Network Working Group
Request for Comments: 5187
Category: Standards Track

P. Pillay-Esnault
Cisco Systems
A. Lindem
Redback Networks

June 2008

OSPFv3 Graceful Restart

Status of This Memo

Abstract

This document describes the OSPFv3 graceful restart. The OSPFv3 graceful restart is identical to that of OSPFv2 except for the differences described in this document. These differences include the format of the grace Link State Advertisements (LSAs) and other considerations.

Table of Contents

1. Introduction 2
2. Grace Link State Advertisement 2
   2.1. Grace LSA - LS Type 2
   2.2. Grace LSA Format 3
3. Additional Considerations for OSPFv3 Graceful Restart 4
   3.1. Preservation of LSA ID to Prefix Correspondence 4
   3.2. Preservation of Interface IDs for Link-LSAs, Network-LSAs, and Router-LSAs 4
4. Security Considerations 5
5. IANA Considerations 5
6. Acknowledgments 5
7. References 5
   7.1. Normative References 5
   7.2. Informative References 6

1. Introduction

Graceful OSPF restart [GRACE] describes a mechanism to restart the control plane of an OSPFv2 [OSPFv2] router that still has its forwarding plane intact with a minimum of disruption to the network.

In general, the methods described in [GRACE] work for OSPFv3 [OSPFv3] as well. However, OSPFv3 will use a grace-LSA with a different format to signal that a router is initiating (or is about to initiate) a graceful restart. This document describes other OSPFv3 differences as well.

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 [RFC2119].

2. Grace Link State Advertisement

An OSPFv3 router initiating a graceful restart of its OSPFv3 software originates grace-LSAs. A grace-LSA requests that the router's neighbors aid in its graceful restart by continuing to advertise the router as fully adjacent during the specified grace period. The grace-LSA contains the restarting router grace-period and the reason code indicating the reason for the graceful restart.

In OSPFv3 (refer to section 2.11 of [OSPFv3]), neighboring routers on any link are always identified by their router IDs. This contrasts with the OSPFv2 behavior where neighbors on point-to-point networks and virtual links are identified by their Router IDs, while neighbors on broadcast, Non-Broadcast Multi-Access (NBMA), and point-to-multipoint links are identified by their IPv4 interface addresses. Consequently, there is no requirement for the router-address TLV [GRACE] for OSPFv3 graceful restart.

The TLV formats of the grace-LSA described in [GRACE] remain unchanged.

2.1. Grace LSA - LS Type

A grace-LSA is defined as an LSA with the LS type equal to 0x000b.

LSA function code	LS Type	Description
11	0x000b	GRACE-LSA

Grace-LSA Type and Function Code

The S2-bit and S1-bit are set to 0 to indicate link-local flooding scope. The U-bit is set to 0 since it isn’t applicable to LSAs with link-local flooding scope.

