires functional extension beyond what can readily be done with the fixed-format Link State Advertisements (LSAs) as described in RFC 2323. This document defines OSPF opaque LSAs based on Type-Length-Value (TLV) tuples that can be used to associate additional attributes with advertised prefixes or links. The OSPF opaque LSAs are optional and fully backward compatible.

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1. Introduction

OSPFv2 requires functional extension beyond what can readily be done with the fixed-format Link State Advertisements (LSAs) as described in RFC 2328 [OSPFV2]. This document defines OSPF opaque LSAs based on Type-Length-Value (TLV) tuples that can be used to associate additional attributes with advertised prefixes or links. The OSPF opaque LSAs are optional and fully backward compatible. This is in contrast to the approach taken in OSPFv3 [OSPFV3-LSA-EXTEND] where the existing LSAs will be replaced TLV-based extended LSAs.

New requirements such as source/destination routing, route tagging, and segment routing necessitate this extension.

The specfication defines the following OSPFv2 opaque LSAs:

1. OSPFv2 Extended Prefix LSA - Allows advertisement of additional attributes for prefixes advertised in Router-LSAs, Network-LSAs, Network-Summary-LSAs, NSSA-LSAs, and AS-External-LSAs [OSPFV2]

2. OSPFv2 Extended links LSA - Allows advertisement of additional attributes for links advertised in Router-LSAs.

Additionally, the following TLVs are defined:

1. OSPFv2 Extended Prefix TLV - Top level TLV advertising attributes for a prefix in the OSPFv2 Extended Prefix LSA.

2. OSPFv2 Extended Link TLV - Top level TLV advertising attributes for a link in the OSPFv2 Extended link LSA.

1.1. Requirements notation

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC-KEYWORDS].

1.2. Acknowledgments

We would like to thank Anton Smirnov for his contribution.

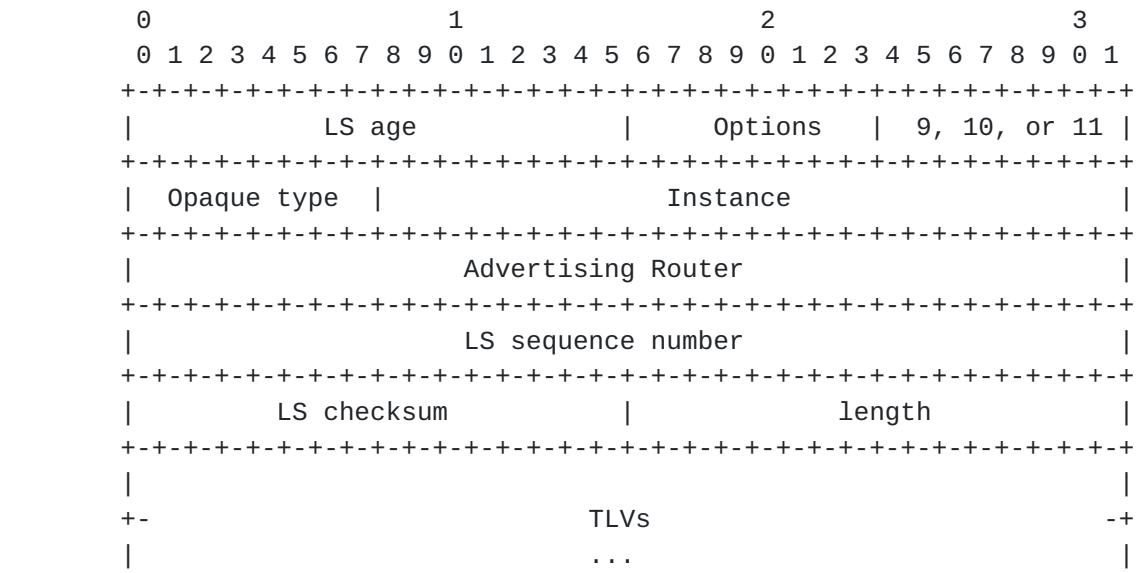
2. OSPFv2 Extended Prefix Opaque LSA

The OSPFv2 Extended Prefix Opaque LSA will be used to advertise additional prefix attributes. Opaque LSAs are described in [OPAQUE].

Multiple OSPFv2 Extended Prefix Opaque LSAs can be advertised by an

OSPFv2 router. The flooding scope of the OSPFv2 Extended Prefix Opaque LSA depends on the scope of the advertised prefixes and is under the control of the advertising router. In some cases (e.g., mapping server deployment), the LSA flooding scope may be greater than the scope of the corresponding prefixes.

