

Internet Engineering Task Force (IETF)
Request for Comments: 6823
Category: Standards Track
ISSN: 2070-1721

L. Ginsberg
S. Previdi
M. Shand
Cisco Systems
December 2010

Advertising Generic Information in IS-IS

Abstract

This document describes the manner in which generic application information (i.e., information not directly related to the operation of the Intermediate System to Intermediate System (IS-IS) protocol) should be advertised in IS-IS Link State Protocol Data Units (LSPs) and defines guidelines that should be used when flooding such information.

Status of This Memo

This is an Internet Standards Track document.

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Table of Contents

1. Overview	2
2. Conventions Used in This Document	3
3. Encoding Format for GENINFO	3
3.1. GENINFO TLV	3
3.2. Use of Sub-TLVs in GENINFO TLV	5
4. GENINFO Flooding Procedures	5
4.1. Leaking Procedures	6
4.2. Minimizing Update Confusion	7
4.3. Interpreting Attribute Information	7
5. Use of a Separate Protocol Instance	7
6. Applicability of GENINFO TLV	8
7. Standardization Requirements	8
8. Security Considerations	9
9. IANA Considerations	9
10. Acknowledgements	9
11. Normative References	10

1. Overview

[ISO10589] defines the format of Type-Length-Values (TLVs) that may be sent in IS-IS Protocol Data Units (PDUs). The first octet of a TLV encodes the "type" or "codepoint" that provides a scope for the information and information format that follows. The protocol is therefore limited to 256 different codepoints that may be assigned. This number has proved generous as regards the information required for correct operation of the IS-IS protocol. However, the increasing use of IS-IS Link State Protocol Data Units (LSPs) for advertisement of generic information (GENINFO) not directly related to the operation of the IS-IS protocol places additional demands on the TLV encoding space that have the potential to consume a significant number of TLV codepoints. This document therefore defines an encoding format for GENINFO that minimizes the consumption of TLV codepoints and also maximizes the flexibility of the formats that can be used to represent GENINFO.

This document also discusses optimal behavior associated with the advertisement and flooding of LSPs containing GENINFO in order to avoid the advertisement of stale information and minimize the presence of duplicate or conflicting information when advertisements are updated.

The manner in which the information contained in GENINFO TLVs is exchanged between an instance of the IS-IS protocol and the application that generates or consumes the GENINFO is outside the scope of this specification.

In order to minimize the impact that advertisement of GENINFO may have on the operation of routing, such advertisements MUST occur in the context of a non-zero instance of the IS-IS protocol as defined in [RFC6822] except where the rules for the use of the zero instance set out later in this document are followed.

2. Conventions Used in This Document

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].

3. Encoding Format for GENINFO

The encoding format defined below has the following goals regarding the advertisement of GENINFO in IS-IS LSPs:

- o Minimize the number of IS-IS top level and sub-TLV codepoints required
- o Minimize the depth of sub-TLV levels required

In order to support these goals, a new IANA registry has been created. This registry manages the assignment of IS-IS GENINFO Application Identifiers. These numbers are unsigned 16-bit numbers ranging in value from 1 to 65535. Application-specific sub-TLV codepoints are unsigned 8-bit numbers ranging in value from 0 to 255. The assignment of the sub-TLV codepoints is scoped by the Application Identifier. Management of the application specific sub-TLV codepoints is outside the scope of this document.

3.1. GENINFO TLV

The GENINFO TLV supports the advertisement of application-specific information that is not directly related to the operation of the IS-IS protocol.

Type: 251

Length: Number of octets in the value field (3 to 255)

Value:

	No. of octets
+-----+ Flags	1
+-----+ Application ID	2
+-----+ Application IP Address Info	0 to 20
+-----+ Additional Application- Specific Information	0 to (252 - len of IP Address info)
+-----+	

Flags

```

      0 1 2 3 4 5 6 7
    +-----+
    | Rsvd |V|I|D|S|
    +-----+

```

The following bit flags are defined.

S bit (0x01): If the S bit is set (1), the GENINFO TLV MUST be flooded across the entire routing domain. If the S bit is not set (0), the TLV MUST NOT be leaked between levels. This bit MUST NOT be altered during the TLV leaking.

D bit (0x02): When the GENINFO TLV is leaked from Level-2 to Level-1, the D bit MUST be set. Otherwise, this bit MUST be clear. GENINFO TLVs with the D bit set MUST NOT be leaked from Level-1 to Level-2. This is to prevent TLV looping.

I bit (0x04): When the I bit is set, the 4-octet IPv4 address associated with the application immediately follows the Application ID.