2.2. Grace LSA Format

The format of a grace LSA 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
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |           LS age              |0|0|0|          11             |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                       Link State ID                           |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                    Advertising Router                         |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                    LS sequence number                         |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |        LS checksum            |             Length            |
   +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
   |                                                               |
   +-                            TLVs                             -+
   |                             ...                               |
```

Grace-LSA Format

The Link State ID of a grace-LSA in OSPFv3 is the Interface ID of the interface originating the LSA.

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

Grace-LSA TLVs are formatted according to section 2.3.2 of [OSPF-TE].

The following is the list of TLVs that can appear in the body of a grace-LSA.

Grace Period (Type=1, Length=4). The number of seconds that the router's neighbors should continue to advertise the router as fully adjacent, regardless of the state of database synchronization between the router and its neighbors. This TLV MUST always appear in a grace-LSA.

Graceful restart reason (Type=2, Length=1). Encodes the reason for the router restart, as one of the following: 0 (unknown), 1 (software restart), 2 (software reload/upgrade), or 3 (switch to redundant control processor). This TLV MUST always appear in a grace-LSA.

3. Additional Considerations for OSPFv3 Graceful Restart

This section describes OSPFv3 unique considerations in addition to those described in [GRACE].

3.1. Preservation of LSA ID to Prefix Correspondence

In OSPFv2, there is a direct correspondence between summary and external LSA IDs and the prefixes being advertised. However, in OSPFv3, the LSA ID for inter-area prefix LSAs and external LSAs is simply an unsigned 32-bit integer. Hence, to avoid network churn during graceful restart, the restarting router MUST preserve the LSA ID to prefix correspondence across graceful restarts.

3.2. Preservation of Interface IDs for Link-LSAs, Network-LSAs, and Router-LSAs

In OSPFv3, the LSA ID for Link-LSAs and Network-LSAs and link descriptions in Router-LSAs map to their corresponding Interface ID. Changes in the Interface ID during graceful restart will result in a mismatch between the restarting router's pre-restart LSAs and its neighbor adjacency state. These disparities will cause the graceful restart to terminate prematurely.

Synchronizing Interface ID changes between neighbors is possible. However, placing the burden on the restarting router to preserve Interface IDs across restarts provides for a more robust, more deterministic, and simpler mechanism. Therefore, the OSPFv3 Interface ID, as described in section 3.1.2 of [OSPFv3], MUST be preserved by the restarting router across restarts.

Many implementations currently use the interface's MIB-II IfIndex [MIB-INTF] for Interface ID. The persistence of Interface ID across reboots is described in section 3.1.5 of [MIB-PERS].

4. Security Considerations

[OSPFv3-AUTH] relies on manual key distribution which precludes the use of replay protection that utilizes sequence numbers. The replay of an OSPF Link-Update containing a grace-LSA would allow an attacker to deceive neighboring routers into believing that a router that has been taken out of service (either intentionally or via a malicious action by the same attacker) is still active and is in the process of graceful restart. However, this attack is much more difficult than the obvious replay of standard OSPFv3 hello packets to accomplish the same thing by keeping the adjacency up. Since hello packets are sent more predictably and knowledge of the key is not required, the risk added by OSPFv3 graceful restart is insignificant. Hence, this document does not raise any new security concerns other than those covered in [OSPFv3], [OSPFv3-AUTH], and [GRACE].

5. IANA Considerations

A new LSA function code has been assigned for the OSPFv3 grace-LSA. The assignment of 0x000b has been made in the "OSPFv3 LSA Function Codes" sub-registry of the "Open Shortest Path First v3 (OSPFv3) Parameters" registry. OSPFv3 grace-LSA TLVs and sub-TLVs use the "OSPFv2 Grace LSA Top Level TLV" IANA sub-registry of the "Open Shortest Path First v2 (OSPFv2) Parameters" registry.

6. Acknowledgments

Many thanks to Kireeti Kompella, Les Ginsberg, and David Ward with whom much of this was discussed. The authors also wish to thank Kunihiro Ishiguro and Vivek Dubey for their comments.

This document was produced using Marshall Rose's xml2rfc tool.

7. References

7.1. Normative References

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

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

[OSPFv2] Moy, J., "OSPF Version 2", STD 54, RFC 2328, April 1998.

[OSPFv3] Moy, J., Ferguson, D., and R. Coltun, "OSPF for IPv6", RFC 2740, March 1997.

[RFC2119] Bradner, S., "Key words for use in RFC's to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

7.2. Informative References

[MIB-INTF] McCloghrie, K. and M. Rose, "Management Information Base for network management of TCP/IP-based internets: MIB-II", STD 17, RFC 1213, March 1991.

[MIB-PERS] McCloghrie, K. and F. Kastenholz, "The Interfaces Group MIB", RFC 2863, June 2000.

[OSPFv3-AUTH] Gupta, M. and N. Melam, "Authentication/ Confidentiality for OSPFv3", RFC 4552, June 2006.

Authors' Addresses

Padma Pillay-Esnault
Cisco Systems
3750 Cisco Way
San Jose, CA 95134
USA

EMail: ppe@cisco.com

Acee Lindem
Redback Networks
102 Carric Bend Court
Cary, NC 27519
USA

EMail: acee@redback.com