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Extensions to OSPF for Advertising Optional Router Capabilities
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Abstract

It is useful for routers in an OSPFv2 or OSPFv3 routing domain to know the capabilities of their neighbors and other routers in the routing domain. This draft proposes extensions to OSPFv2 and OSPFv3 for advertising optional router capabilities. A new Router Information (RI) Link State Advertisement (LSA) is proposed for this purpose. In OSPFv2, the RI LSA will be implemented with a new opaque LSA type ID. In OSPFv3, the RI LSA will be implemented with a new LSA type function code. In both protocols, the RI LSA can be advertised at any of the defined flooding scopes (link, area, or AS).

Table of Contents

1. Introduction 3
  1.1. Requirements notation 3
2. OSPF Router Information (RI) LSA 4
  2.1. OSPFv2 Router Information (RI) Opaque LSA 4
  2.2. OSPFv3 Router Information (RI) Opaque LSA 5
  2.3. OSPF Router Informational Capabilities TLV 6
  2.4. Assigned OSPF Router Informational Capability Bits 7
  2.5. Flooding Scope of the Router Information LSA 7
3. Router Information LSA Opaque Usage and Applicability 8
4. Security Considerations 9
5. IANA Considerations 10
6. References 12
  6.1. Normative References 12
  6.2. Informative References 12
Appendix A. Acknowledgments 13
Authors' Addresses 14
Intellectual Property and Copyright Statements 15

1. Introduction

It is useful for routers in an OSPFv2 [OSPF] or OSPFv3 [OSPFV3] routing domain to know the capabilities of their neighbors and other routers in the routing domain. This can be useful for both the advertisement and discovery of OSPFv2 and OSPFv3 capabilities. Throughout this document, OSPF will be used when the specification is applicable to both OSPFv2 and OSPFv3. Similarly, OSPFv2 or OSPFv3 will be used when the text is protocol specific.

OSPF uses the options field in LSAs and hello packets to advertise optional router capabilities. In the case of OSPFv2, all the bits in this field have been allocated and there is no way to advertise new optional capabilities. This document proposes extensions to OSPF to advertise these optional capabilities via opaque LSAs in OSPFv2 and new LSAs in OSPFv3. For existing OSPF capabilities, backward compatibility issues dictate that this advertisement is used primarily for informational purposes. For future OSPF features, this advertisement MAY be used as the sole mechanism for advertisement and discovery.

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].

2. OSPF Router Information (RI) LSA

OSPF routers MAY optionally advertise their optional capabilities in a link-scoped, area-scoped, or AS-scoped LSA. For existing OSPF capabilities, this advertisement will be used primarily for informational purposes. Future OSPF features could use the RI LSA as the sole mechanism for advertisement and discovery. The RI LSA will be originated initially when an OSPF router instance is created and whenever one of the advertised capabilities is configured or changed.

2.1. OSPFv2 Router Information (RI) Opaque LSA

OSPFv2 routers will advertise a link scoped, area-scoped, or AS-scoped Opaque-LSA [OPAQUE]. The OSPFv2 Router Information LSA has an Opaque type of 4 and Opaque ID of 0.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            LS age             |     Options   |  9, 10 or 11  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|       4       |                    0                          |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      Advertising Router                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                      LS sequence number                       |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         LS checksum           |             length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+-                            TLVs                             -+
|                             ...                               |
```

OSPFv2 Router Information Opaque LSA

The format of the TLVs within the body of an RI LSA is the same as the format used by the Traffic Engineering Extensions to OSPF [TE]. The LSA payload consists of one or more nested Type/Length/Value (TLV) triplets. The format of each TLV is:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              Type             |             Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                            Value...                           |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

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 zero). The TLV is padded to four-octet alignment; padding is not included in the length field (so a three octet value would have a length of three, but the total size of the TLV would be eight octets). Nested TLVs are also 32-bit aligned. For example, a one-byte value would have the length field set to 1, and three octets of padding would be added to the end of the value portion of the TLV. Unrecognized types are ignored.

2.2. OSPFv3 Router Information (RI) Opaque LSA

The OSPFv3 Router Information LSA has a function code of 12 while the S1/S2 bit are dependent on the desired flooding scope for the LSA. The U bit will be set indicating the OSPFv3 RI LSA should be flooded even if it is not understood. The Link State ID (LSID) value for this LSA is 0. This is unambiguous since an OSPFv3 router will only advertise a single RI LSA per flooding scope.

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|            LS age             |1|S12|          12             |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                          0  (Link State ID)                   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     Advertising Router                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                     LS sequence number                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|        LS checksum            |             Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+-                            TLVs                             -+
|                            ...                                |
```