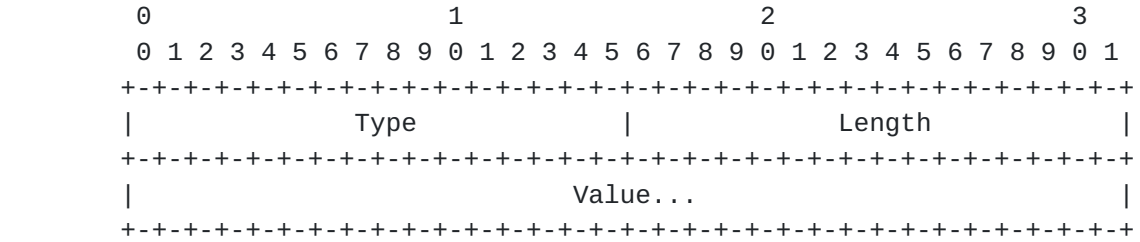
The format of the OSPFv2 Extended Prefix Opaque LSA is as follows:



OSPFv2 Extended Prefix LSA

The opaque type used by OSPFv2 Extended Prefix Opaque LSA is 7.

The format of the TLVs within the body of the OSPFv2 Extended Prefix LSA is the same as the format used by the Traffic Engineering Extensions to OSPF [TE]. The variable TLV section consists of one or more nested Type/Length/Value (TLV) tuples. Nested TLVs are also referred to as sub-TLVs. The format of each TLV is:

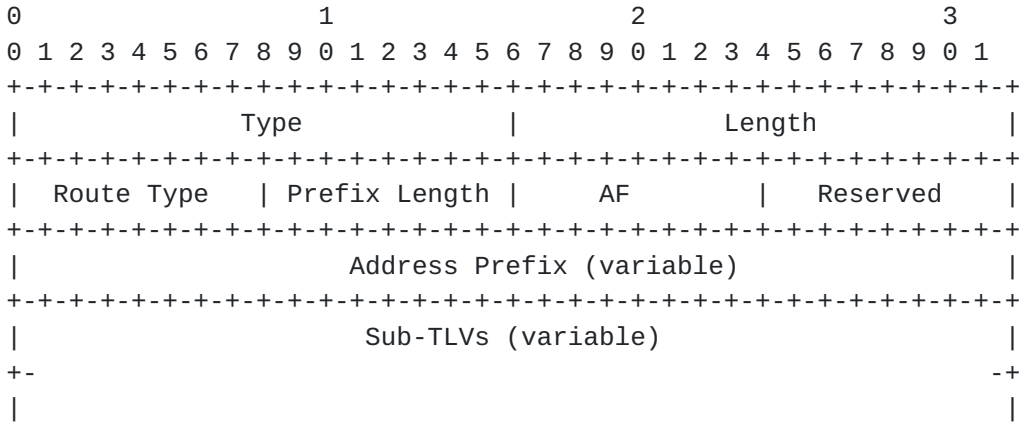


TLV Format

The Length field defines the length of the value portion in octets (thus a TLV with no value portion would have a length of 0). The TLV is padded to 4-octet alignment; padding is not included in the length field (so a 3-octet value would have a length of 3, but the total size of the TLV would be 8 octets). Nested TLVs are also 32-bit aligned. For example, a 1-byte value would have the length field set to 1, and 3 octets of padding would be added to the end of the value portion of the TLV.

2.1. OSPFv2 Extended Prefix TLV

The OSPF Extended Prefix TLV is used in order to advertise additional attributes associated with the prefix. Multiple OSPF Extended Prefix TLVs MAY be advertised in each OSPFv2 Extended Prefix Opaque LSA but all prefixes included in a single OSPFv2 Extended Prefix Opaque LSA MUST have the same flooding scope. The OSPF Extended Prefix TLV has the following format:



OSPFv2 Extended Prefix TLV

Type
The TLV type. Suggested value is 1.

Length
Variable dependent on sub-TLVs.

Route Type
Route type: type of the OSPF route. If the route type is 0 (unspecified), the information inside the OSPF External Prefix TLV applies to the prefix regardless of prefix's route-type. This is useful when prefix specific attributes are advertised by ax

external entity, which is not aware of the route-type associated with the prefix. Supported types are:

0 - unspecified

1 - intra-area

3 - inter-area

5 - external

7 - NSSA external

Prefix Length
Length in of the prefix in bits.

AF
Address family for the prefix. Currently, the only supported value is 0 for IPv4 unicast.

Address Prefix
The prefix itself encoded as an even multiple of 32-bit words, padded with zeroed bits as necessary. This encoding consumes ((PrefixLength + 31) / 32) 32-bit words. The default route is represented by a prefix of length 0.