V bit (0x08): When the V bit is set, the 16-octet IPv6 address associated with the application immediately follows either the Application ID (if I bit is clear) or the IPv4 address (if I bit is set).

Application ID

An identifier assigned to this application via the IANA registry defined later in this document.

Application IPv4 Address Info

The IPv4 address associated with the application. This is not necessarily an address of a router running the IS-IS protocol.

Application IPv6 Address Info

The IPv6 address associated with the application. This is not necessarily an address of a router running the IS-IS protocol.

Additional Application-Specific Information

Each application may define additional information to be encoded in a GENINFO TLV following the fixed information. Definition of such information is beyond the scope of this document.

3.2. Use of Sub-TLVs in GENINFO TLV

[RFC5305] introduced the definition and use of sub-TLVs. One of the advantages of using sub-TLVs rather than fixed encoding of information inside a TLV is to allow for the addition of new information in a backwards compatible manner, i.e., just as with TLVs, implementations are required to ignore sub-TLVs that they do not understand.

GENINFO TLVs MAY include sub-TLVs in the application specific information as deemed necessary and appropriate for each application. The scope of the codepoints used in such sub-TLVs is defined by the combination of the GENINFO TLV codepoint and the Application ID, i.e., the sub-TLV codepoints are private to the application. Such sub-TLVs are referred to as APPsub-TLVs.

Additional levels of APPsub-TLVs may be required when there is variable information that is scoped by a specific APPsub-TLV. These "nested" sub-TLVs MUST be encoded in the same manner as sub-TLVs, i.e., with a one-octet Type field, a one-octet Length field, and zero or more octets of Value.

4. GENINFO Flooding Procedures

This section describes procedures that apply to the propagation of LSPs that contain GENINFO TLVs. These procedures have been previously discussed in [RFC4971]. This section is intended to serve as a reference specification for future documents that define the use of GENINFO TLV(s) for a specific application -- eliminating the need to repeat the definition of these procedures in the application-specific documents.

Each GENINFO TLV contains information regarding exactly one application instance as identified by the Application ID in the GENINFO TLV. When it is necessary to advertise sets of information

with the same Application ID that have different flooding scopes, a router MUST originate a minimum of one GENINFO TLV for each required flooding scope. GENINFO TLVs that contain information having area/level scope will have the S bit clear. These TLVs MUST NOT be leaked into another level. GENINFO TLVs that contain information that has domain scope will have the S bit set. These TLVs MUST be leaked into other IS-IS levels. When a TLV is leaked from Level-2 to Level-1, the D bit MUST be set in the Level-1 LSP advertisement.

4.1. Leaking Procedures

When leaking GENINFO TLVs downward from Level-2 into Level-1, if the originator of the TLV is a Level-1 router in another area, it is possible that multiple copies of the same TLV may be received from multiple L2 routers in the originating area. A router performing downward leaking MUST check for such duplication by comparing the contents of the TLVs. The set of LSPs generated by a router for a given level MUST NOT contain two or more copies of the same GENINFO TLV.

In order to prevent the use of stale GENINFO information, a system MUST NOT use a GENINFO TLV present in an LSP of a system that is not currently reachable via Level-x paths, where "x" is the level (1 or 2) associated with the LSP in which the GENINFO TLV appears. Note that leaking a GENINFO TLV is one of the uses that is prohibited under these conditions. The following example illustrates what might occur in the absence of this restriction.

Example: If Level-1 router A generates a GENINFO TLV and floods it to two L1/L2 routers S and T, they will flood it into the Level-2 sub-domain. Now suppose the Level-1 area partitions, such that A and S are in one partition and T is in another. IP routing will still continue to work, but if A now issues a revised version of the GENINFO TLV, or decides to stop advertising it, S will follow suit, but T will continue to advertise the old version until the LSP times out.

Routers in other areas have to choose whether to trust T's copy of A's GENINFO TLV or S's copy of A's information and they have no reliable way to choose. By making sure that T stops leaking A's information, this removes the possibility that other routers will use stale information from A.

4.2. Minimizing Update Confusion

If an update to a TLV is advertised in an LSP with a different number than the LSP associated with the old advertisement, the possibility exists that other systems can temporarily have either 0 copies of a particular advertisement or 2 copies of a particular advertisement, depending on the order in which new copies of the LSP that had the old advertisement and the LSP that has the new advertisement arrive at other systems.

Whenever possible, an implementation SHOULD advertise the update to a GENINFO TLV in the LSP with the same number as the advertisement that it replaces. Where this is not possible, the two affected LSPs SHOULD be flooded as an atomic action.