OSPFv3 Router Information LSA

The format of the TLVs within the body of an RI LSA as defined in Section 2.1

When a new Router Information LSA TLV is defined, the specification MUST explicitly state whether the TLV is applicable to OSPFv2 only, OSPFv3 only, or both OSPFv2 and OSPFv3.

2.3. OSPF Router Informational Capabilities TLV

The first defined TLV in the body of an RI LSA is the Router Informational Capabilities TLV. A router advertising an RI LSA MAY include the Router Informational Capabilities TLV. If included, it MUST be the first TLV in the LSA. Additionally, the TLV MUST accurately reflect the OSPF router's capabilities in the scope advertised. However, the informational capabilities advertised have no impact on the OSPFs operation - they are advertised purely for informational purposes

The format of the Router Informational Capabilities TLV is as follows:

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|              Type             |             Length            |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|             Informational Capabilities                        |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Type A 16-bit field set to 1.

Length A 16-bit field that indicates the length of the value portion in octets and will be a multiple of 4 octets dependent on the number of capabilities advertised. Initially, the length will be 4 denoting 4 octets of informational capability bits.

Value A variable length sequence of capability bits rounded to a multiple of 4 octets padded with undefined bits. Initially, there are 4 octets of capability bits. Bits are numbered left-to-right starting with the most significant bit being bit zero.

OSPF Router Informational Capabilities TLV

The Router Informational Capabilities TLV MAY be followed by optional TLVs that further specify a capability.

2.4. Assigned OSPF Router Informational Capability Bits

The following informational capability bits assigned:

Bit	Capabilities
0	OSPF graceful restart capable [GRACE]
1	OSPF graceful restart helper [GRACE]
2	OSPF Stub Router support [STUB]
3	OSPF Traffic Engineering support [TE]
4	OSPF point-to-point over LAN [P2PLAN]
5	OSPF Experimental TE [EXP-TE]
6-31	Future assignments

OSPF Router Informational Capabilities Bits

2.5. Flooding Scope of the Router Information LSA

The flooding scope for a Router Information LSA is determined by the LSA type. For OSPFv2, type 9 (link-scoped), type 10 (area-scoped), or a type 11 (AS-scoped) opaque LSA may be flooded. For OSPFv3, the S1 and S2 bits in the LSA type determine flooding scope. If AS wide flooding scope is chosen, the originating router should also advertise area scoped LSA(s) into any attached NSSA area(s). An OSPF router MAY advertise different capabilities when both NSSA area scoped LSA(s) and an AS scoped LSA are advertised. This allows functional capabilities to be limited in scope. For example, a router may be an area border router but only support traffic engineering (TE) in a subset of its attached areas.

The choice of flooding scope is made by the advertising router and is a matter of local policy. The originating router MAY advertise multiple RI LSAs as long as the flooding scopes differ. TLV flooding scope rules will be specified on a per-TLV basis and MUST be specified in the accompanying specifications for new Router Information LSA TLVs.

3. Router Information LSA Opaque Usage and Applicability

The purpose of the Router Information (RI) LSA is to advertise information relating to the aggregate OSPF router. Normally, this should be confined to TLVs with a single value or very few values. It is not meant to be a generic container to carry any and all information. The intent is to both limit the size of the RI LSA to the point where an OSPF router will always be able to contain the TLVs in a single LSA and to keep the task of determining what has changed between LSA instances reasonably simple. Hence, discretion and sound engineering judgment will need to be applied when deciding whether newly proposed TLV(s) in support of a new application are advertised in the RI LSA or warrant the creation of an application specific LSA.