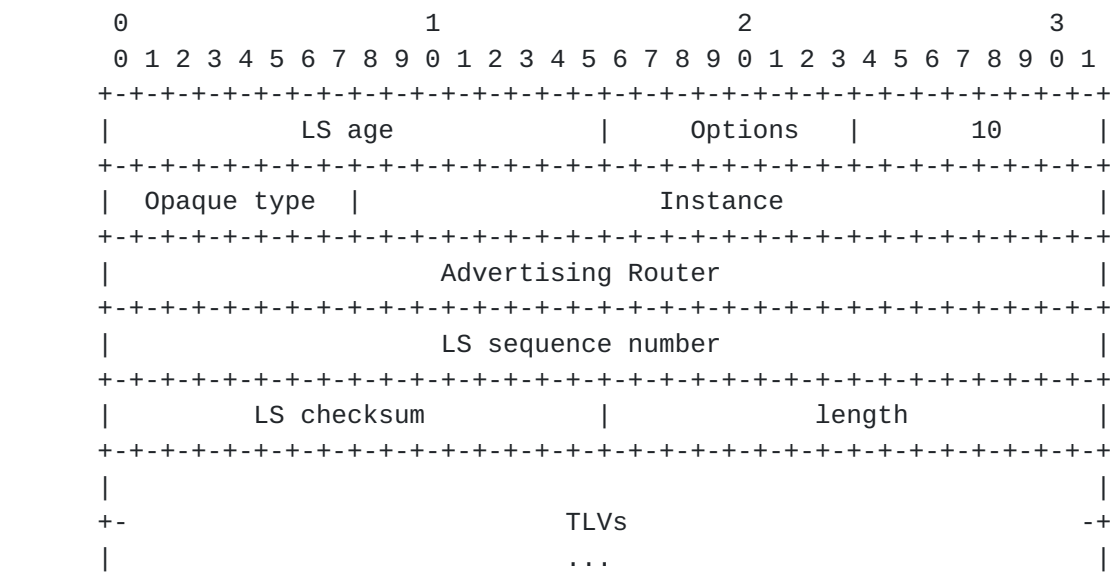
This document creates a registry for OSPF Extended Prefix sub-TLVs in Section 6.

3. OSPFv2 Extended Link Opaque LSA

The OSPFv2 Extended Link Opaque LSA will be used to advertise additional link attributes. Opaque LSAs are described in [OPAQUE].

The OSPFv2 Extended Link Opaque LSA has an area flooding scope. Multiple OSPFv2 Extended Link Opaque LSAs can be advertised by a single router in an area.

The format of the OSPFv2 Extended Link Opaque LSA is as follows:



OSPFv2 Extended Link LSA

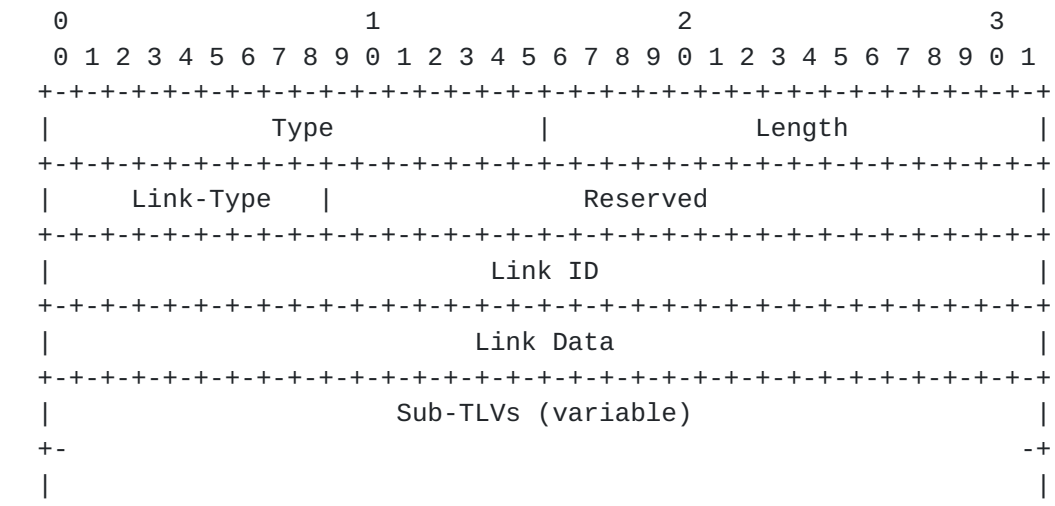
The Opaque type used by OSPFv2 Extended Link Opaque LSA is 8.

The format of the TLVs within the body of the OSPFv2 Extended Prefix LSA is the same as Section 2.

3.1. OSPFv2 Extended Link TLV

OSPFv2 Extended Link TLV is used in order to advertise various attributes of the link. It describes a single link and is constructed of a set of Sub-TLVs. There are no ordering requirements for the Sub-TLVs. Only one Extended Link TLV SHALL be advertised in each Extended Link Opaque LSA, allowing for fine granularity changes in the topology.

The Extended Link TLV has following format:



OSPFv2 Extended Link TLV

Type
The TLV type. Suggested value is 1.