Systems that receive an update to an existing GENINFO TLV can minimize the potential disruption associated with the update by employing a hold-down time prior to processing the update so as to allow for the receipt of multiple LSPs associated with the same update prior to beginning processing.

4.3. Interpreting Attribute Information

Where a receiving system has two copies of a GENINFO TLV with the same Application ID, attribute information in the two TLVs that does not conflict MUST be considered additive. When information in the two GENINFO TLVs conflicts, i.e., there are different settings for a given attribute, the procedure used to choose which copy shall be used is undefined.

5. Use of a Separate Protocol Instance

The use of the IS-IS flooding mechanism as a means of reliably and efficiently propagating information is understandably attractive. However, it is prudent to remember that the primary purpose of that mechanism is to flood information necessary for the correct operation of the IS-IS protocol. Flooding of information not directly related to the use of the IS-IS protocol in support of routing degrades the operation of the protocol. Degradation occurs because the frequency of LSP updates is increased and because the processing of non-routing information in each router consumes resources whose primary responsibility is to efficiently respond to reachability changes in the network.

Advertisement of GENINFO therefore MUST occur in the context of a non-zero instance of the IS-IS protocol as defined in [RFC6822] except when the use in the zero instance is defined in a Standards Track RFC.

The use of a separate instance of the protocol allows both the flooding and the processing of the non-routing information to be decoupled from the information necessary to support correct routing of data in the network. The flooding and processing of non-routing information can then be prioritized appropriately.

Use of a separate protocol instance to advertise GENINFO does not eliminate the need to use prudence in the frequency with which such information is updated. One of the most egregious oversights is a failure to appropriately dampen changes in the information to be advertised; this can lead to flooding storms. Documents that specify the use of the mechanisms defined here MUST define the expected rate of change of the information to be advertised.

If desirable, independent control of the flooding scope for information related to two different applications can be achieved by utilizing separate non-zero protocol instances for each application [RFC6822].

6. Applicability of GENINFO TLV

The GENINFO TLV supports the advertisement of application-specific information in IS-IS LSPs that is not directly related to the operation of the IS-IS protocol. Information advertised in the GENINFO TLV MUST NOT alter basic IS-IS protocol operation including (but not limited to) the establishment of adjacencies, the update process, and the decision process.

7. Standardization Requirements

GENINFO is intended to advertise information on behalf of applications whose operations have been defined in a public specification as discussed in [RFC5226].

The public specification MUST include:

- o a description of the sub-TLV allocation policy
- o discussion of security issues
- o discussion of the rate of change of the information being advertised
- o justification for the use of GENINFO

8. Security Considerations

The introduction and use of the new TLV codepoint for GENINFO in and of itself raises no new security issues for IS-IS.

It is possible that information advertised in a GENINFO TLV by a given application MAY introduce new security issues. The public specification that defines the use of GENINFO by that application MUST include a discussion of the security issues. Where appropriate, it is recommended that either [RFC5304] or [RFC5310] be used.

9. IANA Considerations

Per this document, IANA has registered a new IS-IS TLV in the "IS-IS TLV Codepoints" registry:

Type	Description	IIH	LSP	SNP	Purge
----	-----	---	---	---	-----
251	Generic Information	n	y	n	n

IANA has also created a new registry. The new registry manages the assignment of Application Identifiers that may be used in the Generic Information TLV. These identifiers are unsigned 16-bit numbers ranging in value from 1 to 65535. The value 0 is reserved. The registration procedure is "Expert Review" as defined in [RFC5226]. The expert MUST verify that the public specification that defines the use of GENINFO for the application adequately discusses all points mentioned in Section 7 of this document.

The following information MUST be specified in the registry:

- o ID Value (1-65535)
- o Description
- o Allowed in Instance zero (Y/N)
- o Reference Specification

10. Acknowledgements

The authors would like to thank JP. Vasseur and David Ward for providing the need to produce this document and Tony Li for making sure it was done with appropriate wisdom and prudence.

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Authors' Addresses

Les Ginsberg
Cisco Systems
510 McCarthy Blvd.
Milpitas, CA 95035
USA

EMail: ginsberg@cisco.com

Stefano Previdi
Cisco Systems
Via Del Serafico 200
00142 - Roma
Italy

EMail: sprevidi@cisco.com

Mike Shand
Cisco Systems
250, Longwater Avenue.
Reading, Berks RG2 6GB
UK

EMail: imc.shand@gmail.com