4. Security Considerations

This document describes both a generic mechanism for advertising router capabilities and a TLV for advertising informational capability bits. The latter TLV is less critical than the topology information currently advertised by the base OSPF protocol. The security considerations for the generic mechanism are dependent on the future application and, as such, should be described as additional capabilities are proposed for advertisement. Security considerations for the base OSPF protocol are covered in [OSPF] and [OSPFV3].

5. IANA Considerations

The following IANA assignments are to be made from existing registries:

1. The OSPFv2 opaque LSA type 4 will need to be reserved for the OSPFv2 RI opaque LSA.

New registries will need to be defined for the following purposes:

1. Registry for OSPFv3 LSA Function Codes - This new top-level registry will be comprised of the fields Value, LSA function code name, and Document Reference. The OSPFv3 LSA function code is defined in section A.4.2.1 of [OSPFV3]. The OSPFv3 LSA function code 12 will need to be reserved for the OSPFv3 Router Information (RI) LSA.

Range	Assignment Policy
0	Not to be assigned
1-9	Already assigned
10-255	Standards Action
256-8175	Reserved
8176-8183	Experimentation
8184-8191	Vendor Private Use

OSPFv3 LSA Function Codes

* OSPFv3 LSA function codes in the range 256-8175 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.

* OSPFv3 LSA function codes in the range 8176-8181 are for experimental use; these will not be registered with IANA and MUST NOT be mentioned by RFCs.

* OSPFv3 LSAs with an LSA Function Code in the Vendor Private Use range 8184-8191 MUST include the Vendor Enterprise Code as the first four octets following the 20 octets of LSA header.

* If a new LSA Function Code is documented, the documentation MUST include the valid combinations of the U, S2 and S1 bits for the LSA. It SHOULD also describe how the Link State ID is to be assigned.

2. Registry for OSPF RI TLVs - This top-level registry will be comprised of the fields Value, TLV Name, and Document Reference. The value of 1 for the capabilities TLV is defined herein.

Range	Assignment Policy
0	Not to be assigned
1	Already assigned
2-32767	Standards Action
32768-32777	Experimentation
32778-65535	Reserved

OSPF RI TLVs

* Types in the range 32768-32777 are for experimental use; these will not be registered with IANA and MUST NOT be mentioned by RFCs.

* Types in the range 32778-65535 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.

3. Registry for OSPF Router Informational Capability Bits - This sub-registry of the OSPF RI TLV registry will be comprised of the fields Bit Number, Capability Name, and Document Reference. The values are defined in Section 2.3. All Router Informational Capability TLV additions are to be assigned through standards action.

6. References

6.1. Normative References

[OPAQUE] Coltun, R., "The OSPF Opaque LSA Option", RFC 2370, July 1998.

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

[OSPFV3] Coltun, R., Ferguson, D., and J. Moy, "OSPF for IPv6", RFC 2740, December 1999.

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

6.2. Informative References

[EXP-TE] Srisuresh, P. and P. Joseph, "OSPF OSPF-TE: An experimental extension to OSPF for Traffic Engineering", draft-srisuresh-ospf-te-07.txt (work in progress).

[GRACE] Moy, J., Pillay-Esnault, P., and A. Lindem, "Graceful OSPF Restart", RFC 3623, November 2003.

[P2PLAN] Shen, N. and A. Zinin, "Point-to-point operation over LAN in link-state routing protocols", draft-ietf-isis-igp-p2p-over-lan-05.txt (work in progress).

[STUB] Retana, A., Nguyen, L., White, R., Zinin, A., and D. McPherson, "OSPF Stub Router Advertisement", RFC 3137, June 2001.

Appendix A. Acknowledgments

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