Length
Variable dependent on sub-TLVs.

Link-Type
Link-Type is defined in section A.4.2 of [OSPFV2].

Link-ID
Link-ID is defined in section A.4.2 of [OSPFV2].

Link Data
Link-Data is defined in section A.4.2 of [OSPFV2].

This document creates a registry for OSPF Extended Link sub-TLVs in Section 6.

4. Backward Compatibility

Since opaque OSPFv2 LSAs are optional and backward compatible [OPAQUE], the extensions described herein is fully backward compatible. However, future OSPFv2 extensions utilizing these extensions must address backward compatibility of the corresponding functionality.

5. Security Considerations

In general, new LSAs defined in this document are subject to the same security concerns as those described in [OSPFV2]. Additionally, implementations must assure that malformed TLV and Sub-TLV permutations do not result in errors which cause hard OSPF failures.

6. IANA Considerations

This specification updates the Opaque Link-State Advertisements (LSA) Option Types with the following values:

- 7 (IANA Preallocated) - OSPFv2 Extended Prefix Opaque LSA
- 8 (IANA preallocated) - OSPFv2 Extended Link Opaque LSA

This specification also creates four new registries:

- OSPF Extended Prefix LSA TLVs
- OSPF Extended Prefix TLV Sub-TLVs
- OSPF Extended Link LSA TLVs
- OSPF Extended Link TLV Sub-TLVs

6.1. OSPF Extended Prefix LSA TLV Registry

The OSPF Extend Prefix LSA TLV registry will define top-level TLVs for Extended Prefix LSAs and should be placed in the existing OSPF IANA registry. New values can be allocated via IETF Consensus or IESG Approval.

The following initial values are allocated:

- 0 - Reserved
- 1 - OSPF Extended Prefix TLV

Types in the range 32768-33023 are for experimental use; these will not be registered with IANA, and MUST NOT be mentioned by RFCs.

Types in the range 33023-65535 are not to be assigned at this time. Before any assignments can be made in this range, there MUST be a Standards Track RFC that specifies IANA Considerations that covers the range being assigned.

6.2. OSPF Extended Prefix TLV Sub-TLV Registry

The OSPF Extended Link LSA sub-TLV registry will define will define sub-TLVs at any level of nesting for Extended Link LSAs and should be placed in the existing OSPF IANA registry. New values can be allocated via IETF Consensus or IESG Approval.

The following initial values are allocated:

o 0 - Reserved

Types in the range 32768-33023 are for experimental use; these will not be registered with IANA, and MUST NOT be mentioned by RFCs.

Types in the range 33023-65535 are not to be assigned at this time. Before any assignments can be made in this range, there MUST be a Standards Track RFC that specifies IANA Considerations that covers the range being assigned.

6.3. OSPF Extended Link LSA TLV Registry

The OSPF Extend Link LSA TLV registry will define top-level TLVs for Extended Link LSAs and should be placed in the existing OSPF IANA registry. New values can be allocated via IETF Consensus or IESG Approval.

Following initial values are allocated:

o 0 - Reserved

o 1 - OSPFv2 Extended Link TLV

Types in the range 32768-33023 are for experimental use; these will not be registered with IANA, and MUST NOT be mentioned by RFCs.

Types in the range 33023-65535 are not to be assigned at this time. Before any assignments can be made in this range, there MUST be a Standards Track RFC that specifies IANA Considerations that covers the range being assigned.

6.4. OSPF Extended Link TLV Sub-TLV Registry

The OSPF Extended Link sub-TLV registry will define will define sub-TLVs at any level of nesting for Extended Link LSAs and should be placed in the existing OSPF IANA registry. New values can be allocated via IETF Consensus or IESG Approval.

The following initial values are allocated:

- 0 - Reserved

Types in the range 32768-33023 are for experimental use; these will not be registered with IANA, and MUST NOT be mentioned by RFCs. Types in the range 33023-65535 are not to be assigned at this time. Before any assignments can be made in this range, there MUST be a Standards Track RFC that specifies IANA Considerations that covers the range being assigned.

7. References

7.1. Normative References

[OPAQUE] Berger, L., Bryskin, I., Zinin, A., and R. Coltun, "The OSPF Opaque LSA Option", RFC 5250, July 2008.

[OSPFV2] Moy, J., "OSPF Version 2", RFC 2328, April 1998.

[RFC-KEYWORDS] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", RFC 2119, March 1997.

[TE] Katz, D., Yeung, D., and K. Kompella, "Traffic Engineering Extensions to OSPF", RFC 3630, September 2003.

7.2. Informative References

[OSPFV3-LSA-EXTEND] Lindem, A., Mirtorabi, S., Roy, A., and F. Baker, "OSPFv3 LSA Extendibility", draft-ietf-ospf-multi-instance-02.txt (work in progress).

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